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CENTRE FOR EUROPEAN STUDIES AT LUND UNIVERSITY

Box 201
SE-221 00 LUND
SWEDEN

Phone +46 (0)46-222 88 19
Fax: +46 (0)46-222 32 11
E-mail: cfe@cfe.lu.se

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IIASA	International Institute for Applied Systems Analysis
LDC	Least Developed Country
LNG	Liquid Natural Gas
MNPP	Medzamor Nuclear Power Plant
MoU	Memorandum of Understanding
Mtoe	Million Tonne Oil Equivalent = 41.868 PJ
NATO	North Atlantic Treaty Organization
NEGP	North European Gas Pipeline
NESO	National Emergency Sharing Organisation
NIP	National Indicative Programme
NOx	Nitrogen Oxide
NYMEX	New York Mercantile Exchange
OECD	Organization for Economic Co-operation and Development
OPEC	Organization of Petroleum Exporting Countries
PCA	Partnership and Cooperation Agreement
PJ	Petajoule, 1015 Joule
RCG	Reed Canary Grass
RF	Russian Federation
SEA	Single European Act
SRC	Short Rotation Coppices
TACIS	Technical Assistance to the Commonwealth of Independent States
TAIEX	Technical Assistance and Information Exchange Instrument
TAP	Trans-Afghan Pipeline
TPES	Total Primary Energy Supply
TRACECA	Transport Corridor to Connect Europe via the Caucasus to Asia
UNFCCC	United Nations Framework Convention on Climate Change
USDA	United States Department of Agriculture
WTI	West Texas Intermediate

CHAPTER ONE: INTRODUCTION

Energy Security in Europe

Bo Petersson & Barbara Törnquist-Plewa

Since 2006 the energy-security and climate change nexus has dominated political agendas in Europe and globally. Energy security and climate concerns have soared to the top of political agendas all over the Western world, and forums like the European Union and G8 have treated the discussions as highest priority issues. Meanwhile, all over Europe the public opinion seems ready to accept far-reaching measures, also at the expense of individual freedoms of manoeuvre, to curb carbon emissions and promote the use of renewable energy. In the words of the so-called Copenhagen school, the energy-security and climate change nexus has become heavily securitized (Buzan et al 1998). This field opens up vast challenges for policy makers all over the world, but also for practitioners of scholarly research.

Notably, there are two opposing trends that can be witnessed in the social sciences inquiry into energy security issues. First, the urgency of the energy security issues seems to have proven early globalization theorists right; the paramount threats to security in our contemporary times do not recognize national borders. The relevance of the old military reading of the nature of international threats seems to have died with the end of the cold war. There are multiple examples. The probable end to easily accessible reserves of fossil fuels is a global long-term threat; the spectre of terrorism and insecure supply lines is a common immediate danger, and climate change is a looming threat that proves the irrelevance of national borders. This is the denationalization thesis come alive (Scholte 2000).

The opposite trend is also clearly visible, however. Political and economic developments in e.g. Russia and its surroundings seem to prove the renationalization thesis to be right, i.e. the idea that national borders and geopolitical thinking are actually being reinforced under globalization. Russia has emerged as an energy superpower (Scholte 2000). It has about a third of all proven gas reserves globally, and it is the supplier of another third of the European Union's imports of natural gas. 2006 saw numerous instances when Russia seemed to attach a political price tag to the continuous supply of gas to former Soviet republics such as Ukraine, Belorussia and Georgia. Political bickering in relation to resource-rich Central Asian republics and the counter-moves to pipeline projects planned to break the Russian monopoly of supply routes from the Caspian region indeed seem to spell the return of power politics. According to this reading, the realist world has returned with a vengeance.

So, scholarly debates are prone to continue. Meanwhile, the scholarly community direly needs to review the conceptual tools used to analyse this contradictory world. Our experience is rife with buzzwords within the social sciences; originally indispensable concepts that have become worn out due to overextension and overuse. One need only mention concepts such as identity, globalization and risk society. Now, energy security is the next likely candidate. The definitions used or implied are almost as numerous as the instances of its usage.

The examples are manifold (Yergin 2006). In Western Europe, energy security has often been interpreted as security of supply at reasonable prices. This concern has commonly been believed to be met by the diversification of supply. With recent years' increasing awareness of threats from potential terrorist attacks against pipelines, refineries, tankers and other parts of the supply and distribution system, and as climate security and concerns about carbon emission and global warming have entered everyday awareness, the complexity has increased. When interpretations made in other parts of the world are brought in, the complexity increases even more. In supplier states like Russia, energy security is naturally interpreted in terms of the projected stability of energy markets. China and India again have different concerns, such as how to satisfy their soaring energy consumption needs on an increasingly volatile world market. The meaning of energy security thus is heavily context-bound and context-dependent. Unfortunately, in the public debate, the concept is often being used without any explications; its meaning is just taken for granted. In fact it cannot be. The scholarly community has an important task to fulfil here, to bring greater conceptual clarity into the terminological morass.

On September 24-25 2007, 60 distinguished participants from 15 countries gathered at a conference organised by the ENSE group at Lund University. ENSE is an acronym for Energy and Security in Europe. Its primary ambition is to link up distinguished experts on different aspects of the energy-security and climate change nexus at Lund University, providing the grounds for trans-faculty, multidisciplinary and internationally competitive research. Since its inception in the summer of 2006 the ENSE group has been coordinated by the Lund University Centre for European Studies. ENSE consists of internationally recognised research milieus from the Faculty of Social Sciences, the Faculty of Humanities, the Faculty of Engineering, the School of Economics and Management, the International Institute for Industrial Environmental Economics, the Research Policy Institute and the Swedish Institute for Food and Agricultural Economics.

The conference was organised into three workshops, dealing with Energy, security and risk; Energy and agriculture; and Climate and energy security. During the two days of the conference there were five keynote speeches and in the three panels all in all 25 papers were discussed. The bulk of these keynote addresses and scholarly papers are, slightly revised, published in this volume.

So, let us briefly introduce the papers in the order that they appear in the volume. In

Chapter Two, Joshua W. Busby discusses the security implications on climate change, analysing how climate change can pose both a direct threat to a country's national security and also how it can indirectly threaten a country's extraterritorial interests. He sees adaptation and mitigation measures as components of the global strategies of how to combat climate change and how to counter its security implications. He also stresses the necessity that the United States, China, India and Indonesia take on their responsibilities in this regard. In Chapter Three, Carole Nakhle takes on a slightly different perspective when addressing the nexus between the energy security and climate change issues. While agreeing that the issues have to be addressed together and underlining that she does not see a tension between them, she also argues that governments have to focus on those issues that lie in their power to control, and therefore that energy security issues in practice have to be addressed first. If they are, she argues, the climate change issues will be dealt with, but, she writes, there is a need to 'develop all these things cautiously and bit by bit'.

Decision-making aspects are brought to the fore in Chapter Four as Raphael Sauter suggests an agenda-setting framework for the better understanding of the EU energy policy process in the context of energy security and climate change policy. He argues that the route of agenda-setting typical of EU energy security policy needs to face ongoing processes at the level of 'low politics'; the failure of linking up low and high politics processes results in a fragmented agenda and questions the likelihood of relevant policy outputs, he argues. The EU's difficulties in addressing conflicts and trade-offs with the integration of energy security and climate change policies highlight the need for institutional changes in the EU, he argues.

Returning to the issue of how to accomplish global cooperation in trying to address security challenges emanating from climate change, Dennis Tänzler assesses in Chapter Five prospects for cooperation between the European Union, which so far has been in the driver seat when it comes to efforts to promote measures mitigating climate change, and the United States that under the administration of George W. Bush has been so adamantly opposed to Kyoto and post-Kyoto cooperation schemes. He sees encouraging signs of a convergence between climate and energy security agendas in the United States, and believes above all that the next presidential administration, regardless of whether it will be headed by Barack Obama, John McCain or Hillary Clinton, will be decidedly more forthcoming in this global work. Since many writers have addressed the essentiality of having China more committed and engaged in global carbon reduction work, it is very valuable to include a Chinese perspective on these issues in the volume. In Chapter Six, Qin Tianbao argues that during the past 15 years, China's attitude to climate change and its legal and policy response has largely changed from that of a stander-by to a stakeholder. The change can according to Qin Tianbao be illuminated by developments in three arenas: the transformation of the competent national authority for climate change, adjustment of general laws and policies, and shift of focuses of specific actions. These developments are carefully traced in his chapter.

Where the first papers have been more global in scope or advanced perspectives from outside of Europe, the next two papers deal more specifically with Europe as such and centre on issues of technological change and innovation. In Chapter Seven, Heleen Groenenberg et al argue that EU energy policies are evaluated with respect to their capacity to simultaneously meet the objectives of mitigating climate change, securing energy supply and improving competitiveness. Technological innovation will be highly vital here, and energy innovation policies need to meet a number of requirements to be successful. Going through a number of these, the authors argue that there is a need to prioritize future action for an energy transition in the EU. Providing a complementary perspective on problems of innovation, Lennart Schön and Astrid Kander present in Chapter Eight a long-term pattern of evolution of energy systems. Their focus is on industrial dynamics and its impact on energy systems. The authors discern three epochs in the historical data: the present one is called the modern areal epoch whose innovations are still under incremental evolution. Although important innovations are taking place both on the energy supply and demand side, these are likely to remain insufficient in the foreseeable future to meet the growing energy demand from China, India, Russia and other fast growing economies. The authors therefore argue that the increase in energy prices as compared to industrial products will continue. This is likely to foster political tensions over energy issues, challenge innovative capabilities in Europe and pose great potentials for increasing profits in energy technologies.

The next cluster of papers retains the focus on change and innovation but discuss above all present and future challenges to agriculture, not least in Europe, as biomass has been many been dubbed the solution to the demands for more carbon-neutral energy supplies. Thus, in Chapter Nine Josef Schmidhuber examines the impact of the rising demand for bioenergy on agricultural markets and prices. He thereby argues that the demand for bioenergy is significant enough to create a change in the traditional paradigm for global agriculture, which has been characterized for decades by robust supply growth, slowing demand growth and falling real prices for agricultural produce. Based on the likely price effects in food and energy markets, he goes on to assesses the impact of rising bioenergy production on food security, differentiating between effects on availability, access and stability of food supplies. Quite clearly Schmidhuber cautions against seeing bioenergy as a magic bullet solution to global climate and energy security problems; that potential is simply lacking, he holds. In Chapter Ten Malena Rosén Sundström points out that within the general context of the EU's Common Agricultural Policy (CAP), the EU has in recent years taken several steps to increase the production of renewable energy. Her focus is on how the changes brought about by these measures have affected and are likely to affect the member states in the short-term with regard to their political positions in the CAP. She concludes that energy crops will continue to play an important role in EU agriculture in the years to come and that rising energy security concerns will remain a vital aspect governing the future evolution of the

CAP. In Chapter Eleven Håkan Rosenqvist et al present an analysis of energy crop production costs from the perspective of the farmer. The objective of their paper is to calculate indicative cost ranges on a regional level for a number of energy crops. The analysis was made for three cases, two of which refer to the knowledge and technical level in 2005, and one of which refers to that in 2020.The production cost consists of three main components: the costs of cultivation, land and risk. In terms of concrete results the energy crop production costs were estimated to be consistently lowest for short rotation coppices like poplar and willow and highest for annual straw crops like hemp and sorghum.

In the next cluster of papers there is a move towards issues oriented more squarely towards security and risk. In a technically sophisticated paper Niels Kalstad Svendsen and Stephen Wolthusen argue in Chapter Twelve that critical infrastructures such as the electric grid, oil and gas pipelines, telecommunications, and financial services are characterized by direct and transitive interdependencies which may not always be readily visible. Vulnerability in elements of one infrastructure can lead to a cascade of failures. In some cases this chain is established immediately after the failure (as in the case of a telecommunication link going down), and in some cases these failures manifest themselves only after a certain time (as in the case of emergency fuel based power generator running out of fuel). In their paper the authors describe several statistical and algorithmic approaches for the analysis of critical infrastructure interdependencies. They argue that their techniques can be used e.g. to determine consequences of detonations in a fuel storage facility, water dam rupture or side effects of rupturing pipelines. In Chapter Thirteen Eshita Gupta assesses, through the construction of an index, the relative geopolitical oil supply vulnerability of 26 net oil-importing countries. So she does on the basis of five factors – oil import dependence, concentration of supply sources, political risk in supplying countries, market liquidity, and the share of oil in their total primary energy supply – which influence the countries' exposure to global geopolitical developments. Her conclusion is that the risk measures of the most vulnerable countries (such as Japan and Switzerland) is found to be about 40 times higher than that of the most secure countries (such as China and Australia). The major factors that make the former most vulnerable are their almost total import dependence, poorly diversified sources with major imports from politically difficult OPEC countries, and relatively higher oil share in their total primary energy supply.

The final six papers all approach the energy security issues through a more or less geopolitical reading. They discuss risks and threats in a more traditional way where the hazards facing the energy supply of the European Union most frequently have a common denominator by way of Russia. Partly providing a counterargument to ideas about a prevailing Russian grand design in the area of energy supplies, however, David Dusseault criticizes in Chapter Fifteen vintage geopolitical models that to his mind have been recycled and applied to the contemporary energy issue. His paper therefore seeks to take the energy issue out of the restrictions of the energy security discourse and subject it to a more nuanced treatment in which actor agency on the part of diversified Russian and international interests are examined in conjunction with existing physical, financial, informational and institutional conditions. He thus expects that bilateralism in the energy sector is not the result of a geo-political grand strategy on the part of the Russian state, but the product of actors' contingency based upon their specific preferences as well as the conditions under which energy strategy formation takes place at any specific time. Returning to more traditional perspectives, S. Frederick Starr in Chapter Fifteen addresses Russia's regained great power status and its newly recovered assertiveness in the foreign and security policy arena where it has been made very clear that Russia is more than prepared to use its position as a dominant energy supplier to achieve political ends. He argues that the European Union's response to those political manoeuvres has been less than staunch and that the absence of e common energy policy for the EU has certainly not helped matters. He recommends the EU to review its alternative supply routes, not least to look into the options of finding energy suppliers in Central Asia and the Caucasus. Sharing the basic perspective on Russian motives, Robert Larsson in Chapter Sixteen explores Sweden's imports of Russian energy and raises a few issues of concern, in particular the issue of whether Swedish dependency on Russian energy constitutes a security problem. He comes to the conclusion that is that as of today there is still no such security problem relating to energy supplies or the Swedish security situation, but that there might be implications for Sweden and the wider Baltic Sea Region in the future, should dependence increase and Russia's coercive energy policy continue. Problems that might arise today are, according to his argument, first and foremost related to the political and economic levels and less so to the military security level. The risk for supply interruptions aimed at Sweden is low, but most states in Europe could experience a coercive policy or be negatively affected by Russia's policy against the former Soviet states. This may result in tension and friction within the whole European Union area and might so affect Sweden.

The final three papers looks into European Union counter responses to potential Russian political manoeuvres to use the energy tool to bolster its influence. In Chapter Seventeen Sylwia Niewiem thus focuses on the nexus between the European Neighbourhood Policy (ENP) and the external energy security issues of the EU. More specifically, she discusses how the European Union uses the ENP to tackle European energy security interests. By way of example she focuses on policies toward Ukraine, on the one hand, and the South Caucasian states Armenia, Azerbaijan, and Georgia with an outlook on the Black Sea region and Caspian Sea, on the other. In so doing she makes an inventory of different aims, instruments, implementation of the interests, and finance of these in relation to energy security issues. She concentrates on issues such as energy diversity (e.g. alternative transit routes and suppliers) and on regional cooperation to enhance integration and cooperation. Using a similar approach, Barbara Janusz makes in Chapter Eighteen an inventory of problems that remain to be solved before the Caspian supply route can be considered to be stabilized.

In the introductory parts of her chapter she presents a general framework comprised by the European Council's strategic document on an Energy Policy for Europe and thus underlines the desirability of diversifying the suppliers and the supply routes of energy to the EU. Regarding the Caspian, Janusz' main conclusion is that the lacking clarity of its legal status hampers mutual cooperation since any bilateral agreement against the will of remaining littoral states will seem legally uncertain. On a more optimistic note, Svante Cornell in the final Chapter Nineteen discusses the current quest for alternative energy resources that could reduce Europe's dependence on Russian energy. Here the Caucasus region plays a crucial role, because it is the only area in Europe's vicinity that has the potential to serve as a key producer and transit area for new sources of European gas supplies. Cornell finds there to be 'a clear match' between the European strategic interest and those of the states of the Caspian region. Europe is in need of diversified access to energy, and other supply routes to Europe, and to have strategic access to the Central Eurasian inland; while the states of the region desire closer ties in the economic and security fields to Euro-Atlantic institutions. Thus, both parties would stand to gain from an enhanced cooperation, he argues.

This completes the overview of the chapters. Before closing the introduction the editors wish to acknowledge the generous financial support of the conference provided by the Bank of Sweden's Tercentenary Foundation and Lunds Energi koncernen. They would also like to express their gratitude to their co-organisers Karin Bäckstrand, Niklas Bernsand, Helena Johansson, Lena Neij and Johannes Stripple for greatly contributing to the success of the conference.

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CHAPTER TWO

Assessing the Connections between Climate Change and Security

Josh Busby

Introduction

The focus on my paper is on the security implications of climate change. I initially began this project in 2004 when tasked by the Woodrow Wilson Center to write a paper for Kofi Annan's UN High-Level Panel on Threats, Challenges and Change.[1] In that paper, my co-author and I suggested that climate change was expected to yield more intense and frequent extreme weather events, potentially putting thousands into harm's way from the elements, from death and disease. Extreme weather events are supposed to disproportionately affect developing countries that lack the capacity or willingness to care for their own citizens. In the end, we worried if these events come to pass that might create increased demands for humanitarian intervention.

That was the beginning of the project, but I have subsequently expanded it to a set of other papers, one that looks conceptually at the threat of climate change for U.S. national security which is likely to come out in the journal *Security Studies*[2] and another that looks at what the United States ought to do in light of these security consequences, a paper which will be published by the Council on Foreign Relations.[3] In addition, there are a few shorter interventions on climate and security that are more relevant to transatlantic and UN audiences, one on-line in Atlantic community.org and another in the recent issue of *Disarmament Times*.[4]

In this presentation I will 1) spell out what I think the main security concerns of climate change are, (2) connect climate change to the issue of energy security, and (3) talk about what should be done. I will try to make special reference to the European context, as I am sure that is one of your main motivations for participating in this gathering.

1 Purvis and Busby 2004.

2 Busby 2008, forthcoming.

3 Busby 2007b.

4 Busby 2007a; Busby 2007c.

The Links between Climate Change and Security

In my conceptual work on climate and security, I have written about how climate change can pose both a direct threat to a country's national security and also how it can indirectly threaten a country's extraterritorial interests.

I have also discussed the broader security externalities of energy policy and climate change by looking at (1) how petroleum dependence may contribute to two social bads, both terrorism and climate change and (2) I have also written about how nuclear power, which has been revived as a means of dealing with climate change, may also pose a proliferation risk. There are other strategic aspects of climate politics, particularly with respect to China's rise which I will come to in a bit.

How can climate change pose a direct threat to a country's national security? First, the effects of climate change could render a country uninhabitable (as may occur in some small-island nations) or pose a threat to a badly located national capital. Think of an extreme weather event that strikes a nation's capital and paralyzes its seat of government. Even if a nation's capital is not affected, one could observe a natural disaster, made more likely by climate change, that is so swift in its effect and intense in its scale that it exceeds the capacity of local police and emergency response, thus requiring the diversion of military assets for homeland defense, humanitarian relief, and restoration of order. Think of the after effects of Hurricane Katrina or the recent fires in Greece which required Greece to mobilize 6000 soldiers to help with firefighting.[5] Climate change could also alter countries' territorial borders, and here I am thinking mostly of Arctic ice melt, and the ways in which new sea routes and resources could be exposed to exploration and transit, potentially leading to inter-state conflict over control of those resources.

That may never come to pass, but if anyone followed the news over the summer, you might remember that the Russians dispatched research teams to the North Pole, claiming it as their own, which was swiftly followed by Canadian action and Danish and Norwegian teams, each seeking evidence of under water land extensions that would connect the edges of their landmasses to underwater Arctic seabeds, a means by which countries could legally lay claim to a portion of Arctic resources under the Law of the Sea Treaty.[6]

In my conceptual paper, I explore which kinds of climate effects could pose direct threats to U.S national security, and these are likely applicable to other countries. In that paper, I examine abrupt climate change, rising sea levels, extreme weather events, and Arctic ice melt. I suggest that the evidence is inconclusive that either abrupt climate change or rising sea levels pose a threat to national security in time scales that most policymakers care about.

However, for both extreme weather events and Arctic ice melt, there is enough

5 Carassava 2007.

6 Associated Press 2007; MacAskill 2007.

scientific evidence to suggest we are already at risk.[7] In the European context, if I were to imagine what kinds of effects policymakers should worry about most, I would say extreme heat and droughts, primarily in the Mediterranean, with the enhanced risk of fire as Greece recently experienced and excess-heat related deaths as France and Italy experienced in 2003.[8] Flooding in Northern and Central Europe could also necessitate the kind of disaster response that could overtax civilian capabilities. Finally, I think Europe should be worried about member states with potential Arctic claims being embroiled in broader political disputes over resources and transit, particularly with Russia.

But, states also have security interests beyond their own borders which could also be adversely affected by climate change. These same problems could affect countries overseas, some of which may be strategically important to a distant country's national security. Let us say you are the distant country. How could climate effects overseas affect your interests?

Let us say your embassy, military bases, or a place where a large number of your citizens live is hit by a storm surge, made more likely by climate change. Your government would likely be called in to airlift your officials and citizens out of harm's way. You also might have strategic assets damaged, if an airbase in the South Pacific, for example, sustains heavy hurricane damage.

But let us say it is an ally that faces its own Katrina-like event. That government, perhaps consumed by its own domestic emergency, might not be able to sustain its contributions to a joint military effort. Perhaps the government would face domestic lawlessness that it could not contain on its own, requiring the mobilization and participation of foreign troops to restore order and provide humanitarian aid, much as the United States and other governments did after the 2004 tsunami.

Maybe that government is not even an ally. Maybe it is Nigeria and just a significant source of your raw materials. Maybe it is Indonesia and you have some concerns that there might be problems of transit through the straits of Malacca if Indonesia is destabilized after a climate-related event.

Perhaps you are worried that adverse climate effects could destabilize a government that you may not count as an ally but one where domestic disorder could have spillover consequences or blowback on your country. Let us say Morocco and North Africa face sustained droughts, contributing to domestic discontent, greater support for terrorist operations, and an exodus of people to Europe, looking for better economic opportunities.[9] In my work on this aspect, I explore the possibilities for climate change to contribute to violent conflict, state failure, and humanitarian disasters. I look at three mechanisms by which climate change might contribute to violent conflict, exploring (1) empirical evidence by Marc Levy and others that

7 ACIA 2005; IPCC 2007a.

8 IPCC 2007c.

9 See footnote 8 on IPCC regional projections.

shows increased volatility of rainfall is associated with the onset of conflict[10] (2) I look at the work that suggests refugees can be correlated with the increased risk of violent conflict by Salehyan and Gleditsch[11] and (3) I look at research by Brancati how natural disasters are associated with the increased risk of violent conflict.[12]

Climate Change and Energy Security

Beyond these direct and indirect threats to national security is the broader strategic context for climate policy and energy security. As you probably read, at least some evidence suggests China is now the largest emitter of greenhouse gases.[13] In the last few years, China has been building enough new electricity generating capacity every year to equal the entire power sector in the UK. China's power needs are being largely met by coal, and these are not the reasonably efficient coal plants of the West. These are dirty, antiquated models. What is worse, it appears that the Chinese central government will have difficulty reining this in even if it wanted to.[14] Historically, the rise of new powers has been associated with interstate war. Climate and energy policies are and are going to be a new important fault line in international politics.

When the U.S. finally gets religion about climate change (which is going to happen sooner rather than later, the politics is changing), the rich industrialized nations of the West will finally be more or less on the same page. But, China and India do not want to have their people's future life possibilities constrained because of a problem that historically was largely created by others.

In this setting, it is in everyone's interest to avoid facing a situation where consuming nations compete over sources of energy, by dividing the world up into spheres of influence and parochially controlled sources of resources. At the same time, it is also in everyone's interests to avoid the worst effects of climate change and to avoid climate change becoming a new source of friction.

What Should be Done

To that end, I now turn to what should be done. Emissions reductions and climate mitigation in the short-run will do very little to protect us in the West or developing countries from the effects of climate change that are already inevitable. Some climate change is already built-in so we need to be ready to adapt. Sadly, very little money is being directed to this problem, Dutch and British investments perhaps being something of an exception.

Advanced industrialized countries will need to spend tens of billions of dollars to

10 Levy, Thorkelson, Vörösmarty, Douglas and Humphreys 2005; Hendrix and Glaser 2007.

11 Salehyan and Gleditsch 2006.

12 Brancati 2007.

13 International Herald Tribune 2007.

14 MIT 2007.

insulate themselves from the worst effects of climate change. Coastal areas may be especially vulnerable to storm surges. Early warning systems, better building codes, discouraging settlement in vulnerable places, among other measures, are likely to be important and cheaper than disaster response.

Internationally, developing countries, while they have less to lose, are likely to lose more of the little they do have. Developing countries have limited resources to insulate themselves from climate effects, yet the resources for adaptation that the World Bank's Global Environmental Facility (GEF) manages are around $200 million when,[15] in reality, tens of billions of dollars are needed.[16] The U.S. is a contributor to the GEF, but it has not contributed to the two adaptation funds that the GEF manages. It is not a party to the Kyoto Protocol, nor is it a contributor via the Clean Development Mechanism, a portion of the proceeds of which are going to be directed to adaptation.. Some of the rules for adaptation will be discussed in Bali, but European nations could helpfully put the U.S on the spot by pointing out how little the U.S. has done. They themselves should step up to offer more resources for adaptation.

But, even if the world invests these billions in adaptation, some disasters will still happen, and countries will need enhanced capabilities to prevent this from getting out of hand, both at home and abroad. In my paper for the Council, I make some recommendations about enhanced weather reconnaissance capabilities that the U.S. might seek to invest in. I also suggest some pre-positioning of lift capabilities and authorization to buy locally grown surplus food might be something that the new Africa Command should explore. I also propose, following a British model,[17] that the U.S. invest in a Risk Reduction Pool, where monies and initiatives in Africa could be jointly managed by the Defense Department, State and other agencies. If those ideas sound interesting, I encourage you to look for that paper for more substance.

But, let me emphasize that adaptation without mitigation will ultimately be self-defeating. Unless we move to a decarbonized economy by the middle of this century, climate effects will likely surpass the adaptive capacities of most countries. However, to move to a decarbonized future, we need to encourage private sector innovation. To that end, the world needs the U.S. to adopt a mandatory, market based control regime like a carbon tax or a cap and trade system. I hope that comes sooner rather than later. Getting started has proven to be the hardest thing for us, so even if our short-term targets initially look modest, I think once we have a clear signal with future targets built-in for more significant reductions, the private sector will get the message.

However, it is China, India, and Indonesia that need to get the message and the incentives to make clean energy and control of emissions part of their future. China and India need incentives that pay them to build the cleanest coal plants that the

15 Global Environmental Facility 2007.

16 HM Treasury 2006.

17 DFID 2004.

market can provide, with the possibility for carbon sequestration. They will certainly need more money for renewables, but sadly, they may need to build more nuclear plants, and our export credit guarantees and other measures may need to help them in every conceivable way move to a cleaner energy future.

Finally, Indonesia I include in this mix because by some accounts, it is the third largest emitter of greenhouse gases based on deforestation and forest fires. In the paper for the Council, I suggest that rich nations be prepared to provide resources to pay the Indonesians to slow down their rate of deforestation, thus paying in to the $250mn avoided deforestation pilot scheme the World Bank is supporting and that was authorized at the last G8 meeting.[18]

If these and other measures are adopted, I'm hopeful that the world will be able to avoid the truly awful effects of climate change or, at the very least, diminish their destructive impact through risk reduction and through a sustained move to a decarbonized energy future.

Concluding Thoughts

My observation based on the proceedings of this conference is that we have actually a series of parallel conversations going on, which sometimes lead to us to talk past each other. This is partly because the issues of energy security and climate change are actually dealt with by different agencies and institutions, with different motivations, each pursuing their disparate agendas. As a number of speakers have noted, even as people speak platitudes about the need to address climate change, the reality is a deepening of our dependency on oil, gas, and coal. At some point, if the dialogue on climate change actually gets serious then these discussions will actually have to merge much more than they have.

I think another reason for parallel dialogues, and partly because there are, as our organizers have pointed out, many different definitions of energy security out there, with different countries having quite different conceptions of what energy security means for them. At the same time, we also have quite different conceptions in this room of what we mean when we talk about climate security. In the context of my talk, I used climate security in a narrow sense, suggesting that the effects of climate change could be on a scale and speed that resemble the effects of an armed attack, that they put so many people into harm's way that a nation's civil defense capabilities could be overwhelmed.

Other people have used climate security in the context of the need to support the earth's life-sustaining processes. Others speak of climate security as any threat from climate change that harms human welfare.

I actually think that that notion of human security is so vague and amorphous as to be largely meaningless and problematic. We have to remember why we use the term security. Is it merely because we think that word will get the attention of busy

18 World Bank 2007.

decision-makers, make issues of low politics seem like high politics? And to what effect? What do we anticipate that they will do with such knowledge? I think my presentation represented the ways in which climate security will be interpreted by the national defense/security crowd. In that, I think I raise a number of legitimate concerns for adaptation, but clearly, the nature of the response to the kinds of problems I raised may be quite different than what people who seek to appropriate the security mantle are hoping for.

When you look at the IPCC working group reports to the 4th Assessment, you find that they present a number of central findings about extreme weather events with high confidence, both about what has already been observed and what we are likely to see in the future.[19] These conclusions are based on their reading of the summary evidence from a number of regional reports. And most of those regional reports suggest that developing countries in Asia and Africa will be the hardest hit by climate change and that as much as they may currently wish to focus on poverty reduction and economic growth, whether they like it or not, climate change is going to buffet them, and so responses to climate change are not likely to be a luxury they can wait to deal with when they are rich.

As I said earlier, IPCC estimates are based on regional projections. So, for example, in the European region, when I talked about risks of extreme drought and fire in the Mediterranean, this is based on the IPCC, not a fantastical example that I pulled merely to alarm you.

The IPCC has suggested that some effects of climate change, like abrupt climate change, are so long-range and uncertain that I discounted their likely significance as security threats in the short-run.

So, the reason why I focus on extreme weather events as effects of climate change is that they are the ones climate scientists think are most likely in the coming decades. Extrapolating from these physical effects to the potential political and economic effects is fraught with difficulty. For this reason, I identified a number of different causal mechanisms by which climate change could cause violent conflict for which there are historical analogues that we can subject to empirical testing. Those include the expectation that climate change will contribute to more variable rainfall, refugee crises, and disasters, all of which have been found by Levy, Salehyan and Gleditsch, and Brancati as correlated with the onset of conflict.

However, as I have discussed today, the landscape of security concerns associated with climate change extends beyond violent conflict. I spoke about the possibilities of extreme weather events creating humanitarian disasters that exceed civilian capabilities and drive demand for military intervention.

I also mentioned in passing earlier work I wrote about nuclear power and proliferation concerns. That is part of a broader challenge of meeting energy needs without exacerbating climate change or creating additional security externalities. In discussing energy security, I focused heavily on the potential for new geo-political

19 IPCC 2007b; IPCC 2007a.

fault-lines over climate change between the West and rising powers in Asia.

Finally, in thinking about remedies and solutions, I suggested we have to approach the problem by identifying appropriate strategies. We have to ensure that if we actually believe climate change poses a security problem that we respond in ways that minimize or reduce those risks. In the short run, that means adaptation to prevent climate change from creating unacceptable security risks. In the long run, mitigation of climate change through policies that reduce greenhouse gas emissions and move us to a new energy economy will be required. When policymakers get serious about that agenda, the two conversations of this conference on climate and energy will finally intersect.

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CHAPTER THREE

Energy & Climate: The Real Priorities

Carole Nakhle

A great debate is raging; Energy security and Climate change have indeed become linked in the public mind, but in a largely negative way. That debate poses Energy Security against Climate Security as though we have to make a choice. But this choice is false. A degree of realism is urgently needed because:

- The world is not running out of oil
- It is the end of cheap oil era
- Carbon emissions still on the rise and all targets are being missed
- Fast developing countries are putting their economic growth and energy needs first, regardless of carbon emissions
- Slower developing countries are putting their urgent basic needs first, while at the same time they are crucified by the high cost of oil

It is clear that things are not going right: the policies are not working and the priorities are wrong.

A Few More Inconvenient Truths:

Fossil fuels are not going to be phased out

There are those who think that the world is going to get by through renewable and nuclear energy but a degree of realism is urgently needed. We all know that coal, oil and gas will remain the dominant source of energy up to 2030, as put by the Energy Agency Outlook.

Last year *(2006)*, the world consumed 83.7mbbl/day close to a thousand barrels per second. The latest forecasts from the IEA predict a global oil thirst by 2015 of 99mbbl/day and 116mbbl/day by 2030. In Europe, the situation is no different. So this is clearly not the end of oil age and in the telling words of Javier Solana, the EU's foreign affairs spokesman, he said, and I quote, 'We should go and look for more oil and gas[20]".

The world is not running out of oil but it is end of cheap oil era

Climbing estimates:
Reserves are being constantly revised in line with new discoveries, changes in prices and technological advances. Estimated world oil reserves doubled from 630 bnbbl of oil in 1975 to 1189 bnbbl in 2005. High oil prices open up even more opportunities as smaller fields become commercial. Technology opens up more accessible and economic oil reserves. Let me give you some examples: The US Gulf of Mexico, the North Sea, the Barents Sea... Prof. Odell, a former senior adviser to the British Government, claims that 'the world is running into oil instead of out of it[21]'.

But, whatever other problems there are about energy at least in this part of the world, actual shortages of resources in the ground (or under the ice) are not one of them. The problems are of course: costs, transportation and politics. It is clearly that it is not the end of oil age but the age of really cheap oil is over because even in the Middle East costs are rising and of course in the more remote areas of Eastern Siberia etc. they are rising fast still. There is plenty of oil and gas around at a price.

We must be realistic about our carbon reductions.

Despite all the international rhetoric, carbon emissions are soaring upwards and simply setting targets is getting us nowhere. All the nearer-term targets for limiting emissions – both set by the Kyoto protocol and the tougher ones adopted by the EU – are going to be missed. The IEA predicts that world carbon emissions will be up 55% by 2030. We all know that China and India are putting energy needs first and quite rightly so. The Chinese government keeps on repeating its firm view that energy and growth come first. And very recently, the head of China's powerful economic planning agency (the National Development and Reform Commission) said and I quote "The ramifications of limiting the development of developing countries would be even more serious than those from climate change[22]". In a more extreme situation, the Chinese called the West "Robbers and thieves who suddenly became right minded". So unless we tackle that, all our concern with carbon footprints and capping emissions will be completely marginal.

We are also trying to strike a balance about the poor and developing countries.

It is no use just telling the poorer countries of the world to pay more for their energy

20 Solana, J., (2006) "Towards an EU External Energy Policy" Speech given at the EU Energy Conference, Brussels, 20 November 2006

21 Odell, P. (2008) 'Reports of the oil industry's imminent death are greatly exaggerated', *The Guardian*, Friday February 15

22 Chong, W. (2007) 'Action plan aims to cut gas emissions', *China Daily*

to offset carbon. As the Australian Prime Minister said recently, and I quote, "that sort of thing just slows growth and damages everybody[23]". The famous Copenhagen Consensus Centre tries to prioritise which world needs should be tackled first. And in the list of the main 15-20 needs, fixing climate change came last. Why? Because climate change seems marginal compared to the pressing issues of poverty alleviation, hunger, economic development and energy needs. There are too many needs and too few resources to tackle them all. About 3bn people are currently living in poverty and about 1.6 bn people are living without electricity. 2-3bn will be added to the world population over the next 30-50 years, an increase that will almost completely take place in developing countries. To meet the needs of the additional population, food production needs to double. But today we see that the focus on biofuels, especially those using food crops as feedstock, is pushing upwards the price of corn and sugar, and is competing with food for land and water!

The poor is bring crucified by high oil prices

What people tend to forget is that the hardest-hit victims of higher energy prices are those who are already at the edge of survival and substance. The resources needed to fund education, raise healthcare standards, manage water supply, etc. are already drained away fast into petrodollars. Any hope for raising the standards of these people depends on a large increase in energy demand. The cheapest energy is the kind that is going to be used. In 2005/6, ten of Africa's poorest countries paid to meet their energy bills the equivalent of all the financial aid that they have received24.

Out of the Energy Maze:

Given all these issues and realities, where then should we start finding our way out of this maze or labyrinth?

The timescale between energy security now and climate security for our children are very different:

The energy security problem is here and now. It is already with us:
We are more dependent on turbulent Middle East and threatening Russia.

- Russia's energy blackmail and unreliable gas flows were recently described as "Russia's certain brutality' as Mr Sarkozy terms it[25].
- There is stronger competition for energy resources: with rising Asia, resources are being taken away from Europe.

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23 Howard, J. (2006), 'Trying for Balance on Climate Change', Dec. 11.

24 Howell, D., Nakhle, C. (2007),*Out of the Energy Labyrinth*, IB Tauris

25 'Sarkozy warns Russia against 'brutality' in exercising its energy strength', *International Herald Tribune*, August 27, 2007

Keeping energy supplies flowing and keeping the lights on and keeping warm in Northern Europe are very high and immediate priorities. If handled right they will lead on to a better energy mix, combining cleaner and more secure energy with affordability and defeat of world poverty. They provide the best path to a low-carbon safer future. If neglected they could lead in the quite near future to big dangers, low growth, poverty, even wars as the struggle for energy resources grows more desperate. Governments need to get their priorities right.

- As put bluntly in the Stern Report "what we do now can only have limited effect on the climate over the next 40 or 50 years".
- What is going to move China in the right direction is not targets and lectures but immediate concern about its dangerous pollution and vulnerable energy mix. What the Chinese and the developing world want is a diverse energy supply and genuinely commercial alternatives.

As for the poorer nations, their priority is to guarantee the survival of these populations. How can we expect them to think about the long term problem of climate change when they have to live and eat today? Climate change is definitely not a priority for them. Its full effects will only be felt 30-100 years down the line – a lifetime in poor countries compared to current economic and political urgencies.

Be realistic about the alternatives:

Those who want to phase out fossil fuels and replace them by renewables should be aware of the downside of renewables.

Rising populations mean rising food demand. Diversion of crops to biofuels can be dangerous. The OECD warned that government support for biofuels will cause food shortages and lead to the destruction of natural habitats - while making little impact on climate change. Hence one really wonders whether the EU target of obtaining 10% of its transport fuel from plants by 2020 is realistic. Even in the 'best-case scenario', biofuels will only be able to achieve a 3% reduction in energy-related CO_2 emissions by 2050[26]

As for solar and wind power, one has to see the cost. Besides, wind power is highly unreliable (35% capacity), not to mention how intrusive it is. What about nuclear? It is politically sensitive, and there is the unsettled question of nuclear waste, so this is certainly not a speedy answer.

Therefore, I don't see a magic bullet. We need to develop all these things cautiously and bit by bit.

26 Doornbosch, R., Steenblik, R., (2007) 'Biofuels: is the Cure Worse than the Disease?' OECD

Don't be anti-energy: Not another Marie Antoinette saying "Let them wear two woollies!"

Protesting at Heathrow airport will mean more empty planes flying and more private jets. And more emissions, not less. Planting trees sounds morally right. Setting targets sounds good and purposeful. But they won't get us nowhere!

For governments that live on votes and in the short term the energy dilemma is acute because energy industry decisions are very long term but the first results may be unpopular and painful so no wonder ministers don't want to take them and prefer to push them on somebody else. Even today politicians are nervous about deciding about nuclear power (back in the 1980s, the UK decided to build 13 nuclear power stations but only one was built 30 years later). The truth is that politicians hate taking strategic long term decisions where results are not immediate. Ministers anyway are bad at taking long term, and sometimes painful, decisions on energy issues, since they live in most cases in the short term and need instant popularity.

What we want from governments is backing for the research to put us on this path. We need to get real breakthroughs in the real technologies.

- Best progress will come through things like hybrid vehicles, new aero engines, lighter materials, low-energy home appliances and other devices which people find CHEAPER AND BETTER, not more bureaucracy and interference.

- Energy efficiency makes more economic sense (for £1 invested, the company makes a return of £3), hence meeting both energy and climate security.

- Carbon Capture and Storage requires special attention. It can make the consumption of the large reserves of oil, gas and coal much cleaner and greener.

Of course the central driver is the present and likely future price of oil. And the key question is whether the huge falls in the oil price (as in the past) are going to occur again. Although there is a general belief that high oil prices are here to stay, a global recession can send them spiralling downwards. Companies' investment decisions all turn on this central question of whether oil price is going to stay high or collapse, and so do the decisions of all investors in alternative energy sources and energy savings, ranging from nuclear power right through solar power and unconventional oil and all the other energy sources.

Conclusion

Practical steps can be taken to reduce world oil dependence and they can be taken without causing unacceptable suffering. Now you may say you have heard all this before. Well you have – back in the early eighties when many warned of a looming energy crisis and the urgent need to cut oil dependence. The difference is that none of the changes needed took place. But this time the transition can happen and must happen. Last time world oil prices collapsed and people just gave up on energy savings and on planning for alternatives like nuclear power. This time we believe that the transition can work, providing we choose the right priorities. Concerns about carbon emissions and climate dangers will certainly help. But the real driver is going to be the world's overriding and expanding need for more reliable, secure and affordable energy. This is the challenge we must put first.

Changing the world's climate is going to take decades, even centuries, to produce results. We see the dangers of greenhouse gases but we think that governments should plan to do things which are in their control first (energy innovation, energy savings, environmental improvements, dramatic cuts in transport cost, more efficient fuel use, home insulation…). Promises about life for our great grandchildren should come later, because if we do not get things right in the next few years the greener promised-land will never be reached.

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Climate and Energy Security: Prospects for a Transatlantic Approach

Dennis Tänzler

Climate and energy security are not only increasingly prominent headlines for international politics but also a twin challenge for transatlantic relations. There are good reasons for this prominence. Science tells us that we have only a limited window of opportunity.[27] If we do not take decisive action within the next five to ten years, it will be hard to avoid some of the worst impacts of global climate change. In my presentation, I will touch on five points. First I will outline the milestones of international climate policies. Second, I want to summarize the security implications linked to climate change as far as they can be assessed today. Third I will argue that the basis for a future global climate agreement will be a transatlantic consensus. I will argue that there is common ground in the area of climate and energy policies that might serve as the springboard for a comprehensive global approach on climate change. Fourth, I will discuss ways to engage other countries and suggest what issues need to be part of a global framework on climate change. Finally, I will conclude by suggesting ways to create some new dynamics into the international climate-change process.

Milestones of International Climate Policies

Summarizing the milestones of international climate change policies means to focus on two major international agreements: a very strong U.N. framework convention on climate change agreed on in 1992 and the Kyoto Protocol, adopted in 1997.[28]
The 1992 UN framework convention was ratified by 189 countries. Its ultimate objective is to avoid dangerous climate change. Some analysts have argued that the convention equals a security treaty for some countries – namely small island states which are in danger of disappearing because of rising sea levels. An important normative aspect of the framework convention on climate change is that it points

27 See IPCC 2007: Summary for Policymakers. In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA; Stern 2006: The Economics of Climate Change. The Stern Review.

28 See for a detailed analysis of both agreements, Sebastian Oberthür and Hermann E. Ott 1999:The Kyoto Protocol. International Climate Policy for the 21st Century. Berlin: Springer.

out the common but differentiated responsibility of industrialized and developing countries to combat climate change. This means that industrialized countries, because of their historical responsibility for causing greenhouse gas emissions, should take the lead in reducing greenhouse gases and developing countries will follow.

The Kyoto Protocol was adopted in 1997 after two years of difficult negotiation. This protocol has been subject to highly controversial debates within the transatlantic as well as international community. It took until 2005 to enter into force after US President Bush had announced already in 2001 that the US will not ratify the agreement. The Kyoto Protocol includes legally binding emission reduction targets for industrialized countries. There are no emission reduction targets for developing countries, but there are provisions in the protocol to ensure that developing countries will start to reduce emissions and at the same time foster sustainable development. So called flexible mechanisms need to be regarded as the innovative core of the protocol – at least as far as the development of new regulatory frameworks is concerned. The mechanisms are likely to be part of any future global approach on climate change, above all the development and implementation of emissions trading systems. Emissions trading is meant to provide geographical flexibility in meeting a certain emission target at lowest cost, thereby enabling deeper emission cuts. Accordingly, emissions reductions do not necessarily need to occur by taking action in a certain country, but can be implemented wherever they can be achieved at lowest cost. In permit trading systems, the overall amount of available permits is generally capped. Assuming a certain limit of emissions is granting geographical flexibility in meeting the target. Moreover, assuming that a certain amount of resources is generally available for emission abatement, emissions trading should allow for higher emission reductions. Jointly implemented emission reduction projects within the framework of the Clean Development Mechanism (CDM) or Joint Implementation (JI) represent the other flexible mechanisms. The CDM is a good example for how international cooperation between the North and the South could be designed in order to achieve benefits for all players involved. Industrialized countries invest in projects in developing countries that will help reduce emissions. By doing so, they get so-called certified emission reduction units which they use to comply with their emission targets under the Kyoto Protocol.

In the light of the increasing volumes of emissions certificates traded globally, the certified reduction units or emission permits might become one the most powerful world currencies of the 21st century. At least a new quantified reference system for governmental as well as business affairs has been introduced. However, such a system is not an end in itself: It needs to be assessed against the background of the emissions reductions which have so far been achieved. The calculation by the UNFCCC secretariat points out that the innovative instruments are – at least in the way they are currently designed – not sufficient to trigger far reaching emission reductions. They are not yet appropriate means to enforce technological change. The international climate community is, of course, very well aware that further efforts are needed and the ongoing process to review the achievements under the Kyoto Protocol is a good example that the international climate regime needs to be regarded as a joint learning process. Accordingly, plans are underway in the international community to start negotiating a new climate agreement from 2008 on.[29] There is some urgency here if an agreement should be adopted by 2009 in order to ensure the entry into force of a new global framework in 2012. Since the relevant conference will take place in Copenhagen the agreement is likely to be called the Copenhagen Protocol. Given the topics already discussed in recent years, the negotiations as well as the agreement will need to tackle the questions of mitigation, adaptation, financing, and technology. The crucial feature of the agreement is likely to be differentiated commitments of those countries contributing most to global greenhouse emissions. They will be asked to reduce GHG emissions substantially in the years to come. At the same time, this discussion could hardly be separated from the need for a technology funding mechanisms in order to trigger innovations urgently needed, especially in those countries with growing emissions and lacking capacities to reverse this trend. Moreover, such a technology funding mechanisms might be an appropriate way to link all those four challenges also including the questions of adaptation and compensation.

It is more than clear that these negotiations will be very complicated. Creative solutions and willingness to compromise are prerequisites for a successful outcome. From my perspective, four components will be decisive. First, the European Union needs to demonstrate renewed leadership. That means the EU has to show that the climate policies it has adopted so far will be successful to meet the reduction targets under the Kyoto Protocol. Second, the EU needs to convince the US to take part in such an "informal" transatlantic leadership initiative on climate change in order to set an example for other important parties in the global climate game so that the at present largest emitter takes the risks of climate change seriously and acts accordingly. Third, they both need to engage emerging countries like China and India which today belong to the major emitters even if they are historically far away from the responsibility of the transatlantic partners. Last but not least the international community will need to compensate countries most affected by climate change since these countries usually lack the capacities to adapt whereas their contribution to the overall problem could be neglected. The latter factor is increasingly discussed against the backdrop of the security implications of climate change. Why this new "framing" is also of relevance for international politics will be outlined in the following section.

29 See for an analysis, Chukwumerije Okereke, Philip Mann, Henny Osbahr, Benito Müller and Johannes Ebeling 2007: Assessment of key negotiating issues at Nairobi climate COP/MOP and what it means for the future of the climate regime. Tyndall Centre for Climate Change Research Working Paper 106. Oxford (UK).

The Security Implications of Climate Change

Climate change as forecasted by the IPCC will overstretch many societies' adaptive capacities. Especially during the year 2007 a number of risks assessments are published that indicate a substantial change for national, regional and international security.[30] Especially the comprehensive risk assessment undertaken by the German Advisory Council on Global Change indicates that the extent of the environmental stress will reach new dimensions. The assessment outlines as upcoming major conflict constellations the climate-induced degradation of freshwater resources as well as in food production, an increase in storm and flood disasters and – basically as a result of the three aforementioned trends – a substantial increase in environmentally-induced migration.

In some regions of the world, climate changes may hence contribute to internal destabilization processes and state failure with diffuse conflict structures and inter-state conflicts. These conflicts may challenge the stability of the international system. Already fragile and conflict-ridden states – particularly in North Africa and its equatorial belt, the Middle East, and South Asia – will be hit first and hardest. South Asia with populous countries like India, Pakistan or Bangladesh is an example of one of the so called "tipping points" in climate security, given the glacial retreat already visible in the Himalayas. This irreversible trend will have especially severe consequences for this region since the Himalayas are - for good reasons - called the "water tower" of South Asia. The prognosticated retreat will jeopardize the water supply for at least 500 millions of people. These dynamics will increase the social crisis potential in a region which is already characterized by cross-border conflicts (India/Pakistan), unstable governments (Bangladesh/Pakistan) and a number of local conflicts which are in part already triggered by water scarcity or environmental degradation.[31] Similar trends could be expected in Central Asia, a region already hit by political and social tensions, weak governance structures, conflicts over access to water and energy resources (especially along the lines of agricultural vs. hydropower production interests) and poor infrastructure, especially with respect to the irrigation facilities in place. Last, but definitely not least, the first "real" climate related conflict can currently be observed in the Arctic due to the melting of the ice sheet. Here the interlinkages between climate and energy security got especially visible since enormous energy resources are likely to be more easily accessible in case of a shrinking of the Greenland ice sheet. In the light of competing territorial claims by Canada, Denmark, Norway, Russia and the United States the international community needs

30 See for example German Advisory Council on Global Change 2007: World in Transition. Climate Change as a Security Risk. London and Sterling; CNA 2007: National Security and the Threat of Climate Change. Alexandria (Virginia) as well as IISD 2007: Climate Change and Foreign Policy. Winnipeg. An up-to-date reading list on "climate & security" is available at http://www.ecc-platform.org.

31 Tänzler, Dennis, Boris Schinke and Christoph Bals 2006: Is there „Climate Security" for India? "Tipping Points" as Drivers of Future Environmental Conflicts. Background Paper.

to seek a political solution to avoid future resource conflicts regarding the exploration of oil and gas.

These trends will not occur consecutively, but simultaneously and in parallel to global trends like population dynamics, urbanisation and an increasing demand for (energy) resources throughout the world. The outline of potential future regions at risk shows that climate-change induced conflicts will only in part be caused by environmental change. Governance deficits, poverty, lack of the rule of law, ethnic tensions etc are also key factors to be taken into account (also with a view to potential policy solutions). At the same time resource scarcity and land degradation are not new phenomena at all.[32] Research shows that transboundary water cooperation and national resource management are already pillars of a preventive diplomacy. By jointly managing shared water resources, countries build trust and prevent conflict. Several of the world's major river basins like those of the Nile, the Jordan, and the Indus, have been the subject of cooperative negotiations. It is obvious that these arrangements need to be strengthened in the future under changing climate conditions. New water management strategies and infrastructures may be needed and accordingly new financial resources are required. It remains to be seen to what extent the evolving adaptation framework under UNFCCC and the Kyoto Protocol will be appropriate to contribute to improved structures of conflict prevention.

The Prospects for a Transatlantic Consensus

Some of the security implications of climate change outlined above will certainly have an impact on regional security complexes and could hardly be avoided completely - despite decisive international efforts. However, in order to limit the magnitude of climate induced conflicts in the future, international climate negotiations become a crucial component of a risk minimization strategy. For a number of reasons, these negotiations need a transatlantic consensus to be successful.[33] First, the U.S., Canada, and the EU are responsible for about two thirds of industrialized GHG emissions. Hence, they caused the lion's share of the anthropogenic greenhouse gases in today's atmosphere. Because of this historical responsibility, emerging economies like China and India are only likely to follow and to accept legally binding commitments if the U.S. and EU take the lead in reducing greenhouse gas emissions.

Second, from a transatlantic perspective, there is a long history of political and economic cooperation. Forward looking policy solutions on both side of the Atlantic can potentially generate environmental innovations. The expansion of renewable energies in Germany and also the expansion of wind energy within the United States,

32 See for an inventory of environmentally induced conflicts between 1980-2005; Alexander Carius, Dennis Tänzler, and Judith Winterstein 2007: Eine Weltkarte von Umweltkonflikten. Ansätze einer Typologie. Report on behalf of the German Advisory Council on Global Change. Berlin: Adelphi. (available at www.wbgu.de).

33 See for a more detailed discussion Tänzler, Dennis and Alexander Carius 2004: The Prospects for a Transatlantic Climate Policy. In: Journal of Transatlantic Studies, Vol. 2, No. 2, 209-226.

in states like California or Texas, are good examples of this trend. At the same time, decision makers on both sides of the Atlantic should be aware that their first and foremost obligation is to stop and reverse negative emission trends. The GHG emission trends from 1990 to 2010 make it quite clear that policy efforts so far have been insufficient. Two trends are visible. On the one hand, there has been a tremendous increase in U.S. GHG emissions since 1990, although data for 2004 and 2005 indicates that this negative trend may at least be slowed down.[34] On the other hand, the EU has shown since 1990 that a reversal of the emission trend is possible. However, the EU is still far away from the emission reductions it aims to achieve. It still has some way to go before it is in compliance with the Kyoto target. From a more optimistic perspective there is some reason to argue that the EU will achieve the target since some of the measures adopted will show impact only in the years to come. One important example in this regard is the development and implementation of emission trading systems. Emission trading as an instrument invented initially in the United States is now one major pillar of European Climate Change Policies and an example of what a transatlantic climate policy approach might look like.[35]

Third, agendas are converging. One reason for this development might be because the dialogue between the U.S. and the EU countries are based on increased scientific certainty. If we compare today's discussion regarding human influence on the climate system with that of five years ago, we see a tremendous difference. More importantly, we can see that there is a convergence of the overall climate and energy security agendas as a couple of examples can illustrate.[36]. Specific policy measures to tackle the challenges of climate change and energy security have been adopted on both sides of the Atlantic. During the EU Council meeting in March 2007 the heads of EU member state governments agreed to increase renewable energies production as a share of total energy consumption to 20 percent by 2020.[37] This target is mandatory whereas the discussions before the meeting suggested only an indicative target. Furthermore, a binding 10 percent target for the share of bio-fuels as part of EU transport fuel consumption in 2020 was adopted as well as the intention to improve energy efficiency also by 20 percent in 2020. The commitment to improve

34 See for recent GHG trends, UNFCCC 2006: GHG Data 2006. Highlights from Greenhouse Gas (GHG) Emissions Data 1990-2004 for Annex II-Parties. Submitted under the United Nations Framework Convention on Climate Change (UNFCCC). Available at www.unfccc.int

35 See for a discussion of selected climate policy instruments, Oberthür, Sebastian and Dennis Tänzler 2007: Climate Policy in the EU: international regimes and policy diffusion. In: Paul G. Harris (ed.): Europe and Global Climate Change. Politics, Foreign Policy and Regional Cooperation. Celtenham (UK), Northampton, MA (USA): Edward Elgar, 255-277.

36 Carius, Alexander and Dennis Tänzler 2006: Climat énergie: une nouvelle composante due contexte de la sécurite. In: Les Cahiers de la Sécurité, Environment, changement climatique et sécurité, No. 63, 157-186.

37 See Council of the EU 2007: Presidency Conclusions Brussels, 8/9 March 2007.Available at www.consilium.europa.eu.

energy efficiency levels is important because, as the European Commission pointed out in the fall of 2006, it means that greenhouse gas can be significantly reduced at minimal cost. A number of observers regard this EU council as a successful integration of both agendas, that of climate change and energy security. Some are so euphoric as to claim to see in the meeting the rebirth of the European spirit. In addition, the area of climate security has gained more prominence in the EU. Under the German EU presidency the EU Council conclusions in June included an invitation for the European Commission and the High Representative of the EU, Javier Solana, to present a joint report on climate security during the spring Council meeting in 2008.

In the United States there are also encouraging signs towards such a convergence of climate and energy security agendas. This is also true for the US administration. In the State of the Union speech of 2007 President Bush pointed out – for the first time - that climate change is an important issue. He also emphasized that there is a need to increase energy independence and cut gasoline usage, by 20 percent in ten years. The US administration mandated a higher proportion of alternative fuels and announced measures for increasing the fuel efficiency standards for cars and light trucks. In sum, this might not be a sufficient response to the challenges outlined before. However, it is a significant departure from the positions taken the years before. Even more important, there are promising activities at the state level. For example, more than 20 states have introduced renewable energy portfolio standards in order to trigger the expansion of renewable energy production. It is worth noting that these states agreed to adopt binding targets regarding the share of renewable energies. Analysis suggests two reasons: states are guided by environmental policies on the one hand but on the other they recognize the need for energy independence.[38]

There are further reasons why the prospects for a new transatlantic consensus on climate change are promising. First, there is a huge political dynamic in the US as to whether to set a cap on GHG emissions. In the EU, the Council meeting in March mentioned before agreed on a binding unilateral EU commitment to cut GHG emissions by 20 percent by 2020 compared to 1990 levels. In addition, the EU emphasized the need of a 60 to 80 percent reduction in developed countries until 2050. When we take a look at the debates in the U.S. Senate, there are a number of proposals for a cap and trade system introduced in 2007 including caps to be set in 2020 and 2050 respectively. Moreover, there are also regional climate policy approaches in California that aim at similar long-term emissions reduction targets. Hence, there are at least starting points to discuss what a future climate change policy should look like, and this is especially the case with respect to the development and implementation of emissions trading systems. The EU will leave the learning phase of its system in 2008 and the major lesson to be learnt from this phase is: More stringent

38 See Tänzler, Dennis 2005: The diffusion of renewable portfolio standards within the United States. Paper presented at 3rd European Consortium for Political Research (ECPR), Budapest, 8-10 September 2005.

allocation plans are to be adopted for the first commitment period from 2008 to 2012.[39] At the same time, regional systems are under development in the United States. I may note, for example, the Regional Greenhouse Gas Initiative (RGGI) approach of nine Northeastern States, and a system to be developed by California and five further states at the west coast.[40] Due to the typical diffusion pressure within the federal system of the United States, these approaches at the state level are likely to have significant effects on the national level. As a key aspect of the pluralistic competition within the US federal system, policy innovations like standards and procedures for emissions inventory and registry are likely to spread across the whole country after a 'critical mass' has been reached. In addition, there are senate proposals for national cap and trade systems to be discussed in the upcoming months.[41] Most importantly, we need to mention the Lieberman proposal which is co-sponsored by the potential future presidents of the United States McCain, Obama, and Clinton. Given their future ambitions this is a meaningful political support for developing and implementing a national emission trading scheme.

Second - and this might be as important as the political will outlined above - is the increasing pressure by business actors to establish market-based solutions to tackle the problem of global climate change. A number of important companies and business have asked for a global market for emissions in order to get investment security and the same conditions in the United States and within the European Union.[42]

New Partnerships, New Ways of Engagement

Emissions trading and the expansion of renewable energies are only some of the issues where transatlantic policy learning and increased cooperation between the U.S. and the EU is needed. Especially the question of emission trading is a useful example to trace the process of a joint transatlantic learning curve as part of the multi-level game of transatlantic relations. In the summer of 2007 consultations started to harmonize existing and evolving emission trading systems at both sides of the Atlantic and throughout the world. The objective of this so called "International Carbon Action Partnership" is to finally pave the way for a global emission market.[43] Partners include inter alia EU member states, the European Commission and representatives of the two evolving regional systems at the west and the east coast of the United States.

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39 See for an analysis of the European Trading System, Meadows, Damien 2006: The Emissions Allowance Trading Directive 2003/87/EC explained. Chapter 4 in: Delbeke, Jos (ed.): The EU Greenhouse Gas Emissions Trading Scheme. EU Energy Law, Volume IV.

40 Marris, Emma 2007: Western States launch carbon scheme. Nature 446, 8 March, 114- 115.

41 Pew Center 2007: August 2007:Chart: Summary of Cap-and-Trade Climate Legislation Proposed in the 110th Congress. Washington, D.C.

42 USCAP 2007: A Call for Action. United States Climate Action Partnership. See www.us-cap.org.

43 For more information on the International Carbon Action Partnership, please see http://www.icapcarbonaction.com.

This kind of partnership can also be a catalyst for further global action that needs to involve newly industrialized countries. Given the increasing emissions in countries like China and India, this is a key aspect to provide for an increase of global mean temperature below 2° Celsius. One major challenge is how to transform energy systems in the light of the significantly increasing global energy demand. Therefore, a global deal on low carbon technologies needs to be achieved which can lead the way towards a de-carbonized future. To this end energy efficiency improvements in the power plant sector is one of the most urgent tasks. Proving the feasibility of carbon capture and storage (CCS), and in gasification technologies is another one. The outstanding importance of expanding renewable energies and of developing high-capacity grids does not need to be mentioned again. However, in order to alleviate energy poverty as one the key barriers to development, the promotion of decentralized energy systems needs further international support. The initiative "Lighting Africa" by the World Bank is one good example in this regard. It aims at providing up to 250 million people in Sub-Saharan Africa with access to non-fossil fuel based, low cost, safe, and reliable lighting products by 2030.[44]

Coming back to the prospects of the international climate change arena, there are signs that newly industrialized countries are more likely to agree in a first step to a flexible or a sectoral emission target.[45] Such a commitment may be linked to the expectation by these countries to gain improved access to clean technologies. In the light of enormous increases in energy demand in China and India – as forecasted by the International Energy Agency – the international community may be forced to accept such a compromise. New ways of financing are not only needed to facilitate technology transfer but also with respect to adaptation planning. The funds under the UN framework convention on climate change and under the Kyoto Protocol will play a key role in this regard. However, the setup of these funds has been accompanied by difficult negotiations on the governance structures. The future discussions about adaptation priorities in the course of more and more visible climate changes are likely to be even more complicated.

Against this backdrop there is an increasing need for projects that jointly address mitigation and adaptation needs. This brings us back to the converging agendas of climate and energy security. For example, water scarcity in the MENA region is not a potential challenge depending on future climate change but it is already existing today. At the same time energy demand is, partly driven by population growth, increasing in this region. In order to provide clean energy for the "sunbelt countries" the development of a system of solar thermal power plants in the desert seems more realistic today than some years ago when the price of crude oil was the main barrier for renewable energy technologies. Such a system of solar power plants would serve multiple purposes: reduce CO_2 emissions, increase the security of energy supplies as

44 For more information on the initiative, please see http://lightingafrica.org.

45 See for a discussion, Bodansky, Daniel 2007: Working Paper: International Sectoral Agreements in a Post-2012 Climate Framework. Prepared for the Pew Center on Global Climate Change.

well as create additional jobs and earnings for people in North Africa and the Middle East. In addition, there are plans to use the waste heat generated by the plants to desalinate water and hence to tackle the problem of water scarcity which is getting more and more severe in this regions. A comprehensive concept building on these pillars and moreover including the idea of a transmission grid connecting the EU-MENA region was suggested by the National Energy Research Center of Jordan together with the Club of Rome and the German Aerospace Center.[46] Regardless of the feasibility of this project, addressing the question of how to deal with increasing resource demand when supply is likely to be substantially reduced by the impact of climate change will be a key question in the years to come – not only for the transatlantic community but for a number of regions around the world.

Conclusions: New Dynamics Are Needed

There are ways to achieve a transatlantic as well as a global consensus on how to address climate change and renew transatlantic dialogue. Policy approaches could be harmonized; research cooperation needs to be increased. One transatlantic step in this direction could be the Energy and Technology initiative promoted by the US and German Foreign Ministers Rice and Steinmeier.[47] During a US-EU high level meeting in March 2007 they brought together high level representatives from energy, research, and venture capital in order to accelerate the innovation and deployment of new energy technologies across the Atlantic. Such initiatives can bring new dynamics to international negotiations under the auspices of the United Nations which are otherwise sometimes overstrained by the number of topics and players. These negotiations might thus be facilitated by dialogues between the G8 countries and, as intended by the Bush administration, other major economies like Brazil, India, China, Mexico, and South Africa. In the end, however, the aim of all these pathways needs to be the development of a shared understanding of the nature of future commitments. Meetings like that of the G8 in Heiligendamm in Germany may be highly problematic because of the lack of participation of civil society representatives. However, they need to be referred to as means to generate new dynamics, so urgently needed in order to agree on substantial mitigation and adaptation measures as part of the international climate change regime. This is also the expectation for the start of international climate negotiations for a multi-track approach in Bali, at the end of 2007. Bali is only a first step to agree on substantial results for targets and timetables, on the one hand but also new forms of partnerships to address the questions of technology transfer, financing, and adaptation, on the

46 See Knies, Gehard 2007: TREC: Renewables for Security and Stability. In ECC-Platform, February 2007 Edition. Available at www.ecc-platform.org.

47 See U.S. State Department 2007: Ensuring a Sound Energy Future: Remarks With German Foreign Minister Frank-Walter Steinmeier and European Commissioner for External Relations and European Neighborhood Policy Benita Ferrero-Waldner, U.S.-EU Energy CEO Forum, Washington, DC, March 19, 2007.

other. Further steps will be needed in 2008 and 2009 to deliver a comprehensive framework for the years to come. To this end the new momentum in transatlantic climate and energy policies can be the catalyst for the new dynamics needed.

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http://www.icapcarbonaction.com.

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CHAPTER FIVE

From Bystander to Stakeholder: China's Perspective on Climate Change

Qin Tianbao

Introduction

No issue dominated the political agenda and the newspapers in the run-up to thisyear's Group of Eight (G8) Summit more than climate change. Backed up by the world scientific and economic community in the conclusions of the Intergovernmental Panel on Climate Change's (IPCC) Fourth Assessment Report, and buttressed by unprecedented levels of public support, Germany's Chancellor Angela Merkel has placed climate and energy security at the heart of both the 2007 German presidencies: the G8 and the European Union.

This attention is very timely: we now know global warming has become an "undoubted truth" and the human activities are "most likely" the main reason. [48]Currently, the concern and the political disenchantment about global warming of the most countries around the world have reached a level never met before. However,, the chairman Dr. R.K. Pachauri thought that it is far from enough, he hoped that the report could shake the public and the government and drive them to take more serious activities.[49]

The EU is at the forefront of international efforts to combat climate change. The Environmental Ministers of EU member states reached the *Declaration on Climate Change* in Brussels on February 20, 2007, and agreed that European greenhouse gas emissions should be reduced by at least 20% below 1990 levels by 2020, no matter what actions other countries decided upon, and that the EU was prepared to reduce emissions by 30% below 1990 levels by 2020 if other countries were to undertake serious actions, or in the case of industrialised countries, mandatory deep emissions reductions.[50]

48 The Fourth Report of the IPCC released in February 2007 pointed out clearly that human activity should take more than 90% responsibility for the last 50 years' global warming. IPCC, *Climate Change 2007: The Physical Science Basis Summary for Policymakers*, available at http://www.aaas.org/news/press_room/climate_change/media/4th_spm2feb07.pdf (last visited on March 9, 2007).

49 Q&A: The IPCC Report on Climate Change, available at http://environment.guardian.co.uk/climatechange/story/0,,2004768,00.html (last visited on March 9, 2007).

50 "Climate change: New report form the world's leading scientists underlines the need for urgent

Although the US as the biggest GHG emissions emitter refused to ratify the Kyoto Protocol (KP) in 2001, the situation is still developing in a positive direction. U.S. people have paid more attention to global warming after Hurricane Katrina. Al Gore who has served in the White House for 24 years urged U.S. congress to act on climate change,[51] and he was awarded the Nobel Peace Prize for his documentary "An Inconvenient Truth" which arouses concerns of the general public. Recently, the Supreme Court made a landmark ruling in the *Massachusetts v. EPA* case on the EPA's authority to regulate carbon dioxide emissions from vehicles. The ruling seems to be bolstering the Congress' efforts to come up with comprehensive legislation to address climate change.[52] It is said that the ruling may have potential implications for the new round of negotiations on climate change. In the G-8 Summit, the Bush Administration agreed at least that the future post-2012 climate regime should be negotiated under the UN and finalized by 2009.

As a responsible developing country, China attaches great importance to climate change. Although the KP did not require China to take any obligations on emission reduction, China has taken a series of policies and measures to address climate change in the overall context of national sustainable development strategy, making positive contributions to the mitigation of and adaptation to climate change. Especially, in June, 2007, China published the China's National Climate Change Programme53 which shows its determination to reduce GHG emissions.

We will find that, during the past 15 years, namely from 1992 (the ratification of the UNFCCC) to 2007 (the publishing of the National Programme), China's attitude to climate change and its legal and policy response has changed from a bystander to a stakeholder. The change becomes much clearer after the KP came into force. Generally speaking, the evolution can be illuminated at least by three perspectives: the transition of the competent national authority for climate change, adjustment of general law and policy, and shift of focuses of specific actions. All these policies and laws responding to climate change have gained remarkable achievements in reductions of GHG emissions, but China still needs the courage and determination to further its efforts in order to make its due contribution to the world.

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global action", available at http://www.evropa.bg/en/del/info-pad/news.html?newsid=2482 (last visited on March 9, 2007).

51 "Gore urges Congress to act on climate", available at http://www.usatoday.com/weather/climate/globalwarming/2007-03-21-gore-global-warming_N.htm#uslPageReturn (last visited on March 9, 2007).

52 Felicity Barringer, "Ruling Undermines Lawsuits Opposing Emissions Controls", in *New York Times*, April. 3, 2007, available at http://www.nytimes.com/2007/04/03/us/03impact.html (last visited on April 25, 2007).

53 "China releases National Climate Change Programme", available at http://www.ccchina.gov.cn/cn/NewsInfo.asp?NewsId=8077 (last visited on June 9, 2007).

Reasons behind the Change of China's Perspective

What impels China to change its perspective on global warming? The main reason is that China has already faced and will surely face more severe challenges caused by climate change. Concretely, it may be attributed to, at least, the three following interrelated factors.

As a developing country China would suffer much more from climate change

China has gradually realized that as a developing country at a low development stage, with a huge population and relatively low capacity to tackle climate change, China would suffer from climate change much more than most other counties. According to the *National Climate Change Assessment Report*, the negative impacts from climate change are mainly found on agriculture, water resources, nature ecology system, coastal areas, and the public health.

Impacts on water supply and demand

Climate change has made the conflicts between water supply and demand much more severe, and has made the problem of desertification extremely prominent. In recent years, the water resources in north China have apparently diminished, and the water supply shortage phenomenon was also observed in South China. The tendency of desertification in north China has become much more serious while the climate has become drier since the 1960s. At the same time, glaciers with a percentage of 82% in west China are shrinking. As a result, melt water resources would gradually be exhausted which would threaten China's water supply in the long term, especially for the west areas whose river surface flows are mainly relying on the melt water resources.

Impacts on China's agricultural production and food security

It is estimated that future climate change can affect agriculture and livestock industry in the following ways[54]: increased instability in agricultural production, where the yields of the three main crops, i.e. wheat, rice and maize, are likely to decline if no proper adaptation measures are taken; changes in distribution and structure of agricultural production as well as in cropping systems and varieties of crops; changes in agricultural production conditions that may cause drastic increases in production cost and investment needs; increased aggravation of desertification, shrinking grassland areas and reduced productivity that result from increased frequency and

54 *China's National Climate Change Programme*, Prepared under the Auspices of National Development and Reform Commission, People's Republic of China, Printed in June 2007, p.16.

duration of drought occurrence due to climate warming; and potentially increased rate of disease breakout for domestic animals.

Impacts of rising of sea level and frequency of tropical storms

It is predicted that up to the year 2100, the sea level in south China will rise from 60 to74 centimeters. The sea level rising will not only enlarge the submerged areas near the coast and accelerate coast erosion but also destroy the coastal wetlands, mangroves and coral reef ecosystem which would have negative impacts on coastal fishery. Confronted with the threats of flooding, sea water intruding and tropical storm, a group of cities with large populations and advanced economies such as the Yangtze delta are the most vulnerable districts. For a long period the economic loss aroused by tropical storms has an average percentage of 0.25% of the GDP in a specific year.

Impacts on health of the public

Accompanying the increase in frequency and intensity of heat waves, the degree and the scope for cardiovascular diseases and diseases such as malaria and dengue fever would be increasing. In addition, accompanying severe floods, infectious diarrhea such as cholera would accordingly increase. Furthermore, the temperature increment would enlarge the epidemic-stricken areas, the population under threat would be larger and larger. Research indicates that if the concentration of carbon dioxide doubles in the future, the plague source areas in China would increase by 40%.

China's sustainable development strategy requires reduction of GHG emissions

China is still a low-income developing country with a large population requiring that it sets poverty-reduction and economic development as overriding priorities to increase citizens' welfare. China has the largest population in the world with 1.31 billion in mainland China in 2005 accounting for 20.4% of the world total. China is still at a low level of urbanization; and in 2005, urban population accounted for only 43% of the national total population, lower than the world average. [55]

In 2005, the per capita Gross Domestic Product (GDP) of China was about US$ 1,714, only about 1/4 of the world average level. Remarkable disparity in economic development exists among different regions of China. By the end of 2005, the poverty-stricken people in China's rural areas numbered 23.65 million, with a per capita annual pure income less than US$ 90.[56]

However, the CO2 emission intensity of China's energy consumption is relatively

55 *China's National Climate Change Programme*, Prepared under the Auspices of National Development and Reform Commission, People's Republic of China, Printed in June 2007, p.15.

56 Ibid, p.16.

high because of the coal-dominated energy mix. In 2005, the primary energy production and consumption in China were 2,061 Mtce and 2,233 Mtce, of which raw coal accounted for as much as 76.4% and 68.9%, respectively.57 Because of the coal-dominated energy mix, the CO2 emission intensity of China's energy consumption is relatively high.

There is no precedent where a high per capita GDP is achieved with low per capita energy consumption in industralised countries. With its ongoing economic development, China will inevitably be confronted with growing energy consumption and CO2 emissions. The issue of GHG mitigation will pose a challenge to China to create an innovative and sustainable development pattern. In other words, the domestic sustainable development requires especially China to reduce consumption of energy and subsequent GHG emission.

The increasing international pressure forces China to undertake obligations of emission reduction.

The pressure for China's implementing the KP is growing. The existing accord – the Kyoto Protocol – did not oblige China and other developing countries to cut CO2 and other GHG emissions. However, China's whole amount of CO2 emissions is less only than the U.S, though its per capita emission is still much lower than the world average level. In addition, China is in an intense and high economic development phase and a period of heavy industrialization, so the intensity of CO2 emissions will become much more serious than in other countries. In 2020, it is predicted that China will have the largest emission amount, replacing the U.S. as no. 1 on the list of emission countries.

Under such circumstances, China will inevitably be the focus of the second round of negotiations to be initiated in 2012. As a senior official said: "In this sense, the new round of negotiations (of KP) is no less important than that of China's entry into WTO, we have suffered great pressure!"[58] China is shifting ground and realizing that it must be a player if it wants to shape the post-2012 framework. This shift in position is a potentially important step in tackling global warming and shows that China is ready to engage in international talks on limiting emissions.

The evolution of China's legal and policy response to climate change

In general, to a certain degree, China was like a bystander and its policy and legal response to climate change were passive, reactive and somewhat of a side effect

57 Ibid, p.15.

58 "The Climate Brainpower Setting up Process on in China: the pressure is as heavy as entry into WTO", available at http://china.dayoo.com/gb/content/2007-01/23/content_2742095.htm (last visited on March 9, 2007).

before the KP came into force. Currently, China has reoriented itself into being a stakeholder and has taken many more active, positive and specific actions to control climate change.

Transition of the national competent authority and relevant functions

Firstly, the deepening of the understanding of the nature of the climate change issue and its priority in China can be exemplified by the transition of the national competent authority and its relevant functions.

At the every beginning, climate change was only regarded as a meteorological issue, and so the Meteorological Agency (CMA) was the national competent authority. In order to make other ministries involved, China in 1990 established the Coordination Committee on Climate Change under the State Council's Environment Protection Committee (EPC)[59]..

The situation changed during the government's institutional reform starting in 1998. In the same year, China set up the National Coordination Committee on Climate Change (NCCCC), in place of the previous Coordination Committee. The NCCCC is an inter-ministerial organisation acting as consultancy and coordination agency. Its main mandates are to make and harmonize policies and activities on climate change among different ministries, and furthermore, to submit questions and opinions of great importance but with differences of opinion to the State Council for decision-making, in order to promote the international negotiations and domestic implementation of the UNFCCC and its KP. According to the division of labour, the National Development and Reform Commission (NDRC)[60] is now the national competent authority and leading in coordinating climate change policies and actions adopted by various ministries.

Meanwhile, China is increasingly attaching great importance to the role of scientists in providing scientific consultation and decision-making suggestions. On January 12, 2007, the Experts' Committee on Climate Change was established under the CMA and has increased its work since then. A most direct inducement for establishing the Experts' Committee is the coming negotiations for the second commitment period of KP. The setup of the Experts' Committee is a breakthrough in the climate policy of China, which indicates demonstrably that China has taken positive steps, after having reacting rather passively from the outset.

Recently and notably, China established the high-level National Leading Group

59 The Environmental Protection Committee under the State Council was made up of leaders of various related ministries under the State Council. It was the State Council's consultancy and coordination agency for environmental protection work. The EPC was repealed in China's institutional reform in 1998.

60 The NDRC is China's macro-economic regulatory department under the State Council, with a mandate to develop national economic strategies, long term economic plans and annual plans, and to report on the national economy and social development to the National People's Congress.

on Addressing Climate Change and Managing Energy Conservation and Pollution Reduction headed by Premier Minister Wen Jiabao. The Leading Group will be responsible for deliberating and determining key national strategies, guidelines and measures on climate change, as well as coordinating and resolving key issues related to climate change. The Office of the Leading Group, whose capacity shall be strengthened, is established within the NDRC.[61] The move is aimed at achieving the target of cutting energy consumption per unit of GDP by 20 percent and emissions of SO2 and chemical oxygen demand (COD) by 10 percent by 2010 from the 2005 level set out by the 11th Five Year Plan. [62] The government has regarded it as one of its important mandates and determined to play a dominant role in addressing the issue.

Clearly, the reformation of China's national coordination committee, the shift of competence from CMA to NDRD and the establishment of the National Leading Grouping, have shown that climate change is not just a technical issue, but rather an urgent problem which is likely to affect China's economic development and social progress in the long term. Following this new understanding, China began to adopt an active attitude to the issue and bring it into the scope of national security. Since then, the climate change issue has entered into China higher level's political agenda and is given higher priority than before.

The adjustment of general law and policy on climate change

Before the KP came into force, China had adopted a series of policies and laws, but GHG control was just an additional purpose, and international cooperation was only indirectly related to climate change. After the Protocol came into force, China integrated "GHG emission reduction" into its Five Year Plan for the first time, prepared the NCCAR in order to discuss climate change and its impact and passed several laws and regulations to implement the the final target set up by the UNFCCC. And in the field of climate change China also developed international cooperation directly with foreign countries and international organizations.

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61 *The Circular of the State Council on the Establishment of National Leading Group on Addressing Climate Change and Managing Energy Conservation and Pollution Reduction, Guofa (2007) 18*, available at http://www.gov.cn/zwgk/2007-06/18/content_652460.htm, last visited on July 9, 2007.

62 The Five-Year Planning for National Economic and Social Development of the P. R. of China（before the 11th Five-Year it has been called "Five-Year Plan"） is China's comprehensive plan for national economic and social development. It mainly plans for national key construction projects, the productivity distribution and the proportion relations of the national economic by which proved the target and the direction for national economic. China already has eleven Five-Year plans counted from the first "five-year plan". Generally speaking, five-year plan is of the highest force in China and it always can be implemented very well in China.

General law and policy before the KP's entry into force

A. Adoption of a sustainable development strategy

In the beginning of 1990s, China introduced the concept of sustainable development. In 1994, China developed *China's Agenda 21* and in 1998, it took sustainable development as its guiding principle and strategic target by approving its *Outline of 9th Five-Year Plan for National Economic and Social Development and Long-term Objectives by 2010.*. The adoption of a sustainable development strategy efficiently promoted the reduction of GHG emissions.

B. Development of climate-related industrial policy

One of the main reasons of generation of GHG is the human activities, especially industrial activities on acquiring fossil fuels.[63]In this regard, the GHG emissions amount could be decreased if the climate-related industrial policy was improved. In order to adjust the industrial structure and reduce energy consumption, China strengthened the macro-level control, and accelerated the development of the tertiary industry while restructuring the secondary industry. At the same time, it has developed lists of encouraged and restrained industries, and encouraged the development of those industries and products which have high economic efficiency and low energy consumption.

C. Promulgation of laws related to climate change

In recent decades, China has promulgated or amended numerous laws on resource conservation and environmental protection, such as the *Energy Conservation Law 1997*, *Forest Law 1985 (amended in 1998)*, *Law on Prevention and Control of Air Pollution 2000*, and *Cleaner Production Promotion Law 2002,* etc. Although many of those laws do not stipulate reductions of GHG emission directly, their implementation and enforcement has as a matter of fact meant an actual contribution to the reduction of GHG emissions in China.

D. Promotion of international cooperation on climate change

China attaches much importance to international cooperation in the climate change field; and it has developed wide cooperation with foreign nations and international organizations which has promoted China's GHG emissions reduction. For example, in the energy field, China and the U.S. signed the *Cooperation Agreement on Energy Conservation and Renewable Energy* which promoted cooperation and communication especially on energy conservation and renewable energy.

63 See supra note 1.

General law and policy after the KP came into force

After the KP came into force, China insists on a sustainable development strategy as always and promotes energy conservation and industrial adjustment. In the next decades, China will change the pattern of economic development, insist on economical, clean and secure development and achieve sustainability. One ultimate goal of all these strategies is to improve environmental quality and control GHG emission.

A. Taking energy conservation as one of the basic national policies

In order to better implement a sustainable development strategy and promote energy conservation, the 11th Five-Year Plan mandates China to accelerate transformation of the economic growth pattern. It stipulates taking energy conservation as a basic national policy, developing circular economy and protecting the environment, accelerating the development of energy conservation and environment-friendly society, harmonizing relations between economic development, population, resources and the environment. Furthermore the *Outline* set forth the target of energy conservation and pollution reduction.[64]

B. Promoting climate-conscious industrial policy

Aiming at fulfilling the binding index set out by the 11th Five-Year Plan, China has also promulgated several regulations and taken on many activities to optimize the energy consumption structure and cut down redundant production capacity in order to reduce energy consumption and mitigate GHG emissions.

For example, China requires that 399 kinds of manufacturing techniques and products should be phased out, such as small mines in the area of state-owned mine fields, thermal generator sets with unit capacity under 50,000 KW, blast furnaces and self baking aluminium cells less than 100 m^3 and so on. Meanwhile, key energy conservation projects on economizing and substituting oil, co-generation and surplus heat utilization, etc. have become a breakthrough for industrial energy conservation in the period of 11th Five-Year Plan.[65]Further, China has strengthened the management of investment access of construction projects, strictly controlling newly-initiated projects, especially high energy-consuming enterprises related to steel, electrolytic aluminium, copper smelting, alloy iron, calcium carbide, coke, cement, coal. In addition, in January 2007, China decided to close down over 50 million KW small thermal power sets and 7 to 10 million KW oil-electric generator

64 See the *Outline of 11th Five-Year Planning for National Economic and Social Development* (full text), available at http://www.chinanews.com.cn/news/2006/2006-03-16/8/704064.shtml (last visited March 9, 2007).

65 "The Potential of Energy Conservation in Industry", available at http://www.ccchina.gov.cn/cn (last visited on March 9, 2007).

sets, and will not authorize new thermal power sets any more. In this way, China would save more than 50 million tons SCE (Standard Coal Equivalent) and reduce over 1.6 million tons emission of SO2 each year.

C. Developing climate-specific laws and regulations

In 2005, China promulgated the *Renewable Energy Law* to encourage and support the renewable energy-generated electricity combined to the grid; support the development of independent power system construction in those areas which are not covered by power networks to service the local production and living; set up a specific fund for renewable energy development, support science and technology research and standards development, provide preferential loans and reductions and exemptions of taxes for projects included in a catalogue of guidance regarding the development of renewable energy industry.

In addition, China's Legislature has made a draft amendment to the *Energy Conservation Law* in 2008, which aims at enhancing energy conservation management and improving the energy utilization efficiency.[66] The amendment will be the core of the legal energy conservation system.

In order to promote the development of CDM projects, China issued the *Measures for Operation and Management Clean Development Mechanism Projects* aiming at accelerating the achievement of the final goal of the UNFCCC and sustainable development of China.

Meanwhile, China is accelerating the draft of the *(Basic) Energy Law* and the *Regulations on Energy-Saving Buildings* which has started to solicit public opinions. Furthermore, the first draft version of the *Law on Promotion of Circular Economy* has been finished. All these laws and regulations would play important roles in mitigating GHG emissions.

D. Actively enhancing international cooperation on climate change

In recent years, in addition to participating in the activities under UNFCCC and KP, China attaches both bilaterally and multilaterally greater importance to international cooperation for addressing climate change.

At the bilateral level, China has established cooperative relations with many other countries, and has established working groups on climate change with Australia, Canada, Japan, the US and even some developing countries, such as Brazil and India. In 2005, China and EU issued a *Joint Declaration on Climate Change*. China and EU have agreed to control climate change jointly and promote substantial cooperation,

66 "China will speed up to promulgate the *Energy Conservation Law*", available at http://www.ccchina.gov.cn/cn (last visited on March 9, 2007.

including technology cooperation on CCS and the near Zero Emissions Coal Initiative (nZEC), supporting clean energy and energy efficiency technology, and promoting energy protection and renewable energy exploration.[67]

At the multilateral level, the Asia-Pacific Partnership on Clean Development and Climate (AP6) was established by Australia, China, India, Japan, Republic of Korea and the United States in Sydney, January 2006. The AP6 is a ground-breaking climate change approach bringing together key developed and developing countries on practical, pro-growth, technology-driven efforts involving environmental protection and energy conservation technologies such as clean coal, nuclear energy and renewable energy etc.[68]

Shift of focuses of actions in specific areas

Although the specific action areas in China before and after the KP varied very little, it is clear that the scope of action in each area has been extended, and more important, focuses have been shifted to pertinent actions after the KP came into force. Among other things, China has made much more efforts on energy conservation and development of new and renewable energy, which is bound to contribute directly to the achievement of goals of GHG reduction.

Specific actions before the KP came into force

A. Attaching importance to energy conservation

For a long time, the Chinese people have understood the basic situation; that is, natural resources including energy are not sufficient to support long-term social and economic development at a higher growth rate. Actually, China did construct an energy development strategy in 1981, and the strategy could be described in brief as "to explore and save energy simultaneously, with the priority on energy conservation". Since 1995, China has promulgated and implemented a series of regulations of energy conservation and has made great progress in energy conservation and energy efficiency.

For example, as to energy conservation standards, China issued the first batch of 9 mandatory national Energy Efficiency (EE) standards for household appliances in 1990. In order to promote energy efficiency, the China Certification Center for Energy Conservation Products (CECP) was established in 1998. It is in charge of the organization, management and implementation of the certification of energy conservation products. The certification of energy conservation products is a

67 "Sino-EU will take substantial activities on climate change", available at http://www.ccchina.gov.cn/cn (last visited on March 9, 2007).

68 "The biggest clean coal power plant cooperation project between China and Australia will be constructed this year", available at http://www.ccchina.gov.cn/cn (last visited on March 9, 2007).

voluntary scheme aiming to save energy and reduce emissions. Energy conservation certification speeds up the technical advancement of energy efficiency. At the end of 2001 25.58% certified products met EU requirements for the A level. [69]As a result of these measures, from 1980 to 2000, the energy intensity per GDP unit has decreased by 5.32% annually.

B. Development of new and renewable energy

New and renewable energy is an important kind of energy since it has positive mitigating effects on GHG emissions. The Chinese government has paid great attention to the research and application of new and renewable energy sources, which have developed rapidly since the 1980s.

In 1995 China formulated the *Guidelines on Renewable Energy Development Program (1996-2010)* describing the main tasks involved in the renewable energy development in China, i.e. to raise conversion efficiency, to reduce production costs, to expand the proportions in the energy mix, and to develop new technologies. China provides many preferential policies to encourage the development of new and renewable energy, such as deductions and exemptions of tax and low or free interest loans. For instance, enterprises using wastes (including gas pumped from mines) generated in their production can be exempted from income tax for 5 years.

C. Management and conservation of forests

Forests play an important role in mitigating global warming. Therefore, the Chinese government attaches great importance to forestation and forest protection. As early as in 1978, China has engaged in forestry projects construction. And in 1982, China set out a nation-wide system of voluntary tree-planting. China has implemented forestry eco-construction projects in key districts such as the "Three-North" Regions (including parts of northwest, northeast and North-China) Shelterbelt Project and key Shelterbelts projects in the upper and middle stream areas of the Yangtze River. By 2002, the accumulated total forestation areas reached 14.66 million ha, and aerial seeding areas reached 16.53 million ha. In sum, more than 94.967 million ha forests have been conserved. [70]

Specific actions after the KP comes into force

A. Taking energy conservation as a high national priority

After the KP came into force, energy conservation has been upgraded to a long-term strategic guideline for China's economic and social development. In 2006, China

69 Jiang Kejun et al: "The Development and Climate Case Study: China", 2003, http://developmentfirst.org/Studies/ChinaCountryStudy.pdf, (last visited on May 6, 2007).

70 See supra note 21.

issued a *Decision Concerning the Strengthening of the Work on Energy Conservation* which puts energy conservation at a strategic position and states energy conservation to be an urgent task. Accord to the *Decision*, the amount of energy consumption per unit of GDP should decline to 0.98 ton SCE which would be 20% lower than the amount at the end of "11th Five-Year Plan" period. The annual energy conservation rate should be 4.4%. Energy consumption per unit of main industrial products should as a rule achieve or approach the advanced international level of this century. According to the newly amended *Energy Conservation Law*, China shall step up energy pricing reforms, establish a national fund for energy efficiency, and adopt tax and other incentives for energy efficiency investment.

For instance, China issued its first comprehensive national standards for energy conservation designing of public building in 2005, aiming at reducing the energy consumption amount of heating, aeration, air conditioners and lighting by 50% compared with the public buildings constructed in 1980s.[71] In the same year, China created the compulsory system of China Energy Label (CEL). According to the CEL system, most of the standards are equal to or even more stringent than those of EU.

B. Facilitating development of new and renewable energy

After the KP came into force, the Chinese government highlights the role of new and renewable energy for easing the pressure of energy demands and GHG emissions, and gives priority to the development of renewable energy resources in its national energy development strategy.

In 2005, China passed the *Renewable Energy Law*, which defines responsibilities and obligations of government, enterprises and users in the development and use of renewable energy and provides a series of policies and measures including total quantity objective systems, power generation in-grid system, price management systems, cost amortization systems, special funds systems and tax preference systems, etc.

For this end, the State Council approved the *Medium- and Long-term Plan for Development of Renewable Energy* which set up specific goals for four main types of renewable energy: hydroelectric resources; biomass energy; solar energy; and wind power. Specifically, the installed capacity of hydroelectricity will reach 290 million KW, biomass power 20 million KW, wind power 30 million KW and solar energy power 2 million KW, thus trying to make total power installed capacity of renewable energy installations reach over 30% by 2020.[72]

To encourage new and renewable energy, China has promised to apply a favorable financial taxation policy, investment policy and obligatory market share policy.[73] For

71 "China will Implement More Strict Reiteration On public building Energy Conservation designing", available at http://www.ccchina.gov.cn/cn (last visited on March 9, 2007).

72 Zhang Guobao, "Speech at Minister Forum of Beijing International Renewable Energy Conference", November 7, 2005, Great Hall of the People, Beijing, China.

73 See supra note 20.

example, China will provide four types of financial taxation policies to support the development of biomass energy.[74] In addition, since January 1, 2007, a refund policy will be applied to normal VAT taxpayers in coal-bed methane pumping and sealing enterprises.[75]

C. Developing forestry directly for climate mitigation

As has been well established, forestry has a carbon-fixation function, and energy forestry can directly provide clean energy by supplying materials for bio-diesel oil and electricity generating units. After the KP came into force, the guidelines of Chinese forest developments are undergoing dramatic changes, from a timber-producing orientation toward an ecological function. China is beginning to cultivate biomass energy forestry to diminish its fossil fuel consumption.

During the period of the 11th Five-Year Plan, China will make further efforts to promote forestry development and is especially focused on the following key projects: (1) The Natural Forest Protection Project which aims at implementing a logging ban along the upper reach of the Yangtze River and Yellow river, greatly reducing timber output in key state-owned forest regions in the northeastern and inner-Mongolia area and protecting natural forest in other areas, speeding up tree and grass-planting activities, enforcing forest protection; (2) The Grain for Green Project which is to transfer slope cultivated land into forest in areas with severe soil erosion, sandification and salt-alkalization by means of forest rehabilitation; (3) The project on development of fast-growing and high-yielding forest plantations in key areas which aims at relieving the domestic timber-demanding pressure and protecting natural forests better; (4) Desertification Control Project in the vicinity of Beijing and Tianjin; and (5) Shelterbelt Construction Project in the Three North areas and down stream of Yangtze river as well as other key areas.[76]

China also attaches great importance to the cultivation of biomass-energy forest. According to the State Forestry Administration's Plan, China will provide raw materials for 6 million tons of bio-diesel oil supply by planting biomass energy forest.[77]

74 "Bio-energy exploration receives policy support again", available at http://www.ccchina.gov.cn/cn (last visited on March 9, 2007).

75 "Key activities on strengthening mine gas prevention work and speeding up the industrialization coal-bed methane", available at http://www.ccchina.gov.cn/cn (last visited on March 9, 2007).

76 Wang Chunfeng: "Afforestation in China", http://www.utoronto.ca/cccs2002/ChangbaishanProgram/WangChunfeng-SFA.ppt (last visited on May 7, 2007)
"China identified 11 key projects in forestry development during the period of 11th Five—Year Planning", available at http://www.gov.cn/jrzg/2006-02/27/content_212688.htm (last visited on March 9, 2007).

77 "0.2 billion mu forestry land will be used for developing biomass energy", available at http://www.ccchina.gov.cn/cn/NewsInfo.asp?NewsId=7097 (last visited on April 30,2007)

Achievements and Deficiencies of China's Efforts to Control Climate Change

Achievements of China's efforts in the past decades

China has, as far as possible, been paying more attention to the reduction of the growth rate of energy consumption and emissions. It has developed feasible and effective measures and strategies based on its domestic situation in order to guarantee the realization of its social and economic development goals and, at the same time, reach its target for protecting the global climate. And in practice, China's policies and laws responding to climate change have gained remarkable achievements in reductions of GHG emissions.

Concretely, the energy consumption per unit of GDP has fallen from 2.69 ton SCE in 1999 to 1.43 ton SCE in 2005. The amount of CO_2 emissions per unit GDP has dropped nearly 50%, with 4.1% per year. The rate of energy conservation is far higher than the average world level. According to the method of linking relatives, China has accumulatively saved approximate 900 million tons STE which is equal to 18 billion tons of CO_2 emissions.[78] According to experts' estimations, the cumulative net absorption amount gained from forestation during 1980 and 2005 was approximately 3 billion tons CO_2.[79] More importantly, the per capita GDP energy consumption in 2006 declined by 1.23% as compared to the same period of the previous year.

All the above efforts and achievements should be sufficient to illuminate that China is a responsible country and that it has made its due contributions to the global climate change control.

According to a report by the Center for Clean Air Policy based in the US, China has adopted 'unilateral actions' since 2000 that have already reduced emissions. Furthermore, it is expected to reduce emissions by 2020 to those levels projected below (see table 1).[80]

78 "China's efforts on climate change wins the affirmation from international society", available at http://www.ccchina.gov.cn/cn (last visited on March 9, 2007).

79 See supra note 28.

80 This parts is adapted from the publication of the Center for Clean Air Policy - *Greenhouse Gas Mitigation in Brazil, China and India: Scenarios And Opportunities Through 2025: China Fact Sheet* , Washington, (November 2006)

Change in China's emissions due to recent policies (table 1)

Sector	BAU Scenario		Recent Policies Scenario		
	2000 Emissions (MMT CO2)	2020 Emissions (MMT CO2)	2000 Emissions (MMT CO2)	Emissions Change from BAU (MMT CO2)	**% Change from BAU**
Electricity	1,199	3,102	2,960	142	**-5%**
Cement	643	1,098	937	162	**-15%**
Iron/Steel	200	323	294	29	**-9%**
Pulp/ Paper	63	141	111	30	**-21%**
Transport	195	676	643	34	**-5%**
TOTAL	2,299	5,340	4,935	395	**-7%**

If all existing policies/program and additional measures are fully implemented China would by 2020 reduce emissions from the sectors evaluated by 20% below BAU—an emissions reduction of nearly a billion tons—equivalent to 83% of China's electricity sector emissions in 2000 (see table 2).

Overall reproductions by sector (table 2)

Sector	**BAU Scenario**		**Mitigation Scenario**		
	2000 Emissions (MMT CO2)	**2020 Emissions (MMT CO2)**	**2000 Emissions (MMT CO2)**	**Emissions Change from BAU (MMT CO2)**	**% Change from BAU**
Electricity	1,199	3,102	2,658	444	-14%
Cement	643	1,098	866	233	-21%
Iron/Steel	200	323	257	65	-20%
Pulp/ Paper	63	141	105	36	-25%
Transport	195	676	460	216	-32%
TOTAL	2,299	5,340	4,346	994	-19%

Deficiencies of China's efforts to control climate change

Although China has made notable progress in combating climate change, there are still some deficiencies which might impair the achievement of the objectives of China's legal and policy efforts in this field.

Firstly, local governments commonly favor economic benefits rather than emissions reduction. We have seen many examples of the central government demonstrating its great concern for climate change, especially the compulsory goals on energy efficiency and emissions reduction that were included in the 11th Five-Year Plan. However, the central government's moves to reduce carbon consumption are challenged by local political autonomy and regional complexity, as well as a lack of policy coordination. Especially, since 1992, the GDP has served as the core measure of China's economic status and is the primary standard against which the achievements of local governments are measured. The government tends to take short-term actions in pursuing economic benefits because of the importance of the GDP. Many local governments pursue GDP growth instead of comprehensive, coordinated, and sustainable development. This could be righted if traditional measures of GDP are replaced with an environmental perspective that takes ecological damage into account. This might give a clearer and more representative view of the success of economic development.

Secondly, the implementation and enforcement of climate laws and regulations in China is relatively lax. China has enacted many laws and policies focusing on or related to climate change, and these laws have established a legal framework for China's green measures aimed at emissions reduction and sustainable development. Current Chinese laws on emissions and pollution reduction are replete with policy statements, but remain relatively weak in provisions for the effective punishment of violators. In many cases, factories caught excessively emitting or polluting are often under-fined rather than held fully responsible for the damage done. The already-soft laws are made even weaker when local governments and officials act as umbrellas for industries that contaminate the environment but also contribute to local revenue.

Thirdly, public participation remains underdeveloped in China. Public awareness of climate change problem is lacking and the influence of nongovernmental sectors such as the science community, civil society, and media is still limited. What is lacking in the short term in China is a sound system of checks and balances that can hold local officials accountable and give violators their due punishment. Such a system can guarantee that promises are translated into action, and that the good are rewarded and the bad punished. This is where an active civil society, a free media, and a better-educated public come in.[81]

If unresolved, all these problems will inevitably undermine the efforts taken by China and even jeopardize the achievement of the goal of emissions reduction in coming years.

Outlook

Nowadays, global warming has become an undisputable truth.[82] As a global problem, addressing climate change requires a "global response". Now it is the time for all sovereign states to unite and undertake more active activities to combat the climate change problem.

81 Yingling Liu, "China's Coming Environmental Renaissance", available at http://www.worldwatch.org/node/5510 (last visited on March 24, 2008).

82 See supra note 1.

Given that emission reduction pressure keeps increasing, it is important for China to adjust its policies and take on a much more flexible and pragmatic attitude to form its strategy on the post-KP global climate negotiations.

We are pleased to see that China has attached more importance to the climate change issue and indicated its willingness to deal with it with a positive attitude after the KP came into force. China is already doing what European economies are doing or planning to do: installing new nuclear power plants; expanding hydro, wind, solar and other renewable energy; and running their energy-intensive industry and infrastructure more efficiently.

As a responsible developing country, China will not wait to adopt its own measures until the governments of the US and other big established polluters show that they are serious about tackling climate change. Actually, it is foreseeable that China, as a stakeholder, will pay higher attention to the climate change, become more active in participating in climate change negotiations in the near future, and promote earlier achievement of the targets of UNFCCC and its KP.

The G8 summit was a good place to show this sign. At that time, China's President Hu Jintao promised to the international community, China remains committed to pursuing sustainable growth, and China will adhere to the principle of common but differentiated responsibilities established in the UNFCCC. It will actively address the challenges posed by climate change in proportion to its national strength and its level of economic development.[83]

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83 Le Tian, "China Still Committed, Hu Tells G8", China Daily, June 9, 2006, p.1.

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CHAPTER SIX

Climate Change Mitigation and Security of Energy Supply Will Benefit from Technological Innovation

Heleen Groenenberg, Francesco Ferioli, Stijn van den Heuvel, Marcel Kok, Ton Manders, Stephan Slingerland, Bas Wetzelaer

Climate Policies and Supply Security Policies: Synergies and Trade-offs

The consumption of fossil fuel for energy production is by far the most important source of greenhouse gas emissions in the world. Consequently, policies that aim to reduce greenhouse gas emissions need to target foremost a range of technologies to curb fossil fuel related greenhouse gas emissions, including technologies for improved energy efficiency, a switch from coal to natural gas and low emission sources (such as renewable and nuclear energy) and CO2 capture and storage. In its Communication Winning the battle against climate change'84 the European Commission emphasized the importance of a portfolio of climate change policies and technologies.

Apart from climate change mitigation, security of energy supply has re-emerged as a chief concern in European energy policies, which was demonstrated once more by the Commission's energy policy package[85]. A reduced supply security may arise from a number of causes. Short term disruptions in energy supply may originate from extreme weather and accidents, which damage energy infrastructures. In addition, a properly functioning electricity supply requires good short term balancing of the supply and demand of electricity to warrant quality and avoid black outs. On the long term, fossil fuel depletion and the concentration of fossil fuel resources in politically unstable regions of the world may affect security of energy supply. It is particularly this role of fossil fuels in energy supply which will affect the possibilities

84 COM(2006)676 final.

85 SEC(2007)12

to curb greenhouse gas emissions in the long term. Policies for long term supply security will therefore seek to reduce the role of imported oil and natural gas and to stimulate low carbon energy sources.

A number of studies have recognized that a range of technologies may contribute to simultaneously curbing greenhouse gas emissions and improving the security of energy supply (e.g. Berk *et al* 2006, Bardley and Lefevre 2006). These include energy efficiency technologies, capture and storage of CO_2 from coal-fired power generation, renewable energy sources, including biofuels in transport, and nuclear energy. By 2050 world wide contributions from the most important technologies for CO_2 emission reduction may amount to 31-53% from energy efficiency measures, 20-28% from CO_2 capture and storage, 11-16% from fuel switching, 5-16% from renewable energy, 2-10% from nuclear energy, and about 6% from biofuels in transport (IEA 2006).

Synergy will not occur in all cases. A greater reliance on natural gas instead of coal will lead to both a cleaner electricity production and an increasing import dependency. If on the contrary focus is on decreasing the imports of gas and increasing the use of coal in power generation, the climate is worse off.

Need and Policy Requirements for Technological Innovation

Need for technological innovation

As mentioned above, various technologies may contribute simultaneously to mitigation of climate change and securing energy supply. However, few low carbon technologies are fully commercial and able to compete with fossil fuel based energy. Therefore, further innovation and market diffusion of energy technologies are vital to accomplish emission reductions and to warrant supply security in the long term.

In addition, technological innovation is considered beneficial for the economy in a country or region (Jochem and Madlener 2003). Firstly, many new technologies, particularly those improving energy and material efficiency, will ultimately reduce costs, both for production processes and for consumers. New technologies are often still expensive when they are introduced in the market, and for many of them costs may be reduced by improving economies-of-scale. Secondly, innovativeg industries and countries that enter new markets early have a competitive advantage, which they may exploit to increase profits. Thirdly, the introduction of new technologies may trigger efforts to improve the performance of traditional technologies. Fourthly, saved costs in a resource efficient economy may be re-invested. In many cases this will move capital from a few power generators and energy-industry industries to a range of small and medium consultants and companies providing equipment and capital goods. Finally, overall economic efficiency will benefit from increased recycling, improved capital and labour productivity, and intensified product use.

Obviously, these beneficial effects for the economy will not be equal for distinct innovative technologies. For instance, a cost reduction and reinvestment of resources will likely occur mostly for energy efficiency measures.

Requirements for effective innovation policies

Although transition from a fossil fuel intensive energy system to a low carbon energy system requires also changes in regulations, infrastructures, habits, and capital flows, we will focus only on the need for a technological change. Many authors (e.g. Kemp *et al,* 2000, Geels, 2004; Suurs and Hekkert, 2005, Van Den Berg *et al,* 2007) have reflected on fundamental ingredients for a successful long term strategy for technological innovation. These may be summarized as follows.

Allow for diversity and co-evolution - Crucial to an effective strategy for a long term energy transition is a varied knowledge base and support for a diverse portfolio of innovative and promising technologies. This implies not picking a particular technology, e.g. biofuel or CO_2 capture system as a winner, but rather encouraging all of them. This will allow so-called co-evolution of candidate technologies over time. Future technological developments, cost reductions, and preferences among consumers and companies will then eventually resolve which technology will become dominant. However, while a variety of technologies needs to be supported to allow the best technology to develop and take over, this does not exclude the need for setting priorities in the allocation of available public resources over the portfolio of promising technologies.

Use a long term horizon - A long term horizon for energy policies is needed to provide companies and consumers with confidence that investments in climate friendly technologies eventually will be paid back. A long term horizon is important for instance in an emissions trading scheme, but also for other policies reducing the financial risk of investments, such as a feed-in scheme or a CO_2 price guarantee. A long term perspective will also increase the likelihood that research and development efforts in innovative technologies will be rewarded. As such, a long term horizon of policies is fundamental to a transition to a low carbon energy system.

Seek short term efficiency - While in the long run a transition to a low carbon economy is imperative, this should not rule out opportunities for reducing emissions and improving supply security in the present energy system. Opportunities for such short term efficiency gains are numerous, including in particular a host of energy efficiency measures in all economic sectors. In other words, while system transition is under way, optimization of the present system must not be forgotten.

Consider path dependence - Path dependence refers to the fact that it may be difficult to replace technologies and infrastructures in place, since investment costs may be high, technological and economic lifetimes may be long and processes may be standardized. People tend to decide on the basis of limited knowledge, and generally have a limited foresight period, which may hamper the evolution of innovative technologies. Examples of factors contributing to path dependence include the standardization of processes, especially when combined with economies of scale, long life-times of technologies and high investment costs of processes and infrastructures. Path dependence implies that any modification needs to fit within the existing framework. This hampers the breakthrough of innovative, superior technologies and is referred to as the lock-in effect. Thus, prior to providing policy support to any energy technology implications for other promising but possibly less mature technologies should be considered. For instance, widespread deployment of micro CHP will reduce the potential for central CO_2 capture and storage; widespread deployment of CCS will continue reliance on fossil fuels and reduce the need for renewable energy.

Facilitate - Finally, governments need to facilitate the development of a variety of promising technologies. Authorities may adopt a number of roles in this respect. Firstly, they may exert an innovation push by providing financial support. Secondly, they may stimulate demand for new technologies by formulating environmental or technical standards or by providing economic incentives. Thirdly, they may involve a range of actors and promote the diffusion and exchange of knowledge among those. Technologies may be conveniently grouped into categories representing the development stage they are in. Table 1 provides an overview of technologies in respectively the R&D, demonstration, upscaling and commercialization phases, and the barriers these face on their way to commercialization. A more detailed discussion on policies to overcome these barriers will be provided in section 4.

Table 1 Innovative energy technologies in distinct innovation phases and overview of principal barriers to their uptake (based on IEA 2006)

	Technological	Cost	Other barriers
R&D PHASE			
Hydrogen fuel cell vehicles	X	X	
Ethanol (cellulosic), Fischer-Tropsch diesel (biomass-to-liquids)	X	X	Higher CO_2 reduction than 1st gen ethanol not awarded
Hydrogen	X	X	Need for infrastructure
Industry - Process innovation basic materials	X	X	
Industry - Feedstock substitution	X	X	
Photovoltaics	X	X	
Ocean energy	X	X	Available sites
Stationary fuel cells	X	X	Need for infrastructure
CCS – oxyfuel combustion	X	X	
Nuclear generation IV	X	X	
DEMONSTRATION			
Industry - Material/product efficiency	(X)		No consideration life cycle envir impacts
Industry - CCS	(X)	X	
Concentrated solar power	(X)	X	
CCS – post/precombustion	(X)	X	
UPSCALING			
Hybrid vehicles		X	
Biodiesel from oil seeds, Ethanol (grain/starch, sugar)		X	Feedstock supply Food versus fuel competition
Fischer-Tropsch diesel (biomass-to-liquids)	X	X	
Industry - Fuel switch		X	

Industry – Cogeneration	X	
Wind on and offshore	X	Public resistance onshore Intermittency
Solar heating and cooling	X	Lack of information Lack of regulatory framework
Hydro	X	Env & social concerns (large systems)
Biomass gasification, co-firing	X	Environmental concerns Food versus fuel competition
Geothermal	X	
COMMERCIAL		
Vehicle fuel economy & non-engine techn		Consumer behaviour
Ethanol flex-fuel vehicles		Feedstock supply at gas stations
Industry - Motor and steam systems		Lack of awareness Lack of expertise
Buildings: miscellanous efficiency measures		Lack of awareness Split incentives
Nuclear generation III		Safety Disposal of waste Proliferation Public opinion

EU Energy Policies

In the previous sections we discussed policy requirements for ongoing technological innovation, and we gave an overview of the maturity of barriers to the uptake of key energy technologies. In this section we will evaluate to what extent EU energy policies are instrumental in meeting challenges to the further diffusion of technologies outlined above.

Objectives of EU energy policies

Objectives of EU energy policies were proposed by the EC in the energy policy package[86]. Ideally, such policies would contribute to mitigating climate change and enhance the security of energy supply at a reasonable cost. In addition, energy policies should contribute to a stronger competitive position of the European Union. Policy objectives were formulated in qualitative and quantitative terms for climate change mitigation and security of supply (Table 4.1). Quantitative targets are formulated in particular for climate change mitigation. Greenhouse gas emissions should be reduced by 20%, and by 30% if other countries commit themselves to reduction targets as well. Additional targets have been set for renewable energy sources, bio-fuels and energy efficiency: 20% renewables in 2020, 10% biofuels in 2020 and 20% energy efficiency. The former two are binding, the latter is not.

Objectives for improving security of supply are qualitative and emphasize the importance of the internal energy market, external energy relationships, and mechanisms to ensure Member States solidarity. However, no timelines or specific actions are set for actions to improve supply security. As for competitiveness, the proposal claims that a competitive market will inevitably lead to improved energy efficiency and investments. Investments in energy efficiency and renewable energy should advance innovation. No specific actions or timelines were proposed in this respect.

The European Council attached to its March 2007 Council Conclusions an action plan for European energy policy in the 2007-2009 period, largely based on the EC proposal. The Action Plan comprises a number of priority actions (Table 2). Five priority actions are distinguished, which to some extent overlap. For instance, security of supply will also benefit from a proper regulation of the internal market for gas and electricity, from an effective international energy policy, wider deployment of energy efficient technologies and renewable energy, and from the development of innovative technologies.

In the long list of actions measures to advance technological innovation only take up a minor share. While the importance of new technologies is underlined, the only action formulated to promote technological innovation is to strengthen R&D and the technical, economic and regulatory framework for CO_2 capture and storage by

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2020. A detailed roadmap to provoke the technological revolution needed to realize a low emission society is absent.

Table-2 Priority actions and key points in European energy policy 2007-2009; European Council March 2007

Priority action	Key elements
Internal market for gas and electricity	• Implementation of legislation on opening up of energy markets • Appropriate investment signals, including development of regulatory framework • Separation of supply and production (unbundling) • Independence national energy regulators • Co-operation national regulators • Coordination network operation
Security of supply	• Diversification • Crisis response mechanisms • Transparency of data on oil stocks and supplies • Analysis of potential and costs of gas storage • Assessment of impact energy imports on MS supply securities • Establishment of Energy Observatory
International energy policy	• Negotiating of partnerships and cooperation agreements with Russia; • Strengthen relationships Central Asia, Caspian and Black Sea regions; • Intensify partnerships US, China, India, Brazil, and others for reducing GHG, energy efficiency, renewables, CCS; • Implement Energy Community Treaty, with possible extension to Norway, Turkey, Ukraine, Moldova • Use all instruments under the European Neighborhood Policy • Enhance relationships Algeria, Egypt, others in Mashreq/Maghreb region • Build dialogue with and enhance decentralized renewables and energy access in Africa • Promote energy access in context of UN-CSD

Energy efficiency and renewable energies	20% efficiency improvement over 2020 level Five priorities: transport, dynamic efficiency requirements of equipment, consumer behavior , technology & innovations, buildings Commission proposals for efficient lighting regulation International negotiations for sustainable production and trade in efficient goods and services Review of guidelines for State Aid 20% renewables by 2020 10% biofuels by 2020 Aim for framework with differentiated national targets and national action plans, and provisions for sustainable biomass production Implementation Biomass Action Plan, especially for demonstration of 2nd generation biofuels Analysis of potential for cross-border and EU-wide synergies and interconnection for reaching renewable target Exchange of best practices
Energy technology	Importance of generation efficiency and clean fossil fuel technologies Strengthen R&D and technical, economic and regulatory framework for CCS by 2020 Welcomes Commission's intention of mechanism to stimulate realization of up to 12 demonstration of sustainable fossil fuel technologies

In addition to the actions listed in the European Council Conclusions, main features of the EU external energy policy had been outlined previously in a speech of the High Representative for the Common Foreign and Security Policy, Secretary General of the Council of the EU (Solana 2006). These are mainly concerned with security of supply issues, but also involve energy efficiency, renewable energy sources and the Kyoto mechanisms (Box 1). Also in these principles for external energy policy the role of technological innovation is modest. Low emissions technologies should be 'encouraged', but no reference is made to a stepwise strategy for realizing the much needed technological reform.

Box 1 Guiding principles of EU external energy policy (Solana, 2006)

1. *Improving production and export capacities in producer countries and developing and upgrading energy transportation infrastructure in producer and transit countries.*
2. *Improving the climate for European companies' investments in third countries and opening up the production and export of energy resources to EU industry.*
3. *Improving conditions for trade in energy through non-discriminatory transit and third party access to export pipeline infrastructure.*
4. *Enhancing physical and environmental security as well as the energy infrastructure safety.*
5. *Encouraging energy efficiency, use of renewable energies including bio fuels, low emission technology and rational use of energy worldwide.*
6. *Implementing the relevant Kyoto Protocol mechanisms.*
7. *Diversifying energy imports by product and country.*
8. *Creating an international regime for the supply of enriched uranium to countries that have chosen the nuclear option, in line with non-proliferation commitments and taking into account the EURATOM treaty provisions.*
9. *Promoting strategic reserve stocks and encouraging joint stock holding with partner countries.*

The EU emissions trading system

A principal policy instrument for mitigation of climate change CO_2 emissions in the EU is the EU Emission Trading System (EU-ETS)[87]. While the present system already encompasses 45% of all CO_2 emissions and 30% of greenhouse gas emissions in the EU, the intention is to further elaborate this system. It would be expanded to other gases and sectors, including carbon capture and storage and be linked where possible to other compatible schemes (e.g the Californian and Australian systems).

The EU ETS was introduced as a market-based approach to reduce CO_2 emissions in a cost-effective manner. Such a market-based approach to environmental problems should ideally solve two common market failures: the externality of environmental impacts, and the lack of incentives for technological change (Jaffe *et al.*, 2005). The ETS is a market-based instrument that gives a price to the environmental externality of CO_2 emissions. This price depends on the supply and demand for CO_2 emission allowances, and therefore on the allowances initially allocated at the start of a trading period in the scheme. In this way, the common market failure of not internalizing environmental damage in production costs is addressed to a certain degree by a cap-and-trade regime.

However, cap-and-trade approaches do not provide the incentives needed to compensate innovators for inducing technological change. In addition to not addressing this technology market failure, the ETS has design features that make it worse. The short-term horizon of the trading periods, without perspective of long-

87 2003/87/EC

term deep emission reductions, will make participants in the scheme prefer the technological options that are more competitive and cost-effective in the short term rather than highly innovative, step-change technologies, such as CCS. This is likely to deter the development of technologies that involve particularly high demonstration costs, as the return on investment in innovation is unlikely to be sufficient. For the ETS to work more effectively to promote such technologies there would need to be a clear long-term perspective of deep emission reduction requirements, preferably operating at a global level.

Other EU energy policies

Apart from the EU-ETS a host of directives and supporting policy documents have been prepared by the European Commission to meet objectives of its energy policies.

Since the early 1990s, various measures have been taken to improve energy efficiency. Implemented directives specify standards for energy efficiency in hot water boilers[88], domestic refrigerators[89], and ballasts in fluorescent lighting[90], and household appliances must have their energy efficiencies labelled[91]. Minimum standards for the energy performance of new and renovated buildings have been set, and certification of buildings and inspection of energy systems therein regulated[92]. The promotion of cogeneration in the internal energy market has been regulated[93], and a recent framework directive on ecodesign requirements defines conditions for setting standards for energy-using appliances[94], including e.g. heating, water heating, electric motors, lighting domestic appliances, office equipment, consumer electronics, ventilation and air conditioning.

The promotion of renewable energy has also been taken up by the EU, and Member States are required to set and achieve targets for renewable energy[95]. In addition, Member States must meet the EU-wide target of 5.75% biofuels to replace diesel or petrol for transport purposes by 2010[96]. A Biomass Action Plan[97] and a Strategy for biofuels[98] were formulated, although these do not hold any specific measures or binding requirements. The former relates to the promotion of the use

88 92/42/EEC
89 95/57/EC
90 2000/55/EC
91 92/75/EEC
92 2002/91/EC
93 2004/8/EC
94 2005/32/EC
95 2001/77/EC
96 2003/30/EC
97 COM(2005)628
98 COM(2006)34

of biomass in heat production, electricity production and transport, while the latter addresses in particular the possibilities to ensure the supply of sustainably produced biomass.

Several measures and plans exist to reduce CO_2 emissions from transport. Voluntary agreements have been made with automobile manufacturers in Europe, Korea and Japan[99], to reduce average CO_2 emissions from vehicles to 140g CO_2/km in 2008, 2009 and 2009 respectively. A strategy to further reduce emissions to 120 g CO_2/km has been proposed[100]. The Commission also considers standards for rolling resistance, the promotion of tire pressures, as well as more stringent rules on vehicle labeling. It aims to include aviation in the EU-ETS[101], and to connect ships to the electricity grid while they are in the harbor[102].

As a cross-cutting measure tax incentives can be a powerful tool. The Commission plans to revise the Community framework for the taxation of energy products and electricity[103], and has proposed to tax private cars according to their pollution levels[104]. Nevertheless, taxation is as yet a Member State competence, which hampers the introduction of far-reaching green tax measures.

On top of these policies, research as outlined in the Seventh Framework Programme will contribute to the development of low carbon technologies. In addition, following the Commission's Environmental Technologies Action Plan for the EU[105], more than 30 technology platforms have been launched to stimulate the take-up of environmental technologies.

As to the security of energy supply, a number of directives and regulations have been adopted to secure supply of natural gas and electricity. Common rules on the storage, transmission, supply and distribution of natural gas and on organisation of the gas sector have been laid down[106]. Likewise, generation, transmission and distribution of electricity, and the organisation of the electricity sector, market access, authorisations, and system operations have been regulated[107], as well as conditions for access to the network for cross-border exchanges in electricity[108]. Furthermore, Community financial aid is granted to enhance the development of trans-European energy networks[109]. Security of natural gas supply is promoted by a common framework within which Member States can define gas supply security policies[110].

99 Resp 1999/125/EC, 2000/304/EC, 2000/303/EC
100 COM(2007)19
101 COM(2005)459
102 2006/339/EC
103 2003/96/EC
104 COM(2005)261
105 COM(2004)38 final
106 2003/55/EC
107 2003/54/EC
108 Regulation 1228/2003
109 Regulation 2236/95
110 2004/67/EC

Contribution of EU Domestic Energy Policies to the Uptake of Innovative Technologies

How do the policies aforementioned affect the development of promising energy technologies? This section will provide an overview of the distinct policies and measures that affect the diffusion of technologies of distinct maturity. Policies that are typically applied to stimulate technologies in the R&D phase are R&D subsidies or a technology platform for diffusion of knowledge. Technologies in the demonstration phase would typically need investment support. EU policies for upscaling include the EU-ETS and the possibility to exempt clean technologies from taxes. Commercial technologies may be stimulated further by standards, labelling or other instruments. However, we will demonstrate that policies characteristic to a particular innovation phase may act on technologies of distinct maturities. For instance, the EU-ETS is considered a typical instrument for upscaling, but may advance relatively undeveloped or commercial technologies as well.

In the *R&D* phase technologies in industry, power generation and transportation, for which major technological improvements and cost reductions are necessary (Table 3). In fossil fuel based power generation it is particularly stationary fuel cells and CO_2 capture using oxyfuel combustion that still need substantial R&D. Renewable energy sources in these phase include photovoltaics and ocean energy. Also fourth generation nuclear power plants need considerable research and development. In the transportation sector, the most important technologies in need of massive R&D include hydrogen fuel cell vehicles, the production of cellulosic ethanol as a transport fuel, a number of process innovations in commodity production, feedstock substitution in industry. Existing EU policies for these technologies consist of R&D support in the Seventh Framework Program and support of a technology platform, following the EC's Environmental Technology Action Plan[111].

Technologies that are ready for large scale demonstration include post-combustion CO_2 capture in pulverized coal plants and NGCCs, as well as precombustion capture in IGCCs and CO_2 capture in industries. Concentrated solar power is also in this phase. A number of material and energy saving processes in industry are also ready for demonstration (Table 4). For most of these technologies ongoing R&D is being supported by EU R&D programs, apart from CO_2 capture from industrial processes in e.g. ammonia production, the iron and steel industry, or cement production. A policy that may be help to upscale concentrated solar power is the exemption of an energy tax allowed under the Community framework for taxation of energy products and electricity[112]. Furthermore, most of these technologies could in principle be deployed by participants in the EU-ETS, although CO_2 capture and storage operations will need to be opted in under the EU ETS Directive before the trading scheme can effectively incentivize the option. It must be noted that the CO_2 market price would

111 COM(2004)38 final

112 2003/96/EC

need to be sufficiently high to make deployment under the ETS profitable. Models suggest that CCS would be deployed at substantial levels for a CO_2 market price of 25-30 €/t CO_2 (IPCC 2005). While the effect of the EU-ETS on expansion of these technologies is uncertain, no targeted support for demonstrations exists at the EU level. Potential other barriers, such as a lack of information or public acceptance, are not being addressed yet by EU policies.

A wide range of abatement technologies have been demonstrated already, and need upscaling to realize large scale deployment (Table 3). For these technologies, a wide range of instruments were implemented at the EU level to reduce technical and financial risks. These technologies comprise power generation from a range of renewable sources, including on and offshore wind, biomass, and geothermal energy. Solar heating and cooling is also in this phase. In the transportation sector, it is hybrid vehicles and ethanol flex-fuel vehicles that in principle could be deployed at a wider scale to further bring down costs, just as biodiesel and ethanol from sugar or starch. In industry, fuel substitution in commodity production could be introduced at a wider scale. For some technologies in this phase EU policies were designed to overcome additional barriers. For instance, an adequate fuel supply, competition with food crops and environmental concerns related to the production of biofuels and the use of biomass in power production were addressed in the Biofuels Directive and the EU Strategy for Biofuels. A lack of information and the lack of a regulatory framework to advance solar heating and cooling were addressed in particular by EU legislation on the performance and certification of buildings[113].

Finally, a range of commercial abatement technologies exist that are cost-effective but which have not managed to expand rapidly for various reasons (Table 6). In power generation, it is particular nuclear energy technologies from the second and third generations that are not being deployed massively for safety concerns and limited public acceptance. In transportation, more efficient vehicles and energy saving technologies not related to the engine (aerodynamics, tires) are options that face limited interested from the consumer. In industry, more efficient motor and steam systems are often hampered by a lack of awareness of potential energy savings, lack of expertise of managers, or split budgets for energy efficient investments and for paying energy bills. Further diffusion of CHP is hampered by the high costs of natural gas, and the need for industrial CHP installations to be operated day and night, while cheaper coal capacity tends to set electricity prices during the night. Material and product efficiency are often not improved because there is insufficient incentive for industries to reduce these impacts throughout the life cycle of their products. Finally, important savings may be realised cost-effectively in buildings and appliances. However, high investment costs, a lack of awareness, and split incentives obstruct a rapid expansion of many of these technologies. Obviously, little R&D or investment support exists for these technologies. Some of these technologies are incentivized by the EU-ETS, in particular industrial motor and steam systems, as

113 2002/91/EC

well as cogeneration. However, since costs are not considered the most important obstacle to these technologies, no cost-reducing incentives have been implemented. EU policies mostly focus on overcoming other barriers, such a lack of information or interest, or barriers to an adequate supply of biomass.

Table 3 EU policies for CO_2 abatement technologies in need of substantial R&D: the Seventh Framework Program and Technology Platforms under the ETAP

	R&D FP7	ETAP
Transport vehicles		
Hydrogen fuel cell vehicles	X	X
Transport fuels		
Ethanol (cellulosic)	X	--
Hydrogen	X	X
Fischer-Tropsch diesel (biomass-to-liquids)	X	X
Industry		
Process innovation in commodity production	X	X
Feedstock substitution	X	--
Power generation		
Photovoltaics	X	X
Ocean energy	X	--
Stationary fuel cells	X	--
CCS – oxyfuel combustion	X	X
Nuclear generation IV	--	--

Table 4 EU policies of CO_2 abatement technologies ready for demonstration at a commercial scale

	R&D		Demo	Upscaling		Commercial		
	FP7	**ETAP**	**Investment support**	**EU-ETS**	**Tax benefits** [3]	**Standards**	Labelling	Other policies
Industry								
Material/product efficiency	X	--	--	X [1]	--	--	--	--
CCS	--		--	X [2]	--	--	--	--
Power								
CSP	X	--	--	X	X	--	--	--
CCS post combustion coal	X	X	--	X [2]	--	--	--	--
CCS post combustion NGCC	X	X	--	X [2]	--	--	--	--
CCS – IGCC	X	X	--	X [2]	--	--	--	--

[1] Dir 2003/87/EC
[2] forthcoming
[3] allowed under Dir 2003/96/EC

Table 5 EU policies for CO_2 abatement technologies that need upscaling for further cost reduction

	R&D		Demo	Upscaling		Commercial		
	FP7	**ETAP**	**Investment support**	**EU- ETS**	**Tax benefits** [2]	**Standards**	**Labelling**	**Other policies**
Transport verhicles								
Hybrid vehicles	X	--	--	--	--	--	--	--
Transport fuels								
Biodiesel	X	--	--	--	X	X [3]	--	X [4]
Ethanol (grain/starch, sugar)	X	--	--	--	X	X [3]	--	X [4]
Industry								
Fuel switch commodity prod.		--	--	X [1]	--	--	--	--
Cogeneration	--	--	--	X		--	--	X [6]
Power								
Wind on and offshore	X	--	--	X	X	--	--	--
Solar heating and cooling	X	--	--	X	X	--	--	--
Hydro	X	--	--	X	X	--	--	--
Biomass	X	--	--	X	X	--	--	X [5]
Geothermal	X	--	--	X	X	--	--	--

[1] 2003/87/EC, [2] under Dir 2003/96/EC, [3] Biofuels Dir - 2003/30/EC, [4] EU Strategy Biofuels - COM(2006)34 final, [5] Biomass Action Plan- COM(2005)628, [6] 2004/8/EC

Table 6 EU policies for CO_2 abatement technologies facing other than cost barriers for wide scale deployment

	R&D		Demo	Upscaling		Commercial		
	FP7	ETAP	Investment support	EU-ETS	Tax benefits [1]	Standards	Labelling	Other policies
Transport								
Ethanol flex-fuel vehicles	X	--	--	--	--	--	--	--
Vehicle fuel economy	--	--	--	--	--	--	--	--
Non-engine technologies	--	--	--	--	--	--	--	--
Industry								
Motor systems	--	--	--	X	--	--	--	--
Steam systems	--	--	--	X	--	--	--	--
Materials/product efficiency	--	--	--	--	--	--	--	--
Buildings & appliances								
many…	--	--	--	--	--	X [2]	X [3]	--
Power								
Nuclear II and III	--	--	--	--	--	--	--	--

[1] under Dir 2003/96/EC; [2] 92/42/EEC, 95/57/EC, 2000/55/EC, 2002/91/EC, 2005/32/EC [3] 92/75/EEC, 2004/8/EC

In section 2 we gave an overview of requirements for effective policies to realize an energy transition. Such policies would typically allow for diversity and co-evolution of different technologies, and facilitate the development of promising technologies by stimulating R&D, creating demand, and promoting exchange of information. They would combine short term optimization of the current energy system with a long term horizon, and consider path dependence to avoid a lock-in in a particular technology. To what extent does the present EU energy policy mix meet these requirements?

Diversity and co-evolution - Analysing the EU energy policy mix and its contribution to the further expansion of innovative energy technologies, it may be concluded that EU policies allow for a variety of technologies to develop simultaneously. Development of these technologies is stimulated both by 'innovation push' instruments, i.e. R&D support programs that should all be instrumental in overcoming major technical and cost barriers, and by pull instruments, which create a technology demand by labelling, imposing a standard or creating a financial incentive. In particular the recent setup of a range of European technology platforms (ETAP) may prove an important stimulus for the advancement of a number of promising technologies.

Facilitation - Nevertheless, the policy mix applied is suboptimal since not all policies are tailored to the barriers that distinct technologies face. In principle, the financial risk related to technologies in the demonstration phase could also be reduced if they would be deployed by participants in the EU-ETS to limit CO_2 emissions. Concentrated solar power could in addition benefit from tax exemptions[114]. However, it is uncertain if these instruments will be sufficient to overcome the high upfront costs that may be associated with realizing non-commercial technologies at a large scale. As to technologies in the up-scaling phase, no genuine cost incentives exist to promote hybrid vehicles, or first generation biodiesel or ethanol in transport, although Member States are allowed to offer tax benefits to energy from renewable sources[115]. Furthermore, some of the additional barriers to the expansion of technologies in the up-scaling phase have not been addressed by EU policies. These include e.g. public resistance against onshore wind energy, and the intermittency of wind-based power. Structural EU policies to overcome environmental and social concerns related to large scale hydropower have not been implemented either. Regarding policies for stimulating commercial technologies a large scope seems to exist for standard setting and labelling in industry and transport. Such measures could help to steer consumer behaviour during the purchase of cars, and to address the lack of awareness or expertise in industry related to energy efficient technologies. Thus, there is scope for EU energy policies to better accommodate the particular development needs of technologies in different stages of maturity.

Short term efficiency - The present policy mix seeks foremost to realize the emission reductions that may be realized in the present energy system, since these are most easy to accomplish.

Long time horizon and path dependence - The long term horizon of policies is merely reflected in the R&D subsidies for innovative technologies that are far from the market still. The time horizon and emission ceiling of the EU-ETS are presently too low to induce substantial technological change. However, the wide variety of technologies that is being supported suggests that a clear vision as to how to account for path dependencies and how to avoid a lock-in in particular technologies is lacking. It is this aspect in particular that would need more attention in the present EU energy policy mix. A road map for the evolution of the energy system is needed to effectively mitigate climate change and secure energy supply, both in the short and the long run. Such a roadmap needs to take into account path dependencies: wide deployment of decentralized electricity production will impede large scale deployment of CCS; large scale deployment of CCS will reduce the need for a breakthrough of hydrogen technologies. However, short term optimization of the present energy system is required to curb GHG emissions today, and the risk of a lock-in in a fossil fuel based energy system cannot be excluded entirely.

114 Dir 2003/96/EC

115 2003/96/EC

Contribution of EU International Collaborations to the Uptake of Innovative Technologies

In the previous section we have seen shortcomings of EU domestic policies in the promotion of innovative and promising energy technologies. To what extent do the EU's external relationships and international collaborations make up for these shortcomings?

Partnerships for securing fossil fuel supply

A large share of the EU partnerships for improving supply security is focused on an adequate supply of fossil fuels. These external relationships are needed to keep the EU's current fossil fuel based energy supply up and running. In the conclusions of the European Council in March 2007 the Energy Dialogue with Russia and the Energy Community Treaty with South-East Europe are mentioned explicitly as actions to be taken further. Regional co-operations of the EU exist in particular with the Caucasus/ Central Asia region ('Baku Initiative'), Baltic Sea region (BASREC), Southern Mediterranean (EUROMED) and South East Europe ('Energy Community Treaty'). More recently, also an EU – Africa energy dialogue has started. Aim of these co-operations is on one hand to assure flows of gas and oil to Europe (in particular from the Caucasus region and Northern Africa), on the other hand to stimulate market openings similar to that in the European Union in neighbouring countries. Recent involvement of China in Africa has also spurred the EU – African energy relations, which partly overlap with development cooperation but are also meant to give Europe access to Africa's fossil energy resources. Important bilateral energy co-operations exist furthermore with China, India, Norway, Russia, Ukraine and the USA. These countries are either main producers of fossil fuels (Norway, Russia), crucial transit routes (Ukraine) or main consumers of energy (United States, China, India).

International technology collaborations

Apart from the partnerships for securing fossil fuel supply discussed above, the EU is involved in a range of international technology collaborations. These were all established to advance the development of specific technologies, and a selection is listed in Box 2. These partnerships are all very useful for exchanging information and experiences among participants and political agenda setting, and allow a wide range of technologies to further develop simultaneously. Their focus on relatively immature technologies implies a longer time horizon than most EU domestic policies. However, while they all focus on one or a limited subset of technologies, they will not provide an overall vision for realizing an energy transition, in which path dependencies and remedies for potential lock-ins are suggested. Strong leadership and political will is needed to compose such a vision and to set priorities.

Box 2 EU technology collaborations

IEA Energy Technology Implementing Agreements
: *41 agreements with varying participation, ranging from advanced fuel cells to wind energy systems*

Carbon Sequestration Leadership Forum
: *21 countries and EU participating, aim is to stimulate research, demonstration and development of carbon capture and storage technologies*

International Partnership for the Hydrogen Economy
: *16 countries and EU participate, goal is to accelerate the transition to a hydrogen economy.*

Renewable Energy and Energy Efficiency Partnership (REEEP)
: *Public private partnership backed by more than 200 governments, businesses and ngos. Its aim is to structure policy and regulatory initiatives for clean energy, and facilitates financing for energy projects.*

Methane to Markets Partnership
: *Partnership of 20 countries with high methane emissions. Aim of the cooperation is to reduce methane emissions in particular in agriculture, coal mines, landfills and oil and gas systems.*

World Bank Gas Flaring Reduction Initiative
: *Cooperation of 5 donor countries and EU, 12 target countries, 9 oil companies and 2 multilateral organisations (OPEC, World Bank) aiming to reduce gas flaring at oil production.*

Extractive Industries Transparency Initiative
: *Initiative of 20 countries that supports improved governance in resource-rich countries through the verification and full publication of company payments and government revenues from oil, gas, and mining.*

ITER Nuclear fusion Project
: *ITER is a joint international research and development project in which 7 countries cooperate. It aims to demonstrate the scientific and technical feasibility of fusion power*

Conclusions

In this paper we assessed the adequacy of the EU energy policy mix for meeting the three objectives of the EU energy policy, as formulated in the EC's energy policy package: climate change mitigation, a secure energy supply, and competitiveness. Many technologies may contribute simultaneously to reducing CO_2 emissions and improving the security of energy supply, although exemptions exist as well, such as a switch to natural gas technologies. As to the latter objective, we started from the presumption that technological innovation is a vital precondition for competitiveness, since technological innovation will ultimately lead to cost reduction, it will provide a competitive advantage, push improvement of traditional technologies, lead to re-investment of saved resources and to an improved capital and labor productivity.

Ongoing technological innovation and expansion of energy technologies are key elements of a transition to a low carbon energy system. A successful long term strategy to realize such a system allows for a wide range of promising energy technologies to further develop simultaneously; it has a long term horizon to provide companies and consumers with confidence to invest in clean technologies; it seeks to optimize the present energy system to realize short term emission reductions; it attempts to avoid a lock-in in existing technologies; and it facilitates the development of a range of promising technologies by providing financial support, stimulating demand and/or promoting the diffusion of knowledge and expertise amongst stakeholders.

Today's EU energy policies are most likely not sufficient to mitigate climate change and secure energy supply in the long term. Current EU policy documents tend to flag a wide range of issues that are relevant for mitigating climate change and securing energy supply. Quantitative targets have been formulated for renewable energy, biofuels and energy efficiency, which may help to put some pressure on the expansion of nearly commercial technologies. However, no objectives have been specified to speed up technological innovation in the EU. The EU-ETS, which is the cornerstone of EU climate policy, in its present form does not provide the incentive for major investments in innovative technologies. Therefore, complementary policy objectives and instruments for stimulating specific technologies will prove useful. Policies for security of supply have a short to medium term horizon and focus on securing an adequate fossil fuel supply, and measures to stabilize the electricity grid. Securing energy supply on the long term (e.g up to 2050) would require energy policies to be focused more on technological innovation. Although a range of domestic energy policies and international technology collaborations allow for a range of energy technologies to further develop simultaneously, not all barriers that technologies face are addressed adequately. Important deficiencies include *inter alia* targeted support for technologies that need to be demonstrated still, stimulation of hybrid and flex-fuel vehicles, and exploitation of possibilities for labelling and standard setting in industry and transport. In general, current policies focus on realizing short term efficiency gains in the present energy system and lack a vision as to exactly how the present energy system would eventually evolve into a new intrinsically low carbon and secure energy system.

Therefore, while continuation and strengthening of external relationships is vital for an adequate fossil fuel supply in the short and medium term, and while technology collaborations with the rest of the world are crucial to further develop a range of promising energy technologies, there is an apparent need to prioritize future action for energy transition in the EU in a transition roadmap. In particular, such a roadmap to an energy transition would hold a program for future diffusion of promising technologies, indicating not only R&D priorities, but also stepwise actions to advance demonstrations and subsequent upscaling of technologies. It would also provide insight into how innovative technologies could be accommodated by existing and new energy infrastructures. How would the present electricity grid need to be adjusted to allow for large scale deployment of decentralized electricity production from intermittent renewable sources? How would a future hydrogen distribution network be designed? Would it require adjustment of the existing gas network, or construction of new pipelines? Would a separate CO_2 pipeline network be required to transport CO_2 to suitable underground storage locations, in anticipation of a breakthrough of hydrogen technologies? What would need to be the timing of required actions, and what would be the role of industries, the European Commission, national governments, and financial institutions? All these issues would need to be addressed in a long term energy strategy for the EU. That will provide the fundamental basis for innovative technologies to curb CO_2 emissions and secure energy supply in the long term.

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CHAPTER SEVEN

Industrial Dynamics and Innovative Pressure on Energy -Sweden with European and Global Outlooks

Lennart Schön and Astrid Kander

Introduction

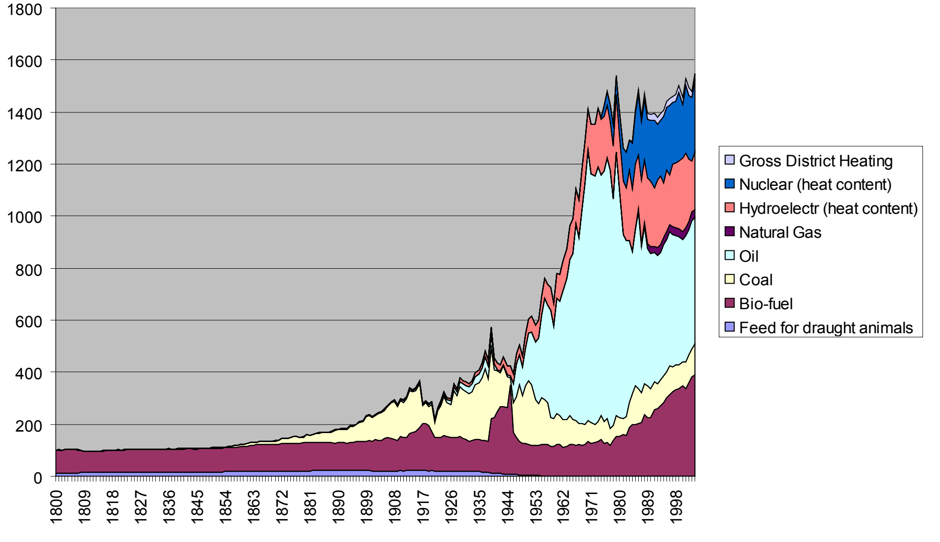
This paper addresses the long-term pattern of evolution of energy systems. We propose a typology of three main epochs: the *Traditional Areal*, the *Industrial Punctiform* and the *Modern Areal*, that can be discerned in Swedish data, and partly in data for other European countries as well. Typologies, like the one we propose, always suffer from the weakness of being static, thus not "explaining" why one system changes over to another one. A perspective of industrial dynamism, put into the context of evolution of energy systems, is thus necessary in order to provide some perspectives on the forces operating to change the systems. Changes in relative prices work as one important stimulus for change in economic systems. Shifts in energy systems, when a new energy source has increased its share, have historically always been preceded by a period of lowered relative price of that energy carrier (Kander 2002). Here we focus on another price relation that puts the present transformation of energy systems into perspective: the price of energy relative to prices of manufactured capital goods. This indicator shows imbalances in the industrial system between the primary and secondary sector and highlights where the pressure to come up with innovations is the strongest. During the last century there has been a cyclical pattern in this price relation, a Rostowian pattern, and we propose that the industrial dynamism behind this pattern can be analysed from the Dahmenian concepts of *market widening* and *market suction* (Schön 1990). Market widening means a shift in supply due to innovations, and market suction means a shift in demand in complementary activity due to the same innovations. Typically there will be an imbalance in the system until market suction stimulates sufficient new innovations in the complementary activities, lowering the demands or widening the provision of resources of the complementary kind. We show that the "normal" Rostowian long-swing pattern in relative prices has been broken in the last couple of decades, with a continued increase in relative prices of energy, indicating that the innovative pressure is still very strong on complementary activities (energy markets) and that the transition to the

Modern Areal Epoch so far has not widened the energy provision base sufficiently. On the demand side large scale market suction processes have taken place, increasing the energy demands due to the spread of industrialization to large and fast growing economies like India and China. The current innovative pressure on energy markets offers opportunities, but the imbalance between primary and secondary sectors creates in addition political tensions among nations, since access to energy sources is a necessity to avoid economic stagnation. Addressing and resolving these political tensions is necessary for European energy security in the coming decades.

Three Energy Epochs

We have in previous works outlined the Swedish energy history and have a fairly accurate picture of the long term growth in energy consumption specified with respect to energy sources (Schön 1990, Kander 2002). The growth of the different kinds of energy carriers and the total growth of energy in Sweden between 1800 and 2006 is depicted in figure 1.

Figure 1: Swedish long-term energy consumption, PJ, 1800-2004.



Sources: 1800-2000: Kander (2002), 2001-2004: Statistics Sweden.

On basis of this picture and further analyses we propose that the Swedish energy history is well described in terms of three energy epochs: the Traditional Areal, the

Industrial Punctiform and the Modern Areal , see Table 1. The first two epochs are dominated by traditional area based sources (fuelwood, muscle energy) and industrial punctiform energy sources (coal, oil, nuclear power). This is clearly visible in the data in graph 1. The third epoch has only recently begun, with a return to a dependence on area bound energy sources, and thus there is as yet no dominance of these sources in the graphs. However there is a strong political drive for progressing further in this direction, especially for climatic reasons.

Table 1: Three energy epochs

	Traditional Areal	**Industrial Punctiform**	**Modern Areal**
Time period	-1850	1850-1980	1980-
Energy provision	Fodder, firewood, wind, water, peat	Primary: Coal, oil, uranium Secondary: gas, electricity,	Biofuels (pellets, brickets, wastewood for district heating, spent pulping liquor), wind play an increasing role
Technical appliances	Ploughs, stoves, wind and watermills	Steam engine, electrical motor, combustion engine	Fuel cells
Economic Growth	Slow	Rapid	Rapid
Primary Energy Consumption	Stable	Rapid growth, except for the crises	Slow growth
Production structural changes	Stable	Relative expansion of industry and transports	Industry stabilizes its share (but energy light branches expand), transports increase, the rest of the service sector does not increase its share
Energy intensity	Declining	Declining during crises (WWI, WWII and Oil crises in the 70s), more or less increasing in between	Decreasing (from the 70s)

Traditional Areal signals that energy production is based on land areas with traditional (low knowledge intense) methods. Transports of energy carriers are limited and energy consumption is mainly confined to what the land (and wind and water) can produce in a certain locality. The consumption of energy is direct, so there is no process of transforming primary energy into secondary energy in industrial plants before consumption.

Motive power is achieved through muscle power and directly working water and wind power (mills) and the revolutionary invention of transforming combustible energy sources into motive power in steam engines has not yet diffused to any considerable extent. Economic growth is slow, but takes place without concomitant increases in energy consumption, so energy intensity (energy/GDP) declines. This has to do with more land being put under the plough without proportional increases in draught animals and thermal efficiency improvements of household stoves (Kander 2002).

The *Industrial Punctiform Epoch* means that the energy sources are harvested at particular sites, typically mines (Wrigley 1962). Fossil fuels are obvious examples, and later comes the extraction of uranium for nuclear power. Mining deep down in the earth to extract energy sources means that the energy base expands considerably, without much competition over scarce land resources. During the Industrial Punctiform Epoch economic growth is generally fast, except for in crises and the industrial and transport sectors expand in relative terms. Mechanized production and new processes are introduced at a large scale. The result of the market widening for central innovations in energy technology and their diffusion into new areas of applications is a rapid growth of total energy consumption, mainly in the form of stored fossil fuels and uranium. However, innovations also increase the thermal efficiency as well as overall industrial efficiency. Thus, somewhat paradoxically energy intensity declines in most industrial branches (Schön 1990).

The *Modern Areal Epoch* means that innovation and capacity building are important for the production and utilization of areal bound energy sources. This is a response partly to environmental threats from global warming, partly to rising energy prices and partly to the insecurity of becoming dependent on oil from politically unstable regions like the Middle East or nations that use their oil and gas exports for political purposes, like Russia. Biofuels in this period, unlike the Traditional Areal Epoch, is not only consumed directly by households, but also distributed as district heating or used for plants that combine heat and electricity production. Wind power is not used (as in the traditional energy areal epoch) for small local use for grinding purposes, but in large plants for electricity generation, which is distributed in the large scale electricity nets.

While we find the typology of three energy epochs very suitable for describing the Swedish energy history, the third epoch is less relevant for other European countries. The transition from Traditional Areal epoch to the Industrial Punctiform System took place with different timing in Europe, with England being the clear leader and other countries following. Tables 2 shows that by 1850 England was already completely dominated by fossil fuels consumption (90%) and in the Netherlands the share was 40%. Sweden and Spain at the time only had 2% of their energy supply covered by fossil fuels. Sweden as a cold country was outstanding in its high firewood consumption and the share of total energy was 73%, while Italy, Spain and the Netherlands had relatively more muscle energy.

By 1950 the Netherlands had become almost as dependent on fossil fuels as England & Wales, and Sweden, Spain and Italy had increased their fossil fuel share tremendously. Sweden and Italy at the time were outstanding in generating electricity by other means than fossil fuels (hydropower), see table 3.

By 2000 it is clear that the countries vary considerably with respect to their transition into the Modern Areal Epoch. Sweden is the only country of these five that has a substantial share directly covered by biofuels (23%). However, the electricity generated by other means than fossil fuels has increased its share in all countries, and part of it comes from renewable sources, see table 4. Therefore some indications of the Modern Areal Epoch are present also in other European countries.

Table 2. Composition of energy consumption in 1850 (%)

	England & Wales	Sweden	Netherlands	Italy*	Spain
Muscle	7	25	38	41	50
Firewood	0	73	11	51	46
Wind, Water	2	<1	10	1	2
Fossil fuels	91	2	41	7	2

* 1861.
Source: Kander, Malanima, Gales and Rubio (2007), Warde (2007)

Table 3. Composition of energy consumption in 1950 (%).

	England & Wales	Sweden	Netherlands	Italy	Spain
Muscle	3	6	10	27	27
Firewood	0	21	0	17	12
Wind, Water	0	<1	0	0	0
Fossil fuels	97	64	90	47	59
Primary electricity	0	9	0	10	2

Source: see Table 2.

Table 4. Composition of energy consumption in 2000 (%).

	England & Wales	Sweden	Netherlands	Italy	Spain
Muscle	2	2	2	4	4
Firewood	0	23	0	2	0
Fossil fuels	90	40	88	88	88
Primary electricity	9	33	10	6	7

Source: see Table 2.

The high Swedish figures of biomass can be compared with the EU average of 3.4% from biomass in primary energy in 2001. To increase this share to 8.5% in 2010, as suggested by the European Commission is possible, but not likely to take place (European Commission 1996). Most estimates of potentials for biomass production in Europe claim that the prospects for increasing the biomass share substantially are great (even though they differ in the figures they come up with) mainly through growing energy crops on set- aside agricultural land (Berndes et al 2003). However, there are many conflicting interests in land (food production, preserve nature for the sake of biodiversity etc), which is likely to increase the price of land and land related products. This in turn will increase the innovative pressure on areal energy provision.

Industrial Dynamism

The basic concept for the analysis of industrial dynamics related to technological change is *'development blocks'* – once conceptualized by the economist Erik Dahmén

(1950,1970,1988). Another concept with some similarities to the development block was launched by economists in the 1990s, namely General Purpose Technology (Bresnahan and Trajtenberg 1995, Helpman, 1998). Some radical innovations in the energy system, such as the steam engine, the electrical motor and the combustion engine, developed into technologies for nearly all purposes. This was however a drawn-out process over generations. The concept development block, that combines the characteristics of the innovation with economic relations, captures the main dynamics of this process. The basic innovation enters into different development blocks over time on its path to becoming a General Purpose Technology (Enflo, Kander and Schön 2007).

There are two central characteristics of the development block: innovations and complementarities. Radical innovations in particular have the propensity to create new complementarities – i.e. new dependencies are established between specific functions or properties within the production process or between production and infrastructure or institutions. It takes time, however, to bring forth the complementarities and in this process bottlenecks and imbalances appear that in turn may stimulate further investments, accelerating the transformation and structural change of the economy.

This process of transformation has two main dimensions that Dahmén labeled *market widening* and *market suction,* later translated somewhat misleadingly as 'supply push' and 'demand pull'.

Innovations in secondary products (capital goods)

Market widening is the most dynamic part in the process since it is the direct consequence of the radical innovation. The innovation shifts the supply function, lowering the price of a certain good or service, and hence extending the use of it when old technologies are substituted for or new areas are opened. The price effect may be enforced if there are economies of scale or network externalities involved that augment technical efficiency and consumer values. This dynamic is even further enforced if demand is highly price elastic leading to great volume increases – in such cases there are strong growth pushes.

Innovations in primary products (energy)

Market suction, or demand pull, arises mainly due to the complementarities that are specific to the development block. Innovative market widening leads to shifts in demand for complementary factors to the radical innovation in the secondary products, such as new competencies, services or *primary energy.* These have a lower elasticity in the supply function, i. e. are more difficult to increase the production of, at least in the short or middle term, which results in price rises that also attract investments and innovative behavior, which add to the dynamism of the development block. With successful complementary innovations the relative price of the complementary factors, such as energy, eventually falls. If no such extension of the ability in supplying key inputs (such as energy) appears, this dynamism may be cut short.

Innovations on the primary products side, as a response to market suction, may lead to further market widening. Thus, if an innovation reduces the use of a certain input (such as energy) for a particular energy service, the overall effect may be reversed since the lower price and the volume increase may lead to an increase in the total use of that input (a mechanism also called *rebound effect or 'take back' effect*). Mostly the concept 'rebound effect' only refers to the market widening for a particular application of an innovation, for instance more kilometers traveled by car when car engines become more energy efficient. However, market widening in the Dahmenian sense is more dynamic and entails new applications for the innovation, such as the combustion engine expansion from cars to trucks, ships and airplanes. It may thus be useful to distinguish between *market widening for a single application* (giving rebound effects) and *market widening into new applications* (giving production structural effects that also may increase energy use).

Imbalances and change

In the breakthrough periods of radical innovations, the positive contribution to productivity from technical change tends to be hampered by bottlenecks from unfulfilled complementarities (Schön 1991, 1998). Thus, periods of industrial revolutions are characterised by severe imbalances in growth. A productivity paradox, i.e. rapid technical change coinciding with slow productivity growth, was recognized in conjunction with the computer in the 1980s but it also appeared with the breakthrough of electricity in industry at the turn of the century in 1900 (David 1990, Schön 1990). The positive effects from innovations upon productivity and growth span a long period with successive development blocks.

When the complementarities are accomplished, the factors within a block mutually increase their marginal returns and productivity is enhanced. The development block approach is evolutionary in the sense that growth is not an even process but rather discontinuous over time, involving a struggle between new and old combinations or blocks in the economy - a struggle that intensifies in periods of creative destruction. In Swedish industrial and social development electricity is central to a number of development blocks with strong potentials and complementarities. The electrification of industry required large investments in the generation and distribution of electrical power and in the development of the electro-technical industry and of industries consuming electricity. This had to be achieved simultaneously. The dynamism is further strengthened by economies of scale in the network. Thus, combined technological and institutional change have cleared the way for successive integration of the grid from local, to regional, to national and to European scale with concomitant effects on the price structure, leading to shifts in supply and demand functions for electricity (Schön 1990, 1991).

Furthermore, one can notice a pattern - presented in Schön: 1994, 2000a, 2000b - with two phases in the long term transformation process based upon a number of radical innovations that have great potentials of creating development blocks. New technologies in the fields of energy, communication and transportation are of particular importance in this respect. In *a first phase* denoted as industrial revolutions, basic innovations appear within the *spheres of production*. Their application and early diffusion is very much a process of technical change creating strong tensions between old and new parts in the production processes. A *second phase*, roughly a generation later, has a stronger focus on developing the *infrastructure* based upon the new technology. Such a development, when the technology becomes part of the backbone of society, is based very much upon experience of the new technique and of the social and institutional adaptations that occur. Thus organizational change at a wider scale comes to the forefront.

The second phase of infrastructural development is of course also dependent upon a further innovative development of the technology that widens the scope of application, with e.g. more powerful, more efficient and more flexible engines. A more efficient infrastructure is developed and technology becomes more standardized. It is only in this second phase that radical innovations such as the steam engine, the electrical motor, the combustion engine or, still within the prospect, microelectronics become pervasive technologies for most purposes in modern societies of different vintages.

At this stage growth potentials expand. Markets widen both geographically and socially when modern technologies become available to many. When growth rates and total volumes increase, demand for primary inputs becomes even more pronounced, Complementary innovations that will widen the resource base of materials and energy become crucial for the furthering of growth. Thus, the development of an infrastructure with railways from the mid-nineteenth century was crucially dependent upon new steel processes as well as more efficient steam engines. The mid-twentieth century expansion of 'golden growth' with infrastructures built upon motorization and electrification was heavily dependent upon great increases in energy supply and in material producing technologies.

In table 1 some characteristics of market widening and market suction are presented. It is especially worth noticing their effects on growth and energy prices relative to manufactured capital goods.

Table 1: Two principal features of a development block

	Market widening **= shift in supply due to innovation**	**Market suction** **= shift in demand in complementary activity due to innovation**
Radical Innovations	Technical appliances (e.g. original and new motor)	Energy provision (primary energy - secondary energy – delivered energy)
Incremental Innovations	Increased thermal energy efficiency	Reduced losses in refinement and transportation
Prices	Relative price decrease of technical appliances	Relative price increase of primary/secondary energy until this sector can meet up with the demand.
Growth effects	Positive growth effects	Bottlenecks may hamper growth

The Rostowian price pattern

Market widening and suction are not phases but simultaneous forces in a development block. However, the process is cumulative in the sense that reactions by the complementary sector to market suction may lead to innovations that give rise to further market widening. The time perspectives in reactions differ between sectors. Generally supply functions in primary sectors (energy) are less elastic than in secondary sectors (manufacturing). Walt Rostow once observed that there are long wave-like swings in the price relation between primary and secondary products that fit quite well into the periods of successive innovative changes of industrial revolutions and infrastructural development respectively (Rostow 1978). Thus, with innovative changes in industrial production markets have widened and demand for primary inputs has increased. The response of the primary sector has been slower, though, and the relative prices of industrial products and primary products have shifted. Over some decades, however, there has been a response in the primary sector combining increased capacity in production and transportation with innovations in the handling and processing of materials and energy. This response has been crucial for long term growth to be sustained.

Figure 2 . Price ratio between machinery and primary energy 1885-2006. 1910/12=1

Sources: Schön (1988, 1990), Ljungberg (1990), Kander (2002), Statistics Sweden

In figure 2, the price ratio between secondary and primary products is represented by machinery equipment and energy carriers respectively since 1885. Until around 2000 there is a clear Rostowian pattern. Relative machinery prices peak around 1890, 1930 and 1970, and the peaks are followed by very distinct relative price falls in the periods 1895-1915, 1940-1955, 1970-1985 under the impact of market widening from innovative machinery and increasing demand of energy. The latter sector is slow in expanding supply but this market suction leads in turn to a reaction with falling energy prices during the 1920s and 1960s in lieu of the adaptive enlargement of primary production up to the peaks in relative machinery prices (peaks that precedes international crises). The time pattern is however broken from 2000 when this latter phase of relatively falling energy prices due to supply response is missing. Thus, relative machinery prices continue to fall - this indicates a global shift not only with the diffusion of innovations in the secondary production sector but also with an increase in labour supply and a concomitant increase in energy demand relative to supply at a much larger scale than before. This prolonged relative price increase of energy is a symptom of insufficient innovative response in the energy supply sector so far.

Concluding Discussion: Innovative Pressure during the Modern Areal Epoch

There is a strong innovative pressure on energy during the Modern Areal Epoch. During the last decade, the energy sector has been unable to respond but by relatively rising energy prices (Figure 2). Can we expect a more innovative response in the near or medium long term? The answer depends on the relative strength of the growing demand for energy and the innovations that are able to amplify energy supply and cut down on energy demand.

During the last decades, global industrialization has accelerated. The rapid growth of the Chinese and Indian economies since 1980 means that global growth has reached levels of all-time high and this signifies that global supply and demand shifts occur at new levels. It also means that the interplay between market widening and market suction processes becomes even more powerful.

A relevant question is whether the rapidly growing economies in China and India are now proceeding along the energy development trajectories of the earlier industrialisers in Europe, or whether they are leapfrogging and rapidly entering the Modern Areal Epoch. Significant for the Modern Areal Epoch is the decline in energy intensities (see table 1). China managed to lower its energy intensity substantially between 1980 and 2000, but then it leveled out and since 2003 the intensity has increased. Structural change at the industry and sector (sub-industry) level actually increased energy intensity over the period of 1980-2003 (Ma and Stern 2006). This allows the interpretation that China is stuck in the growth of the development blocks around the combustion engine and electricity, rather than in the growth of energy light sectors such as ICT and BioTech. This may indicate that domestic demand from basic needs and construction has become more important in China.

Globally, innovations take place in response to rising energy prices and environmental concerns and innovative pressure is centered within the two main development blocks of the Modern Areal Epoch : ICT (Information and Communication Technology) and BioTech (Biotechnology). These two development blocks are partly integrated, since much of BioTech relies heavily on ICT for its evolution, for instance microprocessors that manage production in more energy efficient ways. One branch of Bio-Tech is dealing with the options of amplifying energy supply by increasing the availability and efficiency of biomass production and conversion.

Crucial for future energy costs are the prices of energy for transportation, and the innovative pressure is hence presently strong on the production of liquid fuel and gas from solid fuels such as biomass. Automotive biofuels have only recently become commercially viable. To date such biofuels are however still produced through a traditional distilling process of sugar-rich biomass grown in fields (sugar beets, grain or sugar canes). In the so called *second generation of biofuels* more efficient use of more varied biomass will be possible, enabling for instance the use of forest waste products for biofuel production and the supply on the market may widen substantially.

The potential for increasing area bound energy supply is of course a matter of conflicting interests in land. Food supply is one competing interest. With growing income levels dietary changes will certainly take place towards more meat, dairy products and beverages that demand relatively more land. A second reason for conflicting interests is the wish to cultivate crops in a more environmentally friendly way, with less pesticides etc, something that will reduce the yields per hectare. There are thus conflicting environmental interests here: between the use of land for energy crops to decrease greenhouse gas emissions and between the use of land for low external input (LEI) farming, which is considered to produce more healthy food (Ericsson and Nilsson 2006). A third conflict is with biodiversity: to have more plantations for biofuels will threaten wildlife and many extinct species. A fourth conflict is over water-supplies; in case of water shortage, should the water be used for food production or for biofuels? The most crucial issue in historical light is, however, whether the Modern Areal Epoch is able to overcome the limitations posed by the Traditional Areal Epoch, where Punctiform energy sources paved the way for further economic growth. This is a matter of knowledge creation, competence and technical solutions in relation to the enormous energy requirements of present economies.

In principle there are of course other options for innovative response from the energy sector than expanding the use of areal energy sources. All fossil fuels have environmental costs that are severe, and in addition the global supply is limited. The only one of these options that does not come in conflict with the goal to decrease greenhouse gases is to expand the use of nuclear energy. However, also uranium is limited and this option entails severe security problems, in peacetime, and even more so in wartime.

In conclusion, we can sum up by saying that although important innovations are taking place both on the energy supply side and on the demand side, it is likely that these are insufficient in the foreseeable future to outbalance the growing energy demand from industrialization in China, India, Russia and other fast growing economies. The development blocks are still unbalanced and the market suction responses in the energy sector are too weak in relation to the industrial market widening. Therefore we foresee that the increase in energy prices compared to industrial products will continue. Apart from augmenting political tensions over energy issues, this imbalance challenges the innovative capabilities in Europe, dependent on substantial imports of energy, and poses great potentials for increasing profits in energy technologies.

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EU Energy Security from an Agenda-Setting Perspective– Implications for EU Climate Change Policy?

Raphael Sauter

Introduction

Since the adoption of the EU climate and energy package at the EU spring summit 2007 energy security and climate change have been portrayed as core objectives of European energy policy (Council, 2007). Similar to the 2000 Green Paper on security of supply the recent attention to EU energy security – and to European energy policy in general – was mainly caused by focusing events. In 1999 it was the tripling of energy prices that led to renewed interest in the EU's security of energy supply, more recently it was the conflict between Russia and the Ukraine about gas prices that led to the perception of Russia as a potentially unreliable supply country that might at some point constitute a threat to EU's energy security. These events triggered political leaders to put energy security on the top of the political EU agenda.

Cyclical attention to energy security triggered by events is a major feature of energy policy at the Community level. While it has regularly attracted attention since the 1970s only very few coordinated measures have been adopted and implemented. Major internal measures include member states' obligation to maintain minimum stocks of crude oil since the late 1960s (now under the coordination of the IEA - International Energy Agency in Paris). At the external level the EU has started several initiatives aimed at enhancing energy security such as the Energy Charter that entered into force in 1998 and the EU-Russia Dialogue. Overall progress on coordinated common actions explicitly dealing with energy security has been very slow with member states' being reluctant to accept EU action in a field considered as core element to national sovereignty[116].

In 2006 energy security was (again) brought to the EU energy policy process by

116 This should not imply that other community measures adopted in the field of energy policy (e.g. energy efficiency and the promotion of renewable energy sources) have not contributed indirectly to energy security.

'high politics'. This raises the question how this particular route of agenda-setting – as opposed to a 'low politics' route – has influenced the subsequent policy process and if this has implications for the integration of EU energy security and climate change policies. This paper sets out an agenda-setting framework to answer these questions. It draws upon the agenda-setting literature with particular emphasis on the concepts of problem definition and framing as well as 'venue shopping'. Previous studies indicate the importance of these concepts in the EU policy process and their ability to improve our understanding of these processes (Princen and Rhinard, 2006; Daviter, 2007; Princen, 2007).

This paper aims to link the agenda-setting literature with the study of European energy policy with a particular focus on energy security. Energy security with its various dimensions is prone to become subject to various problem definitions and frames in the agenda-setting process of EU energy policy. The paper suggests that due to the persistence of frames at the level of 'low politics' the emphasis put on energy security by 'high politics' can merely overcome inertia in the EU policy-making process. From this analytical perspective, further research needs to analyse how successful integration of EU energy security and climate change policy can be achieved on the basis of strategic framing and venue choice. The paper's scope is mainly conceptual, but illustrates some of its arguments on the basis of initial document analysis and observations since the publication of the 2000 Green Paper on security of supply.

The paper is structured as follows. The next section suggests a theoretical framework from an agenda-setting perspective for the analysis of energy security in the EU energy policy process. This will put particular emphasis on the role of problem definition and framing as well as institutional venues. In the following section major elements of the energy security concept are summarised. On this basis the subsequent section identifies major frames for energy security used in the EU policy process. It then illustrates the importance of the institutional venue in the light of the recent renewable energy policy process. It will conclude with some preliminary findings and possible implications for the challenges of integrated EU energy security and climate change policies.

Theoretical Framework: Agenda-Setting in the EU

Due to the lack of jurisdictional competences in the field of energy policy, i.e. the absence of a 'common energy policy', the European Commission had to rely on competences in other policy areas to introduce a European energy policy over the last decades that has increasingly impinged upon national energy policies (McGowan, 1996). Policies were mainly based on competences related to the establishment of an internal market and environmental protection. Andersen (2001) described this introduction process of European energy policy as 'in from the side' through other DGs (e.g. market liberalisation by DG Competition) and 'from above' through political summits (e.g. Energy Charter). The EU energy policy process has been subject to a limited number of studies (Matláry, 1997; Andersen, 2001), whereas most studies focused on the formulation, adoption and implementation of specific directives often with a strong interest in the interaction with national energy policies (e.g. Midttun and Svindland, 2001).

Matlary (1996) argues that energy policy – or more precisely energy security policy – at the European level has only attracted attention as 'high politics' issue: "As long as gas and oil flow and there are no nuclear accidents, energy issues remain largely a matter of 'low politics'" (Matlary, 1996: 258). This is also reflected by the Commission: "the central role of energy is […] generally only experienced and acknowledged by the European citizen in crisis situations (e.g. oil shocks, Chernobyl, Gulf war)" (CEC, 1997: 1). From this perspective focusing or salient events are an explaining variable for the emergence of energy security on the political EU agenda. As with recent developments of European energy policy, political leaders played a crucial role in putting it to the top of the political agenda via 'high politics'.

Different routes of agenda-building

The way an issue is introduced to the EU policy process can have important consequences for the subsequent policy processes. Building on previous research on EU agenda-setting (Princen and Rhinard, 2006) it is expected that an agenda-setting perspective could make several contributions to EU energy policy research: a better understanding of the EU energy policy process and possibly the identification of structural biases in this process. Most studies that used agenda-setting approaches to EU policy processes applied rational choice models to analyse the relationship between EU institutions and member states (Pollack, 2003) or focused on the role of individual EU institutions within the agenda-setting process (Jones and Clark, 1999; Schmidt, 2000; Tallberg, 2003; Burns, 2004).

Whilst agenda-setting research is an emerging strand of literature in EU policy studies, it is a well established research field in the political science literature often in conjunction with the analysis of national political systems. It is interested in the question how an issue becomes an issue, i.e. a policy problem, on the agenda. Agendas can be distinguished between *formal* agendas where issues receive serious attention from decision makers as compared to the *public* agenda "which consists of issues which have achieved a high level of public interest and visibility" (Cobb, Ross et al., 1976: 126). Theoretical frameworks for the analysis of agenda-setting were developed in the US context and are mostly interested in agenda-building processes of formal agendas (Cobb, Ross et al., 1976; Baumgartner and Jones, 1993; Kingdon, 1995).

Princen and Rhinard (2006) combine this strand of literature with EU policy studies and distinguish two models of the EU agenda-building processes: a 'high' and 'low politics' route. While the 'high politics' route is initiated by political leaders for example at EU summits as the result of focusing events, the low politics route is initiated at the expert level. Subsequently, issue specification in the high politics route is dominated by the formulation of political consensus, whereas in low politics it is about the formulation of rather technical details. Whilst the high politics route seeks expansion towards lower levels, in the low politics route the issue needs to be expanded to higher levels of decision-making. Both agenda-building routes can interact or intersect and are not mutually exclusive.

The significance of an 'high politics' route lies in the potential to overcome political and administrative inertia when it comes to formal or 'governmental' decision-making and therefore overcome barriers that might have prevented decisions on issues that were initiated at the level of 'low politics'. This seems particular relevant for the European energy policy arena which was characterised by a "fragmented organizational structure and the incrementalist, consensus orientation of the Commission" (Padgett, 1992: 59). This was particularly true in the case of energy security with proposals by the Commission often rejected by member states (Surrey, 1992). However, the flip side of a 'high politics' agenda-building process is the possibility that the issue gets 'lost' as soon as the political salience of the issue disappears or by technical details or frames in the processes of low politics (Princen and Rhinard, 2006).

Problem definition and framing

Frames are therefore of central importance in the policy process and the agenda-building process in particular. The institutional setting of the EU with its multiple access points (Peters, 2001) facilitate the emergence of several issue specifications from low-level processes. This gains even more importance in a policy with unclear jurisdictional competences such as energy policy where every action at EU level needs to be very carefully framed. Weiss (1989) argues that problem definition is even in the heart of the political process. It fulfils three roles in the policy process: first, it defines the intellectual framework at the beginning of the policy process, second, it is as process itself "a weapon of advocacy and consensus" (Weiss, 1989: 117), and, finally, it can be an outcome of policymaking in terms of changed definitions and language as well as changed advocacy structures.

Problem definition is important within the agenda-setting process since it predetermines possible solutions to the problem and influences the access of actors to the decision arena. Rochefort and Cobb (1994) argue that the chances of a problem to attract the attention of particular political institutions which all have different selection procedures will be influenced by problem definition and thus affect the policy outcome. Whilst a certain problem definition is necessary for an issue to enter the formal agenda, this does not automatically result in the adoption of the intended policy. A specific problem definition for agenda access can at the same time hinder a problem definition that leads to the adoption of the intended policy (Dery, 2000).

Previous research showed how the re-definition of an EU policy issue enabled the adoption of a policy proposal that was blocked for decades (Radaelli, 1995).

While problem definitions pre-determine solutions, actors' access and institutions involved, they do not necessarily include a solution to the problem and set clear institutional rules about the inclusion or exclusion of specific actors in the agenda-setting process. By contrast, framing does fulfil these functions. It includes problem definition, a solution to the problem, rules about who should be involved and a justification for action (Rein and Schon, 1991). The latter is particularly relevant at the EU level since every action at EU level needs to be very well justified in order to overcome resistance by member states including various national actors (Princen, 2007). Analysing the role of policy frames in the development of European environmental policy Lenschow and Zito (1998) suggest that the extent to which policy frames impact upon policy outcomes depend on the degree of their institutionalisation. The latter can be analysed in terms of the organisational, procedural and normative structure. Organisational and procedural structures are mainly reflected in the organisational characteristics and institutional rules, whereas normative structures can be derived from policy instruments and the rhetoric used.

Consequently the institutional venue influences framing. Thus, besides problem definition and framing, the institutional venue can be identified as a critical factor in the agenda-setting process. The active search for a certain institution that supports a particular frame has also been called 'venue shopping'(Baumgartner and Jones, 1993) which can be defined as "[…] finding a decision setting that offers the best prospects for reaching one's policy goals" (Pralle, 2003: 255). It assumes that policy entrepreneurs who aim to "push their pet solutions, or to push attention to their special problems" (Kingdon, 1995: 165) look for favourable policy arenas. The relevance of strategic venue choice is supported by the multiple access points in the EU system. Venue choice is strongly related to issue framing because an issue frame can influence which venue is assigned to an issue and a venue can influence how an issue is considered (Baumgartner, 2007).

This section established the significance of different agenda-setting routes in EU politics and the role of problem definition and framing during an issue career. Relating this to the issue of EU energy security policy, we expect conflicts between different frames and problem definitions: the introduction of energy security as 'high politics' issue due to focusing events can entangle a certain problem definition (e.g. import dependency from Russia) that might be at odds with dominant problem definitions at the level of low politics (e.g. insufficient energy market integration). From this perspective several questions for the analysis of EU energy security policy arise: Can the initiation of energy security via the 'high politics' agenda building route help to overcome inertia in the EU energy policy process with respect to energy security? What are the implications for EU climate change policies?

Energy Security and Climate Change

Energy security with its multiple dimensions is prone to conflicts about problem definitions, alternative solutions and ways of implementation during the agenda-setting process: energy security "[…] is one of the most overused and misunderstood concepts in the energy debate" (Helm, 2002: 175). The following paragraphs briefly introduce the concept of energy security[117]. It also highlights the interactions between energy security and climate change.

The term 'security of supply' has been used in many different ways generally biased from a national perspective (Mitchell, 2000). A nation's dependence on energy imports and the availability of national resources are likely to be reflected in the national understanding of security of supply and consequently in the measures taken to face this challenge. Global contextual factors that influence the concept of security of supply include geopolitics, the international economic system or changes in the world oil and gas industry. This is also reflected in the asymmetric level of energy security among EU member states that leads to different policy responses and reflects the context dependency of national energy security concepts that come into play at the EU level.

Based on the literature dealing with the concept of energy security over the last decades, the following key features of the concept can be summarised:

- Availability of adequate amounts of energy at affordable prices (Deese and Nye, 1981; IEA, 1985; Belgrave, Ebinger et al., 1987; Yergin, 2006);

- Imports do not equate vulnerability and do therefore not necessarily constitute a threat per se to energy security (e.g. Nye, 1981; Stern, 2002);

- Time sensitivity, i.e. the distinction between short-term and long-term threats to energy security (PIU Energy Review, 2001):
  Short-term: physical unavailability of imported fossil fuels or physical disruption of the infrastructure of networks due to bad weather, inadequate capacity or industrial action
  Long-term: high or volatile prices or insufficient investment can be a security threat;

- Risk as a measure to quantify energy (in-)security (e.g. IEA, 2007). From this perspective an energy system can be considered as secure if the risk for supply disruption is sufficiently low and the price to pay reflects the cost of provision. The usefulness of the risk concept in the context of energy security has been questioned since a risk probabilistic function cannot be based on unknown variables (Stirling, 1994).

Depending on the problem definition chosen mainly three policy objectives can be derived:

117 In this paper the term 'energy security' is generally used since it reflects the multiple dimensions of the concept as compared to the supply focus the term 'security of supply' implies.

- sufficient investment along the fuel supply chain (flexibility and responsiveness in the context of competitive market behaviour) which contributes also to
- a reliable infrastructure including networks
- diversity defined in terms of fuel type, fuel sources (by geographic region or company), technology types or even to technological knowledge source (by country, sector, or economy) (Grubb, Butler et al., 2006).

Strategies to achieve these objectives can roughly be distinguished into preventive ('how to avoid threats to energy security?') and mitigating ('how to deal with disruptions?') measures and according to the intervention target along the fuel supply chain: resource acquisition, fuel trade & delivery, energy conversion, energy distribution, and energy consumption (Stirling, 1993). The following main strategies are regularly identified in the literature: diversification of supply, demand reduction of fossil fuels, 'right' investment framework, stock piling, market integration with other countries, dialogue with both consumer and supply countries as well as new fuel independent technologies.

How do these strategies relate to the objective of reducing carbon emissions? Traditionally, security of supply was considered as a core objective of energy policy: "Governments generally regard security as vital pre-condition for the achievement of other policy objectives in energy" (NERA, 2002: 5). According to this interpretation other policy objectives such as competitiveness or climate change would be of 'second order'. From this perspective, privatisation, liberalisation, and competition as top agenda items of energy policies in the 1980s and 90s have only been possible because security of supply was considered as given – at least to a certain extent – also due to low energy prices and no major supply disruptions with the exception of the Gulf war in the early 1990s. In the late 1990s events (high and volatile prices and blackouts in different regions) have re-emphasised the role of energy security. Discussions then focused on the potential tension between liberalised market frameworks and energy security (e.g. NERA, 2002). Potential conflicts between energy security and climate change are only an emerging discussion (e.g. Helm, 2005; Stern, 2007). The interaction between energy security and climate change policies is often approached from the perspective how climate change policies affect energy security. Energy efficiency and diversification using renewable energy and nuclear are considered as contributing to both energy security and climate change objectives. On the other hand, energy security measures such as the increased use of domestic energy resources (e.g. coal) might result in additional greenhouse gas emissions.

EU Energy Policy: 'High Politics' Meets 'Low Politics'

The previous section summarised how energy security can be approached from different perspectives and underlined that the problem definition chosen will influence the dominant energy security policy objective and in turn policy solutions and instruments. This is reflected in how energy security is dealt with at the EU level. The policy process is strongly driven by focusing events that affect the problem definition and framing of energy security. The recent energy policy discussion at the EU level from 2005/2006 was strongly influenced by the import dependence mainly from Russian gas and the need to achieve both energy security and climate change objectives in energy policy. Yet, it soon became clear that dominant market frames dominate the policy process. At the same time national perspectives on 'energy security' became evident in the subsequent discussions. This is also reflected in the discussion about the legislative framework to achieve the 20% renewable energy target by 2020 – a core policy that should contribute to both: energy security and GHG reductions.

Energy security

At the Hampton Court meeting in 2005 the UK presidency of the European Council put forward an initiative for a common European energy policy that was broadly supported by other EU political leaders. In response the Commission published a Green Paper in early 2006 that reflected the triad of energy policy objectives with the internal energy market as core objective. Energy security was nevertheless the priority at the EU spring summit 2006 after the gas price conflict between Russia and Ukraine (Council, 2006). The European Council called for an Energy Policy for Europe in response to current challenges in this policy area and on the basis of the 2006 Green Paper (Council, 2006). The indicative list of actions puts security of supply as the first objective with three main lines of action: mitigating strategies to face supply disruptions, diversification, and an external energy policy. Other measures such as renewables and energy efficiency are also linked to energy security.

While this indicative list of action does not explicitly refer to the internal energy market as a means to achieve energy security, the energy policy working programme 2007-2009 adopted at the 2007 spring summit lists as first objective the internal market for gas and electricity "that will have major benefits for competitiveness and EU consumers as well as increasing security of supply" (Council, 2007: 16). The action plan for an energy policy for Europe covers both external and internal measures and can be interpreted as a continuation of existing policies despite ambitious targets in some areas (Sauter and Grashof, 2007). This change in priorities between 2006 and 2007 indicates that the priority for energy security that was achieved at the level of 'high politics' solicited by focusing events in 2006 has been coopted one year later by other dominant frames at the level of low politics.

As argued by Lenschow and Zito (1998) an indicator for the influence of frames on policy outcomes is the degree of their institutionalisation (see above). Institutional changes with the progress in European integration were the basis for several frames for European energy policy with ramifications for the framing of energy security. Three frames can be derived from this perspective: the internal energy market, environmental protection, and infrastructure. The Single European Act (SEA) with the introduction of majority voting on internal market initiatives led to the internal energy market as the "master frame" (Nylander, 2001: 294) in energy policy for the European Commission. The SEA enabled the Commission to progress in the field of energy policy on the grounds of insufficient market integration. With the Treaty on European Union two other changes were introduced (Matlary, 1996): the provision on trans-European networks (TENs) and the reinforcement of EU environmental policy. With TENs the European Commission gained competences for a common programme for the coordination and development of infrastructure projects. Both of these changes led to the emergence of new potential policy frames (or justifications) for legislation in the field of European energy policy. These frames resulted in a certain problem definition of EU energy security which in turn predetermined policy objectives and instruments. Procedural changes in form of majority voting and the full inclusion of the European Parliament with its rather pro environment and integrationist perspective affected energy policy. At the same time the subsidiarity principle enshrined in the Maastricht Treaty was used by some member states to prevent integrationist action in the field of energy policy (Collier, 1996).

Documents published by the Commission since the 2000 Green Paper reflect the three dominant frames. They also highlight the influence of focusing events on the priority of these frames which are at the same time used as problem and solution. The 2000 Green Paper (CEC, 2000) argues that environmental concerns – mainly climate change – and the progress towards an internal energy market require an energy security policy at EU level. While using a broad definition of energy security including many of the dimensions discussed in section 3, its emphasis seems to be on the external risk and it suggests diversity as the major objective to achieve energy security. It underlines to consider the risk of import dependency and not import dependency itself. Acknowledging the fact that the EU does not have the power to directly influence the supply side, it suggests besides a broad range of measures two avenues for action: strategic partnership with supplier countries and the promotion of renewable energies as the most promising way of supply diversification in the long term. Furthermore, it stresses the need for demand policy – also due to the fact that measures in other areas are considered as very limited due to the lack of political consensus (ibid.: 82). In its final report to the Green Paper the Commission highlights the need for a Europe-wide definition of security of supply (CEC, 2002: 5). At the same time the dominance of the master frame of internal energy market as solution to energy security is underlined in the Commission's response to the Californian electricity crisis 2001. It argues that the internal energy market will prevent such crises in the EU: "A power blackout like the one in California recently is not possible in the internal market, which is reinforced by rules governing investment, competition and access to resources and transport networks which protect against this type of breakdown" (CEC, 2002: 8).

Subsequently – also as response to the 9/11 attacks – energy security as a question of secure energy infrastructure gained more significance as frame highlighted in the 2003 communication “Energy Infrastructure and Security of Supply” (CEC, 2003). After severe power blackouts in the winter of 2003 energy security was increasingly discussed in terms of sufficient investments in energy infrastructure and how the regulatory framework needs to be adapted in order to ensure secure energy infrastructures. While the initial proposals on the basis of the 2000 Green Paper were mainly focused on securing fossil fuel supplies (oil stockpiling and gas storage) (Council, 2003), in December 2003 the Commission proposed a directive “concerning measures to safeguard security of electricity supply and infrastructure investment” that was later adopted (EC Directive 2005/89/EC) and strongly linked to the internal energy market objectives reinforcing the 2003 directives on the internal electricity and gas market. Both energy security directives that were finally adopted in 2004 and 2005 were mainly embedded in the dominant master frame according to which a functioning internal energy market would guarantee security of supply. It could be argued that energy security has been used in the policy process as a policy objective or frame to fulfil expectations by member states with the actual intention to enforce the internal energy market as an instrument for the energy security problem (Stirling, 1993).

As the 2000 Green Paper the 2006 Green Paper shows a quite broad problem definition of energy security. It does not focus on one particular dimension of energy security but refers to a broad range of related issues: increasing import dependency, reserve concentration, raising demand, and increasing prices. The proposed solutions equally cover a broad range of measures with the priority of a fully competitive energy market to spur investments in energy infrastructure. While the diversification of energy supply countries is mentioned the relation to Russia is framed in a neutral way to which relations needs to be further developed among equal partners (CEC, 2006: 15).

The above examples underline the predominance of a certain frame at the level of ‘low politics’ and the limited impact of ‘high politics’ policy ambitions as long as they are not incorporated in institutional changes. It remains to be seen to what extent energy related changes in the Lisbon Treaty (Art. 100) will affect policy frames, if ratified by all member states. Despite proposals by the Commission being subject to unanimity voting and thus providing space for national perspectives on energy security, the Commission will have another justification for action in this policy area affecting problem definitions and policy frames. Several recent examples underline, however, member states’ preference to national energy security policies: the Baltic Sea Pipeline manifests the ‘special relationship’ between Russia and Germany, Hungary justified its support of the “Blue Stream” Pipeline against critics who interpreted this support as an initiative against a common European strategy that “it was impossible to undermine something that did not exist” (The Economist, 2007). Also the long debated issue of a coordinated approach to gas storage was not addressed but delayed by calling for further analyses.

A "key conundrum" (Vinois, 2007: 22) remains how the subsidiarity principle reflected in the national sovereignty over the national energy supply mix can be combined with an effective European energy security policy – even more so in the context of climate change policies. Decisions on the energy supply in one member state will inevitably affect the EU's position with respect to energy security and carbon emissions. Member states are keen to keep control over their national energy supply mix although the governmental capacity to implement national policies has decreased with increased integration and liberalisation of the internal energy market.

While the 'high politics' agenda-setting route appears to have had limited impact in terms of progress towards a coordinated EU energy security approach in the short-term, it might have opened up new space for future action due to changes in the new Treaty. It is however unclear to what extent this can go beyond mitigating policy measures. On the other hand, high politics made it possible to overcome political entrenchment or lock-in in the field of RES policy that contributes to both energy security and climate policy objectives. The binding RES-target that was rejected in the Council by energy ministers shortly before the March 2007 summit was subsequently supported by the UK prime minister and French president (Parker, Laitner et al., 2007).

Renewable energy policy; energy security and climate change

Renewable energy sources (besides energy efficiency) have been discussed as means to achieve both energy policy objectives: energy security and GHG reductions (e.g. Awerbuch and Sauter, 2006). With the adopted binding RES-target for 2020 the political leaders of the EU appear to have confirmed that political will at the level of 'high politics' can overcome barriers persisting at the level of low politics, although it remained largely unclear how this target should be implemented. The issue specification is subject to political consensus among member states mainly in relation to the breakdown of the overall target into national targets. Thus the subsequent policy process on the elaboration of national RES-targets into a legislative proposal by the Commission is a mixture of low and high politics. The process exemplifies how conflicts about problem definition and frames are actually a struggle about access to and power in the policy process.

The conflict about how to define renewable energy sources emerged already at the summit. Some member states insisted that renewable energy sources should include low carbon energy sources as defined in the Commission's 2006 Green Paper (CEC, 2006: 11). As a consequence, the energy action plan includes a cross-reference to the contribution of low carbon energy technologies such as nuclear or clean coal when it comes to the definition of national 2020 RES-targets. The focus on low carbon technologies questions the special policy support for renewable energy sources from an innovation policy perspective. It also enables member states to push for their 'pet technology' (e.g. renewables or nuclear).

This leftover created subsequently a conflict about the appropriate institutional venue in which this conflict should take place. As with previous legislation on renewable energy it would seem coherent to base new legislative proposals in this area on Art. 175 EC Treaty concerning environmental protection on the basis of the qualified majority voting procedure. However, some member states claimed that such a proposal needs to be based on clause 2 of Art. 175 EC Treaty according to which the Council can only decide unanimously with the European Parliament (EP) in a mere consultative role. This clause needs to be used if a proposal has significant influence on national energy supply mixes. The EP has traditionally been a strong supporter of ambitious renewable energy targets and was therefore an important partner for renewables advocates within the Commission.

The example of renewable energy policy as cross-cutting policy between energy security and climate change underlines the importance to create feedback loops between the different levels of politics within the EU. While political leaders play an important role in launching new policy programmes, processes of low politics need to echo the required changes in order to be prepared to provide them. One relevant factor is frames incorporated at the institutional level. From this perspective, recent institutional changes within the Commission (e.g. the creation of the "Energy and Climate" unit at DG ENV) are first steps to enable a more integrated perspective on energy and security and climate change policies.

Conclusions

This paper set out an agenda-setting perspective as framework for a better understanding of the energy policy process in the context of energy security in the EU. It argued that the discussion about policies for EU energy security and climate change need to take into account the underlying policy processes. Major interest of this paper was in the question if the fact that energy security has been initiated on the EU agenda via 'high politics' mainly caused by focusing events had any impact on the subsequent policy process. It raised the question if this agenda-building route helps to overcome inertia in the policy processes or if the political momentum is lost as soon as the salience of the issue disappears. Based on a preliminary document analysis the paper suggests that a major challenge for energy security policy is to link up with 'low politics'.

'High politics' was, at first glance, not able to overcome inertia and incremental policy changes in European energy security policy. The Commission's reliance on its competences in other policy fields mainly based on internal market and environmental competences had an impact on the dominant frames at the level of 'low politics'. As in the past, the recent EU energy policy process indicates that energy security is used rather as 'buzzword' without any clear foundation regarding the underlying problem, solutions and instruments. Problem definition and solutions are contested in different institutional venues. A broad range of problem definitions and solutions is used without facing necessary trade-offs. The result is a fragmented agenda between 'high politics' and 'low politics'. This is exemplified in the discussion about the legislative proposal to achieve the 20% RES-target by 2020 – a key policy contributing to energy security and climate change objectives. It highlights the importance of institutional venues in the phases of agenda-setting and policy formulation.

The difficulties in addressing conflicts and trade-offs with the integration of energy security and climate change policies at the EU level highlight the need for institutional changes. It remains to be seen to what extent the new Lisbon Treaty might stimulate such changes. This raises the question how procedural changes can create new institutional venues that can advance the integration of these two energy policy objectives or to what extent energy security and climate change are institutionalised as contradicting frames within the EU policy process. Finally, in order to better understand the impact of the agenda route 'high politics' on policy outcomes, a detailed analysis of the different stages of an issue career is required.

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CHAPTER NINE

The "Renewable Revolution" and the CAP - Reforming the EU:s Agricultural Policy?

Malena Rosén Sundström

Introduction

The European Union's (EU) Common Agricultural Policy (CAP) is a policy area well known for its reluctance to change. Several attempts to major reform have been made since its inception as a truly common policy in the 1960s. With the latest reform in 2003, however, a number of more thorough changes were introduced. In the reform package, the need to take *sustainability* into consideration in European agriculture was emphasised. One concrete measure was the establishment of an energy crops scheme. This scheme was not only in line with the Union's declared adherence to the principle of sustainability in its policies, but also represented a way of supporting (urgently needed) increasing energy production. Development of new – and renewable – energy sources is an important step towards greater energy security within the Union.

Since the CAP reform of 2003, the EU has taken new steps to increase the production of renewable energy. Directives such as the Biofuels Directive (2003), the Biomass Action Plan (2005) and an Energy Policy for Europe (2007) have obvious relevance for the CAP framework. The focus in this paper is on how the changes brought about by these measures have affected and – perhaps even more importantly – *will* affect the member states in the short-term with regard to their political positions in the CAP. Pertinent questions include:

– *How have actors in the Agriculture Council responded to the increased emphasis on the production of energy crops?*

– *Could changes in agriculture brought about by the conversion of land to the production of renewable energy lead to changes in the member states' political positions with regard to the CAP, and thus ultimately the power structures within that policy accord?*

The paper concludes with a discussion on whether the increased emphasis on renewable energy, such as energy crops, and the changes that follow, will push ajar a window of opportunity for wider reform of the CAP in the years to come.

The main body of empirical material consists of official EU documents and the *Agra Europe* journal, which furnishes rich illustrations on the ongoing discussions and negotiations in the EU's agricultural sector and most particularly the Agriculture Council – illustrations which often take on an 'insider' hue. This paper is the tentative first step in what might hopefully evolve into a more comprehensive study. A subsequent step will have to provide a more detailed picture of the various actors involved in the policy area, e.g. through interviews with member state representatives and other network actors. Also, in a second part of a more extensive study, I plan to include the EU's external relations, with regard to energy crops. These specific relations become increasingly relevant for a much wide range of areas including security and trade, as the Union expands its production of energy crops.

Negotiations and Reform in the EU

Negotiations are central in EU decision-making, as repeatedly confirmed by many political scientists (e.g. Wallace 1996, Smith 1996, Elgström & Jönsson 1998). I have argued elsewhere that EU negotiations possess two distinct characteristics that by their combination and reach differentiate them from 'purely' national and international negotiations in a reform perspective: the frequency of *inert supranational compromises* and the extensive use of *linkages*, such as package deals and issue linkages (Rosén 2001, Rosén & Jerneck 2005). Supranational decision-making increases the propensity to compromise, but these compromises are often very complex. A supranational compromise is preceded by compromises reached at lower levels, in different political cultures, which makes it inert or inflexible. As new compromises are reached and built upon previous ones, it becomes increasingly difficult to make new ones. The room for compromises decreases, since every new compromise presumes the dismantling of an old one, a process usually associated with considerable political cost since more than one level is involved (Stenelo 1991).

Linkages between different compromises – within and between policy areas – are common in the EU, where it is known as the 'Community method' of decision-making (Spence 1995:385). The higher the political level, the more frequent the use of linkages. The aim is to create a 'bigger cake', i.e. to increase the prospects of win-win solutions, so as to make everyone interested in a deal. These characteristics of EU negotiations make decision-making rather path-dependent, and decrease the possibilities of sudden and substantial reforms. A supranational compromise is therefore likely to be more resistant to change, than its national counterpart. This, of course, also brings with it positive consequences: it hinders hastily agreed decisions and contributes to a predictable and stable political environment.

There are however many factors affecting just *how* difficult it is to negotiate reform in a given case. Here, I will limit the analysis to two such factors: the *actors* – in terms of leaders, coalitions and networks – and *internal and external pressure* (for a discussion on other factors, see Rosén 2001; Rosén & Jerneck 2005). In the processes of preparing compromises and linkages, coalition building and leadership play important roles. A coalition is defined as 'a set of actors that coordinate their behaviour in order to reach goals they have agreed upon' (Elgström 2000). With 'mobile' actors, apt to find different coalition partners depending on the issue at hand, agreement on change is more likely, than in policy areas where the actors have cemented their positions. A leader is an actor who actively drives negotiations forward, while being primarily concerned with collective interests rather than pure self-interest (Malnes 1995). A leader performing well will unmistakably enhance the prospects of agreement. In case of the CAP, the Commission has often acted as a (reform-minded) leader, something to be expected due to its formal prerogative to initiate new legislation and its overall integration-driving role (Sannerstedt 2005:108).

The characteristics of *networks* in a policy area will also affect how susceptible it is to reform. Networks are more or less stable sets of public and private actors, which are linked to each other by systematic communication and the exchange of resources, such as expertise and information (Jönsson *et al* 1998). In the literature on networks, these are often characterised as either *policy communities* or *issue networks*. The former have stable memberships, high insularity and strong inter-dependencies among their members, while the latter have fluid memberships, high permeability and weak inter-dependencies among their members (Peterson 1995:77). A policy area dominated by a policy community will be more resistant to change than a policy area dominated by an issue network. Members of a policy community often have at least two incentives to resist reform: first, there is a risk that a reform will have unintended political and economic consequences, making status quo a 'safer' option; and second, because reform is likely to alter the distribution of power and influence, members of the existing policy community (holding central and powerful positions) risk losing their power and influence as a consequence of a redesigned policy (Daugbjerg 1999:413-414). In issue networks, on the other hand, 'each member is prepared to break up the compromise and further its own interest when an opportunity arises' (Daugbjerg 1997:130).

Internal and/or external pressure are other factors affecting the likelihood of successful reform of a policy area: the need for reform becomes poignant because of internal and/or external pressure. Such pressure, in other words, pushes a reform window ajar and an opportunity for change arises. In the CAP case, external pressures (e.g. trade agreements) have proven more likely to lead to reform than internal pressure (e.g. the economically untenable situation of the CAP in the closing years of the millennium). Finally, we have to bear in mind that not only are there different factors affecting how difficult it is to negotiate reform in a certain policy area, but that the picture is further complicated by the realisation that there are also *different degrees of reform*. Resistance to change is basically likely to be greater the more far-reaching the proposed change is. Here reform refers to changes that alter the objectives and the instruments and their settings, labelled 'second-order changes', and those even greater forms of change, called 'third-order changes', when the very policy paradigms are affected (see Daugbjerg 1999:412 for further information on this classification.)

The 2003 CAP Reform: Sustainability and Multifunctionality

In 1999, a reform of the CAP was negotiated within the framework of Agenda 2000, aiming to prepare the EU for the big Eastern enlargement. The Agriculture Council did not manage to reach an agreement on its own. Thus, the CAP reform was not settled until the summit of the European Council in Berlin, and so became part of an overall compromise between the Heads of State and Government – constituting an example of issue linkage on the highest political level. The French President Chirac, a former Agriculture Minister with extensive knowledge of the policy area and supporting French interests in maintaining a status quo, strongly influenced these negotiations. The result was a much watered-downed reform. However, as a result of the fierce resistance put up by the reform-minded group comprising Sweden, Denmark and the United Kingdom (and for a while, also Italy), an agreement was made of a 2003 review of the milk quota system, an issue which had been a severe hurdle in the negotiations (Rosén & Jerneck 2005:70-71).

What eventually became the 2003 reform was thus initially planned to be a mere 'mid-term review' of the 2000-2006 program, tackling residual aspects of Agenda 2000 (Garzon 2006:97, AE 10/1 2003). Isabelle Garzon, working as a principal Commission administrator, thinks that general discontent with the distribution of payments in part explains why it turned into such a substantial reform package. Most payments were made to a minority of large farms, and there seemed to be a need of greater fairness in the system. However, other aspects were also brought up, not seldom springing from civil society debates, e.g. 'respect of environmental and health standards and support for rural development' (Garzon 2006:100). Concerns about health standards and food safety were triggered by the outbreak of BSE in Germany and the United Kingdom. The sustainability aspect was influenced by the EU's own Sustainable Development Strategy, but also by the Union's Kyoto Protocol commitments. A greater production and use of biofuels instead of fossil fuels could contribute to decreasing greenhouse gas emissions. There was also an emphasis on rural development, and for European agricultural policy to pay more attention to aspects of farming beyond the mere production of food (multifunctionality).

The Commission's initial proposal was resisted by several member states. *Agra Europe* reported: 'What is clear is that if France and the rest of the anti-reform majority do not accept the Commission's latest proposals, any chance of effective reform is dead. This set of measures represent just about the bare minimum of change needed to begin the radical reform which the Commission had originally intended. If the principle of decoupling[118] is not incorporated into the policy, what would be the next stage of gradual reform – gradually *moving away from agricultural production policy towards the rural and environmental policy* desired by the Commission and the reformers – will be impossible' (my italics, AE 10/1 2003).

The reform package included the establishment of an energy crops scheme, supporting the production of energy crops through a 'carbon credit' of €45/ha (COM 2006, 500 final). This was of course a result of environmental concerns, particularly the solemn commitment to cut greenhouse gas emissions, but was also driven by a need to find new tasks for rural labour. Judging from the readings of *Agra Europe*, the member states do not seem to have reacted either way to the crops scheme. In the minutely detailed accounts of most sectors and issues of the CAP, including everything from dried carrots to the tagging of goats, the energy crops scheme is in fact not commented at all. There is, however, a positive reaction from the Chairman of the Policy Committee of the European Landowners Organisation (ELO)[119], Dr. Alan Buckwell, to an early draft proposal in 2002: 'we applaud the proposal to separate the issue of renewable energy from set-aside through a scheme of carbon credits. […] With the appropriate incentives and fiscal arrangements, land management can play a very important role in reducing green house gas emissions by supplying renewable energy (from biomass, bioethanol and wind power) and by sequestering carbon in soils and forests' (AE 11/10 2002). The energy crops scheme 'survived', and became part of the final agreement on CAP reform. The new member states were however not included in the energy crops scheme.

With the 2003 reform, Garzon reports that there was clearly 'a new policy discourse on agricultural policy' in the EU. The Commission developed 'a new rhetoric whereby it emphasised a new political vision of agriculture based on multifunctionality and sustainability' (2006:119). Garzon argues that the two 'catch words' have become almost synonymous in the new CAP discourse: 'Multifunctionality is closely connected to the efforts to make sustainability an overarching principle of European public policies, and is now largely identified with it' (2006:183-184). Sustainability could be argued to be a norm with 'unobjectionable' status: 'Such predominant norms are considered impossible to oppose openly; at least by most people in a certain geographical context and during a certain time period' (Elgström 2005:29). Critics will instead have to rely upon 'indirect attack'. Rather than openly opposing the measures for increased sustainability they will have to argue, for instance, that it is not relevant in a certain area; try to negotiate exceptions or transition periods; or use another, competing norm to make their case (Elgström 2005:29). In case of the energy crops scheme, the exclusion of the new member states at the outset constituted

118 The disconnection of direct aid payments of production.

119 ELO is a federation of national associations from the EU-27 and beyond, which claims to represent land owners, land managers and rural entrepreneurs at the European political level, according to its website: http://www.elo.org/objectives.php.

an example of how a transition period was used to placate sceptic members.

Summing up the 2003 reform, it is clear that networks have become looser. Farmers' interest groups can no longer claim a 'monopoly' on agricultural issues on the European agenda, as other groups, concerned with environmental and health issues for example, have begun to assert themselves (as noted by Garzon). The Commission in general, and the Agriculture Commissioner Franz Fischler in particular, acted as leader of the reform, ably supported by a reform-minded minority. There was external pressure to adapt the policy area with regard to the EU's Kyoto Protocol commitment (after all, agriculture had intrinsic potential to produce – and use – more renewable energy, thus cutting down on the use of fossil fuels) – and to the concurrent trade talks in the WTO Doha Round, which started in 2001.

The Biofuels Directive (2003): The Commission Is Toughening Its Stance

In 2003, the EU (the Commission and Parliament) introduced the Biofuels Directive, with the aim of:

Promoting the use of biofuels in keeping with sustainable farming and forestry practices laid down in the rules governing the common agricultural policy could create new opportunities for sustainable rural development in a more market-orientated common agriculture policy geared more to the European market and to respect for flourishing country life and multifunctional agriculture, and could open a new market for innovative agricultural products with regard to present and future Member States.

Two important factors contributing to the launch of this directive were the aims of reducing energy import dependency and the emissions of greenhouse gases. Again, multifunctionality and sustainability were lead words. The directive provided an impetus to increase renewable energy sources: a target of renewable energy accounting for 2 % of all energy use was set for 2005 (and 5,75 % for 2010). Member states would also have to report their targets to the Commission on a yearly basis. However, a concern soon surfaced that coordination between the EU and national levels might be lacking. While the EU aimed to stimulate the production and use of biofuels, French national fiscal incentives for biodiesel use were *reduced* in January 2004. In the UK, the reduction of biodiesel taxation presented in the spring budget was deemed too low to effectively boost use and thus the industry. In Italy, there were also uncertainties about the future of a three year detaxation programme on biodiesel, about to expire that year. 'Apart from Germany, which still produces over half of all the biodiesel in the EU, most member states have still to create the necessary framework to implement recent directives on the use of energy crops', *Agra Europe* wrote in April 2004 (AE 14/5 2004).

Not all signs were negative. *Agra Europe* reported that 'several countries are now developing their fledgling biofuels industries, spurred on by the Biofuels Directive and the need to set policy targets and increase production', with the major ethanol producers in the EU at the time being France, Poland, Spain, Sweden, Germany and Lithuania (AE 12/11 2004). Still, many EU members did not follow the directive of reporting its biofuel target to the Commission that year, and legal warnings ('yellow cards') were issued (AE 18/3 2005) as a consequence. In mid-2005, the Commission stepped up its legal battle with the member states that had failed to report measures taken at the national level in order to stimulate the production of biofuels, with a second warning (AE 8/7 2005).

One of the failing members was the United Kingdom, which was presiding over the Council at the time. Though having declared herself a keen supporter of biofuels as an alternative energy source, the Commission remained impressed by the modest target of 0,3 % that the UK reported for 2005 (AE 9/9 2005). At the end of 2005, the Commission declared its intent to bring Luxembourg, Italy and Portugal before the European Court of Justice, because of their continuing lack of implementation of the Biofuels Directive (AE 16/12 2005). The Commission had to toughen its stance and resort to legal action when several member states failed their obligations under the directive. In December, *Agra Europe* stated that the Commission's strategy of 'naming and shaming' did seem to have some effect, and that rising oil prices should be adding further to the incentives to increase the share of biofuels. Only two member states, Sweden and Germany, had met the targets set out in the directive up to that point (AE 4/11 2005), with Sweden being 'best in class' with a target of 3 % which seemed to be in reach (AE 11/11 2005). Overall, the EU only reached a meagre 1,4 % market share for biofuels (AE 10/2 2006).

With the Biofuels Directive, the Commission once again acted as leader, this time applying legal force on non-complying member states. Although agriculture was highlighted as an important contributor, and possible beneficiary, in the Directive, there was limited action in the Agriculture Council on the topic.

The Biomass Action Plan (2005): Rising Security Concerns

The Commission announced an action plan on biomass in late 2005, as part of a 'fundamental review of its energy policy' (COM (2005) 628 final). In the plan, the Commission stated that the EU had a great potential to increase the production of biomass for energy use. It estimated the production in 2020 to be 3,5 times higher than in 2005. The growth potential would come from forests, bio-wastes and agriculture, with the 'increase from agriculture […] driven by the reform of the common agricultural policy'. Thus, the CAP reform was explicitly mentioned as playing an important role in the renewed energy policy. The fundamental review of the EU's energy policy was attributed to three factors: the need for Europe to stay competitive, sustainability and the security of supply.

The importance of security of supply was underlined by the gas crisis between Russia and Ukraine, which started with the Russian state-owned supplier Gazprom cutting exports to Ukraine on January 1, 2006. This also had an impact on some EU member states, such as Germany, Austria and Hungary, who are major importers of Russian gas. Although the conflict ended only a few days later, it had become clear to EU leaders just how vulnerable the Union is as a large importer of energy. Austria, who held the Council Presidency in the first half of 2006, immediately put the issue of biomass high on its agenda (AE 13/1 2006). However, in the Agriculture Council there was also an internal issue contributing to the debate on biofuels: the long overdue reform of the sugar industry now finally going to take place. Bioethanol might become a new potential use of sugar beet when the sugar sector was reformed and quotas cut, and so the Commission added it to the list of crops eligible for the carbon credit (AE 10/2 2006).

Austria stated that it hoped progress on biofuels would be one of its major achievements as Council President. The issue was strongly supported by the Agriculture Commissioner Mariann Fischer Boel, who declared at the meeting of the Agriculture Council that she would make the development of agricultural products for emerging bioenergy markets 'one of her personal priorities' (AE 27/1 2006). Reactions to the Biomass plan in the Council were generally positive, though with some major points of frictions. First, Belgium, France, Italy, Lithuania, Austria and Cyprus raised the issue of levying protective tariffs on imports of biofuels, which would effectively hinder cheap imports (particularly from the large producer Brazil). Second, Belgium, Italy and Lithuania made it clear that they did not regard the 'carbon credit' to be at all sufficient for the stimulation of an increased production of renewable energy. Third, France and Italy stated that biomass energy should be derived from a wider range of sources than just wood and cereals, e.g. vegetable oil and animal residues.

There were also concerns among the member states on how to secure an increase in subsidies for farmers growing energy crops. The introduction of the scheme to the new member states was also considered problematic. Especially Romania and Bulgaria, slated to become members in 2007, were considered to have a high potential to produce biomass. Potential imports of biofuels turned out to be a another bone of contention. There was general accord that the EU should prioritise internal production, 'rather than relying on increased imports from third countries'. However, 'France suggested the introduction of new customs codes for the import of biofuels, linked to the origin of raw materials. This would differentiate imports of e.g. ethanol made from sugar beet and sugar cane, respectively, which could effectively hinder imports from cane-producing states such as Brazil'. The Commission repeated its aim of a balance between imports and internal production (AE 17/1 2006).

When the Heads of State and Government met at a Brussels Summit in March 2006, it was agreed that they would try to increase the use of biofuels in the transport sector to 8 % by 2015, and to increase the share of renewable energy to 15 % by that same year. This was part of the Energy Policy for Europe strategy that was being worked out, although 'there was no mention of how such proposals could be turned into reality or any details of specific measures to reach this target' (AE 31/3 2006).

In 2006, there was a review of the CAP reform (COM (2006) 500 final). The most important countries (in EU-15) using the energy crops scheme in 2005 were Germany, France and the UK. It was expected that 'in case of bioethanol, production capacities between 2005 and 2008 are likely to increase four times with major production capacities in France, Germany and Spain. […] Likewise, the biodiesel production capacity might almost double between 2005 and 2007 with major investments in Germany, France and Spain'. The Commission proposed to extend the energy crop regime to all Member States from 2007.

An Energy Policy for Europe (2007): Energy Policy at Centre Stage

At a conference on farming in the UK, Agriculture Commissioner Fischer Boel emphasised the importance of 'renewable energy sources as an opportunity to combine effectiveness and environmental sustainability' (AE 5/1 2007). In her speech, she also underlined the necessity of national governments to back the development of the biofuels sector, e.g. by tax reductions. This was in line with the Commission's launch of a proposal of an integrated climate and energy policy, with the aim of boosting the EU's energy security and competitiveness, as well as combating global climate change.

The adopted measures built upon three pillars: a true internal energy market, accelerating the shift to low carbon energy and energy efficiency. The Commission declared it hoped that the EU would maintain its role as one of the world leaders in renewable energy, and proposed a binding target of 20% of its overall energy mix to come from renewable energy in 2020. At the March Summit in Brussels, presided by Germany, energy and climate change were the main concerns. *Agra Europe* reported: 'While there is little doubt that national leaders will back a plan to make binding a 10 % target of biofuels in all fuel use by 2020, a similar binding target of for 20 % of energy to come from renewable sources caused heated debate' (AE 9/3 2007). The UK, Sweden and Italy, as well as Germany, were strongly advocating a binding target for renewable energy, while France, Poland and the Czech Republic were ardently opposed to such an action. Germany finally managed to find an acceptable solution for all, where it was agreed that member states would make different contributions to the 20 % target, depending on their state of technology (AE 16/3 2007).

The successful negotiation outcome in Brussels also resulted in a firm decision on integrated climate and energy policy in line with the Commission's proposal (Council of the European Union. Presidency Conclusions, 8-9 March, 2007).

In early and mid-2007, there were signs of renewed activity in the stalled Doha Round trade talks. With regard to agriculture, a traditionally difficult area in these talks, Agriculture Commissioner Fischer Boel said she 'would not allow the Doha Round of international trade talks [to] be the main driver of our domestic policy for farms and rural areas in the years ahead'. She also declared that 'the EU would not agree to swallow just about anything in terms of agricultural concessions in the talks' (30/3 2007). In July, biofuel tariffs came up as a potentially new bone of contention in the international trade negotiations. Visiting Brussels, the Brazilian Foreign Minister Celso Amorim declared that his country would fight for the elimination of import duties on biofuels. At the moment, the import tariff is almost 50 % on ethanol in the EU, with the purpose of protecting the newly reformed sugar sector. Biodiesel and ethanol should be on a par with tariff-free hydrocarbons like oil, according to the Brazilian Foreign Minister.

The EU Trade Commissioner, Peter Mandelson, said although the production of biofuels 'can benefit farmers both in Europe and the developing world', the EU:s biofuels policy is 'not ultimately an industrial policy or an agricultural policy – it is an environmental policy, driven above all by the greenest outcome' (AE 6/7 2007). However, some EU policymakers expressed doubts that Brazilian biofuels really are 'green'.

There were also EU concerns about the disadvantages of bioenergy in mid 2007. In order to make sure that production is in line with the sustainability aim, the Commission has discussed the possibility to create some form of biofuel certification (AE 27/4 2007). Certain members, e.g. the Czech republic, have expressed concerns over rising food prices, resulting from the 'compulsory blending of biofuels with fossil fuels' from September. Other agricultural products which may also be used as renewable energy sources, such as wheat and sunflower oil, have seen increasing prices over the last year, which has in turn contributed to the nascent 'food versus fuel'-debate. Despite discussions on potentially negative aspects of bio energy, it nonetheless constitutes a very important component of the EU's renewed energy policy – and is likely to continue to do so for the foreseeable future.

Prospects on Future Reform: From Food to Sustainability – to Energy Security?

The Commission had slated a CAP 'Health Check' for November 2007, with a subsequent reform process to start in 2008. The Commission will once again take the lead in an effort to make the CAP more up-to-date, and the issue of renewable energy appears to be an important part in this plan, considering the Commission's newly launched Energy Policy for Europe, and the Agriculture Commissioner's personal engagement in the energy crops question.

The reform-minded minority, made up by Sweden, the UK and (often) the Netherlands and Denmark is likely to stay supportive of comprehensive measures aiming for more efficient European farming. At the Summit in March, Sweden, the UK and Italy formed a coalition, backing the German Presidency's proposal. With regard to energy crops, an interesting question is whether the traditionally strong Franco-German axis in agriculture will stay intact – which so far has meant marginal reform. The UK, Austria and Germany have all emphasised renewable energy during their respective Council Presidencies. The most important countries (in the EU-15) adopting the energy crops scheme in 2005 were Germany, France and the UK. Thus, both Germany and France will have an interest in energy crops, since both are large producers of relevant crops. There are, however, also marked differences: France is evolving and increasing the production of nuclear energy, while Germany seems more inclined to support other forms of energy, such as different forms of renewable energy. Germany acted as a strong leader in finding an acceptable compromise among the member states with regard to the Commission's Energy Policy for Europe in the spring of 2007.

France has adopted a protectionist stance with regard to imports of biofuels, highlighting a point of disagreement between member states, where some are more willing than others to accept that a large part of the EU's energy will continue to be supplied by sources outside the Union. However, this is also linked to the question of security of supply, which is likely to be a high-order issue for the European Council. The balance between the EU's internal production and import is a central security aspect of energy. The networks surrounding the CAP have been changing, as demonstrated in the reform of 2003. The policy community of farmers' interests that have for a long time dominated the EU's agricultural policy, have finally had to relinquished some power to interlinked interests, such as those expressed by environmental groups and consumers. Since a policy area characterised by issue networks is likely to be more open to reform, this increases the chances of further CAP reform.

The revived Doha Trade Round will probably also impact the evolution of the CAP – despite the Agriculture Commissioners' blunt statement that international trade talks should not bethe main driver of reform. Brazil's concern over high EU-tariffs on biofuel was a warning that this issue is likely to be added to the Doha agenda when negotiations are resumed – a new external pressure in the making. Internal pressure will derive form the phasing in of the new member states in the overall CAP framework, and the full inclusion in the energy crops scheme from this year. There is also the question of what positions the new members will support in the Council. Depending on what coalitions are formed, reform will be more likely or less likely: will the new members form a wholly new coalition, reflecting the fact that they are in a similar situation, being phased in into the CAP? Or will they align themselves with either the reform-minded majority or the status quo advocates? Alignment with reformers, coupled with the existing external pressure would open a window of opportunity for further and more far-reaching reforms, of a second-order character. That energy crops will continue to play an important role in EU agriculture in the years to come would seem obvious. Sustainability will certainly continue to be an important principle in the CAP, but following the gas crisis of 2006, rising energy security concerns will probably be another vital aspect governing CAP evolution.

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Impact of an Increased Biomass Use on Agricultural Markets, Prices and Food Security: A Longer-term Perspective

Josef Schmidhuber

Introduction

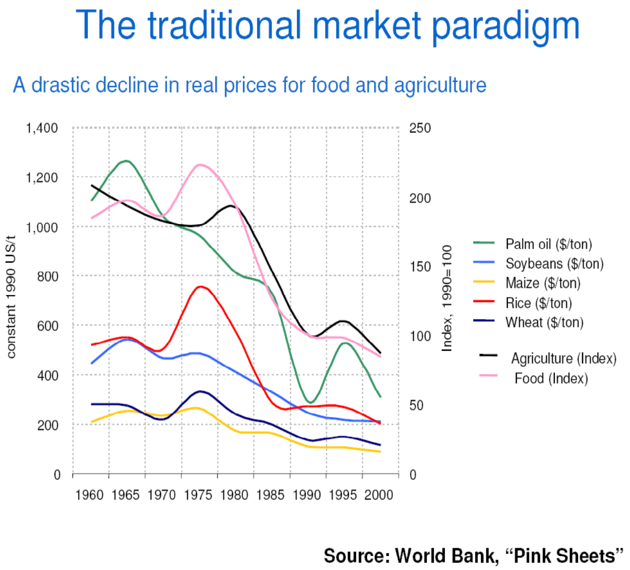


Figure 1: Real prices for food and agriculture

For decades, global agricultural markets have been characterised by steady production and productivity growth, slowing demand and as a result, falling real prices for agricultural produce. From 1973 to 2000, for instance, food prices fell by about 60% and agricultural prices by about 55% in real terms (World Bank, 2004, Figure 1). While the decline over the last four decades was particularly pronounced, it was part of a longer-term trend observed during the entire century not only in international markets but in regional and national markets as well. Over the last century, real prices for agricultural and food products in the US declined by 72 per cent and 76 percent, respectively (USDA).

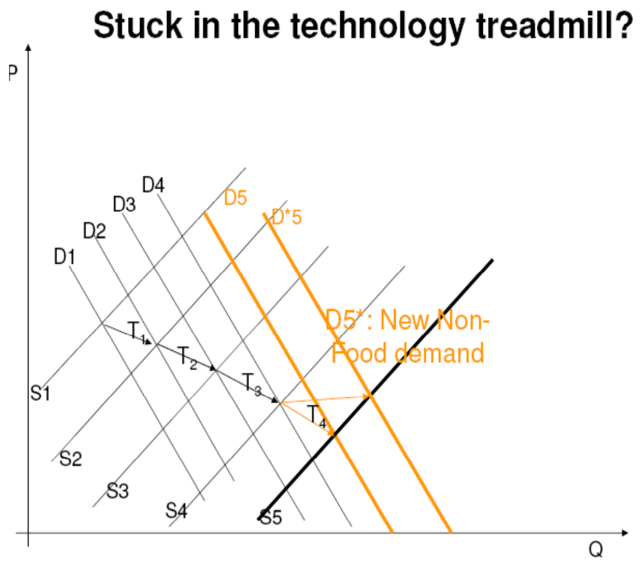


Figure 1: Cochran's treadmill: traditional paradigm

This decline in real prices has rested on two main pillars. On the supply side, rapid technological progress in agriculture meant lower unit costs of production and, with competition in product markets, lower profit margins per unit of output and lower commodity prices. Together with declining product prices, the pressure on farmers to adopt the new technologies rose and competition in product markets effectively squeezed farmers' profits. They accrued largely to buyers of food and agricultural products, with a consequent decrease in real costs of food and fibre products to consumers (Gardner 2002).

In many countries, higher productivity in agriculture was accompanied by an intensification of production methods, i.e. higher applications of fertilizer, pesticides, and an expansion of irrigation. For most new high-productivity technologies only produced higher output if combined with higher levels of inputs. And finally, farmers tried to expand the production base. Lower profits margins per unit of output required increased volumes, more cropland and higher cropping intensities. The result was a massive increase not only in productivity but also in total output.

On the demand side, a drastic slow-down in global population growth and increasingly saturated demand[120] resulted in a steady slowdown in demand growth, first

120 Not only in developed and emerging markets, but also and rapidly so in many advancing developed countries. For a complete analysis of the driving forces see e.g. Schmidhuber and Shetty 2005.

in developed countries and later, and rapidly so, in a growing number of developing countries. As mentioned above, it is consumers who have benefited the most from advances in agricultural productivity. In real terms food prices have declined to their lowest levels in history so that consumers today eat better while spending less and less of their budget on food. Clearly not all countries and regions have benefited from these advances. In parts of the developing word, notably in sub-Saharan Africa, they have yet to produce any meaningful impact. But in many developing countries progress towards providing more, better and cheaper food has been impressive. The rapid decline in real food prices has allowed consumers in developing countries to embark on food consumption patterns previously enjoyed only by consumers in industrialized countries at much higher gross domestic product (GDP) levels. Today, consumers in developing countries can purchase more calories than ever before -- and more than consumers in industrialized countries ever could at comparable income levels. In China, for instance, consumers today have about 3000 kcals/day and 50 kg of meat per year at their disposal - at less than US$1000 nominal income per year (Schmidhuber and Shetty, 2005). Since the early 1960s, global average calorie availability has increased from about 1950 to 2680 kcals/person/day while protein availability has nearly doubled from about 40 to 70 g/person/ day.

With growing saturation levels, the growth rates of world demand steadily declined and are projected to fall further -- from 2.2% p.a. from 1969-1997/99 to 1.6% to 2015 and 1.4% for 2015 to 2030. The decline will even be more pronounced in developing countries where growth in aggregate food demand is projected to fall from 4.0% p.a. to 2.2% and to 1.7% for the same periods (Bruinsma, 2003). FAO's long-term outlook to 2050 suggests that the decline in growth will become even more pronounced after 2030, with growth rates for aggregate food demand declining to 0.9% for the world as a whole and 1.1% p.a. for the developing world (FAO, 2006). Even a rapid decline in the number of the 850 million now undernourished would not alter this outlook substantially[121] in the longer term. The world could easily produce the additional food needed to feed them well, and do so without any significant "price stress" on world commodity markets. If today's hungry are hungry it is because they are unable to purchase enough food and not because the world cannot produce enough. The potential demand is simply too small to challenge the spare production and productivity capacity of global agricultural production.

Potential demand from energy markets could, however, be large enough to challenge the spare production capacity of world agriculture. How large the potential of energy markets is, how much and what type of agricultural produce is competitive in the energy markets and how this growing competition is changing price formation in commodity markets will be illustrated in this paper. It will also examine whether the non-food demand potential is large enough to stop the slow-down in overall

121 A third factor, albeit unrelated to agriculture, added to the decline in real prices over the last decade: Driven by globalization and growing competition in global manufactures markets, nominal prices for industrial goods and thus for the numéraire used to deflate agricultural prices have declined faster than nominal prices in agriculture (IMF, 2006).

demand growth or even reverse it.

The size of the competitive potential will crucially depend on how much agricultural produce becomes a competitive source of energy in the overall energy market. At current energy prices, some agricultural feedstocks have indeed already become competitive sources of energy, at least under certain production environments. As a consequence, demand for these feedstocks has expanded and already supports prices for these commodities. Where demand was particularly pronounced as in the case of cane-based ethanol, bioenergy demand has created a quasi intervention system and an effective floor prices for agricultural produce – sugar in this case. With higher energy prices the range of products competitive in the energy markets has increased, strengthening the floor price effect for agriculture in general (Schmidhuber, 2005). In some countries, policy incentives to use and/or produce bioenergy further added to the demand for agricultural produce and lowered the parity price equivalent to a point where many otherwise uncompetitive feedstocks became economically viable in the energy market (Schmidhuber, 2006).

The growing dependence of agriculture on energy markets has also created a growing concern that high and rising energy prices will create new or augment existing food security problems as a growing number of poor consumers are priced out of the food markets by rising energy demand or are exposed to more pronounced swings in food supplies and prices. This paper will show that higher prices can indeed add to food security problems, but that price increases are not open-ended and fears of a global neo-Malthusian scenario are unwarranted. The main reason for this is an endogenous ceiling price effect (Schmidhuber 2006). As feedstock costs are the most important cost element of all (large-scale) forms of bioenergy use, feedstock prices (food and agricultural prices) cannot rise faster than energy prices in order for agriculture to remain competitive in energy markets (ceiling price effect). Barring massive subsidies for bioenergy, the need to maintain competitiveness should create an endogenous brake on food prices.

Before floor and ceiling price effects are discussed in detail, it should be useful to estimate the potential size of bioenergy production and thus how far demand for agricultural produce can expand. The next section therefore examines the various potentials of bioenergy production, juxtaposes them with the overall energy markets and provides an idea as to what the regional distribution is likely to be.

How Big Is the Potential for Bioenergy?

A number of studies have assessed the global and regional potential of bioenergy production. Their estimates differ considerably and the interpretation of the results presented has to be vetted carefully against the basic assumptions made (see e.g. Smeets et al. 2004, Fischer and Schrattenholzer, 2000). Assessments differ due to (i) different scopes in terms of countries and feedstock coverage, (ii) different assumptions made as to "reserve" resources (land, water, etc.) required to meet the world's need for food, forest and fibre demand, (iii) different definitions of potentials (theoretical, technical, economic) or (iv) simply because they pursued completely different methodological approaches. To discuss the differences in the various studies in greater detail would exceed the scope of this paper and distract from its main purpose. Instead, the focus will be to give an idea of the magnitude of the potential and to illuminate the discussion by identifying the various forms of potentials.

The analysis by Fischer and Schrattenholzer (2000) helps illustrate some of the salient points that determine the various "potentials" and provides plausible estimates for their magnitude. The study is comprehensive in terms of country coverage, provides regional details and distinguishes five major possible sources of biomass, i.e. arable land, grasslands, forests, as well as animal and municipal wastes[122]. The study also distinguishes technical from economic potentials and takes account of cropland needs for food, forest and fibre production based on FAO's long-term outlook for global agriculture (Bruinsma, 2003). It is therefore compatible with many other assumptions made in this paper.

The theoretical potential

At the most general level, the global bioenergy potential is defined by the total amount of energy produced by global photosynthesis. Plants collect a total energy equivalent of about 3150 Exajoule, EJ [10^{18}J/a] (Kapur, 2004) per year or nearly seven times the global current amount of energy used [total primary energy supply in 2004 was about 460 EJ (IEA, 2004a)]. While no doubt impressive, the photosynthesis potential as such is rather irrelevant for an assessment of global bioenergy potential. For one thing, it includes vast amounts of biomass that cannot be harvested because it is too inaccessible or because the cost of harvesting would be too high. For instance, nearly one third of photosynthesis, or about 1150 EJ/a, is produced as phytoplankton and other plants in the oceans (Kapur, 2004). Maritime photosynthesis products not only form the basis of the oceans' food chains but are also difficult if not impossible to harvest. Similarly, much of what grows on land is either not harvestable (too remote, etc) or simply not available for energy use, being required for other purposes.

The theoretical potential is not only limited by the global area suitable for photosynthesis production but also, and decisively so, but the low energy efficiency of photosynthesis. Plants are hugely inefficient converters of solar energy and will therefore face growing competition from more efficient methods of collecting and converting solar radiation. At around 0.5 Watt/$m^{2,}$ the power density rates of plants is extremely low and just a fraction of what solar energy can already provide, i.e., between 20-60 Watt/m^2. This makes biomass a remarkably poor way of harvesting solar energy and means that (i) huge areas of land would be necessary to make a sizeable contribution to global energy supplies and (ii) that biomass production will have to compete increasingly with more efficient solar energy converters,

122 Bioenergy crops and crop residues can come from both arable land and grasslands.

particularly solar panels. It is therefore important to determine how much of the theoretical potential can be made technically available and how much of the latter is economically viable.

Table 1: Agricultural and energy markets, potentials and actual use

			[9]Exajoule/a	[10^{18} Joule]/a		million ha
Energy source:	Potential and actual use	Year	World	OECD	non-OECD	World
All sources (TPES)		1973[2]	253	157(62.3%)	95(37.7%)	
		2004[2]	463	231(49.8%)	232(50.2%)	
		2030[2]	691	285(41.2%)	406(58.8%)	
		2050[2]	>850			
Biomass	Actual use	2004[2]	49[11]	8	41	
	Theoretical potential		>>2000	Global photosynthesis: ~ 3150 EJ		
	Technical potential	1990[1]	225	48[12]	177[12]	
		2050[1]	400	80[12]	320[12]	
	Economic potential	2050[1]	158			
Biofuels	Ethanol[7] (actual)	2004[3]	0.84	0.34	0.51	9.52[4]
		2006	1.01			
	Biodiesel[7] (actual)	2003[3]	0.06	0.04	0.02	0.47[4]
	Potential[1]	2050[1]	53[10]			
	Use	2030	4.8(8.4)[13]	2.3(4.0)[13]	2.5(4.4)[13]	
Resources:			million ha			
Agricultural land[8]	Used for agriculture	1997-99	1506	658	848	850[4/5]
	Total suitable		4188[8]	1406[6]	2782[6]	
	Used for biofuels	2006	14			~1% of land
		2030	32.5 (57)[13]			~2% of land

1 Potential based on Schrattenholzer and Fischer, IIASA, 2000

2 Based on IEA 2004b: Key energy statistics, 2006 (TPES), EIA (US) projections for 2030 are 761 EJ (in terms of consumption)
3 Derived from http://www.earth-policy.org/Updates/2005/Update49.htm, Earth Policy Institute
4 Assuming an average yield per hectare for ethanol of 4200 l (3000 l US maize, 5500 l Brazil cane, 6900 l France sugar beet) and of 3800 l/ha for biodiesel (average palm oil, rapeseed oil, etc.). Most recent yields are about 10% higher for cane and 20% higher for maize.
5 850 million ha would be required to meet 2002 road transport fuels needs (77 EJ) at current yields (l biofuel/ha), technology, and crop composition.
6 Area for developed and developing countries, not OECD and non-OECD
7 Assuming an energy content of 34 MJ/l for biodiesel and 21.1 MJ/l for ethanol
8 Bruinsma (ed), World agriculture: towards 2015/2030, An FAO Perspective, 2003, total suitable land for rainfed agriculture
9 23.8845 Mtoe = 1 EJ
10 IEA (2004a), "Biofuels for Transport", table 6.8.; road transportation in 2030 about 120 EJ; total 132 EJ; EIA.
11 15-60 EJ: most biomass fuels are not traded on world markets, estimates of consumption are highly uncertain.
12 Based on regional estimates from Schrattenholzer and Fischer, IIASA, 2000
13 The IEA Energy Outlook 2006 assumes a 4% share in road transportation in 2030 in the reference case, 7% in the alternative scenario

The technical potential

The technical bioenergy potential is essentially that part of the theoretical potential that can be harvested in practice and thus be harnessed for practical energy use. Again a number of studies have gauged the volume of biomass that can technically contribute to global energy supplies. Not surprisingly all estimates suggest that the technical potential is a relatively small fraction of the theoretical one. Fischer and Schrattenholzer for instance estimate that the global technical potential of bioenergy was about 225 EJ/a in 1990 and that it could increase to about 400 EJ/a by 2050. The near doubling in the potential from 1990 to 2050 largely reflects anticipated increases in crop yields and to a minor extent assumes growing amounts of municipal and agricultural wastes resulting from population growth and rapid urbanization.

With about 177 EJ in 1990, non-OECD countries would account for the lion's share of the global technical potential, Africa and Latin America together providing about 42% of that figure. In contrast, the technical potential of OECD countries, about 48 EJ, is rather limited and accounts merely for 21 percent of the overall technical potential[123].

The long-run economic potential

More important than purely technical availability, however, is the question of how

123 It is interesting to note that the regional estimates for the potentials of bioenergy correspond almost exactly to current and actual use of biomass. This holds both for shares between OECD and non-OECD countries as well as for the distribution within OECD countries. Current use in the OECD countries for instance is about 8 EJ/a or 16% of total current biomass use. The potential is estimated to be 80 EJ/a or 20% of the total potential in 2050.

much technically-available bioenergy potential is economically viable. The two crucial parameters here are the prices of fossil energy and the costs of producing bioenergy. This means that the technical potential needs to be scaled down further to that part of the bioenergy stock that can compete with fossil energy after harvesting, transport and processing. These overheads can be substantial and accordingly reduce the amount of bioenergy that is profitable to use. Even more important is that increased use will mean that the costs of using bioenergy can and will increase rapidly at the margin of using an additional unit of biomass. How steeply long-term supply curves will increase is difficult to gauge. The increase in marginal costs of global sugar production illustrated in Figure A3 (Annex) is no doubt exaggerated by massive subsidies that keep high-costs producers in operation (right end of the curve). A massive increase in biomass use and thus growing competition for area should, however, also result in a rapid increase in marginal costs, once traditional production acreage is exhausted. Based on the IIASA-WEC A3 scenario, which assumes a continuation of high economic growth, rapid technological development and fossil energy prices in the middle of the existing long-term estimates, Fischer and Schrattenholzer find the economically viable potential to be in the range of 150 EJ/a globally (Fischer and Schrattenholzer, 2000).

It is important to set this in the broader context of current and future energy needs. First, the 150 EJ/a should be seen in the context of future energy needs, projected at some 850 EJ/a by 2050, so that the contribution of bioenergy would "only" be around 17.5%, or only 7% above its current share of 10.6%. Second, the 150EJ/a are based on the use of biomass, not of biofuels. While second-generation biofuels should lower conversion losses and costs considerably, the 150 EJ/a would melt down to about 53 EJ/a in terms of biofuels at current conversion technologies and efficiencies (IEA, 2004a).

The current short-term economic potential

The assessment of the long-term economic potential depends crucially on assumptions made about the prices of fossil energy, the development of agricultural feedstocks and future technological innovations in harvesting, converting and employing biofuels. In their current state all these factors also determine the competitiveness of the various forms of bioenergy and it should thus be useful to examine how they currently influence what feedstock is viable in what production or farming system.

The key indicator in examining the question of short-term potential and economic viability is therefore the break-even point for the various forms of bioenergy and how sensitive this is with respect to fossil energy prices and most importantly agricultural feedstock prices. Break-even points are given by the so-called parity price, i.e. the price of fossil fuel per unit of energy at which the various forms of bioenergy become competitive. This indicator will be discussed in section 3 of this paper and key parity price levels will be presented.

The main factor that determines the parity price of a particular form of bioenergy is the cost of the feedstock (market price adjusted for subsidies and other policy interventions that do not affect prices directly). At the industrial level of bioenergy production, feedstock costs account for the lion's share of total costs and can exceed 80% of total production costs. As the energy market is large compared to the agricultural feedstock markets, prices of agricultural feedstocks are endogenous to changes in fossil energy prices. As also demonstrated in section 3 of this paper, large energy markets can create both a floor price for agriculture as well as a ceiling price, i.e. the price for agricultural feedstocks that is still low enough to keep a given form of bioenergy in the energy market. As this price cannot be exceeded in the long run, to keep a given feedstock viable in the energy market, the current economic potential of bioenergy is an endogenous potential that depends not only on the price changes in fossil energy markets but also, and crucially so, on the demand for and the price of the feedstocks.

Current, actual use of bioenergy

The discussion of the biomass potentials suggests that the demand for biomass could create substantial demand for agricultural resources, but that the economically viable use of biomass is crucially dependent on prices for fossil energy, agricultural prices and the cost of converting biomass into marketable bioenergy. What still needs to be discussed is how much of the potential has already been reaped, what feedstocks are used and what forms of biomass are employed as the basis for bioenergy production.

In 2004, global biomass[124] use accounted for 49EJ or nearly 10.6% of total primary energy supply (TPES) (IEA, 2006, see also Table 1). Table 1 also shows that the importance of biomass use differs considerably across countries and groups of countries. In general, biomass is a more important contributor to energy supplies in developing countries where it accounted for nearly 19% of their TPES in 2004, equivalent to 41 EJ, while it is much less important, both in absolute terms and as a share of total energy supply, in OECD countries. In almost all developed countries it accounts for less than 5% of TPES and in 2004 represented a mere 3.4% for the OECD countries on average.

While biomass accounts for small shares of TPES in almost all OECD countries, the importance varies widely across the various developing regions. Whereas biomass is entirely irrelevant for all oil and/or gas rich countries in the Near-East/North-Africa region, it is often the most important source of energy in most countries in sub-Saharan Africa. In some of these countries, bioenergy accounts for more than 90% of the TPES, examples are Tanzania (92%), Ethiopia (92.1%) and the Democratic Republic of Congo (93.5%) (for details see Figure 3).

For discussion of the possible impacts of bioenergy on agricultural markets it

124 Combustibles and waste

is important to note that the major role it plays in developing countries is not a new phenomenon. The forms of bioenergy used in developing countries make that clear. They have little to do with the advanced and modern forms of bioenergy that have become *en vogue* in developed countries as a result of high fossil fuel prices and environmental concerns. The latter essentially reflect advanced development and demand for high-end environmental goods. In contrast, high biomass use in developing countries is often based on low-end products like charcoal, fuel wood or even cow dung and is often associated with environmental damage (deforestation) and health problems (fuel wood in India). The dominant role of these semi-marketable or non-marketable feedstocks, mostly based on forest products or by-products of agricultural production, means that the use of biomass in most developing countries has had no, or only limited, impact on international agricultural markets. The bioenergy that has most affected agricultural markets is probably biofuels, i.e. highly marketable bioenergy based on traded feedstocks such as cereals, sugar or cassava. Their use for energy production has created considerable public interest but their contribution to the energy markets is almost negligible. In 2006 they provided only about 1.1EJ or 1.3% of road transportation needs and thus less than 0.3% of total energy supplies (Table 1).

As these feedstocks will play a dominant role in the supply of first-generation biofuels, the obvious question is how much land is necessary to make a sizeable contribution to current energy needs. Meeting global road transportation needs, which are about 77EJ/a or about 18% of global energy use, for instance. A mechanistic way to address this question is to assume current conversion efficiency, current yields, current feedstock composition (sugar cane, maize, rapeseed, etc.) and the proportions of bioethanol to biodiesel production and calculate the land area needed to produce 77 EJ in terms of biofuels. The resulting answer is around 850 million ha, equivalent to the total cropland currently used for food and fibre production in developing countries (Table 1). But this is an unrealistic answer as it ignores the endogenous limits stemming from the fact that the demand for these feedstocks would drive up their prices and limit their use. Encroachment on existing land and expansion of overall crop land would consequently also be curtailed. The exercise is nonetheless useful as it shows that the energy market is “big” relative to the agricultural market and that energy prices will determine agricultural prices where agriculture is a competitive feedstock. When competitive, the energy market affects the agricultural markets and creates a floor price for agricultural produce but the contribution of agriculture would be too small to affect the energy market. How these floor price effects work in practice and how rising feedstock prices create a ceiling price effect for agricultural produce will be discussed in the next sections.

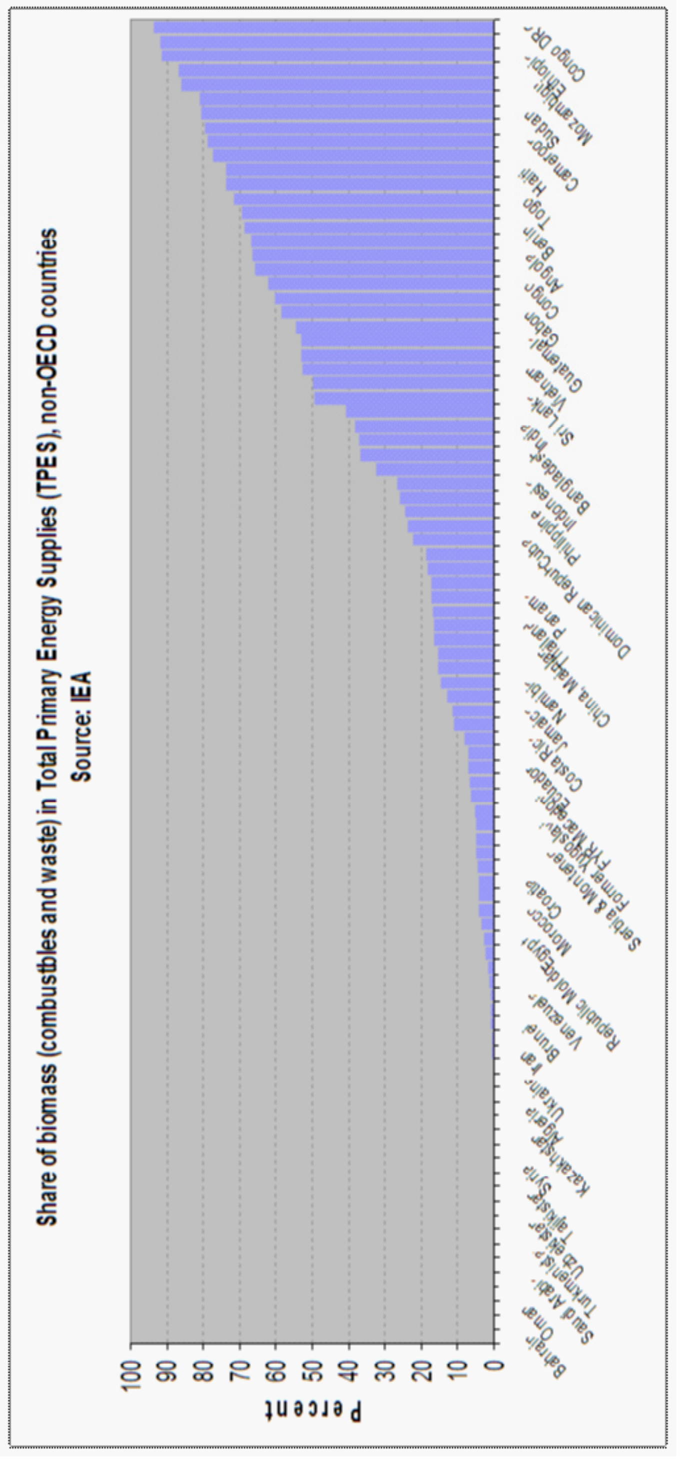


Figure 3: The share of current bioenergy use in developing countries

Price Effects

Higher fossil fuel prices create a floor price for agricultural products

Agricultural prices have always been affected by energy prices. Hitherto, this price link was largely limited to the impacts of higher energy prices on the prices of agricultural inputs, i.e. the prices for fertilizer, pesticides, or diesel. Higher input prices often resulted in a rationalisation of production and thus lower output. This has changed. With rapidly rising energy prices and improved bioenergy conversion technologies, higher energy prices are also affecting agricultural *output* prices. As prices for fossil energy reach or exceed the energy equivalent of agricultural products, the energy market creates demand for agricultural products. Where demand from the energy sector is large/elastic and agricultural feedstocks are competitive in the energy market, a *floor price effect* for agricultural products results. The output price effect creates incentives to produce more rather than less.

How big is demand from the energy sector?

The effectiveness of this floor price mechanism strongly depends on the volumes of agricultural output/feedstocks that can be absorbed by the fuel market, i.e. on demand from the energy sector being sufficiently large. As illustrated in section 2, the volume of global demand for energy is indeed large compared with the energy that agricultural feedstocks can deliver. This means that demand for agricultural feedstocks should be elastic as long as biomass energy can be sold at prices that ensure coverage of total costs. In practice, the volumes depend, inter alia, on the degree of market integration.

What crops are competitive at what energy price...?

The point where total costs for biomass-based energy production are covered by revenues from sales of bioenergy (ethanol, biodiesel, etc.) is referred to as the parity price of a given feedstock. This is the point where the costs (feedstock, upstream and downstream transport, conversion, wages, capital) of producing a unit of the bioenergy (ethanol, biodiesel) are equal to the costs of producing the same energy unit from fossil energy (petrol, diesel). In other words, this is the point where bioenergy producers break even. Figure 5 provides parity prices for a selection of agricultural feedstocks, farming systems and fuels (ethanol, diesel, BTL[125]).

The blue diagonal reflects a parity price line for the conversion from crude oil

125 BTL stands for Biomass to liquid and in practice refers to fuel products engendered by Fischer-Tropsch Synthesis on the basis of biomass conversion. Commercially, these products are known under such names as "Sunfuel" or "Synfuel".

to petrol which allows mapping feedstock parity prices for crude oil into feedstock parity prices for refined petrol. To mention just a few of these break-even points, there lie at US$28/bbl for cane producers in Brazil's south-centre region, at US$35/bbl for the average in Brazil, at US$38/bbl for large scale cassava-based ethanol production in Thailand, at US$45/bbl for palm oil-based biodiesel in Malaysia, US$58/bbl for maize-based ethanol in the US and can up to nearly US$100 for BTL production in Europe (for more detail see e.g. Schmidhuber 2005). It is important to note that these parity prices have been calculated for very specific production and conversion environments and may thus not necessarily apply to the same or similar feedstocks in different production environments. Likewise, they are based on the exchange rate to the US Dollar that applied for the underlying year of the calculations and may change for the same year and feedstock over time. The appreciation of the Brazilian Rais since 2004/05 has almost certainly raised the parity prices that have been derived for this period. And finally, these are parity price that are based on average feedstock prices of 2004-05 and in some cases even at feedstock prices of 2000-2002.

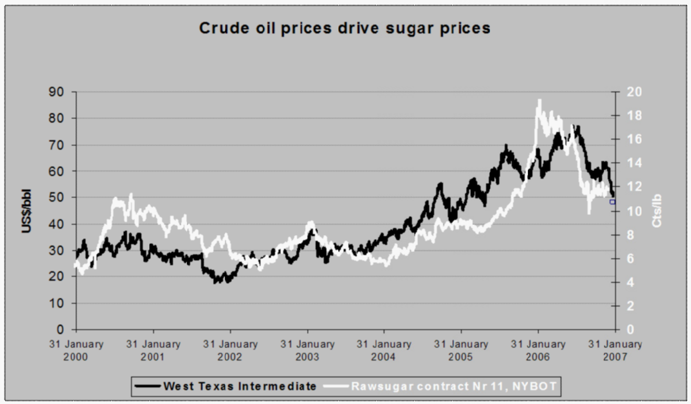


Figure 4: Sugar prices track crude oil price above US$35/bbl

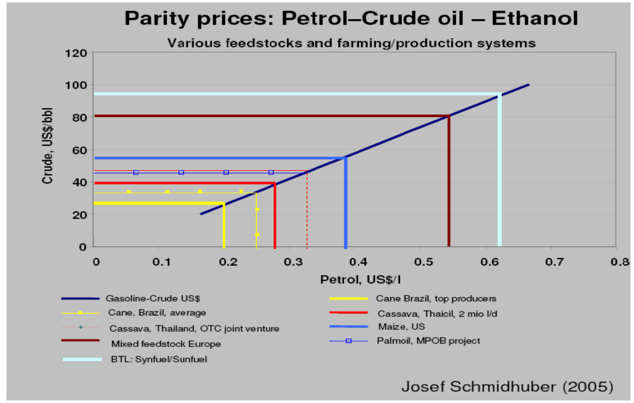


Figure 5: Parity prices for various first generation feedstocks

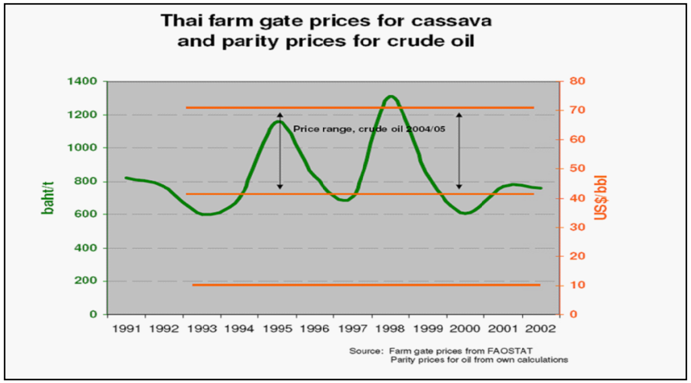
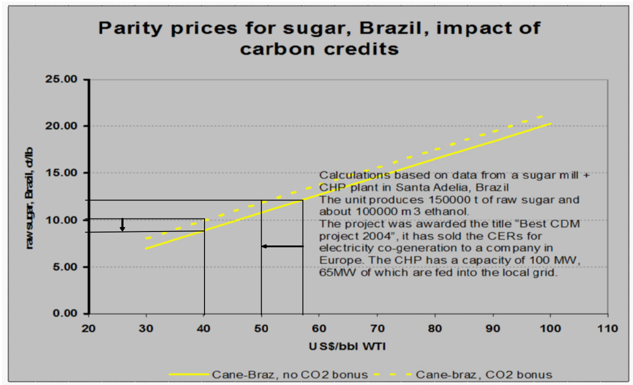


Figure 6: Floor and ceiling price effect for Cassava, mega plant



... there is no complete market integration in practice ...
In practice, however, demand for biofuels is not driven by infinitely large demand. There are numerous constraints that limit the ability of the biofuel sector to reap the full demand potential, at least in the short run. For transportation fuels, availability for the final consumer and thus demand is circumscribed by bottlenecks in the distribution (lack of petrol stations), technical problems in transportation and blending systems (no pipeline transportation for ethanol due to corrosion problems), insufficient conversion capacities, delays in engine adjustments and development, and many more. In short, the entire "field-to-wheel" system is not yet fully developed for biofuels. For heating fuels, bottlenecks include logistical problems within households, lack of storage capacity given the much higher space requirements and the lower energy density of biofuels, unresolved emission problems (micro-particulates, NOx, CO, etc.), etc.

... except for cane-based ethanol in the Brazilian petrol market.

While most bioenergy markets are still in their infancy, there are a few that are already largely developed and integrated. The Brazilian sugar/ethanol market is probably the most developed and integrated as well as the most profitable one. Market integration is characterised by: (i) a high market penetration for cars that can run on ethanol or any blend of ethanol and petrol; (ii) a country-wide system of petrol stations that offer ethanol; (iii) a growing share of sugar mills that can flexibly switch between sugar and ethanol production; (iv) a small but also rising share of specialised ethanol plants; (v) high-tech conversion and energy production systems, e.g. an integrated energy production system with a growing share of combined heat power plants and electricity co-generation.

The cumulative experience over the last 30 years of cane-based ethanol production has resulted in a sharp decline in production costs (see Goldemberg, et al 2004 for details). The integrated cane-based ethanol/electricity co-generation system in Brazilbecomes a competitive energy provider at crude oil prices of about US$35/bbl. At this level, Brazilian sugar millers can produce ethanol cum electricity without subsidies. This also means that as of this threshold, prices for sugar should move *in sync* with petrol prices, and if markets are fully integrated, the co-movement of sugar and petrol prices should even hold for rather short-term changes. Figure 4 one depicts this co-movement of sugar and oil prices. It shows that (i): demand for ethanol has created a floor price for sugar at about US$35/bbl. Oil prices above US$35/bbl make cane-bioenergy (ethanol and electricity) competitive for the energy market and create a co-movement of energy and sugar prices. At (and above) this price level, a sugar/ethanol producer in Brazil will sell sugar only for a price that is at (and above) the energy price equivalent[126]. (ii) the co-movement of sugar and oil prices is strong, particularly over weeks and months but often even on a daily basis.

126 A price of US$35/bbl corresponds to about USc7/lb for raw sugar

Higher use of cane for ethanol production reduces sugar availabilities for exports onto the world market (Figure A2) and these sugar exports in turn lift international sugar prices. The net result is a close link between energy prices (both for ethanol and crude oil) and sugar prices, i.e. that sugar prices closely track oil prices (Figure 4).

How does the energy-agriculture price transmission work in a fully integrated biofuel market?

Full flexibility on both the demand and the supply side ensure the tight price link in practice: On the demand side, the rapidly growing share of flex-fuel vehicles (FFVs)[127] i.e. cars that can run on gasoline and any blend of hydrous or anhydrous ethanol up to 85 percent, allows consumers to shift almost instantaneously between the two energy alternatives (ethanol and petrol). By the end of 2005, almost 900,000 FFVs had already been sold. The share of these vehicles in new car registrations is expected to rise to 80% in 2006 and several car manufacturers have announced that in future they will only be producing FFVs (F.O. Licht, 2006). With the rapid increase in FFV sales, the share of ethanol in the Otto fuel market increased to 40% in by the end of 2005 (F.O. Licht, 2006).

On the supply side, the growing share of sugar mills that can flexibly shift between sugar and ethanol allows producers to switch almost instantaneously between sugar and ethanol production[128]. As Brazil is not only the second-largest producer of sugar but also the by far the most important exporter, these shifts between sugar and ethanol determine the availability of sugar on the world markets and thus world market prices for sugar[129]. In short, the consumers ensure the link between oil and ethanol, the producers between ethanol and sugar prices; together they create a strong link between oil and sugar prices (Figure 4). (iii) However, the high and rising flexibility does not exclude that prices for sugar over- or undershoot their energy parity price levels in the short run. But the high flexibility on both sides and an increasing awareness in the financial industry of the tight link ensures that the two prices move quickly back to the fundamental parity price relationships.

127 The share of FFV in new car registrations in Brazil reached 34% in December 2005, (Sillas 2005) but increased to 80% by the end of 2006 (F.O. Licht).

128 There is full flexibility at the margin but not full flexibility for the average of cane processed by Brazil's sugar mills. Most mills are able to make a maximum of about 55% of one product and 45% of the other. In the early weeks of a typical harvest and before the flow of cane has reached its peak, most mills tend to make more ethanol than sugar. "*With alcohol stocks remaining low, the product is usually more attractive than sugar. The characteristics of cane which matures early in the harvest also make it more suitable for distilling into ethanol than refining into sugar. However, once harvesting has reached its mid-year peak and mills are working at full capacity, they have to make a similar amount of each product in order to keep pace with the flow of cane reaching them. It is only when the flow of cane slows towards the end of the harvest that mills can really choose whether to make more sugar or alcohol with relative prices and apparent prospects of each product at that time playing a key role*" (F.O. Licht, 2006).

129 The close link between sugar prices and ethanol prices are corroborated by the strong correlation between Brazil's sugar exports and ethanol prices.

Econometrically, this co-movement is corroborated when a co-integration regression (more precisely "threshold co-integration") of the two series is undertaken. It can be shown that the price for sugar (Nymex, contract No 11) and oil (WTI, spot) are co-integrated with a threshold of about 35US$/bbl.

No other country and production system has a bioenergy market with the same level of market integration. There are, however, a number of markets where market integration and thus the price link has become increasingly tight. These include the wood pellets market and to a lesser extent the wood chips market in Austria, the prices for both have been following with a growing degree of correlation the prices for heating fuel in 2006 and 2007. A low level of market integration is not a phenomenon that is limited to the bioenergy segment of the energy markets. It also applies to the gas sector both vis-à-vis the oil market and for the gas market across continents. The lack of market integration between the European and the US gas market is largely a reflection of physical market separation, as gas can only be economically shipped in liquid form. The growing importance of gas liquidification and thus of improved transportation options is likely to bring these markets closer together and their price movements more into sync.

Fossil fuel prices also create a ceiling for agricultural prices

Energy prices not only can create a lower limit for agricultural prices, they can also create an upper boundary. In the long run, agricultural prices will not rise faster than energy prices. If they do, and irrespective of their doing so in the short run, agricultural feedstocks price themselves out of the energy market. Floor and ceiling prices together can thus create a price corridor for agricultural products, in which price fluctuations are (co-)determined by their energy equivalents and the current energy price. Figure 6 shows the ceiling price that can be paid by a cassava-based ethanol plant in Thailand. If cassava prices move above 1200 baht/t as they did in the late 1990s, only very high oil prices of US$70/bbl and above would keep cassava in the ethanol market. If cassava prices rise above this level, the feedstock loses its competitiveness in the bioenergy market, demand for it falls or ceases altogether and prices decline again. Figure 7 illustrates how additional payments/benefits (in this case through the "Clean Development Mechanism (CDM) of the Kyoto Protocol) can alter the parity price levels and affect the ceiling price effect.

The effect of a long-term price ceiling does not exclude short-term supply disruptions or speculative reasons creating short-term swings that exceed the parity price level. The very high sugar prices (which exceeded their parity price levels to oil by a margin of about 4ct/lb in late November 2006) are a case in point. The ceiling price effect has also become visible in other agricultural markets. In Germany for instance, higher maize prices have made maize too expensive a feedstock for biogas production and resulted in lower demand and a situation where half of the plantsare making losses on a total cost basis[130]. Similarly, lower oil prices and maize prices of US$4/bushel and more have squeezed the profit margins for maize-based ethanol production in the US which will, in the long run, create a ceiling price somewhere in the vicinity of US$5/bushel. At these and higher price levels, particularly older ethanol plants should become unprofitable and this would – barring major subsidies – reduce maize demand and thus put a lid on maize price increases. Again, this does not mean that maize prices cannot increase further in the short run. Should, as some observers[131] predict, US maize supplies become exhausted by June 2007, short-term price peaks of US$6-7/bushel are deemed possible. At these prices, however, a growing share of ethanol producers would not even meet variable costs[132], thus cease production in the short term and relieve upward price pressure in the US maize markets.

Price transmission from energy to agriculture: multiple channels and a growing number of agricultural markets/commodities

The price transmission from energy markets to agricultural markets takes place through a number of channels. *First*, there are direct, own price links on the supply side. When higher energy prices make an agricultural product competitive for the energy markets, the energy market sucks up agricultural feedstock and thus raises feedstock prices. The link weakens again when demand has driven prices up to a point where agricultural feedstocks become too expensive as a source of energy for the energy market. *Second*, there is an indirect price transmission through substitutes on the supply side. Higher price for a given product (e.g. sugar) create increasing competition with other agricultural crops, thus reducing the availability of these products on the markets and driving up their prices. In addition, rising energy prices increase the number and the quantities of agricultural feedstocks that are competitive for bioenergy and can therefore no longer be supplied to food and feed markets. For instance, the use of cassava in Thailand for bioethanol production will reduce the availability of this product for exports and thus support cereal prices both in Thailand and, because of lower cassava exports, elsewhere. Likewise, the expansion of palm oil production in Malaysia has already created competition for other plantation crops and has reduced rubber and cocoa production. *Third*, there is price transmission through the demand side. Higher oil prices have already increased prices for nylon and other synthetic fibres and thus indirectly increased buttressed prices for cotton. Likewise, higher oil prices raise the prices for synthetic rubber and thus will increase the competitiveness of natural rubber. This provides room for natural rubber prices to rise.

130 Based on a presentation by Dr Broderson, Managing Director, DLG, at the DKB-Eliteforum Landwirtschaft 2006, Schloß Liebenberg, Germany, November 2006.

131 Randy Schnepf, Congressional Research Service of the US, Presentation at the SAF, SAF-agriculteurs de France, Prospective PAC Agro ressources et Politique agricole commune, 8 rue d'Athènes 75 009 PARIS, 15 March 2007.

132 The short-term production criterion.

Differential price impacts across agricultural markets

The co-movement of prices, however, is not a universal feature across all agricultural markets. Prices will neither increase unabatedly (*open-ended*) nor *uniformly* across all food products. The ceiling price effect discussed above is crucial for understanding why an increased bioenergy use is unlikely to create *open-ended* food price increases and thus a global, long-term food security problem. Importantly, and as demonstrated above, food prices cannot rise faster than energy prices simply because they wouldthen lose their competitiveness in the energy market. The fact that there are different levels of competitiveness for individual feedstocks and that many feedstocks contain both energy and protein means that the price effect will not be *uniform*. In the long run and barring major policy distortions (subsidies, border measures, etc.), food products will only enter the bioenergy market if they are competitive feedstocks for conversion into fuel (heating or transportation). This means that feedstocks like sugar, cassava or palm oil could experience the strongest price rise, because they have the lowest break even points (Figure 5) and the highest level of competitiveness. The second reason for a non-uniform price increase is that the bioenergy demand is limited to the energy part of feedstocks and this selective demand creates a considerable amount of protein-rich by-products. This means that protein prices are likely to rise less rapidly than energy prices or could even fall in absolute terms. The importance of the selection of feedstocks and the impacts on energy versus protein prices is available from Table 1.

Table 2: Differential price effects of different bioenergy scenarios (Schmidhuber, 2005)

	An additional 10 million tonnes of ...				
	Sugar	Maize	Sugar and Maize	Soybeans and Maize	Sugar, Maize and Soybeans
Corresponding energy [biofuels]	0.195 EJ	0.087 EJ	0.282 EJ	0.167 EJ	0.349 EJ
Commodity	... used for biofuels would change international prices (percent) in the long-run by :				
Sugar	+9.8	+1.1	+11.3	+2.3	+13.8
Maize	+0.4	+2.8	+3.4	+4.0	+4.2
Vegetable oils	+0.3	+0.2	+0.2	+7.6	+7.8
Protein	+0.4	-1.2	-1.2	-8.1	-7.6
Wheat	+0.4	+0.6	+0.9	+1.8	+2.0
Rice	+0.5	+1.0	+1.2	+1.1	+1.4
Beef	+0.0	+0.2	+0.2	+0.4	+0.4
Poultry	+0.0	-0.4	-0.4	-2.1	-2.0

Source: @2030 simulation results

In general, prices for energy-rich crops (sugar, starch-rich crops or woody biomass) stand to benefit from the added energy demand, while those for protein-rich commodities and those for by-products of the bioenergy conversion process are likely to decline. Such negative price impacts have already been noticeable for some by-products such as glycerine, DDGS[133], corn gluten feed and soybean meal; Table 2 summarizes the impacts on international commodity prices for five different bioenergy scenarios. Price changes relate to long-term price changes in real terms relative to a scenario without agricultural feedstocks used for bioenergy.

The results from model-based simulations suggest that prices for protein may decline not only relative to energy but also in absolute terms. As long as biofuels are produced from feedstocks that are providing energy without simultaneously creating protein-rich by-products (sugar cane, sugar beets, palm oil), downward pressure on protein prices will predominantly be relative to energy prices. Protein prices may increase slightly in absolute terms, as higher energy prices in feed rations would also result in a rise in protein prices, as the energy content of protein feedstuffs would substitute for some of the energy content in energy feedstuffs. At the same time, competition for acreage on the supply side should reduce acreage for protein crops which should also support protein prices. The basic idea of this outcome is depicted by column 1 of Table 2 where it is assumed that a limited amount of sugar (10 million tonnes of sugar in raw sugar equivalents) is absorbed by the biofuels market. In this case, the prices for protein rise, albeit in a very marginal way.

Model results also suggest that if biofuels are produced from feedstocks with high protein contents (oilseeds, notably soybeans, but also cereals), the downward pressure on protein prices is likely to be substantial. As expected the extent of the downward pressure strongly depends on the protein content of the feedstock. It is likely to be particularly pronounced in the case of biodiesel production from soybeans, where, for every litre of biodiesel, 4 kg of soybean meal will have to be absorbed by the market. In fact, soybeans have been the most important feedstock for biodiesel in the US. The results of model simulations in Table 2 suggest that the price effect can be noticeable. For every additional 10 million tonnes of soybeans combined with every extra 10 million tonnes of maize, protein prices would fall by 8%. Also derived products which require large quantities of protein feed such as poultry meat would experience a mild downward pressure on prices (2%).

There are, however, reasons to assume that this downward pressure on protein prices as well as the upward pressure on energy prices are unlikely to increase proportionally with higher quantities of the feedstocks used for bioenergy. For one, protein feedstuffs for animal feed rations also contain energy and the cheaper energy

133 The wet milling process renders for a tonne of maize used to produce ethanol a total of xx kg of CGM and xx kg of CGF. Alternatively, the dry milling renders 321 kg of Distillers Dried Grains Soluble (DDGS). CGM and CGF have a protein content of 60% and 21% respectively, and a protein content of about 75 MJ ME, i.e. somewhat less than maize but somewhat more that barley. DDGS on the other hand has a protein content of 27%, 11% fat and 9% fibre. In either case, these by-products are suitable substitutes for traditional protein-rich feedstuffs like soybean meal, even though their high phosphorous and crude fibre contents can put limits on their maximum suitable shares in the feed rations. These limits depend on the type of livestock, and are relatively low for non-ruminants and but higher for ruminants. (Percentages according to K. Davis, 2001),
http://www.distillersgrains.org/files/grains/K.Davis--Dry&WetMillProcessing.pdf

in the feed proteins will start to replace the energy from the increasingly expensive energy feedstuffs (within the relevant physiological limits). This effect has already been noted within the current, first generation use of bioenergy crops. For another, a growing shift towards the second generation of bioenergy feedstocks will further strengthen the co-movement in protein and energy prices. The application of second-generation bioenergy technologies means that the entire crop will be used to produce bioenergy, in contrast with the present practice of utilizing only a (potentially small) part of the feedstock (energy) while the protein-rich rest is returned to agricultural markets. Both, the feed effect as well as the shift towards second-generation bioenergy technologies will stop protein prices from falling and energy prices from rising so that they move again in sync (Schmidhuber, 2005).

The third factor that can have an important effect on relative prices can emerge from support and protection policies. Subsidies and tariffs are important reasons today why cereals are used in the US and in Europe as feedstocks in the bioethanol industries of these countries (some of the most important trade barriers are illustrated in Figure A4, Annex). Whether protection and subsidies could be justified on grounds of energy security, infant industry protection, or environmental benefits is a debatable issue. For the analysis of price effects on agricultural markets it should suffice to note that these tariffs keep prices for feedstocks higher than they would otherwise be and thus increase, directly or indirectly, prices for food with consequent effects on food security. The next and final section of this paper will examine how the price effects (floor price effect, ceiling price effect and differential price changes) discussed in section 4 could affect food security. The price impacts on the various dimensions of food security, i.e. food availability, access to food, food utilization and stability will be discussed separately.

Impacts on Food Security

The FAO defines food security as a "situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (FAO, 2002a). This definition comprises four key dimensions of food supplies: *availability*, *stability, access and utilization.* The first dimension relates to the *availability* of sufficient food, i.e. to the overall ability of the agricultural system to meet food demand. Its sub-dimensions include the agro-ecological fundamentals of crop and livestock production, as well as the entire range of socio-economic and cultural factors that determine where and how farmers perform in response to markets. The second dimension, *stability*, relates to individuals who are at high risk of temporarily or permanently losing their access to the resources needed to consume adequate food. This is either because these individuals cannot insure *ex ante* against income shocks or because they lack enough "reserves" to smooth consumption *ex post* or both. The third dimension, *access*, covers access by individuals to adequate resources (entitlements) to acquire appropriate foods for a nutritious diet. Entitlements are defined as the set of all those commodity bundles over which a person can establish command given the legal, political, economic and social arrangements of the community of which he or she is a member. Thus a key element is the purchasing power of consumers and the evolution of real incomes and food prices (Schmidhuber and Tubiello, 2007). However, these resources need not be exclusively monetary but may also include traditional rights e.g. to a share of common resources. Finally, *utilization* encompasses all food safety and quality aspects of nutrition; its sub-dimensions are therefore related to health, including the sanitary conditions across the entire food chain. It is not enough that someone is getting what appears to be an adequate quantity of food if that person is unable to make use of the food because he or she is falling sick.

Access to food

Agriculture is not only a source of the commodity food but, equally importantly, also a source of income. In a world where trade is possible at reasonably low cost, the crucial issue for food security is not whether food is "available", but whether the monetary and non-monetary resources at the disposal of the population are sufficient to allow everyone access to adequate quantities of food The key factors that affect changes in access to food are real incomes and real prices for food. A greater role of bioenergy has an effect on both.

Price effects: Higher prices will reduce the purchasing power of consumers with adverse effects on their food security. But as discussed prices will neither increase indefinitely nor uniformly across all food products. In the long run, neither food energy nor protein prices can rise faster than fuel energy prices in order for these feedstocks to remain competitive in the fuel energy market. This means that a global long-term food security problem due to increased bioenergy use would only be credible when and if real *energy* prices continue to rise. And even if they did, it would only reduce access to food and increase food insecurity if real food prices rose faster than real incomes.

In the short run and during first-generation bioenergy use, prices for energy will rise faster than prices for protein. In a food insecurity situation where protein rich feedstocks are in short supply, the extra amounts of protein at lower prices would attenuate the adverse impacts from higher food energy prices, and may even make food rations more nutritious and thus improve the quality of food. As discussed, generally lower protein prices would be the outcome of a bioenergy scenario that would be based on the use of protein-rich oilseeds such as soybeans or rapeseed perhaps combined with the use of cereals such as maize or wheat as feedstocks for ethanol production. As also discussed, while these feedstocks indeed play an important role today, their low energy efficiency and their low carbon sequestration effects suggest that they will give way to more efficient converters of sunlight such as sugar cane or ligno-cellulosic feedstocks such as straw, miscanthus, poplar, or willow. In the long run, it is also unlikely that the wedge between protein and energy prices will continue to increase.[134]

Income effects: An increased use of bioenergy is likely to affect not only prices and price patterns but also levels and the distribution of incomes, particularly in developing countries. For farmers, bioenergy should boost their overall revenues by raising both the prices they fetch for their products and the volume of products that they can sell on the markets. The price effect was discussed above. The positive volume effect is due to the fact that bioenergy makes certain farm products such as straw or crop residues -- for which there is currently no market other than bioenergy -- marketable products. A higher use of these products means that farmers may also face higher prices for some of their inputs and they may need to buy inputs like feedstuffs which where previously produced on the farm. In the long run, they may also face higher wages if and where bioenergy boosts overall rural incomes. They may also face higher resource costs, notably higher land prices, as higher price for agriculture tend to capitalise on these scarce resources. Overall and notwithstanding the long-term adjustment processes in costs for land and labour, the positive revenue effect will exceed the costs and increase net farm incomes. Higher wages in rural areas and more employment effects should also increased overall rural incomes (trickle-down effect). The net effect on incomes in rural areas in general and in agricultural incomes in particular should thus be positive. And this also holds for access to food and food security in rural areas, and thus for 70 percent of all poor and undernourished, globally. The income effects of an increased use of bioenergy will also depend on the type of bioenergy with respect to factor demand. Where bioenergy is labour- intensive, factor incomes from cheap labour could help engender higher incomes for the poor. Conversely, where bioenergy is capital-intensive and labour-saving, impacts on incomes and thus access to food could be negative. Particularly hard hit will be land-less rural households that are both net buyers of both food and energy, particularly if they fail to benefit from the macro-economic benefits that bioenergy can bring about (higher employment rates and higher wages). The exact effects of course require further empirical analysis.

While many rural areas stand to benefit, urban households will face higher prices for food. Important here is to recall that food prices and energy prices rise in tandem and that the strength of the link between the two increases with rising energy prices. For net buyers of food and energy, this would be particularly negative. At the household level, a poor urban household with a high expenditure share on food and energy would be particularly hard-hit. What types of households stand to benefit or lose from the parallel increase of food and energy prices needs to be examined empirically. At the country level, a first empirical analysis has already been undertaken. The results are summarized in Figure 9a-d. These 4 charts show countries

134 For the interpretation of these price effects it is important to bear in mind that they reflect changes at the margin. Higher use may not simply have a proportionally higher price effect.

with less than US$5000 GDP per capita sorted under four rubrics according to their net trade positions for food and energy imports. The graphs illustrate the per capita net-trade positions in nominal US Dollars of 2004 at different levels of oil prices, ranging from US$30/bbl to US$60/bbl. The energy imports include all forms of energy (oil, coal, gas, electricity). For the price changes in the energy sector it is assumed that the non-oil forms of energy increase in sync with oil prices. The revenues from agricultural exports refer to all agricultural products; the price links are endogenous and model-based. The strength of the link increases in a more than linear manner. This is due to the fact that higher energy prices make a growing number of commodities competitive for the energy market, and thus lifts their price with energy prices. It the long run, higher levels of energy prices will also provide incentives for bioenergy investments and thus lead to a higher degree of market integration. Another consequence will be a co-movement of energy and agricultural prices for more products and in a firmer manner for each product.

The results of the analysis make it possible to categorise countries under four principal rubrics. Countries that are importers of agriculture and energy are in a lose-lose situation as they face higher current account deficits from both product rubrics and the deficit is likely to accelerate with rising energy prices. As discussed below, within this lose-lose rubric, two cases are to be distinguished. First, countries which can pass on the higher import expenditures for food and energy to value-added export products; and second, countries which import food and energy without being able to pass the extra costs onto their export sectors. In contrast, the positive extremes are countries that are traditional net exporters of both food and energy; these countries stand to benefit from price increases of both product categories and the increases in total current account surpluses are more than linear relative to the increases in oil price. Indonesia or Malaysia fall under this win/win rubric. And finally there are countries that export either food or energy and they tend to win or lose depending on the relative size of the food or energy exports and imports. They are in the upper left and lower left quadrant and are characterised as win/lose or lose/win cases.

The discussion of the results in the context of food security is limited to the lower left quadrant, i.e. the net importers of both food and energy. These are the countries that will experience the strongest negative effects on their current account as they face both higher expenditures for food *and* energy; and, as explained, the negative current account effect will accelerate as the link between food and energy prices get tighter as energy prices rise. These countries are likely to face a lose/lose situation not only for their current account but also as far as their food security situation is concerned.

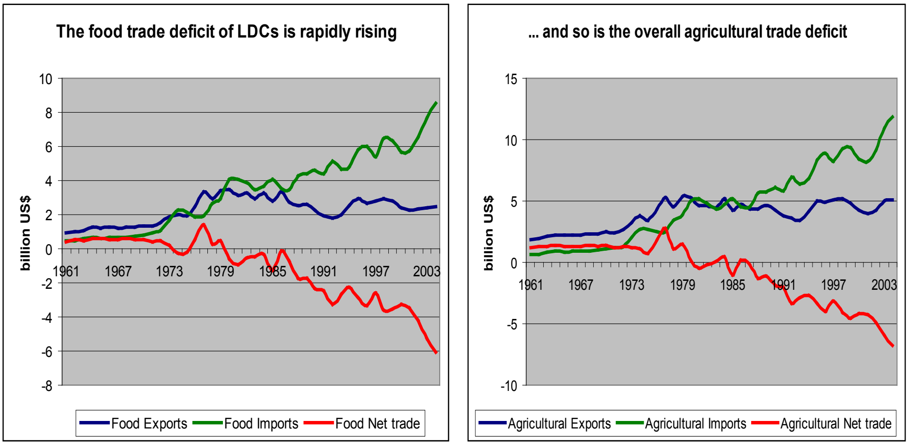
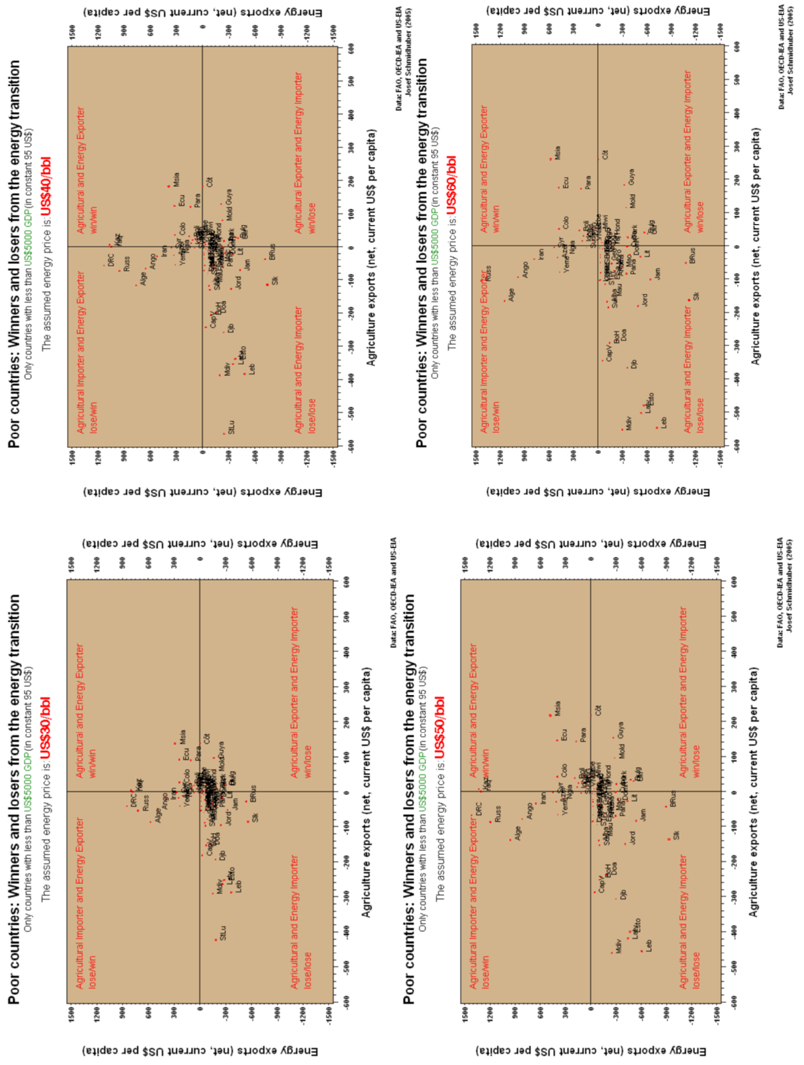


Figure 8a/b: Food and agricultural trade deficits of LDCs, 1961-2004, Source FAOSTAT

However, as for individual households, the impacts of higher food and energy prices will not be uniform across all countries in the lose/lose category. While all countries will experience a similar negative effect on their import expenditures, there are considerable differences with respect to their ability to pass these prices onto their exports and thus increase export revenues. Countries like the Maldives or many of the Caribbean countries (St. Lucia, Jamaica) should be able to pass at least a part of the input price increases onto their exports (tourism). At least in the long run, their higher food and energy import expenditures should translate into higher export revenues. This is particularly so, where export demand for tourism is rather inelastic, i.e. where tourists continue to spend their holidays in their favourite spots even if prices have increased. The Maldives could be a case in point.

But there are also countries where the possibility of passing higher import costs onto exports does not exist, or does so to a much lower extent. These are countries like Jordan, Lebanon, etc., which would indeed face a double blow on their trade balance. Whether and to what extent this translates into a food security problem depends of course on the overall income levels in these countries. Overall, the poorest of the poor may be particularly hard hit. Most LDCs are both net importers of food (43 of 52 in 2002/04), net importers of agricultural products in general (38 of 52 in 2002/04) and overall they have considerable and rapidly growing multi-billion trade deficits for both food (US$6 billion) and agriculture (US$6.9 billion, see Figure 8a/b). As they are also the countries with the lowest level of GDP, the adverse effect from higher energy and agricultural imports relative to national incomes is likely to be particularly strong. How strong this effect is in practice will depend on the possibilities of individual countries to substitute for energy and agricultural imports or to pass higher import prices onto value-added exports.



Figures 9a-d: Impacts of higher energy prices on net trade values in energy and agriculture

Food availability

Food availability is the net effect of changes in production, net trade and stocks[1356]. The analysis here will focus on production and trade aspects, as availabilities from stocks do not matter in the long run, notwithstanding their crucial role for short-run food supplies.

In general, higher use of agricultural produce for non-food purposes should lower

135 [16] Food availability=food production + net trade (imports-exports) – stock changes defined as (ending stocks-beginning stocks)

domestic food availability. The extent of lower food production would, however, depend on the type of feedstock used to produce bioenergy. Where bioenergy production is based on agricultural by-products (straw, molasses, crop residues, cow dung, etc.) or an increased use of forestry products and by-products (wood chips, saw dust, etc.) that have been used for other industrial purposes (e.g. the paper and pulp industry) the impact on domestic food availability is likely to be small. This is the case for traditional bioenergy use in developing countries, which was based on by-products such as straw, crop residues or dung and could be the case for second-generation bioenergy which is likely to be based on ligno-cellulosic feedstocks such as wood or straw. The current, first-generation bioenergy feedstocks by contrast are largely based on food commodities which indeed compete either directly with food on the utilization side and indirectly on the production side for the resources needed (land, water, labour, capital) to produce food.

Higher domestic production of non-food products affects availability from trade, both directly and indirectly. Directly, as higher levels of non-food production (wood, etc.) are likely to lower the availability of food products for exports. Indirectly, as higher non-food exports could increase trade revenues and thus increase the purchasing power needed for food imports. This indirect effect would be particularly pronounced if and when the employment and income effect of a booming domestic bioenergy industry raises the purchasing power of people with low purchasing power and low food consumption levels. In this case, higher import availability would simply be a manifestation of enhanced access. As noted before, whether more food becomes available will therefore crucially depend on the distribution of the additional incomes generated by a burgeoning bioenergy industry.

Stability of food supplies

The stability element of food security relates to the risk of losing temporarily or permanently access to the resources needed to consume adequate food. While this risk has numerous components, important here is the risk that arises from possible swings in food prices that are pronounced enough to price poorer and food insecure segments of a population out of the food market. The basic question therefore is whether the rising demand for bioenergy makes agricultural prices more or less volatile. The impacts on price variability work through numerous channels and depend on many factors and a quantitative answer would have to be model-based. Without any quantitative results, this paper can only discuss some of the principal issues.

A priori, a rising non-food demand should reduce the size of the food market and make this smaller market more susceptible to exogenous shocks. Fewer producers would make supply less elastic and thus less able to compensate for such a shock. What is more, demand for energy could be very inelastic in the short run, particularly in rich industrial countries. This could mean that energy consumers in rich countries price food consumers in poorer countries out of the food market. However, there is also reason to assume that the expectations of a marked increase in price variability may not be justified and that prices may even be less variable in an agricultural market with higher bioenergy use. First, and as discussed in section 3 of this paper, the overall energy market will not only create a floor price for agricultural produce but also a ceiling price. This ceiling price effect is due to the need for agricultural produce to stay below the energy price equivalent in order to remain competitive. This should put a cap on price hikes particularly in the long run. There are also reasons to assume that this very mechanism will even be effective in the short(er) run, particularly if prices increase in a pronounced way. The main reason for the limits on short-run price peaks is that feedstocks account for a large share of total costs and this share of course rises further if feedstock costs increase. In large ethanol production plants, for instance, feedstock costs can account for about 70-80% of total costs. This means that the short and long-term production criterion for profitability in such plants will be close to each other and that they will cease converting food into bioenergy altogether when feedstock prices become too expensive. In other words, when variable costs cannot be covered, plants will stop producing in the short run and thus help stabilise prices. The importance of feedstock costs is illustrated in Table 3 where simulations for two cassava-based ethanol plants with different feedstock prices and different plant sizes are depicted.

Table 3: Impacts of size of the processing plant and feedstock costs on the share between fixed costs and variable costs (source: own calculations based on project proposals)

Feedstock price for cassava In baht/t farm gate	Ethanol plant capacity	
	200,000[1] l/d (1,300t cassava/d)	2,000,000[2] l/d (12,800 t cassava/d)
	share of capital costs %	
713	29	21
1000	23	17
1500	17	12

1.) This plant will be located in the Chok Chai district of Nakhon Ratchasima, Thailand's main cassava-producing province. It is a joint venture of the Agricultural Co-operative Federation of Thailand and O.C.T. Land & Energy L.C., USA. The former is 4000 member farm co-operative and will hold 60% of the registered capital, the latter is an affiliate of O.C.T. Fiberglass Products, based in Wichita, Kansas and will hold 40% of the capital.

2. A feasibility study endorsed by Thai Oil and "strategic partners" found an ethanol plant of this size appropriate and necessary to match the company's fossil fuel refinery capacity and its blending needs for gasohol production. The investment needs have been pegged at US$150-250 million, daily output would be about 1.5-2 million l. It should be noted that the plant would consume, at an extraction rate of 167 l ethanol/ cassava a total amount of about 4.3 million tonnes of cassava per annum. This is about 25% of total cassava production (2000-04 average) and equivalent to the entire output of the Nakhon Ratchasima district, Thailand's main cassava producing area. It is interesting to note that this investment project has not been implemented but is likely to be substituted by three smaller cassava-based ethanol plants.

Another important factor that affects the magnitude of possible price swings is the extent of short-term substitutability in using feedstocks for food and non-food uses. High substitutability between food and non-food markets would enlarge the overall market volume and make prices c.p. less variable[136]. Brazil's sugar-based ethanol production is a case in point. Given the high market integration of this market and its significant size both in domestic energy and international sugar markets, the non-food use of sugar works like a giant buffer stock for the sugar market that releases sugar on the market when it becomes too expensive for ethanol production and sucks it up when sugar is too cheap and it is more profitable to produce bioenergy out of the same feedstock. It can already be shown that not only the price levels of sugar but also the variability of the sugar prices follows closely the variability of energy prices; with the growing integration of the sugar-ethanol market, magnitude and frequency of sugar price variations closely trace those in crude oil.

The high degree of integration in the sugar market is however not (yet) characteristic of other agricultural feedstock markets. In most bioenergy markets substitutability is still low and rising utilization of agricultural feedstocks for bioenergy eats into the volumes of the corresponding food markets. This is particularly the case for many perennial crops (miscanthus, poplar, willow, etc.) where the limited or completely missing substitutability in conjunction with a multi-year area allocation to non-food production makes it more difficult to shift from non-food use to food use and vice versa. A massive shift towards such feedstocks may make overall food markets more susceptible to price shocks.

The discussion of the impacts of an increased bioenergy use shows that higher agricultural and energy prices can provide both a threat to but also an important opportunity for improving food security. At the country level, the short-term *static* effects of the likely price changes for food and energy will crucially depend on the net trade position for these products and the ability of a country to pass on higher import prices to higher export values for derived products. Similarly, the effects at

136 The positive effects of an enlarged market on the stability of food prices are well researched for feed/food substitution. For details see e.g. FAO 2002b, online at: http://www.fao.org/docrep/004/y3557e/y3557e09.htm#o

the individual household level will depend on whether a household is a net buyer of these products. In general, it can be expected that individual households will either be in lose/lose or in a win/win situation. In general, rural households stand to benefit from both higher food prices and higher volumes of marketable produce which they can sell as bioenergy feedstocks. Urban households stand to lose as net buyers of both food and energy.

Policies can play an important role in mitigating the adverse effects on net buyers of food and energy and ensure that net sellers of both are able to fully harness the benefits. If and where the right policies are in place, the use and production of bioenergy affords rural areas the chance of a renaissance. It could help attract resources back into the countryside, mitigate urbanisation pressures and initiate a new rural dawn. But a lot more work is needed to analyse the appropriate companion policies in order to maximise the benefits for rural areas without causing massive problems for urban dwellers.

Summary, Conclusions and Outlook

The paper illustrated that energy markets are affecting agricultural markets and showed how. It briefly introduced nature and size of bioenergy potentials, examined price and market effects and discussed possible impacts on food security. The key findings and the main conclusions that follow from these findings can be summarized as follows:

1. Rising prices for fossil energy have made a growing number of agricultural feedstocks competitive feedstocks for the energy market. The extra demand has resulted in a global increase in agricultural commodity prices and the creation of a floor price effect for competitive feedstocks. The potential demand from the overall energy market is so large that it could result in a change in the overall paradigm of rapidly rising supply, increasingly saturated demand and falling real prices that has governed international agricultural markets over the last 40 years.
2. Higher real prices in agriculture will have numerous effects on rural areas, rural industries and food security. They create opportunities but also new challenges. Higher real prices can help revitalise rural areas and help reduce rural poverty. The combination of higher prices and more marketable produce will raise overall revenues for agricultural households. In tandem, rural, non-agricultural households could benefit from new employment opportunities and higher wages and thus higher incomes. The positive income effect should be particularly pronounced where bioenergy production and processing is labour-intensive and access to land is relatively equitable. Overall, the effect could be a global renaissance of agriculture and a revitalisation of rural areas.
3. A new bust after the first generation boom? While bioenergy has the potential to arrest the long-term downward trend in real prices for food and agriculture,

the effect may be limited in time and size and even a longer interruption in falling real prices may not mean a complete and permanent departure from the century-long downward trend. Episodes of rising real prices are not new and the long-term price decline over the last century was characterised by three periods or rising real prices (1900-18, 1933-48, 1973-80, 2000-2007). These periods lasted more than a decade and they were typically followed by pronounced bust cycles. High-price periods have led farmers to expand and intensify production, investments in land and technology and assume debt to an extent that has later proven unsustainable. What is more, much of the increased price was typically capitalized in the price of land rather than resulting in the longer-term profitability of farm operations. Higher values of collaterals, high short-term profitability followed by pronounced bust cycles led to large amounts of non-performing loans in agriculture and periods of widespread financial distress in farming. The US "farm crisis" of the 1980s is the most recent example (Gardner, 2003).

4. The current bioenergy-triggered boom could also be followed by a marked bust cycle. It could be ushered when the second generation biotech feedstocks enters the market on a large scale. Second-generation technologies could make many of the first generation feedstocks (i.e. the traditional agricultural and food commodities) unprofitable and result in a demand and price shift from food commodities to forest commodities. This shift could make not only first-generation feedstock production unprofitable, but the entire production chain as well because second-generation processing technologies will be entirely different. For food prices, this should result in less demand and possibly a return to falling real prices.
5. New support and protection policies in developed and developing countries for bioenergy, combined with new policy initiatives (CDM, JI, GEF, etc.) at the international level and a growing engagement by International Financial Institutions could add to possible over-investments in bioenergy production. The simultaneous commitment to investing in the same sector could result in a global "fallacy of composition" problem. As more efficient first-generation plants come on stream and as second-generation technologies enter the bioenergy markets, a lot of investments in first-generation bioenergy could turn sour or remain profitable only if real prices for fossil energy remain high and rising. The first signs of such problems are already visible in the low profitability of maize-based biogas production in Germany and of maize ethanol plants in the US given currently rising maize prices.
6. The growing dependence of agricultural prices on energy prices also means that there will be an endogenous cap on food price increases. In order to remain competitive for the energy market, agricultural feedstock prices cannot rise faster than energy prices in order to remain competitive as a source of energy. This creates an implicit ceiling price effect, which is given by the energy equivalent

of an agricultural feedstock. The ceiling price effect is crucial for understanding that agricultural prices and markets will not continue the recent boom sparked by the spike in oil prices but also to understand that concerns about a looming global neo-Malthusian scenario are unwarranted137. Only if energy prices continue to rise will agricultural prices follow. Overall, floor and ceiling price effects are creating a new equilibrium for an increasing number of agricultural commodity markets. With rising energy prices and a growing degree of market integration between energy and agricultural feedstock markets, both the levels and variability of agricultural commodities will increasingly be determined by those of energy prices.

7. The impact on food security needs to be analysed in the context not only of higher food prices and lower availability but also in terms of rising incomes for farmers and rural areas as well as changing price variability. A priori, competition with food production will result in lower availability and an increase in food expenditures for the poor. Particularly net buyers of both food and energy would suffer from the parallel increase in food and energy prices. As net buyers of food and energy, the poorest of the poor could be particularly hard hit. At the country level, many developing economies are currently facing a double burden on their current account balance through higher expenditures for food and energy imports. The same holds for individual households that are both net buyers of food and energy. However, many rural households stand to benefit both through higher prices for their produce and higher volumes of marketable production. As 70 percent of the poor live in rural areas, the overall net effect on food security could be positive. While rural households stand to benefit as sellers of food and energy, urban households stand to suffer from higher expenditures for both. Importantly, food expenditures rise more than linearly as the price link between energy and food prices tightens with rising energy prices. While the inter-country effects have been quantified for this paper, the intra-country effects would need to be gauged by a detailed analysis of household balance sheet effects.
8. One of the challenges for the orientation of development policy is to design and implement policy measures that help to ensure that the growing use of bioenergy is conducive to reducing poverty and hunger, i.e. that "bioenergy becomes pro-poor"; in theory, this will be the case, the closer the factor demand of bioenergy is complementary to the factor endowment of the poor; in general this is the case when bioenergy use and processing are labour-intensive, capital-saving, and technology-saving. Pro-poor policies would help to adapt bioenergy use and processing accordingly so that they are based on little capital and simple

137 The predictions of a massive dooms day scenario caused by an increase of use of agricultural commodities for biofuel are numerous and massive. For instance, BBC International quotes the Cuban Fidel Castro of claiming that the US ethanol programme alone will cause 3 billion deaths from hunger, i.e. half the world's population. http://news.bbc.co.uk/2/hi/americas/6505881.stm

technologies and abundant low-skilled labour. Pro-poor policies will also promote and foster access to technology and capital (e.g. through the CDM and CDM like mechanisms), provide access to land (land reform, etc.).

9. Functioning institutions can make an important contribution to making bioenergy pro-poor. Co-operatives for instance can bundle the interests of the poor, accumulate and attract capital for the necessary investments, organise feedstock supplies in large quantities and qualities and create a countervailing power to the high power concentration of firms operating in the energy market. While this paper did not explicitly discuss options, some of the examples used to assess the profitability of such co-operative operations have been presented (see e.g. Cassava-based ethanol production in the Chok Chai district of Nakhon Ratchasima).
10. FAO and other international organizations have an important role to play in providing information and analyses that help to create the basis for investments in bioenergy in developing countries. They may also have an even more important role in ensuring that the policy distortions of developed countries agricultural markets', which were slowly and painfully reduced in the 1990s, will not be re-introduced through the "bioenergy backdoor". Failure here would not only impede the development of the bioenergy income potentials in developing countries but also compound and prolong a possible bust period after the current boom cycle. A simple first step to level the bioenergy playing field would be a noticeable reduction in tariffs for biofuels in developed countries, noticeable for bioethanol. As depicted in Figure A4 (Annex), these entry hurdles in developed countries can be considerable.

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Annex

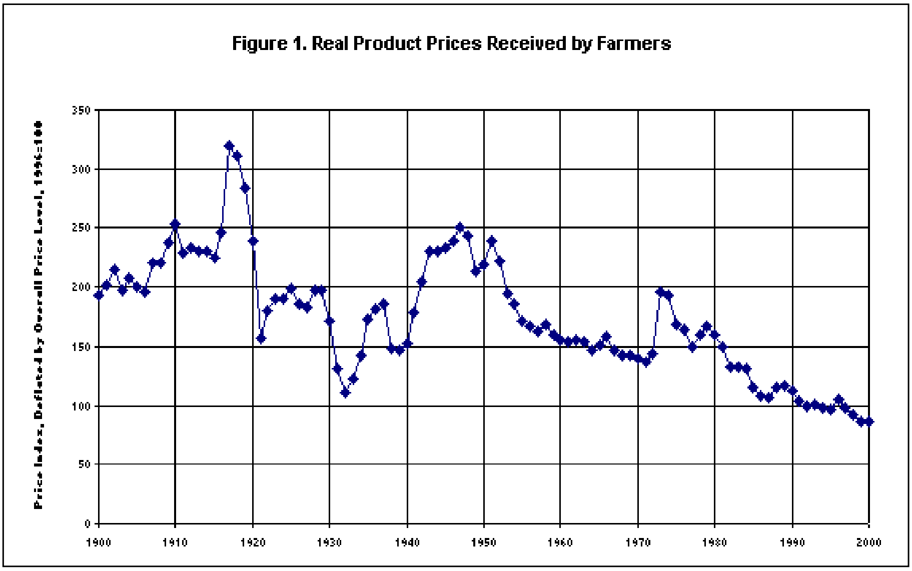

Figure A1: Long-term real prices for agriculture in the US, Source, Gardner 2003.

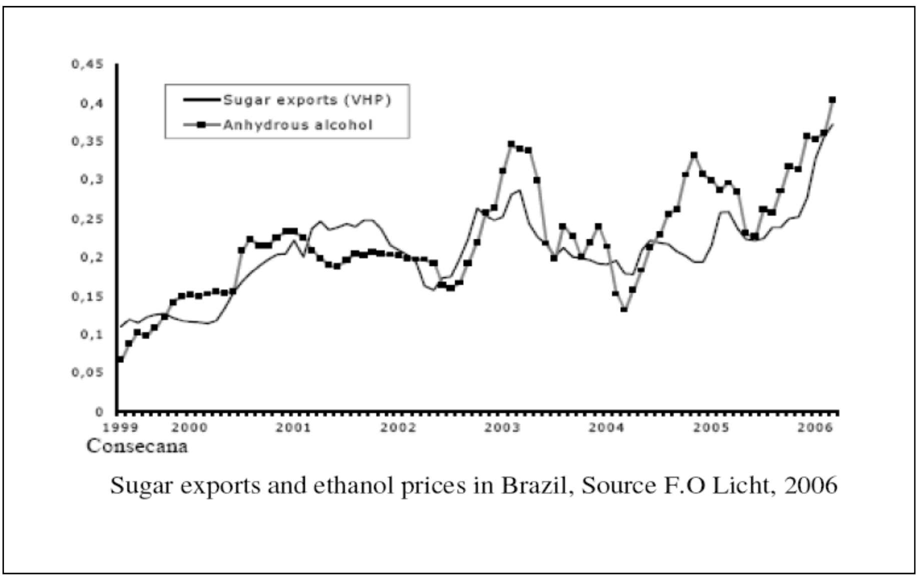

Figure A2: Ethanol prices track sugar exports in Brazil

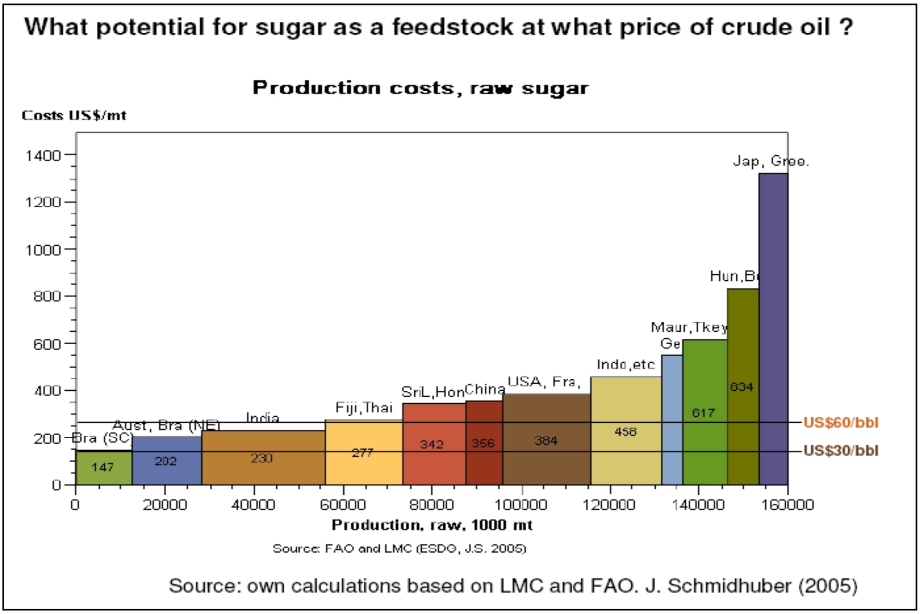

Figure A3: Supply curve of sugar and potentials for biofuels

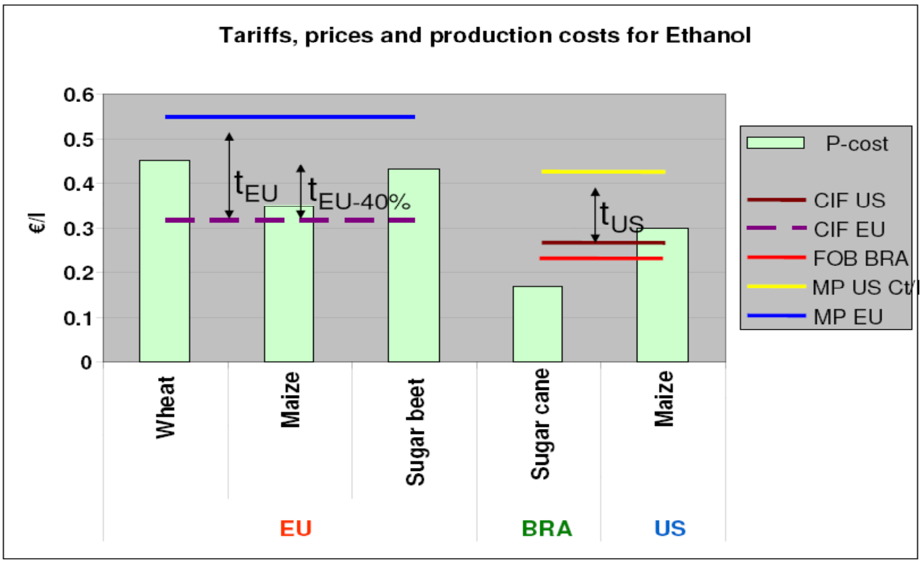

Figure A4: Tariffs and production costs for ethanol in the EU, Brazil and the US

Production Costs in the EU for Energy Crops Production in Different Scales

Håkan Rosenqvist, Lars J. Nilsson and Karin Ericsson

Introduction

Various assessments of the potential biomass supply show that dedicated energy crop plantations are necessary if bioenergy is to make a substantial contribution to the energy supply in Europe and elsewhere (Ericsson & Nilsson 2006; Berndes, Hoogwijk & van den Broek 2003). It is also clear that the cost of biomass accounts for a substantial part of the total production cost of bioenergy carriers such as electricity and transportation fuels. Understanding the character and weight of different cost components in energy crop production is therefore important when addressing issues concerning implementation strategies.

Energy crop production costs in Europe have been analysed in a number of studies, e.g. (VIEWLS 2005; Nikolaou, Remrova & Jeliazkov 2003). In this paper we present an analysis of energy crop production costs from the perspective of the farmer. We included overhead and brokerage costs, as well as the cost of risk, three cost items that are generally not included in other production cost assessments. We estimated the cost of land by using the opportunity cost based on grain production. The analysis was made for a number of promising energy crops on a regional level in Europe. The objectives of the study presented in this paper were to calculate indicative ranges of production costs for these crops and to identify and analyse the structure of production costs. The analysis was made for three cases, two of which refer to the knowledge and technical level of 2005, and one of which refers to that of 2020. Due to uncertainties concerning commercial yield levels for many energy crops and future costs of various production inputs, the aim was not to produce exact numbers but to explore cost structures and relative costs.

This study was conducted within the integrated project Renewable Fuels for Advanced Powertrains (RENEW) (2004-2007) and has after that also been developed in the EU project BIOPROS. One task within this project was to calculate the total cost of producing BTL (biomass-to-liquid) fuels, something which motivated the present study[138].

138 A more detailed report is available on the project website: http://www.renew-fuel.com/home.php

Scope and Time Frame

The geographical scope of this study is Europe, which was divided into six regions: Northern, Western, Eastern and Southern Europe, the Alps and the UK & Ireland. Nine promising energy crops were identified: willow, poplar, eucalyptus, reed canary grass (RCG), miscanthus, switch grass, hemp, triticale and sorghum. Each of these crops can be grown in at least one of the regions.

The economic analysis of these crops was carried out for three cases that are summarized in Table I. All costs in this paper are expressed in Euros at the price level of 2005.

Table I: Description of the three cases in terms of the assumed knowledge and technical level and the scale of cultivation.

Case	Knowledge & technical level	Cultivation area per region/country (ha)
1. Present situation	2005	10 000
2. Hypothetical scenario	2005	>100 000
3. 2020 scenario	2020	>100 000

Production Cost Components

In this analysis the energy crop production cost is divided into three main components:

- the cost of cultivation
- the cost of land
- the cost of risk

The cost of cultivation

The cost of cultivation mainly includes the cost of establishment, fertilization, harvest, field transports, road transports (30 km to gathering point), brokerage, weed control, administration, overhead and wind-up (when terminating the cultivation). Many of these cost items, e.g. establishment and fertilisation, include both labour and machinery costs.

The crops analysed in this paper are in different development stages in terms of plant breeding, availability of special machines and the organisation and existence of crop markets. Our qualitative judgement concerning the development level of each of the different energy crops is presented in Table II. Awareness of the status of development of the crop is important when making calculations for future scenarios. In this analysis we assumed that the less developed crops have greater potential for future cost reductions than do well developed crops. Firstly, we expect plant breeding to lead to faster yield increases for the less developed crops. Secondly, the transition from small to large scale cultivation is expected to reduce costs due to for example a high degree of coordination.

Table II: Assumed development levels and life span (years) of different energy crops.

Crop	Development level	Life span
Willow	Low	22
Poplar	Low	22
Eucalyptus	Low	22
Miscanthus	Low	21
RCG	Medium	10
Switch grass	Medium	10
Hemp	Medium	1
Triticale (whole crop)	Well	1
Sorghum (whole crop)	Well	1

The cost of land

There are different methods to estimate the cost of land. The cost can be a tenancy cost, the interest rate of purchased land or an opportunity cost. In this study we applied the opportunity cost. The other two options, which both relate to the price of land, were seen as less suitable options for these calculations. Firstly, the price of land usually reflects the marginal cost of the land and should therefore not be used as an average cost of land for a region. The farmer who places the highest bid gets to buy or rent the land. Secondly, the price of land is greatly influenced by agricultural subsidies, which we prefer to keep out of these calculations.

The cost of risk

Farmers often ascribe a higher *cost of risk* to less developed, perennial energy crops than to traditional, annual crops due to their limited knowledge and experience of growing these crops, and to the long-term commitment that these crops entail in terms of land use. The life spans of the different energy crops are shown in Table II. In order to compensate for the higher risk, farmers generally require a risk premium, i.e. higher economic margins, for perennial energy crops than for annual crops, in order to grow them. The size of the risk premium depends on the farmer's level of risk aversion, as well as on the level of expected or perceived risk in the investment. The risk premium has to be generally higher for short rotation coppices (SRC) than for perennial grasses. The estimates of the cost of risk in this study are based on our informed guess since there is no empirical basis for quantifying the cost.

Method

A method was developed for the purpose of making it possible to obtain comparable cost estimates for different crops in different regions. For each crop three types of calculations were made:

1) Base-case calculations,
2) Main calculations and
3) Scenario calculations

Base-case calculations

A so-called base-case calculation was made for each crop in which the costs of cultivation were calculated for a set of yields within the yield range of the crop under European conditions. The calculations were made using a model developed by Rosenqvist (1997). This model combines the present value method and the annuity method, thus making it possible to compare the economics of perennial and annual crops. The calculations were based on a discount rate of 6%. The assumed life spans of the crop cultivations are presented in Table III. The calculations refer to current (2005) knowledge and cultivation methods. Cost data for Northern Europe in 2005 was used in the base-case calculations for all crops, regardless of whether the crop can be grown in this region. The base-case calculations were carried out as a first step in the economic analysis in order to make the calculations for the different crops in a consistent way. Thanks to this consistency it is possible to compare the production costs of the different crops.

Main calculations

In the main calculations, energy crop production costs of the different regions were calculated. The calculations refer to current (2005) knowledge and cultivation methods and take regional differences in yield and cost levels into account.

The cost of cultivation for a crop in a particular region was established by multiplying the base-case cultivation cost pertaining to the yield level of the region by the cost level of that region. The cost level in each region was calculated based on regional prices of a number of key inputs that were used as cost indicators. The prices of these inputs were collected by project partners and included the prices of e.g. farm labour and fertilizers. When calculating the cost level, inputs were given the same weight as they have in cost distribution of willow production in Northern Europe. By limiting the data collection to a small number of clearly specified inputs, we reduced the workload for project partners and made the calculations more consistent. The cost levels in different regions were set in relation to the cost level in Northern Europe (the cost level of which was used in the base-case calculations). The cost level was estimated to be the highest in Northern Europe (1.0) and the lowest in Eastern Europe (0.41). The cost levels in the other regions were estimated to be: 0.94 (the UK and Ireland), 0.89 (W. Europe), 0.86 (the Alps) and 0.83 (S. Europe). Data on energy crop yields for the different regions were also collected. The yields presented in Table III reflect what can be achieved today in commercial cultivation assuming the crop is well managed (fertilized, but not irrigated). These yields are in general lower than those in optimized field trials.

Table III: Estimated energy crop yields for non-irrigated crops grown on soil of average quality in different regions and the relative yield increase for energy crops compared to cereal crops that were assumed for the 2020 scenario. The unit of the yields is tonnes of dry matter per hectare and year (tDM/ha/y) except for wheat and barley.

	Annual yields of 2005						Relative yield increase by 2020
Crop	N. Europe	UK/ Ireland	W. Europe	The Alps	S. Europe	E. Europe	%
Willow	9	13	10	10	-	9	+40
Poplar	9	13	10	10	-	9	+25
Eucalyptus	-	-	-	-	12	-	+25
Miscanthus	10	18	16	11	-	11	+60
RCG	7.5	-	-	-	-	7.5	+40
Switch grass		-	-	-	13	-	+40
Hemp	10	-	11	10	-	10	+25
Triticale (whole crop)	11	-	12	11	8.0	9	+5
Sorghum (whole crop)	-	-	10	-	-	-	+5
Barley (wet)	4.2	8.1	5.5	6.4	2.0	4.2	-
Winter wheat (wet)	6.2	10.2	7.9	6.0	2.0	5.5	-

The cost of land was estimated for each region as a cost range using the opportunity cost based on cereal cultivation. The cost of land at the low end of the cost range was defined as the net gross margin of cereal (50% spring barley and 50% winter wheat) production. This calculation was made from a long-term perspective including all costs at farm level. The cost of land at the high end of the cost range, on the other hand, was calculated from a short-term perspective and based on cultivation of winter wheat. In this calculation only 50% of the costs for workload, machinery and overhead were included in order to account for the fact that farmers generally have resources tied up in cereal production that maybe are too costly to be shifted to another activity in the short-term perspective.

The cost of risk for each crop was estimated based on our informed guess as there is no empirical basis for quantifying this cost. The cost of risk was assumed to be highest for the least developed crops. The cost of risk was assumed to be €0.9-1.1/GJ for SRC, €0.4-0.8/GJ for perennial grasses and €0.2/GJ for annual straw crops.

Scenario calculations

Based on the main calculations crop production costs for two scenarios were also calculated. The first hypothetical scenario (Case 2) is based on the cost and technical level of 2005, in combination with large-scale energy crop production. Because of the assumed large-scale cultivation, we assumed reductions in the costs of cultivation and risk for the less developed crops. An increased production volume will increase competition between companies involved in perennial energy crops, decrease the distance between fields containing these crops and decrease the costs of organisation, advising and brokerage. The fixed costs of special machinery will also decrease per hectare due to a higher degree of utilization of the machinery, increased competition between different contractors, and lower manufacturing costs for machinery due to a shift from single, custom-made machines to longer production series.

The second scenario (Case 3) is based on the cost and technical levels of 2020 in combination with large-scale production. By 2020 the cost levels in the different regions were assumed to have converged[139]. The cost reductions for this scenario were assumed to be larger than those for the first scenario. For example, the costs of risk were assumed to be halved, reaching €0.4/GJ for SRC. In addition, this scenario includes relative yield increases and a range of 25-60% for SRC and perennial grasses to cereal crops (Table II).

139 Price level differences within the EU are decreasing. During recent years price levels have increased faster in the new member states in Eastern Europe than in the old member states. Similar developments have previously been seen in Southern Europe. Price levels are unlikely to converge completely within the EU, but the differences are likely to be smaller in the future than they are today.

Results and Key Observations

Comparison between crops

Our results show that the analysed crops can be divided into three groups with regard to their production costs: (i) SRC crops, (ii) perennial grasses and (iii) annual straw crops. Our results concerning the energy crop production costs for the three most promising crops in each region are shown in Figure 1 (present conditions) and Figure 2 (2020).

The SRC crops, i.e. willow, poplar and eucalyptus, were estimated to have the lowest production costs for all three cases. The cost range is about €4-5/GJ under present conditions and about €3-4/GJ in the 2020 scenario assuming large-scale production. The relatively low costs in this group are due to the low *annualized* costs of harvest (which is done every third or fourth year) and establishment (which is done once during the 22-year life span of the plantation) (exemplified by willow in Figure 3). Also, the cost of handling wood chips from SRC is low and there is little need for storage.

The production costs of perennial grasses, i.e. miscanthus, RCG and switch grass, were estimated to be about €6-7/GJ under present conditions and €5-6/GJ for the 2020 scenario. These crops have low costs of establishment, but high costs of handling, including storing (exemplified by RCG in Figure 4).

The annual straw crops, which include triticale, hemp and sorghum, were estimated to have the highest production cost, about €6-8/GJ under present conditions, and to have small potential future cost reductions. The production costs of this group are higher due to annual costs for establishment and harvest and high costs for storing and handling of the crop.

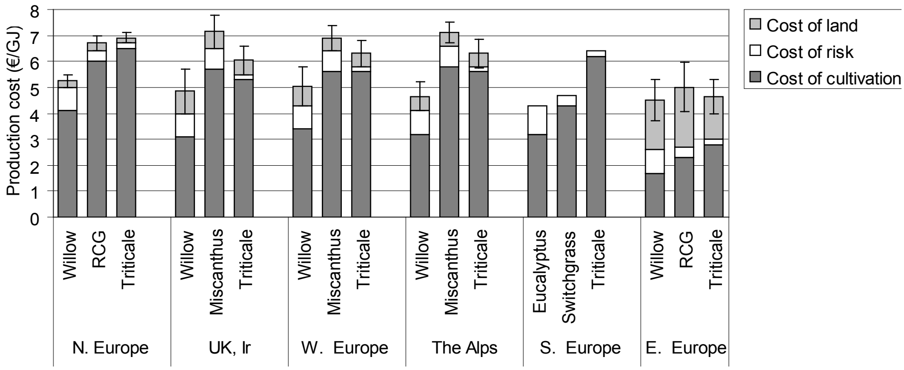

Figure 1: Energy crop production costs for the three most promising energy crops in each region under present conditions (Case 1). The error bars show the minimum and maximum costs of land.

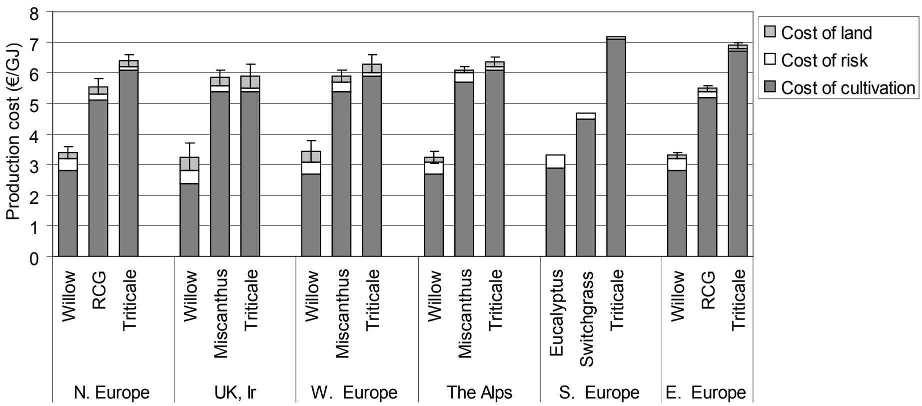

Figure 2: Energy crop production costs for the three most promising energy crops in each region for the scenario of 2020 assuming large-scale production (Case 3). The error bars show the minimum and maximum costs of land.

Regional comparison

Our results show that the energy crop production costs are somewhat higher in Northern Europe than in other regions under present conditions (Figure 1). The differences in costs between the regions are, however, rather modest as a result of using the opportunity cost to estimate the cost of land. Regions with generally high cost levels have relatively low costs of land. The cost of land being zero in Southern Europe can be explained by the low grain yields in this region. It is possible that the cost of land in this region should have been estimated using the opportunity cost based on another crop.

In the scenario for 2020 the differences in production costs between the regions are very small (Figure 2). The reason for this is the assumed convergence of cost levels between regions in Europe.

Case comparison

Our results for the 2020 scenario show a considerable decrease in production cost for the SRC crops. There is also a decrease in costs for the perennial grasses, but not as great as that for the SRC crops. The reduction in costs for the perennial grasses is smaller due to the difficulty in achieving further cost reductions in the handling of bales. It should be noted that for both the SRC and perennial grasses, large yield increases will be required in order to reach the production cost levels in the 2020 scenario. Due to the assumed convergence of cost levels in Europe, future cost reductions in Eastern Europe are relatively modest since the gains in overall productivity are offset by an increase in cost level.

Given our scenario assumptions, the distribution of costs in energy crop production differs between the three cases, especially for the SRC crops. Our results show that transportation and fertilizers will account for a larger proportion of the production costs in the future (Figures 3 and 4). In order to reduce the transportation costs logistic chains must be optimized further. Two ways to reduce the cost for fertilizers are to use sewage sludge or waste water as fertilizers. The use of energy crop plantations as vegetation filters, for the purification of waste water by nutrient removal, can be economically interesting for both farmers and operators of waste water treatment plants (Börjesson & Berndes 2006). In such an arrangement the farmer benefits from higher yields and lower costs of fertilizers. The yield increase is caused by both the fertilizing effect and the secured water supply. Lindroth and Båth (1999) have shown that water availability is often a factor limiting willow crop growth, thus making waste water irrigation particularly interesting for relatively dry areas. The use of sewage sludge (that meets the environmental requirements) can also be an economically attractive option for farmers and is used by many willow growing farmers in Sweden. Farmers that spread sewage sludge on their fields receive economic compensation from the waste water treatment plant and reduce their costs for fertilizers (Hasselgren 1998).

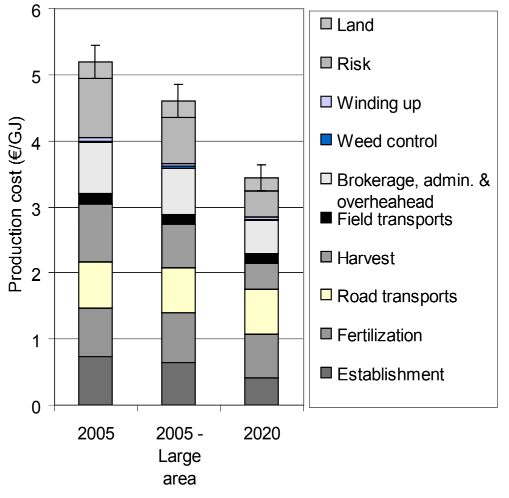

Figure 3: Breakdown of the production costs of SRC for the three cases: the example of willow cultivation in Northern Europe. The error bars show the minimum and maximum costs of land.

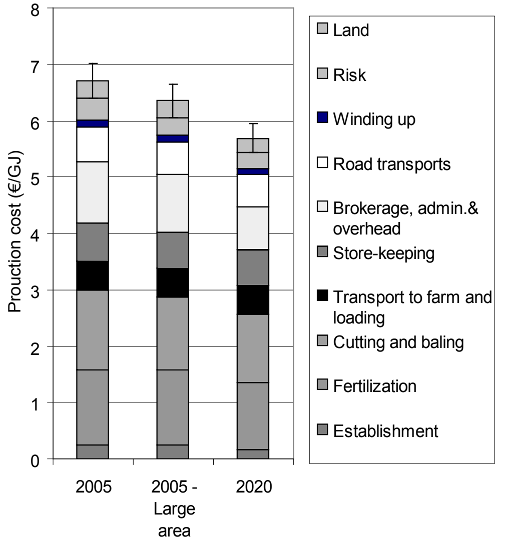

Figure 4: Breakdown of the production costs of a perennial grass for the three cases: the example of RCG cultivation in Northern Europe. The error bars show the minimum and maximum costs of land.

Discussion and Conclusions

This paper presents an analysis of the production cost of a number of energy crops. It should be noted that whether these crops will be adopted by farmers or not, does not depend only on the production cost per GJ, but on the relative viability of these crops and traditional crops such as cereals. Hence, future prices of grain and biomass will also play an important role as to if and where energy crops will be grown.

Our results show that energy crop production can be profitable in the short term in some conditions and assuming that biomass prices remain in the range of €4-5/GJ as in recent years. The energy crop production costs were estimated to be consistently lowest for the SRC crops and highest for annual straw crops. The production cost of the SRC crops was estimated to be about €4-5/GJ under present conditions. Due to the low level of development of these crops in terms of breeding and machinery, the potential for cost reduction was assumed to be large. As a result, the production cost for SRC was estimated to be reduced to €3-4/GJ by 2020. Hence, production costs are lowest for the energy crops that are associated with the highest cost of risk and the largest changes at farm level in terms of workload and machinery. Policy instruments supporting the development and adoption of these crops will be necessary.

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A Framework for Modeling Logical, Physical, and Geographic Dependencies between Critical Infrastructures

Nils Kalstad Svendsen, Stephen D. Wolthusen

Introduction

The security and reliability of energy supplies and transmission paths depends on a large number of factors. These include soft factors such as supplier policies and the political environment as well as maintenance of the infrastructure components and appropriate policies and procedures for handling any anomaly, but must necessarily also include consideration of factors such as sabotage or acts of terrorism. Moreover, the energy sector does not stand in isolation but is only one (albeit important) part of the interdependent critical infrastructure of modern industrial societies.

Critical infrastructures besides the energy sector include telecommunications, financial services, health care, public services, and transportation, although the number of sectors considered varies (Brömmelhörster, Fabry & Wirtz 2004; Marsh 1997) and are defined as services whose longer-term disruption would lead to major effects on the population including deleterious effects on health, loss of life, and severe economic damage. While the electric power grid spanning the European continent has been described as the most complex engineering system ever built, it is in fact only one component in an even larger system whose interactions can severely affect each other. This was made evident by the large-scale power failures experienced in August of 2003 in the northeastern U.S. and Canada (Hilt 2004) following a series of disruptions in the Ohio region and more recently by events in northern Germany that destabilized much of the European power grid in November 2006 (Bundesnetzagentur für Elektrizität…, 2007; E.ON Netz 2006). While such events are dramatic and widespread, they are also typically limited in duration and services are recovered quickly. However, this is not always the case and large parts of the mutually supporting infrastructure may be damaged or destroyed at the same time, e.g. by natural disasters such as storms, flooding, or earthquakes as was made particularly evident in the aftermath of the hurricanes Katrina and Rita along the coast of the Gulf of Mexico which eliminated virtually the entire critical infrastructure from telecommunications and energy to water supplies, medical and government services. At a smaller scale, the effects of longer-term failures were also made evident as a consequence of a loss of electric power over a period of six days in February of 2006 in Steigen, Norway, where a critical depletion of community resources occurred and a number of key services could no longer be maintained.

One aspect particularly worthy of consideration is that the interdependencies among infrastructure elements are often cyclical in nature and, moreover, that such interdependencies may both occur at large and unintuitive scales and can also form multiple interlocking cycles that operate at different time-scales. Owing to this, a failure in one infrastructure element may well lead to an inability to remedy this failure in a timely manner, thereby exacerbating and further escalating an infrastructure failure through cascading further failures.

The traditional approach to this type of problem (where amenable to technical solutions) has been to substantially over-engineer systems with redundancy and reserve capacities. However, this is increasingly insufficient for two reasons. First, with control and ownership of critical infrastructures increasingly in the private sector, the added cost of excess capacity and robustness beyond a demonstrated need (e.g. as stipulated in legal or regulatory requirements) becomes difficult to justify, resulting in only a selected subset of contingencies being considered. Moreover, it is to be observed that much of the cost of an infrastructure element's failure is externalized. While this may be irrelevant in case of government-owned and -controlled infrastructures, it limits the incentives of private infra-structure operators. The second reason to be considered is that most sizing and contingency planning is conducted using statistical failure and robustness models. Such models may consider cascading failures but will otherwise tend to treat failure causes as independent random variables. This, however, is insufficient; not only can events be coordinated in case of sabotage or acts of terrorism to maximize damage and confusion, but there may also exist hidden dependencies, particularly among different infrastructure types such that a causative event will result in simultaneous events whose cumulative effect is unanticipated.

The graph-based modeling approach reported in earlier research (Svendsen & Wolthusen 2007a, b, c, e) provides a mechanism for capturing and analyzing large-scale interdependencies together with dynamic effects such as time-dependent cyclical dependencies and resulting cascading failures. This, however, requires a considerable level of abstraction to maintain acceptable computational and spatial complexity and is focused solely on logical interdependencies. Research by the present authors has extended this model to also include geolocation and the consideration of geospatial relationships among infrastructure components in assessing risks and evaluating scenarios (Svendsen & Wolthusen 2007d; Wolthusen 2004; Wolthusen 2005).

As reported by Svendsen & Wolthusen (2007d), existing general geospatial models suitable for such cross-domain modeling (as opposed to e.g. detailed hydrological or atmospheric models used in flood and fire simulations) are limited in the buffering mechanisms that are offered, typically only resulting in circular buffers (in the two-dimensional case) and spherical buffering in three-dimensional cases without any underlying physical model. While this allows for interactive analysis based on expert assessments, it is clearly unsatisfactory for more detailed analysis.

In this paper we therefore provide a further refinement of the geospatial sub-model described earlier by incorporating abstract dynamic event models. These sub-models provide approximations of the event behavior with limited computational complexity and are therefore limited to an appreciable extent in their precision, but must still be limited to relatively small spatial volumes given the polynomially increasing number of interactions to be considered. However, despite these limitations the sub-models allow for a more ac-curate and semi-interactive analysis of a number of questions and scenarios such as the sizing of perimeters cleared of non-flammable materials and environmental influences on minimum response times for emergency responders in case of fire or the dynamic influences of terrain features on flooding patterns which otherwise would lead to surprises in coarser models omitting some terrain features or dynamic properties.

The remainder of this paper is therefore structured as follows: Section 2 provides a review of the terminology and model for the framework reported in earlier research with related work being discussed in section 3. The necessary steps for refining the model at a local level to include dynamic external events are then detailed in section 4 followed by a qualitative evaluation and discussion in section 5 and brief conclusions in section 6.

Background

This section summarizes the essentials of the previous work of the authors, briefly mentioned in the introduction, in the area of graph models of critical infrastructure and three dimensional geospatial buffering. The purpose of the section is to introduce both the terminology and the problems that are to be further elaborated in the principal sections.

Multigraph model

Interactions among infrastructure components and infrastructure users are modelled in the form of directed multigraphs, which can be further augmented by response functions defining interactions between components. The vertices $V = \{v_1, \ldots, v_k\}$ are interpreted as producers and consumers of m different types of services, named dependency types. Transfer of services takes place along the edges connecting the nodes in the network. Each edge can transport or transfer one dependency type d_j chosen from the set $D = \{d_1, \ldots, d_m\}$.

In the general case it is assumed that all nodes v_a have a buffer of volume V^j_a (indicating a scalar resource; this may represent both physical and logical resources and, moreover, may be subject to further constraints such as integral values) for each dependency type d_j. Assuming that the amount of dependency type d_j in node v_a can be quantized as N^j_a. For each node we can then define a capacity limit $N_{Max}(v_a, d_j)$ in terms of the amount of resource d_j that can be stored in the node. The dependency types can be classified as

- Ephemeral, where $V^j_a = 0$ for all nodes v_a, and it follows that $N_{Max}(v_a, d_j) = 0$
- Storable and incompressible, with $N_{Max}(v_a, d_j) = \rho V_a$, where ρ is the density of the resource
- Storable and compressible, with $N_{Max}(v_a, d_j) = P_{Max}(v_a, d_j) V_a$, where $P_{Max}(v_a, d_j)$ is the maximum pressure supported in the storage of resource d_j in the node v_a.

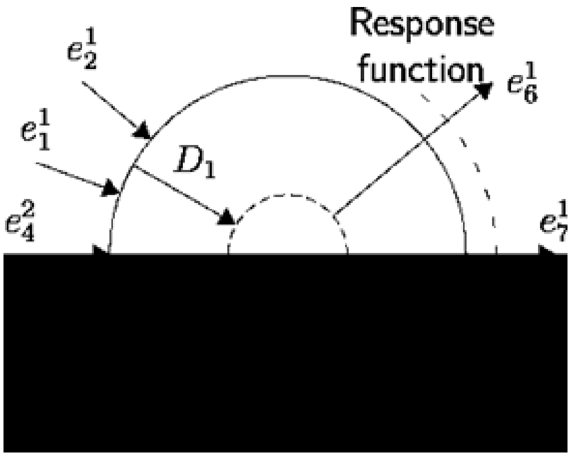

Figure 1: The parameters that define the functionality of a node, and its outputs

Further refinements such as multiple storage stages (e.g. requiring staging of resources from long-term storage to operational status) and logistical aspects are not covered at the abstraction level of the model described here. Non-fungible resources must be modeled explicitly in the form of constraints on edges or dependency sub-types. Pairwise dependencies between nodes are represented with directed edges, where the head node is dependent on the tail node. The edges of a given infrastructure are defined by a subset E of $\mathbf{E} = \{e_1^1, e_2^1, ..., e_{n_1}^1, e_1^2, ,..., e_{n_m}^m\}$, where $n_1, ..., n_m$ are the numbers of dependencies of type $d_1, ..., d_m$, and e_i^j is the edge number i of dependency type j in the network. A further precision of given dependency, or edge, between two nodes v_a and v_b is given by the less compact notation $e_i^j(v_a, v_b)$. In addition to the type, two predicates $C_{\text{Max}}(e_i^j(v_a, v_b)) \in N_0$ and $C_{\text{Min}}(e_i^j(v_a, v_b)) \in N_0$ are defined for each edge. These values represent the maximum capacity of the edge $e_i^j(v_a, v_b)$ and the lower threshold for flow through the edge. Hence, two $g \times m$ matrices, where $g = |E|$ and m is the number of dependency types, C_{Max} and C_{Min} are sufficient to summarize this information.

Let $r_a^j(t)$ be the amount of a resource of dependency type j produced in node v_a at time t. $D(t)$ is defined to be a $k \times m$ matrix over Z describing the amount of resources of dependency type j available at the node v_a at time t. It follows that the initial state of D is given by $D_{aj}(0) = r_a^j(0)$, and for every edge in E we can define a response function $R_i^j(v_a, v_b): \quad D_{aj} \times V_a^j \times N_a^j \times N_{\text{Max}(v_a, j) \times C_{\text{Max}} \times C_{\text{Min}} \to} N_0 \text{(1)}$

that determines the i-th flow of type j between the nodes v_a and v_b (illustrated by fig. 1). The function $R_i^j(v_a, v_b)$ w.l.o.g. is defined as a linear function, and may contain some prioritizing scheme over i and v_b. By constraining the response function to a linear function and discrete values for both time steps and resources, linear programming approaches can be employed for optimization of the relevant parameters; interior point methods for this type of problem such as (Karmarkar 1984; Schrijver 2003) can achieve computational complexity on the order of $O(n^{3.5})$, making the analysis of large graphs feasible.

Given the responses at time t, the amount of resource j available in any node v_a at time $t+1$ is given by $D_{aj}(t+1) = r_a^j(t) + N_a^j(t) + \sum_{i,s | e_i^j(v_s, v_a) \in E} R_i^j(v_s, v_a, t).$
(2)

A node v_a is said to be functional at time t if it receives or generates the resources needed to satisfy its internal needs, that is $D_{aj}(t) > 0$ for all dependency types j which are such that $e_i^j(v_b, v_a) \in E$, where $b \in \{1, \ldots, a-1, a+1, \ldots k\}$. If this is the case for only some of the dependency types the node is said to be partially functional, and finally if none of the requirements are satisfied the node is said to be dysfunctional. For further argumentation on the motivation for the model, the granularity of the model, and example networks and scenarios we refer to (Svendsen & Wolthusen 2007 e, c). For further modeling of networks carrying ephemeral and storable resources, and the reliability of the network components we refer to (Svendsen & Wolthusen 2007a).

3D Geolocational Buffering

3D geolocational buffering as described by Svendsen & Wolthusen (2007d) requires the introduction of both volume and time-dependent features, and is therefore an extension of more common definitions found in GIS environments. In the following geolocational buffering thus defines a time dependent contamination or destruction area (2D) or volume (3D) surrounding a point, line, or polygon-shaped event source.

The classical GIS approach to 3D buffering is among other places described by Khuan & Rahman (2005). This is often a static approach where uniform conditions are considered around a source. Applying this in a CIP scenario we could for example find that a road accident can damage a fiber-optic cable 1.5m under the ground — merely because it is within the blast radius of a road accident involving a tanker truck. For CIP applications this approach neglects some critical features. In particular we are most interested in knowing what kind of obstacles lie between the source and the edge of the buffer zone. Without this knowledge, the buffer zone becomes a theoretical worst-case scenario which does not take natural or man-made protections into account. The main objective of our work is therefore to determine whether one infrastructure constitutes a threat to another, but it makes no sense to say that a gas line constitutes a threat to a power line if they are on different sides of a hill or that a flooding river is a threat to the surrounding infrastructure if the river runs in a deep ravine. In order to enable such considerations we choose a dynamic approach based on cylindrical or spherical coordinates and partition of the "event sphere" into spherical sectors. This allows detection of eventual obstacles between an event source and eventual points of interest. At the core of any model is the discretization of a continuous phenomenon and translation of physical phenomena to relations between the modelled objects.

Physical Features

The number of parameters and physical scope (albeit reduced significantly over a more abstract regional or national model) of the model requires the use of several approximations so as to obtain a model of suitable computational complexity. Most critical infrastructures considered here are physical infrastructures such as cables and pipelines. Such infrastructure can be damaged or destroyed in numerous ways. This can be natural phenomena (e.g. storms or fire), human actions (e.g. excavations, sabotage, or terrorist acts), or accidents in other infrastructure (e.g. a pipeline blast causing pressure waves and fires). All these events can be modelled in detail. Cables has a certain elasticity which provides a threshold for breaking, fires can be modelled based on material and heat capacities, and pressure waves from an explosion can be modelled based on the amount of explosives and their properties. Including all these features in a model gives us a model of not only high computational complexity, but also creates a long initiation time for each scenario, where not all of the information may be available. We are therefore aiming at a model that can be initiated based on topological information and high-level geospatial information – such as type of vegetation (grassland, trees or asphalt) and human created infrastructure (houses, walls, bridges and tunnels). Then we aim at creating a buffer around some source based on an analysis determining whether it is likely that the incident will cover this area within a certain time with the primary intent being on supporting planning and decision-making, not detailed outcome analysis as may be required for engineering aspects.

Modeling principles

We assume that an appropriate polygon mesh 3D representation is provided by a GIS tool. Geographic information and spatial information of the type described above must be available. This includes infrastructure, buildings, ground properties (terrain formations), vegetation, and certain properties of these. These objects are named geospatial objects, and constitute a group O. Further a set of events is defined. We start by defining a set S of events that are of interest in a critical infrastructure environment, this can for example be fire, explosions, flooding, leakage of toxic chemicals, or other hazardous fluids. An event can originate from different types of sources: point source (e.g. fire or explosion), line source (e.g. pipeline leakage) or polygon source (e.g. flooding).

Each element o_i of O is assigned a resistance parameter ρ_{ij}, describing how resistant the element o_i is to event j. The parameter ρ can be of different nature and granularity. In order to achieve the goal of simplicity and low computational complexity Svendsen & Wolthusen (2007d) made the assumption that

$$\rho_{ij} = \begin{cases} 0 & \text{if } o_i \text{ is not resistant to event } j \\ 1 & \text{if } o_i \text{ is resistant to event } j. \end{cases}$$

While yielding useful results in constrained environments, this representation reported by Svendsen & Wolthusen (2007d) with its discretization of time and space is inappropriate in a number of areas such as the analysis of fire hazard and requires a more fine-grained differentiation between models. Moreover, for each time step an analysis of a small part of the area or space to be covered must be carried out and the size of the extension of the buffer zone is based on the average or overall properties of the area to be covered. This requires the models ability to efficiently scan a 2D or 3D polygon efficiently for objects of different resistances.

3D Point Buffering

In this case we assume a point source at the origin of a three-dimensional space. The source is assigned a potential P, describing the capacity of the source in terms of available substance, pressure, or a number of other parameters depending on the modeled phenomenon. Based on P we assume that a model for how the pressure wave, substance or event propagates can be derived. There are two principal features that are to be captured in this model, namely propagation speed and intensity. The propagation speed v mainly depends on the resistance or conductivity of the traversed medium or substance, while the intensity I depends on the potential P and the distance r from the source. The dependency on the distance will often be proportional to r^n, where n is a positive number. However, this is not always the case, e.g. in the case of a fire which may gain energy and speed as larger areas are covered.

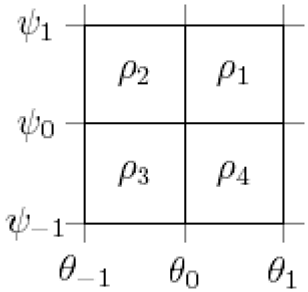

Figure 2: Planar projection of a 3D buffer surface for point source

We use spherical coordinates for space representation. A location is uniquely determined by the 3-tuple (r,θ,ψ), where r is the distance from the origin to the point, θ is the angle between the positive x-axis and the line from the origin to the point projected onto the xy-plane, and ψ is the angle between the positive z-axis and the line formed between the origin and point. The angular parameters are discretized so that r_{ijk} represent the distance between the source in angular direction (θ_j,ψ_k) in the i-th iteration. As in the two-dimensional case our approach is to analyze the volumes (not the area) in the vicinity of the point of interest on the propagation limit or buffer surface. Figure 2 shows a planar projection of the vicinity point of the surface point $r_{i,0,0}$, and visualizes the discretization of the angles.

We are now to estimate $v(P,r_{i,0,0})$, and start by introducing $c = v(P,r_{i,0,0} \mid \rho = 0)$, the potential extension of the buffer at the point $(0,0)$ at iteration i. We define four volumes in the vicinity of the point of interest, each of form similar to the one sketched in fig. 3, based on the four vicinity grids of fig. 2. Analyzing the resulting volumes we can now determine the resistances ($\rho_1,\rho_2,\rho_3,\rho_4$) for each volume, and from this adjust the length of c according to equation 3.

$$v(P,r,\theta,\psi,\rho_1,\rho_2,\rho_3,\rho_3) = \begin{cases} v(P,r,\theta,\psi) & \text{if } \sum\rho = 0 \\ \frac{v(P,r,\theta,\psi)}{4} & \text{if } \sum\rho = 1 \\ \frac{v(P,r,\theta,\psi)}{2} & \text{if } \sum\rho = 2 \\ \frac{3v(P,r,\theta,\psi)}{4} & \text{if } \sum\rho = 3 \\ 0 & \text{if } \sum\rho = 4. \end{cases} \quad (3)$$

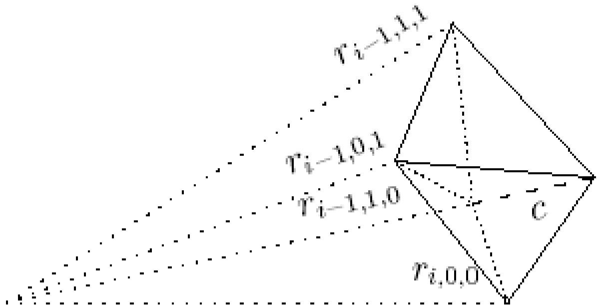

Figure 3. An extension volume of the 3D buffer for a point source

The references to the angles are kept in order allow the inclusion of features such as gravity and atmospheric features to the model. We note that again the angular partition has to be considered carefully at the initialization of the model. The area of a spherical surface grows as $p r^2$ so the granulation becomes a major issue at large distances from the center. However, amplitudes of event propagation tend to decay at the same or faster speeds.

Related Work

As in any model, one of the main concerns in the modeling and simulation of critical infrastructures as described in this paper is the balancing between the necessary abstraction to achieve acceptable computational complexity and sufficient levels of detail to capture the desired properties. This is exacerbated in case of critical infrastructures by the large scale of the overall systems to be considered (e.g. covering the entire European continent in case of the power grid) and requires further limitation of the model to smaller regions. This limitation is in some sense arbitrary and risks losing sight of critical interactions.

Moreover, the models described in this paper are concerned solely with events and their impact but do not consider root causes. Perrow (1984) describes a number of case studies that illustrate the impact of such increasing complexity such as e.g. how a change from linear to complex interactions in production and design chains augments the potential for what he calls system accidents. These are accidents which occur as a combination of management, design, and operator errors where guilt often cannot be assigned unambiguously to a specific party. Faulty design, faulty measurement tools and poorly understood interactions can easily lead to disaster scenarios even at relatively small scales such as a single facility.

A number of models and modeling approaches for different aspects of critical infrastructures have been devised in recent years in addition to domain-specific models, some of which are tied to different national approaches to critical infrastructure protections. A survey of international activities and approaches in this area can be found in Brömmelhörster, Fabry & Wirtz (2004), while Bologna *et al.* (2006) provide a timely review of 78 recent and ongoing research and development efforts in the critical infrastructure area including modeling and simulation environments and group these by way of the level of granularity, namely components, infrastructure, interdependent infrastructures, and nation-level overviews, while the instruments are coordination and road map, assessment, method and tools. According to Bologna et al (2006), thus far the majority of the projects lies within two principal clusters: Coordination and road maps and assessment for national overviews and all instruments listed applied to components and infrastructures. There is an apparent gap both to adapt tools to interdependent infrastructures and methods and tools for national overview. The expected conclusion or analysis of this gap can be found in another overview of the critical infrastructure interdependency modeling provided by Pederson *et al.* (2006), which surveys analytical tools and research projects. Pederson *et al.* conclude that the challenges for critical infrastructure interdependency modeling are the same as for any modeling and simulation effort: data accessibility, model development, and model validation. The situation is further complicated by the extremely large and disparate cross sector analyses required.

Examples of qualitative models include agent-based approaches such as the micro-simulation by Barton and Stamber (2000), the high-level simulation by North (2000) and applications to complex adaptive systems such as the models proposed by Thomas *et al.* (2003). Higher-level models using qualitative approaches such as system dynamics have been proposed e.g. by Pasqualini and Witkowski (2005) while similar general principles from control systems theory have also been proposed at a qualitative level by Sullivan *et al.* (1999) and refined further by James and Mabry (2004). Additional related qualitative research includes the European Project ACIP (Schmitz 2003) and related research on the Critical Infrastructure Modeling and Assessment Program (CIMAP) by Rahman *et al* . Similar approaches have also been described by Amin (2000) and Rinaldi (2004).

As noted by Wolthusen (2004), one of the key problems with more detailed analyses lies not so much in the actual processes but rather in both obtaining and safeguarding the information that is necessary to conduct these analyses. Not only does this typically require the merging of information from different, normally segregated, groups within a single infrastructure provider but also the integration of information from both sector-wide competitors and across sectors. Not only does this cause potential problems with confidentiality requirements and conflicts of interest (leading e.g. to a reluctance to share information with both competitors and government entities unless backed by a clear regulatory mandate) but also creates risks by the very fact that the information is being collected and analyzed, which can also be used by saboteurs or terrorist groups to investigate the maximum damage that can be effected e.g. by coordinated attacks on infrastructure components within a given resource limit. Until recently, significant amounts of information such as right-of-ways for pipes and cables of different infrastructure types were often treated as a matter of public record e.g. for the convenience of construction work which needs to be aware of any relevant cables and pipes in an excavation or building area. Gorman (2005) made use of these public records for the case of fiber-optic telecommunication lines and performed a mapping and dependency analysis, resulting in a major public policy debate on the freedom of academic research and access to such records.

Model Refinement

This section elaborates the model for geospatial buffering presented in section 2 on two specific points: Refinement of the resistance parameter and a better scheme for scanning extension volumes than the one used in section 3. The resistance parameter is a key notion in the model described in 2, and elaboration on this parameter seems appealing in order to make the model more applicable to different event types and scenarios. The parameter describes a predefined volume's ability to resist a given event, or how much intensity that is required of a given event to destroy/disturb a unit of the object. We further note that the precise semantics will vary significantly from one event type to another. Depending on the complexity of the modeling effort and the level of simplification assumed the form of the resistance parameter will appear to be close to detailed interpretations as known from electric circuits or be more abstract as in defining an object's resistance to fire. For each event type, every spatial volume is assigned a resistance value for each event that is to be considered in the simulations. This section therefore elaborates selected event types, specifically on the resistance parameter for blast overpressure, wildfire, and flooding events. Individually all three events have been subject to considerable modeling efforts, and are of large interest in critical infrastructure protection as they are common threats to a number of infrastructure elements and may occur frequently.

Flood

Water management in coastal and riverine environments presents a particularly severe problem for critical infrastructures given the large potential for extensive damage. Moreover, hydroelectric power plants and the lake and river dams associated with them form a vital component of the power supply and peak buffering storage in many (mountainous) countries such as Norway. One argument in favor of water management using dams is that they allow the regulation of water levels in rivers and dampen the effect of flooding and large variations; this can e.g. also affect riverine navigation and therefore the transport sector. What might not be as obvious is that in time of extreme weather these installations may also become a threat to adjacent areas as their capacity levels are reached or the ability to regulate water levels is otherwise impaired (e.g. owing to turbine or bypass maintenance). At certain points dam operators must ensure that output from the dam is larger than the input, meaning that previously known flood scenarios might become too modest. This is the motivation for advanced methods of computational hydraulics and hydrology (Cao *et al* 2004; Alfredsen & Sæter 1998). Flash-floods (Smith) represent another type of flooding that according to many has become more and more frequent in recent years. Such events are caused by intense rainfalls (often combining several weeks' worth of normal precipitation in a brief interval of a few hours) that congest the draining systems turning the roads of urban areas into rivers.

Common results of flood simulation programs include the determination of areas touched by a flooding scenario. And an important addition to this in critical infrastructure protection is knowledge of the maximum elevation an installation might support. In this setting, the resistance parameter is a quantification of the height that the water can rise above ground level before the infrastructure at a location is damaged (e.g. by blocking the intakes of emergency power supply diesel generators). In order to determine this, a detailed analysis of the dependencies of the infrastructure at the location has to be established to ensure that not only the primary function but also all of its prerequisites for functioning are considered; this is generally not covered by the level of granularity of the overall models considered in this paper. Interesting aspects are e.g. the positioning of ventilation intakes, fuse location, draining around the building, and waterproof bulkheads and walls to prevent inundation from below the waterline, e.g. through pipes in a building's basement. With this motivation, the resistance parameter r is defined to be the vertical distance from the terrain surface to lowest critical elevation of an installation. Note that this also allows for negative r, e.g. in the case of underground installations.

This provides an approximation based on which a ranking of endangered facilities or potential emergency installation can be established. For each flooding scenario, it can be determined quickly that based on a certain water level and propagation speed the installation in a certain building is threatened.

Blast overpressure

Overpressure blasts have for obvious reasons been studied very closely by armed forces (US Department of Army… 1990; Hyde 1992; US Department of Army… 1986). More recently, blast load has become a topic for civilian research, often in the setting of protecting civilian buildings from the threat of terrorist activities as is further discussed by Remennikov & Rose (2005) and Baylot *et al* (2004). The authors have discussed overpressure blast in previous work (Svendsen & Wolthusen 2007d), and this section summarizes some of this modeling effort. Consider a gas pipeline being located in proximity to a telecommunications exchange. For the threat of a blast emanating from the gas pipeline, it is necessary to perform an analysis that takes the terrain configuration as well as the type of event (a vapor cloud explosion typical of a gas explosion) into account (Cleaver *et al* 1997; Alonso *et al* 2006). Such an analysis is only partially achievable using 2D or 2.5D dimensional GIS analysis. Assume a scenario as presented in fig. 4 with a point source S of a possible explosion located in the vicinity of two buildings A and B in a city landscape. Building B contains a mobile phone base station T. A 2D simulation of a point source buffer around S, shows that T is protected by the building A.

If we now consider a 3D simulation of the same scenario we would have to investigate or collect information regarding the exact location of T also in the vertical direction. Assuming that T is located on the roof of B, and that B is a taller building than A we may very well have a scenario in the xz plane as is sketched in Fig. 5. In this case only the lower part of B is protected by A, and we do indeed have a dependency between the infrastructure in S and the infrastructure served by T in this area.

Besides capturing shadowing effects in a different way than a 2 or 2.5D model, a 3D model can also take more physical constraints into consideration. The pressure generated by an overpressure blast decays proportionally to $1/r^2$ where r is the distance to the pressure source. Finer tuned efforts can thus be used to estimate infrastructures resistance to explosions.

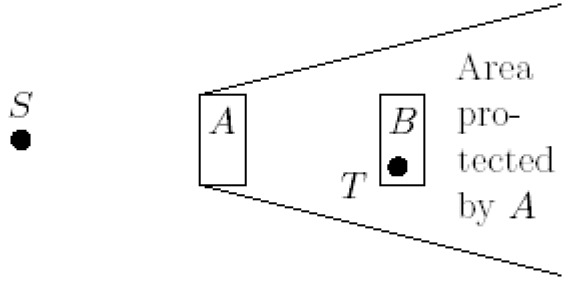

Figure 4. The result of a 2D or 2.5D simulation

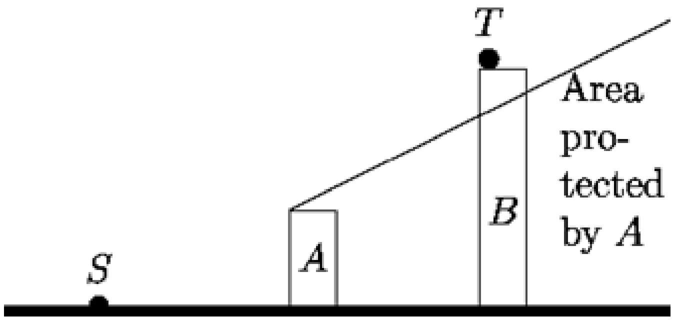

Figure 5: The result of a 3D simulation seen in a xz section

Wildfire

There are essentially two types of fires, wildfires in open areas and fires in built-up areas. In a built-up area a fire will soon be discovered and eventually brought under control by fire-fighters. Detailed modeling of the dynamism of fires within and between buildings is outside the scope of our effort. Wildfires on the other hand represent a potential danger for many plants and facilities located in less densely populated areas, as e.g. refineries, pump stations, and high voltage transmission lines tend to be. Modeling wildfires is a complex task (Mandel *et al* 2004) involving numerical coupled atmospheric and fire models, map data, aggregated fire information, and field information. Exact result covering e.g. how heat fluxes from fires feed back into the atmosphere to create fire winds and how atmospheric winds drive the fire propagation require models of high computational complexity. As described on a general level in the introduction, initialization and computation of such model may well be too time consuming for a CIP scenario, which again motivates our simplified approach.

This scenario differs itself from the others by the nature of the phenomenon. A flood or an explosion over pressure blast is strongest, or has the highest potential, at the source and loses momentum during propagation. Fires may start as innocent, small events, at the source, and then suddenly gain momentum and propagate over large areas. The energy of a fire increases as more flammable material is covered and fire-winds grow. Thus a fire does not stop burning until there is a lack of flammable material, or unless external conditions such as wind direction change. In order to capture such factors the discretization of the wildfire scenario has to be quite different from the one used in section 2. The main limitation of this discretization scheme is that the control volumes grows at a rate $O(k^2 a^3)$, where k is the number of iterations and $a = r_k - r_{k-1}$. Thus the granularity is undesirable and the results become too coarse at a certain distance from the source. To avoid this, a scheme where the extension volumes are of the same size is proposed.

As we will assume a point source for the fire it is in our interest to keep the iteration steps of the radius (a) constant in order to capture the dynamic features of the model. Thus the adjustment that has to be done for each increment of r_k is to adjust the angular opening θ_k that is seen in Figure 6. We start by deriving the expression for the extension volume depicted in the figure. As the volume of a sphere is $\frac{4\pi}{3}r^2$, it follows that the volume of a section of the sphere with angles θ_k and radius ka is $\frac{1}{3\pi}k^3a^3\theta_k^2$. The volume of extension volume is then found by subtracting the volume of a cone of radius ka from the volume of

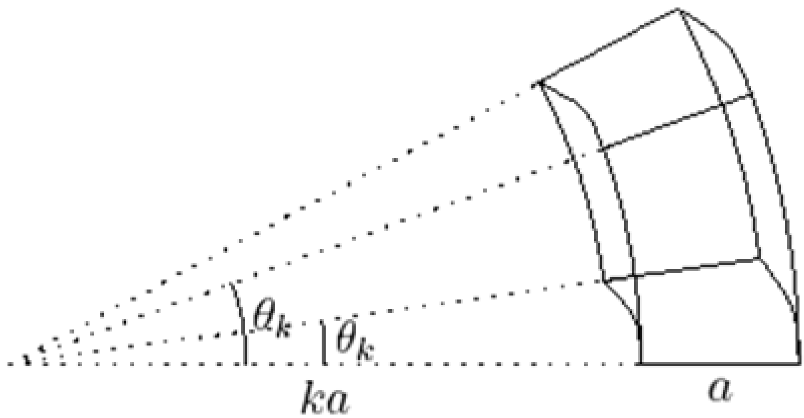

Figure 6: Extension volume

a sphere segment of radius $(k+1)a$, that is

$$\begin{aligned} V &= \frac{\theta_k^2}{3\pi}(k+1)^3a^3 - \frac{\theta_k^2}{3\pi}k^3a^3 \\ &= \frac{\theta_k^2 a^3}{3\pi}(3k^2+3k+1). \end{aligned} \tag{4}$$

In a similar way we can find the volume of an the extension volume when the angle is q_{k+1} and $r = (k+1)a$ by substitution

$$\begin{aligned} V' &= \frac{\theta_{k+1}^2}{3\pi}(k+2)^3 a^3 - \frac{\theta_{k+1}^2}{3\pi}(k+1)^3 a^3 \\ &= \frac{\theta_{k+1}^2 a^3}{3\pi}(3k^2 + 9k + 7). \end{aligned} \tag{5}$$

Our imposed condition is that $V = V'$ which by combining Equation 4 and 5 gives us the following relation between q_k and q_{k+1}

$$\theta_{k+1} = \sqrt{\frac{3k^2 + 3k + 1}{3k^2 + 9k + 7}}\theta_k. \tag{6}$$

As there is no guarantee that q_k divides $2p$, there will be a number of volumes that are smaller than the other volumes. This can be treated as edge effects, and the effect can further be minimized by orienting the spherical coordinate system such that these exception points are always located outside the zones of interest.

This discretization of the space can be viewed as a voxel representation, and each voxel (extension volume) is assigned a set of attributes relevant to fire propagation. Three physical features are considered important, namely the type and quantity of flammable material within the voxel, wind direction and intensity, and humidity. The type of material and humidity can be summarized in a resistance parameter for the voxel. Together with the wind intensity, which is time dependent, the resistance parameter forms the basis for the potential of an eventual fire in the voxel. All voxels can be initialized with these parameters before the simulation starts. Information about the voxels can be collected e.g. using airborne laser scanning of the area of interest as described by Hyyppä *et al* (2004)]. These are widely used forestry techniques, but the collected data can also be used to classify and quantify biological material in an area. Generally the spatial representation of the topological information will differ from the voxel representation of the space. To solve this we propose that for every voxel one makes a random sampling of a number of points in the area corresponding to each voxel, and find an average of this. Further meteorological data forms a basis for a time dependent vector field that can be associated with the considered volumes. Together with meteorological data and topological information this forms the information sources needed to perform the desired simulation.

As motioned we assume that the fire originates from a point inside the sphere of radius a. The determination of a specifies the granularity of the simulation, as this decides the volume of all extension volumes. Whenever it starts burning in the source voxel its potential is transformed to energy which causes the intensity of the fire to raise. The intensity is time dependent and will grow and decline in a similar way as e.g. the gamma distribution. In this way we capture that the intensity of a fire in each voxel grows relatively fast, and then has a slow decay before it fades away. The steepness of the curves depends on the resistance of the voxel, and the amplitude will depend on the potential.

To determine how the fire spreads from one voxel to another a probabilistic approach is chosen. Based on the resistance of a voxel, the fire intensity of neighboring voxels and wind direction and intensity a probability for ignition can be determined at every time step. Using this approach the model captures at least some of the dynamic features of the wildfire.

In discrete models of continuous environments there will always be errors. In this case one of these errors is due to the heterogeneity of the environment and the need for averaging properties of all the objects within one voxel. This can be a challenge when incorporating natural rivers or fire breaks into the model. As long as the width of the break or the river is smaller than $2a$ the heuristic nature of the model still allows for fires to cross the obstacle. However this also reflects the probability of a spark from one tree igniting vegetation of the other side of a break or a river, – so the model can still be reliable. In this aspect it might be dangerous with too small a as this can overestimate the capacity of an inserted obstacle.

Algorithm 1 Main steps of an algorithm for wild fire propagation

```
Scan area of interest to determine resistance parameters for all objects
Collect meteorological data
Determine voxel representation based on fire origin
for t = t_0 to t = t_max do
    Update wind information and if necessary voxel potentials
    Determine the potential of all voxels
    Determine propagation probabilities and eventual propagation
    Update intensity and time
end for
```

As an application example of this method one can make a model of the area surrounding a plant of any kind in order to evaluate the fire security and awareness of the plant. Using multiple, randomly chosen (or according to distributions based on risk assessments) fire origins the average response time for fire-fighters and sufficient devegetated buffer area around the plant can be determined.

Evaluation and Discussion

Section 4 gave a few examples of the applicability of the geospatial buffering models, and further application scenarios could have been described, also in combination with the multi-graph model of critical infrastructures presented in Section 2.1. Further there is nothing in the model preventing the combination of different sub models. Here one could e.g. imagine a scenario simulating a wildfire causing a petroleum tank to explode, the methodology can then readily include a simulation of the consequences of the resulting blast overpressure on the surrounding infrastructure, and finally the multigraph model could be used to evaluate the consequences of these events on other infrastructures.We anticipate that the methodologies are useful not only in infrastructure planning and scenario evaluation, but also has a potential for applications related to real time applications for situational awareness as a decision support tool in the field.

The models have limitations in not being able to capture secondary and dynamic effects. Examples of such effects playing an important role are blast reflexions and kinetic effects of flood carvings. These could be considered as extensions of the model, although this would lead to increased complexity and bring the presented model closer to existing, sector specific models. Our claim is that these limitations are covered by the advantages of the joint effect of the two models presented in this paper. The multigraph model can be used to identify indirect dependency chains between infrastructures, and geospatial buffering can be used to investigate in detail the strength of dependencies and effects introduced by geographical proximity.

A final comment on the model is that it might be particularly well suited for scenarios such as wildfires. These occur in area where the level of detail of available datasets is limited. As a consequence application of models with high level of detail necessarily involves interpolation of existing and estimation of new data points. Thus the presented model might be just as well calibrated for application scenarios in natural environments, as no precision is gained by running a detailed model on insufficient data.

Conclusion

In analyzing interdependencies of critical infrastructures a number of aspects require consideration. Frequently the identification of said interdependencies provides a first important challenge, particularly since these dependencies will frequently form cycles or even intersecting cycles which can then lead to feedback effects as well as short-term effects as has been described in earlier research (Svendsen & Wolthusen 2007 a-c, e).

However, there are several additional factors which need to be taken into account when performing risk assessments for interdependencies. These can be external risks such as fires or flood damage or can indirectly interrelate critical infrastructures (e.g. a gas pipeline in proximity to other infrastructure elements such as high voltage transmission lines that may be affected in case of a mishap at the former). As described in earlier research, it is therefore frequently desirable to model not just the logical interdependencies but also to include the geospatial relationships among infrastructure elements and hazards.

In the present paper we have extended the previously described hierarchical model with further sub-models which approximate (albeit at a much coarser level than might be achievable with dedicated models) a selection of hazards for critical infrastructures, namely fire, flooding, and blast damage. These sub-models were used to investigate the dynamic properties of each event over time as well as the interactions of the event types with the terrain modeled by resistance factors specific to a given event type.

The resulting sub-models yield an approximation for geospatial buffers affected by the event types together with additional information such as the degree to which a structure is affected if warranted by the event type. This allows the dynamic modeling of buffers over time to identify whether e.g. terrain features will be sufficient to hold back flooding events from a given structure or to perform worst-case assessments of the minimum cleared area around a structure that will allow emergency responders to react to a fire approaching this structure.

The computational and spatial complexity of the algorithms required to perform these analyses significantly exceeds the requirements of the abstract graph-theoretical model used for analyzing large-scale interdependencies, requiring the selection of a smaller geospatial area for further analysis and refinement. However, the integration of the large-scale graph-based framework with the capability to perform a more detailed local analysis represents a feasible process; given the limitations in accuracy provided by the sub-models described here, a fully automatic analysis is not wholly desirable as some artifacts caused by abnormal terrain and structural configurations (which may not even be represented in the underlying geospatial data) will require expert review for confirmation. However, even within the more confined area under consideration, the trade-off between computational complexity and accuracy in sampling the area or volume affected by the events under consideration is not negligible and may, particularly in environments where interactive assessment is required for situational awareness, require significant trade-offs.

Further research will therefore include an investigation of different spatial sampling regimes including both structured, random, and hybrid sampling mechanisms and the use of higher-level semantic information about terrain features to constrain the sample space while retaining acceptable accuracy in the process. In addition, each of the sub-models provides a number of opportunities for further refinement to improve accuracy and validation against domain-specific models. However, it is imperative that the computational and spatial complexities of these models is not increased appreciably for these to remain effective in interactive application environments.

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Assessing the Relative Geopolitical Risk of Oil Importing Countries

Eshita Gupta

Introduction

Oil is the fuel that drives the economy and its regular supply is inevitable for economic growth of countries. The world is heavily dependent on oil to meet its energy requirements – it provides about 35% of the global energy demand.[140] The oil industry is almost wholly globalized. In 2005, approximately 60% of the global oil supply was internationally traded.[141]

The mismatch between supply and demand drives international trade in oil. On one hand are North America, Asia-Pacific, and Europe, which hold just 10% of the world's reserves and account for about 78.6% of demand; on the other hand are Middle East, FSU (former Soviet Union), and Africa, with 81.3% of the world's reserves, accounting for 15.5% of world's oil demand in 2005 (BP 2006) (Table 1).[5]

On the supply side, oil reserves are unequally distributed, with over 60% of the world's oil reserves concentrated in the sedimentary basins of the Middle East.[142] Members of OPEC (Organization of Petroleum Exporting Countries) – Saudi Arabia, Algeria, Indonesia, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, United Arab Emirates, Angola, and Venezuela – hold 75.2% of the world's oil reserves and control about 41.7% of oil production.[143] Most of these oil-producing countries are characterized by high degree of political and economic instability (Table 2).

On the demand side, large consuming countries such as the US, EU (European Union), Japan, India, and China are increasingly becoming dependent on oil imports to meet their requirements. At present, the US and most European countries obtain the bulk of their oil supply from non-OPEC sources. However, as the production in non-OPEC countries (such as Canada, Norway) is declining, all the consuming countries are progressively becoming dependent on the politically unstable OPEC-Middle East (which represents 81% of OPEC) for oil imports. The growing dependence on

140 IEA (2006)

141 *BP Statistical Review* (2006)

142 EIA (2007), *Oil and Gas Journa*l estimates

143 *BP Statistical Review* (2006)

the same sources is increasingly stimulating intense geopolitical competition among the major importing states, to strive and secure potential imports.

The expanding international trade and growing dependence of major consuming countries on a few politically difficult producing countries are likely to increase the world's vulnerability to long-term oil supply disruptions. The high cost of oil imports, the risk of sudden supply interruptions, and the insecurity about oil market conditions make oil-importing countries extremely vulnerable to such oil disruptions.

This paper assesses the relative geopolitical oil supply vulnerability of 26 net-oil importing countries for the year 2004 on the basis of five individual indicators of geopolitical oil risk – net oil import dependence; concentration of supply sources; political risk in supplying countries; ability of a consuming country to switch between different suppliers; and share of oil in total primary energy supply using a modified version of the HHI (Herfindahl-Hirschman index). The countries studied have been selected from three major oil-consuming regions – Europe, North America, and Asia-Pacific – which together account for about 80% of the total world consumption.[144] The countries are the US, Japan, Korea, Germany, India, Italy, France, China, Spain, the Netherlands, Belgium, Turkey, Sweden, Greece, Poland, Portugal, the Philippines, Finland, Austria, the Czech Republic, Slovakia, Hungary, Switzerland, Australia, New Zealand, and Ireland.

The paper is organized as follows. Section 2 provides the literature review on geopolitical risks and the selected indicators to measure it. Section 3 describes methodology and data sources. Section 4 gives the results. Section 5 concludes the paper.

Literature Review on Geopolitical Oil Risk and Its Indicators

The security of oil is conceptualized as a state in which a nation perceives a high probability that it will have a regular supply of adequate oil at affordable price. A risk related to disruption in oil supplies to consuming countries is the probability of an event affecting supply (CIEP 2004).

The literature makes a distinction between short-term and long-term risks. Short-term risks are usually linked with supply shortfalls due to acute weather conditions, terrorist attacks, accidents, and other events that affect 'operational security' or 'systems security'. Long-term risks to oil security are associated with the supply shortfalls due to the political and economic instability in producing countries, strategic actions and policies of producing countries, oil infrastructure breakdowns in domestic country or producer countries, decline in investment in oil production and transportation facilities, and market or government failures (CIEP 2004, INDES 2004).

In this paper we focus on the long-term risks of oil supply disruptions. In this context, a number of studies have identified the following growing geopolitical oil

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risks in the long term (Blyth and Lefevre 2004, CIEP 2004, INDES 2004).

- Increasing risk of collusion among major oil-producing countries to strategically control oil supply linked with the concentration of oil resources
- A risk of supply shortages due to breakdowns in international political and economic systems (such as government failures in centralist political structure of fragile producing states)

For the present analysis, the geopolitical oil supply vulnerability of an economy is defined as an exposure to such long-term risks and is measured by various indicators.

A large literature exists on different indicators of geopolitical energy security (Blyth and Lefevre 2004, CIEP 2004, Neff 1997, ECN 2004, and IEM 2005). Generally, the exposure of an economy to external supply disruptions is measured by net energy import dependence. From the security point of view, dependence on domestic fuel supply is preferred over imported fuel, as it avoids risks from geopolitical insecurities and exchange rate uncertainties. The greater the level of imports, the greater the possibility and cost of disruption, if it occurs. However, import dependence cannot be considered as the only factor of importance as security of supply involves a large number of aspects, such as the concentration of suppliers and political risk in the supplying countries. The higher the geographical diversification of the supply sources, the lower is the risk associated with the loss of any particular supply source. In addition, diversification in favour of economies that are politically more stable can further shield importing countries from geostrategic risks. Another important factor that determines geopolitical risk is the size of domestic oil imports relative to the size of world imports, also known as market liquidity. This measures the ability of a given country to switch between various suppliers.

Methodology and Data Sources

Deriving geopolitical oil risk measure using HHI

Neff (1997), Hirschhausen and Neumann (2003), ECN (2004), and Blyth and Lefevre (2004) have suggested a measure of geopolitical risk on the basis of the above-discussed indicators using the 'Shannon diversity index' or Herfindahl–Hirschmann Index (HHI) approach. Following Blyth and Lefevre (2004) and Neff (1997), we have derived GORMs (geopolitical oil risk measures) of the selected countries using a modified version of the HHI.

First, for every consuming country, market shares for each of the countries from which it imports its oil are calculated as a proportion of its total oil demand. If a consuming country also produces oil domestically, then it is considered as one of the suppliers, with its share of the market determined by its production.[145]

Second, for each consuming country, the degree of supply concentration is measured using the modified HHI, which is defined as the sum of squares of the adjusted market shares of different oil-exporting countries. The market shares are adjusted for political risk in the oil-exporting countries using the ICRG (International Country Risk Guide) risk ratings. It is important to note that at the time of summing up of the adjusted market shares, the value of domestic production is given a value of zero, as domestic production is assumed to not contribute towards geopolitical risks.

The measure is then adjusted with the factor relating to the market liquidity of a consuming country. Unlike Blyth and Lefevre (2004), who have measured market liquidity as the ratio of world oil supply to the oil demand of a consuming country, we have measured market liquidity as the ratio of world oil imports to the net oil imports of a given country[146] (as the amount which an exporting countries consumes domestically is not available for trade).

The resultant risk measure for a given oil importing country is multiplied by its oil share to obtain the contribution of oil in the overall geopolitical energy risk of an economy. The higher the share of oil in TPES (total primary energy supply), the greater is the direct exposure of an economy to the above measured oil market concentration risk.

The methodology is explained with the help of an illustration (case of Sweden and Switzerland) in the appendix.

In our approach, we have assumed that OPEC (Organization of Petroleum Exporting Countries) member countries act as a single supplier. The crucial design of supply diversification entails independence of the sources. In the current structure of the oil market, where OPEC defines production quotas for all member countries, oil prices are very sensitive to changes in OPEC production policies.

Data sources

The 2004 data on oil import diversification has been obtained from various sources: (1) *Oil Information 2005* for the OECD (Organisation for Economic Co-operation and Development) countries; (2) *BP Statistics 2006* for China; (3) *Integrated Energy Policy 2006* for India; and (4) *Energy Statistics Yearbook 2006* for the Philippines. The data on the oil reserves, production, oil shares, and consumption has been taken from *BP Statistical Review 2006* and the *Energy Information Administration 2006*.

145 Here, our approach differs from Blyth and Lefevre (2004). In their approach, they measured concentration of the oil resources at the global level and thus, considered all the supplying countries that can physically supply a given consuming country, while like Neff (1997), we have considered only those countries that were net exporters to a given consuming country in 2004.

146 For example India has the market liquidity of about 35% which means that world's oil imports are 35 times the Indian net oil imports.

Results and Analysis

Results

The final values of GORM of the selected oil-importing countries with corresponding ranks across the selected countries are given in Table 3. The rank of 1 represents the most vulnerable country, and the rank of 26 represents the least vulnerable country. The data in Table 3 is also represented by a bar graph in Figure 1.

The average GORM for the selected 26 countries is estimated to be about 0.26. In Table 4, we have categorized the 26 countries into four homogeneous classes on the basis of their GORM value using univariate clustering.[147]

The 'most vulnerable' countries class has the average GORM of 0.667 and includes two countries, Japan and Switzerland. The 'more vulnerable' countries, with average GORM of 0.504 are slightly less vulnerable, and include three countries—Philippines, Korea, and Greece. The third tier of 'less vulnerable' countries consists of nine countries – Austria, Finland, Ireland, Spain, the Czech Republic, Portugal, Poland, Turkey, and Italy, and has average GORM of 0.281. The fourth class of 'least vulnerable' countries has the GORM of 0.122 and is occupied by twelve countries –Australia, US, China, Hungary, Belgium, New Zealand, India, Sweden, France, Germany, the Netherlands, and Slovak Republic.

The above inter-country differences with respect to the GORM also indicate certain regional patterns. The average GORM of all the selected European countries, at 0.26, is equal to the all-country average risk. The average GORM for five European countries – Switzerland, Greece, Ireland, Portugal, and Finland – at 0.42, is more than double the average risk of the rest of the European countries (0.20 for other 13 countries).

The average GORM of all the seven Asian economies, at 0.28, is found to be slightly above the European and all-country average. However, for the three Asian economies – Japan, the Philippines, and Korea – the average risk of 0.57 is significantly higher than the all-country and the Asian average. The relatively lower overall Asian average risk (all seven countries) is explained by very low-risk measures of China and Australia. New Zealand and India, on the other hand, are found to have moderate risk.

The analysis done so far is based on the aggregate risk measure. However it is important to analyse individual indicators to understand relative positions of countries. As explained earlier, five factors govern the differences in the GORM among various consuming countries. As the GORM implies, the more vulnerable countries consistently represent higher values for most of the individual indicators

147 Homogeneity is measured here using the sum of the within-class variances. To maximize the homogeneity of the classes, the sum of within-class variances is minimized. This methodology was first introduced by W D Fisher (1958).

(Table 5 and Figure 2). The above-mentioned five indicators are discussed below.

Net import dependence:

First, the GORM is negatively related to the share of domestic production in total demand (or positively related to the net import dependency rates). (See Illustration and Figure 2 in Appendix).

The impact of this factor on the GORM is quite significant for all the European countries and the five Asian countries (except Australia and China), which on average imported about 95% and 90% of their oil demand, respectively, in 2004. The US was about 64% import-dependent in the same year.

Concentration of supply sources:

In the second measure of geopolitical risk, the import dependence of the selected oil importing countries is combined with the concentration of the import sources (using the HHI of market concentration). The higher the HHI of market concentration, the higher is the GORM.

As explained earlier, while measuring the concentration of import sources, OPEC member countries are grouped as a single supplier. Thus, the countries with higher dependence on OPEC are expected to have a higher GORM.

It is observed that the supply sources of most Asian countries (except Australia, China and New Zealand) are poorly diversified with very high dependence on OPEC–Middle East countries. On the other hand, the European countries and the US, due to their geographical advantage, are able to import more competitively (as compared to most Asian importing countries) from countries other than OPEC members, such as Canada, UK, Norway and FSU (Illustration, Table 5 and Figure 2).

Adjustment related to the political risk in supplying countries:

The value of the GORM increases appreciably for most of the consuming countries after the inclusion of the political risk factor.

The oil producing countries in Latin America (particularly Venezuela), the Middle East, followed by Africa (essentially Nigeria) are the most conflict-prone and politically unstable and thus, generally have poor presentation in political stability ratings (Table 2 give political risk ratings of major oil producing countries based International country risk guide (2004-05).

It is observed that the adjustment with respect to the political risk in supplying countries has the largest impact in case of the Asian countries such as Japan, Philippines and Korea that have very high dependence on highly unstable Gulf and African economies. For the US and most of the European countries, the relative contribution of this factor is found to be less, as currently, the bulk of their imports are from OECD (Western European oil-producing countries) and FSU countries, which are relatively politically more stable (according to International country risk guide (2004-05)). The only exception to this trend includes Greece, Switzerland, Portugal, Turkey and Spain, which have relatively higher dependence on OPEC and African countries.

Adjustment related to the market liquidity:

The GORM is negatively related to the market liquidity (Figure 2).

The adjustment for market liquidity has a significant effect on the overall risk for the US and most Asian economies. In all the 26 countries considered, the US, followed by Japan and China, presents the worst situation with respect to market liquidity. In contrast, the market liquidity of most European countries (except Germany) is relatively higher. The adjustment has very little effect on the overall risk for the European economies, reflecting their relatively greater ability to switch between different oil suppliers.

Adjustment related to the share of oil in TPES:

The GORM is positively related to the share of oil in TPES (Figure 2).

The adjustment with respect to the share of oil significantly deteriorates the relative vulnerability position of most European economies (with average oil share) and the US (but slightly with over 40% oil dependence). Notable exceptions to this trend include Sweden, Slovak Republic, Poland, Hungary, and Czech Republic, each deriving about 20% of their primary energy from oil in 2004. In contrast, the adjustment improves the relative risk of most Asian countries.

Discussion

Within Europe there are enormous differences between countries. Interestingly, Switzerland emerges as the most oil supply vulnerable European country while Sweden turns out to be the most secure European country (illustration). The five most vulnerable European countries, namely, Switzerland, Greece, Ireland, Portugal, and Finland (with risk measures significantly above the European average) display almost similar trends with respect to the individual indicators. Most of the European economies have very high oil import dependence and comparatively higher market liquidity. However, the import dependence of these five economies is very poorly diversified in terms of supply sources, which results in relatively much higher overall geopolitical risk as compared to other European countries (especially Sweden, France, Germany, Italy, Belgium, and the Netherlands) which have well-diversified sources. At the same time, these five economies are among the most vulnerable countries with respect to the share of oil in TPES.

Within Asia-Pacific, Japan, Korea, and the Philippines are found to be vulnerable for almost all measures: their energy mix is highly biased in favour of oil; their high import dependence is very poorly diversified with a very high dependence on politically unstable OPEC member countries (mainly on OPEC-Middle East); and their market liquidity is also comparatively low (except in the case of the Philippines). India, on the other hand, has a relatively lower oil share in its energy mix (which significantly improves its relative position in the final measure), but except that, it is vulnerable as assessed by all measures. New Zealand is extremely vulnerable in terms of two indicators: high oil import dependence and the share of oil in TPES. Notable exceptions to this Asian trend include China and Australia. Australia (with somewhat higher oil share) and China (having relatively lower market liquidity) are found to do well with respect to most of the indicators.

The US is observed to be vulnerable mostly with respect to market liquidity and (to a lesser extent also) its import dependence. But its high import dependence is found to be well diversified both by countries and regions (with relatively lower dependence on OPEC), which significantly reduces its risk compared to other countries.

Further, it is observed that despite differences in individual indicators, some countries have almost identical GORMs. The examples of India and the three European countries, namely, France, the Netherlands, and Germany are quite interesting. All the four countries have nearly equal overall geopolitical risk but unlike India the other three countries are almost entirely dependent on imports for meeting their oil requirements. However, their well-diversified imports and much lower market liquidity (except Germany) result in nearly the same overall risk. In fact,on the similar basis, Sweden and the US have much lower levels of risk as compared to India and other Asian countries such as Japan, Korea, and the Philippines (Table 3 and Figure 1).

Conclusion

The major conclusion of this paper is that there are large differences in the GORMs of the various oil importing countries. The GORM of the most vulnerable countries (such as Japan and Switzerland) is found to be about 40 times higher than that of the most secure countries (such as China and Australia). The major factors that make these economically most developed countries most oil supply vulnerable are their almost total import dependence, poorly diversified sources with major imports from politically difficult OPEC countries, and relatively higher oil share in TPES. By evaluating the basis of such differences in the overall GORM of the economies, policy- makers can identify and, thus, address the problems that can protect nations from the threat of sudden oil supply disruptions.

First, policies that reduce oil import demand can significantly reduce the vulnerability of the various economies to geopolitical developments. However, in the short run, such policies include measures such as increasing domestic production and restraining oil demand, which are difficult to achieve and impose high economic costs.[148] As a result, in the short to medium term, diversification of oil supply sources is a more feasible option for dealing with such risks. In this regard, it may be pragmatic for the consuming countries (particularly for countries such as Switzerland) to reduce their dependence on politically difficult OPEC countries and diversify their import sources in favour of relatively more secure regions such as the FSU and the Caspian Sea or work at seeking improvements in geopolitical relationships through consumer–consumer or consumer–producer dialogues and investments in upstream sector in oil-producing countries. In the longer term, diversification of oil supply sources will not be easily achieved, as the world oil production will be increasingly concentrated in OPEC countries, especially in the Middle East, where most oil reserves are concentrated. Thus, the best policy measures should induce reduction in overall oil dependence through measures such as increasing oil efficiency and making oil demand more responsive to prices. This would help in improving market liquidity and reducing import demand for a given consuming country.

At the international level, it is important for the consuming countries to cooperate among themselves in order to reduce the negotiating stance of oil exporting countries. Also, global oil security requires sustainable development of the major oil-producing countries. Thus, the consuming countries should make efforts to assist the economically and politically unstable producing countries in overcoming their difficulties.

Appendix

Illustration

GORM (geopolitical oil risk measure) of Sweden (the least geopolitical oil vulnerable European country and Switzerland (the most geopolitical oil vulnerable European country)

In 2004, Sweden and Switzerland imported 100% of their total oil. The market liquidity was about 20000%[149] n case of Sweden and 25954% in case of Switzerland. The share of oil in TPES (total primary energy supply) was 29.3% for Sweden and 46.2% for Switzerland.

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148 Most of the Asian and European economies such as Japan, Korea, Philippines, Belgium, and the Slovak Republic have no indigenous reserves and are entirely dependent on imports for meeting their requirements. Other countries such as the US, China, and India have only limited reserves, and thus domestic supply increases would be achieved at very high cost. Second, the economic cost of eliminating oil imports by reducing oil consumption would be enormous.

149 In other words, in 2004, the world oil imports were 200 times the net oil imports of Sweden.

Geopolitical oil risk measure is obtained in the following manner.

Step 1 Computing market shares

The following are the market shares of various suppliers for Sweden.
Domestic supply – 0.0%; OPEC – 12.3%; Malaysia – 0.0%; Denmark – 28%; Norway – 26%; UK – 6.6%; FSU – 26.1%; non-specified – 0.4%

The following are the market shares of suppliers for Switzerland.
Domestic supply – 0.0%; OPEC – 87.7%; Malaysia – 0.0%; Italy – 0.3%; Netherlands – 1.16%; Norway – 2.66%; Turkey – 0.4%; UK – 3.91%; FSU – 3.75%
For a given country, the share of domestic production reduces the market shares of other suppliers, and thus, the GORM tends to favour countries with higher domestic production.
Import dependence represents the first measure of geopolitical oil supply risk.[150] However, both these countries are 100% import-dependent and thus market shares of the their suppliers before and after the adjustment by the domestic production share are the same.
$GORM_1$Sweden=100%

$GORM_1$Switzerland=100%

Step 2 Deriving second measure of geopolitical risk

The import dependence is combined with the concentration of the imports sources (using the HHI of market concentration).[151]
In this example it implies:
$GORM_2$Sweden = (.123) ^2 + (.281) ^2+ (.001) ^2+ (.259) ^2+ (.066) ^2+ (.261) ^2+ (.002) ^2+ (.001) ^2+ (.001) ^2+ (.001) ^2 = .235
$GORM_2$ Switzerland = (.878)^2 + (.003) ^2+ (.012) ^2+ (.027) ^2+ (.004) ^2+ (.039) ^2+ (.038) ^2= .774

Step 3 Adjusting second measure with the political risk in supplying countries

ICRG (International Country Risk Guide) political risk ratings range between 0 for high risk and 100 for low risk. The risk ratings (for various supplying countries) given by ICRG are first expressed as a proportion of 100 (maximum stability) and then the reciprocal of this figure is used as the political risk factor. This is done to

150 Net oil import-dependence is defined as the ratio of net oil imports (defined as the sum of the net crude oil imports and net refining product imports) to the oil supply (defined as the sum of crude oil domestic production and net oil import).

151 Here we have only considered import sources of the crude oil.

derive a parameter, which moves in the direction of the overall index. [152] For instance, in the case of OPEC, which has the average political risk rating[153] of about 59, the political risk factor is obtained in the following manner. r1 corresponding to OPEC = 1/(59/100) = 1.69. Likewise, political risk is calculated for all other sources.

Third measure of geopolitical oil risk is obtained as follows.

$GORM_3$ Sweden = (.123)^2*1.69+ (.281) ^2*1.16+ (.001) ^2*1.31+ (.259) ^2*1.13+ (.066) ^2*1.16+ (.261) ^2*1.47+ (.002) ^2*1.12+ (.001) ^2*1.34+ (.001) ^2*1.00+ (.001) ^2 *1.22= .301

$GORM_3$ Switzerland =(.878)^2*1.70+ (.003) ^2*1.28+ (.012) ^2*1.13+ (.027) ^2*1.13+ (.004) ^2*1.46+ (.039) ^2*1.17+ (.038) ^2*1.47 = 1.313

Step 4 Adjustment for market liquidity

The market-liquidity-adjusting factor is derived by assuming an exponential function, which adjusts the measure of market concentration for risk due to limited market liquidity for a given country. The inverse of the market liquidity (ratio of world oil imports to net oil imports of a consuming country) is taken as the exponent of the function to obtain a parameter ($e^{(1/P0)}$) that moves in the direction of the index. [154]

Market liquidity adjusting factor for Sweden = $e^{(1/200)}$ = 1.00534

Market liquidity adjusting factor for Switzerland = $e^{(1/259.54)}$ = 1.00386

Fourth measure of geopolitical oil risk is obtained as follows.

$GORM_4$Sweden = ($GORM_3$ Sweden (.301))* 1.00534 = .302

$GORM_4$Switzerland = ($GORM_3$ Switzerland (1.313))* 1.00386 = 1.32

Step 5 Adjustment for the share of oil in TPES

Final geopolitical oil risk measure is obtained as follows.
GORM5Sweden = (GORM4Sweden (.302)) * .293 = .089
GORM5Switzerland = (GORM4Switzerland (1.32)) *.462 = .609
Similarly, we obtain the GORMs for other 24 countries.

Region	Share in world reserves (%)	Share in world consumption (%)
North America	5	29.5
Europe	1.5	20
Asia Pacific	3.4	29.1
Africa	9.5	3.4
Former Soviet Union	10.2	5
Middle East	61.6	7.1

152 For details refer to Blyth William and Lefevre Nicolas (2004)

153 The political risk of OPEC is obtained by taking the weighted average of the political risk in the individual member countries. Here, the percentage of the total OPEC reserves held by each member is used as the weight for each country.

154 For details refer to Blyth and Lefevre (2004)

Latin America	8.6	2.8

Source BP Statistical Review 2006

Table 2 ICRG political risk ratings of the oil producing countries[155] (2004-05)

Country	Political risk rating
Iraq	33.792
Nigeria	43.083
Venezuela	51.333
Indonesia	51.583
Angola	57.458
Algeria	58.250
Iran	60.375
Libya	65.083
Argentina	65.458
Brazil	66.500
Saudi Arabia	66.583
Russian Federation	67.875
China	69.792
Kazakhstan	70.333
Mexico	72.833
Qatar	73.125
Oman	76.125
Malaysia	76.625
Kuwait	77.292
United Arab Emirates	77.958
United States	82.542
United Kingdom	85.500
Canada	86.542
Norway	88.125

Table 3 Final Geopolitical oil risk measures (2004)

Countries	Final geopolitical oil risk measure	Final geopolitical oil risk measure-rank
Asia-Pacific		
Australia	0.019	25
New Zealand	0.091	23
Japan	0.724	1
Korea	0.486	5
India	0.122	21
China	0.016	26

155 ICRG political risk ratings range between 0 for high risk and 100 for low risk

Philippines	0.499	4
Average AP (All 7c)	0.280	
Average AP (3 c) Japan; Korea; Philippines	0.570	
North-America		
United States	0.097	22
Europe		
Austria	0.234	13
Belgium	0.163	17
Czech Republic	0.223	14
Finland	0.2854	8
France	0.1362	19
Italy	0.2853	9
Spain	0.275	11
Hungary	0.189	16
Ireland	0.350	6
Netherlands	0.148	18
Poland	0.274	12
Turkey	0.284	10
Slovak Republic	0.195	15
Sweden	0.089	24
Switzerland	0.609	2
Portugal	0.323	7
Greece	0.528	3
Germany	0.134	20
Average-E (18c)	0.262	
Average-E (5c)	0.419	
Average-total (26 c)	0.261	

E – Europe; AP – Asia-Pacific; C – countries

Figure 1

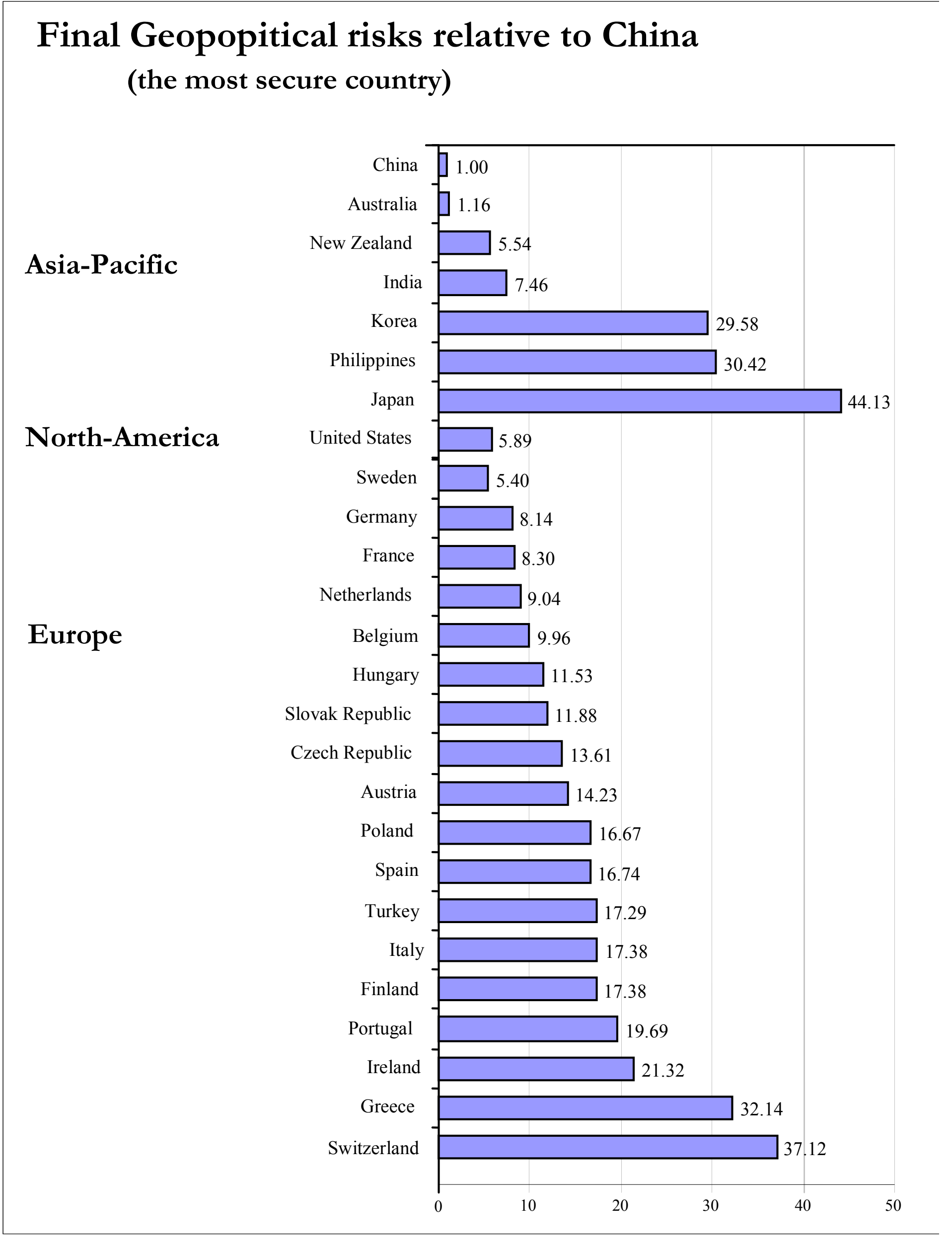

Final Geopopitical risks relative to China
(the most secure country)
Asia-Pacific
North-America
Europe
China
1.00
Australia
1.16
New Zealand
5.54
India
7.46
Korea
29.58
Philippines
30.42
Japan
44.13
United States
5.89
Sweden
5.40
Germany
8.14
France
8.30
Netherlands
9.04
Belgium
9.96
Hungary
11.53
Slovak Republic
11.88
Czech Republic
13.61
Austria
14.23
Poland
16.67
Spain
16.74
Turkey
17.29
Italy
17.38
Finland
17.38
Portugal
19.69
Ireland
21.32
Greece
32.14
Switzerland
37.12
0
10
20
30
40
50

Table 4 Grouping of the countries on the basis of their GORM

Most vulnerable avg GORM (0.667)	**More vulnerable avg GORM (0.504)**	**Less vulnerable avg GORM (0.281)**	**Least vulnerable avg GORM (0.117)**
Japan	Korea	Austria	Australia
Switzerland	Philippines	Czech Republic	New Zealand
	Greece	Finland	India
		Italy	China
		Spain	United States
		Ireland	Belgium
		Poland	France
		Turkey	Hungary
		Portugal	Netherlands
			Slovak Republic
			Sweden
			Germany

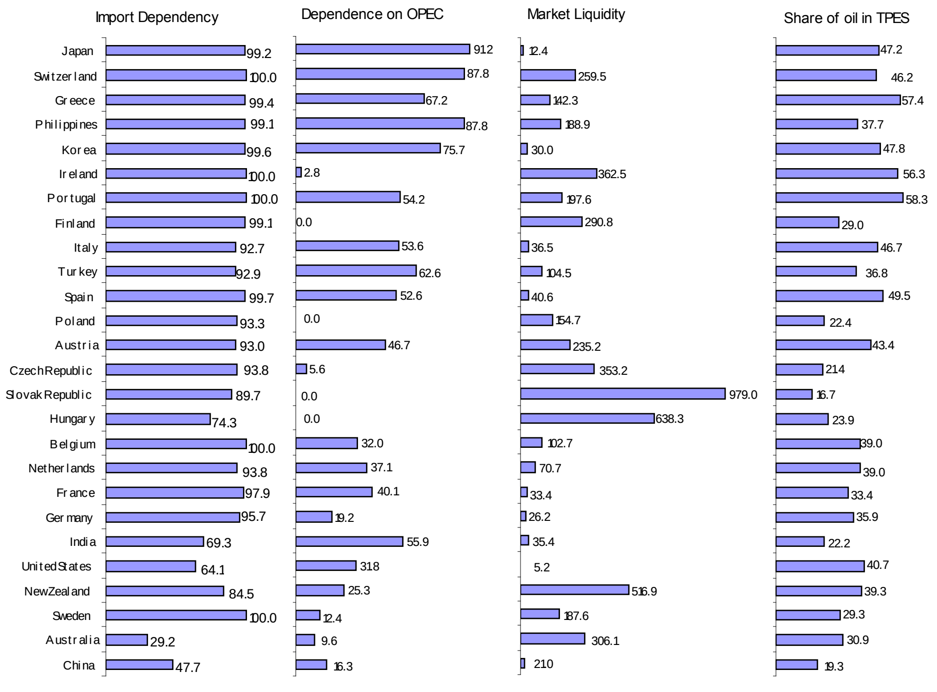
Table 5 Diversification and average political risk for all 26 selected countries.

Region	Countries	Major suppliers	**Average [1] political risks**
Asia-Pacific	China	DS (52%), AP (13%), A (10%), FSU (5%), ME (18%)	0.76665
	Australia	DS (71%), AP (24 %), ME (5%)	0.45978
	New Zealand	DS (15%), AP (43%), ME (40%)	1.23453
	India	DS (31%), A (16%), ME (47%)	1.14252
	Korea	AP (13%), A (5%), ME (77%)	1.63746
	Philippines	AP (6%), ME (92%)	1.66965
	Japan	AP (6%), A (4%), ME (89%)	1.67054
	Average AP	DS (24%), AP (15%), A (5%), ME (52%)	1.23
North America	United States	DS (36%), NA (19%), LA (14%), A (12%), ME (14%)	0.98126
Europe	Sweden	E (61%) FSU (26%), ME (8%)	1.30370
	Germany	E (33%), A (15%), FSU (40%), ME (7%)	1.35312
	France	E (30%), A (19%), FSU (22%), ME (27%)	1.44946
	Netherlands	DS (6%), E (25%), A (5%), FSU (27%), ME (33%)	1.36712
	Belgium	E (27%), FSU (38%), ME (28%)	1.45348
	Hungary	DS (26%), FSU (73%)	1.09197
	Slovak Republic	DS (10%), FSU (89%)	1.31903
	Czech Republic	DS (6%), A (6%), FSU (84%)	1.39721
	Austria	DS (7%), E (7%), A (24%), FSU (33%), ME (28%)	1.45758
	Poland	DS (7%), FSU (91%)	1.36371
	Spain	NA (13%), E (7%), A (35%), FSU (16%), ME (27%)	1.57884
	Turkey	DS (7%), A (21%), FSU (25%), ME (46%)	1.51573
	Italy	DS (7%), E (5%), A (33%), FSU (26%), ME (28%)	1.48488
	Finland	E (17%), FSU (81%),	1.39994
	Portugal	NA (5%), E (8%), LA (8%), A (46%), FSU (15%), ME (16%)	1.56490
	Ireland	E (97%)	1.16071
	Greece	A (7%), FSU (31%), ME (61%)	1.61572
	Switzerland	E (8%), A (80%), FSU (4%), ME (8%)	1.64581
	Average E	DS (5%), E (18%), A (16%), FSU (40%), ME (18%)	1.43

DS – domestic supply; NA – dependence on North America; E – dependence on Europe;

LA – dependence on Latin America; AP – dependence on Asia; A – dependence on Africa; FSU – dependence on Former Soviet Union; ME – dependence on Middle East

Figure 2 Individual indicators for the year 2004 (in descending order of GORM)



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CHAPTER FOURTEEN

Prospects for European Energy Security

S. Frederick Starr

"Security" is not an objective condition but a subjective state. Because of this, no non-European can tell a European whether he or she should, or should not, feel secure. The best that can be done is to indicate the objective conditions that prevail and report whether or not those conditions would arouse a sense of insecurity in the outside observer.

If Europe has grounds for feeling insecure with respect to its supply of energy, as I believe to be the case, it has little to do with the degree of its dependence on one source. True, the more sources of energy a country can turn to means greater freedom from any one of them. But if a dominant supplier, i.e., one providing more than a third of one's energy, charges reasonable market prices and reliably delivers the gas in a spirit of genuine partnership, there should be no problem. The dominant supplier may compete vigorously in a market but does not seek to monopolize it. To the extent that it has succeeded in gaining a strong market share, it does not use that position as a card to be played in some broader geopolitical game.

None of this can be said of Russia today. When the USSR first proposed a pipeline to deliver gas to Europe in the 1980s it assured customers that it would be a reliable partner, meeting its contractual obligations even when Russia's own gas supply is short and never allowing politics to interfere with deliveries.156 Soviet authorities met this expectation down to 1991. Under President Putin, however, their successors have turned their back on this prudent policy, and with radical effect. Manipulating the delivery of this natural resource, some of it Russian and the rest purchased at exploitative prices from now independent states of Central Asia,157 is seen as the key to Russia's geopolitical recovery as a "great power." The status of a "great power," however, is defined in nineteenth century terms of territorial domination and political control. The chosen policy tool for achieving this status is for the protectionist state to pursue its interests through nominally independent business entities, and with the

156 Anders Aslund, "EU Needs Policies on Russia and Energy," Telos-EU, Agence intellectuelle, 11 January 2007.

157 As of 2008 the Central Asians successfully forced Russia to pay them near-world prices for their gas. Russia will simply pass the added cost on to European consumers.Vladimir Socor,"Russia to Increase Purchase Price for Central Asian Gas: Outlook and Implications," Eurasia Daily Monitor, Vol. 5, No.50 (17 March, 2008), The Jamestown foundation.

grim determination to assure that any gain for one side means a loss for the other. Russia does not pursue this in all areas of the economy, nor does it need to do so. By vigorously implementing this approach in the "commanding heights" of energy supply, it shapes the entire environment not only for itself but for its customers as well.

This is the problem that Russia poses as a gas supplier and this is the source of what many believe to be Europe's energy insecurity today. When it began to recover from the economic crash of 1998 Russia became a petro-state.[158] Prime Minister Chernomyrdin, former CEO of Gazprom, was arguably the chief architect of the new approach. Under Mr. Putin this has continued, but in such a way as to turn the country into a retro-state. While China and other Asian countries embrace globalization, Russia rejects it in favor of a kind of mercantilism that directly recalls the narrowest forms of early modern European statecraft.

In a frontal and brazen manner, Russia has imposed this policy on both the suppliers and customers for its gas. Under Prime Minister Chernomyrdin it decided to punish Turkmenistan for demanding that Russia sell Turkmen gas to Europe at European prices and remit a fair share of the profits to Ashgabat. Overnight the GDP of Turkmenistan fell by nearly 25%.[159] Both Europe and the United States knew this was happening but decided to do nothing about it, smugly assuming that it was not their business to interfere. Vigorous maneuvering by Turkmenistan's President Niyazov eventually forced President Yeltsin to back down and eventually to sack his Prime Minister. But the practice of such coercive policies revived under Mr. Putin's presidency, this time directed against such diverse national targets as Ukraine, Belarus, Turkey, Finland, Hungary, Poland, Rumania, Bulgaria, and the three Baltic States. However, a new element has entered the picture as well, namely, the playing off of one customer against others. All too often Moscow has found eager European collaborators in this project, Germany being notable for both the eagerness and the callousness with which it steps into to the role of Mr. Putin's enabler.

It is striking that those countries that bear the weight of Germany's energy policy are the same ones that suffered most from German actions in the period 1939-45. The fact that Berlin cloaks its actions in pieties left over from the era of Ost-Politik does not change the essentially Bismarkian core of its current hard course.

Faced with this situation, the European Union long hid its head in the sand. While Azerbaijan, Georgia, Turkey, Britain, Norway, and the United States were planning and building the Baku-Ceyhan pipeline, the EU chose to stand on the sideline and to let the U.S. cover all political and economic risk, even though the

158 S. Frederick Starr, "Petro-State: Wondering About the Future of Russia? It All Comes Down to the Price of Oil," The International Economy, vol. XII, no. 6, November/December ,1998, pp. 48-50.

159 Suha Bolukbasi, "The Controversy Over Caspian Sea Mineral Resources: Conflicting Perceptions, Clashing Interests," Europe-Asia Studies, Vol.5, No.3, (May 1998) pp. 397-414; also "Russia," RFE/RL, No. 136, part 1, (16 July 1996), and ibid., Vol..1, No. 64, part 1 (July, 1997).

main customer for BTC oil is Europe.[160] Now, however, it promises to "get tough," with Angela Merkel even threatening to apply EU anti-monopoly legislation to Gazprom, as it has successfully done with Microsoft.[161] Yet in spite of recent gains on the long-imperiled Nabucco project, there is as yet no European energy policy. Even the threat to impose anti-monopoly legislation remains just a threat, leaving Moscow to believe, quite reasonably, that European legislation is a discretionary tool to be applied, or not applied, at the convenience of the dominant states in Europe, rather than a law that must either be applied or changed, but not ignored.

It remains to be seen whether the more decisive mood beginning to emerge in the EU will result in concrete and effective action. With a convert's zeal, the EU now professes an interest in countries like Azerbaijan, Kazakhstan, and Turkmenistan that it has long ignored or treated merely as the object of censure for perceived shortcomings in the area of democratization.[162] For the time being, however, this newly minted interest is expressed more in terms of satisfying Europe's needs rather than of bi-lateral understandings that embrace the needs of these countries as well, particularly in the area of security. Such an approach falls far short of what is required, and far short of what both China and the U.S. have done in the region. Until the EU can present itself to Azerbaijan, Kazakhstan and Turkmenistan as a reliable long-term partner who is willing to address these countries' real needs as well as its own, it is unlikely that its new approach will succeed.

Particularly revealing in this respect is the EU's passivity in the face of last year's action by Moscow against Georgia, when it cut off 100% of that country's gas supply in order to discipline it for seeking to regain control of territories wrested from its control with Russian support.163 For several winter months Georgians froze but the EU reacted ineffectively. Only when neighboring Azerbaijan stepped in with gas for Georgia did the situation change. Such experiences, carefully watched by governments across the Caucasus and Central Asia, do not encourage the states of those regions to rush into new agreements to provide gas to Europe.

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160 Svante E. Conell, Mamuka Tsereteli, Vladimir Socor, "Geostrategic Implications of the Baku-Tblisi-Ceyhan Puipeline," in. Frederick Starr, Svante E. Cornell, eds., Baku-Tblisi-Ceyhan Pipeline:Oil Window to the West, Silk Road Paper, Central Asia-Caucasus Institute, Silk Road Studies Program, 2005, pp.27-32. This threat was occasioned by Gazprom's efforts to buy European energy assets; see "Barriers Going Up All Over Europe," Moscow Times, 3 March 2008.

161 This threat was occasioned by Gazprom's efforts to buy European energy assets; see "Barriers Going Up All Over Europe," Moscow Times, 3 March 2008.

162 "US, EU, Caspian and Black Sea States Plan Common Energy Market," Environment News Service, 30 November 2006, available at http://www.ens-newswire.com/ens/nov2006/2006-11-30-02.asp; and "The EU Wants to Build an Energy Strategy in the Caspian Region," Kavkaz Center, 11 January 2007, available at http://www.kavkazcenter.com/eng/content/2007/01/11/7137.shtml

163 Vladimir Socor, "Russia's Energy Supply Cutoff to Georgia: Another Wake-Up Signal to the West," *Eurasia Daily Monitor*, Jamestown Foundation, 23 January 2006.

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CHAPTER FIFTEEN

A Grand Strategy or Contingency: Russia's Energy Relations in the Eurasian Context

David Dusseault

Introduction: A Word about Theory and Approach

This paper is in part a response to the need to address the perceived theoretical, methodological and interpretive weaknesses in contemporary scientific literature concerning the nature of energy policy formation in Eurasia. The main focus of the research is the Russian Federation by natural default. Current conditions in the globe's hydrocarbon resource base along with market forces have shifted global energy majors' as well as states' focus towards Russia as a potential well-spring of oil and gas, providing the lure of boundless opportunities to maximise economic profit and secure supplies of crucial commodities necessary to the maintenance of firms' economic solvency and states' political legitimacy.

However, as much as the image of Russian oil and gas provides potential investors and public servants with images of uninterrupted supplies of strategic natural resources, profit, and with it domestic political stability, Russia's predictedascendancy to the status of energy superpower has ushered in a period of trepidation on the part of consumer states and international energy companies alike. Despite all the natural wealth and economic potential the country possesses, Russia, under the Putin regime, is short of a seemingly indisputably important, internationally recognized commodity: credibility.

In terms of the social science perspective, the gap between natural resource based potential and state capability to organise disparate societal interests to achieve an adopted strategy provides an immense field for seeking out explanations to just how and why this gap exists.[164] Although full of possibilities for social scientists to conduct

164 This literature focuses on the existence and nature of the resource curse. See for instance Cooper ,J. (2006): "Can Russia Compete in a Global Economy" in *Eurasia geography and Economics* Vol. 47, No. 4, pp. 407-425; Aslund, A. (2005): "Russian Resources: Curse or Rents?" in *Eurasia geography and Economics* Vol. 46, No. 8, pp. 610-617; & Ahrend, R. (2005): "Can Russia Break the Resource Curse" in *Eurasia geography and Economics* Vol. 46, No. 8, pp. 584-609.

meaningful enquiries, the energy field is fraught with just as many constraints on the research, which however daunting, fortunately should be familiar to all those that have previously struggled to design a research programme in other fields of the social sciences.[165] What makes the energy question particular may not be comprised solely of the challenges it presents contemporary society or social scientists in terms of issue scope. Instead we, researchers ourselves, may be handcuffing our own attempts to explain energy policy through the scientific inadequacy of present day models applied to the energy phenomena.

In order to release the energy issue from the existing directionless debate, this paper then bases its arguments on several fundamental principles of social scientific inquiry.[166] All research in the fields of social science starts with questions, not answers. If we as social scientists were as sure about other aspects of society as we seems to be concerning Russia's role in Eurasian energy policy, there would hardly be any need for our intellectual production beyond affirming indisputable, universally accepted truths.

Second, if we assume that there is a need and an added value to be derived from questioning our current understanding of the nature of energy policy formation in Eurasia, then the goals of this intellectual exercise should not be only confirming currently held, popular assumptions, but instead should serve to challenge conformity by aiming for possible answers based on derived scientific inference[167]. Deriving inference from our research, although exposing the limitations of explanatory power of social scientific enquiry, simultaneously allows us to identify further holes in our knowledge and continue the pursuit of a more precise conceptualisation of our social

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165 The four areas which comprise a research programme include the research question, the theory, data and the utilization of the data. King, G. Robert O. Keohane, & Sidney Verba (1994): *Designing Social Inquiry: Scientific Inference in Qualitative Research* Princeton University Press pp 12-13. Out of the four components, data collection seems to be the most problematic due to the strategic nature of the resources themselves, the opaqueness of associated strategy formation and the insider nature of the sector's decision-making processes. However, this article will deal more so with the nature of the research question. It is suggested that by choosing a narrow research question such as "Is Russia an energy superpower?" researchers involved in the current debate limit their focus to a restricted trench of the energy sector dealing with the concept of security of supply and demand. The limited nature of the research programme ignores crucial physical, financial, informational and institutional factors. The limited scope of the research under-determines the quality and quantity of the descriptive and causal inference gleaned from the research.

166 King, G. Robert O. Keohane, & Sidney Verba (1994): Designing Social Inquiry: Scientific Inference in Qualitative Research Princeton University Press pp 7-9

167 King, Keohane and Verba see the distinction between scientific research and the collection and analysis of facts being formed by the production and use of descriptive and causal inference. According to the authors descriptive inference allows social scientists to use "observations from the world to learn about other unobserved facts" while causal inference allows for, "learning about causal effects from the data observed." The key role of both forms of inference in social science research is its ability that enables the researcher to go beyond the observation and statement of plain facts and formulate a more general understanding of how factual observations fit into a generalisable social dynamic. See King, G. Robert O. Keohane, & Sidney Verba (1994): Designing Social Inquiry: Scientific Inference in Qualitative Research Princeton University Press p. 8

reality.

Third, in addition to conducting all research associated activities in a transparent and public manner, our work needs to be carried out according to accepted rules of the scientific game. The method by which we do research distinguishes social scientific enquiry from other forms of less robustly structured intellectual pursuits. In part, the application of method assures that the conclusions we obtain are not only accurate in relation to the model and data collected, but with the addition of newly gained data and improved methodology, obtained conclusions can be further questioned and our collective understanding of the object of research honed.

Following on from my colleagues' related work on this exact issue[168] I would characterise the current treatment of the energy issue and Russia's increasingly central role in the Eurasian energy sector in many cases as substantively incomplete, lacking sufficient data on specific actors and their associated interests. Under such conditions, the remedy does not need to be explained here, simply to say that more fieldwork is needed to fill in the gaps in the data.[169]

However, in the worst case, treatments are methodologically insolvent. In some instances, inappropriate independent variables are over specified. In others, assumptions are used to fill in substantive data gaps contributing to overt speculation or deterministic conclusions. In the case of significant amounts of data, appropriately developed cognitive constructs or sound methodology to treat the data and explain the phenomena with the required degree of scientific objectivity and professionalism are underdeveloped or are simply absent.

The solution to the current crisis in Russian energy sector research cannot be forthcoming in this paper. Instead my intention is to argue for a more accurate assessment of the nature of Russia's role in the Eurasian energy sector. To do so, I intend to present some of the existing pertinent questions and data surrounding Russia's energy sector and subject the material to more rigorous tests in order to assess the degree of validity of each question's conclusions and to proffer alternative hypotheses where necessary and identify directions for subsequent research into the issues in question.

Starting Off on the Wrong Foot?

In the first lines of a recent article by William Zimmerman[170] the basic syndrome

168 Aalto, P. David Dusseault, Michael Kennedy & Markku Kivinen (2007): Is Russia Becoming an Energy Superpower? The Social Structuration of Russia's Energy Sector Paper presented at the ICCEES Regional Conference Berlin, 2-5 2007

169 For instance, Michael Bradshaw suggests that more research is needed into the internal workings of Russian energy firms and ministries along with their decision-making processes in order to better comprehend the observable effects of Russian energy policy. See Bradshaw, M. (2006): "Observations of the Geographical Dimension of Russia's Resource Abundance" in Eurasian geography and Economics Vol. 47, No. 6, pp. 724-746

170 Zimmerman, W. (2007): "Normal Democracies and Improving How they are Measured: The Case of Russia" in Post Soviet Affairs Vol. 23, No. 1 pp1-17

facing researchers of the contemporary Russian state is laid plain. As area specialists, we are forced to deal with the spectre of Russian exceptionalism. Following on from Zimmerman, the particular difficulty posed by Russia as an outlier means that researchers and analysts are forced either into arguing for or against Russia's degree of normality within a particular set of observations. Arguing for exceptionalism calls into question whether it is actually possible to divine scientific inference from the Russian case and apply these lessons to other data sets. On the other hand, if exceptionalism is rejected, the individual researcher is perceived as an apologist, blind to Russia's particular political, social and economic foibles. Even more disturbing is the apologists' perceived inability to comprehend the threats that the Russian state posses to its neighbours and the stability of the international order.

The reason I mention this discrepancy brought up by Zimmerman is simple. The straightforward dichotomy in terms of Russia's role in the world and the nature of the Russian state's strategies as understood by researchers is pervasive in the present treatment of Russia's increasing role in the world's energy sector. Already back in 2002, analysts and journalists began to speak of Russia's intensified activity and influence in the world's energy markets in terms of an energy superpower.[171] This discourse has since moved away from the question whether Russia will become an energy superpower. It is now assumed that Russia is striving to become an energy superpower. Researchers, journalists as well as public servants are now seemingly more interested in finally "proving" that this state of affairs is an accurate and fair representation of the social reality.[172] Despite clear economic, political, physical evidence to the contrary, the framing of the general research question which is on most observers' lips these days can be formulated in the following manner: **Is Russia an Energy Superpower?**

Many seem convinced that Russia's march to a renewed superpower position in the international arena is assured, fuelled by the continuing demand for exports of its natural resources[173]. Therefore making an attempt to "disprove" the obvious would only add fodder to an already open-ended debate framed in the exceptionalism context. From a social scientific point of view, the question is too narrow in its scope[174]. Perhaps, a more scientifically sound argument would be formed through

171 Hill, F. (2002): "Russia: The 21st Century's Energy Superpower" The Brookings Review Vol. 20, No. 2 pp. 28-31

172 See for instance Tymoshenko, Y. (2007): "Containing Russia" in Foreign Affairs May/June Vol. 86, Iss. 3 p69; Goldman, M.I. (2004): "Putin and the Oligarchs" in Foreign Affairs Nov. / Dec. Vol. 83, Iss.6; p.33

173 In his work on Russian GDP, Tabata has shown that the natural resource sector has not played the central role in the recent increase in the country's economy. Instead, it is consumer confidence, evidenced by increased consumer spending that has fueled economic growth in Russia. See Tabata S. (2006): "Observations on Changes in Russia's Comparative Advantage" in Eurasian Geography and Economics, Vol. 47, No. 6, pp. 747-759 and Kuboniwa, M., S. Tabata, & N. Ustinova (2005): "How Large is the Oil and gas Sector of Russia? A Research Report" in Eurasian Geography and Economics, Vol. 46, No. 1, pp. 68-76

174 Robert Yin divides research questions into categories who what where when and why. The

a redressing of the fundamental research question which would allow researchers to take advantage of a wider set of data available concerning the Russian energy sector.

Evidence for Reformulating the Superpower Discourse

It is one thing to announce that the sky is falling. It is an entirely different intellectual enterprise to substantiate that this assessment is indeed accurate. Beside utilising a tautology (Russia is or it is not a superpower) to formulate the basis for social research, another major fault of the Russian energy superpower discourse is that in its current manifestation, the data utilised to support the theory is a collection of events, such as a string of gas and oil shut offs to transit countries[175], the construction of new pipelines that bypass former transit states, or the removal of foreign energy majors from substantial oil and gas development projects on the territory of the Russian Federation. Juxtaposing events as "proof" of a politically motivated agenda without taking into consideration the historical context within which the events occurred or identifying the dynamics (signified by operationalised independent variables) that underwrite such actions subtracts from a more fundamental understanding of the underlying interests (descriptive & causal inference) that contribute to state policy formation.

Modifying the direction of the research into Russia's energy policy formation away from the superpower discourse would not demand a major paradigmatic shift, mining of significant amounts of new data or the identification of major behavioural trends in energy sector actors' preference formation and agency. In fact several potentially interesting areas for further scientific inquiry have been identified previously by geographers, economists, IR theorists, sociologists and political scientists alike.

Some potentially important research questions have already been unearthed and could serve to contribute to an improved understanding of the implications the Russian energy sector may have not only domestically, but in a regional as well as global context. For instance, M. Bradshaw[176], Gaddy and Ickes[177] have done significant

use of interrogatives in framing the question allows for a wider explanation to the phenomenon under observation. The questions also then to a large extent determine the type of experiment that is best suited to the research programme. In the case dealt with in this article, the question "Is Russia an energy superpower?" allows for only two answers yes and no. The limited amount of outcomes to a large extent limits the amount of data necessary to support the question's theories, the level of critical analysis of the data needed to ascertain its relation to observed outcomes and most importantly to large extent determines the nature of the conclusions before the research is begun. See Yin, R. K. (1994): Case Study Research: Design and Methods 2nd ed. Sage Publications: London.

175 See Larsson, R. (2006): Russia's Energy Policy: Security Dimensions and Russia's Reliability as an Energy Supplier Scientific Report FOI Swedish Defence Research Agency as published at http://www.foi.se

176 Bradshaw, M. (2006): "Observations on the Geographical Dimensions of Russia's Resource Abundance" in Eurasian Geography and Economics, Vol. 47, No. 6, pp. 724-746

177 Gaddy, C.G. & B. Ickes (2005): "Resource Rents and the Russian Economy" in Eurasian Geography and Economics, Vol. 46, No. 8, pp. 559-583

amounts of research into the structure of rent in the Russian natural resource sector, identifying not only the nature of the benefits accrued from resource export, but who tends to benefit from the exploitation of Russia's natural resources. Those who benefit are not defined plainly as Putin's cronies or heads of favoured companies. The picture is more complex. In one sense, a very disturbing trend concerns the flow of resource rent away from the peripheral regions, where the resources are located to the federal centre. This relationship indicates that those that own resources do not necessarily benefit from their exploitation, an issue that cropped up during perestroika and now seems to be left unresolved.

Recent work by K. Martin[178], Milov et al[179], Sagers[180], Bradshaw & Bond[181], and Aslund[182] question the nature and degree of state intervention in the energy sector. Far from being a situation in which we could describe the Russian state's and Russian energy majors' interests as being either mutually exclusive or entirely unified, an accurate representation of the relation between the state and the business community has so far eluded social scientists. Journalists report on splits amongst competing groups or individuals within the presidential administration of Russia or amongst the firms or governmental ministries.[183] However, attempting to substantiate this speculation is highly problematic due to constraints mentioned earlier in the paper[184]. Many of the above authors also categorise state intervention in the energy sector giving mixed marks to the Putin administration according to the policies adopted and the suitability of state institutions to carry out the state's policies.

Other researchers such as Yakovlev & Zhuravskaya[185] have tended to conduct their analysis on a more general level and investigate the nature of competition amongst firms at the regional and federal level and their ability to capture state bureaucracies

178 Martin, K. (2007): "Russian Efforts to Control Kazakhstan's Oil: The Kumkol Case" in Post Soviet Affairs Vol. 23, No. 1 pp 18-37

179 Milov, V., L.L. Coburn, & I. Danchenko (2006): "Russia's energy Policy, 1992-2005" in Eurasian Geography and Economics, Vol. 47, No. 3, pp. 285-313

180 Sagers, M.J. (2006): "Russia's Energy Policy: A Divergent View" in Eurasian Geography and Economics, Vol. 47, No. 3, pp. 314-320

181 Bradshaw, M. & A.R. Bond (2004): "Crisis Amid Plenty Revisited: Comments on the problematic Potential of Russian Oil" in Eurasian Geography and Economics, Vol. 45, No. 5, pp. 352-358

182 Aslund, A.(2005): "Russian Resources: Curse or Rents?" in Eurasian Geography and Economics, Vol. 46, No. 8, pp. 610-617 & (2006): "Russia's Energy Policy: A Framing Comment" in Eurasian Geography and Economics, Vol. 47, No. 3, pp. 321-328

183 See Babich, D. (2007): "Russneft: Torn by Two Kremlin Groups?" in Russian profile as Published at http://www.russiaprofile.org/page.php?pageid=Business&articleid=a1187000324

184 See the comment on data collection in footnote 2.

185 See Yakovlev, E. & E. Zhuravskaya (2005): State Capture: From Yeltsin to Putin as published at www.cefir.ru/download.php?id=180. See also Ponomareva, M. & E. Zhuravskaya (2004): "Federal tax Arrears in Russia: Liquidity problems, Federal Redistribution or Regional resistance?" in Economics of Transition Vol. 12, No. 3, pp. 373-398. Zhuravskaya, E. (2005): State Capture in a Federation WZB Economics and Politics Seminar Series as published at www.wz-berlin.de/mp/sem/past/2005/wzb_zhuravskaya.pdf

for their own economic interests. This research contradicts the conventional wisdom that state and business sector interests coincide fully and the source of policy formation is the state itself. In her work, the author finds that it is the firms at both levels that are competing to take over state assets, mostly at the regional level, and not vice versa. Other regional analysts[186] in their case studies have identified competition amongst the federal energy majors and other business conglomerates over political resources at the regional level, indicating that even within the same region, the likes of Gazprom, Rosneft, and Lukoil have their own networks of political supporters and differentiate themselves according to their interests and domestic strategies, even though they are supposedly playing on the same Kremlin team.

Still more research points to the replication of organisational models of political and economic resources between the regional and federal level. The concept of a national hero has been attributed solely to President Putin and his scheme to have the country's major industries contribute to the country's long term socio-economic development. However, companies such as Tatarstan's Tatneft have been fulfilling this role in the Tatar Republic since the late perestroika period.[187] The intertwining of political networks and financial flows serves to create a formidable political machine which affords the local population economic and social stability and the political leadership with loyal cadres for the bureaucracy and a reliable source of budgetary funds. In a related vein, the business strategies and roles of the energy majors could be investigated in conjunction with suggestions made by Gaddy and Bradshaw regarding resources rents mentioned above.

From the technical perspective, Leslie Dienes[188] and Clifford Gaddy[189] illustrate severe concerns regarding the past exploitation and future sustainability of Russia's precious hydrocarbon resource base. Russia is far from being able to count on a smooth transition from maturing brown fields in Western Siberia to green field projects

186 See Gnezditskaia, A. (2004): Unidentified Shareholders: The Impact of Petroleum Power over the Banking Sector in Russia vis-à-vis other Petro-states as published at http://socsci2.ucsd.edu/~aronatas/scrretreat/Gnezditskaia.Anastasia.doc; See also Glatter, P. (2003): "Continuity and Change in the Tyumen' Regional Elite 1991-2001" in Europe-Asia Studies Vol. 55, No. 3, pp 401-435 & Yorke, A. (2003): "Business and Politics in Krasnoyarsk Krai" in Europe-Asia Studies Vol. 55, No. 2, pp 241-262

187 Sharafutdinova, G. (2001): "Concentrating Capital helps Tatarstani Leaders in Battle with Putin's Centralisation" in Russian Regional Report Vol. 6, No. 36 as published at http://www.isn.ethz.ch/pubs/ph/details.cfm?lng=en&id=14134; McCann, L. (2004): "Globalisation and Post-socialist Development: The Tatarstan variety of Capitalism" in Post Communist Economies, Vol. 16, No. 3 September p 353; Sharafutdinova, G. (2004) "The Oligarchs are Coming?! Political Implication of Capital Expansion in the Case of Tatarstan" at http://casnov1.cas.muohio.edu/havighurstcenter/papers/Young%20Researchers%2004/Sharafutdinova.pdf; and Sharafutdinova, G. (2003) "Crony Capitalism and Pluralism Democracy Undermined by Competitiveness?" as published at www.sog-rc27.org/Conference/dc_2003_papers.html

188 Dienes, L. (2004): "Observations on the problematic Potential of Russian Oil and the Complexities of Siberia" in Eurasian Geography and Economics, Vol. 45, No. 5, pp 319-345

189 Gaddy, C. (2004): "Perspectives on the Potential of Russian Oil" in Eurasian Geography and Economics, Vol. 45, No. 5, pp 346-351

in the eastern regions of the country. Due to physical, financial and institutional constraints, Russia's technical capacity to deliver to the expanding markets of Asia forms a more significant and basic problem for consumer states outside the security discourse: the lack of commercially viable hydrocarbon resources to satisfy increasing demand.

In terms of Russia's energy sector involvement within the economies of the CIS, several recent works point to the differentiation of political and economic capacities of the states themselves following the collapse of the USSR.[190] Other authors have discussed in detail the Russian energy majors' economic strategies in the CIS.[191]Again competition and differentiation amongst the firms' strategies underline the general trend that although Russian influence in the CIS is fairly strong, business development can be characterised as more of a reconstruction of former production and supply networks that existed under the centralised Soviet system than an all out push to re-establish political hegemony over the former Soviet republics. This may be in part due to the physical existence of indigenous political elites with their own established political and economic interests in mind when dealing with Moscow[192].

Finally, the frames, through which Russia[193] and its neighbouring states[194] perceive, formulate and pursue energy strategy differs on a regional basis. Our research at the Aleksanteri Institute has found a clear demarcation between what can be termed as Russia's European and Asian energy interfaces.[195] On the one hand, the institutional constraints that define the EU Russian relationship may be hindering a long term, multilateral agreement on supply and demand between the RF and the EU.[196] On

190 For a general overview on the variance in energy resources and capacities, see Dusseault, D. (2007): Over A Barrel: Dependency Theory and the Energy Sector in the CIS in Dusseault, D. (ed.): The CIS: Form or Substance Kikimora Publications: Helsinki; For industrial analysis see Vahtra, P. (2007): "The Role of Russian Energy Companies in the CIS" in Dusseault, D. (ed.): The Dynamics of Energy in the Eurasian Context Kikimora Publications: Helsinki

191 For industrial analysis see Vahtra, P. (2007): "The Role of Russian Energy Companies in the CIS" in Dusseault, D. (ed.): The Dynamics of Energy in the Eurasian Context Kikimora Publications: Helsinki

192 An excellent example of such a case is that of A. Lukashenka in Belarus. Despite the existence of political rhetoric supporting the political union of Belarus and the RF, disparate economic interests between the two countries exist. See Aleksanteri Institute Eurasia Energy Group (2006): Belarusian Russian Relations The Energy Dynamic on the Borders of the EU Memo No.1 as published at http://www.helsinki.fi/aleksanteri/energy/publications/policy_memos.htm

193 Kivinen, M. (2007): "Frames of Russian Energy Policy in Transition" in Dusseault, D. (ed.): The Dynamics of Energy in the Eurasian Context Kikimora Publications: Helsinki

194 Kennedy, M. (2007): After Liberalism In European Enlargement and Energy Dependence Paper Presented at 'After Liberalism' Conference organised by the Social Science Research Council and the Institute for Eastern Europe, Moscow June 2007

195 See Aleksanteri Institute Eurasia Energy Group (2006): Internal Dynamics of the Russian Energy Sector The Energy Dynamic on the Borders of the EU memo Nr. 2 as published at http://www.helsinki.fi/aleksanteri/energy/publications/policy_memos.htm

196 See for instance, Romanova, T. (2007): "The Evolution of the Energy Dialogue from 2000 to 2005 and Beyond" in Dusseault, D. (ed.): The Dynamics of Energy in the Eurasian Context Kikimora Publications: Helsinki

the other hand, it is the institutionally under-determined nature of Russia's relations with the emerging consumer nations of NE Asia that may provide opportunities for Russia to develop its eastern resources more quickly, if conditions develop favourably over the medium to long term.[197]

Summing up the Evidence

By reviewing the current trends of research into the Russian energy sector, the explanatory weaknesses, in terms of inference generation, of the security paradigm are exposed. Indeed, the security tack may be useful in clarifying specific aspects of relations among certain actors at a particular stage of their energy relations198. However, expanding the scope of the energy sector issue into the context of the above mentioned research, one can conclude that the security discourse's added value comes into play only when interests and subsequent energy strategies have been solidified; and is at a loss to produce insight into the causality behind historical events that lead to the securitisation of energy relations between states before their policy positions become increasingly mutually exclusive. By neglecting the interaction of particular pre-existing conditions, mechanisms, and preferences that lay the foundations for potential competing energy policies from the outset, researchers only provide insight post-factum, thus too late for substantial policy re-think or modifications

Reformulating Social Science Research into Russia's Energy Sector: Contingency as Strategy

Far from being pre-ordained as laid out in the security paradigm, Russian energy policy in the context of the research outlined above, can be portrayed as a set of actions undertaken by associated actors within the policy environment in which they find themselves. It is hardly likely that in an abstract sense while taking into all the constraints that Russian energy firms encounter in their activities that they will be able to maximise to the full extent (I assume here total gate keeper status over decisions of supply and demand in the Eurasian energy sector) under prevailing conditions. Instead, the historical record has demonstrated thus far that actor agency in the Russian energy sector has been far from perfect in terms of following a set plan to the letter. Instead, Russian agency has taken advantage of the opportunities presented within the prevailing policy environment under a sector-based consolidation

197 See Dusseault, D. (2007): "The Great Leap Eastward: Russia's Energy Strategy in Northeast Asia" in Dusseault, D. (ed.): The Dynamics of Energy in the Eurasian Context Kikimora Publications: Helsinki

198 Here the security approach may be able to shed light on mechanisms and tit-for tat strategies that states may utilize once relations in the energy sector have disintegrated beyond normally institutionalized, negotiated market and political means. See Palonkorpi, M. (2007): The Energy Security Complex in the Caucasus paper presented at NISA Conference Power, Vision and Order in World Politics 23rd-25th May 2007 University of Southern Denmark

strategy.

This contingency based approach is better suited for gleaning inference due to its rejection of determinism. Whether it is the failure to structure incentives for long term investment, resolving conflicts over the ownership of formerly centrally controlled critical infrastructure, management of the resource base, inefficient or unbalanced rent distribution, or managing the environmental fallout from industrial production, the challenges put forth by existing physical, financial, institutional and informational factors are compounded by interaction with human activity. Simply put, the actions undertaken now by actors in the energy sector have ramifications for future activity. In that sense, there are no guarantees that steps taken today will ensure future strategic success.

Redefining the Research Focus: New Questions, New Answers

The type of questions asked to a large extent determines the nature of the research programme as well as the type of answers derived from the research. For purposes of providing new directions for research into the formulation of Russia's energy policy, I follow the structuration paradigm developed by Aalto, Dusseault, Kennedy and Kivinen.[199] Without going into too much detail, the structuration paradigm is a distillation of Giddens' and Wendt's attempts to characterise actor agency within a specific policy context. The independent variables that influence both energy policy as well as actor agency are financial, physical, institutional, and informational factors. The dependent variable is Russian energy policy formation. The authors hypothesise that the extent to which the four factors are present in observable cases, the more likely energy policy will be "structured", i.e., more influenced by the environment in which the strategy is formulated. The causal inference that can be derived from the hypothesis then becomes clearer. The more structured the environment is from which policy derived, the more complicated it becomes for actors to maximise interests.[200]

The gap between the Russian state's capability to exploit its natural resource wealth and the security paradigm's predictions for strategy maximisation are unbalanced in light of the physical, financial and institutional hindrances the industry faces. Based upon the critique of the security paradigm's viability in the context of the highlighted research and through the application of the structuration model, I have delineated

199 Aalto, P. David Dusseault, Michael Kennedy & Markku Kivinen (2007): Is Russia Becoming an Energy Superpower? The Social Structuration of Russia's Energy Sector Paper presented at the ICCEES Regional Conference Berlin, 2-5 2007

200 The onus of maximising strategy under conditions determined by the observable degree of the independent variables is thus placed on the actor due to the fact that ultimately it is the actor's perceptions of the environment that determine the preferred strategy. However, the relationship between actor and institutions is hardly unidirectional. As mentioned earlier, the policy environment influences actor agency as much as actors influence the structure and nature of the environment over time. This reinforcing relationship among actors and the policy environment is in constant flux and as such is more likely to provide limited opportunities to actors to influence the policy environment fully and vis-versa.

three macro-areas in which social science based research into the Russian energy sector may derive policy relevant value.

First, in the security paradigm, Russia's state is presented as a unitary system, with federalism perceived as in the best case procedural, in the worst case, an out and out sham. Even if it can be argued that in a procedural sense the institutions of democratic government are opaque and do not allow for divergent interests to be heard in the public political arena, it does not necessarily mean that regional elite interests, political and economic, do not deviate from Moscow's preferences. The variation in institutional, physical, informational, and financial factors on a region by region basis in Russia would support the concept of a complicated bargaining process among the relevant federal and regional elites in the strategic energy policy formation process.

Research question: How is Russian energy policy formulated?

Discussion:

Russian strategic interests are not entirely the product of a continuously centralising state bureaucracy under the guidance of the Kremlin elite. The federal structure of the Russian state betrays the fractured nature of interests and their formation along not only federal and regional lines, but within the regional units as well, at the local level. The formalised institutional distribution of political preference formulation and agenda setting is complicated by the existence of cross-cutting and competing economic interests, financial flows, and shared physical (geological and environmental) factors.

If any lessons could be learned from the Yeltsin presidency, it was that regional elites have their own interests that are not always in line with those of the Kremlin, no matter how powerful the federal centre's power of administrative persuasion is. Economic and political interests in the regions are fused to varying degrees across the constituent units of the RF[201]. Many regions see Moscow not as an arbitrator or a mechanical distributor of the Federation's resources, but as a serious economic as well as a political competitor with its own interests and motivations that sometimes run contrary to those of regional elites. Instead of displaying a clear, mutually exclusive delineation among federal and regional decision making responsibilities and capacities, the Russian federal system is inhabited by legislative gray areas, where core concepts such as resource ownership, oversight, and associated rent distribution between Moscow and the regions are left seemingly ambiguous. This institutional no-man's land may provide Russian regional and federal decision-makers the manoeuvrability and security needed to forward their interests in a very short-term, cynically organised policy environment. Without consensus among actors or

201 See Dusseault, D. (2007): The Nature of Russian Federalism: Centre Periphery Power Relations in Russia's Regions Ph.D. thesis Department of Political Science, University of Dublin, Trinity College (forthcoming)

significant incentives to play by the established rules of the game over the long term, resources have more value left in the ground than in a commercialised form because their value and ownership are neither guaranteed by the state's institutional structures or the actors that populate the state itself[202].

If we assume that Russian energy policy must take into consideration not only federal level prerogatives (both domestic and international, formed in Moscow), but those of the regional and local preferences (formed locally), the process of policy formation in Russia becomes more manifold and should be re-examined. The main objective of this research direction would be identifying the actors, their interests and their interplay with prevailing physical, financial, informational and institutional conditions that determine Russian energy policy.

Second, in the security paradigm, the influence of the internal institutional structure of the state is de-emphasised by aggregating industry interest formation exclusively to federal level state actors: the presidential administration, federal level oligarchs, ministries, and energy sector monopolies. The existence of gray areas in natural resource rent distribution contradicts the strong state/state centred model and could be evidence of a complicated set of competing political and economic interests both inside and outside the Kremlin walls.

Research question: What role(s) does the state play in energy policy formation in the Russian Federation?

Discussion:

Although I understand and to a large extent agree with the critical analytical tack on Russia's energy policy taken by Milov et al[203], their analysis is in scientific terms, incomplete. It is one thing to identify the shortcomings of a particular policy. However, without providing conclusions drawn from the inference gleaned from their analysis, particular solutions to the identified policy deficiencies are hardly forthcoming. If we agree for the time being that Russian interests are not determined solely by the Kremlin elite, but are a compilation of regional and federal interests that change over time, then we need to refine our research into the different roles played by the Russian state in energy policy formation in order to qualify and quantify state intervention in the sector as well as locate pressing areas of policy that need to be addressed.

For starters, the Russian state's most obvious function in energy policy is its support

202 This situation may have significant relevance when it comes to developing the Eastern Siberian resources. The lack on consensus in terms of how to develop the region's hydrocarbons, the delegation of financial and institutional costs, along with who stands to benefit may altogether hinder the region's oil and gas reserves commercialisation for the growing markets of NE Asia and North America.

203 Milov, V., L.L. Coburn, & I. Danchenko (2006): "Russia's energy Policy, 1992-2005" in Eurasian Geography and Economics, Vol. 47, No. 3, pp. 285-313

of a domestically formed energy strategy in the international context. However, the Russian state also plays a role in the domestic structuring of policy, the distribution of rents from the profits accrued from resource export, as well as coordinating sector-based efforts to maintain the industry's production and competitiveness.

Far from being a unitary omnipotent actor though, the Russian state is apparently geared to perform macro-level functions[204]. The Kremlin leaves the details of exploration, production and organisation up to the country's energy majors, ministries and individual actors, who compete amongst each other for their own preferences within a wider, more general set of strategic priorities. A valuable contribution to the literature from this macro project would be to discover the degree to which sector-based interests overlap with the state-based preferences in the Russian energy sector, determine the extent to which the state can organise and aggregate interest competition among various actors and assess the appropriateness of observable policy outcomes in the state based, industrial and societal context.

Third, Russian energy policy does not take place in a vacuum. As much as Russia's domestic interests hold sway in policy formation, Russian energy policy interests interact with the preferences, conditions, and structures that exist in the international context. Causality in terms of energy policy competition on the international level is therefore is multi-directional.

Research question: How does Russian energy policy manifest itself internationally?

Discussion:

The scope in which Russia could serve to influence the world's energy sector is again differentiated through regionally based constraints. Russia's influence in the near abroad can be interpreted differently from its relationship with it and strategic markets in the EU, the emerging markets in Asia and prospective markets in North America. For instance, observing Russia's behaviour in the Central Asian countries of the CIS, the Russian state is an institutionally strong, resource poor, geographically and financially advantaged actor compared to the resource rich, institutionally, financially and physically (geographically) weak former Soviet republics. Russia's ability to set the energy sector agenda in Central Asia is due to this specific combination of the four factors, particularly due to the country's geographical position and resulting natural monopoly over export transit routes from the region.

This advantage dissipates in the context of Russia's western neighbours in the post-soviet space. Russia is still resource rich, institutionally stable, and financially

204 Bradshaw, M. (2006): "Observations on the Geographical Dimensions of Russia's Resource Abundance" in Eurasian Geography and Economics, Vol. 47, No. 6, pp. 724-746 & Bradshaw, M. & A.R. Bond (2004): "Crisis Amid Plenty Revisited: Comments on the problematic Potential of Russian Oil" in Eurasian Geography and Economics, Vol. 45, No. 5, pp. 352-358

solvent when compared to Belarus, Moldova and Ukraine. However, Russia is at a physical disadvantage due to the location of major pipelines that run through these transit states on to European markets. The difficulties experienced in Russia Ukraine, Belarus and Moldovan interstate relations may be due to the fallout from the collapse of the USSR: inefficient energy consumption, opaque resource and infrastructure ownership, debt-induced asset swaps, the institutionalisation of short term political, economic and social incentives and the spawning of unstable domestic and interstate political regimes. Seen in this light, explanations for the subsequent monetarisation of the energy trade, the construction of the North European Gas Pipeline (NEGP) and the overall souring of regional relations extend far beyond the scope of the geo-political discourse.

Russia in the EU context is geographically disadvantaged, institutionally strong, resource rich and moderately financially endowed compared to its EU counterpart. However, Russia's capacity to agenda set is contained when it concerns relations with the strategic consumer states in Europe. Russia's lack of direct access to the EU market may result in an inability to translate resource wealth into political capital in an EU institutional context. One of the EU's major institutional organising principles is liberal market competition and free transit of economic goods within the EU. Russia on the other hand is pursuing a rationalisation programme in the energy sector where vertically integrated energy majors are intent on creating a unified value chain from green field exploration to retail sales in the oil and gas industry. Whether the pursuit of these dissonant policies is politically motivated is subject to great speculation and is hardly the point here. What prevents Russia from being able to agenda set consistently and comprehensively may be its inability to interpret, navigate, and respond appropriately to disaggregated EU energy policy preferences. While Germany has signed on as the major European actor in the NEGP project, objections raised by the Baltic States, Poland and Sweden concerning the routing of the NEGP, UK concerns over Russian attempts to acquire downstream assets, and the EU requirement for reciprocity in acquisition of Russian upstream assets may be all symptomatic of a strategic policy dissonance between Russia and the EU developing from internal institutional factors and cannot be explained solely through a geo-political or even an economically rational lens.

Considering Russian interests in Asia and North America, the lure of both regions' consumer markets may be irresistible in terms of their economic potential. However, while being resource rich and geographically proximate, the Russian Far East is underdeveloped institutionally, hampered financially, as well as in an informational sense. Russia's policy and future role is therefore yet to be determined as emphasised by the delay in choosing a method of development and transit of Eastern Siberian resources. One need not look any further than the recent sale of Shell assets in the Sakhalin projects to Rosneft/Gazprom, or TNK-BP's decision to surrender its control over the Kovytka Gas Field project over to Gazprom. The major question looming here is will Russian resources be on line if regional demand continues to rise or will the whole enterprise be scuppered by internal policy squabbling and changing international conditions. In this final macro-field, it would be valuable to ascertain what is the combination of factors that contribute to and at the same time hinder Russia's energy strategy in a comparative research framework.

Conclusion

The security discourse ignores the variable conditions under which actor agency is produced due to the narrowness of its research question and lack of paradigmatic scope and structural robustness. In the energy sector, actors may have several priorities based on their ability to fulfil those preferences under ideal conditions over a period of time. Contingency thus can be seen as actors pragmatically taking advantage of short or medium term opportunities presented under prevailing conditions that fall within a more general, long term strategy. Whether the long term strategic preferences, in this case energy superpower status, are ever fulfilled cannot be fully ascertained by extrapolating preference maximisation from short to medium term decision-making, especially if incentives and conditions for actor agency are positioned to favour short versus long term strategies. By expanding the research programme to investigate factors that enter into actors' energy policy formation calculus, a more accurate picture of Russian energy policy can be formulated and a greater understanding of what ramifications energy policy can produce beyond the borders of one state may be in reach of researchers and analysts alike.

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CHAPTER SIXTEEN

Is Sweden's Dependence on Russian Energy a Security Problem?

Robert L. Larsson

In March 2006, the European Union declared its intention of developing a common energy strategy. Efforts have been made, but results are yet to be seen. Meanwhile, every single EU member has opted for bilateral policies towards energy exporters, trying to tackle mounting energy demands at a time when global hydrocarbon resources are slowly but steadily being depleted. Norway (together with the Middle East) has been the key supplier of oil to Sweden. However, Sweden has gradually increased its imports of Russian oil and could, at least theoretically, be importing Russian natural gas in the near future. This is evidence that Russia has recovered from its Soviet hangover. Today it enjoys a pivotal position as a producer on the energy markets and it is dedicated to using its newly regained power to greatest extent possible.

The United States, China and India are also increasing their energy consumption enormously, which strengthens Russia's importance as a supplier even further. A new great game is being enacted on the Eurasian landmass, where all the great powers are competing for access to the energy of Russia and the former Soviet Union (Noreng, 2000). Thus, there are reasons to explore the potential security consequences of increased energy dependence on Russia. A further reason for such exploration is the planned North Stream gas pipeline through the Baltic Sea, from Russia to Germany, which might be realised in the coming decade.

This paper explores Sweden's imports of Russian energy and raises a few issues of concern, in particular the issue of whether Swedish dependency on Russian energy constitutes a security problem.

Dependency is here seen as a state of being extensively affected by external factors that the state in question cannot itself control. An assessment of risks stemming from increased energy dependence must therefore include at least two dimensions, one being the capabilities and intentions of the energy supplier (in this case Russia), and the other being the sensitivity and vulnerability of the importing state (in this case Sweden).

Sweden's sensitivity and vulnerability in terms of energy are initially addressed here at the aggregated level by taking an implicit stand in neoliberal interdependence, while eschewing any deeper theoretical discussion, and by drawing upon current data on Sweden's energy situation. The intentions and capabilities of the energy supplier, Russia, are addressed in subsequent segments of this paper. The paper concludes with a brief overview of possible repercussions and answers the research question posed above.

Sweden's Energy Situation

Sweden is far from self-sufficient in energy and has a relatively high energy consumption rate compared with other IEA countries. In 2002, nuclear and hydropower each produced 46% of Sweden's electricity (IEA, 2004:17f). The lion's share of total energy consumption (39%) was taken by industry, while residential energy use and transport took 22% each. The commercial sector used 14% (IEA, 2004:19).

Due to the current phasing-out of nuclear energy in Sweden, energy production is expected to shift gradually away from nuclear power, but hydropower cannot be expanded as rivers are environmentally protected. Swedish policy stipulates that a transition towards ecologically sustainable sources should be promoted and usage of fossil fuels should be kept low (IEA, 2004:20f). This is one of the reasons why in early 2006, Sweden established a government commission against oil dependence. The development of the natural gas sector is very slow and has been neither promoted nor opposed by the government, although it would be hard to see any fossil fuel being embraced by any Swedish government, regardless of political stand. The IEA has noted the existence of a Swedish perception that natural gas is a competitor to biofuels, a domestic resource with lower greenhouse gas (GHG) emissions. The tax regimes in Sweden by and large favour biofuels and electricity before natural gas, but there are great inconsistencies. Peat, which is not very important for Sweden, has large emissions of GHG, yet is treated as biomass and consequently exempted from all taxation (IEA, 2004:84). This anomaly probably stems from an ambition to promote renewables and domestic fuel sources.

Sweden therefore faces a dilemma. As no efficient, economically or politically feasible or environmentally sustainable alternative energy source has emerged, the closing down of nuclear reactors and the refusal to expand hydropower have left Sweden with only one option, at least for the near future – to import energy. Given the fact that the remaining nuclear power can also be seen as an imported source of energy (in 1977 Sweden gave up the idea of extracting domestic uranium for environmental reasons), IEA figures show that in 2002, 70% of Sweden's total primary energy supply (TPES) was imported (IEA, 2004:19). A review of Sweden's imports, more specifically crude oil, natural gas and electricity, reveals that Russia is a key energy supplier for Sweden and that its importance is continuing to grow.

Sweden's Energy Sensitivity – Russia in Focus

Swedish imports of crude oil have shifted greatly over time, not least during recent years. Imports from Iran and Norway have gradually declined, while imports from Denmark appear to have risen. One explanation is that statistics these days show country of dispatch rather than country of origin. There is in fact no Danish oil, it is simply a country of dispatch. The most interesting *de facto* rise is therefore imports from Russia. Since 2001, Russia's share has risen from 5% to 37% of total imports, as can be seen in Table 1 (Svenska petroleuminstitutet, 2001, 2002, 2003, 2004).

Table 1. Sweden's Crude Oil Imports 2001-2006					
Country	**Share of total imports**				
	2001	**2002**	**2003**	**2004**	**2006**
Denmark	12%	15%	18%	29%	27%
Russia	**5%**	**20%**	**19%**	**27%**	**37%**
Norway	46%	34%	38%	26%	25%
Iran	16%	11%	15%	8%	1%
Great Britain	9%	13%	5%	6%	3%
Venezuela	4%	5%	4%	4%	6%
Saudi Arabia	6%	-	-	-	-
Others	2%	2%	1%	0%	1%
Sources: Svenska petroleuminstitutet, 2002, 2003, 2004, 2005, 2006.					

When it comes to heating gas oil (*Eldningsolja typ 1*), Russia is also the key state. In 2004, Sweden imported 262,000 m^3 from Russia, which was a 44% share of the total imports. Concerning fuel oils (*Tjockolja Eo 2-6)* Russia's share is more modest, only 41,000 m^3 (about 11%) (Svenska petroleuminstitutet, 2005).

In the case of electricity, Sweden is also turning to Russia. During cold winter days, Sweden's electricity shortfall is the largest in the Nordic region (although Finland and Norway also have problems). In 2003, the shortfall reached 1900 MW, of which 1500MW (79%) was provided by Russia (while the rest was provided by Poland and Germany) (FNB, 2003). Russia's future importance can also be expected to increase.

In July 2005, Bas-El, a conglomerate comprising 15 of the most energy-intensive companies in Sweden (that together use about 25 TWh/year) (PJ, 2005), suggested that an electricity cable should be built from Russia, via Kotka in Finland, to Sweden. The Russian consortium responsible has not been disclosed, but capacity is expected to be about 8 TWh per year. There will possibly be one additional cable, according to Bas-El in a statement to Swedish Television. Russia would hold a majority stake in the cable and the rationale behind the cable is said to be an attempt to tackle Sweden's rising electricity prices. The state-owned ore-mining company LKAB is one of the companies spearheading the initiative to import electricity from Russia (Rapport, 2005), but development has been slow.

Although natural gas only makes up 1.5% of Sweden's TPES, gas has taken a 20-25% share of the available market in those areas where it has been introduced. The industrial sector uses 44% of the gas consumed. Currently, gas comes from the Dong company in Denmark, and to a minor extent from EON/Ruhrgas in Germany, and the gas grid is limited to the west coast (between Trelleborg and Stenungsund). The Swedish importer, Nova Naturgas AB, is owned by Ruhrgas (30%), Statoil (30%), Fortum (20%) and Dong (2%). Fortum and Sydkraft (owned by German E.ON (55%) and Statkraft (45%)) have been interested in extending the gas grid to Stockholm and the Mälardalen region (IEA, 2004:79f). E.ON has also established itself as a new face on the Swedish energy market in the aftermath of hurricane Gudrun and subsequent public criticism that Sydkraft had to endure.

Furthermore, the Nord Stream pipeline, formerly known as the North European Gas Pipeline (NEGP), has been on the agenda for several years, but on 11 April 2005 it was announced at a trade fair in Germany that Russia and Germany had signed an agreement on the pipeline (Dempsey, 2005:1). The idea is that the Russian energy behemoth Gazprom will own 51%, while the German E.ON and BASF will own 24.5% each. The UK is positive about this pipeline (Wagstyl, 2005:11) and the Netherlands' Gasunie has also expressed its intention to take part (Global Pipeline Monthly, 2005:4). The route would be from Vyborg in the Gulf of Finland to Greifswald in Germany. One option that has been presented, by Gazprom's subsidiary Peter Gaz, is that a connecting pipeline spur would go from the Baltic Sea to the east coast of Sweden. This option would be highly advantageous from a supply point of view, but the level of sensitivity and vulnerability might increase and so far this does not appear to be a politically feasible option (Larsson, 2007). As of 2007, 1 billion cubic metres (bcm) of gas from Nord Stream have been earmarked for the Dong company (Nord Stream, 2007), which means that Sweden could end up buying Russian gas via Denmark.

Sweden's Energy Sensitivity and Vulnerability

In short, sensitivity can be understood in terms of responsiveness within a policy framework, which includes issues such as how quickly and at what cost an actor can react given 'an unchanged policy framework' (Keohane and Nye, 2001:11-13). Here, this refers to what a state can do (and pay for) if an energy supply interruption occurs, without changing physical parameters or the political processes. As seen above, it is a fact that Sweden is 100% dependent on imports of oil, natural gas and uranium (if Sweden refrains from exploiting its own resources). For its TPES, it is 70% dependent on imports. Russia is the key supplier to Sweden when it comes to oil and its importance is on the rise. However, an import index is no proof of vulnerability, but only of sensitivity (Keohane and Nye, 2001:13). Sweden's energy situation can thus be characterised as highly sensitive and increasingly dependent on Russia. Sensitivity is not a problem *per se*, but sensitivity can lead to vulnerability.

Vulnerability covers issues of availability and costliness, i.e. an actor's liability to suffer externally imposed costs as a result of a policy change. It focuses on who sets the rules of the game and is most important for political strategies in relation to commodities and raw materials. Both sensitivity and vulnerability can relate to economic, political or military issues (Keohane and Nye, 2001:11-13). However, it lies outside the scope of this paper to encompass all aspects of sensitivity and vulnerability. Therefore, only a few of the physical parameters of vulnerability are mentioned to give an idea of Sweden's situation.

There are numerous issues that can be used to identify a situation of vulnerability and four general points can illustrate when it occurs. A state that is dependent becomes vulnerable when: '1) The supply of the material in question is relatively concentrated to a few geographic sources, especially if they are in nations that have substantially different political or economic systems and aims; 2) supply is readily subject to manipulation or to interruption as a consequence of such contingencies as political decisions, wars, internal upheavals, labour strikes, terrorism, or embargos; 3) there are no readily available economical substitutes for, or stockpiles of, the particular material; and 4) recycling possibilities are limited in scope or not feasible within the time available' (Jordan and Kilmarx, 1979:18f; see also Szuprowicz, 1979:274).

The first two points outlined above are further addressed below. Concerning the third and fourth points, it can be said that the problems are largely managed by the Swedish Energy Agency, which operates the Swedish National Emergency Sharing Organisation (NESO). Three things should be also underscored in this context.

Firstly, shortfalls in oil are met by demand restraint, fuel switching and stock draws. Sweden has no state-controlled stocks of oil today (Energimyndigheten, 2005). In order to reach the IEA emergency reserve commitment, Sweden's regulation therefore obliges oil companies and large consumers to hold stocks of oil (25% of last year's net imports or consumption). New plans are nonetheless being drawn up, and there are certain stockholding agreements with Denmark, Finland, Ireland and the United Kingdom (IEA, 2004:78f). Dependence on oil for power generation has gradually decreased (from 77% in 1979 to 33% today) (Energimyndigheten, 2005), but it is unlikely that further decreases can be made (IEA, 2004:85).

Secondly, Sweden has to import electricity during peak consumption periods in wintertime. The Swedish electricity transmission system operator (*Svenska Kraftnät*) has been instructed by the government to keep a reserve capacity of up to 2000 MW, which is seen as a temporary measure (between 2003 and 2008) while waiting for a commercially sustainable solution to meet peak demands (IEA, 2004:27).

Thirdly, although Swedish usage of gas is small, pipeline capacity for natural gas in Sweden is two bcm/year, (that could be expanded to 2.9 bcm/year). Currently only

0.98 bcm/year is used (IEA, 2004:79). Sweden does not have any storage facilities for natural gas, apart from a plant for demonstration purposes, due to technical and geological reasons (IEA, 2004:82).

Thus, there are certain ways to tackle sensitivity and vulnerability and make them much smaller problems. In addition, only a minor share of Sweden's imported oil is used for power generation. The transport sector uses 60% of imported oil, while the industrial sector takes 22%, the residential sector 6%, and 6% is used for non-energy purposes (IEA, 2004:74). In general, one-third of all refined oil is exported (IEA, 2004:78) and when it comes to heating oil, Sweden exports more than it imports. Figures from 2004 for example show that Sweden imported 358 000 m^3 and exported 3 222 000 m^3, mainly to the US, Great Britain, Norway and the Netherlands (IEA, 2004:78). Hence, Sweden's dependence on Russian oil has a bearing on issues relating to power generation, but not to a high extent. The potential impact on the transport sector, refining industry and domestic sector is much larger, especially as a factor in the balance of trade when it comes to re-exports.

The situation described above can be seen as an argument against Sweden being vulnerable, but this argument is only partly valid. It is valid insofar as it is correct when it points to vulnerability against supply interruptions that stem from non-antagonistic actors (technical failures or natural disasters). When it comes to antagonistic political risks connected to security of supply of energy carriers, there are security dimensions that lie beyond the issue of getting sufficient energy for imminent consumption needs. As a consequence, if dependence is seen in a political security context, sensitivity is also important (Keohane and Nye, 2001:14). The vulnerability points listed above, especially the first two points listed by Jordan and Kilmarx (1979), can be seen in the context of Russia becoming a key provider of energy to Sweden. The associated risks can be seen in Russia's intentions, capabilities and past actions – the topic of the next section of this paper.

Russia's Intentions and Perceptions of Energy and Dependence

Russia's Energy Strategy (Ministry of Industry and Energy, 2003) outlines Russia's goals, policy and visions to the year 2020. It states that one of Russia's prime concerns is energy security, but energy policy is also meant to contribute to the overarching goal of national security. Energy policy is intended to be used to avert geopolitical and macroeconomic threats, and Russia therefore aims to take advantage of its geopolitical position. It explicitly states that 'ensuring national security – that is the fundamental task of the energy policy' (Ministry of Industry and Energy, 2003).

Russia is also striving to increase transit of energy carriers from the CIS states over Russian territory, but at the same time, it aims to reduce its own transit over third-party territory and ensure that vital infrastructure is developed and remains under state control (Ministry of Industry and Energy, 2003). Even if Russia aims to be a reliable trading partner (Ministry of Industry and Energy, 2003), the strategy basically involves Russia opting for policies aimed at making other states dependent on Russian energy, while simultaneously taking action to reduce its own export dependence. This asymmetrical dependence is beneficial for Russia, not only as a line of defence, but also as it gives room for manoeuvre in its foreign relations. It can take advantage of the dependence of others in order to coerce political or other concessions.

Russia's Energy Capabilities

By and large, Russia can pursue its policy as it sees fit, even if this stands in contrast to policies preferred by the market. Roughly speaking, the Kremlin controls 100% of Russian gas production and 30% of oil production. In addition, it controls all vital bottlenecks and important infrastructure for export. The Kremlin does not always have to act by force, as several actors act in harmony with the Kremlin's desire, sometimes due to a form of 'self-censorship', where energy firms refrain from actions that conflict with Moscow's intentions (Larsson, 2006a).

It must be mentioned that Russia is no dictatorship and Putin's hard-line view on economic security and energy (see Putin, 1999; Olcott, 2004; Balzer, 2005) is not shared by all members of the government or administration, within which there are several factions. However, the somewhat liberal groups nonetheless have much less impact on policymaking than the hard-liners. In fact, according to some sources the highest echelons of power today have a background in the security structures, depending on definition even to a higher degree than during the time of the Soviet Union (Novaya Gazeta, 2005). Whether this is a problem can be debated (Vendil Pallin, 2007). It is important to underscore that these people hold state positions within the bureaucracy or in parliamentarian committees, while at the same time they have been appointed to the board of Russia's most important energy companies (Gazprom, Rosneft, UES, Transneft to mention but a few) (Larsson, 2006a).

One additional reason is that there is a common perception among the leading market actors that independence, autarchy, hegemony, control over neighbouring territory and control over resources are still of paramount importance (see Zarubezhneft, 2005; Belton, 2006). This is Russia's undisputed 'resource power', which can be seen as a lever that can be utilised to achieve a preferred policy outcome (Keohane and Nye, 2001:220). This has happened on numerous occasions and a few of these are worth mentioning.

Russia's Track Record of Conducting Coercive Energy Policy against Individual States

During the reign of Yeltsin, energy cut-offs were frequently used as a political weapon in relations with the former Soviet republics. The frequency has since dropped, but the practice is still used (Leijonhielm and Larsson, 2004:117-128). A few cases can be mentioned here. Georgia is largely dependent on foreign energy suppliers and unexplained cut-offs have occurred on politically important occasions (Civil Georgia, 2003b). The official reason given has often been Georgia's debts (Civil Georgia, 2003a), but the cut-offs seem to have coincided with special occasions such as elections, bilateral negotiations or Russian bombardment of Georgian territory. One such occasion was in January in 2001 (Baran, 2001) and other interruptions to supply followed in 2003.

In Ukraine, Russia has attempted to gain influence by exchanging debts for infrastructure. There are also several examples of Russian pressure and cohesive energy policy coinciding. One example occurred in 1993 (Felgenhauer, 1999) and another in 1995 (Balmaceda, 1998:260). Furthermore, ever since the beginning of the 1990s, Russia and Belarus have been arguing over energy (among other things) and Gazprom has cut the gas flow on several occasions, for example in 2003, 2004 and 2006. Some of these interruptions have also affected Poland (RFE/RL, 2004). A third example was in the winter of 2005-2006 during the Russian-Ukrainian gas row, when the Kremlin called for 'marketisation' of gas prices (Larsson, 2006b).

In the winter of 1992-1993, Yeltsin cut energy supplies to Estonia, Latvia and Lithuania in order to effect a policy change (Smith, 2004:6). In Lithuania, Russia cut oil deliveries on nine occasions in 1998-1999 alone. The reason was that it wanted Lithuania to cede control over pipelines, ports and refineries to Lukoil (Smith, 2004:6). Another example are the gas cut-offs that coincided with the adoption of Estonia's law on aliens, which affected the situation for the ethnic Russians living in Estonia (Oldberg, 2003:51). In the case of Moldova too, gas cut-offs and threatened cuts have been common. In the winter of 1999 Gazprom cut the gas supply, citing Moldova's continuously rising debt as the reason (Johansson, 2003:29).

Russia's Track Record at the Aggregated Level

At the aggregated level, it can be said that according to the IEA, no full cut-off has occurred to Western customers since 1968, when energy deliveries started (Ahrend and Tompson, 2004:21). Apparently, Russia acknowledges a difference in importance between former Soviet states and Western Europe. On this basis, imports of Russian energy can be divided into three groups. The first group is the former Soviet territory, basically the CIS and the Baltic countries, where numerous incidents have been recorded, even against current EU and NATO members (Baltic countries). The second group is made up of the former Warsaw Pact members, of which some are now also EU and NATO members (Poland). Russia has been less willing to use the energy weapon against these states to the same extent as against its former territories, but these states are now definitely being seen as affordable 'collateral damage'. After the gas row between Russia and Ukraine in 2006, it is clear that most of Europe belongs to this group. However, the third group, which basically consists of the Western states of Europe, the USA and possibly Japan and India, have not experienced any overt direct cuts to date, but issues of concern exist as these states are affected by Russia's policy towards the CIS area (e.g. 80% of European gas imports from Russia go via Ukraine). This pattern is highly visible if Russia's foreign policy against the Baltic and CIS states is scrutinised (Hedenskog and Larsson, 2007).

When these cases are analysed and put in a wider context, a pattern emerges, namely that the energy lever can be used in several ways and serve several purposes. By and large, these actions can have military, political, social, economic or other non-military foreign policy-related underpinnings. The imminent reasons or drivers could be several, i.e. relate to a will to enforce some kind of political concession in ongoing negotiations, enforce infrastructure take-over, enforce economically favourable deals or make a political statement (Larsson, 2006a, p. 260ff). Basically, all incidents where Russia has used the energy lever are political statements, but in the 1990s, the driver of enforcing concessions was common.

Both political and economic drivers exist under a security umbrella in Russia and in this case boil down to the intention of extending Russia's influence abroad (see Vahtra and Liuhto, 2004). This complexity also shows that the political level is prepared to endure political ill-will not only for its political priorities, but also for economic reasons (where the revenues mainly, but not exclusively, go to energy firms). In addition, energy companies are willing to conduct economically unfavourable activities in the interest of the state. They know that the rules of the game can change in a fortnight, most likely to the Kremlin's advantage.

Outline of Possible Problems and Implications for Sweden and the Baltic Sea Region

First and foremost, there is the overarching risk that when dependence on a sole supplier increases, the level of vulnerability also increases and the situation infringes on state autonomy. Even if the formal sovereignty remains, the manoeuvring space is infringed. Dependence can thus bring constraints that would not have existed otherwise. This point is general, but specific to the extent that the constraints might be linked to the actor on which the importer is dependent.

Russia's ability to use the gas tap in an attempt to put pressure on Sweden would be conditional on Sweden becoming connected to Nord Stream and hence the present danger is nonexistent. Furthermore, Russia has so far had no inclination to act this way against a state such as Sweden. What Nord Stream does bring, however, is an increased risk for states such as Belarus and Poland. One of the rationales behind Nord Stream is that Russia wants to send gas to Germany without transiting through Belarus, Poland or the Baltic Countries. This rationale is grounded in the belief that energy transit is too pricy and makes Russia vulnerable. These states have shown great aversion towards Nord Stream, since they both lose transit money and become more vulnerable to Russian pressure and supply interruptions. By having Nord Stream, Russia is able to turn off the gas to Belarus and Poland without harming its relations with Germany, which are seen as most important by the Kremlin. Thus if Sweden for whatever reason advocates Nord Stream, even it does not connect to it, it risks harming relations with opponents of the pipeline, namely Estonia, Latvia, Lithuania, Poland, Ukraine and Belarus. This risk would naturally be exacerbated if Sweden were to connect to Nord Stream.

Industries and oil consumers naturally want government policy to act in their interest. Should oil or gas supplies from Russia to Sweden be tampered with as a result of Sweden's foreign policy, the importing energy companies would likely hold the government responsible and possibly increase their lobbying activities for some kind of cushioning policy, if not a shift in the foreign policy course. Initially, only the importing companies would be affected by any future cut-offs, but if long-duration interruptions were to come about, end-consumers (i.e. the electorate) would also be affected. This naturally has political implications. If it goes this far, an impact could possibly also be seen on energy consumption and Sweden would have to turn to its other neighbours for assistance. Nor should it be forgotten that energy imports are not only an issue of energy needs, but are also of pivotal importance for the refining industry and the potential for re-export. This means that neighbouring importers of refined products from Sweden have to bear part of the burden for Sweden's foreign policy. Naturally, this raises the threshold for a policy against Russia that risks affecting energy supply. This possibility, or risk, is not as far-fetched as it may seem.

The case of Germany illustrates that when dependence on Russian energy increased during Chancellor Schröder's tenure, a rapprochement and subsequent appeasement of Russia followed. Crucial factors have been the friendship of Putin and Schröder, but also integration and cooperation between the major energy corporations Gazprom, Ruhrgas, E.ON and BASF/Wintershall. An apparent consequence put forward by analyst and journalists alike, which is not apparent in the political declarations, is that German criticism of Russia's lack of democracy and rule of law basically vanished under Chancellor Schröder, as did criticism about Russian human rights abuses in Chechnya (Benoit and Thornhill, 2005:2). Germany's behaviour also came under fire from other European states and NGOs. Any government that decides to increase its dependence on Russia must therefore also weight the pros and con of balancing pragmatism against normative principles.

Poland and the Baltic countries, for example, have looked upon the Russian-German energy cooperation with great scepticism (Pustilnik, 2005:9). Poland, Lithuania and Belarus feel that Schröder has sacrificed them to Russia as a consequence of its dependence on Russian energy. Angela Merkel, the new Chancellor of Germany, now seems to pay greater attention to the views held by neighbouring states such as Poland, but the question is still open.

The German situation also highlights a problem that Sweden has to face, namely prioritising among its neighbours. If Russia continues to act coercively on the Baltic energy market, Sweden might have to choose what to do. Staying silent in order to secure its energy needs will negatively affect Swedish relations with the Baltic countries, and possibly also with other EU members. The EU as such will also be affected negatively, as a clash might emerge in the process of developing a common energy strategy. It has been argued that as issues in the Baltic Sea region (such as energy) become securitised, problems also occur when states compete for access and influence even within the EU framework (Browning and Joenniemi, 2004:245ff). If Sweden chooses to be a loyal EU member, it runs the risk of affecting its relations with Russia and subsequently its key supplier.

There are also other political questions to tackle as a result of increased imports of Russian energy, for example when Sweden closes down its nuclear plants and imports electricity from Russia. From Sweden's point of view, Russian electricity is environmentally unfriendly as it largely stems from coal (which is dirty) and nuclear power (which is dirty according to common Swedish perceptions). During the first years of the new millennium there were discussions that despite the agreement with the EU on phasing out the Lithuanian nuclear power plant Ignalina, Ignalina might be able to sell more electricity if Russia were to buy Ignalina electricity and re-sell it to Sweden. According to Lithuanian politicians at the time, Lithuania was prepared to keep the power plant running as long as it was economically feasible. Hence, according to this argument, Sweden would have contributed to prolonging the operation of Ignalina while closing down its own plants (Trelleborgs Allehanda, 2005), something which would have affected the environmental cooperation in the Baltic Sea Region (BSR). Today, the situation is different. Ignalina will close down, although a new nuclear power plant is on the Lithuanian and Polish agendas.

Furthermore, vulnerability relates to the actor's liability to suffer costs when policies have been altered, i.e. it is rather long-term in nature (Keohane and Nye, 2001:13). Consequently, there are several issues and questions that must be dealt with when dependence increases. For example, would a small state like Sweden be willing to refrain from its advocacy of human rights or democracy in order to satisfy its energy needs? Would it be willing to acknowledge Russia's activities in Chechnya as justified? Would Sweden be willing to keep silent if fellow EU-members, such as the Baltic countries or Poland, fell prey to Russian energy cut-offs, hostile take-overs or blackmail? In such an event, would Sweden be willing to accept a worsening of its own relations with these states as a result of keeping silent or taking Russia's stand? These are all still open questions.

It is true that Russia has traditionally been a reliable supplier to the West, but now Estonia, Latvia, Lithuania and Poland are part of the West. By staging numerous cut-offs of energy towards Georgia, Moldova, Belarus and Ukraine and largely misbehaving toward the BSR and the CIS members, Russia's reliability can be questioned on political grounds. It is unlikely that Russia would explicitly and immediately cut energy supply, but it would not be wrong to assume that importers could face technical problems, contractual disagreements, increased obstacles in negotiations, price increases or Russia turning to other customers once the contracts expire.

Trigger of a Crisis

As indicated, neither dependence nor vulnerability poses an immediate danger unless something happens that triggers a crisis. The question naturally arises as to what would trigger a crisis or coercive Russian action. A few such triggers are wars, revolutions, civil unrest, nationalisation, state monopolies, boycotts and transport availability (Szuprowicz, 1979:281). Russia has all of these phenomena, although it was 16 years since its last 'revolution'. If one plausible trigger should be mentioned, it is the topic of Chechnya.

Chechnya is a sensitive subject for Russia and several states, such as the UK, Sweden and Denmark, have all had difficult relations with Russia when it comes to Chechnya-related bilateral relations. One incident was when Denmark refused to extradite the Chechnyan spokesperson Akhmad Zakayev to Russia, as Russia's demands were not backed up by sufficient evidence. Russia then chose to boycott an EU summit in Copenhagen (that later moved to Brussels) and threatened to boycott Danish goods. Zakayev was nevertheless released. At the time, many Danish companies operating in Russia quickly experienced 'bureaucratic checks' and other problems with red tape. Putin's party, the United Russia, stated that '[e]ach Russian must give up travels to Denmark, Danish goods, and contacts with Denmark [sic] companies' (Akhtyrov, 2002). It can be concluded that Russia was basically prepared to sacrifice Danish products (and the Danish export market) in a reactive boycott.

Increased dependence further aggravates these risks, and should anything trigger a crisis, it is primarily not the energy consumption that would be affected, but Swedish energy companies operating in Russia might encounter real or invented contractual or bureaucratic problems or tax reviews.

Barriers against Supply Interruptions

Some argue that Russia needs revenues from energy exports and would thus not be inclined to cut supply, as a situation of interdependence exists (Stern, 2005). This is true when it comes to interruptions of long duration, but in basically all the cases mentioned previously, cut-offs have been rather short and most often only partial. They have not inflicted any great economic losses on Russia. In fact, some cut-offs in combination with debts have resulted in Russian take-over of energy infrastructure, something that in the long run can be profitable. Besides, by having a large currency reserve and an oil stability fund, Russia can easily afford these losses.

True, there is a degree of interdependence as Russia is dependent on foreign states for transit, but Russia is willing to go to great lengths to bypass transit and the asymmetries are so large that even the widest definitions of interdependence are not sufficiently generous. In addition, the impact from political ill-will that so far has fallen upon Russia is negligible. Within the former Soviet territory, Russia's reputation as a reliable energy provider is already destroyed, but up until 2006, the

West chose to look away. After 2006, the West acknowledged the problem but even if Russia misbehaves further, there is no evidence of this having an impact on the West's willingness to import Russian energy.

Summary and Conclusions

This paper explores Sweden's imports of Russian energy and raises a few issues of concern. To the question of whether Swedish dependency on Russian energy constitutes a security problem, the short answer is: *No, not today – but it could if Sweden starts importing Russian gas.*

The long answer is that there is not yet a security problem relating to energy supplies or the Swedish security situation. However, there might be implications for Sweden and the wider BSR in the future, should dependence increase and Russia's coercive energy policy continue. Increased usage of natural gas, especially Russian natural gas, would therefore not be in line with Sweden's national security priorities. These risks first and foremost seem to be related to the international security political relations and system of trade in the BSR. Problems that might arise today, on current premises, are first and foremost related to the political and economic levels, not the military security level. The risk for supply interruptions aimed at Sweden is low, but most states in Europe could experience a coercive policy or be negatively affected by Russia's policy against the former Soviet states. This may result in tension and friction within the whole EU area, including Sweden. Six further conclusions can be drawn from arguments presented in this paper.

First, Sweden is highly sensitive, as it imports most of its energy. It is becoming increasingly dependent on Russian oil and is to a lower extent dependent on Russian electricity. It would likely become dependent on natural gas too by connecting to the Nord Stream pipeline, if that ever materialises. A pipeline spur to Sweden does not seem feasible at this point, but would strongly exacerbate the security problems of dependency. Gas imports from Russia via Denmark will most likely only have a marginal impact.

Second, in the short run, diversification of imports and usage of alternative energy sources are difficult when it comes to oil, as Swedish oil imports are mainly earmarked for the transport and refining sectors. Dependence is not problematic *per se*, but the lack of alternatives and other issues lead to vulnerability within these sectors. It is important to stress that Swedish vulnerability within the oil sector is not primarily a matter of national security, since the oil is not used for power generation and usage of natural gas is limited. However, the issue of import dependence is further aggravated by Russia's intentions, past actions and capability. This is especially notable in view of the fact that Russia is moving away from democracy and the rule of law and basically lacks the checks and balances that would make its actions predictable. However, since the suppliers of the Middle East, which Sweden used to have as key suppliers, are far from politically stable, the risks of Russian unreliability should not be exaggerated.

Third, vulnerability only becomes an immediate danger if something triggers a crisis that subsequently leads to a supply interruption. Russia's actions against Sweden and Denmark on issues related to Chechnya show that such issues might well be plausible reasons to trigger a crisis in the future. Dimensions such as this affect Sweden's foreign and security policy beyond the ordinary energy policy.

Fourth, repercussions in the wake of a crisis might not necessarily be instant, but could materialise as partial supply interruptions, contractual disagreements, technical difficulties or price increases that seem to be based on physical or technical grounds but that in reality have political underpinnings.

Fifth, should any of this happen (of which supply interruptions is the most serious), there are several risks and consequences. Russia's use of the energy lever on Sweden or any of the states in the BSR can basically affect domestic importers (firms), energy consumption needs (for power generation or fuel production), domestic end-consumers (households and industries), foreign consumers of re-exported oil or refined products, foreign relations to third parties and development and relations within the EU. Many security- and foreign policy-related frictions might thus arise in this context.

Finally, the existing barriers against usage of the energy levers are few and weak. By and large, they do not provide any real protection against a short-duration cut-off. However, a full and continuous supply interruption would hardly materialise in the near future. Nevertheless, Sweden's energy security goes far beyond supply security and has a bearing on the whole Baltic Sea Region.

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CHAPTER SEVENTEEN

The Nexus between ENP and European Energy Security

Sylvia A. Niewiem

Introduction

The European Union is one of the major global players on the international energy market and one of its largest consumer of oil, gas, coal and others energy resources. The EU's largest suppliers are the Middle East, Russia, Algeria and Norway. Oil, gas and other energy sources are imported mostly by pipelines and tankers. Thereby, the EU's neighbouring countries - e.g. its Eastern neighbours - play a significant role as transport states.

In addition, the EU is one of the largest importers of energy resources. In this regard the EU is facing the following challenges: the EU energy consumption is supposed to rise from 50% of today's consumption to 65% in 2030. The import of gas is supposed to rise from 57% to 84% and oil import from 82% to 93% by 2030.[205] Therefore the EU countries are forced to increase their imports either by increasing their imported amounts from their suppliers or by searching for new suppliers or energy sources. Since the demand of other states i.e. the rising economy of China is growing as well the EU is facing rising competitiveness with the other "energy hungry" countries. Ensuring the rising demand is one of the external energy security challenges of the EU, the other being ensuring the actual supply needs.

In the last two years energy security has become a top political issue. The topic of energy security was given high priority within the agenda of the European Commission, the European Council as well as national governments. Until recently energy security was an issue that was mostly dealt with at the DG TREN. Nowadays, the question of how to enhance energy security is embedded in different policies of the EU and subject to different Directorates-General. Not only the common internal energy policy but even the need for a common external energy policy has become of vital importance.

The EU had to start to integrate energy issues into relations with third countries

205 Energy Policy for Europe, Com (2007) 1 Final, 10 January 2007, p. 3.

since external dependence on imports seemed to be continuing to grow as described above. The European Commission adopted a Communication on a new energy policy for Europe[206] in January 2007. In order to reach the priorities included in the external energy policy a link was made to the European Neighbourhood Policy. Energy security strategy issues became a thematic dimension within the framework of ENP. Those issues include: energy efficiency, energy savings, renewable energy sources, but also market integration and network development. All of these objectives are included within the ENP itself.[207]

This paper shall focus on the nexus between the European Neighbourhood Policy and the external Energy security issues of the EU. Focus shall be put on "how the European Union uses the ENP to tackle European energy security interests". The first chapter shall focus on the external energy security aims and of the energy related aspects within ENP. There will be information e.g. on official papers, decisions, agreements on energy security issues.

In the second and third chapter an example of the relationship between ENP states and regions and the EU are given. The focus will be put on the eastern direction of the ENP. In this regard the ENP process is divided into western NIS (Ukraine and Moldova) and the South Caucasian states Armenia, Azerbaijan, and Georgia. In both cases the main focus shall be put on the different aims, instruments, implementation of the interests, and finance of these within the ENP in relation to energy security issues. Chapter two will focus on Ukraine whereas Chapter three will pay attention to the South Caucasus region with an outlook on the Black Sea region and Caspian Sea where appropriate.

This paper will concentrate on issues such as energy diversity (e.g. alternative transit routes and suppliers) and on regional cooperation to enhance integration and cooperation. This limitation has to do with the particular characteristics of the selected ENP states. A further reason is the complexity of the issue of external energy security as a whole and the difficulty to discuss all of its aspect in a limited amount of pages.

External Energy Security and ENP – Objectives, Measurements, and Instruments

In the context of the EU's rising dependency on external energy sources and in the light of the recent energy disputes of Russia with Ukraine or Moldova the EU placed the topic of energy security in the very focus of its political agenda. One of priorities of the EU in regard of energy security is to avoid "strategic dependence". In a broader context this focuses on reducing the dependency on one main supplier –especially since the new EU member countries are depending to a large extent on Russian gas

206 Energy Policy for Europe, Com (2007) 1 Final, 10 January 2007.

207 An External Policy to serve Europe's energy interests, S160/06, p.1, 2.

and oil - and on the development of alternative energy transport routes.[208]

Many of the states surrounding the EU serve as transit countries or as suppliers. Therefore, European neighbours play a vital role in the EU energy security efforts. The EU realized that the enhancement of strategic energy partnerships with neighbouring countries could make an important contribution to the energy security strategy of the EU.[209] In regard of the security aims of the EU, energy became from the very beginning a central element of ENP.[210]

ENP shall contribute to the enhancement of energy cooperation between the EU and its neighbours by providing more energy dialogue, the progressive convergence of energy policies, improving energy network connections, promoting energy efficiency, the use of renewable energy sources and the possible participation in EU energy programmes and events.[211]

In recent years various enhancements of energy security within the framework of ENP can be could be seen. The energy cooperation efforts of the EU apply to various energy issues and measures. Progress has been made in the area of intensification of bilateral policy dialogues and regional energy initiatives. For example, the EU signed Memoranda of Understanding with Ukraine and Azerbaijan. Both are currently being implemented. A further one with Algeria in regard of a strategic energy is in preparation. The bilateral dialogue with e.g. Morocco and Moldova have been enhanced. Regional multi-country level initiatives such as the Black Sea and Caspian Sea initiative (Baku energy initiative) or the Mediterranean Energy Forum (Euro-Mediterranean Initiative) and the Africa-Europe energy partnership are being intensified. There are several network projects that are significantly developing and will contribute to the EU energy security after finalization. These are e.g. the development of a Black Sea - Caspian Sea energy corridor, Ukraine's intention to use the Odessa-Brody pipeline, the Mediterranean gas and electricity ring, the construction of the Arab gas pipeline route: Egypt – Jordan – Syria - EU, Tunisia's expansion of the gas pipeline to Italy, or Morocco's increase in electricity interconnections with Spain.[212]

In addition to these steps, there are several plans and preparations for progress on building energy relations with neighbouring countries. One of these plans is the extension of the Energy Community Treaty to Ukraine and Moldova. Both have an observer status at the moment. This treaty shall also be extended to other ENP countries if appropriate. Other examples are plans to engage ENP countries in the initiative towards the development of an international energy efficiency agreement.

208 Tsereteli, Mamuka (2004)

209 To this sentence see Non – Paper on Strengthening the ENP, Com (2006)726 Final, 4 December 2006, p. 15.

210 CaucazEuropenews, "EU seeking for close cooperation in energy with South Caucasus", 10 March 2006.

211 An External Policy to serve Europe's energy interests, S160/06, p. 2.

212 The European Neighbourhood Policy Fiches on Sectors, September 2007, p. 6.

Further efforts are made to let ENP countries participate in the Intelligent Energy Programme and for the support of networks on energy security and energy market integration. A EU Coordinator for key network projects shall be appointed. The starting project shall be the Nabucco gas pipeline.[213]

In order to enhance the cooperation with southern neighbouring countries the EU wants to intensify the energy relations with the Mashrek/Maghreb energy producer and transit countries. A very ambitious project is the idea of an overall EU-ENP legal framework in regard to suppliers, consumers, and transition countries. At this stage a feasibility study should be launched in order to find out the potential of an EU - ENP Energy Treaty.[214]

Furthermore, there are efforts to enhance energy efficiency, the use of renewable energy sources, and on the dialogue on nuclear issues with the ENP countries. Non-proliferation, nuclear safety and security and combating trafficking of nuclear materials are further issues on the agenda for the dialogue with ENP countries using nuclear power.[215]

The key operational instruments of the implementation of ENP are Action Plans. Each of these plans are individual bilateral agreements with binding commitments. The aim of these three-year Action Plans is a cooperation that should take steps toward deepening bilateral economic integration and political cooperation. These plans identify all key areas where reforms are necessary. They also include the above described energy objectives and measurements. By now, the EU has signed action plans with twelve countries. [216] These AP's are reviewed and progress reports are published on a regular basis. In addition, assistance programming documents such as Country Strategy Papers 2007-2017 and National Indicative Programmes 2007-2010 are being prepared.[217]

The review of Action Plans showed that different ENP countries are facing similar challenges in different fields, among them energy. In reference to these similarities, the Commission included related recommendations in its report[218] on "strengthening the ENP" that was presented in December 2006. The recommendations replied to the reinforcement of thematic regional cooperation.

The thematic dimension is defined as the sum of sectoral issues that are of interest for ENP countries and others. Therefore, these issues should be addressed: in the

213 External energy relations – from principles to action", COM (2006) 590final, 12 October , 2006, p.5.

214 Non – Paper, Strengthening the ENP", Com (2006)726 Final, 4 December 2006, p. 4 and 16.

215 The European Neighbourhood Policy Fiches on Sectors, September 2007, p. 7, Non – Paper on Strengthening the ENP", Com (2006)726 Final, 4 December 2006, p. 17.

216 Non – Paper, Strengthening the ENP", Com (2006)726 Final, 4 December 2006, p.5.

217 DG External Relations an European Neighbourhood Policy, ENP reference documents

218 On 4 December 2006, the Commission launched its Communication on Strengthening the European Neighbourhood Policy. Accompanying this Communication, the Commission published progress reports assessing progress made in implementing the Action Plans.

framework of regional cooperation rather than within bilateral agreements. The aim is that through the enhancement of the thematic dimension the ENP partners should be supported with the implementation of their Actions Plans, e.g. in the field of energy. As well as bringing the legal bilateral agreements to a larger group of participants, the EU suggests the enhancement of peer contracts. The comparison of ENP Action Plans showed the similarities of content and necessary methods of implementation of ENP countries. The attention of ENP countries can be drawn to energy supply, transit and security. These are issues where they might have common interests. The intensification of relationships through the exchange of experiences and regular thematic contact between ENP partners could contribute to the development of ENP states.[219]

One of the instruments for implementing the thematic dimension is TAIEX. This tool provides opportunities to learn about best practices and legislation development. Another opportunity is the participation in Community agencies and programmes. The Council announced this approach in March 2007. However, the participation will depend on how far the ENP countries fulfil the legal and technical requirements laid down in the individual Action Plans. The plan on peer cooperation includes the development of relationship between all ENP countries from South to East. This approach shall add to the missing multilateral dimension to Eastern ENP countries.[220]

Financial support for the realization of the ENP projects was provided through EC assistance under various geographical programmes including TACIS (eastern neighbours and Russia) and MEDA (southern Mediterranean neighbours), as well as thematic programmes. As of 1 January 2007, the EC assistance instruments were replaced by the European Neighbourhood and Partnership Instrument (ENPI). The ENPI is supposed to be more flexible and so called “policy -driven”. The amount of approximately 11.2 billion Euro EC funding is calculated for the budgetary period 2007-2013.[221]

Energy Related Issues within ENP

The case of Ukraine: Strategic interests

The Ukraine plays a vital role in regard to the EU’s energy security. The EU’s imports of gas from Russia and the Black Sea to Western Europe are crossing the Ukraine as a transit country.[222] Around 40% of gas imports to the EU - including almost 90% of

219 Non – Paper, Strengthening the ENP”, Com (2006)726 Final, 4 December 2006, p.5, 6.

220 Strengthening the European Neighbourhood Policy, Com (2006)726 Final, 4 December 2006, p. 8.

221 Art. 29 No. 1, Regulation (EC) No 1638/2006.

222 Directorate General External Relations, The EU’s relation with Ukraine - Overview

gas imported from Russia – are passing the Ukraine as a transit country. This gas is being further conducted on the one hand_to the Slovak Republic and Germany, and on the other to Austria, Slovenia, and other countries. Furthermore, gas is delivered to Hungary and to Poland mostly for internal consumption. In addition, the Ukraine has after Russia the second largest natural gas storage capacities in Europe. These are significant figures and explain the interest of the EU in energy cooperation with this neighbour.[223]

The Ukraine is one if not "the" leading partner in the Eastern neighbourhood. Its interest lays in further integration with the EU and more security in its independence efforts from Russia. However the Ukraine is also the one that is most vociferously proclaiming its desire of EU membership.

ENP – energy related objectives, measurements and instruments

As a consequence of the above described interests both are permanently increasing their cooperation. The EU and Ukraine committed themselves to deepen their cooperation by achieving further economic integration and deeper political cooperation. Ukraine plays a vital role in the EU's energy policy since the EU wants to ensure the transit of its energy imports as part of its energy security policy. Therefore, energy will remain a key element within the EC's assistance strategy to Ukraine.[224] The main objective of the enhanced EU-Ukraine co-operation concentrates on the assistance of the reform in the Ukrainian energy sector and the improvement of the transition safety and security. The EU aims to provide assistance in the energy sector with focus on promoting the restructuring and development of Ukraine's energy sectors, regional cooperation, infrastructure interconnections, new pipelines, energy efficiency and renewable energy sources.[225] Furthermore, there is a possibility that in the future the Ukraine could become an electricity supplier to the EU.

In the time period 1991-2006 the EU donated more than 2.4 billion Euro to the Ukraine. Among other things there was assistance under the TACIS programme, macro-financial assistance and support under the thematic budget. To achieve the priorities of the Action plan , further changes under the ENPI such as cooperation tools Twinning or TAIEX are introduced. Theses instruments are added to other types of assistance such as infrastructure and equipment funding, pool funding and budgetary support and interest rate subsidies.[226]

Bilateral cooperation is expected to grow in the next years. In order to promote and to realize this there are several main documents and activities alongside the EU-Ukraine Action Plan with its follow up- and assistance documents. These are

223 Hudak, Vasil , Herrberg, Antje, Solonenko, Iryna (editors), (2004), p. 21.

224 Ukraine - Country Strategy Paper 2007-2013, p. 3,9,10.

225 External energy relations – from principles to action", COM (2006) 590final, 12 October , 2006, p. 5.

226 Ukraine - Country Strategy Paper 2007-2013, p. 16, 30.

the Memorandum of Understanding and the activities in regard of the Energy Community Treaty.

ENP action plan and follow ups

The policy objectives of the Ukrainian reform agenda are defined in the Partnership and Cooperation Agreement (PCA) of April 1998 and the EU-Ukraine Action Plan of February 2005.[227] In general terms the aims are to deepen bilateral economic integration and political co-operation. In December 2006 the Commission published a progress report for the Ukraine with evaluation of the previous developments, the realization of contracted steps and recommendations for the following steps. In addition, a EU - Ukraine Country Strategy Paper for 2007 - 2013 and the National Indicative Programme (NIP) for 2007 - 2020 were prepared. These are follow-ups on the EC assistance in the future. They include the future priority key areas of support, programmes and instruments. In this strategy report the following recommandations of the Commission are included. The programme should not continue to be governed by a “top-down” approach and the over-detailing of the National Indicative Programmes (NIPs) should be lowered in order to increase the flexibility to react to needs. In this new programme focus shall be laid on the definition of strategic objectives rather on specific activities. In addition, national authorities should be involved in the process from the beginning A genernal priority in the energy, transport, and environment sector is to strengthening adminstrative capacity for defining and implementing sectoral policies relevant to EU policies and legislation.[228]

The “new” NIP includes more details of operations undertaken by the ENPI. It defines a limited number of priority areas with objectives and results to be achieved. The sub-priority 1 of priority Area 3 “Support for Infrastructure Development” relates to non-nuclear energy. In the period 2007-2010 assistance of almost 200 Mio. Euro is given to area 3. That makes up 40% of the entire programme. Furthermore, expected long term impacts, specific objectives and expected results are also included.[229]

Memorandum of understanding

The “Memorandum of Understanding on cooperation in the field of energy between Ukraine and the EU” (MoU) was signed at the EU-Ukraine Summit of 1 December 2005. The document aims the integration of the Ukrainian energy market to that of the EU. It contains road maps covering the four areas: nuclear safety, the integration of electricity and gas markets; enhancing the security of energy supplies and the transit of hydrocarbons, and improving the effectiveness, safety and environmental

227 To this sentence see Ukraine - Country Strategy Paper 2007-2013

228 Ukraine - Country Strategy Paper 2007-2013, p. 11, 14.

229 National Indicative Programme 2007-2010

standards in the coal sector. Furthermore plans are included for the development of a roadmap on energy efficiency, renewables and climate change. Besides, Ukraine's interest to be integrated in the EU and the South East Europe electricity market has been included as well as its interest in playing a greater role as an exporter of electric energy to the EU.[230]

The achievement of the objectives set out in the Memorandum is being implemented. For example, assistance is given to the integration of the energy sector by ENPI as well as funds from the EIB and EBRD. Further investments are given to the modernization of the existing transit infrastructure. The country itself is taking certain measures in order to establish minimum oil stocks that will strengthen the security of energy supply. The measures of the Ukrainian government to reverse the flow of the Odessa-Brody pipeline in the original south-north direction would increase the oil flow from the Caspian region. This would support the EU's aim of diversification of its oil supplies. There are currently ongoing evaluations of the possibility of the extending the pipeline to Poland with financial support of the EU. Potential developments are made with regard to the integration of the Ukraine with the electricity and gas networks and systems. Combating climate change is another issue included in the MoU. There is a working group preparing the implementation of the Kyoto Protocol and developing improvements in regard of energy efficiency.

Energy treaty

Another step concerns the Energy Community Treaty that entered into force on 1 July 2006. This is a multilateral treaty signed by the EU and nine partner countries of the South East of Europe. With the adoption of the treaty all non-EU member states of South-East Europe are being integrated into the single energy market of the EU. The aim is enhancing energy security by improving the creation of a regional energy market and the initiation of investments. With this initiative the EU extends the relevant EU energy acquis to the Western Balkan. Ukraine - next to Norway - has applied officially for the membership and has an observer status since November 2006. With regard to this it commits itself to implement the EU energy acquis.[231]

Expectation – realization gap

EU officials express their satisfaction with the development of the cooperation between the EU and Ukraine taking into account the necessary improvements laid down in the progress report.

Ukraine, on the other hand, is not fully satisfied with its status of an ENP

230 MoU on co-operation in the field of energy between the European Union and Ukraine, 1 December 2005

231 External energy relations – from principles to action", COM (2006) 590final, 12 October , 2006, p.5.

country. It has repeatedly declared its belief to be a European country and not only a neighbour.[232] Its sentiments apply to the missing membership opportunity. Despite those misgivings the ENP is viewed as an intermediate framework. It can be viewed that Ukraine developed a pragmatic approach toward implementation of ENP.[233] The proposals of the progress report of December 2006 and the strategy paper are evaluated by Ukrainian officials as "big steps forward" even though there is still the expectation gap. This attitude was undermined in recent times by the absence of the Ukrainian foreign minister from the important ENP Conference in Brussels in the beginning of September 2007.[234]

The case of South Caucasus: The importance of the region

The region of South Caucasus lays between the Black Sea in the West and the Caspian Sea in the East. It comprises the former Soviet republics Armenia, Azerbaijan, and Georgia.[235] The history of this region in a geopolitical context is quite complex. Complication arise in this former Soviet area through the Russian-Western relations tensed by energy security and military-strategic aims within NATO, EU enlargement and the own interests of Georgia, Armenia and Azerbaijan.[236] The South Caucasus faces challenges of unresolved regional disputes, namely Nagorno-Karabakh, Abkhazia and South Ossetia[237] that go hand in hand with international crime and trafficking.[238] with regard to energy the following situation prevails: Azerbaijan has significant untapped oil and natural gas reserves that need to be developed.[239] Armenia and Georgia have neither large oil nor gas resources. Both countries are highly dependent on net energy imports. Their importance lays in their status as transit states since important oil and natural gas transit routes are passing their territories. The two main energy priorities that are more or less shared by all three of them are the aims of diversification of their energy suppliers and their interests in transit revenues.[240]

Strategic objectives and pipeline projects

After the EU's last enlargement South Caucasus became a neighbouring area. The

232 i.e. in Emerson, Michael, Noutcheva, Gergana, Popescu, Nicu (2007)

233 Solonenko, Iryna (2006), p. 5,6.

234 Huliq.Com (2007), EU: Neighbourhood Policy Focuses On Economics, Not Membership

235 Encyclopedia of Earth, Energy profile of the Caucasus region

236 Federico Bordonaro (2007)

237 Georgia's breakaway regions of Abkhazia and South Ossetia, Armenia and Azerbaijan's dispute over Nagorno-Karabakh and the traditionally troublesome Armenian-Turkish relations

238 International Crisis Group, Europe Report N°173 – 20 March 2006, p. 1.

239 Energy Administration Information, Country Analysis Briefs – Azerbaijan

240 Encyclopedia of Earth, Energy profile of the Caucasus region

EU is seriously concerned that the regional conflicts might spill over.[241] A further reason behind the rising interest of the EU is as mentioned before energy security.

As described in the previous chapters one of the strategic goals of the EU is the diversification of supply routes to Europe. Therefore, the EU's interest in the region of the South Caucasus with the potential for alternative energy supply routes to Europe was increased through the enlargement of the EU. This opened new perspectives for the energy diversification plans of the EU.[242] Next to the rising energy demand the enlargement of the EU to Bulgaria and Romania raised the importance of the Black Sea area in terms of economic, energy and security issues. This area is called the "Wider Black Sea" and has the potential to become a gateway between the Balkans and the South Caucasus by linking Georgia to the EU member state Romania. Furthermore, via Azerbaijan, there would be a gateway to the strategically important Caspian Sea. In this regard, there is a close connection between the EU efforts in South Caucasus and enhancing relations to the Central Asia states. The EU would be interested in a secure energy passage through which the Eastern Caspian resources could be transported to Western Europe via Azerbaijan-Georgia-Turkey and South-Eastern Europe.[243]

There are several important pipeline projects to support the EU energy diversification plan. Some of them have been realized, some are under construction. One is the Baku-Tbilisi-Ceyhan oil pipeline (BTC) that opened on 25 May 2005. The pipeline connects Azerbaijan and Turkey by passing through Georgia and delivers oil from the Caspian Sea to the east Mediterranean coast. Russia is not participating in this project. Due to the oil revenues the countries of the region like Azerbaijan, Georgia, or Kazakhstan have the potential to develope into wealthy energy states. Furthermore, the political balance of power in the region might also be influenced.

Another project is the gas pipeline "South Caucasus Pipeline" (also: Baku-Tbilisi-Erzurum Pipeline - PTE). The pipeline is a pendant to the oil BTC pipeline and should transport gas from the Shah Deniz gas field in the Azerbaijan sector of the Caspian Sea to Turkey and Georgia. In the long term – after becoming connected with the planned Nabucco pipeline - the PTE should deliver gas to Europe. The PTE is 692 kilometers long and was completed in December 2006.[244]

A further important pipeline project is the "Nabucco gas pipeline". The pipeline should transport gas from the eastern end of Turkey across Romania, Bulgaria and Hungary into Austria. Nabucco is geo-politically significant because the pipeline will bypass Russia, much like the BTC. The project is to be completed by 2013.

Once the South Caucasus Pipeline, the Nabucco Pipeline and the Trans-Caspian Gas Pipeline are completed and connected there would be the possibility of transporting natural gas from the Middle East and the Caspian region such as

241 International Crisis Group, Europe Report N°173 – 20 March 2006, p. 1.

242 Tsereteli, Mamuka (2004)

243 Federico Bordonaro (2007)

244 Wikipedia, South Caspian Pipeline

Iran, Azerbaijan and Turkmenistan to Western Europe and to the countries along its path. Furthermore, these alternative routes would reduce the dependency on Russian energy suppliers. In addition, the alternative gas route would support the planned reforms of the European Gas sector since the EU aims building an internal gas market with different operators and options of delivery routes.

The above described strategic interests and plans significantly influenced EU's decision to include the South Caucasus in the European Neighbourhood Policy. Another reason was that the EU had looked at its own foreign and security capabilities and its conflict-mediation abilities and had launched the European Security and Defence Policy in 2004[245].[246]

ENP - strategies and measurements

The inclusion of the three countries in the ENP reflects the commitment to become more engaged in the South Caucasus region. The EU expresses as the objectives of ENP to "share the benefits of the EU's 2004 enlargement with neighbouring countries in strengthening stability, security and well being for all concerned. It is designed to prevent the emergence of new dividing lines between the enlarged EU and its neighbours and to offer them the chance to participate in various EU activities, through greater political, security, economic and cultural cooperation."[247] The European Commissioner for External Relations and European Neighbourhood Policy, Benita Ferrero-Waldner emphasized the significance of the three republics to the EU and the aim "to work together with Armenia, Azerbaijan and Georgia towards building a more stable, prosperous and secure neighbourhood".[248]

Nevertheless, the engagement towards the South Caucasus was developing slowly. The Partnership and Cooperation Agreements (PCA) with Azerbaijan, Armenia and Georgia signed in 1996 entered into force in July 1999. In order to support these three states with technical assistance the Commonwealth of Independent States (TACIS) programs was implemented. In 2001 three individual Country Strategy Papers for the period 2002-2006 were adopted. However, due to the ongoing regional conflicts the implementation as well as expected regional cooperation was facing difficulties. This was a time when it became evident that the differences had to be addressed within the ENP. The EU started to became more active by appointing an EU Special Representative (EUSR) for the South Caucasus in July 2003.[249] After the recommendation of the Commission in 2004 Azerbaijan, Armenia and Georgia were included in the European Neighborhood Policy. In March 2005 Country Reports

245 One of the first missions of ESDP were launched in Georgia, the South Caucasus.

246 International Crisis Group, Europe Report N°173 – 20 March 2006, p. 2

247 See as well International Crisis Group, Europe Report N°173 – 20 March 2006, p. 7.

248 European Commission, Press Releases, "Commissioner Ferrero-Waldner to visit South Caucasus 2-3 October", IP/06/1287

249 International Crisis Group, Europe Report N°173 – 20 March 2006, p. 1,2

for these three states were published. After several postponements of negotiations the ENP Action Plans were adopted on 14 November 2006. The AP's were followed by the publication of the new Country Strategy Paper and National Indicative Programme including priorities for EC assistance for the period 2007-13.[250]

The AP's above all identify the following reform priorities: The included strengthening of democratic structures and of the rule of law, support for economic and social development, strengthening the respect for human rights and the promotion of regional cooperation.[251]

Besides these similarities, the individual APs include the details described beneath on energy issues. The joint Action Plan with Armenia includes as one of the key priorities (priority area 6) the "development of an energy strategy, including an early decommissioning of the Medzamor Nuclear Power Plant (MNPP)". Specifically, a comprehensive energy strategy should be developed that should comply with the EU energy policy objectives. Enhancing participation in regional cooperation initiatives in the Southern Caucasus, e.g. energy, is one of the specific actions, included in another priority area (area 8) "Enhanced efforts in the field of regional cooperation". Another emphasized action is the continuation of "cooperation in the energy and transport fields in the context of the EU/Black Sea/Caspian littoral states and neighbouring countries initiative".[252]

The joint Action Plan with Georgia also refers to strengthening regional cooperation (priority area 5). With regard to the priority area 8 "Transport and Energy", Georgia's transit potential is highlighted and its participation in the framework of the "Baku Initiative".[253]

The Action Plan with Azerbaijan includes priorities that differ from the other two Action Plans. Priority area 8 refers to the "strengthening [of the] EU-Azerbaijan energy bilateral cooperation and [the] energy and transport regional cooperation, in order to achieve the objectives of Baku Ministerial Conferences". As specific actions the "….implementation of the Memorandum of Understanding on the establishment of a Strategic Partnership between the European Union and the Republic of Azerbaijan in the field of energy" are highlighted.

Azerbaijan is the only one of the three South Caucasus countries with whom the EU has signed a MoU. This memorandum emphasizes the positive effects of the gradual harmonization of Azerbaijan legislative with the energy acquis of the EU. This would be a step forward towards economic integration as well as enhancing political cooperation with the EU. The MoU stresses the objective of enhancing energy supplies safety and security from Azerbaijan and Caspian basin to the EU. Furthermore, to increase "development of the comprehensive energy demand

250 DG External Relations, ENP reference documents

251 Action Plans of Armenia, Azerbaijan, and Georgia.

252 EU / Armenia Action Plan, p. 8,9,31,32.

253 EU / Georgia Action Plan, p. 9, 11, 32, 34

management policy, technical cooperation and the exchange of expertise".[254] This agreement indicates the significance of Azerbaijan as an energy partner in regard of supply and transit. It reflects the EU's energy security objectives to diversify its energy supplies.[255]

The financial assistance of the EU to the South Caucasus was over 1.2 billion Euro from 1991-2004. The assistance consists in supporting the reduction of legal administrative reform, the development of trade, investment and a functioning market economy, rule of law and governance, democratic institutions and civil society, reduction of poverty, and food security. The donors are mainly provided through TACIS and macro-financial assistance.[256]

The expectation - realization gap

Even though each Action Plan should be adjusted to the specific requirements and conditions of each country - as pointed out above - possibly "the" main objective of the Action Plans is to encourage regional cooperation and to serve as basis of a resolution of the regional conflicts. This was demonstrated during the time of the negotiations of the Action Plans when risen conflicts between Azerbaijan and Cyprus led to the postponement of the Action Plan negotiations for all three countries. This main objective does not converge entirely with the aims of the three South Caucasus countries. They negotiated strongly for their individual interests that should be included in the AP.[257]

Overall the perception of the three states in regard of ENP is mixed. Azerbaijan views the ENP positively and seeks to become a partner in oil and gas matters and therefore wants to contribute to EU's energy security. However, it does not want to be viewed as a consumer. Armenia's interest in EU integration is more pragmatic. The ENP is viewed as possibility to enhance the economic and legislative transformation and modernization process and to escape the regional isolation.[258] The country drafted a National Program including measures to bring Armenian legislation into compliance with the EU acquis. However, it is less keen on cooperation on security and conflict - related issues.[259] Out of these three state, Georgia is the most ambitious on political and economic integration with the EU. It opted strongly for joining NATO quickly. This was driven by fears of an uprise of Russian power. The country viewed the AP positively in terms of inclusion of individual policy tools and

254 European Commission, Press Releases, IP/06/1516, EU / Azerbaijan Action Plan, p. 8, 34-36.

255 Leila Alieva (2006), p. 16.

256 Directorate General External Relations, The EU's relation with Armenia, Azerbaijan, Georgia – Overview's

257 International Crisis Group, Europe Report N°173 – 20 March 2006, p.7, 9,10

258 Emerson, Michael, Noutcheva, Gergana, Popescu, Nicu (2007), p. 24.

259 International Crisis Group, Europe Report N°173 – 20 March 2006, p. 9, 10

cooperation instruments that were missing in the PCA.[260]

The inclusion of the South Caucasus states in the ENP has positive effects for the EU as well as the three states even if improvements of ENP should be taken into consideration. The EU's interest in South Caucasus is interlinked with its strategic energy security aims of diversifying energy supplies and supply routes. The region connects the Black Sea and the Caspian Sea and is a gateway to Central Asia with its rich energy resources. The Central Asian states on the other hand show a strong desire to become integrated with the EU and to push the transformational reform in their countries. The ENP could promote these reforms and transition processes. At the same time the implementation of the ENP would support the achievements of EU's objectives. If the ENP will be effective it would even fulfil three aims: the reform of the South Caucasus, diversification of energy supplies and transit routes, and the strengthening of the ENP as an instrument itself. The last mentioned aim refers to overcome the criticisms the ENP is suffering from.

However, there are several points that might slow down or impede the successful implementation of the Action Plans and leave room for improvement of the efficiency of them. One is the difficulty of contributing to the resolution of the conflict Nagorno-Karabagh on one hand and on the other hand to enhance the regional cooperation of the three countries. Another possible weakness is the missing close cooperation with the civil society on implementing the measurements of the Action Plan. This might lead to overlooking reform potentials of the societies in these countries and could slow down the regional cooperation process between the states in the South Caucasus.[261]

Conclusion and Outlook

The EU pursues as one of the priorities of its external EU Energy Policy the building up of energy relations with its neighbouring countries.[262] This includes the enhancement of energy security through diversification of transit routes and suppliers. Another objective is the enhancement of integration and cooperation with and between neighbouring states.

The enhancement of external EU energy security issues in the context of the ENP framework by integrating them of the economic and political transformation process seems reasonable. Since the development of one thematic issue - such as energy development - is always linked to other sectoral improvement in a country, enhancing integration with ENP countries is developing. The efforts to integrate Ukraine in the new Energy Community Treaty are a positive example of this. By evaluating the integration process of ENP countries all relevant factors have to be taken into account, meaning the overall development of the economical and political

260 Gogolashvili, Kakha (2007), Conference paper, p.3.

261 Leila Alieva (2006), p. 17.

262 Energy Policy for Europe, Com (2007) 1 Final, 10 January 2007, p. 24.

transformation of the ENP states since they influence the energy integration process as well. If integration efforts and continuing approaches will develop positively than this will have a positive influence in regard of energy integration.

Positive development has been made in the energy field with regard to diversification. The "Baku initiative" addressing energy policy issues being joined by some ENP states together with Central Asia and Turkey is one example of this. Another project that can be mentioned in this context is the "Nabucco Pipeline" that will go from Central Europe to Turkey and will transfer the Caspian resources to Western Europe.

Overall, the nexus between energy security and ENP seems reasonable and positive developments can be seen. Nonetheless, is has to be taken into account that not every external energy security objectives can be reached within ENP.

The ENP has the potential to become a powerful instrument by implementing economic growth, enhancing cooperation and integration and supporting political stability to ENP countries. However there might be issues that could strengthen the ENP as an instrument.

One issue lies within the EU itself. Even though the EU as a whole is one of the world largest energy powers the external issues of energy policy still remain within the competence of European member states and are a matter of national sovereignty. Therefore, external Energy decisions are still made on an intergovernmental basis. There are serious efforts being made on the way to a common external energy policy but this project has not been finalized yet. Therefore, different interests of single EU members may contradict the efforts within ENP in regard of energy aspects. An example is the different interests that sometimes contradict the pipelines project.

The second issue is the relation of ENP states to Russia. It is not always obvious if the EU is considering enough the sensitivity of the situation of ENP states stuck in the middle between the interests of the EU and of Russia. ENP states often have close relationships to Russia. Evidently, the reason lays in the history of the country but also in the geographical closeness to Russia. Therefore, in long term the countries have to strengthen their relationships not only with the EU but with Russia as well. This has to do with the economical dependency as well as due to geographical reasons. The ENP states should not be put in the situation to strengthen their cooperation with one side and to have to turn its back to the other. This might have negative outcomes for the overall transformation process of these countries.

If the matter of energy security would in a short time become a "real" common energy policy such as the internal market and if more attention could be paid to the relationships between ENP states - and Russia, then the ENP as an instrument could support the realization of the external energy security objectives of the EU.

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CHAPTER EIGHTEEN

European Energy Policy and the Caspian Sea Resources. The European Interests in Settling the Dispute About the Caspian Sea Legal Status

Barbara Janusz

Given the gradual exhaustion of European oil and gas resources and at the same time European Union's increasing dependence on the energy supplies the European Council has recently adopted a strategic document called Energy Policy for Europe. The proposed new EU energy policy shall aim at creating a single European energy market and diminishing the preference for national approaches in energy security. On the other hand it shall lead to greater diversification of the sources of raw materials imported to EU. Particular attention will be given to the resources from the Caspian Sea, which will be focused on in this paper. However due to lacking legal clarity in regard to the Caspian legal status any bilateral agreement against the will of remaining littoral states will seem legally uncertain hampering mutual cooperation.

It has recently become a common practice to define countries' energy policy in the context of both external and internal security of energy supply as well as the need to combat climate change. Security of supply has become a priority for numerous international political organisations, including NATO, the Group of Eight (G8) and the European Union. Especially the latest, being one of the world's leading proponents of environment-friendly economic development, in its energy policy adheres strictly to the requirements of sustainable development promoting a climate friendly policy. Hence, the so-called Energy Policy for Europe (EPE), which has been adopted at the European Council in March 2007 has set three main objectives for the future EU energy strategy: first, to strengthen the competitiveness in the internal market to secure the internal energy supply, second, to ensure the security of supply of resources imported from abroad and last, to reduce greenhouse gas emissions to the atmosphere. Due to the complexity of these topics this paper will address only the issue of external security of supply in more detail.

The Three Pillars of EU Energy Policy: Internal Energy Market, Security of Supply, Climate Change Policy

The domestic oil and gas production in Europe gradually decreases, whereas internal consumption will increase in the near future due to the fact that potential alternative energy resources will not be available to cover existing demand[263]. In the coming 20-30 years the EU will cover about 70 percent of its energy demands, compared to 50 percent today, from import[264]. Because of the decrease in domestic production the estimated gas import by the EU will increase from 40 percent today to 70 percent in 2020[265]. Already today the oil import to the EU is estimated to be 90 percent of EU demands[266]. The new member states of the EU import up to 90-94 percent of their oil and 60-90 percent of their gas demand. The current EU energy supplies from outside the European Economic Area come mainly from Russia and Algeria. Given the total amount of energy imported from Russia to the EU countries the existing dependence becomes visible. Among the few other countries exporting energy to Europe are the OPEC countries (24% of oil imports)[267] and on the background of the EU Council Directive[268] concerning oil stocks there will be more opportunities for cooperation between the EU and the GCC in the management of supply disruptions. These opportunities have been provided in the frame of the so called EUROGULF[269].

The EU wants to decrease its dependence on a single supplier through diversification by means of energy supply sources from the Caspian Sea. Among the priority projects of European interest, which have been listed in Decision 1364/2006/EC of the European Parliament, is the Nabucco pipeline designed to bring gas from the Caspian to Central Europe. The Caspian Sea region including Iran (132.5 thousand million barrels at the end 2004[270] and proved oil reserves of 27.50 trillion cm at the end of 2004)[271] and the former Soviet republics, especially Kazakhstan and Turkmenistan, posses significant gas reserves and might be able to fill the supply gap from Russia. They could thus serve to diversify the supply sources, hitherto emanating from Russia. The Caspian Sea resources cannot become a substitute but

263 Current share of gas production of the EU: 11,3% and share of gas consumption of EU: 17,5%.in: BP Statistical Review of World Energy 2003, P.22 and 25.

264 Green Paper 2006, 1, P.3.

265 Communication from the Commission to the Council and the European Parliament - Final report on the Green Paper "Towards a European strategy for the security of energy supply", COM/2002/0321 final, P.2.

266 www.eia.doe.gov/emeu/international/reserves.htm.

267 BP Statistical Review of World Energy, June 2002, P.18.

268 Council Directive 98/93/EC of 14 December 1998 amending Directive 68/414/EEC.

269 An EU- GCC Dialogue for Energy Stability and Sustainability, http://europa.eu.int/comm/energy_transport/doc/2005_04_eurogulf_kuwait.pdf .

270 BP Statistical Review of World Energy, Oil, 2005, P.4.

271 BP Statistical Review of World Energy, Natural Gas, 2005, P.20.

rather an alternative to the current energy supplies to the EU. Whether the region will be able to fully exploit its economical potential will mainly depend on the settlement of the legal dispute about the status of the Caspian Sea, the political stability within the respective countries and the policy of the external actors involved in the region in political and economical terms (USA, China, EU).

Legal framework for the EU energy policy

Since the beginning of the new economic order created in post-war Western Europe, the regulations concerning the energy sector were reserved as the sole competence of the Member States and constituted a part of national energy law. Exercising one's rights in this strategic economic sector was considered to be an indispensable element of national sovereignty. At the same time, the limited European natural resources and their uneven geographic distribution forced the Member States to import, which gradually contributed to the creation of transnational energy regulations within EC law. Coal and atom were the only energy carriers that were not dominated by national regulations. They became common upon the signing of the Treaty establishing the European Coal and Steel Community in 1951 and the Treaty establishing the European Atomic Energy Community in 1957. All remaining branches of the power industry, being within the general regulations of the Treaty establishing the European Economic Community, did not benefit from any particular community regulation, but were subjected to the rules of free market and undisturbed competition. It was not until the Treaty of Maastricht (1992) that the pursuit to form a common energy market and a common EU energy policy had gained a more developed legal basis[272].

The EU has subsequently and gradually been adopting more detailed legal regulations[273] including the one passed by the Council of the European Union

272 Since the Treaty establishing the European Coal and Steel Community expired in 2002, and the regulations of the Euratom Treaty have the status of special regulations, it can be assumed in this study that the common energy policy bases on the regulations introduced by the Treaty establishing the European Community (TEC). However, TEC itself contains some provisions decreasing the influence of the Community on this policy and strengthening the independence of Member States in the energy sector, e.g.: art. 16 of TEC talks only about a casual obligation of Member States to inform one another and agree, within the structures of the Council, on all the issues relating to foreign policy and security that are of general interest. The objective of such activities is to ensure, by means of agreed undertakings, that the Union has the most efficient influence possible in this field.

273 White Paper of the European Union of 1995; Framework Programmes for the energy sector for the years 1998-2002 and 2003-2006; Programme of activities entitled: Intelligent Energy – Europe of 2003; Directive no. 96/92/EC and 98/30/EC; Decree no. 1228/03 of the European Parliament and Council of 2003; Green Paper of the European Union on a European Strategy for Sustainable, Competitive and Secure Energy of March 2006; so-called, the Energy Package of the European Commission dated 10.01.2007, adopted at the EU Council's summit in Berlin in March 2007.

in 2007[274]. The agreed concept of the EU energy policy is supposed to help the achievement of the three main objectives: boosting competitiveness in the energy market, increasing the security of energy supply and combating climate change. The set goals are the effect of the Union's many years of experience in the energy field. They were also expressed in legal instruments previously adopted in Lisbon (the Lisbon Strategy from 2000), in Kyoto (the so-called Kyoto Protocol to the United Nations Framework Convention on Climate Change of 1998) and in many other energy supply contracts between the Union and Russia. This "geographically" diversified process of achieving the EU energy policy objectives can be metaphorically presented as a legislative journey of the European Union between the three cities: Lisbon, Moscow and Kyoto.

"Lisbon": Ensuring the competitiveness of the UE economy and the necessary access to energy sources.

The so-called Lisbon Strategy for the European Union, adopted in 2000 by the European Council, presumed that within 10 years Europe would become the world's most competitive economy[275]. In 2006 this strategy has been complemented with a clear provision relating to the necessity of creating a common EU energy policy. One of the main objectives is supposed to be the creation, within the EU, of an efficiently operating internal energy market. It would contribute not only to increasing EU's competitiveness, but also to the sustainable development of the Union and the ensuring of its energy security. This goal should be achieved by means of a real opening up of national electricity and gas markets, coming into force on 1 July 2007. It is supposed to contribute to a greater competitiveness on these markets and to a deeper and better integration between the trans-European grids and gas pipeline systems in the member states. However, so far the achievements of the Lisbon Strategy in the energy field have not been impressive. There are no necessary deep changes in the community legislation and the existing regulations are not adequately implemented by member states, which is detrimental to EU competition towards other countries. This applies both to the true opening of the energy markets, and the use the existing energy infrastructure in a better way. Building the relevant elements of the Lisbon Strategy will enable the access of renewable energy to electricity grids, increase competitiveness and, at the same time, strengthen the European internal market.

274 See: summit conclusions entitled "European Council Action Plan (2007-2009) – Energy Policy for Europe". The conclusions were based on the presumptions of the so-called Energy Package adopted by the European Commission on 10.01.2007, in relation to which three additional communications with detailed regulations concerning the three aspects of the Package have been published, i.e.: An Energy Policy For Europe, Prospects for the internal gas and electricity market, Priority Interconnection Plan. See: http://www.consilium.europa.eu/ueDocs/cms_Data/docs/pressData/en/ec/93135.pdf, P. 20-22.

275 „Lisbon Strategy" UKIE, http://www.nauka.gov.pl/mein/_gAllery/82/823.pdf.

"Moscow": Ensuring security of supply.

The EU is aware of its growing dependency on energy supplies. It is estimated that within the next 20-30 years its energy imports will increase from 50% to 70% of the energy demand[276]. An additional problem is securing the supplies of energy from outside the EU to its internal market. At present, next to Norway and Algeria, Russia is the main producer of crude oil and gas for European markets. 16 percent of EU oil imports and 35 percent of its gas imports come from Russia. This figure will in 2020 reach 85 percent of the total energy import to EU.[277] Existing linkages between the EU and Russia have been additionally strengthened by the conclusion of a so-called EU-Russia Energy Dialog in 2000[278]. Algerian gas supplies go to southern European countries, which cannot be reached by deliveries neither from Norway nor Russia. Spain covers 75 percent of its gas demand from Algeria, Portugal- via Spain- 100 percent and Italy 54 percent[279]. The growing energy import dependence brings EU to an effective diversification of its energy sources and its transportation routes. At the same time, it also underlines the development of more efficient systems of Member States' cooperation in reacting to energy crises, in accordance with the mechanisms of the International Energy Agency and the standards of the European Energy Charter.

The problem of supply security appeared for the first time as a result of the Middle East crises in the 70's, which led to an almost four-time increase in world crude oil prices. It was then that Europe, on one hand, started the efforts at ensuring secure and regular crude oil supplies and, on the other hand, initiated the policy of increasing the role of its own resources, including nuclear energy, and took steps aiming at the rationalization of energy consumption. At that time also, the EU issued a number of directives relating to energy security, which obliged Member States to consult with the European Commission about their energy actions. According to the document, the Energy Policy for Europe, the development of a common approach to EU external energy policy has to be speeded up. It shall involve consumer, producer as well as transit countries, dialogues and partnerships among others with organisations such as OPEC. To that effect, the European Council has emphasised the need to intensify its relationship with the Caspian Sea countries to diversify sources and routes[280].

276 Green Paper of 2006 r., 1, page 3.

277 Umbach, F.: Global Energy Security. Strategic Challenges fort he European and German Foreign Policy (Globale Energiesicherheit. Strategische Herausforderungen für die europäische und deutsche Außenpolitik), Munic 2003, P.180.

278 http://europa.eu.int/comm/energy/russia/overview/index_en.htm.

279 ICG, "Algeria's Economy: the vicious circle of oil and violence", ICG Africa Report, No.36, 2001.

280 7224/1/07 REV 1, P. 19.

"Kyoto": Promoting sustainable development and combating climate change

In the times when man-inflicted climate change is more and more apparent, the European Union has been making efforts to adjust its energy policy to the principles of a low-emission economy. At the same time, the EU aims at signing a new global agreement to limit greenhouse gas emissions. The foundations of the policy to reduce gas emissions to the atmosphere, i.e. to combat climate change that is adversely affecting the natural environment, were laid in 1998 by the Framework Convention on Climate Change and Additional Protocol to it, the so-called Kyoto Protocol[281]. To achieve these objectives the EU has included them into its European Energy Strategy document, which strongly emphasizes the necessity of climate change prevention through achieving by 2020 three clearly formulated goals[282]. These are a 20% reduction of CO2 emissions, a 20% reduction of total primary energy consumption by increasing the consumption of renewable energy to 20% of the national energy mix in three sectors: electricity, biofuels and heating and cooling. The achievement of the last of these goals is connected to reaching a minimum 10% share of biofuels in this mix. The question of nuclear energy usage, which today constitutes 30% of electrical energy consumed in Europe, is to be decided by individual member states, which is why it will not be discussed below.

Institutional reform of the EU versus energy policy

The proposals based on the above-mentioned three pillars, i.e. competitiveness, security of supply and low-emission economy, will require the Union to maintain a coherent and reliable external policy. What seems to be a problem is that the competences of the community institutions in this respect have not been specified enough. The energy policy has not been "made common", and, as a result, these regulations are within the competences of both the Community and the Member States. The future institutional reform of the EU, which has been adopted in the Reform Treaty from Lisbon in December 2007 will have significant impact on the common energy policy of the Union[283]. According to these regulations, a High

281 In 1997, at the conference in Kyoto, the parties of the Framework Convention on Climate Change reached an agreement concerning the levels of reducing greenhouse gas emissions in industrialised countries. Industrialized countries were obligated to reduce in the years 2008-2012 the emission of six greenhouse gases by about 5% in comparison to the level from 1990. This commitment did not cover only three countries: Iceland, Australia and Norway, which were allowed to increase their emission in comparison to 1990 by 10 %, 8 % and 1%, respectively. Russia, Ukraine and New Zealand, on the other hand, negotiated to keep their emission levels from 1990. See: the website of United Nations Framework Convention on Climate Change (UNFCCC) http://unfccc.int/2860.php.

282 See: footnote no. 3.

283 See: „Traktat reformujący Unię Europejską. Mandat Konferencji Międzyrządowej – analiza prawno-polityczna. Wnioski dla Polski", ed. Jan Barcz, Materials from experts' conference which took place on 11 July 2007; J. Barcz, Prawno-polityczne ramy debaty nad przyszłością Unii Europejskiej, Sprawy Międzynarodowe 2006, no.

Representative for foreign affairs and security policy, who is, at the same time, the Vice-president of the European Commission, will be the person solely responsible for the foreign policy, including energy matters. At present, these competences are executed jointly by the Commission and the European Council. Secondly, the present energy policy of the EU is incoherent due to the complexity of the issues resulting from the necessity to reconcile national interests with Community interests. To change these tendencies, the EU is planning to work out efficient solidarity mechanisms in order to develop the common external energy policy and, in particular, to be able to cope with energy supply crises. What has been achieved so far is the creation of a special group of energy coordinators, whose job it is to ensure the efficiency of EU initiatives in the area of energy. The group gathers ad hoc, and consists of energy experts from individual countries and representatives of the Council's Office and the Commission. Its tasks include the collection, processing and circulation among the Member States of information, analyses and evaluations of supply security with a view to support the EU in situations requiring quick actions in case of energy crisis. What matters for the efficiency and coherence of the common European foreign energy policy are the efforts aiming at achieving an integrated internal market for electricity and gas.

The European Commission will also prepare a number of additional actions in the area of energy policy, both at the European and world level. These actions are supposed to strengthen the existing international energy security structures, e.g. the Energy Charter Treaty, the activities within the G8 or the actions undertaken to implement the provisions of the Kyoto Protocol in the period after 2012. The EU wants to make energy security issues an integral part of its external relations and, to achieve that, it is planning to build adequate partnerships with third countries, in particular in Eastern Europe and in Africa. These objectives are to be met by means of sector studies, strategic reviews and action plans, which are supposed to constitute the basis of the future energy policy.

EU Security of Energy Supply Versus Caspian Sea Resources

A clear EU policy on securing and diversifying energy supplies has been defined in the Green Paper[284] and Energy Policy for Europe, where it has been announced to be the first priority in the building of a coherent external energy policy of the EU. These documents set the "priorities for the upgrading and construction of new infrastructure/…/ shall be clearly identified notably new gas and oil pipelines

1, page 5 and the following.

284 These provisions appeared in the text of the so-called Green Paper of the European Commission issued in March 2006. The text of the Green Paper, see: http://ec.europa.eu/energy/green-paper-energy/index_en.htm. Additionally, Directive no. 204/67/CE on securing gas supply appoints a group of gas coordinators consisting of the representative of Member States, gas suppliers and recipients, and working under the control of a member of the European Commission. This group aims at the realization of the existing energy standards in order to guarantee the security of supplies to the liberalised community market.

and liquid natural gas (LNG) terminals"[285]; "the effective diversification of energy sources and transport routes will also contribute to a more competitive internal energy market"[286]. The development of a pan-European Energy Community Treaty and a new energy partnership with Russia have been emphasized. The Caspian Sea countries have been briefly mentioned in this context as important gas suppliers and transit routes, without defining their long-term position within the pan-European Energy Community[287].

Why energy diversification?

There is an obvious and strong impact of geopolitical developments on the security of energy supply and on the vulnerability of societies to import risks. The high dependence on almost exclusively two single sources, i.e. deliveries from Russia and Algeria, puts importing countries into a risky position. Any unexpected disruption due to technical problems in the extraction or transport might be difficult to compensate for and can come at high economical costs. Such a dependence of the EU mainly on two supplier harbours threats to its long term energy security and urges the EU to become more active in other resource rich regions. Higher degrees of market integration and closer economic and structural ties with reserve production capacities in countries other than Russia and Algeria, could, in turn, imply broader flexibility of the EU in its energy security policy and lower political risks while retaining for Algeria and Russia the strategic reserve function of the EU. Here mentioned energy supply diversification might refer to fuel types, fuel sources, technology types and sources[288], however only the introduction of equally reliable energy sources shall be considered.

Although the energy supply from Algeria has never been disrupted, the importing countries are seriously worried in terms of their energy security due to the unstable political situation in Algeria. The position of the main single energy supplier towards the European market is currently held by Russia. Its expected growth in the next future might pose a significant threat to EU energy security. Even after becoming a member of the G8 and this year for the first time assuming its presidency, Russia is still not necessarily to be called a fully democratic state. Russia's commitment to fulfilling its legal obligations sometimes seems to be politically driven. This was underlined by the recent gas shortages when Russia cut off supplies to Ukraine in January 2006 creating shortages in Europe. Also EU's eastern members have already experienced shortages in their energy supply due to the cut off in energy supplies

285 2.6 (i), Green Paper, 2006, P.15. As examples have been mentioned the gas pipelines from the Caspian region, North Africa and the Middle East and the Central European oil pipelines supplying Caspian oil to EU.

286 Energy Policy for Europe, P. 18.

287 Ibidem.

288 Nera, Security in Gas and Electricity Markets, final report for Department of Trade and Industry: ref 003/08 SGEM/DH London, 21 October 2002, P.7.

done by Russia to Belarus and Ukraine. Driven by this experience and by its high dependence on Russia's energy deliveries Poland has worked out and presented an alternative energy security plan to the EU countries at the beginning of March 2006[289]. This proposal aimed at the creation of an energy security alliance between the EU and a dozen of other countries, similar to NATO structures, centered on the mutual obligation to guarantee energy security to all countries that import Russia's energy. The Polish proposal does not seem to have gained much of support among the other EU member states. Nevertheless, the alternative sources of energy supply to Europe shall be wider considered in the future.

Summarizing, there are three guarantees for the energy security of Europe, firstly; there is a still significant share of domestic energy production within the EEA, which in the short term prevents its entire dependence on external suppliers; secondly, the EU dependence on energy imports from Russia implies Russia's dependence on the energy export to EU countries; thirdly, the energy supply to the European countries will be more diversified and one of the most suitable regions for doing so seems to be the Caspian Sea, due to its relatively close location to European markets and already existing infrastructural ties. While the supply from Russia and Algeria is expected to growth in the near future it seems to be necessary in terms of EU energy security to make additional efforts towards diversifying gas deliveries to the European market especially from the Caspian Sea. Kazakhstan dominates in the oil production in the Caspian region with proven reserves of 39.6 thousand million barrels total from the Tengiz, Karachaganak and Kashagan fields at the end of 2004[290]. Turkmenistan predominates in gas production, with proven reserves of 2.90 trillion cm at the end of 2004[291]. Azerbaijan had proven reserves of 7.01 thousand million barrels at the end of 2004[292]. The ability to diversify the sources of supply is however limited mainly through existing fixed transport infrastructure. The proposed diversification through the use of resources coming mainly from Kazakhstan and Turkmenistan are routed through Russia, which makes the deliveries from the Caspian Sea to the EU directly und independently of Russian participation very difficult.

EU programs for the states of the Caspian region

Soon after the dissolution of the Soviet Union some instruments of the European strategy in the CEA have been started. First and most important were the Agreements on Partnership and Cooperation, which have been signed with most of the post-Soviet republics. The Agreements were to serve as basis and support for the development of bilateral relations of the EU with these countries. Another instrument, the so called Technical Assistance to the Commonwealth of Independent States (TACIS)

289 International Herald Tribune, 7.03.2006, P.1.

290 BP Statistical Review of World Energy , Oil, 2005, P.4.

291 BP Statistical Review of World Energy , Natural Gas, 2005, P.20.

292 BP Statistical Review of World Energy , Oil, 2005, P.4.

programme[293] was launched by the European Community in 1991. The TACISs Programme provides grant-financed technical assistance to 12 countries of Eastern Europe and Central Asia and mainly aims at enhancing the transition process in these countries. Another important project was started in 1993: the Transport Corridor Europe Caucasus- Central Asia (TRASECA)[294] in the framework of the TACIS programme with the aim of creating a Europe-Central Asia transport passage and reviving the historical transport linkage between the two regions- the Silk Road. The Black Sea Regional Energy Centre (BSREC)[295] was created in 1994 under the SYNENERGY program of the European Commission, in cooperation with eleven countries from the Black Sea region. Its aim was to enhance the implementation and harmonization of the EU laws and energy policy with the local regulations of the member states. Another example of EU involvement in the post-Soviet space is the Interstate Oil and Gas Transport to Europe (INOGATE)[296] funded mainly under the EU's TACIS Program. Its aim was to promote regional cooperation and integration of the pipeline systems and facilitating the transport of energy resources of oil and gas from NIS countries to Europe.

The newest initiative of the EU towards most of the post-Soviet republics including those from around the Caspian Sea is the so called European Neighborhood Policy (ENP)297. It does not cover Russia, which enjoys a separate Strategic Partnership[298] with the EU defined in the Four Common Spaces[299]. The ENP shall support the development and intensification of the mutual relations of the EU with its new neighboring countries after its enlargement eastwards. In exchange for a greater economic integration with the EU common market the neighboring countries covered by ENP will be required to pursue political, economic and institutional reforms based on the principles of rule of law, democracy and stable economy. The two main objectives of the EU are on the one hand achieving stability and security in the region, as well as the support of iis economic interests in the region concerning trade and transit of oil and gas[300]. The European Neighbourhood and Partnership Instrument (ENPI) is the main financial instrument to support the implementation of ENP, focusing in particular on supporting the implementation of the ENP Action Plans.

293 http://europa.eu.int/comm/external_relations/ceeca/tacis/.

294 www.mfa.uz/modules.php?op=modload&name=Sections&file=index&req=viewarticle&artid=191&page=1.

295 http://www.bsrec.bg/.

296 http://www.inogate.org/en/.

297 Text on: http://europa.eu.int/comm/world/enp/pdf/strategy/strategy_paper_en.pdf. Further information on: http://europa.eu.int/comm/world/enp/index_en.htm.

298 http://europa.eu.int/comm/external_relations/russia/intro/index.htm.

299 http://europa.eu.int/comm/external_relations/russia/summit_05_05/finalroadmaps.pdf#ces.

300 The European Union's new eastern neighbours / Advisory Council on International Affairs. The Hague, 2005. - 48 S., Kt., Lit. Hinw., Anh. (AIV; No. 44).

Oil and gas pipelines from the Caspian to Europe

The intensification of energy supply from the Caspian region to Europe would be of mutual interest to both parties. EU's energy consumption constantly increases and for the post-Soviet resource-rich states the energy trade is considered a way of tackling their socio-economic and internal political problems. The main problem of the Caspian region is the lack of transport routes able to carry oil and gas from the Caspian Sea to the European market independently of Russian pipelines. Due to the historical conditions the dependence on the existing limited infrastructure, which is totally owned by Russia, this is the main delivery obstacle for the Caspian producers.

There are a few arguments in support of building direct infrastructural link from the Caspian Sea to Europe. First of all, there would be the already mentioned geopolitical and economic independence for the Caspian countries as well as for Europe from the connecting states, in this case from Russia. Secondly, the lack of pipeline access limits production in the region. Thirdly, there are other big consumer states willing to import energy from the Caspian Sea. In this context the oil pipeline from Kazakhstan to China, which is planned for 2008, and the advanced negotiations between China and Turkmenistan about the building of a new gas pipeline are to be mentioned. China bids much more than European investors and its supply demand is much higher then the EU's. Fourth, transporting oil by pipeline is being considered as safer and more environmentally friendly then shipping it by tankers due to the high possibility of damage caused by resulting oil spills.

If the EU claims that the future necessity of diversification of energy deliveries to its internal market are to be taken seriously, the first step to doing so would be the establishment of links between the already existing or planned European crude oil pipelines with the oil fields in the Caspian region. First of all there would be a reasonable option to transport Kazakhstan oil through the Caspian Sea to Azerbaijan and Georgia and further through the Black Sea by extending the Odessa-Brody pipeline to Plock, which might be linked into either the Druzhba route or the existing line to the Polish Baltic Sea port of Gdansk. There have been advanced talks between the Kazakhstan State oil Company KazmunaiGaz and the Azeri National Oil Company with its Ukrainian and Polish partners to revive the Odessa-Brody pipeline and fill it with oil from Kazakhstan and Azerbaijan. However, during a meeting in Turkmenistan in June 2006 a new declaration was signed on the construction of the gas pipeline along the Caspian Sea coast, which shall tie these three countries together. Its conclusion coincided with an informal energy summit held in Poland between the Presidents of six countries interested in obtaining Caspian resources: Poland, Ukraine, Azerbaijan, Kazakhstan, Georgia and Lithuania. Another possibility would be to link the Caspian Sea with the planned Constanza-Omisalj-Trieste pipeline, which shall link the port of Constanta in Romania via Croatian Omisalj onto Trieste in Italy. Another option might be a linkage of the Caspian fields with a planned Burgas-Alexandropoulis pipeline, between the Bulgarian port of Burgas on the Black

Sea and the Greek port of Alexandropoulis in the Mediterranean Sea, which would avoid oil transport through the already overloaded Bosphorus. Another possibility would be an agreement with the operator of the in 2005 opened Baku-Tbilisi-Ceyhan oil pipeline on the construction of an additional link to any on the existing European Black Sea ports and further on to existing or planned pipeline systems.

The wide range of existing European gas pipelines seems to be suitable to transport gas from the Caspian region to the European market. First of all there is the Turkey-Greece-Italy interconnection, about which the first protocol was signed in 2000 in the frames of the INOGATE Program, to transport gas from the Caspian region, Iran and the Middle East to Europe. Also the so-called Nabucco gas pipeline connecting Turkey - Bulgaria - Romania - Hungary - Austria might carry gas from the Caspian region and the Middle East. The Greece, Former Yugoslav Republic of Macedonia, Serbia, Bosnia, Croatia and Slovenia gas pipeline, which is currently in its very early stages of development, might also provide for the transport of gas from the Caspian Sea. There will also be a gas pipeline from the Azeri field of Shah Deniz via Georgia to Erzurum in Turkey; this is the BTE gas pipeline. Another option for European shares in the Caspian production might be the widening of the existing gas pipeline from Turkmenistan to Iran and its extension to Turkey and further to Turkey-Greece and Turkey-Romania interconnections. Also, the Ukraine gas transit network might play a particularly important role in this context.

Obstacles of a legal nature to the planning of a Trans-Caspian pipeline

With respect to the unclear legal status of the Caspian Sea I will firstly leave aside the discussion whether the newly Caspian states are bound by the Soviet-Iranian treaties, and secondly, avoid the argument whether the Caspian Sea is a sea or a lake in legal terms. According to international law[301] the basis for the current legal status of the Caspian Sea are the Soviet-Iranian Conventions from 1921 and 1940[302]. These treaties however do not regulate neither the matters of development of the Caspian seabed and its subsoil mineral resources, nor the pipelines, nor the protection of the Caspian environment and therefore it no longer appears sufficient to deal with these complex problems. The need for a new set of provisions regarding the Caspian's legal status has been acknowledged by the Caspian littoral states and has been embodied in their ongoing negotiations. For a number of years discussions have been raging whether the Caspian Sea is a lake or a sea in legal terms. It is not just a theoretical dispute, because it would determine what type of international law should apply to

301 Art 34, Text: United Nations Conference on the Succession of States in respect of treaties--Official Documents--Volume III--Conference Documents (United Nations Publications, Sales No. F.79.V.10);

1991 The Declaration of Alma-Ate, in 31 International Legal Materials 1992, s.143-149.

302 The Treaty of Friendship Russian Socialist Federal Soviet Republic and Iran (26 February 1921) in LNTS, No.268 and Treaty of Commerce and Navigation (1940); Treaty of Commerce and Navigation of 25 March 1940, LNTS, No. 2530.

the Caspian Sea – the law of the sea, or the customary law for international lakes. However, the recent legal developments as well as the course of the ongoing states negotiations on the legal status of the Caspian Sea pinpoint that the future solution will be a compromise between all littoral states regarding an entirely new legal status of the Caspian Sea to be fixed in a common agreement.

Serious differences of opinion expressed during the continued negotiations ended up in bilateral agreements on the development of seabed and subsoil mineral resources concluded parallel to the multilateral negotiations. In practice this means that alongside the preparation of the mutual Convention on the status of the Caspian Sea the littoral states might try to work out a legal base for specific activities in the Caspian Sea- such as development of the mineral resources, fishing, navigation, etc. The states will reach comprehensive agreements on all particular regimes moving forward step by step thus narrowing the field of disagreement. Until now there has only been one agreement accepted by all the Caspian littoral states since the break-up of the Soviet Union, namely the Framework Convention on the Protection of the Marine Environment of the Caspian Sea, signed in 2003 in Tehran.

Another direct effect of the troublesome multilateral negotiations on the status of the Caspian Sea have been bilateral agreements concluded in 1998-2003 between Russia, Azerbaijan and Kazakhstan[303]. These treaties were to settle delimitations of the seabed and subsoil in the northern part of the Caspian Sea without specifying the legal status of the selected sectors, whether the sectors are under the sovereign rights of the state parties or not. The conclusion of the North Caspian Treaties 2003 between Russia, Azerbaijan and Kazakhstan or similar legal acts of some Caspian littoral states in the future creates legal uncertainty. It might have direct impact upon any activity – such as for instance building pipelines in the Caspian Sea - undertaken by the Caspian littoral states themselves or with the support of other countries. First of all it has to be underlined that according to the Vienna Convention on the Law of Treaties the North Caspian Treaties have no legally binding force with regard to Iran and Turkmenistan, who have not been parties to these treaties. With few exceptions "a treaty does not create either obligations or rights for a third State without its consent"[304]. Furthermore, Iran and Turkmenistan have been questioning the validity of the North Caspian Treaties by using the argument that the approbation by all littoral states is a condition sine qua non of any lawful use of the Caspian water and

303 Kazakhstan-Russia on July 6, 1998, Azerbaijan-Russia on September 23, 2002, and Azerbaijan-Kazakhstan on November 29, 2001 and its Protocol of February 27, 2003.
Kazakhstan –Azerbaijan Treaty, in Russian on: http://www.caspinfo.ru/library/doc/inter/inter_01.htm.
Russia –Azerbaijan Treaty, in Russian on: http://www.president.kremlin.ru/text/docs/2002/09/30520.shtml.
Additional trilateral Tripoint Agreement has been reached between Azerbaijan, Kazakhstan and Russia on May 14, 2003- ratified by Kazakhstan am 4. December 2003 and by Azerbaijan am 9. December 2003.

304 Art. 34.

seabed resources[305]. Nevertheless they remain in accordance with the former Soviet-Iranian treaty praxis and the international customary law of the sea which justifies their lawfulness.

For the time being there has been no compromise between bilateral and multilateral approaches in the Caspian Sea. However, a multilateral solution seems to be more favorable for a peaceful long term settlement. Such a multilateral solution may allow for the avoidance of a politically uncomfortable situation by modifying reached agreements by the decision of an appropriate court or arbitrage solution. This was the case when the continental shelf agreements between the United Kingdom and Netherlands as well as between United Kingdom and Denmark had to be modified in light of the International Court of Justice judgement in the North Sea Case[306]. In their earlier agreements United Kingdom, Netherlands and Denmark agreed upon an equidistant tripoint, without considering Germany's interests. Also the equidistance principle used by these states has proven inapplicable[307]. Aware of all the differences between the Caspian and the North Sea cases as well as knowing that the United Nations Convention Law of the Sea finds no direct application to the Caspian dispute and that the Caspian case might not be submitted to a International Court of Justice decision, the legal classification of the bilateral delimitations agreements in the Caspian Sea are ones of considerable uncertainty. Instead, there should be strong international support for the idea of a multilateral solution of the Caspian dispute including technical help as well as political encouragement of effective negotiations including all Caspian littoral states.

Conclusions

To sum up the EU energy security policy, we might say that it is in its preliminary stage of development. The European Energy Policy document relating to the guidelines of the EU new energy policy adopted by the European Council in 2007 is a summary of the Union's achievements so far in the field and, at the same time, it is a significant step forward on the way to guaranteeing energy security in the region. It was also the first of a number of necessary documents that will have to be adopted in order to realize the newly formulated goals of the EU energy policy. The Union's plans concerning the competitiveness of the energy market, security of supply and sustainable development are ambitious. Despite the lack of clearly formulated criteria for the assessment of the realization of these stipulations or their interrelation, it seems that the aspiration to reduce the emission level according to the requirements of the Kyoto Protocol is of primary importance, which is also indicated by a wide

305 Iran has refused to recognize this agreement. See UN doc. A/56/850, March 1, 2002.

306 Colson, D. The Legal Regime of Marine Boundary Agreements in: Charney, J.I.& Alexander, L.M. (eds.), International Maritime Boundaries, Vol. 1, London/Dordrecht/Boston: Martinus Nijhoff, P.62.

307 ICJ Reports, 1969: 45. para. 81.

range of precisely formulated community regulations. The achievement of these objectives will guarantee the realization of the other two and result in an increased supply security and the creation of an efficiently operating internal market. However, the future will show how effective the proposed actions are in the implementation of these guidelines.

Even today we can see that the above-mentioned changes in energy policy are accompanied by a significant increase in the ecological awareness of developed societies, which show an understanding and accepting attitude and engage in the creation of new energy initiatives aiming at environmental protection and supply security. At the same time, there are several problems connected with the achievement of the set community goals. The first of them refers to the future of energy policy both inside the Community, due to unclear competences of community bodies in this field, and in its foreign policy. The recently adopted Reform Treaty of Lisbon, if it comes into force, will probably bring positive changes in this respect. What may, however, appear to be a serious difficulty is the fact that most Member States differ from one another in their strategies relating to primary energy sources and, as a consequence, there is a difference in EU investment priorities. For instance, coal accounts for 5% of the energy mix in France while in Poland 60%. Another problem will be the scope of power of particular Member States to decide about the shape of their energy mix. Despite the European Council's decision at its session in Hampton Court in 2005 concerning the freedom of states to decide about their priority primary energy sources, at its Berlin session the Council introduced the obligation of a 20% share of renewable energy in the national energy mix, which limits the freedom of Member States in this respect. The EU efforts at guaranteeing the free access of consumers to energy services in the whole Union will have a similar effect. In this way, even though Member States will not lose control over the composition of their energy mix, they will not have any influence on the decisions of energy consumers as to which supplier they want to buy energy from. Another problem connected with the building of a community energy policy is the necessity of diversifying energy supplies resulting from the necessity to guaranteeing security. This is because the problem no longer consists only of traditional bilateral economic relations of particular Member States with energy producing countries. It is also necessary to build an efficiently operating transborder transmission infrastructure, which would enable the free transmission of electricity inside and outside EU.

For economic as well as political reasons European Union's interests in the Caspian region are expected to grow in the near future. On the one side there is an urgent necessity for EU to diversify is energy supply, both in natural gas and in oil, to escape possible threats to its energy security coming from the dependence on single, even if previously reliable, supplying countries. On the other hand especially after it extension in 2003 and accession by ten new member states the need to redefine EU relations and policy towards the neighboring countries and regions became compelling. The Caspian region's proven energy sources cannot be further ignored by the Europeans. A new EU strategy towards the Caspian region including a redefined trade policy is needed. There will be more EU attention to and positive involvement in the political, economic and legal developments in the Caspian region aimed at securing and strengthening existing relationships between the EU and the Caspian littoral states, as well as at the creation of new areas of understanding and cooperation. The Caspian states have since the collapse of the Soviet Union experienced the mixed blessing of their natural richness while they have at the same time often been at odds with each other in political, ethnical, territorial terms and therefore would welcome assistance from their European partners assuming that the EU would respect the independent position of the Caspian states. Especially valuable seems to be the European tradition of peaceful dispute settlement, which might be of particular interest in the Caspian debate bringing solutions and there from resulting economic gains for the Caspian Sea littoral state and at the same time reassuring and strengthening the EU's economic presence in the Caspian region.

Summing up, it must be emphasized that the nature of the European Union's common energy policy is complicated. The complexity of this issue results from the fact that energy interests of particular Member States differ significantly and that the states find it hard to accept a gradual loss of control over this strategic field of economy. At the same time, an extensive dependence of most of these countries on the imports of energy sources from outside the Union and their simultaneous need to guarantee their security in this respect, makes them willing to cooperate and create uniform legal bases within the European Union. Hence, several vital elements will influence the shape of the Union's energy debate in the next years. Until 2009, the European Commission and the Member States will be working together on new guidelines for the energy policy. In 2010, the European Council, basing its argument on the effects of union legislation implementation, will adopt an energy action plan. Its shape will depend on the results of the debate about the EU budget reform, which is planned for 2008/2009 and will specify the scope of budget expenditure on, among other things, the energy industry and the European neighbourhood policy. Within this discussion EU will not miss its great opportunity that might be offered by the Caspian region. To get its resources to Europe but at the same time not to get affected by the legal uncertainties of the Caspian Sea division, the EU should use all available sources to ensure that its activities are not being perceived as intervention into regional internal affairs. It needs however to make every effort to help the Caspian states find a solution to the Caspian use related problems.

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CHAPTER NINETEEN

Europe's Energy Security: The Role of the Black Sea Region

Svante E. Cornell

Europe's growing dependence on imported fossil fuels have emerged as an increasingly major political issue. The ever-tightening global oil markets have led the price of oil to rise above levels unimaginable only several years ago, with gas prices following suit. Meanwhile, Europe's growing consumption of natural gas is being met principally by Russian exports. Growing concerns have nevertheless developed in Europe regarding Russia's reliability as an energy supplier, following increasingly reckless Russian behavior towards its neighbors and toward European investors. Following the adage that energy security lies mainly in diversity, a new quest for alternative energy resources that could alleviate some of Europe's dependence on Russian energy has developed. The Caucasus region plays a crucial role in this context, because it is the only area in Europe's vicinity that has the potential to serve as a key producer and transit area for new sources of European gas supplies. There is a clear match between the European strategic interest and those of the states of the Caspian region. Europe is in need of diversified access to energy, and other supply routes to Europe, and to have strategic access to the Central Eurasian inland; while the states of the region desire closer ties in the economic and security fields to Euro-Atlantic institutions. As such, the Caspian region is an example of where oil and gas resources can function as an object of cooperation rather than tension.

Russian and Eurasian Gas and European Markets

Among the top policy priorities for EU energy development is avoidance of strategic dependence. Yet a number of EU member countries are already in a position of strategic dependence on Russian natural gas, which is deepening to that. Particularly among new members in Central and Eastern Europe, there is a close to 100 percent dependence on Russia's monopolistic gas supplier, Gazprom. Even France and Germany are increasingly dependent on Russian gas. Meanwhile, Europe's natural gas demand is projected to increase substantially in the future. Even under conservative scenarios, the demand for importing natural gas to the EU will double from 200 billion cubic meters (bcm) per annum in 2002 to 400 bcm by 2030, with total demand rising from 400 bcm to up to 600 bcm in same period.[308] The greater portion of this increase is likely to come from gas producing countries of Eurasia. Indeed, significant untapped production capacity likely to emerge in Europe's neighborhood is mainly located in Russia and the Caspian Sea basin – adjoining the Wider Black Sea region.

It is also clear that Russia is in no position to single-handedly provide a substantial portion of this increase – even with immense investments that do not seem to be forthcoming. As former Russian Deputy Minister of Energy Vladimir Milov has observed, Russia "faces an investment crisis, especially in gas", and had "done nothing" to invest in infrastructure that would enable it to increase production substantially, particularly on the important Yamal peninsula.[309] Indeed, Gazprom has consistently failed to invest in new field infrastructure, relying on large Soviet-era fields for the bulk of its production. With the exception of the large Zapolarnoye field in Western Siberia, Gazprom's fields are either stable or declining in production.[310] Hence Russia's own natural gas production has reached a level whereby it cannot grow considerably – let alone generate substantial new export capacities – without substantial investments in billions of dollars. Indeed, Russia will soon need to invest heavily in new fields to maintain its current output level.

On the other hand, the energy producing states of the Caspian basin – Azerbaijan, Kazakhstan and Turkmenistan – have large untapped potential production of both oil and natural gas. Turkmenistan alone produced 90 bcm per year in the late Soviet era – a substantial amount compared to Gazprom's exports to Europe, which at present are of the order of 140 billion. To this should be added smaller capacities in Azerbaijan, which may reach 30 bcm by 2012, and Kazakhstan and Uzbekistan. The energy producers of the Caspian region hence have a production potential equal to or greater than Gazprom's. Meanwhile, their domestic markets are considerably smaller, whereas Russia's export capacity stands to be affected by domestic consumption.

It is hence a near-certainty that gas from Azerbaijan, Turkmenistan and Kazakhstan will be reaching Europe in increasing quantities in the following decades. This process has already begun with the completion of the Baku-Tbilisi-Ceyhan oil pipeline in 2006, which is presently delivering light Azerbaijani crude oil to European refineries, with a capacity set to expand to 1,8 million barrels per day (ca. 85 million tons per year). As for gas, there is every reason to believe that Caspian gas will reach Europe in the next decades.

308 Gordon Feller, "Gas Pipelines Vital For European Security", *Pipeline and Gas Journal*, October 2004.

309 "How Sustainable is Russia's Future as an Energy Superpower?", Summary of presentation by Vladimir Milov at Carnegie Endowment for International Peace, 16 March 2006.[http://list.carnegieendowment.org/t/80287/192304/42757/0/]

310 "Natural Gas Supply for the EU in the Short to Medium Term", Clingdael International Energy Program, March 2004; "Turkmenistan: Putting Gazprom – and Russia – in a Bind", *Stratfor.com*, 15 April 2005.

If this appears certain, the question is through which export routes these resources will be transported to Europe. That new pipeline capacity is needed is obvious, and this gas can reach Europe in various ways. It can be transported independently and directly from producer states through a varied set of routes to European markets, increasing Europe's energy security by diversifying its supply routes. This, of course, requires the building of new transportation networks, which will be discussed below. Yet unless such alternative delivery options are constructed to bring natural gas from fields in Azerbaijan, Turkmenistan and Kazakhstan to Europe, Russia is likely to fill the vacuum by controlling the transportation of this region's gas – using its monopoly position in Central Asia to buy gas cheaply and using its monopoly of supply in Europe to sell gas at several times the price to Europe. Indeed, Gazprom's pledges to increase exports to Europe to 180 bcm by 2010 are not likely to come from domestic production;[311] instead, it would re-export Caspian gas at a profit In the process, Moscow would make a large profit while increasing its political leverage over both Europe and the states of Central Eurasia. This is consistent with Russian energy policy, but as seen below, this represents a prospect that lies neither in Europe's interest nor in that of the producer states.

Russian Energy Policy

Russia has had a clear and discernible policy regarding energy resources as relates to both Europe and the Wider Black Seas region. This policy has consisted of a number of facets, all of which have sought to capitalize on energy as the main vehicle for the strengthening of Russia's influence over its neighboring regions. The strategy has had several main aspects: state control over the production of gas for export; keeping a monopoly on acquiring Central Asian gas at cheap prices; achieving increasing dominance over the European consumer markets; and utilizing dominance over both the import from and export to CIS countries of gas for political purposes.

To begin with, Moscow has ensured that the Russian government exercises control over the energy sector in the country. It has become patently clear from the Yukos affair and subsequent developments that private or foreign actors will only play a role as minority shareholders in major Russian energy assets. The treatment of western companies in recent times, locked out of the Shtokman field and bullied by the government on environmental charges in the Sakhalin-2 context provides examples of this. The position enjoyed by Gazprom, in particular, and its symbiosis with the highest echelons of the state have made the relationship between the Russian state and its largest corporation increasingly murky. Gazprom is neither a corporation with distinct interests; nor a direct tool of the government, in the sense of being subordinated to it. Indeed, most of the decision-makers determining Gazprom's moves are also decision-makers in the Russian state, and also have personal stakes in

311 "Gazprom expects to increase gas exports to Europe to 180 bcm by 2010.", *Gateway to Russia*, 17 December 2004. [http://www.gateway2russia.com/st/art_260393.php]

business entities connected to Gazprom. This lack of transparency bodes ill for the future, as it is a factor of instability in case a new redistribution of assets takes place in Russia similar to the campaign against the oligarchs that President Putin conducted after coming to power.

Gazprom has been surrounded by murky deals. In numerous cases, the company has accorded beneficial deals to newly created companies whose ownerships structures have been unclear. For example, companies like Eural Trans Gas and RusUkrEnergo have been subcontracted to manage gas deliveries to Ukraine. In 2003, Eural Trans Gas – a company with no hard assets – netted a profit of $767 million on this scheme, money that Gazprom had little reason to let go by subcontracting a subsidiary. This has led to growing worries among Gazprom's minority shareholders that individuals with stakes in the company are also personally benefiting from offshoots of this kind. Obviously, this lack of transparency created long-term doubts of the company's viability.

On the foreign policy front, Moscow's policies – understood here as a symbiosis between Gazprom and the Russian government – have been consistent. The main purpose has been to secure Moscow's monopoly on the transit of all oil and gas from the former Soviet republics to consumer markets in Europe. This in practice implies securing Russian control over the energy exports of the states of the Caspian region.

Moscow's overarching objective has been to secure continued monopoly over Caspian gas supplies. Indeed, prices for the sale of Russian gas in European markets have been rising as the global oil price has increased. Meanwhile, Moscow has been able to secure continued low prices for acquiring gas from Central Asian states, who have no other outlet for their gas. By the early 2000s, the price differential had reached ridiculous proportions. Moscow paid Turkmenistan $57 per thousand cubic meters (mcm), half of which was in cash and half in barter – implying goods estimated worth half their cash value in reality. Hence Moscow effectively paid Turkmenistan around $45 per mcm. Importing this gas enabled Moscow to use cheap Central Asian gas to supply the Russian domestic market, freeing up gas production that was instead sold to European consumers at over $250 per mcm. This amounted to a four- to five-fold profit, even accounting for transit costs. In this way, Moscow was able to hold off investments in the billions of dollars in its own fields – growing exports needs could simply be substituted by Central Asian gas supplies. Instead of *spending* billions on investments in infrastructure, Moscow could *make* billions on the price difference.

With regard to non-energy producing former Soviet states, ranging from the Baltic states to Ukraine and Georgia, Moscow has used its continuing monopoly on energy deliveries for political purposes. Moscow has prevented Kazakhstan from using Russian pipeline networks to deliver oil to the Baltic states for export. This may constitute an anti-competition policy, but Moscow's use of the energy card has taken much more serious proportions, especially against Georgia. At numerous occasions, Moscow has cut gas and electricity supplies to Georgia for blatantly political reasons.

This has been related mainly to the Georgian ambition to have Russian military bases removed from its territory. In 2001, for example, Russia cut gas supplies on January 1, in spite of the gas deliveries being paid in advance by the American AES company, at that time running Tbilisi's gas distribution system. The perhaps main and most famous incident was in January 2006, when Moscow targeted Georgia and Ukraine simultaneously, cutting gas supplies to Ukraine after having sought to force Ukraine to pay European prices for gas overnight. As far as Georgia was concerned, mysterious explosions destroyed gas pipelines and electricity wires carrying energy to Georgia, explosions that have never been resolved but which have been blamed on Russia's security services. Likewise, a minor oil spill provided cause for Moscow to shut down deliveries to Lithuania in July 2006, while the same pipeline continued to deliver energy supplies to Belarus.[312]

Another element has been Russia's aim to make inroads into downstream infrastructure and distribution systems in Europe. Indeed, Gazprom's ambitions to gain control over assets in western Europe led to a controversy with the United Kingdom in 2006. When British regulators raised doubts of Gazprom's plans to acquire Centrica, the owner of British Gas, Gazprom CEO Alexei Miller noted that "Attempts to limit Gazprom's activities in the European market and to politicize questions of gas supplies, which are in fact entirely within the economic sphere, will not produce good results".313 This was followed by threats that Russia's gas exports would be reoriented towards Asian markets. Russian attempts to gain control over downstream assets stands in steep contrast to Russia's increasingly staunch refusal to let economic considerations determine ownership structures upstream, in Russia itself.

Third, Moscow has sought to sustain its control over the former Soviet Union's oil and gas suppliers and to make up for the damage where it has failed to do so. Moscow lost its total monopoly on West Caspian oil with the building of the Baku-Tbilisi-Ceyhan pipeline. However, its priorities are to ensure continued monopoly over Caspian gas from both the eastern and western shores, as well as a monopoly over East Caspian oil. As far as Azerbaijan is concerned, Russia's monopoly over gas exports is threatened by the building of the Baku-Erzurum gas pipeline, which flows in parallel to the BTC pipeline, and which will deliver gas from the Shah-Deniz field to Turkish markets.

However, Moscow has tried to offset the loss of control over Azerbaijan's oil supplies by seeking to commit the Turkish market to growing volumes of Russian gas supplies. This prospect was greatly aided by the building of the Blue Stream pipeline, crossing the Black Sea, delivering an eventual 10 bcm to Turkey by 2010. The Turkish market is already heavily overcommitted in terms of gas, having committed to supplies from Azerbaijan, Turkmenistan, Iran and Russia that the Turkish market

312 Vladimir Socor, "Seven Russian Challenges to the West's Energy Security", *Eurasia Daily Monitor*, 6 September 2006.

313 "Gzprom Warns EU to Let it Grow", *BBC News*, 20 April 2006.

cannot absorb. The building of the Blue Stream pipeline – a $3.2 billion project – cemented Moscow's influence on the Turkish gas market. This entails that Turkey is in no position to buy volumes of Azerbaijani gas from Shah-Deniz beyond the phase one gas supplies from 2007 to 2011. The larger volumes to be produced from 2012 onward will simply not be consumed by the Turkish market, forcing producers to find alternative markets.

It is in this context that one should see Moscow's ambitions to have Russian gas flow through the Blue Stream pipeline and from there onward to Central European markets. In principle, Moscow's strategy is to shut out alternative transit routes from the Caspian region by committing Russian gas to Europe from a variety of transit routes that will fill up capacity that could be utilized by Caspian producers. It is exactly in this context that the North European Gas Pipeline should be seen. This pipeline, to stretch from Russia's short coast on the Baltic sea across the seabed to Germany, will cost approximately $10.5 billion. This exorbitant cost makes the pipeline much more expensive than a line crossing Ukraine or Belarus, for the very purpose of achieving an export pipeline that does not cross former Soviet countries on its ways to European markets. In other words, Gazprom will be able to cut gas supplies to Ukraine without European customers having to be affected. By the same token, an expanded version of the Blue Stream pipeline will allow Gazprom to commit volumes of gas, probably taken from Central Asia, to European markets, thereby preventing Caspian gas suppliers from selling gas to European markets independently.

Yet Moscow's energy strategy does not stop at this. Beyond seeking to sustain a monopoly on European gas supplies from the East, it is also seeking a greater influence over other alternative supplies to Europe, primarily from Northern Africa. Indeed, Moscow has aggressively pushed for influence over Algerian and Libyan exports to Europe. As Vladimir Socor observes, "In Algeria's case [the third largest gas supplier to Europe], Russia has successfully offered multibillion-dollar arms deliveries as well as debt write-offs in return for starting joint extraction projects in Algeria and joint marketing of the fuel in Europe."[314] This and similar Gazprom activity in Libya has led to growing worries that Moscow is seeking to build a gas cartel to control prices to Europe.

In sum, it appears obvious that Moscow is increasingly capitalizing on energy – and particularly the less fungible commodity that is natural gas – as a tool to boost its influence and might vis-à-vis Europe. Moscow is monopolizing CIS gas supplies to Europe, using its dominance in the CIS for political purposes, acquiring influence over North African producers, seeking control over downstream energy assets in Europe, and simultaneously restricting foreign companies' access to the Russian energy sector. The picture is clear: Moscow is aiming to dominate Eurasian energy, and has repeatedly shown its readiness to use this domination for political purposes. Political use of energy has been blatant in regard to former Soviet states,

314 Vladimir Socor, "Seven Russian Challenges to the West's Energy Security", *Eurasia Daily Monitor*, 6 September 2006.

including EU members as Latvia and Lithuania. But it has also been present in a more subtle way with regard to Western European states. Indeed, former German Chancellor Gerhard Schröder's decision to take up a senior management position at Gazprom even before resigning as German Chancellor raised many eyebrows and led to the suspicion that Germany's support for the North European Gas Pipeline was determined in part by Schröder's private interests. Aside from this, it is already obvious that Russia is seeking – and achieving – an instrument limiting the level of criticism from Europe regarding its domestic turn away from democracy, as well as its treatment of its neighbors and neo-imperial ambitions. European dependence on Russian energy in the final analysis limits Europe's leverage against Russia: its abilities to influence Russia's domestic development and long-term stability is being hit by this dependence, as is Europe's ability to influence Russian foreign policy toward pro-western states in the CIS such as Georgia, Azerbaijan, Moldova or Ukraine.

This situation makes it all the more crucial for Europe to pursue options in terms of energy supplies that would reduce its dependence on a single, major and to that assertive energy supplier. Luckily for Europe, options are present, in the Caspian region.

Europe's Alternative: the East-West Corridor[315]

Europe's future growth in gas supplies is likely to be met not mainly by growing Russian gas production but by gas supplies from the energy-rich states of the Caspian region: primarily Azerbaijan, Kazakhstan and Turkmenistan. These are nevertheless bifurcated both in regional terms and in terms of output. The first main division is geographic: Azerbaijan on the West Caspian is considerably closer to Europe, while the major producers are the states of Central Asia on the Eastern shore of the Caspian. Azerbaijan is mainly an oil producing country, with exports reaching one million barrels per day in 2010, though its gas production may reach the substantial levels of 30 bcm in the next decade. On the East Caspian, Kazakhstan is mainly an oil producer, foreseen to produce up to 3 million barrels of oil per day (ca. 140 million tons per year) by 2015, with much less significant gas production. Turkmenistan, on the other hand, is the exact opposite: gas production constitutes the bulk of Turkmenistan's future promise, with the world's fourth or fifth largest gas reserves, depending on estimates, and a production capacity that could easily reach over 100 bcm, almost all of which is available for export. Finally, Uzbekistan has considerable deposits of both oil and gas; but a larger domestic market and therefore a more limited export capacity.

Only several years ago, the export of Caspian oil and gas to the EU would have seemed utopian. Yet important developments since have made this prospect realistic.

315 This section builds and develops on the chapter "Geostrategic Implications of the Baku-Tbilisi-Ceyhan Pipeline", by Svante E. Cornell, Mamuka Tsereteli and Vladimir Socor, published in *The Baku-Tbilisi-Ceyhan Pipeline: Oil Window to the West*, Washington and Uppsala: CACI & SRSP, 2005.

This is in great part due to the completion of the Baku-Tbilisi-Ceyhan pipeline. This pipeline effectively connects the West Caspian shore with European markets, providing top-of-the line infrastructure for oil and a parallel gas pipeline. This also makes the prospect of East Caspian resources reaching Europe more realistic than ever, as the infrastructure is now in use just across the Caspian.

The Caspian alternative to increasing dependence on Russia was implicitly acknowledged by the EU through the realization of the INOGATE project, implying the construction of pipelines that will connect Europe to the gas producers of the Caspian region. This process is already in course – through the integration of European gas transportation networks on the one hand, and the building of a new energy transport infrastructure connecting Azerbaijan to Turkey, on the other hand. As such, there are two major priorities for the realization of a full East-West corridor: linking the Turkish gas network to the European one; and linking the West Caspian to the East Caspian by Trans-Caspian pipelines. This will create a virtual South Caucasian corridor to Europe, and can be complemented – if found economically viable – by a connection linking the South Caucasus to Ukraine across the Black Sea.

It is obvious that the potential entry of Caspian natural gas to Europe through the South Caucasus and Turkey would help Europe diversify its energy supplies, and to reduce dependence on the state-owned Russian monopoly Gazprom. Indeed, there appears to be little reason for Europe to have the same resources reach Europe via Russia, allowing Gazprom as a monopolist to control prices, while making Europe vulnerable to voluntary as well as involuntary supply interruptions. Developing pipelines directly to the Caspian region will perfectly complement major reforms planned in the European gas sector, aiming at the creation of a competitive market of multiple operators with the interest to have different options of delivery routes.

Such a competitive market is in the long-term interest of Europe – but is objectively speaking also in Russia's interest. Diversification of supply routes and gas sector reform in Europe will eventually drive the Russian monopolistic supplier, as well as the Russian gas sector in general, towards much-needed reforms and transparency that will give it sustainability and stability. Indeed, a driver behind the development of the South Caucasus Energy Corridor has been the inflexibility of the Russian state monopolies, Gazprom and Transneft. By dominating access to markets and by creating barriers to access for others, they have forced producers to look for alternative means to the market. By choosing to exploit its control of energy export as a geopolitical weapon, Russia has forced its southern neighbors to respond with initiatives that will preserve their sovereignty in the face of such threats. The result has been the development of alternative routes, which in turn makes Russia nervous and suspicious. Furthermore, without market liberalization, it will be impossible to attract investments to the Russian gas sector, and without investments, Gazprom will not succeed in meeting its ambitious production goals.

BTC as a Tool of Cooperation

The Baku-Tbilisi-Ceyhan pipeline is important to global oil markets as it provides an additional million barrels of non-OPEC oil a day to world consumers, with a potential to be expanded to 1,8 million bpd. Most important, it is far from the global oil markets' biggest chokepoint, the straits of Hormuz, through which fully 17 million barrels of oil are exported daily. BTC also avoids use of the narrow Turkish straits, which are already at their limits with 3 million bpd already passing through the narrow channel, which is barely half a mile wide. In this regard, BTC has significant advantages as it avoids major transportation chokepoints. This makes BTC the best option for delivering Caspian oil to markets in a safe, timely and economical, and environmentally sound manner.

But the consequences of BTC go beyond the purely economic. For everyone involved, within as well as in every direction from the South Caucasus, the building of the BTC pipeline reconfigures the mental map with which political observers and decision-makers look at the world. Azerbaijan and Georgia will see their futures in more direct relation to Europe through the economic and political link that BTC constitutes. For Turkey, with its significant trade relations to Russia (including the Blue Stream gas pipeline across the Black Sea), BTC is a cause to revisit its eastern vocation even at a time when the Turkish government may otherwise be less inclined to do so. This time, a greater outreach to the Turkic and other lands across its eastern border is not an alternative to Turkey's western aspirations but an enrichment of its connections with Europe. In the eyes of Iranians, the completion of BTC gives greater grounds for perceiving its neighbor, Azerbaijan, not as a weak newcomer to be manipulated but as a truly independent actor, even as one that can effectively mount and conclude significant projects. For even the most skeptical Russians BTC gives powerful evidence that the states of the South Caucasus are not only independent and sovereign, but have powerful friends abroad that can persist in backing a single initiative over more than a decade where Russia has a natural right to influence, but not to dominate or dictate policy.

The BTC pipeline is a symbol of the development of inter-state cooperation and cooperation between governments and the private sector in the region. To begin with, the realization of BTC required a long-term political investment on the part of all three participant countries: Azerbaijan, Georgia, and Turkey. Such was the importance of the pipeline project to the leadership of the three states that the project received the continuous backing of consecutive governments. Various political parties ruling Turkey endorsed the project, while the most ardent support came from then President Suleyman Demirel. In Azerbaijan, the successive administrations of Abulfez Elçibey, Heydar Aliyev and Ilham Aliyev have been supporting the westward export of Azerbaijani oil. Of course, the oil strategy was mainly designed by Heydar Aliyev's long tenure in power. And in Georgia, the transition from Shevardnadze to Saakashvili entailed continuing support for the project. The same can be said for the consecutive U.S. administrations and British governments that supported the project.

Indeed, the BTC project was one of few examples in the former Soviet Union where cooperation on an inter-state basis has been born not out of the dominating influence of a great power but on the basis of joint and mutual interests of the participating states themselves. As such, the BTC pipeline created a very concrete example of the need of Georgia and Azerbaijan to support each other's sovereignty and develop a strategic partnership, as well as a strong force linking Georgia and Turkey, helping to overcome a historically antagonistic relationship. BTC gave Azerbaijani, Georgian and Turkish diplomats across the world a common cause to cooperate on, enabling them thereby to develop links of friendship and mutual interests that have developed into other sectors and contributed to cordial relations among them even where disagreements have emerged.

Secondly, the BTC project provided a venue for former Soviet states to interact with private entities from the West. This is no mean accomplishment: the signing of Power-Sharing Agreements (PSA) between consortia of primarily western companies and the regional governments were a novel element for an elite that almost exclusively stemmed from the Soviet era, entailing a devastating lack of experience in economics and private ownership. To that should be added the fact that unlike most energy-rich countries, Azerbaijan has continued to refrain from the temptation of seeking a renegotiation of the oil contracts. Even in Kazakhstan, pressures for renegotiations are strong, with the logic that they were signed at a time when the countries were weak and the companies strong. But the steadfastness of the Azerbaijani government in rejecting such domestic calls, voiced periodically by the opposition, indicates a socialization process into the governing rules of western business principles.

Looking to the Future: Kazakh Oil and Turkmen Gas

For the United States and Europe, BTC provides further impetus for western involvement in the energy and security sectors of the wider Caspian basin – and indeed, proves that the lofty but near forgotten ambitions of building an east-west corridor linking Europe to Central Asia and beyond via the Caucasus are not only possible but are being realized.

Kazakh oil: Which way?

The first major post-Soviet pipeline to come online was the Caspian Pipeline Consortium pipeline linking Kazakhstan's Tengiz oil field on the Caspian shore to Russia's Black Sea coast. Though being mainly on Russian territory, CPC is the first oil transportation system operating independently from the Russian state monopoly, Transneft. But the quantities of oil coming out of the Kashagan project – forecast at 450,000 barrels per day in 2010 and eventually up to 1.2 million bpd – will require at least one major new export pipeline. For this oil, Kazakhstan could look at variations of three options: a parallel CPC line, feeding Kashagan oil into the BTC pipeline, and exporting to China. Each of these options presents both economic and political challenges. Although CPC can be expanded significantly, the entire flow from Kashagan is unlikely to be fed into CPC for the obvious reason that the Turkish government is highly unlikely to allow an additional million bpd of oil to pass through the heart of Istanbul. The prospect of constructing special lines to bypass Istanbul to the north or south adds to the cost of delivery and further dilutes Russian control. In any case, Kazakhstan has recently shown a desire to reduce its reliance on Russia for the export of its energy resources. It is significant to note that Kazakhstan officially joined the BTC pipeline at its inauguration in Baku in May 2005, and that operators of the Kashagan field own a substantial portion of the pipeline. Initially, Kazakh oil will cross the Caspian by tanker, but Kassymdzhomart Takaev, Kazakhstan's foreign minister, has repeatedly declared that it will construct an underwater pipeline linking its port of Atyrau and Baku. For it to be commercially viable, the construction of this 500-mile extension of BTC would require BTC's capacity to be upgraded to 1.7 million bpd.

Meanwhile, Kazakhstan has deepened its relations with China in the energy sector. For some years after the collapse of the USSR, Russia kept alive the hope that it could persuade Kazakhstan to feed oil for the Orient through Russia's emerging Siberian pipeline system. Since this would have simply rebuilt on its eastern exposure what it was seeking to escape to the west, Kazakhstan declined, turning instead to China. Over a decade the two countries repeatedly discussed the possibility of building a pipeline connecting western Kazakhstan's oil fields with China's Xinjiang province, but each time the two parties concluded that the project was not economically viable. However, as regards both the pipeline and Chinese acquisitions of energy assets abroad, China's mainly state-owned companies have proved willing to pay above-market rates far beyond what a rival might offer; China's 2005 acquisition of the Canadian-based Petrokazakhstan company, Kazakhstan's third largest oil producer, for a sum that set tongues wagging, is only the most recent example of this practice in Kazakhstan. In 2004, construction began on the Kazakhstani section of a three-billion dollar pipeline, capable of carrying up to 400,000 bpd, linking western Kazakhstan to western China. Initially, oil for this pipeline will be provided mainly from the Kumkol deposits operated by Petrokazakhstan. Indeed, China's acquisition of Petrokazakhstan gives valuable indications of China's interest in controlling both production and transportation of energy resources, enabling it to ensure a safe flow of oil to China. But to reach full capacity and hence become commercially viable, the Kazakh-China pipeline will need more oil than is now allocated to it. To address this problem it is expected that at least a part of the oil flowing from the vast Kashagan fields will be fed into this pipeline.

Thus, it is evident that a decade and a half after achieving independence, Kazakhstan is effectively implementing an export strategy of its most valuable product based on multiple routes. As was the case with BTC, decision regarding the balance among them will eventually be guided as much by political as by economic concerns. In all likelihood, Kazakhstan will continually readjust the balance between the amounts of oil being sent into each of the three eventual channels: Russia, China, and the South Caucasus energy corridor. This emerging strategy, if accomplished, will serve Kazakhstan's ambition to become a major actor in global energy markets in the coming decades. More important, it accords with Kazakhstan's geopolitical strategy, which is to seek a balance between the three major powers with which it has close relations, using each to keep the others in check, even as it benefits from links with all three. By successfully diversifying the channels for exporting its most valuable product, Kazakhstan has thus fortified its sovereignty and independence of action.

Turkmenistan's gas

Even though the government of Turkmenistan may wishfully confuse estimated reserves with proven reserves and hence overstate its potential wealth, no one disputes that the country possesses formidable deposits of oil and especially gas that are bound to make their mark on its national life, the region, and world energy markets. Like Azerbaijan and Kazakhstan, the challenge has been to break Russia's imperial monopoly over its exports and to create efficient export channels that will reduce what might be called the "distance tariff." In the late 1990s, talks were well underway for the creation of a trans-Caspian pipeline bringing Turkmen gas westward, via the South Caucasus, to Europe. Despite the length of the planned pipeline, it would have delivered gas to European markets at relatively moderate cost. But when gas rather than the expected oil was discovered in Azerbaijan's Shah-Deniz field, Azerbaijan ceased being merely a transit country for gas to Europe but a significant producer. As this happened, Azerbaijan temporary lost interest in the trans-Caspian gas pipeline to Turkmenistan. The fact that the two countries fell into a bitter dispute over competing claims to mid-Caspian desposits only prolonged the stand-off and added to the ill-will. Russia, taking advantage of this situation, managed to extract a long-term agreement from Turkmenistan to export gas through Russia. With these developments, a significant component of the so-called East-West energy corridor disappeared.

The vision of a trans-Caspian energy corridor linked with Turkmenistan remains unfulfilled. Whether or not it is revived will depend on future political developments in Turkmenistan, which are unknowable. For the time being, Turkmenistan remains legally bound to export gas through Russian pipeline systems at a price that is still below world market levels. Interestingly, there are indications that the Turkmen leadership is becoming increasingly frustrated with this situation. As a result, Ashgabat has begun to look around for potential buyers elsewhere, notably in Ukraine and in Pakistan and India. The former has led to deals that begin to offset the huge burden of forced sales to Russia. The latter has led to the resurrection of a decade-old project to build gas or oil pipelines clear across neighboring Afghanistan to Pakistan and thence on to India. This Trans-Afghan Pipeline (TAP) was initially projected by the American firm Unocal, which managed to elicit a huge degree of cooperation even among otherwise warring Afghan warlords. With the rise of the Taliban, however, the project broke down, only to be revived at the initiative of then Turkmen president Niyazov.

Grasping the continent-wide economic and strategic significance of the project, The Asian Development Bank took a keen interest in it, among other things seeing in it an income stream for the new Afghan government that could help offset the influence of drugs. A feasibility study completed in 2005 offered an encouraging picture for the future, and both Chinese firms and the Russia gas monopoly Gazprom have informally expressed interest in it, as have Indian firms, which have also begun eying oil and gas investments in Kazakhstan and Uzbekistan.

The TAP project continues to suffer from several problems, most importantly the fact that its ultimate success is dependent on Pakistan and India resolving their differences to the extent that they could allow hydrocarbons to cross the Pakistan -Indian border. To the extent that India is reluctant to rely on Pakistan's word for its own energy security, the prospects of building TAP are stalled. This problem, along with what will doubtless be an expensive construction process in Afghanistan itself, will likely put off the TAP for several more years.

But this does not mean that TAP is dead, any more than the project to build a trans-Caspian gas pipeline is dead. If world gas prices remain high and Turkmenistan becomes serious about exporting its huge gas reserves, both options will become fully feasible. Another stimulus to reviving the latter project could be a decision by Europe to reduce its reliance on Russian energy, although there are no indications that such a decision is in the offing. At the same time, India's increasing energy needs (not to mention Pakistan's) are likely to force it to review its objections to a gas line via Pakistan, especially if bilateral relations between the two improve.

Traceca revived: A priority for the EU

Against this background, it is significant to note the substantial initiative that the European Union launched to create a Transport Corridor to connect Europe via the Caucasus to Asia, known as the TRACECA project. An ambitious project designed to build a variety of East-West road, rail and sea links across the region, TRACECA was launched in the early 1990s. Unfortunately, the project was never followed up with significant resources and political attention. As a result, in spite of its truly enormous potential to change the transportation systems of Eurasia and to connect the EU with Central Asia, China and India in a novel and efficient manner, TRACECA has in practice accomplished very little. The failure of the EU to follow through on its initiative and in practice to allow it to self-die has had profound implications or the credibility of the EU as an actor in Central Eurasia.

The building of the Baku-Tbilisi-Ceyhan pipeline (BTC) has brought a revolutionary development to the prospects of reinvigorating the transportation links linking Europe to Central Eurasia through the Wider Black Sea region. Indeed, it is no exaggeration to say that it has changed the mental map of the region for state as well as business entities. BTC will palpably increase the mutual interdependence between Europe and the South Caucasus by adding a million barrels of oil a day to the European market. This may not seem much in view of the oil consumption of Europe, but it is a very significant addition of oil on the margins. To that, it is oil that is neither Russian nor OPEC in origin, thereby serving to diversify European energy sources. As such, BTC and Azerbaijani oil will have an impact on European energy supplies and perhaps on prices that is far beyond what is apparent from its quantities. Once Azerbaijani oil is flowing into the European energy system, any break or interruption of supply would have an instant impact on European consumers, in spite of the fungibility of oil markets. A sharp interruption of supply would be immediately felt. This in turn gives Europe an important stake in the security, stability and development of the South Caucasus as a whole. September 11 showed the need for access to the region; this is a weaker link than the very real risk of breaks in supply of energy. Logically, then, Europe will gradually realize the need for investing politically and economically in the security of the regional states.

Implications for Europe and the South Caucasus

The EU and its member states can do at least five things for the South Caucasus, and by extension for itself. The first would be to revive TRACECA with a serious political commitment and serious financial resources. BTC proved what can be accomplished by combining governmental political support and private as well as development funding. Indeed, as EU states are increasing their development cooperation with the South Caucasus and Central Asia, it is crucial that substantial amounts of this funding be vested in the building of transport and communications infrastructure. Secondly, Europe can expedite the integration of the South Caucasian states in the broader Trans-Atlantic partnership and in NATO, which the U.S. has been supporting and continental European states have been resisting. Third, Europe can actively facilitate the internationalization of conflict resolution processes in the South Caucasus, which are currently monopolized by Russia, which has shown little interest in actually working for the resolution of those conflicts. Fourth, in addition to reviving TRACECA, continuing strong support for the development of pipeline projects of both oil and natural gas is needed. Of particular importance is to reengage Turkmenistan in the development of the Trans-Caspian natural gas pipeline project, which can substantially balance the energy security of Central and Eastern European countries. Finally, Europe plays a key role in continuing support for the democratic political process and economic recovery, based on rule of law, private property and free entrepreneurship.

The case of BTC proves that politically motivated projects can become commercially viable. Technological and engineering advancements may lead to commercial viability for the greater traffic between Central Asia and Europe via the Black Sea and the Caucasus. It is in the interest of Georgia and Azerbaijan, as well as the U.S. and Europe, to promote infrastructure development in the Black Sea, which would connect Central Asian and South Caucasian transportation system directly to the Western shore of the Black Sea via ports in Georgia, using ferry connections, and potentially even pipelines to Ukraine. This East-West axis will be important to develop further the cooperative spirit that has dominated in Caspian energy affairs despite pressures from regional forces opposed to the project.

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Contributors to the Volume

Joshua Busby is an Assistant Professor at the LBJ School of Public Affairs at the University of Texas at Austin. Prior to coming to UT, Dr. Busby was a research fellow at Princeton's Woodrow Wilson School, Harvard's Kennedy School, and the Brookings Institution. He received his doctorate in political science from Georgetown University. Busby is the author of a 2007 special report for the Council on Foreign Relations entitled *Climate Change and National Security: An Agenda for Action*. A lengthier academic treatment on the topic is forthcoming in *Security Studies*. He and Nigel Purvis of the Brookings Institution contributed a piece on climate change and national security for the United Nations' 2004 High-Level Panel on Threats, Challenges and Change. Busby has written widely on climate change and energy for the Center for a New American Security, the Woodrow Wilson Center, *Disarmament Times, The Washington Post,* among other institutions and outlets.

Svante E. Cornell is the Research Director of the Central Asia-Caucasus Institute & Silk Road Studies Program, and a co-founder of the Institue for Security and Development Policy, Stockholm. His main areas of expertise are security issues, state-building, and transnational crime in Southwest and Central Asia, with a specific focus on the Caucasus. He also has expertise in Turkish and Pakistani politics and foreign policy. He is the Editor of the *Central Asia-Caucasus Analyst*. Cornell is the author of four books, including Small Nations and Great Powers, the first comprehensive study of the post-Soviet conflicts in the Caucasus. His articles have appeared in numerous leading academic and journals such as *World Politics*, the *Washington Quarterly, Current History*, *Journal of Democracy*, *Europe-Asia*

Studies, etc. His commentaries and op-eds appear occasionally in the U.S., Swedish, Turkish and Pakistani press. Cornell is Associate Professor (Docent) in Government at Uppsala University and Assistant Research Professor at Johns Hopkins University's Paul H. Nitze School of Advanced International Studies.

David Dusseault is a researcher at the Aleksanteri Institute, University of Helsinki, Finland. He is a member of the Aleksanteri's Eurasia Energy Group and coordinates the Institute's project on the Russian Energy Sector. He has recently been appointed an Honorary Fellow of the Energy Analysis Group, University of Kent, UK. His primary research focuses upon the nature of decision-making of the Russian state. His current work concentrates on political science methodology as it pertains to energy policy research and the economic, political and physical structure of the Russian energy sector on a region by region basis. His upcoming field work investigates the role of the hydrocarbon industry in regional socio-economic development in Western and

Eastern Siberia. His most recent publications include: Aalto, P., David Dusseault, Michael Kennedy & Markku Kivinen: *Is Russia Becoming an Energy Superpower? The Social Structuration of Russia's Energy Sector* (forthcoming); *Expectations, Anticipation and Contingency: Problematising EU-Russia Energy Relations* (forthcoming).

Karin Ericsson has a research position at Environmental and Energy System Studies at the Faculty of Engineering (LTH) of Lund University. In 2006 she received her doctorate with the PhD thesis *Prospects for Bioenergy in Europe - Supply, Demand and Trade.* Her research has mainly focused on bioenergy and is of a multi-disciplinary character, including environmental, technical, economic, as well as political issues. The research has addressed e.g. the potential supply of biomass, energy crop production costs, implementation of bioenergy systems and international trade with biofuels

Heleen Groenenberg is policy researcher at ECN Policy Studies, Amsterdam, the Netherlands. Her work focuses on CO_2 capture and storage, as well as the synergies and trade-offs between climate change and energy security. Heleen finished her doctorate dissertation on post-Kyoto commitments for the industrialized and developing world at Utrecht University in 2002. She has published on many issues relating to the impacts and mitigation of climate change, including the valuation of avoided damage, international differences in economic development and industrial energy efficiencies, primary energy mixes and the security of energy supply, as well as a proper management of value-loading and uncertainties in scientific research for decision support.

Eshita Gupta is working as a Research Associate at The Energy and Resources Institute, TERI, India since February 2006. She is an economist with a postgraduate degree in economics from Delhi school of Economics. She has a number of publications in refereed journals and proceedings on international and national conferences. She has worked extensively in the areas of energy, with major focus work being related to energy security indicators, energy market risks and energy access issues. She has been actively involved in energy supply and demand projections, economic and econometric analysis of various economic variables.

Barbara Janusz-Pawletta, holds PhD in Law from Free University Berlin, and currently holds courses in Mazovien College in Warsaw. She teaches international and European Community law specializing in area of natural resources, maritime affairs and environmental protection law. See her publications in English: *Problems of the Legal Status and Regime of the Caspian Sea* (Royal Institute for International Affairs website, London, 2005); *Necessity of regional governance in environmental issues* (A. Rechkemmer, *UNEO*, Nomos Publisher, Baden-Baden, 2005); *Current Development of the Negotiations on the Caspian Sea Legal Status. Sovereignty Issue*

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Astrid Kander is Docent in Economic History at Lund University, and employed as assistant professor at CIRCLE (Centre for Innovation Research and Competence in the Learning Economy). Her special areas of interest are long term economic growth, innovation, energy and environment. Her major publications in English include: *Economic growth, energy consumption and* CO_2 *emissions in Sweden 1800-2000* (Almqvist & Wicksell International, 2002); Is it simply getting worse? Agriculture and Swedish greenhouse gas emissions over 200 years, Economic History Review, Published article online: 21-Nov-2007;
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Dr. **Nils Kalstad Svendsen** is a postdoctoral researcher at Gjovik University College in the Norwegian Information Security Laboratory. He received his degrees from the Norwegian University of Science and Technology in Trondheim and from the University of Oslo and is a member of the IFIP 11.10 Working Group on Critical Infrastructure Protection as well as of the Institute of Electrical and Electronics Engineers (IEEE) and the Association for Computing Machinery.

Robert L. Larsson is a security policy analyst at the Division for Defence Analysis at the Swedish Defence Research Agency (FOI), an assignment-based authority under the Ministry of Defence. He holds a Masters degree in political science and has studied at the universities of Linköping, Uppsala, Edinburgh, Novosibirsk and Tbilisi. Before joining the FOI, he was a guest researcher at the Georgian Foundation for Strategic and International Studies in Tbilisi. He specialises in the security policy of Russia and the Caucasus with special emphasis on energy issues. He has published such reports as *Russia's Energy Policy: Security Dimensions and Russia's Reliability as an Energy Supplier*, (Stockholm, Swedish Defence Research Agency (FOI) 2006), Scientific Report FOI-R-1934-SE; *Tackling Dependency: The EU and its Energy Security Challenges*, (Stockholm, The Swedish Defence Research Agency (FOI) 2007), FOI-R-2311-SE, and *Nord Stream, Sweden and Baltic Sea Security*, (Stockholm, Swedish Defence Research Agency (FOI) 2007), FOI-R--2251-SE.

Based in the UK, Dr. Carole Nakhle is Energy Research Fellow at Surrey Energy Economics Centre (SEEC), University of Surrey. She also acts as Special Parliamentary Adviser in the House of Lords. Her work focuses on energy policy and security, international petroleum fiscal regimes and energy developments in the Middle East and the High North. She has produced two books. The first, "Out of the Energy

Labyrinth", co-authored with Lord Howell - the former secretary of state for energy – addresses meeting the twin goals of energy security and climate security. The book is available in English, Japanese, Arabic and Turkish. Her second book "Petroleum Taxation: Sharing the Oil Wealth", takes the reader step by step through the entire petroleum taxation story. Her paper 'Can the North Sea Still Save Europe?' is published in the OPEC Energy Review, July 2008 edition.

Sylvia A. Niewiem is Research Associate at the Friedrich Ebert Foundation in Warsaw.

Professor **Lars J. Nilsson** is Head of Research at the Division of Environmental and Energy Systems Studies at Lund University, Institute of Technology. His research interests include energy, climate, and transport policy, including end-use oriented energy analysis and technology assessments of energy efficient end-use and renewable energy technologies – key components in strategies to reduce greenhouse gas emissions and other pollution – including strategies for implementation. He has more than 70 publications, 30 of which in international journals or at conferences with peer-review. He is currently on the editorial boards of Energy Efficiency (Springer) and Biotechnology for Biofuels (open access journal).

Bo Petersson is Professor of Political Science at Lund University where he is also Deputy Head of the Centre for European Studies where he coordinates a cross-faculty research program on Energy and Security in Europe. Apart from this his special areas of interest include identity construction, stereotyping, nationalism and xenophobia, and developments in these fields in Europe, Russia, and Central Asia. His major publications in English include *Stories about Strangers: Swedish Media Constructions of Socio-Cultural Risk* (University Press of America, Lanham, 2006); *National Self-Images and Regional Identities in Russia* (Ashgate, Aldershot 2001); Bo Petersson & Eric Clark (eds): *Identity Dynamics and the Construction of Boundaries* (Nordic Academic Press, Lund 2003); and Bo Petersson & Katharine Tyler (eds): *Majority Cultures and the Everyday Politics of Difference*, (London: Palgrave 2008).

Qin Tianbao is Professor of International and Environmental Law and Senior Research Fellow of the European Studies Centre at the Wuhan University, China where he serves as the Assistant Dean for International Affiliations for School of Law. He is concentrating his study in the areas of laws and policies concerning climate change, energy security, bio-safety and biodiversity, trade and environment, corporate environmental responsibility, and air and water pollution control. His major publications include *Legal Issues on Access to Genetic Resources and Benefit-sharing* (Wuhan University Press, Wuhan, 2006); *China's Peaceful Development and*

Global Climate Change: A Legal Perspective (*Law, Environment and Development Journal*, London, 2007), QIN Tianbao and ZENG Dong: *Citizen's Environmental Rights in the Daily Life* (Wuhan University, Wuhan, 2007); and LI Renzhen and QIN Tianbao: *WTO and Environmental Protection* (Hunan Science and Technology Press, Changsha, 2006).

Malena Rosén Sundström is a PhD Candidate at the Department of Political Science, Lund University. This autumn, she will defend her PhD thesis, on the Swedish Social Democratic Party's handling of the questions of EU- and EMU-membership. She has also written about negotiations about the EU's Common Agricultural Policy, as well as the policy interplay between this area and energy policy, with specific focus on the bio-energy sub-sector.

Håkan Rosenqvist earned his PhD in 1997 (thesis entitled Growing of Salix: Methods of calculations and profitability) and became Associate Professor in 2008. His specialities are economy, energy crops and agriculture economy. He is currently researcher (part time) at the Swedish University of Agriculture Science. He is also involved in research about economics aspects of energy crop productions for Chalmers University and Lund University. He works also in his own consulting firm and is living on a cereal farm in Southern Sweden.

Josef Schmidhuber is the Head of FAO's Global Perspective Studies Unit. He started his professional career in 1990 as a consultant with the World Food Council, worked as an Econometrician and Economist with the FAO and as a Senior Economist with the OECD. He has also assumed numerous short-term assignments with private companies, banks and commodity funds and international institutions. His special areas of interest include climate change, bioenergy, trade, trade liberalization as well as food security and the nutrition transition in developing countries. Recent publications include "Food Security under Climate Change, "Proceedings of the National Academy of Sciences (*Proc. Natl. Acad. Sci.*, 104, 19703-19708, doi:10.1073/pnas.0701976104)", with Francesco Tubiello and "The nutrition transition to 2030. Why developing countries will bear the major burden" Acta Agriculturae Scand Section C, 2005; 2: 150_ 166, with Prakash Shetty. He is a lead author of the Nobel Prize winning fourth assessment report of the International Panel on Climate Change (IPCC) and co-author of "World agriculture: towards 2015/2030", FAO's long-term perspective of global agriculture.

Raphael Sauter is Research Fellow at the Sussex Energy Group at SPRU (Science and Technology Policy Research), University of Sussex, Brighton, UK. His main research interests are sustainable energy policy, innovation policy, energy security and climate change with a particular focus on European energy policy. Most recent publications include Praetorius, B., R. Sauter and J. Watson (2008): On the dynamics of microgeneration diffusion in Germany and UK, in: T.J. Foxon, J. Köhler and C. Oughton (Eds.), Innovation for a Low Carbon Economy: Economic, Institutional and Management Approaches. Edward Elgar, Cheltenham.

Lennart Schön is professor in economic history at Lund University. His research is mainly devoted to the analysis of technological change and long term economic growth. He has, *inter alia*, constructed models of long cyclical processes. Publications in English include Electricity, Technological Change and Productivity in Swedish Industry 1890-1990, *European Review of Economic History*, Vol 4:2 (2000); Swedish Industrialization 1870-1930 and the Heckscher-Ohlin Theory, in Findlay, R. et.al. (eds.) *Eli Heckscher, International Trade and Economic History,* MIT Press (2006); Technological shifts and convergence in Europe since 1950, *Scandinavian Economic History Review* Vol 5 (2007).

Professor **S. Frederick Starr** is Chairman of the Central Asia-Caucasus Institute/ Silk Road Studies Program Joint Center, with offices in Washington and Stockholm. He is the author of twenty books on Eurasian history and politics, as well as on American culture. Recent publications include "A Regional Approach to Afghanistan and Its Neighbors" (Bureau of Asian Research, 2008) and "Greater Central Asia" in the French journal Politique enterangere (forthcoming). He is currently writing a major study of Central Asian civilization in the 8-10th centuries.

Dennis Tänzler is research fellow at Adelphi Research, an independent, non-profit institute that develops and implements innovative sustainable development strategies based in Berlin, Germany. His research focuses on climate and energy policies as well as on peace and conflict studies. In 2007 and 2008 he served the Policy Planning of the German Foreign Office as an expert on climate and energy policies. Dennis Tänzler has ten years of experience in international environmental policy, European environmental policy and policy integration, climate change and institutional aspects of environment, conflict and cooperation. He has published widely on international affairs and environmental policy. He is the program director on the environment, conflict and cooperation platform (*www.ecc-platform.org*). He holds degrees in political science as well as in North American Studies, Cultural Sciences.

Barbara Törnquist-Plewa is Professor of East- and Central European Studies and Director of the Centre for European Studies at Lund University, Sweden. Her research focus is nation-building and construction of national identities in Central and Eastern Europe, language and nationalism, collective memory, myths and symbols, cultural integration in Europe. Her major publications include: *The Wheel of Polish Fortune. Myths in Polish Collective Consciousness during the Firs Years of Solidarity,* Lund 1992*; Vitryssland. Språk och nationalism i ett kulturellt gränsland ("Belarus.*

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Dr. **Stephen Wolthusen** holds dual appointments as professor of information security at Gjovik University College, Norway, and at the department of Mathematics at Royal Holloway, University of London, UK. He received his degrees from Darmstadt University of Technology, Germany and was a member of the research staff and later deputy division chief at the Security Technology Department at Fraunhofer-IGD in Darmstadt, Germany where he still holds an advisory position. He is author and editor of several books, has published more than 50 journal and conference articles and serves as editor in chief of the journal Computers & Security. He is a Senior Member of the IEEE serving as vice chair of the IEEE Task Force on Information Assurance as well as a member of IFIP 11.10, the Association for Computing Machinery and the American Mathematical Society.

(Footnotes)

1 Average political risk is obtained by taking weighted average of the political risk factors based on the IGRC political risk rating. The weights are the respective market shares of the different supplying countries for a given country.