Armed Forces, Capabilities and Technologies in the 21st Century
Environmental Dimensions of Security

Sub-study 1

PEAK OIL

Security policy implications of scarce resources

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November 2010

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Foreword

The Bundeswehr Transformation Centre analyses changes that occur within and outside the Bundeswehr and provides incentives for concept development, armed forces planning and the Bundeswehr's capability profile. It thus assists the Federal Ministry of Defence in centrally managing the transformation process.

In this context, the purpose of security-related future analysis is to acquire knowledge precociously and scientifically based in order to refine conceptual specifications and objectives without making predictions. Being open-ended and not bound by directives, it provides ideas and approaches for aligning the Bundeswehr to face future tasks and therefore is a central part in the process of formulating objectives. Purpose of the study results is to enable the Federal Ministry of Defence to identify long-term issues with relevance to security policy at an early stage before forwarding them, if necessary, to internal or external organisations for a more detailed analysis.

To perform its tasks, one study from the ACT 21 series (Armed Forces, Capabilities and Technologies in the 21st Century) and one Mid-term Study (MTS) will be alternately presented by the Future Analysis Branch every 5 years. ACT 21 studies address conceivable long-term security policy challenges that are to be met within a 30-year time frame whereas MTS studies address challenges that are to be met within a 15-year time frame.

The studies carried out by the Future Analysis Branch of the Bundeswehr are prepared within the area of responsibility of the Federal Ministry of Defence and are exclusively based on open sources. In addition to military expertise, use is made above all of the scientific knowledge of civilian university and non-university research facilities and various federal ministries. The results, however, are not coordinated with other ministries and research facilities and are not intended to interfere with their responsibilities. Against this backdrop, the studies carried out by the Future Analysis Branch do not generally reflect any official views held by the Federal Ministry of Defence. Any specific conclusions, analysis requirements and recommended actions that are of relevance to the armed forces, i.e. internal conclusions, are drawn up in parallel and are only published internally within the Federal Ministry of Defence.

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1. Introduction

In this first part of the study entitled "Armed Forces, Capabilities and Technologies in the 21st Century – Environmental Dimensions of Security", the Bundeswehr Future Analysis Branch addresses the subject of finite resources and their potential security policy implications, exemplary using the scenario in which the global maximum rate of oil production has been exceeded. The second part of the study deals with climate change and demography.

The term "peak oil" stands for the maximum rate of oil production and refers to the point in time at which the rate of a single oil field, of an oil-producing region, or globally reaches its absolute peak. In geological terms, about half of the originally existing resource quantity of oil will be available in underground oil reservoirs at this time.[1] Various measures such as investing in production technologies to develop further resources, economising in oil consumption, or softening existing environment protection regulations, could indeed maintain the production level for a certain period. From peak oil, however, this level will irreversibly decline in the long term. Generally speaking, oil will therefore continue to be available and recoverable beyond the 30-year timeframe chosen in this study, albeit in quantities that are possibly too small to fully satisfy global demands and at considerably higher prices.[2]

In the past already, numerous conflicts were linked to various kinds of raw material deposits. Literature relating to this subject is extensive, and the topic finds broad interest within the security policy community.[3] In most cases, however, such resource conflicts have been restricted to specific regions and have only been of limited relevance to international security policy. [4] In the light of global peak oil, this could change in future with regard to oil as a natural resource: Firstly, a global lack of oil could represent a systemic risk because its versatility as a source of energy and as a chemical raw material would mean that virtually every social subsystem would be affected by a shortage.[5] Secondly, the primarily geographical concentration of the oil deposits and transport infrastructures in the "Strategic Ellipse" (see Figure 1) could lend greater relevance to security policy and generate increased global interest, which amongst other things could result in a shift in geopolitical power.

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1 The term "resource quantity" refers to the total quantity of oil that is still available, regardless of whether the deposits have already been discovered or are regarded as recoverable. For more detailed information about the classification of various types of resources, see Annex, Frequently Asked Questions #3.

2 For more detailed information on the peak oil phenomenon, see Annex, Frequently Asked Questions #1.

3 Cf. Peacebuilding Support Office (PBSO), *From Conflict to Peacebuilding: The Role of Natural Resources and Environment*, May 2008, http://www.un.org/en/events/environmentconflictday/pdf/08.05.2008%20WGLL%20Background%20Note.pdf (accessed on 11 October 2010); Ian Bannon and Paul Collier, eds., *Natural Resources and Violent Conflict: Options and Actions* (Washington, D.C., 2003), http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2004/05/24/000012009_20040524154222/Rendered/PDF/282450Naturaloresourcesoviolentoconflict.pdf (accessed on 11 October 2010).

4 For information about the various types of resource-related conflict constellations, see Matthias Basedau, "Erdölkriege – Kriege der Zukunft?" in *GIGA Focus Global*, No. 6, Hamburg, 2007, http://www.giga-hamburg.de/dl/download.php?d=/content/publikationen/pdf/gf_global_0706.pdf (accessed on 11 October 2010).

5 An example is international goods transport. For a more detailed understanding of the term "systemic risk", see Chapter 3.2.

Figure 1: The Strategic Ellipse[6]

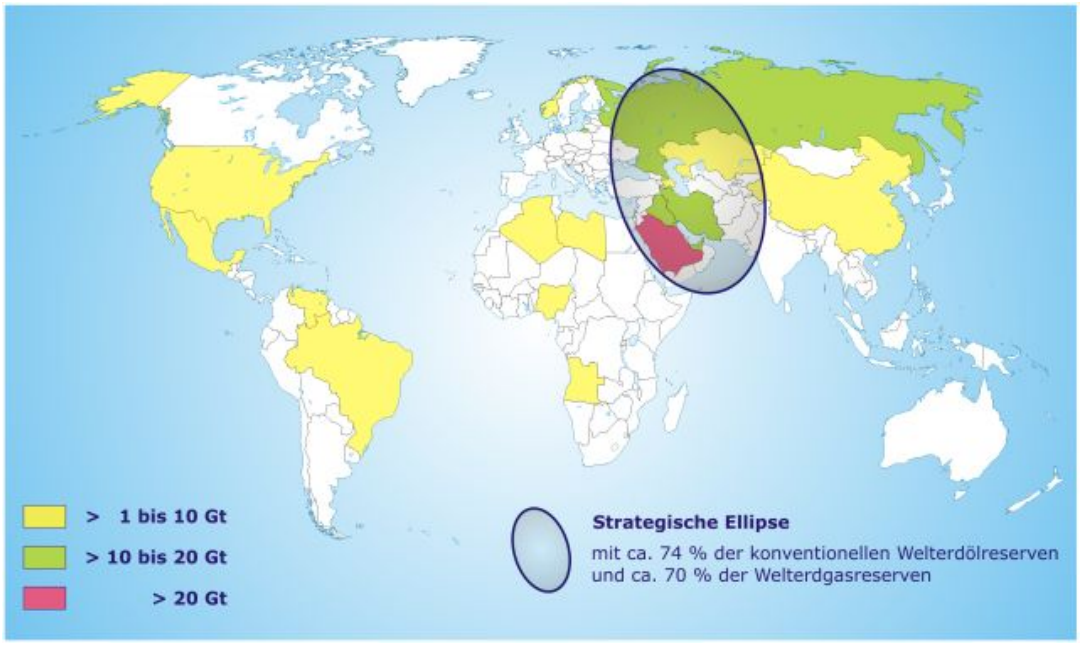

Figure 1 - Glossary

1 bis 10 Gt	1 to 10 GT
10 bis 20 Gt	10 to 20 GT
Strategische Ellipse	Strategic Ellipse
Mit ca. 74% der konventionellen Welterdölreserven und ca. 70% der Welterdgasreserven	with approx. 74% of the world's conventional oil reserves and approx. 70% of the world's natural gas reserves

Source: Federal Institute for Geosciences and Natural Resources (BGR)

The precise global peak oil date is controversial and can only be determined with certainty in retrospect.[7] Available data on global oil reserves vary considerably and hardly provide any scope for outsiders to make an independent assessment.[8] The quality of statements about oil production and relevant conclusions for the occurrence of a global peak oil situation depends on several factors: The reserve levels officially specified by the Organization of the Petroleum Exporting Countries (OPEC), for example, can be disputed on the grounds of non-transparent data acquisition and partly politically motivated information. The higher an OPEC member declares its national reserve levels, the higher the production rate allotted by the OPEC and, in turn, the export profits. A further important factor when it comes to estimating reserves is the applied calculating method. In the past, predictions regarding the

6 The Strategic Ellipse is an area that extends from the Middle East via the Caspian Region to the far north of Russia. This area encompasses approximately two thirds of the natural oil and gas deposits that are known globally and can currently be recovered at reasonable costs (reserve). This specifically concerns countries such as Saudi Arabia, Russia, Iran, the United Arab Emirates, Qatar, Iraq, Kuwait and Kazakhstan.

7 The likelihood that peak oil was actually reached increases with every 12-month interval from the prevailing maximum production rate, whereby security policy implications could also arise much sooner owing to a physical oil shortage that could occur in the interim or due to psychological effects.

8 "Reserves" refers to the total quantity of recoverable resources that have already been discovered but have not yet been recovered. For more detailed information, see Annex, Frequently Asked Questions #3.

production development of oil fields based on originally reported reserves were often too low and had to be adjusted upward. Other aspects such as improved production technologies may also positively effect the "reserve growth" factor.[9]

It is a fact, however, that oil is finite and that there is a peak oil. Since this study is mainly focussed on understanding cause-effect relations following such a peak oil situation, it is not necessary to specify a precise point in time. Some institutions claim that peak oil will occur as early as around 2010.[10] Depending on the development of globally relevant factors, we cannot rule out that peak oil could have serious security policy implications within the review period of the 30-year investigation perspective chosen for the SFT series.[11] The dimension of the potential effects in conjunction with the above-mentioned ambiguity regarding the existing data on the future availability of oil therefore underpins the necessity to look in more detail at the potential security policy implications for Germany.

Apart from the above-mentioned uncertainty factors regarding exact peak oil occurrence, it is foreseeable that when global peak oil is actually reached – and if transformation towards post-fossil societies has not been extensive enough or has occurred too late – it will no longer be possible from a certain point to cover the global demand for oil. Against this background and regarding the long periods of time[12] needed for adjustments in the energy sector aiming at a far-reaching energy transition, it is today's necessity (1) to thoroughly analyse our extent of oil dependence, (2) to identify - based on this information and in time- potential risks , and (3) to discuss alternatives for using oil.

This study is intended to sensitise to the potential security policy consequences, risks and cascade effects that may arise from peak oil excess.

The cause-effect relations described are expressly not to be understood as being inevitable. Rather, they are intended to capture the potential interdependences from different perspectives between the availability of oil and dependence on oil and to thus help to better understand the systemic importance of oil and potential security policy implications that can be derived for Germany.

Chapter 2 at first discusses the importance of oil, oil as a potential conflict factor, and the oil supply situation in Germany. Chapter 3 addresses two potential future scenarios resulting from global peak oil without implying, as already mentioned above, that the situation is inevitable or predicting the date on which the developments might occur. Chapter 3.1 looks at moderate developments that could occur as a result of peak oil. For this purpose, cause-effect relations that could arise as a result of peak oil and that are thought to be highly relevant to security policy have been identified and discussed. Chapter 3.2. addresses a possible special

9 Cf. Federal Institute for Geosciences and Natural Resources (BGR), *Reserven, Ressourcen und Verfügbarkeit von Energierohstoffen* (Hanover, 2009), 19f., http://www.bgr.bund.de/nn_324956/DE/Themen/Energie/Downloads/Energiestudie-Kurzf-2009,templateId=raw,property=publicationFile.pdf/Energiestudie-Kurzf-2009.pdf (accessed on 11 October 2010; the link refers to the German version).

10 Cf. Table 2.

11 For more detailed information on the international discussion on the peak oil phenomenon, see Annex, Frequently Asked Questions #2.

12 Cf. Robert L. Hirsch, Roger Bezdek and Robert Wendling, *Peaking of World Oil Production: Impacts, Mitigation, & Risk Management*, February 2005, 57ff., http://www.netl.doe.gov/publications/others/pdf/oil_peaking_netl.pdf (accessed on 11 October 2010).

case of peak oil consequences in which a so called economic “tipping point” is exceeded, a situation which could lead to non-linear and partly chaotic developments. Even if in this case it is hardly possible to conduct an in-depth security policy analysis, the purpose is to raise awareness about a worst-case scenario. Chapter 3.3. deals with the oil resource-related conflict constellations that could change and expand as a result of peak oil.

The developments described start from the basic assumption that it was not possible to complete an ambitiously timed and comprehensive global energy transition towards a post-fossil economy and society within the investigation period. Accordingly, the study identifies the timely implementation of such a transformation and the development and expansion of systemic basic virtues such as independence, flexibility and redundancy as the central action priorities and proposals for a solution.

The results of the study can only be appropriately interpreted if its methodological approach and basic assumption are clearly understood and if due consideration is given to the fact that the study in part describes a worst-case scenario and, explicitly, not an inevitable development.

Chapter 4 deals with the consequences of the developments described in Chapter 3 for Germany. Chapter 5 summarises the most important findings.

The main objective of the study is to raise awareness about the systemic importance of oil and, in turn, the derivable significance to security policy if peak oil is exceeded. The findings and results are expressly not meant to imply that resources will necessarily have to be secured with military assets. Rather, the study is to be understood as an appeal to think things through at an early stage and to develop both preventive and responsive courses of action. It does not aim at anticipating political decisions.

2. The Importance of Oil

2.1. Oil as a Determining Factor of Globalisation

Today approximately 90% of all industrially manufactured products depend on the availability of oil.[13] Oil is not only the source material for producing fuels and lubricants but is also used as hydrocarbon for most organic polymers (plastic materials). It is therefore one of the most important raw materials in the production of many different products such as pharmaceuticals, dyes and textiles.[14]

As the source material for various types of fuels, oil is a basic prerequisite for the transportation of large quantities of goods over long distances. Alongside information technology, container ships, trucks and aircraft form the backbone of globalisation. International division of labour, to which many countries owe their wealth, would not be possible without today's volume of cost-efficient goods transport. Oil-based mobility also significantly influences our lifestyle, both regionally and locally. For example, living in suburbs several kilometres away from their workplace would be impossible for many people without a car. To a certain extent, the classical suburb thus also owes its existence to oil.

Currently, approximately 87 million barrels of oil are consumed worldwide every day – one barrel having a capacity of 159 litres.[15] Per day, this corresponds to approx. 12 million tonnes or 60 oil tankers (very large crude carriers with a volume of 200,000 tonnes) or a cube with an edge length of about 240 metres. Approximately half of the oil recovered globally is processed into fuels for vehicles, aircraft and ships, roughly 10% of it is used for the chemical industry.[16] In Germany, approximately 100 million tonnes of oil are consumed per year. This corresponds to more than one tonne per inhabitant, approximately 500 oil tankers, or a cube with an edge length of approximately 480 metres. In Germany's transport sector approximately 50 million tonnes of petrol and diesel are consumed per year.

A considerable increase in the oil price would pose a systemic risk because the availability of relatively affordable oil is crucial for the functioning of large parts of the economic and social systems.[17] For some subsystems, such as worldwide goods shipping or individual transportation, the importance of oil is obvious. Overall, however, it is difficult to overlook the entire range of possible challenges that could arise from an exceeded peak oil scenario[18].

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13 Maria Rossbauer, Erdöl. Ein Stoff für Katastrophen, Kriege – und unseren Komfort. Focus-online, 21 June 2010, http://www.focus.de/wissen/wissenschaft/mensch/tid-18703/erdoel-ein-stoff-fuer-katastrophen-kriege-und-unseren-komfort_aid_520924.html, (accessed on 11 October 2010).

14 Cf. Robert L. Hirsch, Roger Bezdek and Robert Wendling, *Peaking of World Oil Production: Impacts, Mitigation, & Risk Management*, February 2005, 8, http://www.netl.doe.gov/publications/others/pdf/oil_peaking_netl.pdf (accessed on 11 October 2010).

15 Cf. *IEA Oil Market Report, Quarterly Oil Product Demand*, OECD/ IEA, September 2010, http://omrpublic.iea.org/world/wb_wodem.pdf (accessed on 14 October 2010).

16 Cf. Claudia Ehrenstein, "Die Jagd auf Deutschlands versteckte Ölquellen", in *Welt online*, 10 November 2007, http://www.welt.de/wirtschaft/article1350102/Die_Jagd_auf_Deutschlands_versteckte_Oelquellen.html (accessed on 14 October 2010).

17 The main risk posed by peak oil is not the fact that there is too little oil but that there is no inexpensive oil available anymore, see Annex, Frequently Asked Questions #7.

18 One example of potential consequences is the way North Korea developed following the collapse of the Soviet Union: After the Korean War, the USSR helped North Korea to develop a modern and productive agriculture. When the USSR collapsed, the inflow of cheap oil suddenly dried up. Agricultural machines had to be put out of service. A return to traditional cultivation methods was aggravated by overfertilised land although the proportion of people employed in agriculture was increased from 25% to 35% in order to compensate for the loss of an estimated 80% of the agricultural machines. Despite this, harvests dropped by 60% between 1989 and 1998. Cf. Jörg

The international community as well as every single country therefore have a vital interest in secure oil supplies. Nowadays, this is relatively easily realised via the world market. OPEC, the leading cartel on the oil market, for the most part has proved willing to cooperate even in crisis situations: The mutual dependence between exporters and importers helps to create a favourable atmosphere – at least from a market-economy perspective.

The systemic relevance and strategic significance that is ascribed to oil in particular and to secure energy supplies in general is also reflected in various strategic documents of states and international organisations.

Already the White Paper 2006 on German Security Policy and the Future of the Bundeswehr, for example, referred to energy security as one of the main challenges of German security policy. It states that the task of supplying Germany and Europe with energy on a sustainable and competitive basis faces challenges such as global growth in energy demands, increasing regional and interregional energy trade, proliferation risks, and increasing environmental protection requirements. It also states that in addition there is a need to improve access to energy and thus the chances of economic development in developing countries. "Energy issues", it says in the White Paper "will play an ever more important role for global security in future."[19]

The European Security Strategy (ESS) of 2003 considers the EU's foreseeable dependence on energy imports, which is expected to rise from 50% (current figure) to 70% by 2030, to be an issue of concern.[20]

The debate in the US, too, clarifies the growing importance of national energy supply. In 2001, the then US Vice President stated in the document that became known as the "Cheney Report" that the daily import of crude oil into the United States would have to increase by 60% between 2001 and 2010 and declared that the Gulf Region was vital to American interests. Against this background, Cheney's proposal to the White House was that securing America's energy should be recognised as a priority of foreign and economic policy.[21] The National Security Strategy of the new administration under Barack Obama, which was approved in May 2010, also recognises future energy supply as an essential factor for the country's competitiveness and prosperity and considers it necessary to make increased efforts to guarantee this supply.[22] In this context, the document declares that the development of new sources of energy forms a part of the strategy's approach.[23] At the same time, it explicitly

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Friedrichs, "Global energy crunch: how different parts of the world would react to a peak oil scenario", in *Energy Policy*, 38 (8), August 2010, 4562-4569, http://www.qeh.ox.ac.uk/pdf/pdf-research/Global%20Energy%20Crunch.pdf (preprinted version accessed on 11 October 2010).

19 Cf. Federal Ministry of Defence, *White Paper 2006 on German Security Policy and the Future of the Bundeswehr* (Berlin, October 2006), 1-123 (here: 20), http://www.bmvg.de/fileserving/PortalFiles/C1256EF40036B05B/W26UYEPW631INFODE/WB2006_oB_sig.pdf.pdf (accessed on 13 October 2010; the link refers to the German version).

20 Cf. *European Security Strategy. A Secure Europe in a Better World* (Brussels, 2003), 3ff. http://www.consilium.europa.eu/uedocs/cmsUpload/031208ESSIIDE.pdf (accessed on 11 October 2010; the link refers to the German version).

21 Cf.Lühr Henken, *Die Rolle des Militärs bei der Energiesicherung 'des Westens'*", contribution at the klima & energie – macht – arbeit Conference, Hamburg, 3 November 2007, http://www.oekologische-plattform.de/texte/energiekonferenz_henken.pdf (accessed on 13 October 2010).

22 Cf. *National Security Strategy*, White House (Washington, May 2010), 9, http://www.whitehouse.gov/sites/default/files/rss_viewer/national_security_strategy.pdf (accessed on 13 October 2010).

23 Cf. *ibid*., 2.

identifies the maintaining of free global trade of fossil raw resources as a basic prerequisite for American security and prosperity.[24]

In its White Paper entitled "China's National Defense in 2008", the People's Republic of China also states that the global energy issue, amongst others, is gaining more importance worldwide and that deep-seated contradictions exist with regard to interests in this context.[25]

Russia, too, sees the increasing global shortage of fossil raw materials as a potential risk for the country's national security.[26] Against this background, the country's new security strategy explicitly emphasizes, amongst other things, the need to build up strategic fuel reserves.[27] Moscow's efforts to develop as broad as possible a range of potential oil buyers, one objective being to become more independent from the European market, are highlighted for example by its intensified cooperation with China in the field of energy policy and, most significantly, the opening of a pipeline to China in September 2010.[28]

Forecasts predict that by 2030, India will be the world's third biggest energy consumer. This explains the significance of energy supply to this important threshold country and why, for several years now, India has intensified its external relations with energy-rich regions such as Africa, Latin America, Central Asia and, last but not least, the Middle East, one of the aims being to diversify its oil imports.[29]

It can therefore be stated that against the backdrop of the ever-decreasing availability of fossil fuels, the challenge of ensuring long-term energy supply is reflected in national strategies worldwide, leaving no doubt as to the vital importance attached to this issue. In this context, the fact that energy supply aspects occupy an increasingly important place in the national security strategy documents of various countries is an indication of the increasing securitisation of this area – a process that, as is explained below in Chapter 2.2 – is likely to have consequences on the nature of future energy relations. The above-mentioned strategy documents explicitly emphasise a principally peaceful method of securing energy supplies. Whether and how efforts towards secure energy supply can be designed conflictively or cooperatively in the face of potential peak oil consequences depends on a number of different conditions, which will be addressed in the following chapters.

24 Cf. *ibid*., 30.

25 Cf. *China's National Defense in 2008*, Information Office of the State Council of the People's Republic of China (Beijing, January 2009), http://www.gov.cn/english/official/2009-01/20/content_1210227.htm (accessed on 13 October 2010).

26 Cf. *National Security Strategy of the Russian Federation until 2020*, Decree No. 537 of the President of the Russian Federation, 12 May 2009, 17, http://www.sicherheitspolitik-dss.de/autoren/lemcke/strat905.pdf (accessed on 13 October 2010; the link refers to the German version).

27 Cf. *ibid*., 20f.

28 Cf. "Energie-Gipfel Russland/China: Öl-Pipeline eröffnet", in *Comcenture online*, 11 October 2010, http://www.comcenture.com/Einzelansicht.374+M5e64855d1d1.0.html?&tx_ttnews%5Btt_news%5D=2446 (accessed on 13 October 2010).

29 Cf. Thorsten Wojczewski and Melanie Hanif, "Indiens neue Energiepolitik und ihre geostrategische Bedeutung", in *GIGA Focus Asien*, No. 9 (Hamburg, 2007), http://www.giga-hamburg.de/dl/download.php?d=/content/publikationen/pdf/gf_asien_0809.pdf (accessed on 13 October 2010).

2.2 Oil as a Potential Conflict Factor

The above comments refer to the aspect of strategic resource security and, in connection with this, the question as to under what conditions and with what means efforts to this end can be implemented cooperatively or conflictively. Since conflicts rarely have a single cause, it is not possible to determine beyond doubt to what extent resources have actually contributed to their development. To date, four conflict constellations have been mainly discussed in connection with oil:[30]

(1) conflicts between oil exporters and importers, where oil importers intervene politically or militarily in exporting countries or where exporters pursue a more aggressive foreign policy by increasing oil revenues,

(2) conflicts between oil importers, which can also take the form of surrogate conflicts,

(3) conflicts between oil exporters, e.g. through cross-border deposits or through direct access to the resources of neighbouring countries by way of conflictive actions, and

(4) conflicts in oil-exporting countries, either in the form of distribution or secession conflicts or attempts to assume central power if it is associated with access to resources – both of which might be supported by third parties.

As a rule, it cannot be concluded from the existence of competition or conflicts in general that there will be an increase in violent confrontations and wars since the constellations addressed here must by no means escalate into violent conflicts. In the past, the most frequent form of oil-related conflicts have been conflicts in oil-exporting countries.[31] At first glance, such conflicts also seem more likely in future in fragile states that are highly dependent on the export of resources if, for example, distribution conflicts can no longer be solved cooperatively within a society. However, export income could also lead to the containment of conflicts and increased stability through improved social policy, strengthened security apparatuses and similar measures. It already becomes clear in this context that the resource – in this case oil – can only have a conflictive effect in conjunction with other conflict variables such as a lack of national capacity to solve problems and the absence of fair distribution mechanisms.

Not only competition for scarce resources but also a certain surplus of resources can hold conflict potential, prolong conflicts or stand in the way of peaceful solutions.[32] The nature of the resource may also influence the form of conflict. Diamonds, for example, are a relatively easily exploitable and transportable resource for which there is an international black market.[33] Raw materials such as oil or natural gas, on the other hand, are not as easily

30 Cf. Matthias Basedau, "Erdölkriege – Kriege der Zukunft?", in *GIGA Focus Global*, No. 6 (Hamburg, 2007), http://www.giga-hamburg.de/dl/download.php?d=/content/publikationen/pdf/gf_global_0706.pdf (accessed on 11 October 2010).

31 Cf. *ibid*., 5.

32 Cf. Peacebuilding Support Office (PBSO), *From Conflict to Peacebuilding: The Role of Natural Resources and Environment*, May 2008, http://www.un.org/en/events/environmentconflictday/pdf/08.05.2008%20WGLL%20Background%20Note.pdf (accessed on 11 October 2010).

33 This is why it was possible for warlords in Sierra Leone at the end of the 1990s to finance a violent conflict that lasted for several years and during the course of which many thousands of people were killed.

utilizable for small non-state groups. The necessary infrastructure to recover, transport, refine and sell oil calls for a relatively stable (state) environment. The control of an oil field alone is not sufficient, transport routes and possible transshipment centres such as seaports must also be freely accessible. What is more, there has been no functioning international black market thus far for oil and natural gas.

In addition, resources can be more than just the cause or the trigger of conflicts. They may also become a conflict resource themselves, with their use providing a basis for financing conflictive confrontations.[34] Resources can therefore also prolong and escalate ongoing conflicts, and an additional conflict can arise over the resource itself as a conflict resource if various conflict parties wish to access it.

The examples and potential conflict constellations outlined here clearly show that the debate on oil, its conflict potential and possible security policy implications are based on an extended security concept involving far-reaching consequences for the actors involved as well as approaches and tools needed to contain or solve conflicts. Chapter 3.3. looks at the possible effects of peak oil on the above-mentioned conflict constellations and also addresses the dimension of conflict within import countries and the special conflict case of a system crisis induced by peak oil, which is described in Chapter 3.2.

34 Cf. Solveig Richter and Jörn Richert, "Kooperation oder Eskalation? Warum Rohstoffknappheit nicht zwangsläufig zu Konflikten führt", in *Internationale Politik*, November/December 2009, 10-16, in this case p. 11ff., http://www.internationalepolitik.de/ip/archiv/jahrgang-2009/earth--wind---fire/download/1dec21cc7b552a8c21c11dea75b65d7b87564156415/original_11_richter_richert.pdf (accessed on 13 October 2010).

2.3. Oil and Aspects of German Energy Security

Depending on context, the term "energy security" is used and operationalised in different ways. Generally, energy security is understood as "provision of inexpensive, reliable and environmentally friendly energy"[35]. The German Government defines energy security as a "secure, sustainable and competitive supply of energy"[36]. These definitions refer to the "triangle of political goals comprising supply security, cost-efficiency and environmental compatibility", which is what the term "energy security" actually means.

A baseline study conducted for the EU (DGTREN) by the Clingendael Institute for International Relations (CIEP) in Den Haag lends the term "energy security" a narrower definition and sees it as the use of political means to minimise the risk of energy crises.[37] In this context, energy crises are lasting imbalances between supply and demand, which provoke price jumps and have negative effects on the economies concerned. Energy security policy therefore aims at preventing energy supply shortages or even supply disruptions.

Regarding oil, political interest focussed for a long time – and logically enough for importing countries – on the minimisation of dependences to prevent shortages.[38] More recent studies[39] extend this concept to include aspects such as the observation of environmental and climate protection goals, which potentially place other demands on a sustainable energy policy:

- inclusion of the technological environment for transforming societies of the fossil era into societies of the post-fossil era,
- consideration of uncertainties regarding the development of energy demand, e.g. in the wake of recessions, including the risks this poses for producer countries, or as well
- conditioning of national energy policy through the respective nation's integration in supranational organisations.

This broader understanding became necessary mainly due to globalisation of the energy markets, which has led to increasing frictions between various actors on different levels. Peak oil would have effects on all of the above-mentioned energy security aspects. These effects are addressed in the following chapters. An extensive analysis of all these problem areas and their interdependences would, however, exceed the boundaries of this study.

In order to estimate Germany's long-term oil supply situation it is important to look at various factors and their complex interrelations. Examples are Germany's dependence on oil

35 Sascha Müller-Kraenner, *Energiesicherheit. Die neue Vermessung der Welt* (Munich, 2007:Verlag Antje Kunstmann), 7.

36 Federal Ministry of Defence, *White Paper 2006 on German Security Policy and the Future of the Bundeswehr*, 20.

37Clingendael International Energy Programme (CIEP), *Study on Energy Supply Security and Geopolitics. Final Report* (Den Haag, 2004), 36ff.

38 Cf. Vlado Vivoda, "Evaluating energy security in the Asia-Pacific region: A novel methodological approach", in *Energy Policy*, 38 (9), September 2010, 5258-5263 (here: 5258).

39 Cf. Andreas Beyer, *Theoretische und methodische Grundlagen zur Analyse von Energie- und Energiesicherheitspolitik,* Kieler Analysen zur Sicherheitspolitik, No. 27 (Kiel ,February 2010), http://www.isuk.org/1/wp-content/uploads/2010/03/Kieler_Analysen_zur_Sicherheitspolitik%20Nr.%2027.pdf (accessed on 11 October 2010); cf. Matthias Christoph Pröfrock, *Energieversorgungssicherheit im Recht der Europäischen Union/ Europäischen Gemeinschaften*, Dissertation (Tübingen, 2007), http://tobias-lib.uni-tuebingen.de/volltexte/2007/3012/pdf/Dissertation_Proefrock_Energieversorgungssicherheit.pdf (accessed on 11 October 2010).

and, in turn, on the respective producer countries, the domestic political situations in these countries, their own oil demand and their role in the international community, the quality of relations between Germany and these countries and potential alternative oil-exporting countries, and the role of other importing countries – above all rapidly growing economies that have a high energy demand of their own, such as modern-day China.

Global peak oil and what could consequently develop into intensified global competition for the remaining oil would lend the diverse factors associated with Germany's supply security new dynamics. This study aims at describing relevant cause-effect relations, using examples wherever possible, and identifies further issues and need for research in areas where an in-depth (e.g. regionally specific) analysis is not possible within the scope of this study. An analysis of the reliability of Germany's situation concerning the supply of oil through imports seems to be a meaningful central starting point for further debate on the effects of global peak oil. The following therefore first of all aims at looking in more detail at Germany's supply relationships.

Table 1: German Oil Imports in 2009

2009 – German oil imports (producer countries and their peak oil)			
Producer countries	Peak oil reached within the review period of the study (possibly reached in 2010)	Percentage (rounded off)	
Russia Δ)	X	35.3%	**90.1%**
Norway	X	14.1%	
Great Britain	X	10.7%	
Libya*)	X	8.5%	
Kazakhstan Δ)	X	7.0%	
Azerbaijan Δ)	X	4.3%	
Nigeria*)	X	3.7%	
Syria Δ)	X	2.7%	
Venezuela*)	X	2.0%	
Algeria*)	X	1.8%	
Ivory Coast	X	1.5%	**9.9%**
Saudi Arabia*) Δ)	?	1.5%	
Egypt	X	1.2%	
Denmark	X	1.1%	
Iran*) Δ)	X	0.8%	
Angola*)	?	0.8%	
Gabon	X	0.6%	
Netherlands	X	0.5%	
Tunisia	X	0.5%	
Brazil	?	0.4%	
Iraq*) Δ)	X	0.3%	
Kuwait*) Δ)	X	0.3%	
Poland	X	0.2%	
Italy	X	0.1%	
Lithuania	X	0.1%	
Trinidad & Tobago	X	≤ 0.1%	
Turkmenistan Δ)	X	≤ 0.1%	
Republic of the Congo	X	≤ 0.1%	

*) OPEC members plus Qatar, United Arab Emirates and Ecuador. As of 2010.

Δ) Strategic Ellipse countries.

Note: Producer countries as well as the original values on which the percentages are based have been adopted from the Federal Office of Economics and Export Control (BAFA).[40]

The annual data regarding the occurrence of peak oil have been taken directly from the text specified in the footnote or, if no information is available, have been derived from it as an estimated value.[41]

Table 1 shows that more than 90% of all oil imports to Germany come from countries that reach or have already exceeded their national peaks during the study's period of review.[42] Various expert analyses assume that it is very likely that peak oil has already occurred for Russia, Norway and Great Britain, for example. These three countries alone currently supply 60% of Germany's total oil import volume.

As long as there is leeway to increase export quantities despite peak oil, e.g. due to low producer countries' national demand or sufficient alternatives for import by other producer countries, there may still be options of compensation for Germany if new and less favourable terms of delivery have to be negotiated. Great Britain, for example, from which Germany receives 10% of its oil imports, is already an oil net importer and can only export oil to Germany after having previously imported from third countries.[43]

While it is assumed that approximately 90% of all oil countries have already exceeded their national peak oil or are likely to reach it by 2015, increasing production rates over several years are considered possible for Brazil and Angola.[44] A reliable estimate of Saudi Arabia's potential is regarded particularly difficult. There are indications, however, that suggest an unfavourable development for the kingdom.[45] This is extremely relevant because ultimately the point at which global peak oil occurs is likely to be determined primarily by Saudi Arabia's oil production potential. In a worst-case scenario, this would mean that even a dominant oil power such as Saudi Arabia could cease to function as a potential compensation factor (swing producer).[46]

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40 Cf. Federal Office of Economics and Export Control (BAFA), *Crude Oil Imports December 2009*, http://www.bafa.eu/bafa/de/energie/mineraloel_rohoel/energieinfo_rohoel/2009/dezember.html (accessed on 11 October 2010; the link refers to the German version)

41 Cf. Jörg Schindler and Werner Zittel, *Zukunft der weltweiten Erdölversorgung* (Berlin, 2008), 46ff., http://www.energywatchgroup.org/fileadmin/global/pdf/2008-05-21_EWG_Erdoelstudie_D.pdf (accessed on 11 October 2010).

42 Owing to the ambiguity of data records on the resources and reserves that are still available globally, Table 1 does not include any specific years but only states the national peaks reached during the study's period of observation. For more than 90% of all states that currently export oil to Germany, 2015 is specified as the latest point at which peak oil will be reached for the respective country. Cf. *ibid.*, 55ff.

43 Cf. Eberhart Wagenknecht, "Den Briten geht das Öl aus – das Ende des Aufschwungs scheint gekommen", in *Eurasisches Magazin online*, 29 September 2004, http://www.eurasischesmagazin.de/artikel/?artikelID=20040910 (accessed on 11 October 2010).

44 On the ranking list of the 40 exporting countries richest in oil, the following countries – in addition to Angola and Brazil – are said to also have the potential to expand their production rates: Thailand, Vietnam, Equatorial Guinea, Sudan and China. Cf. Jörg Schindler and Werner Zittel, Zukunft der weltweiten Erdölversorgung (Berlin, 2008), 11, http://www.energywatchgroup.org/fileadmin/global/pdf/2008-05-21_EWG_Erdoelstudie_D.pdf (accessed on 11 October 2010).

45 The most important and partly contradictory bases for this possible development are:that first of all, Saudi Arabia's production rate has been on the decline for the last five years, but at the same time it is emphasised that increases are possible at any time; that secondly "Ghawar", the biggest oil field in the world, could have exceeded its peak; that thirdly, King Abdullah announced publicly in 2007 that: "The oil boom is over and is not going to return", and: "All of us must get used to a different lifestyle"; fourthly, for the period of review covered by this study, it is necessary to take into account that global oil supplies from Saudi Arabia might decrease due to an increase of 40% in the country's own demand. Cf. *ibid.*, 48; Andreas Postner and Willi Sieber, *Peak Oil. Die internationale Diskussion und mögliche Auswirkungen auf Vorarlberg* (Bregenz, November 2008), 271, http://www.vorarlberg.at/pdf/peakoilstudie.pdf (accessed on 11 October 2010).

46 Cf. Eckart Wörtz, "Saudi Arabia: Energieriese zwischen geopolitischer Neuausrichtung und innenpolitischer Reform", in *FES-Analyse*, September 2006, 7-8.

Although Germany has so far imported comparatively small quantities from the three countries mentioned, yet this potentially unfavourable development restricts the supply alternatives of all countries that are dependent on oil imports, including Germany. In contrast to the European trend, Germany's oil demand is likely to diminish. The Federal Ministry of Economics and Technology assumes that imports will decrease by approximately 10% by 2025 while economic growth remains moderate.[47] With a decline in overall imports and consistent supply quantities from Russia, the Russian share of German oil imports would therefore increase to 40%. Due to the fact that imports from Europe might decline and in order to prevent one-sided dependence on a few countries, Germany's supply relationships could well undergo a restructuring process. Decreasing imports from Europe could be compensated for by imports from the Middle East, the Caspian region and Africa (Figure 2 shows the remaining and already recovered oil quantities in various regions). The 2008 Report by the German Government on the Oil and Gas Market Strategy (*Bericht der Bundesregierung zur Öl- und Gasmarktstrategie*) [48] describes this situation and presents a strategy for securing Germany's supply with oil that meets the specified energy security dimensions. It does not, however, take the peak oil aspect into account.

It seems equally significant to look into possibilities for extending ongoing contracts, e.g. with Brazil or Angola, but also with Russia and other contracting parties.

47 Cf. Energiewirtschaftliches Institut an der Universität zu Köln, ed., *Energiereport IV - Die Entwicklung der Energiemärkte bis zum Jahr 2030 – Energiewirtschaftliche Referenzprognose* (Munich, 2005), 380ff.

48 Cf. Federal Ministry of Economics and Technology, *Bericht der Bundesregierung zur Öl- und Gasmarktstrategie* (Berlin, November 2008), http://www.bmwi.de/BMWi/Redaktion/PDF/B/bericht-der-bundesregierung-zur-oel-und-gasmarktstrategie,property=pdf,bereich=bmwi,sprache=de,rwb=true.pdf (accessed on 11 October 2010; the link refers to the German version).

Figure 2: The Overall Potential of Conventional Oil in 2008[49]

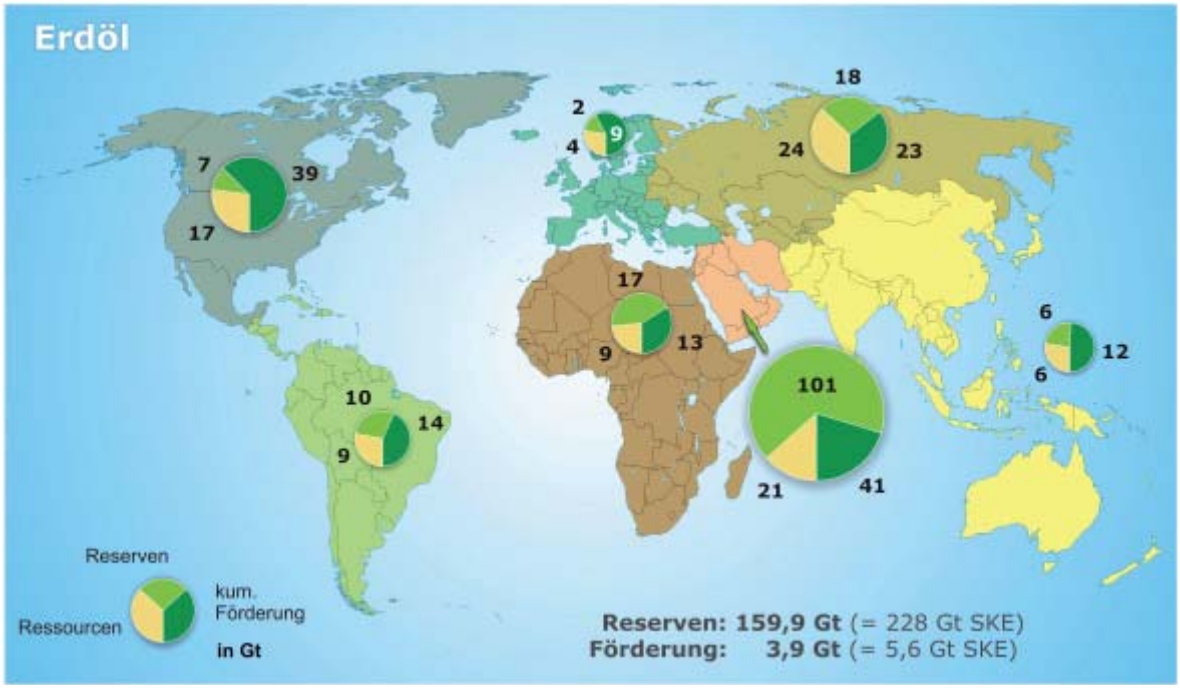

Figure 2 - Glossary

Erdöl	Oil
Reserven	reserves
Ressourcen	resources
kum. Förderung	Aggregate production
in Gt	in GT
Reserven	Reserves
159,9 Gt (= 228 Gt SKE)	159.9 GT (= 228 GT CE)
Förderung	Production
3,9 Gt (= 5,6 Gt SKE)	3.9 GT (= 5.6 GT CE)

Source: Federal Institute for Geosciences and Natural Resources (BGR)

Ultimately, it is hardly possible to calculate from today's perspective how suppliers and consumers will respond to global peak oil.[50] Against this backdrop, the continuous assessment of diversification opportunities seems equally necessary and difficult, particularly with regard to the ousting or competition effects with other oil-importing countries that such efforts would bring about in the face of declining production rates. Generally, an increasing importance of the countries of the Strategic Ellipse for Germany's oil imports becomes apparent. When shaping its relations with these countries, Germany has several prioritisation options. Chapter 4 deals in more detail with the requirements, potentials and boundaries of

49 For the difference between reserves and resources, see Annex, Frequently Asked Questions #3.

50 The following is another example to emphasise this: In view of the country's enormous dependence on oil revenues, it is unlikely that Tehran had forsaken correspondingly higher profit margins for rational reasons. Nevertheless, this situation does not necessarily prove the occurrence of national peak oil either, but it can be concluded that cost-intensive production would not have been profitable due to the decrease in reserves. Cf. Martin Schmidt-Bredow, *"Peak Oil" oder das Erdölproblem*, 2007, http://www.efodon.de/html/archiv/sonstiges/schmidtbredow/peakoil.html (accessed on 11 October 2010)

these options. The interests and commitment of other countries that depend on oil imports, in particular fast-growing economies such as modern-day China and India, are also important factors for global oil supply security and Germany's activities in this connection.

3. Possible Developments after Global Peak Oil

The following chapters describe two possible future scenarios that might occur after peak oil has been exceeded.

Chapter 3.1 considers possible developments for a moderate form of the peak. To this end, possible peak-oil-induced cause-effect relations on security policy are developed and discussed in four chapters. The cause-effect relations described are not to be understood as being inevitable, but might help to grasp the possible interdependences between availability of and dependence on crude oil and thus lead to a better understanding of the significance of oil and deducible implications for Germany's security policy. By today's standards, these cause-effect relations are not only plausible and worth discussing, but also likely to occur, though only in part and under the outlined conditions.

However, future analysis must also cover unexpected and undesired futures of which no more than the first indications can be analysed. Chapter 3.2 therefore looks into a special possible peak oil scenario in which a so-called “tipping point” is exceeded where linear developments become chaotic and finally result in a worst-case scenario in terms of security policy. For example, if the global economy shrinks for an indeterminate period of time, a chain reaction that might destabilise the global economic system is imaginable. Depending on point in time and the level of dependence of the affected society, such a peak-oil-induced, economic tipping point might have such severe systemic implications that only a few general statements as to economic, political, and social developments beyond the tipping point can be made. This will clearly change the analytical framework for all other security policy conclusions. Because of the widely unexplored “tipping point” phenomenon, it is impossible to conduct a comprehensive analysis of possible effects of such a trigger element. Rather, this study is designed to raise awareness of a possible nonlinear economic development due to peak oil and of the related risk of a severe system crisis.

Chapter 3.3 discusses known oil-resource-related conflict constellations and extends them against the background of the contexts described in Chapters 3.1 and 3.2.

3.1 Possible Peak-oil-induced Implications

3.1.1 Oil as an Important Factor Shaping International Relations

Oil, along with economic power and military strength, might gain, due to peak oil, even more importance as a factor shaping international relations and exerting political influence. This might imply an improved standing for producer countries in the international system, greater difficulties in diversifying sources for importing countries, a new role for import-dependent threshold countries as well as a reorganisation of many supply relationships.

Improved standing of producer countries in the international system

In a situation of global economic change due to peak oil, the remaining oil-exporting countries would be in a favourable position: their industries could expect relatively moderate oil prices, provided that adequate state regulation is in place and their budgets might benefit from increasing profits from oil exports.[51] This would increase relative significance of producer countries within the international system. They could use the resulting benefits to extend their freedom of action for shaping domestic and foreign policies and to establish themselves as newly emerging or reemerging regional or even global leading powers.[52]

Oil-importing countries could translate greater competition for noticeably dwindling oil resources into greater competition for the favour of producer countries, for example through intense energy diplomacy. For the producer countries, this would open up a window of opportunity which they could use to aggressively enforce political, economic, or ideological objectives; this window of opportunity would be restricted by declining reserves, more complex oil production conditions, and the ongoing transformation of many countries into mainly post-fossil economies. Already today, Russia's foreign policy calculus, for example, includes energy aspects and the option to use them in order to enforce Russian interests. At the strategic level, this is reflected in Moscow's Foreign Policy Concept of July 2008. In practice, Russia's gas disputes with Ukraine are an indication of a political instrumentalisation of its energy riches.[53] A similar connection between an offensive foreign policy and energy richness can be observed for Venezuela and Iran.[54] Against the background of global peak oil, such trends will probably escalate drastically.

The growth in importance of producer countries may be increased or accelerated by different dynamics: (1) by a politically intended and controlled further shortage of the much-

51 Cf. Chapter 3.1.2 below.

52 The following comments in this chapter are based on the assumption derived from liberal foreign policy research that governments are rational actors seeking to maximise their own interests, the primary goal being the preservation of their own power

53 Marcel De Haas, "Medwedews Sicherheitspolitik: Eine vorläufige Einschätzung", in *Russlandanalysen*, No. 186, 3 July.2009, 3, http://www.laender-analysen.de/russland/pdf/Russlandanalysen186.pdf (accessed on 11 October 2010).

54 Cf. Günther Maihold, *Außenpolitik als Provokation. Rhetorik und Realität in der Außenpolitik Venezuelas unter Präsident Hugo Chavez, SWP-Studie.22*, July 2008, http://www.swp-berlin.org/common/get_document.php?asset_id=5174 (accessed on 11 October 2010); Michael Thumann, "Erdöl als Waffe", in *Zeit Online*, 14 December 2007, http://www.zeit.de/online/2007/51/oel-konflikte?page=1, (accessed on 11 October 2010).

demanded resource and (2) by successful attempts to vertically integrate value-added chains of oil production and processing.

(1) Further shortage following peak oil

Being aware of exceeding peak oil and in view of countries pursuing their own lasting advantages, there might be a deliberate restriction in supplies ("political peaking"), for example, to preserve undeveloped oil resources for the nation's generations to come.[55] The more obvious the actual scarcity of oil, the more expensive oil would become and thus the greater the profits of producer countries. The calculus of "political peaking" would become all the more understandable. Political peaking would further aggravate peak oil-induced supply shortage and related price increases.

Similar effects would be caused by a trend which can be observed mainly in less industrialised producer countries. Oil recovered and refined at home is offered on the domestic market at a price below the world market price, for example to improve the competitiveness of a rather inefficient national industry or to share the country's riches with the population. It is observable that this price distortion leads to an increase in domestic consumption which reduces export quantities and supports a generally inefficient use of oil. Such dynamics could lead to exports increasing more slowly than production, or, in the event of a peak, the exported amount of oil decreasing even more rapidly than the produced amount. After peak oil, this could lead to an additional acceleration of the decrease in globally available production quantities.

(2) Renewed vertical integration of value-added chains

A predictably decreasing number of established oil exporters and the growing importance of big, financially strong oil companies in developing and threshold countries ("New Seven Sisters"[56]) in view of peak oil could lead to promoting the creation of new monopolies.

In a sense, this would undo the liberalisation of oil markets following the crises of the 1970s. After the oil crises, many producer countries expropriated Western oil companies, which had virtually controlled their national oil resources. However, the initial result was not a growing market power of the individual producer countries, but a strengthening of market mechanisms and the establishment of a functioning global oil market for the first time. In particular the break-up of the vertical integration of the oil industry, that is, the control over the whole value-added chain from oil extraction to the operation of filling stations by a single company, led to a noticeable relaxation on the oil market, which, under the circumstances at that time, was in the interest of both producers and consumers. With the upstream and/or downstream expansion[57] of oil companies and depending on governmental influence, the danger of a political instrumentalisation of dependences would grow.

55 Such a behaviour can be observed already today. In April 2008, King Abdullah of Saudi Arabia ordered not to develop sources newly discovered at the time.

56 These are CNPC/ Petrochina, Gazprom, Petrobras, Petronas, Petróleos de Venezuela, National Oil Company of Iran and Saudi Aramco.

57 "Upstream" refers to activities in exploration and production, "downstream" refers to activities with a closer relationship to the consumer. Markets disappear due to the integration of both components in big companies. For example, extracted crude oil is not sold to the highest bidder, but transferred to other divisions of the company. In

Greater difficulties in diversifying sources for importing countries

Against this background, oil-importing countries are likely to intensify their efforts to reduce unilateral dependences and the resulting possibility of political instrumentalisation by individual exporting countries by diversifying producer countries and energy sources. Due to the future concentration of essential oil reserves in the Strategic Ellipse in conjunction with a more intense competition between importing countries, it will become increasingly difficult to diversify sources. As a result, the regions in the Strategic Ellipse would continue to become more important for the future organisation of the oil and gas supply of many importing countries.[58] Overall, in view of peak oil, there is an increase in the probability of regional interference by third countries using different instruments that are available to them. In shaping their relationships with the countries of the Strategic Ellipse, Germany and Europe are faced in particular with the commitment of important threshold countries such as China.

Special role of threshold countries depending on imports

In order to be able to satisfy the enormous appetite for energy of their rapidly growing economies, threshold countries depending on oil imports in particular should be expected to reinforce their commitment in countries with large oil reserves by relying on a broad range of instruments. This commitment may take various forms – these countries may act as trade partners, investors, suppliers of technology and weapons, lenders, "development aid workers" or political advocates in international organisations. In light of global peak oil, it can be expected that China, for example, whose policy is traditionally based on the principle of non-interference, will intensify its pragmatic and regionally widely ranged foreign policy with the purpose of putting a greater emphasis on securing energy ("going outward policy").[59] Since energy imports play such a vital role for sustaining its own economic growth and the related issues of social and societal stability, China does not leave energy supply to the markets, but already today tries to place it under government control.[60] It also supports the foreign operations of its national oil companies by providing regional, broadly based and intensified energy diplomacy. The Chinese commitment in Africa might be the most prominent example for the country's attempts to position itself for sustainably securing its national resource supply. In addition, Chinese oil companies have been making efforts to obtain licences for a share of the reserves in the US for several years, and lately they have been successful. On 12 October 2010, for example, the Chinese oil giant China National

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global terms, this leads to the constraining of market mechanisms and thus to inefficient resource distribution. State-owned companies in particular increasingly prioritise the physical availability of resources rather than their profit-maximising and efficient use. This phenomenon is not limited to companies based in producer countries, but can also be observed in companies based in importing countries.

58 For more information, cf. Chapter 4.2.

59 Cf. Lin, Christina Y., "Militarisation of China's Energy Security Policy – Defence Cooperation and WMD Proliferation Along its String of Pearls in the Indian Ocean", in *International Relations and Security Network (ISN)*, Center for Security Studies (CSS) ETH Zürich, 18 June 2008, http://kms1.isn.ethz.ch/serviceengine/Files/ISN/56390/ipublicationdocument_singledocument/b70929f4-7a87-4e77-afc4-daa73699daea/en/StringPearls.pdf (accessed on 11 October 2010).

60 Cf. Antje Nötzold, "China als Herausforderung für die Europäische Energieversorgungssicherheit", in *Konrad-Adenauer-Stiftung Auslandsinformationen* 3/2010 (Sankt Augustin, 2010), 59-75 (here: 62), http://www.kas.de/wf/doc/kas_18887-544-1-30.pdf?100225134900 (accessed on 11 October 2010).

Offshore Oil Corporation (CNOOC) bought into the Texan reserves of Chesapeake Energy in Texas for several billions.[61]

The Indian energy sector, too, is heavily dominated today by state-owned companies like the Oil and Natural Gas Corporation (ONGC), Oil India Limited (OIL) and the Indian Oil Corporation (IOC). Like China, India is one of the "late bloomers in energy policy"[62] who boost their efforts in positioning themselves in the international competition for remaining resources in order to maintain their rapid economic growth. In this context, the Indian government has introduced the objective of annual economic growth of at least 8% until 2030 and anticipates an increasing demand for energy of 0.9% for every percent of economic growth.[63] According to a scenario established by the Indian government, the country's demand for primary energy will increase by a factor of four by 2032.[64] India would become the country most dependent on energy imports among the BRIC countries (**B**razil, **R**ussia, **I**ndia and **C**hina), in particular with regard to oil.[65] This increasing demand and its relevance for the further development of the Indian economy and consequently the handling of India's massive social problems is unlikely to remain without effect for the increased competition for limited oil resources brought about by peak oil. The Indian strategy for energy supply has so far been characterised by a balancing act between internal economic factors and its foreign policy preferences that have been shaped by India's anti-imperialist identity.[66] The growing dependence on energy imports, however, is increasingly challenging traditional foreign policy principles such as "self-reliance"[67][68]. In view of peak oil, the predicted strong rise in the demand for energy and the perceived need to reduce the unilateral dependence on only four countries – Saudi Arabia, Nigeria, Kuwait and Iran supply around two thirds of all Indian oil imports – India could advance to be an increasingly active international actor for the benefit of supply security. Already today, India takes a comparatively pragmatic approach towards politically unstable countries and regimes seen as problematic by the West. Given the

61 Cf. "China versucht, in USA zu landen", in *Süddeutsche Zeitung online*, 12 October 2010, http://www.sueddeutsche.de/x5O38I/3646744/China-versucht-in-USA-zu-landen.html (accessed on 13 October 2010).

62 In retrospect, the national oil companies of advancing threshold countries presented themselves relatively late as relevant actors on the international oil market. For example, when China went from being a net exporter of oil to being a net importer in the beginning of the 1990s, the most abundant of the oil sources that were still freely accessible had already been occupied by Western oil companies or were developed as joint ventures with the national oil companies (in particular in the Persian Gulf region). Western companies (in particular the successors of the so-called (old) "Seven Sisters"; following mergers, today these are ExxonMobil, Chevron, BP and Royal Dutch Shell) and the national companies of the producer countries had laid down the "rules" of the oil market. Companies like CNPC of China had to turn to areas that were not yet developed or that other companies avoided for political reasons.

63 Cf. Government of India, *Towards Faster and More Inclusive Growth: An Approach to the 11th Five Year Plan (2007 - 12)* (New Delhi, December 2006), 49, http://planningcommission.nic.in/plans/planrel/app11_16jan.pdf (accessed on 11 October 2010).

64 Government of India, *Integrated Energy Policy: Report of the Expert Committee* (New Delhi, August 2006), 31, http://planningcommission.nic.in/reports/genrep/rep_intengy.pdf (accessed on 11 October 2010).

65 Cf. Sören Scholvin, "Die Energiepolitik regionaler Führungsmächte", in *GIGA Focus Global*, No 5 (Hamburg, 2007), 1-8 (here: 4 f.), http://www.giga-hamburg.de/dl/download.php?d=/content/publikationen/pdf/gf_global_0705.pdf (accessed on 11 October 2010).

66 Cf. Joachim Betz and Melanie Hanif, *The Formation of Preferences in Two-Level Games: An Analysis of India's Domestic and Foreign Energy Policy*, GIGA Working Papers No 142 (Hamburg, July 2010), http://www.giga-hamburg.de/dl/download.php?d=/content/publikationen/pdf/wp142_betz-hanif.pdf (accessed on 11 October 2010).

67 Since its independence, India has adhered to foreign policy principles such as non-alignment, non-interference in the internal affairs of third countries, independence through confidence in its own powers and solidarity and cooperation between poor countries. Therefore, the principle of "independence of foreign policy" traditionally has a high status in India, but it is increasingly called into question by the integration of India into the world market and goes hand-in-hand with new vulnerabilities, in particular with regard to the dependence on energy imports.

68 Cf. Sascha Müller-Kraenner, *China's and India's Emerging Energy Foreign Policy*, Deutsches Institut für Entwicklungspolitik Discussion Paper, 15 (Bonn, 2008), http://www.die-gdi.de/CMS-Homepage/openwebcms3.nsf/(ynDK_contentByKey)/ANES-7HJAZ8/$FILE/DP%2015.2008.pdf (accessed on 11 October 2010).

necessity to secure one's own energy requirements in third countries, debates on the basic principles of foreign policy could become increasingly frequent in India.[69]

Likewise, China's increasing commitment in third countries is also based mainly on pragmatic considerations and – according to the principle of non-interference in the internal affairs of third countries – does not contain any normative political conditioning as practiced by many liberal Western democracies.[70] Already today, China is being accused of undermining the principles of foreign and development policy of Western industrialised countries.[71] However, this should not be perceived as a provocation or the intentional undermining of Western political approaches. It is in fact due to China's (and also India's) described role as a late arrival on the global energy market und thus the extensive lack of alternatives for securing energy supply while maintaining their own political principles.[72]

Regardless of the motivation behind China's and India's political approaches, in the face of global peak oil and the fact that these threshold countries with their policy of non-interference have, in terms of energy policy, successfully gained ground or are increasingly trying to do so in regions that are most important in the future, industrialised countries could face a loss of influence in the competition for scarce oil reserves. Against this background and in view of the perceived need to secure the energy supply in the short term, pragmatism might become an increasingly decisive element in international relations. Such a development could have disadvantageous effects on predominantly Western nations' foreign policy approaches, which are based on ethical values and are designed to achieve long-term success.

The primacy of securing energy due to peak oil could thus lead to neglect or at least new selectivity with regard to demands for the protection of human rights, good governance or democratic and ecological development in the relations between countries dependent on oil imports and producing countries. It can be assumed that the relations between Western industrialised countries and countries that lack resources will remain unaffected by this "moral decline". Hence, in the service of energy security, pronounced double standards in foreign policy could be the result of this development.

Reshaping supply relationships after global peak oil

In light of peak oil, the share of oil traded on the global, freely accessible oil market might decrease in favour of oil traded via bilateral agreements. This could, to the detriment of free-market mechanisms, result in an increase in privileged partnerships and conditioned supply relationships. To negotiate these privileged energy partnerships, an intensified energy

69 Cf. Christian Wagner, *Energie, Sicherheit und Außenpolitik in Indien, SWP-Studie 12* (Berlin, May 2007), http://www.swp-berlin.org/common/get_document.php?asset_id=4014 (most recently accessed on 26 October 2010), 20.

70 Cf. Eberhard Sandschneider, *Globale Rivalen: Chinas unheimlicher Aufstieg und die Ohnmacht des Westens* (Munich, 2007), 213.

71 Cf. Antje Nötzold, "China als Herausforderung für die Europäische Energieversorgungssicherheit", in *Konrad-Adenauer-Stiftung Auslandsinformationen*, 3/2010 (Sankt Augustin,2010), 59-75 (here: 63), http://www.kas.de/wf/doc/kas_18887-544-1-30.pdf?100225134900 (accessed on 11 October 2010).

72 Cf. Maximilian Mayer, "Warum Chinas „Energiehunger" nicht zum „Krieg um Ressourcen" führt", in *China aktuell*, No 1, 2007, 57-75.

diplomacy and the provision of attractive compensations – whether material or political in nature – by the importing countries would be of particular importance.

(1) Conditioned supply relationships and package deals

In view of a decrease in production and the producing countries' need to satisfy their own oil demands, it can be assumed that supply relationships would become increasingly selective, and thus attractive return services beyond net sales revenues would become more important as a criterion for selecting privileged recipient countries. Owing to this, the global oil market could adhere to free market rules only to a limited extent. Just as before the oil crises in the 1970s, bilateral conditioned supply relationships and privileged partnerships would once again come to the fore.[73]

Buyers with the ability to submit appropriate offers or to meet the particular conditions would be in a position to undermine global market mechanisms and negotiate their own pricing and supply agreements. This situation could lead to an increase in package deals.[74].

In general, goods and services that – similar to oil – strengthen the economic power of the producer countries or its possibilities to exert political influence would be particularly suitable as compensations for such package deals.[75] Producer countries could progressively demand material and/or political trade-offs that might aid them in closing their technology gap, in overcoming their economic stagnation or, in many cases, in emerging from their political isolation. In international negotiations, for example, importing countries that are represented in relevant bodies like the UN Security Council could act as an advocate for the interests of countries that are rich in resources and influence or block relevant decision processes in their favour. Even though such "deals" can be observed already, this trend might grow considerably. With regard to important oil-producing countries such as Sudan and Iran, China, for example, is already under suspicion of preventing sanctions and thus protecting the regimes in Khartoum and Tehran by its voting behaviour in the UN Security Council.[76]

Goods that cannot be freely acquired on the international market, possibly including even nuclear material, would be of particular interest for package deals. As a result of the significance that these sensitive goods would presumably gain, sanctions and restrictions with regard to these goods might be weakened, and alongside oil-exporting countries this would lead to a betterment in the international system of countries offering these goods.

Importing countries could face another challenge if ideological aspects and differences also played an increasingly important role in the choice of selective oil supplies and privileged partnerships. Relations among oil-importing countries would not be characterised by straight

73 Already today, some OPEC member states insist on contract clauses that restrict the right of the buyer to resell oil to third countries.

74 A package deal is a business transaction (contract) which, in order to be finalised, includes the compulsory conclusion of a second business transaction (contract), thus establishing a direct dependence between both business transactions or contracts.

75 These include defence materiel, technologies for oil production and transport, but also technologies for alternative energy supply, capabilities to secure critical infrastructure, to explore non-conventional oil reserves and to carry out military operations in extreme climate zones. In addition, access to other resources and base or transit rights are also possible compensations.

76 Cf. Cf. Frank Sieren, "Der letzte Freund", in *DIE ZEIT Online*, No 9, 25 February 2010, http://www.zeit.de/2010/09/China-Iran (accessed on 11 October 2010).

interdependences, but would instead be in danger of being drawn even more into the slipstream of competition for limited resources (in this case, oil) as hitherto.

(2) Intensifying energy diplomacy

Investing in oil fields that are not profitably recoverable at current market prices does not fit in with the logic of private-sector actors. In view of the strategic goal of securing access to energy resources, countries could fill this gap in the private sector today with subsidies thus indirectly acquiring exploration rights in third countries. Such a strategically motivated energy policy is considered relatively cost-intensive today.[77] On the one hand, investment decisions might possibly be made that would not have been made under purely private-sector conditions. Exploring newly discovered deposits may thus meet the demand, but exploration costs are often higher than the market price. On the other hand, hardly assessable political costs may be generated, for example by cooperating with regimes that are perceived as politically problematic by predominantly Western countries. However, peak oil would cause an increase in the market price which would make such state interventions more attractive. This calculation could thus change in favour of threshold countries that are already expansionary in terms of resource policy.

The more this kind of resource security is perceived as a mercantilist zero-sum game (in which, given the absence of functioning market mechanisms, one country loses when the other wins), the more energy diplomacy, i.e. foreign policy activities in the service of national energy interests, would come into focus. It is debatable if China does pursue a neo-mercantilist approach with its external energy policy, as is often claimed.[78] In view of peak oil, the spread of this point of view in energy policy would be a plausible development if, as described above, the amount of oil traded on the free market decreases relatively. Although, in light of peak oil, strengthening market forces and thus increasing the distribution efficiency of rare resources should be in the interest of the international community, the moral hazard behaviour[79] known in this context would have to be expected for individual actors.[80]

Resulting uncertainty shared by all actors could have negative consequences for contractual fidelity and reliability in international energy relations. To protect oil supplies, for example

77 For example, German black coal mining is highly subsidised on grounds of strategic national interest.

78 In the international energy debate, the opinion that China pursues a so-called "neo-mercantilist strategy" to secure its energy supply is very popular. This point of view implies that China pursues a strategy aimed at securing the country's energy supply not in a market-based fashion, but by having immediate control over oil and gas production overseas. Chinas commitment concerning oil and gas fields in Africa, Latin America, Central Asia and North America is considered evidence for this perception In addition, many experts believe that Chinese oil companies are not profit-seeking companies, but rather the extended arm of national energy policy. Even though attention should be paid to the "neo-mercantilist point of view", a certain caution must be exercised with regard to the interpretation of Chinese energy policy in particular and national energy policy in general. In order to make reliable statements about the nature of Chinese energy policy (or any other national energy policy), the shares of equity oil (oil that is produced abroad under the control of Chinese oil companies) and market oil (oil that Chinese companies purchase on the world markets) in China's total oil imports would have to be clearly identified. Cf. Xuewu Gu and Maximilian Mayer, *Chinas Energiehunger: Mythos oder Realität?*, (Munich, 2007), 4f.; Cf. Maximilian Mayer, "Warum Chinas „Energiehunger" nicht zum „Krieg um Ressourcen" führt", in *China aktuell*, No 1, 2007, 57-75; Heinrich Kreft, "Neomerkantilistische Energiediplomatie. China auf der Suche nach neuen Energiequellen", in *Internationale Politik*, Vol.61, No 2, Februar 2006, 50-57.

79 A moral hazard may occur when a higher authority (e.g. a government) or a collective body (e.g. an insurance company) tries to enforce a collective rationality that is, however, exploited by individual persons in favour of their own interests and thus likely to be circumvented.

80 For a discussion of the moral hazard phenomenon in the context of energy policy, cf. Chloé Le Coq and Elena Paltseva, *Common Energy Policy in the EU: The Common Hazard of the Security of External Supply*, Swedish Institute for European Policy Studies (SIEPS) (Stockholm, February 2008), http://www.sieps.se/en/dokument_/download-document/66-20081.html (accessed on 13 October 2010).

by bilateral agreements, the intensification of secret diplomacy also seems plausible. In view of the developments outlined above, free and transparent access to national energy resources, to markets and to the trading of energy services would become increasingly difficult.

Geopolitical implications: New strategic alliances and power shifts within international organisations

With new strategic alliances such as the Shanghai Cooperation Organisation or the Gas Exporting Countries Forum, some geopolitical upheavals are already looming. In the face of peak oil triggered increased rivalry situation for oil and the rise of important threshold countries, this could not only contribute towards the formation of a countervailing power against Western organisations and the US as a regulatory power but also affect the supply security of Western industrialised countries.

The growing number of countries that presumably have no more oil available or must or wish to consume their available oil exclusively for their own needs within the reviewed period could also bring changes to OPEC's role and composition. Conceivable would be an accelerated drop out rate of countries that have reached and far exceeded their peak oil as well as the admittance of new members that could in future exploit non-conventional oil reserves such as heavy oil, extra-heavy oil, oil sands or oil sheal.[81]

Owing to the economic rise of large threshold countries and the accompanying increase in the global shaping will , continuous adaptation as to memberships, contribution, and voting weights are expected in international organisations and multilateral associations.[82]

In this context, countries such as Russia will be able to further consolidate and even increase this gain in influence due to their own wealth of resources because, against the backdrop of peak oil, gas in particular will rapidly become increasingly important for global energy supply.[83] While wealth in natural resources alone does not yet make an influential international actor, it can be assumed that, against the backdrop of peak oil and under certain conditions, control over energy could increasingly be transformed into global shaping power and determining influence on international rules.

As explained above, this applies even more the more successful the producer countries' national oil companies are with regard to the already evolving process of vertical

81 Indonesia, for example, became a net importer as a result of a decrease in production quantities and an increase in its own consumption, and left the cartel in 2009. Other OPEC countries, e.g. Nigeria, could follow this example due to high population growth coinciding with stagnating or even falling oil production quantities. The question as to which OPEC members have already exceeded their peak is disputable due to intransparent data. Cf. Daniele Ganser, "Peak Oil. Erdöl im Spannungsfeld von Krieg und Frieden", in Philipp Rudolf et al., eds., *Energie* (Zürich, 2009), 45-60. For an extensive overview of the knowledge acquired so far about resources, reserves, the production and consumption of oil (and other energy raw materials) still existing worldwide, cf. Federal Institute for Geosciences and Natural Resources (BGR), *Reserven, Ressourcen und Verfügbarkeit von Energierohstoffen* (Hanover, 2009), http://www.bgr.bund.de/nn_324956/DE/Themen/Energie/Downloads/Energiestudie-Kurzf-2009,templateId=raw,property=publicationFile.pdf/Energiestudie-Kurzf-2009.pdf (accessed on 11 October 2010).

82 Examples are the recently altered voting weights in the World Bank and in the International Monetary Fund (IMF) in favour of threshold countries and at the expense of industrialised countries as well as the replacement of the G8 by the G20 as a forum for vital world economy policy issues.

83 Cf. Chapter 3.1.3 of this study.

integration[84] of other value-added chain components in the oil sector and the smaller the share of oil traded on the global oil market becomes. As a *conditio sine qua non* for expanding economic supremacy, energy becomes considerably more important for global power shifts in the international system in light of peak oil.

Role of private-sector and state actors

Given the relative independence of private-sector actors, the developments described (package deals, political instrumentalisation of oil supplies, political peaking) require government intervention for the respective actions to be taken by either forcing private companies or engaging state-owned corporations. Another likely result of global peak oil would be greater government involvement in order to ensure control over the scarce resource. The following section (3.1.2) therefore addresses in more detail the change to the role of both state and private-sector actors that can be assumed in light of peak oil.

84 Federal Cartel Office, *Sector Analysis Fuels, Interim Report* (Bonn, June 2009), 3, http://www.bundeskartellamt.de/wDeutsch/download/pdf/2009-07-02%20Zwischenbericht_SU_Kraftstoffe.pdf (accessed on 18 October 2010).

3.1.2 Changed Distribution of Roles for State and Private-sector Actors

With oil becoming ever more important in the wake of peak oil, the roles and positions of states and private business enterprises could undergo greater changes. While states are likely to interlope more in securing oil supplies, private business enterprises on the other hand could increasingly perform governmental functions and tasks. Focus would be placed on three areas in particular: the more intense dispute about production licences, the assumption of governmental security tasks, and the protection of oil infrastructures.

More intense dispute about production licences

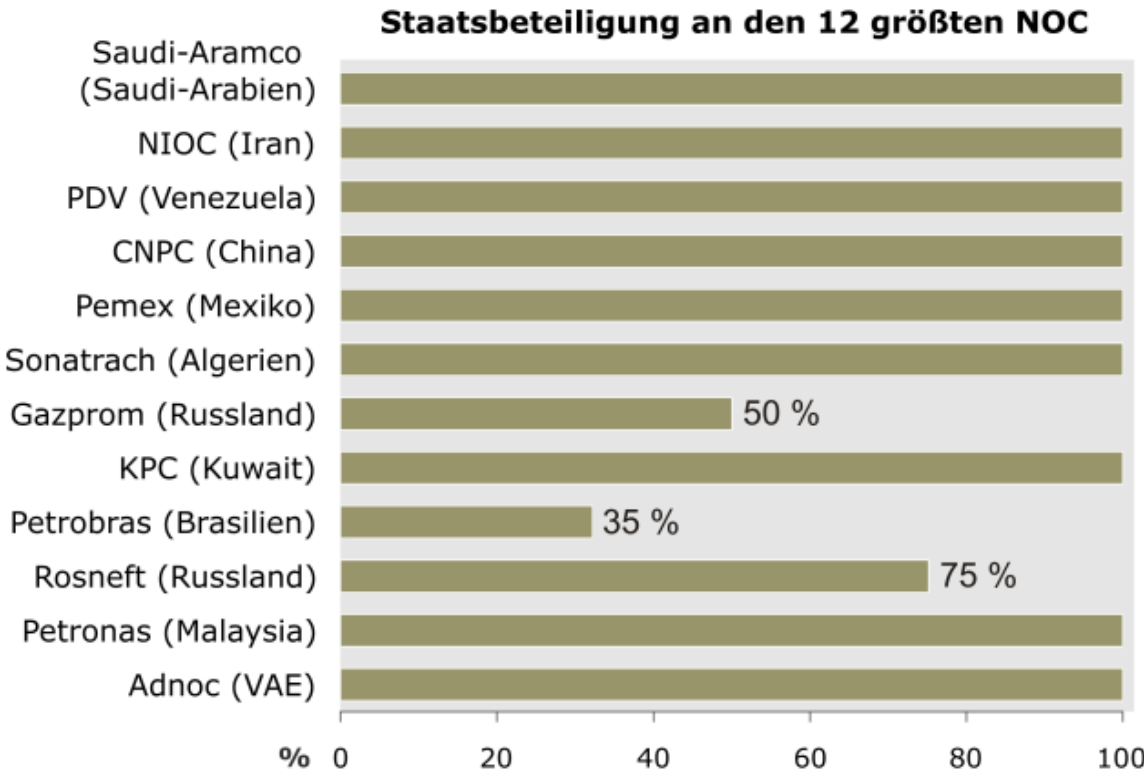
In the event of a shortage of global oil supplies, the exploration of new oil reserves would become a matter of particular importance. Given the fact that most conventional and non-conventional oil resources are located on the territory of sovereign nation-states, it can be assumed that most oil sources will continue to be under the direct control of national governments.[85] Those governments that are not able or willing to explore them themselves via appropriate companies are already seeking partners who are granted appropriate licences. It does not seem likely at present that this proven practice is going to change.

Oil is produced by both state-owned national oil companies (NOCs) and private internationally acting oil companies (IOCs). Owing to the wave of nationalisation in the oil producer countries in the 1970s, the share in global oil reserves held by national oil companies currently lies at more than 80%.[86] It is becoming increasingly difficult for the IOCs to gain access to easily and inexpensively exploitable oil.

85 In cases where sources lie in international waters or controversial regions, cf. Chapter 3.1.3.

86 This, however, only refers to the land-based oil sources and not sea-based oil sources and must not obscure the fact that private international oil concerns also still have a considerable influence. Cf. Hamburgisches WeltWirtschaftsinstitut (HWWI) und Berenberg Bank, *Energierohstoffe – Strategie 2030* (Hamburg, 2005), 65, http://www.berenberg.de/fileadmin/assets/pdf/Strategie_2030_Energierohstoffe.pdf (accessed on 13 October 2010); Federal Institute for Geosciences and Natural Resources (BGR), *Reserven, Ressourcen und Verfügbarkeit von Energierohstoffen* (Hanover, 2009), 45 f., http://www.bgr.bund.de/nn_324956/DE/Themen/Energie/Downloads/Energiestudie-Kurzf-2009,templateId=raw,property=publicationFile.pdf/Energiestudie-Kurzf-2009.pdf (accessed on 11 October 2010); Anna Marohn and Fritz Vorholz, "Die Vernunft geht unter", in *DIE ZEIT Online*, 12 May 2010, http://www.zeit.de/2010/20/Oelkatastrophe-USA (accessed on 13 October 2010).

Figure 3: State Involvement in the 12 Largest National Oil Companies



Source: Federal Institute for Geosciences and Natural Resources (BGR), 2009

Figure 3 - Glossary

Staatsbeteiligung an den 12 größten NOC	State involvement in the 12 largest NOCs
Saudi-Arabien	Saudi Arabia
Algerien	Algeria
Russland	Russia
Brasilien	Brazil
Russland	Russia
VAE	UAE

National oil companies are showing increasing efforts to internationalise their business and hence are serious competition for the large international oil companies. This is not limited to strategic partnerships with other NOCs or IOCs, the aim of expanding is also pursued by obtaining shares in oil resources abroad or likewise by takeovers. Some NOCs are no longer dependent on technology partnerships with private companies since on the one hand they have acquired the necessary know-how and on the other hand have the necessary funds to realise the strategic priorities of supply security and turnover growth. Examples are Petrobras (Brazil), PetroChina and Gazprom (Russia).

Figure 4: Variance in the Relation between the State and State-owned Companies

Source: Accenture[87]

As a result of peak oil and against the background of high demands for oil, it can be assumed that negotiations about production licences will be characterised by increased competition and more intensified disputes [88] between bidders. This would not only affect the allocation of licences for newly to be exploited production regions in particular, but also re-negotiations of existing licences upon untimely termination by governments or scheduled expiration.

Since, under the given circumstances, it is of vital interest for many states to maintain control over the particularly essential resource of oil, the issue of nationalisation of strategically important industries is likely to gain a new topicality and explosiveness in this context. In addition to the nationalisation of oil and transport infrastructures in export and transit countries, this would also be conceivable for central technology areas facilitating the economy and industry transformation to a post-fossil age. Moreover, with regard to central oil products the nationalisation of entire value-added chains cannot be ruled out in case it is no longer possible to ensure sufficient supplies via market mechanisms.

Bidder competition for production licences could lead to drastic price spirals. The more problematic the oil shortage for individual countries, the more intensive this competition would be. In view of the possible dramatic effects and limited short-term alternatives, it must be assumed that these countries will make forced efforts to cover their own oil requirements. This would even further intensify the competition between NOCs and IOCs. In this case, network structures and financial strength would have a very important part to play - either in order to make use of already existing partnerships, to prevail over other bidders, or to gain access to new strategic partnerships.

87 Cf. *The National Oil Company – Transforming the competitive landscape for global energy*, Accenture, 2006, http://www.accenture.com/NR/rdonlyres/82A993FE-CFDA-47EF-9D07-D43584763286/0/NOC_BrochureRVS.pdf (accessed on 13 October 2010).

88 These disputes, however, are by no means to be understood as violent conflicts.

In an extreme case, continuation of intensified competition between bidders is plausible even after the licences have been awarded and could culminate in an attempt to persuade companies to return or governments to terminate licences. One thinkable way to achieve this purpose would be to instrumentalise the local population – particularly in regions with ethnic or religious minorities – aiming at deliberately degrading the concerned oil companies' working conditions. Such a development could result in uprisings similar to the one in the Niger Delta region, where, since the end of the 1990's, indigenous groups have been taking action against the exploration of oil.[89]

Assumption of government tasks by private companies

In regions of fragile statehood in which governments do not perform their main tasks adequately, actors are confronted with what is at least a partial vacuum of government functions.[90] In this environment, domestic and foreign companies that are active in such a neglected region could be forced to assume certain government tasks in order to be able to continue pursuing their actual task effectively. Some companies already use measures to create legitimacy and to stabilise the situation in an environment that is characterised by a low or dwindling governmental presence. In exceptional cases, as long as benefit prospects are good, civilian companies take measures themselves to contain and overcome uprisings in the event of local opposition.[91]. This can be referred to as "corporate counterinsurgency".[92] In addition to a passive security dimension that comprises protecting their own infrastructure, such an approach generally encompasses other dimensions such as targeted improvement of the local population's living conditions, increasing acceptance by promoting local projects, or job creation. On the whole, these measures can comprise a wide range of activities and are not subject to any clear and definite categorisation. In the final analysis, the spectrum of possible tasks would include performing or directly commissioning and monitoring what are actually sovereign tasks of governmental use of force. This, however, would foster legal grey areas and further erosion of state sovereignty and institutions.[93]

Prerequisite for such a situation is always the prospect of economic advantages, without which a private company would not be willing to continue working in conflict regions due to

89 The initially non-violent resistance has meanwhile developed into open insurgency.

90 Inadequacy as regards task performance can be attributed to deliberate withdrawal by the state and to institutional weakness. This deliberate neglect of certain homeland regions on the part of governments is also referred to as "policy of the cunning state". It makes it possible to concentrate national funds on regions that are considered prioritised. Cf. Annette Weber, *Kriege ohne Grenzen und das "erfolgreiche Scheitern" der Staaten am Horn von Afrika, SWP-Studie 26*, September 2008, http://www.swp-berlin.org/common/get_document.php?asset_id=5280 (accessed on 13 October 2010).

91 Mobile companies, as a general rule, leave such regions. In most cases, companies that are tied to the region due to raw material deposits make a cost-benefit analysis.

92 Cf. William Rosenau et al., *Corporations and Counterinsurgency*, RAND, 2009, 2. http://www.rand.org/pubs/occasional_papers/2009/RAND_OP259.pdf (accessed on 13 October 2010). The term "counterinsurgency" (COIN) has repeatedly led to misunderstandings and dissent in Germany due to the fact that it is based on various translations and interpretations. Often translated as "combating uprisings", the term suggests military action against an uprising. Against the background and now recognised assessment that only approximately 15-20% of the activities whose purpose is to put an end to an uprising are of a military nature and that the management and majority of the necessary tasks are the responsibility of the civilian sector, preference is to be given to the translation "controlling uprisings". The reason for this dissent is the insufficiently consolidated historical parallelism between two schools of thought on controlling uprisings. While the enemy-centric COIN school of thought aimed at ending the uprising with the use of repressive police, paramilitary or military measures against insurgents, the population-centric COIN approach focused on protecting the population and gaining its support and - building on this - on gaining legitimacy. In the meantime, this form has prevailed and is used as a basis. In addition to offensive measures taken by security forces against insurgents, the approach above all comprises issues concerning governance, guarantee of government services and improvement of living conditions.

93 If the lack of government presence in the regions concerned is based on a lack of options, this could lead to conflict potential between the host country and the enterprise However, since both actors wish to see the state performing its tasks itself, this conflict potential seems to be of a short-term or rhetoric nature because it can be assumed that a cooperative solution can be found that involves the same objectives.

its fundamental philosophy.[94] As a result, short-term "corporate COIN" campaign efforts and expenditure for stabilising the environment are conceivable. In the long term, this is only plausible if the economic benefit calculation, i.e. the profits that can be expected after taking into account the investments already made, meet the company's expectations or those of its owners. In state-owned corporations, however, this condition could possibly be inapplicable if the procurement of oil [95] is considered to be important enough and its significance is measured lesser in terms of monetary profits than rather in terms of strategic perspective.

Today, some companies are already involved in local state-building measures, even though in most cases only indirectly by strengthening local social structures or participating in governmental programmes. In the event of peak oil with an assumed heavy burden on weak countries in particular, national structures might fail completely or be deliberately withdrawn in some regions leaving companies only the choice to either retreat or to solve problems discretely.

Increased importance of oil infrastructures

When peak oil is exceeded, not only oil immensely gains importance and attention but particularly the needed transport infrastructure as well.[96] Global transportation routes via which oil is distributed with supertankers or long pipeline sections are, due to their broad ramifications, difficult to protect and sometimes provide easy targets for interrupting the oil supply. This would also increase the incentive to sabotage energy infrastructure. In this context, the high return on investment of attacks on pipelines, ports or refineries[97] is likely to automatically put the oil industry in the focus of interest for any actor who seeks to reach his goals by using force.[98] Numerous countries will exceed their production maximum at some point during their oil exploration. Since a major part of the oil reserves remaining after peak oil is concentrated in the Strategic Ellipse, the oil infrastructure in this region is becoming increasingly important for many countries. Interruption of these energy infrastructures would also be an easy and worthwhile target for actors who are willing to use violence. Particularly at the trouble spots of this region's future energy infrastructure, a comparatively huge amount of damage with global political and economic implications could be caused with very little resources and at low risk (high return on investment). The series of attacks in recent years in Nigeria already show these tendencies. Systematic attacks over an extended period of time forced a restriction on production capacities, which even led to the closing of

94 Ideological, political or other motives by decision-makers which lead to functions also being assumed and performed without an advantage cannot be ruled out. Such motives, however, are isolated cases, particularly because it is only possible to run a company without making profit for a limited period unless it is subsidised some other way.

95 As a general principle, this also applies to other resources that are of vital interest to a state.

96 Based on the assumptions taken as a basis in Chapter 2.3, Europe and North America have already experienced their regional peak oil. Other regions are also due to reach their peak soon. In future, this would mean that the share of oil imports from the Strategic Ellipse will increase for most countries. Cf. Hamburgisches WeltWirtschaftsinstitut (HWWI) und Berenberg Bank, *Energierohstoffe – Strategie 2030* (Hamburg, 2005), 44, http://www.berenberg.de/fileadmin/assets/pdf/Strategie_2030_Energierohstoffe.pdf (accessed on 13 October 2010).

97 Attacks must not necessarily be characterised exclusively by acts of physical violence: "Stuxnet is a new Internet worm that specifically targets Siemens WinCC SCADA systems: used to control production at industrial plants such as oil rigs, refineries, electronics production, and so on. The worm seems to uploads plant info (schematics and production information) to an external website. Moreover, owners of these SCADA systems cannot change the default password because it would cause the software to break down." Cf. http://www.schneier.com/blog/archives/2010/07/internet_worm_t.html (accessed on 13 October 2010).

98 If oil supply is interrupted, the shortage of supply and the ensuing price increase provide an even greater incentive for more attacks resulting in an ever intensifying cycle of violence.

pumping stations due to acts of sabotage. The rebel groups aim to achieve a larger share of the local energy companies' profits for the region's population.[99]

The exploration of new conventional and non-conventional oil reserves in not yet explored regions also brings about a diversification of transport routes.[100] Although not likely to equal the importance of the Strategic Ellipse, their complex global branching is expected to place much higher quantitative demands on infrastructure security. As a result, it is hardly possible to ensure comprehensive protection against a coordinated interruption of transport routes at various points. Thus the oil infrastructure gains a considerably more important position amongst the critical infrastructures (CI)[101]. However, highly industrialized societies, technologically complex and highly differentiated in terms of labour division, react very vulnerably to all types of interference with energy supply.[102] In this context, the infrastructure of gas as a partial substitute for oil and, at a later point, the electricity infrastructure, are likely to develop even more into critical infrastructures and require increased protection.[103]

It must be assumed that both states and private companies will adapt to these growing requirements and will increase the security of energy/oil production and transport routes as well as infrastructure. This could lead to an increased degree of activity on the part of private actors when it comes to creating security and stability – a task which originally is a governmental responsibility.

If the industrialised countries' dependence on oil persists, they can be expected to seek to increase their influence on the countries of the Strategic Ellipse to ensure continued energy supply and create a favourable environment for stable production and delivery. This would not inevitably be achieved by military engagements, however, it would in principle generate a further increase in the number of external actors.

In the three areas described above, a shift in the activities and functions of state and private-sector actors becomes apparent. While states are likely to become increasingly involved in the private-company sector or possibly make efforts to intervene in this sector as part of their attempts to secure their oil supply, private companies could find themselves in a very strong position in certain fields that would give them options of action at the same eye level as governments but would also force them to occasionally assume originally governmental functions in order to continue pursuing their primarily economic targets.

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99 For an overview, cf. Redaktion Weltalmanach, ed., *Der Fischer Weltalmanach 2010: Zahlen, Daten, Fakten* (Frankfurt am Main, 2010), http://www.bpb.de/wissen/A5Z5MS,3,0,Nigeria.html, (accessed on 27 October 2010).

100 Cf. Chapter 3.1.3.

101 Critical infrastructures are defined as "organizational and physical structures and facilities of such vital importance to a nation's society and economy that their failure or degradation would result in sustained supply shortages, significant disruption of public safety and security, or other dramatic consequences." Cf. Federal Ministry of the Interior, National Strategy for Critical Infrastructure Protection (CIP Strategy) (Berlin, June 2009), 4, http://www.bmi.bund.de/cae/servlet/contentblob/544770/publicationFile/27031/kritis.pdf (accessed on 13 October 2010; the link refers to the German version).

102 Cf. *ibid.*, 10. In addition, there is a "vulnerability paradox" that can be identified in these societies: increasing robustness and less susceptibility to failure leads to the development of a very deceptive feeling of security. In this case, the effects of a "failure anyway" situation are disproportionately high: To the extent that a country seems to be not very vulnerable to failure in terms of its supply services, each incident of failure has an even greater impact.

103 In this context, cf. Chapter 3.1.3. The increase in the importance of electricity infrastructure in efforts to achieve energy independence becomes particularly clear.

3.1.3 Exploration of Further and Alternative Energy Resources

Alternative energy resources increasingly gain importance due to dwindling conventional oil reserves under peak oil conditions. This includes undeveloped and non-conventional [104] *natural oil and gas deposits, coal and nuclear power as well as renewable energy from biomass to solar energy. The use of such resources harbours security policy implications and new challenges.*

Conflicts over oil reserves in disputed regions and international waters

The exploration of non-conventional oil reserves in times of oil shortage will be subject to a different economic calculus than in times of sufficient supplies. The costs for exploring conventional deposits, especially in terms of environmental damage, are comparatively low. However, with regard to non-conventional oil resources, this is frequently not the case. The environmental damage caused would call a purely economically motivated exploitation into question. Especially the complex processing of tar sands illustrates the economic and, above all, ecological consequences this exploitation may have.[105] Modern production technologies and climate and environmentally friendly methods will increase in importance and bring strategic advantages for actors with the respective high-technology.[106] It would also be a conceivable option that even environmentally conscious societies explore such reserves in order to create a national strategic reserve that would, however, only be exported under exceptional circumstances. Even though the exploration of such non-conventional resources under peak oil conditions will probably increase considerably, it remains questionable whether it would be effective to a large extent on the global market.

There is hardly any proven knowledge regarding the extent of oil reserves in international waters and the Arctic. Yet these potential oil-producing areas will greatly increase in significance.[107] Even if the exploration of such non-conventional reserves requires technical challenges to be overcome as well as financial efforts to be made, the exploitation of such reserves, following global oil shortage and a consequential rise in prices, will become more profitable and, from some actors' point of view, necessary. Moreover, such exploitation would be subject to a different risk calculus, as is demonstrated by the consequences of the Deepwater Horizon accident.[108] The exploration of the Arctic, an industrially largely

104 To understand the difference between conventional and non-conventional oil resources, cf. Frequently Asked Qustions #4, 111.

105 Tar sands are oil deposits that have the properties of bitumen. They are found near the surface and are mixed with large quantities of sand. In Canada, these bituminous beds have a bitumen concentration of 15 to 20 per cent, exploited mainly in open-cast mining. In a complex process using natural gas, synthetic oil is extracted. According to a report by the Canadian Association of Petroleum Producers, the quantity of about three million barrels oil per day extracted from Canadian oil sands is to be doubled by 2020. The emissions from the extraction and use of synthetic oil from tar sands, however, are two to five times higher than with conventional oil. For more information see Werner Zittel, *Zukunft der weltweiten Erdölversorgung* (Berlin, 2008), http://www.energywatchgroup.org/fileadmin/global/pdf/2008-05-21_EWG_Erdoelstudie_D.pdf (accessed on 11 October 2010).

106 In this context, cf. Chapter 3.1.1.

107 Even if "large deposits" are often reported, the extent of these energy resources, above all in the Arctic, is largely unknown. In 2008, a US geological survey study assumed 13% of all undiscovered oil reserves to lie in the Arctic, which has meanwhile been adjusted downward. Cf. Bundeswehr Geoinformation Office, *Erdölvorkommen unter den Polkappen*, Geopolitische Kurz-Info (Euskirchen, 2007), 6.

108 The Cluster of Excellence "The Future Ocean" at Christian-Albrechts-Universitität zu Kiel estimates the overall costs in exchange losses incurred by BP for the oil spill of the Deepwater Horizon platform in the Gulf of Mexico to be at 54 billion euros. These comprise formal monetary costs expected in the market for damages attributable to the company as well as penalties and stricter future constraints. Additional losses in the fishing and tourism industries are estimated at 5 billion euros. Potential damage to health and lost public benefits that are not included in the BP stock exchange value have not been considered. It is assumed that the social costs of the accident are just

undisturbed region, may have unforeseeable consequences for the complex Arctic ecosystem. This would, even against the backdrop of a dramatic oil shortage, meet with resistance by globally active environmental pressure groups or groups that are less affected by oil shortage in their respective states. Moreover, some deposits in the Arctic are located in regions, the ownership of which is not yet settled.[109] Conflicts and disputes about these areas which today are still dealt with cooperatively might increase.[110]

However, the strategic significance in securing resources and the exploration of new and controversial oil-producing areas may increase the probability of a further build-up of military arsenals to enforce those claims. Efforts aimed at expanding military capacities for the protection of own claims on the Arctic can already be seen today. Even if Russia's current activities are primarily aimed at positioning itself as a world power, and the activities of other nations primarily serve to secure their national sovereignty in mostly vast regions, a relevant increase in military expenditure can already be observed.[111] It is still unclear whether NATO will play a role in possible conflicts over Arctic resources; however, all adjacent states, with the exception of Russia, are members of the Alliance. This may imply the involvement of the Transatlantic Alliance in territorial conflicts of one or several member states with another state not belonging to the Alliance, even if NATO would not take action in its function of collective defence in low-profile, non-violent conflicts.

Most recently, China has also shown an increased interest in the Arctic, even if a connection with the existing resources has been denied. However, this could be seen as a sign that interference of additional actors can be expected, especially in the new and disputed regions with strategic raw material deposits.[112]

Similar considerations apply to international waters. The growing possibility of deep-sea resources exploration would increasingly bring unsettled territorial claims as a potential cause of conflict to the fore, as can currently be observed in the territorial conflicts over the South China Sea. Moreover, an exploration of deep-sea resources would lead to an increased importance of maritime high technology. Actors with appropriate capabilities would therefore experience a revaluation. Finally, with the exploitation of high sea deposits, the significance of blue water navies would also increase.

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as high as BP's losses at the stock exchange. Cf. Emanual Söding, Friederike Balzereit, Kirsten Schäfer, *Die Ölkatastrophe im Golf von Mexiko – was bleibt?*, Cluster of Excellence "The Future Ocean", Christian-Albrechts-Universität zu Kiel (Kiel, 9 August 2010), 36f.

109 A list of boundaries and claims can be viewed at the International Boundaries Research Unit of Durham University, http://www.dur.ac.uk/ibru/resources/arctic/ (accessed on 13 October 2010). In 2007, the Kremlin effectively asserted its claim for parts of the Arctic in the media. Just like Norway, Canada and Denmark, Russia has also requested the external border of its continental shelf to be extended. In the Arctic, the claims of ownership have not been settled yet. On the high seas, claims for areas by various states collide due to an uncertain legal situation. This may lead to a controversy about increasingly important resources and a considerable potential for conflict between adjacent states and other states asserting their claims.

110 The presence of conflicts does not automatically lead to the conclusion that wars and armed conflicts will increase since these conflicts do not necessarily have to end in violence. Conflicts about the territorial control over production regions must be separated from conflicts over the actual exploration of oil. In this context, cf. Chapter 3.1.2.

111 Russia has established a paramilitary unit for the protection of the Arctic territory under the auspices of the internal secret service FSB, Canada has started the construction of several patrol boats suitable for the Arctic and has established a naval port and a training centre for operations under Arctic conditions.

112 According to a report by the Stockholm SIPRI-Institute, China has increased its efforts to research the Arctic in order to take account of the political, economic and military consequences of an ice-free and navigable Arctic, including access to expected resources. However, China's strict policy of non-interference in the affairs of third states makes conflictive action against adjacent states improbable. Cf. Linda Jakobson, *China prepares for an ice-free Arctic*, SIPRI Insights on Peace and Security, http://books.sipri.org/files/insight/SIPRIInsight1002.pdf, (accessed on 27 October2010).

Natural gas as an extension of the oil era

Due to its chemical properties, natural gas is seen as a substitute for oil in many fields. Despite a high uncertainty about existing reserves, natural gas is expected to last longer than oil. Natural gas will therefore be one of the most important fossil fuels of the future and will have to replace oil to a considerable extent, at least for a transition phase.[113] Natural gas reserves are usually located near oil reserves, a fact that, first and foremost, leads to security policy challenges that are already present today, due to the geographical position of the "producer countries".[114]

As oil production decreases, similar technologies and infrastructures may initially be employed to expand the use of natural gas. Contrary to oil, natural gas cannot simply be shipped but must be transported as gas via a pipeline or, after compression or liquefaction (liquefied natural gas (LNG)), with special-purpose tankers. Pipeline systems, however, which currently carry the major part of natural gas produced to the consumers, are regionally restricted. Instead of one world market for natural gas there hence are, in fact, several regional markets with limited options for the diversification of supplier relationships, in addition to associated energy security challenges. The pipelines, favoured for transport of natural gas to the customer countries, do not only span countries and regions but frequently also political and economic alliances and cultural areas. Therefore, conflicts over routes, construction and the security of pipelines may gradually increase. This does not only concern the bypass of states and regions that are considered to be unsafe. States that will not be included in the economic development of the reserves or the construction of pipelines also have to be dealt with.[115]

As with oil, we can expect producer countries to try to occupy increasing value-added shares in the processing of natural gas –which, for example, comprises the conversion into liquid hydrocarbons (gas-to-liquids (GtL)) and the further use of natural gas as raw material for the chemical industry. At first, this may relativise the falling revenues and destabilising effects that producer countries may experience due to peak oil conditions. Equally, the current marked increase in the use of LNG technology which enables natural gas to be transported with tankers may result in new trade routes and new buyers of natural gas.

Furthermore, there are substantial non-conventional deposits of natural gas. One of them is methane hydrate – a gaseous methane enclosed in an icelike compound – that lies in the seabed or in perma-frost soil. Under peak oil conditions, the use of these reserves will probably become more attractive commercially. The ecological risks and security policy

113 According to information provided by the International Atomic Energy Agency (IAEA), natural gas will become the most important fossil energy source by 2080 with a share of more than 50%.

114 Cf. Figure 1, p. 7

115 The tensions between Germany, Russia and Poland over the construction of the Baltic Sea pipeline demonstrate the associated potential for conflict. Cf. also Chapter 3.1.2. We also have to anticipate that even with routes through stable and safe regions, the infrastructure may be increasingly jeopardised by terrorists. Thus, the necessity for a geo-strategic stabilisation of larger regions may grow.

challenges resulting from the location of natural gas deposits in the sea and in northern regions will be the same as with the extended exploitation of non-conventional oil reserves.

Expansion of nuclear energy and increased proliferation

Further, partially massive expansion of nuclear energy, which has become apparent in some countries already today, has in the past been seen as an answer to and part of the way out of the oil crisis. If the energy structure is "electrified" further, nuclear energy as well as renewable energies, above all, can make a substantial contribution as a substitute to receding fossil energy sources.[116] There are varying estimates as to how long nuclear raw materials, such as uranium ore, will last but these lie mostly above the estimates for oil.[117] Leaving the problems of safety and ultimate waste disposal aside, many countries see nuclear energy as a comparatively cheap form of energy which also helps to reduce CO2 emissions. However, more nuclear energy would at least increase the statistic probability of accidents occurring which, if exceeding a certain severity, may have dramatic and destabilising regional ecological consequences with global impacts. This holds true even more when further threshold or even developing countries with other, partially "weaker", institutional security mechanisms and technological competences start exploiting nuclear power. In addition, external ecological effects of uranium mining, detrimental to the environment already today, the use of natural water resources to cool nuclear power plants, the dismantling of old, shut-down plants and the problem of the ultimate waste disposal render an ecological overall view even more complicated.

Above all, the expansion of nuclear energy aggravates the problem of proliferation. Given a deteriorating energy situation, it will become more and more difficult for the world community to restrict or control access to nuclear technologies or their use by "critical" states or crisis countries. Despite the efforts of the international community to establish effective monitoring and control mechanisms, these could increasingly be circumvented and sanctions become increasingly less enforceable. Moreover, given declining national oil reserves, the economic incentive to sell or transfer nuclear technology and/or nuclear material may grow substantially, not only in oil-exporting countries. Even oil-importing, industrialised countries may be inclined to transfer their nuclear technology in return for energy resources as part of a political package deal. Despite all efforts to prevent uncontrolled proliferation of nuclear technology which can always be used for military purposes, such incentives or even simple economic opportunities and necessities may put existing contractual obligations or even alliance memberships into perspective. Thus, as a tendency, more states may turn into potential or actual nuclear powers - with impacts on international and regional balances and alliance systems.

116 This concerns the primary energy consumption by industry and households as well as the transport business due to a more intensive use of rail transport and expansion of electromobility.

117 According to calculations by the Nuclear Energy Agency of the OECD, it will last between 50 and 70 years. A report entitled "Uranium: Resources, Production and Demand", issued by the Nuclear Energy Agency of the OECD (OECD/NEA) and the International Atomic Energy Agency (IAEA) and also known as the "Red Book", is published every two years. Cf.: Daniel Lübbert and Felix Lange, *Uran als Kernbrennstoff: Vorräte und Reichweite*, Deutscher Bundestag, Info-Brief (Berlin, 2006), http://www.bundestag.de/dokumente/analysen/2006/Uran_als_Kernbrennstoff-Vorraete_und_Reichweite.pdf (accessed on 13 October2010).

With an increasing transfer of nuclear technology, odds may rise that further states, including "critical" and fragile ones, may use such technologies and material for military purposes. Actors of such states may pass nuclear weapons or at least nuclear material directly on to other state, sub-state or non-state actors. Given the growing amounts of fuels generated during the processing and final waste disposal, there is also an increased probability of theft of serious amounts of nuclear material by terrorist groups or organised crime. It will become more important but also increasingly difficult to control nuclear fuel cycles. The risk that terrorist groups come into possession of simple nuclear weapons or larger amounts of nuclear material could grow.

Competition for land area in energy raw materials and food production

Under peak oil conditions, a massive expansion of the production of renewable raw materials for energy purposes as well as material use can be expected.[118] However, the agricultural land area required is limited. The significantly expanded cultivation of renewable raw materials would increase global competition for agricultural land and water.[119] Plants for energy generation compete with plants for the food industry and animal feed crops. Infrastructural measures, urban sprawl and, in some cases, urbanisation tendencies like, for instance, in Cairo, often lead to further cutbacks in potential land use. The massive rise in oil prices due to peak oil would add to the expenses of energy-intensive agricultural supplies such as fertilisers and pesticides as well as to the transport of agricultural intermediate and finished products.[120] This may lead to constantly rising costs for food or at least to an increased volatility of food prices.[121] Low-income strata in the cities and the rural population would suffer first and foremost, widening social gaps even further. In the light of continuously growing populations predominantly in developing countries, regional food supply shortages may be aggravated and eventually culminate in food crises.

Since potential cultivation areas are limited, the high demand for energy raw materials in industrialised states will, in general, not be fully met by domestic production but will require additional imports. Agricultural areas for bio-energy production mainly exist in threshold and developing countries, for instance in sub-Sahara Africa, the Caribbean, Latin America, and the Commonwealth of Independent States. Thus, on the one hand, the export of renewable raw materials would present an economic opportunity for threshold and

118 Renewable raw materials are primarily used for energy purposes such as fuels or for efficient decentralised cogeneration of electricity and heat. As an easily storable and constantly available energy source, it constitutes a very important component of an accelerated energy transition toward renewable energy. In addition, the material use, for example in the chemical industry, is growing in significance. Conceivable magnitudes for a biomass cultivation range from 200 to more than 700 hexajoule/year (Worldwatch Institute) which amounts from one fifth to well over half of the world energy needs and even beyond. At present, it is expected that under global conditions the maximum sustainable increase in primary energy produced by biomass can only be doubled by 2050; cf. Gerald Kanuf and Imke Lübbeke, *Food security and the use of biomass for energy purpose*, Platform Sustainable Biomass Discussion Paper, December 2007, http://www.wwf.de/fileadmin/fm-wwf/pdf_neu/nachhaltige_biomasse.pdf (accessed on 13 October 2010).

119 Today, 70% of the freshwater are already used for agricultural production. Additionally, the production of meat and milk requires three to four times as much fertile farmland.

120 Cf. Alex Evans, *Rising Food Prices. Drivers and Implications for Development*, Chatham House Briefing Paper, April 2008, http://www.cic.nyu.edu/internationalsecurity/docs/foodbriefingpaper.pdf, (accessed on 13 October 2010).

121 The so-called "tortilla crisis" in Mexico in 2007 has, for example, shown the consequences that a shift in the price structure may have for threshold and developing countries. As the demand for biofuels rose rapidly, promising lucrative business, competition ensued for the limited cultivation areas to grow wheat and plants for the production of biofuels. This led to a shortage and rise in costs for wheat so that the poorer strata of the local population could hardly afford to pay for tortilla which constitutes a basic food. There were massive protests against those price increases. 4 out of 10 Mexican families spend more than 10% of their income on tortilla. Prices increased within the range of 20%.

developing countries. On the other hand, however, these countries, especially the ones lacking own oil and gas supply, would, above all, also have to ensure their own food supply. Given the energy poverty of large parts of the population, they would have to reduce their dependence on depleting oil reserves while at the same time ensuring their supply with both food and bio-energy.[122] However, frequently these countries have too little infrastructure to produce, process, store and transport agricultural raw materials. Investments into irrigation systems and streets have long been neglected. Poorly developed state structures and socio-economic or humanitarian crises complicate even further a better and more equitable supply with food and energy.

Thus, pressure on, and competition for, agricultural land should rise disproportionately. Provided that it has not been possible to achieve a globally sustainable production of biomass, increased disputes about land as a strategic resource would ensue - one of the oldest causes of conflict. In particular, poverty-stricken and rural population groups in threshold and developing countries are forced to develop other and new land areas to grow food crops already today. As forest is converted into farmland, the indigenous population in particular is also jeopardised since they lose their original homeland. State-imposed resettlement programmes in connection with the cultivation of bio-energy crops may even lead to the expropriation of settlement areas.[123] Displacements and unrest bordering on civil war may be the consequences.

Even today, globally acting states and enterprises accelerate the expansion of agricultural land by buying or leasing land worldwide (see Figure 6). As these strategic commitments in the agricultural sector are expected to expand, it will not be easy to distinguish state from private-sector or even sub-state actors and interests in terms of land acquisition. Thus, a lack of land titles, for instance in Africa, apparently makes it easier for investors to purchase land, but exacerbates land conflicts as well.[124] External state or private-sector actors can therefore be expected to exert increasing influence on the development and security policy.[125] In many cases, conflicts could thus ensue due to competition for the use of the "agricultural land" resource.

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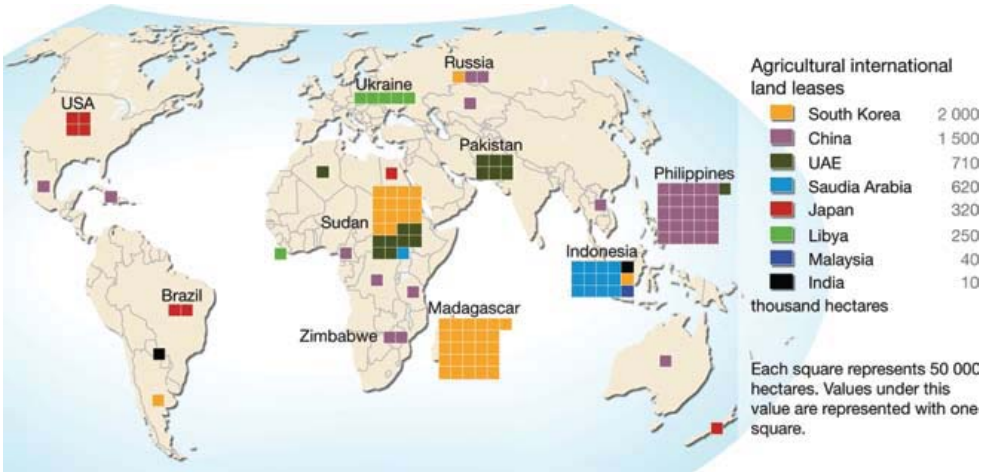
122 Under peak oil conditions, less-developed countries in particular will have to spend more of their financial resources on food imports as well as oil. Already today, threshold countries such as India use a large portion of their export revenues to import oil; cf. Thomas Fritz, *Entwicklungspolitische Folgen des Welthandels mit Agroenergie*, "Brot für die Welt" Discussion Paper (Stuttgart, April 2008), 5, http://www.brot-fuer-die-welt.de/downloads/fachinformationen/diskussionspapier_agroenergie.pdf (accessed on 13 October 2010).

123 This has, for example, already happened in Indonesia where land was confiscated and resettlements were carried out in connection with an expansion of oil palm plantations. Cf. *ibid*, 9ff.

124 "As a result, the money being invested in agrofuels in Africa is focused around large-scale plantation agriculture, tightly integrated into transnational corporate networks.24 And, as in any other sector of agribusiness, corporate profit with agrofuel crops is best assured when these plantations are on the most fertile lands, close to major transportation routes.25 Millions of small farmers still occupy these lands, however, and they have become the main obstacle in the path of the agrofuel rush. It is becoming clear that, whenever agrofuels are on the agenda, the pressure on farmers to leave their land intensifies." African Biodiversity Network, *Agrofuels in Africa – The impacts on Land, Food and Forests*, July 2007, 22ff, http://www.africanbiodiversity.org/media/1210585739.pdf, (accessed on 26 Oct. 2010). 2010).

125 Cf. Chapter 3.1.2.

Figure 5: International Land Leases



Source: UNEP/GRIP - Arendal

In addition, excessive biomass production without sustainable agricultural solutions would exacerbate the impact of climate change. A more intensive agriculture, especially with high-yield crops grown as monocultures, will have additional negative effects especially on those regions that are already facing acute water shortages.[126] The degradation of soil due to erosion, compression, salinisation and desertification may progress considerably. With the destruction of intact eco-systems and the loss of biodiversity the natural regeneration potential of the biosphere would decrease on a local and global level. Without sustainable solutions[127] the rapidly growing production of renewable energy raw materials could intensify economic and ecological crises in many regions of the world.

126 An intensive agriculture with industrialised high-technology systems places heavy demands on irrigation, fertilisation and use of pesticides etc.

127 This includes decentralised approaches, organic farming, synergistic effects and new technologies in the production of energy raw materials, participatory land use etc.

The quest for energy independence, critical infrastructures and wide-area "energy regions"

Energy independence means that a region, a state or a union of states can secure their energy supply with resources existing on their own territory or the territory of the union of states. Thus, imports of energy raw materials or energy itself can be significantly reduced or even completely avoided. Given the concentration of fossil oil and gas resources in the Strategic Ellipse, this means that Europe, for example, but also China would use coal, nuclear power and alternative energy sources to generate energy.

As a fossil source of energy, coal will last significantly longer than oil and gas and is distributed more evenly globally. Yet, it is also finite.[128] The mining site and the place of use (conversion into electricity, steel production etc.) are spatially adjacent or at least located within safe delivery routes. Thus, a massively intensified exploitation of coal would initially not lead to additional direct security policy challenges.

If technologies for a climate-friendly coal power generation (carbon capture and storage (CCS) etc.) are not used globally to the necessary extent in the period under review, the CO2 concentration in the atmosphere will increase considerably and accelerate climate change with all relevant consequences, also in the field of security policy. The same is true for coal liquefaction which can be used on a large scale but with the current state of the art is relatively inefficient energetically and harmful to the climate.[129] Although oil prices in excess of just $50 per barrel are expected to make coal liquefaction generally cost-efficient, the set-up of such plants at short notice will involve high economic and political costs. Complex planning and approval procedures and negative impacts on the environment despite process improvements may pose potential obstacles. In view of global oil shortage, a rise in world coal prices would be expectable so that domestic hard coal or even brown coal must be relied upon. Moreover, it takes longer to (re)develop coal resources than it takes to build a hydrogenation plant. Thus, coal liquefaction would rather be imaginable as a "last resort" to supply the industry, transport systems and armed forces with fuel, as the historic example of Germany during the Second World War shows.

Therefore, the quest for energy independence will, in the foreseeable future, be directed towards regenerative energy sources, the expansion of which is forging ahead rapidly. The generation of energy using wind, sun, geothermal power and biomass is facilitated by the respective geographical features. However, one region or one state alone hardly ever has conditions favourable for all kinds of regenerative power generation. The goal, therefore, are composite projects which diversify the energy supply transnationally and over a very large

128 Coal is, above all, used in the primary industry and for electric energy production. However, some expect the "peak coal" to occur already after 2030.

129 The coal-to-liquid technology (CtL) has a history of almost a hundred years. F. Bergius patented a method to produce liquid or soluble organic compounds from coal as early as 1913, for which he was awarded the Nobel Prize for Chemistry in 1931. The indirect coal liquefaction technology, developed by F. Fischer and H. Tropsch, was filed as a patent in 1925. In Germany, the chemical industry developed both technologies for large-scale production in the 1920s and operated a few plants. During the Second World WarI, up to four million tons of hydrocarbons were produced every year. In the aftermath of the oil crisis, pilot plants for coal refinement (gasification and liquefaction) were planned and put into operation until the 1980s. However, due to low oil prices and an unfavourable economic and ecological balance, fewer plants were built than intended. Yet, the last, very small plant was decommissioned only in 2004.

area, adapting it optimally to the geographic features – wind power at the coasts, solar energy in southern latitudes, hydropower at suitable locations, and biomass on available farmland. The focus in that matter is set to electric power generation by solar technology and wind power, as the example of DESERTEC shows.[130] In this context, the continuing "electrification" of power generation and distribution is designed to achieve efficiency gains and to enable "energy transport" over large distances (intra- and intercontinentally) via high-voltage direct-current power transmission.[131] Moreover, (partially) liberalised electricity markets and currently being established intelligent power network combinations - so-called smart grids - aim to ensure load balancing and optimal electricity distribution. Thus, energy independence will only be gained by means of these spacious and complex electric infrastructures – the so-called supergrids. This additional infrastructure, however, does not only need to be established, but also protected and may therefore become a critical factor.[132] Such an extended and diversified transregional infrastructure for the generation and distribution of power does not only touch on geographical borders of countries and alliances but also on political, economic and cultural systems and is therefore more than merely a technological and economic challenge.It requires a long-term stable economic and (security) policy environment.

130 The Desertec Foundation is an initiative that supports the transmission of solar and wind power from desert and coastal regions to Europe. Other energy sources will be added later. The goal is to achieve a sustainable power supply in EUrope, the Middle East and North-Africa (in short: EU-MENA).

131 These "new grids" include further decentralisation of energy supply, for example via cogeneration of electricity and heat.

132 Moreover, in case of a massive expansion of energy infrastructures, other raw materials (such as copper, rare earths, lithium, tantalum, coltan etc.) will be in demand. As these only last for a limited time period and also due to the location of the producer countries, they become "strategic raw materials" which will result in a global competition for their exploitation. Further "peaks" of these raw materials are possible.

3.1.4 Intra-societal Risks of Peak Oil

Since modern national economies strongly rely on inexpensive fossil raw materials, in particular oil, peak oil would pose considerable challenges to most countries and societies in the event of an incomplete or insufficient post-fossil transformation process. These challenges could entail restrictions in the mobility systems, interruptions in economic structures as well as an erosion of confidence in state institutions.

Restrictions in private and goods transportation

Given that no sufficient alternatives on the basis of regenerative energy sources have been established for transportation, peak oil is likely to cause a substantial rise in costs and possibly huge restrictions in motorised private transportation. This would have immediate effects on the functional mechanisms and ways of life of modern industrialised societies. Sudden shortages could be eased with the use of regulatory or voluntary measures ("mobility vouchers", "car-free Sunday" etc.). However, suburban settlement structures in industrialised countries in particular (living in the suburb - working in the city centre) hamper a rapid transformation of private transportation.[133] If the restrictions are considerable, all economic sectors concerned – from the automobile industry through the construction business to tourism – would experience a downturn. The "mobility crisis" could turn into an important new aspect of the economic crisis.

An increase in goods transportation costs could also have serious implications. Modern-day international division of labour, which involves global process and goods chains of all kinds of commodities, has largely been made possible by the technological progress in the field of freight traffic (container ships, trucks, cooling systems), which is in essence based on fossil fuels. [134] Compared with local public transport and, in parts, private transportation, the task of sufficiently switching all goods traffic over to alternative energy sources is much more complex with today's common means of transportation and technology.[135] Mobility on the basis of fossil fuels is therefore likely for a long time to remain a basic requirement of economic cycles that are highly diversified both globally and regionally. Restriction of this mobility would have immediate effects on global division of labour, trade and price structures. A possible consequence would be bottlenecks in the supply of existentially important goods.

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133 Cf. Lester B. Brown, *Plan B 2.0 Rescuing a Planet Under Stress and a Civilization in Trouble* (New York, 2006), 36f., http://www.earth-policy.org/images/uploads/book_files/pb2ch02.pdf (accessed on 13 October 2010).

134 There are different views regarding the theory that the maritime transport revolution has caused globalisation due to a considerable decrease in transportation costs Cf. David Jacks, Christopher M. Meissner and Dennis Novy, "Globalisation and the costs of international trade from 1870 to the present", in *VOX*, August 2008, http://www.voxeu.org/index.php?q=node/1545 (accessed on 13 October 2010); Davis S. Jacks and Krishna Pendakur, *Global Trade and the Maritime Transport Revolution*, Simon Fraser University, Working Paper (Burnaby, BC, July 2007), http://www.sfu.ca/~djacks/papers/workingpapers/transport.pdf (accessed on 13 October 2010). It is, however, indisputable that oil prices determine transportation costs, in particular when it comes to the transportation of small quantities of goods by land.

135 From a present-day perspective, fully electric trucks are neither ecologically nor economically efficient. An increase in the practice of transporting goods via rail, which *per se* is electrified, would require the same kind of rail network density as the one that used to exist back in the middle of the 20th century before it was thinned out in favour of goods transportation by road, which is more flexible. What is more, the potential increase in goods transportation is already limited today. Radical expansion of combined traffic, i.e. a combination of rail and road transportation, is not an easy task

Food sector uncertainties

If nothing else, existentially important goods include food. Although countries such as Germany are almost self-sufficient when it comes to the basic supply of foodstuffs, peak oil could well have serious consequences in some areas of agriculture. Potential supply bottlenecks would above all jeopardise countries with high food import quotas since the cost of importing food is bound to become very high.[136] After peak oil, there would be significant differences from past food shortages or crises in this context:

- The crisis would concern all food traded over long distances, not just single regions or products. Regions that are structurally already at risk today would however be particularly affected (see figure 5).

- Crop yields also depend on oil. The abdication of machines or oil-based fertilizers and other chemicals to increase crop yield would therefore have a negative effect on crops.[137]

- The increase in food prices would be long-term and would not be the result of a one-off crop failure or a similar situation.

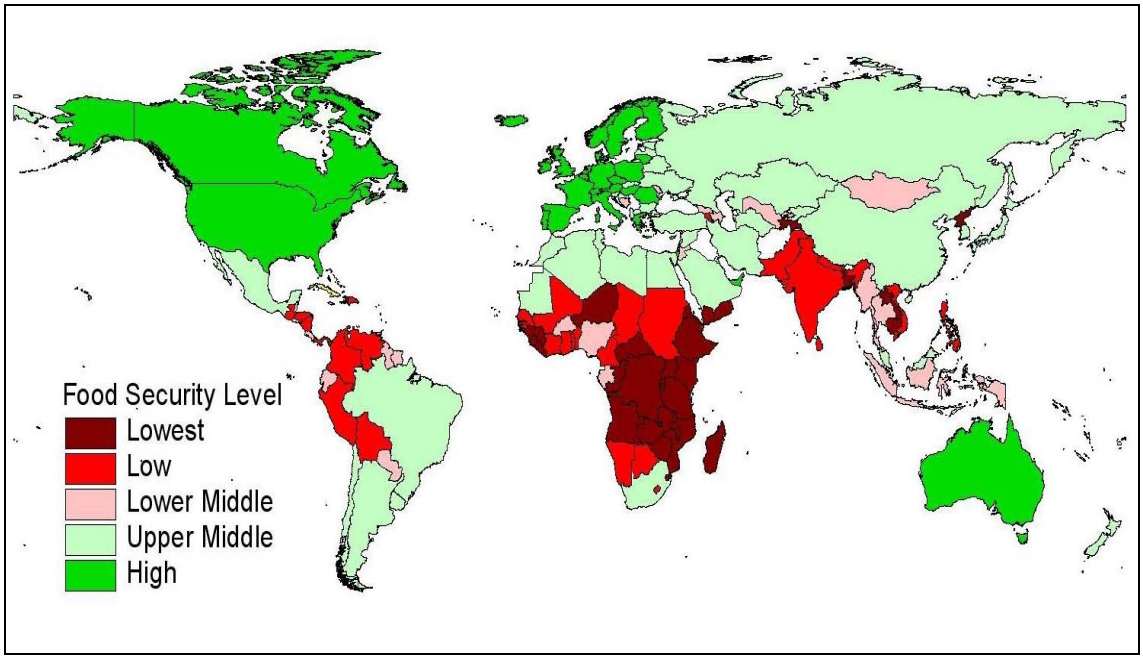
- Competition between the use of farmland for food production on the one hand and for the use of producing biofuels on the other hand could worsen food shortages and crises.[138]

136 For a detailed classification of countries with regard to their food security, cf. Bingxin Yu, Liangzhi You and Shenggen Fan, *A Typology of Food Security in Developing Countries under High Food Prices*, Working Paper (Beijing, August 2009), http://ageconsearch.umn.edu/bitstream/51043/2/IAAE%20food%20security%20typology.pdf, (accessed on 14 October 2010).

137 After the Korean War, the USSR helped North Korea to develop a modern and productive agriculture. When the USSR collapsed, the inflow of cheap oil suddenly dried up. Between 1989 and 1998, the crop yields dropped by more than half. Cf. Markus Noland, *Famine and Reform in North Korea*, Institute for International Economics Working Paper 3-5, July 2003, 5, http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.145.4829&rep=rep1&type=pdf (accessed on 14 October 2010).

138 On the effects of biofuels on food security, see also Chapter 3.1.2.; cf. also Food and Agriculture Organization of the United Nations, *The State of Food and Agriculture. Biofuels: Prospects, Risks and Opportunities* (Rome, 2008), 72ff.

Figure 6: Food Security Levels in the Face of High Food Prices



Source: Bingxin Yu, Liangzhi You and Shenggen Fan (2009)[139]

The probability of serious supply crises with relevance to security policy would climax where the food security levels are already low. Price fluctuations induced by peak oil would lend more weight to problems concerning domestic production or generally insecure trade relations. However, food shortages could also develop into a problem in countries that are as such self-sufficient if food production methods in various parts of the country vary greatly and distribution is inefficient or perceived unfair.

139 Cf. Bingxin Yu, Liangzhi You and Shenggen Fan, *A Typology of Food Security in Developing Countries under High Food Prices*, Working Paper (Beijing, August 2009), Figure 5 in the Annex to this study, http://ageconsearch.umn.edu/bitstream/51043/2/IAAE%20food%20security%20typology.pdf, (accessed on 14 October 2010).

Upheaval in economic structures

Since oil is needed directly or indirectly for the production of more than 90% of all industrial goods, effects would show across the entire economic structure. Since an increase in the price of oil would bring about a shift in almost all price relations, consumption and, in turn, domestic production and foreign trade would have to permanently adapt to the new oil prices (cf. Fig. 6).

Figure 7 : German Imports and Exports Classified by Commodity Groups

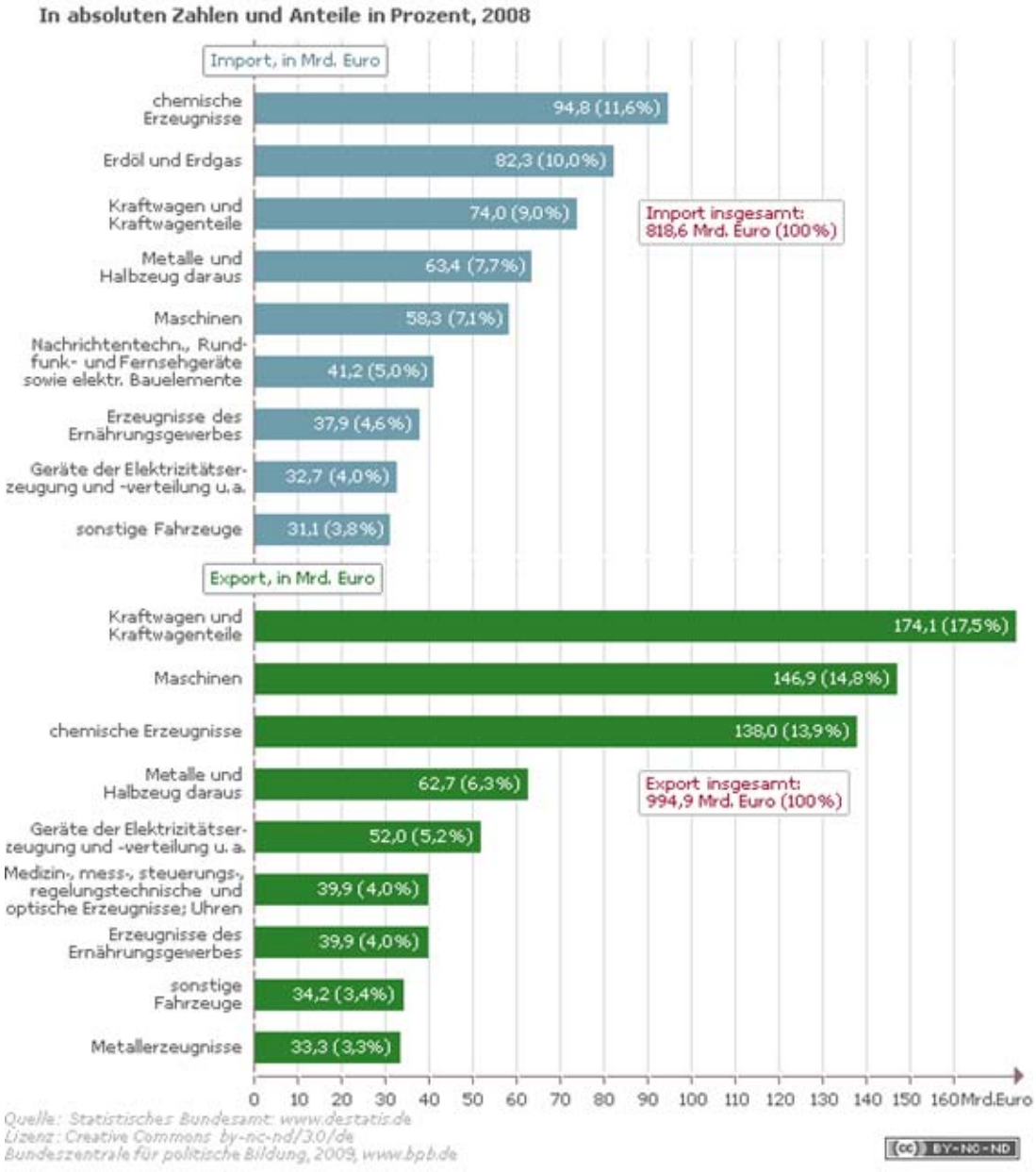


Figure 7 - Glossary

In absoluten Zahlen und Anteile in Prozent, 2008	In absolute figures and proportions in percentage
Import, in Mrd. Euro	Imports in billion euros
chemische Erzeugnisse	chemical products
Erdöl und Erdgas	oil and natural gas
Kraftwagen und Kraftwagenteile	motor vehicles and motor vehicle parts
Import insgesamt: 818,6 Mrd. Euro (100%)	Total imports: 818.6 bn euros (100%)
Metalle und Halbzeug daraus	metals and semi-finished products thereof
Maschinen	machines
Nachrichtentechn., Rundfunk- und Fernsehgeräte sowie elekr. Bauelemente	telecommunications equipment, radio and television sets and electronic components
Erzeugnisse des Ernährungsgewerbes	food-sector products
Geräte der Elektrizitätserzeugung und –verteilung u.a.	electricity generation and distribution equipment etc.
Sonstige Fahrzeuge	other vehicles
Export, in Mrd. Euro	Exports in billion euros
Kraftwagen und Kraftwagenteile	motor vehicles and motor vehicle parts
Maschinen	machines
chemische Erzeugnisse	chemical products
Metalle und Halbzeug daraus	metals and semi-finished products thereof
Export insgesamt: 994,0 Mrd. Euro (100%)	Total exports: 994.0 billion euros (100%)
Geräte der Elektrizitätserzeugung und –verteilung u.a.	electricity generation and distribution equipment etc.
Medizin-, mess-, steuerungs-, regelungstechnische und optische Erzeugnisse; Uhren	medical, measuring, control, regulation and optical products; clocks
Erzeugnisse des Ernährungsgewerbes	food sector products
Sonstige Fahrzeuge	other motor vehicles
Metallerzeugnisse	metal products
Mrd. Euro	billion euros
Quelle: Statistisches Bundesamt: www.destatis.de	Source: Federal Statistical Office: www.destatis.de
Lizenz: Creative Commons by-nc-nd/3.0/de Bundeszentrale für politische Bildung, 2009, 222.bpb.de	Licence: Creative Commons by-nc-nd/3.0/de Federal Agency for Civic Education, 2009, 222.bpb.de

Source: Federal Statistical Office

For this reason, the transmission channels of a price shock are as varied as the various possibilities for using oil and the options available for value chain differentiation. The German automobile industry may serve as an example: The costs for producing as well as

marketing and using motor vehicles would increase in such a way that it would become necessary for the sector to undergo a fundamental reorganisation process.[140]

Due to the increased dynamic force in adapting the economic structures that becomes necessary as a result, it is not possible to rule out considerable frictions on the labour market.[141] New economic sectors, jobs and market opportunities can indeed develop in the wake of post-fossil transformation. This economic upheaval could, however, initially result in significant transformation unemployment. It is regarded as a special form of structural unemployment that can evolve as a result of profound changes in transformation countries.[142] Most importantly, a devaluation of employees' human capital may occur because the change in structure causes thus far fully adequate qualifications to be replaced by other qualification requirements. Depending on its scope and duration, transformation unemployment could develop into a major economic problem.

Societies that are in the process of transformation can in part resort to the anchor function and orientation aid of countries and societies that have already completed the transformation process and from whose successes and failures consequences can be drawn for their own actions.[143] The intended transition towards a post-fossil society, however, confronts everyone with the same challenge because there are no best-practice models. Owing to the novelty of the situation there cannot be any such models yet.[144] In addition, there will be a whole series of differences between the transformation countries, e.g. as regards the existing economic structures, the energy policy efforts made so far to create more energy-efficient and post-fossil structures. Also of significance will be the willingness to undergo a reform, the respective economy-policy priorities, and the institutional capacities of the countries, including their form of government.

Loss of confidence amongst society

In such a case, the affected populations would be faced with two unfavourable developments. They would, on the one hand, experience a lowering of living standards due to a distinct increase in unemployment and mobility costs. Historical case studies reveal that only continuous improvement of individual living conditions provide the basis for tolerant and open societies.[145] Empirical studies for the OECD region also prove that setbacks in economic

140 For an illustrative example of a value chain, cf. David Korowicz, *Tipping Point. Near-Term Systemic Implications of a Peak in Global Oil Production. An Outline Review*, The Foundation for the Economics of Sustainability, March 2010, 20ff., http://www.feasta.org/documents/risk_resilience/Tipping_Point.pdf (accessed on 13 October 2010).

141 During the oil crisis in the mid-1970s, unemployment in West Germany increased fourfold although all actors were aware that this crisis was finite. The latter would not be the case in a crisis induced by peak oil.

142 More profound causes lie on the one hand on the consumer's side, e.g. as a result of collapsed labour markets, faulty supply conditions or even budget restrictions, and on the other hand on the supply side due to the employees lacking qualification, or adequate qualification.

143 The transformation economies of Central and Eastern Europe of the 1990s have oriented themselves greatly on West European models and in part received strong support from West European countries to build their institutions. During their transformation into post-fossil economies, some EU countries, including Germany, lead the way in partly differing areas. Such efforts can also be observed in China, for example.

144 Most importantly in the US, there are already programmes available on a local level that deal very seriously with the preparation for peak oil. Overall, there is a trend in some population groups towards "resilient communities". A very good example is a study carried out by the city of Bloomington (Indiana), http://bloomington.in.gov/media/media/application/pdf/6239.pdf (accessed on 13 October 2010).

145 Cf. Benjamin N. Friedman, "The Moral Consequences of Economic Growth", in *Society*, January/ February 2006, http://www.economics.harvard.edu/faculty/friedman/files/The%20Moral%20Consequences%20of%20Economic%20Growth.pdf (accessed on 13 October2010).

growth can lead to an increase in the number of votes for extremist and nationalistic parties.[146]

On the other hand, it cannot be ruled out that the people's confidence in state institutions as well as politics would be considerably shaken. This confidence is likely to dwindle even more in societies in which it is already weak – in particular if it is becoming obvious in crisis regions that governments have in the past failed to develop suitable solution strategies and provide orientation for society during this period of transition. This personalised loss of confidence, which can express itself, for example, in "dressing down" politicians, could – depending on intensity and duration – consolidate into a general and lasting crisis of confidence towards central national institutions and their ability to solve problems. A society, however, cannot survive without confidence.[147] Sullenness with politics can give rise to lethargy or fatalism and can increase the likelihood of growing political instability and extremism.[148] Via indirect legitimisation chains, this national loss of confidence could also have a negative impact on the legitimisation, functionality and actionability of supranational organisations and institutions as well.

146 Cf. Markus Brückner and Hans Peter Grüner, "The OECD's growth prospects and political extremism",in *VOX*, May 2010, http://www.voxeu.org/index.php?q=node/5047 (accessed on 14 October 2010).

147 Cf. Martin K. W. Schweer, "Politisches Vertrauen: Theoretische Ansätze und empirische Befunde", in Politische Vertrauenskrise in Deutschland: eine Bestandsaufnahme (Münster, 2000), 9-26 (here: 9ff.

148Empirical studies for Europe reveal that loss of confidence in state institutions is more likely to occur in countries with great income differences and a population that tends to belong to the left political spectrum. Cf. Christopher J. Anderson and Matthew M. Singer, "The Sensitive Left and the Impervious Right: Multilevel Models and the Politics of Inequality, Ideology, and Legitimacy in Europe", in *Comparative Political Studies* 41, January 2008, 564-599, http://cps.sagepub.com/cgi/reprint/41/4-5/564 (accessed on 14 October 2010).

3.2 The Systemic Risk of Exceeding the Tipping Point

One fundamental problem when it comes to deriving the security challenges posed by peak oil is the systemic nature of the risk of scarce resources or high resource prices in a complex economic environment. Peak oil can have dramatic consequences for the global economy. The transmission channels of an oil price shock involve diverse and interdependent economic structures and infrastructures, some of which are of vital importance. Its consequences are therefore not entirely predictable. Initially, it will be possible to measure the extent of these consequences, although not exclusively, by a reduced growth of the global economy. The scale of potential peak-oil-induced setbacks in economic growth can include what is referred to as a "tipping point", which determines whether or not an ex-ante analysis of peak oil effects remains possible or not.

The phenomenon of tipping points in complex systems has been known for a long time and is referred to as "bifurcation" in mathematics.[149] Tipping points are characterised by the fact that when they are reached, a system no longer responds to changes proportionally, but chaotically. Currently, reference is made to potential "tipping processes"[150] most notably in the field of climate research. At such a point, a minor change to one parameter – in the case of the climate, a change in temperature – would have a drastic effect on an ecosystem.[151]

At first glance, it seems obvious that a phase of slowly declining oil production quantities would lead to an equally slowly declining economic output. Peak oil would bring about a decline in global prosperity for a certain length of time, during which efforts could be made to develop technological solutions to replace oil. Economies, however, move within a narrow band of relative stability. Within this band, economic fluctuations and other shocks are possible, but the functional principles remain unchanged and provide for new equilibriums within the system. Outside this band, however, this system responds chaotically as well.

From the perspective of economics, at least one border of the band can be identified: an economic tipping point exists where, for example as a result of peak oil, the global economy shrinks for an undeterminable period. In this case a chain reaction that would destabilise the global economic system and cause a clear shift in the analytical framework for all other security consequences would be imaginable. The course of this potential scenario could be as follows:[152]

149 Bifurcation theory refers to the qualitative change of state in non-linear systems under the influence of a parameter μ. Cf. http://de.wikipedia.org/wiki/Bifurkation_(Mathematik) (accessed on 13 October 2010).

150 Cf. Hans Joachim Schellnhuber, "Tipping elements in the Earth System", in *PNAS*, Vol. 106, No. 49 (December 2009), http://www.pnas.org/content/106/49/20561.full.pdf+html (accessed on 13 October 2010).

151 The Gulf Stream would thus not become slower in proportion to global warming but would come to a complete and sudden halt. Similarly, the monsoon would stop at a certain point rather than just become less powerful.

152 Cf. David Korowicz, *Tipping Point. Near-Term Systemic Implications of a Peak in Global Oil Production. An Outline Review*, The Foundation for the Economics of Sustainability (March 2010), 30 ff., http://www.feasta.org/documents/risk_resilience/Tipping_Point.pdf (accessed on 13 October 2010).

The overall production of conventional and unconventional oil would decline.

1. Peak oil would occur and it would not be possible, at least in the foreseeable future[153], to entirely compensate for the decline in the production of conventional oil with unconventional oil or other energy and raw material sources. The expression "foreseeable" is very important in this context. Ultimately, it leads to a loss of confidence in markets.

<u>In the short term</u>, the global economy would respond proportionally to the decline in oil supply.[154]

1. Increasing oil prices would reduce consumption and economic output. This would lead to recessions.

2. The increase in transportation costs would cause the prices of all traded goods to rise.[155] Trade volumes would decrease. For some actors, this would only mean losing sources of income, whereas others would no longer be able to afford essential food products.

3. National budgets would be under extreme pressure. Expenditure for securing food supplies (increasing food import costs) or social spending (increasing unemployment rate) would compete with the necessary investments in oil substitutes and green tech. Revenues would decrease considerably as a result of recession and necessary tax reductions.

153 Cf. Robert L. Hirsch, Roger Bezdek and Robert Wendling, *Peaking of World Oil Production: Impacts, Mitigation, & Risk Management* (February 2005), 57 ff., http://www.netl.doe.gov/publications/others/pdf/oil_peaking_netl.pdf (accessed on 11 October 2010). This study assumes that the economy would take approximately 20 years to adapt to the conditions of a post-peak-oil world. Sufficient investments 20 years before that peak occurs could prevent negative consequences. If the first investments coincide with the peak, the ensuing transition phase would also take 20 years. It is thus implicitly assumed in this context that the respective investment environment for switching to green tech is generally comparable in both cases. In the light of the systemic considerations described here, this assumption should be regarded as a highly disputable simplification. At any rate, however, it shows that the transformation period would be very long, which means that the uncertainty presumed here seems plausible.

154 Cf. *Ibid.*, 24 ff.

155 For ways of substituting oil-based fuels, cf. Chapter 3.1.3.

<u>In the medium term</u>, the global economic system and all market-oriented economies would collapse.

1. Economic entities would realise the prolonged contraction and would have to act on the assumption that the global economy would continue to shrink for a long time.[156]

2. **Tipping point:** In an economy shrinking over an indefinite period, savings would not be invested because companies would not be making any profit.[157] For an indefinite period, companies would no longer be in a position to pay borrowing costs or to distribute profits to investors. The banking system, stock exchanges and financial markets could collapse altogether.[158]

3. Financial markets are the backbone of global economy and an integral component of modern societies. All other subsystems have developed hand in hand with the economic system. A disintegration can therefore not be analysed based on today's system. A completely new system state would materialise.

   Nevertheless, for illustration purposes here is an outline of some theoretically plausible consequences:

   - **Banks left with no commercial basis.** Banks would not be able to pay interest on deposits as they would not be able to find creditworthy companies, institutions or individuals. As a result, they would lose the basis for their business.

   - **Loss of confidence in currencies.** Belief in the value-preserving function of money would dwindle. This would initially result in hyperinflation and black markets, followed by a barter economy at the local level.

   - **Collapse of value chains.** The division of labour and its processes are based on the possibility of trade in intermediate products. It would be extremely difficult to conclude the necessary transactions lacking a monetary system.

   - **Collapse of unpegged currency systems.** If currencies lose their value in their country of origin, they can no longer be exchanged for foreign currencies. International value-added chains would collapse as well.

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156 Although society has great confidence in the market economy system and has little understanding for complex relations, and although the assumption of rational economic systems is debatable, we can presume that as of a certain point during this global recession, all insecurity will give way to the realisation that a critical point has been crossed.

It is not possible to predict exactly how this realisation process will occur. A potential scenario is that initially, massive fluctuations of cash flow will clearly expose the "real economy" consequences of a financial crash, causing panic to break out amongst investors. Resorting to raw materials will neither be possible nor sensible for everyone. Huge quantities of assets will be destroyed. The lack of logical alternative ways out of this situation may then result in the consequences described above.

157 In theory, there are industries that could profit from the situation. The oil industry or companies in the green-tech sector would certainly have an increasing demand for capital. Given the companies' environment, in particular the dependence of these industries on (international) value chains and infrastructures, as well as the dramatically changing conditions on the demand side, it would be implausible to expect "islands of stability" which continue to exist on a "micro level".

158 The term "financial markets" encompasses all markets on which capital is traded. In addition to the capital and credit market, this includes the exchange market and the money market.

- **Mass unemployment.** Modern societies are organised on a division-of-labour basis and have become increasingly differentiated in the course of their histories. Many professions are solely concerned with managing this high level of complexity and no longer have anything to do with the immediate production of consumer goods. The reduction in the complexity of economies that is implied here would result in a dramatic increase in unemployment in all modern societies.

- **National bankruptcies.** In the situation described, state revenues would evaporate. (New) debt options would be very limited, and the next step would be national bankruptcies.

- **Collapse of critical infrastructures.** Neither material nor financial resources would suffice to maintain existing infrastructures. Infrastructure interdependences, both internal and external with regard to other subsystems, would worsen the situation.

- **Famines.** Ultimately, production and distribution of food in sufficient quantities would become challenging.

The developments shown here make it clear that it is essential to secure the supply of energy to the economic cycle in sufficient quantities to enable positive economic growth. A contraction in economic activity over an indefinite period of time represents a highly unstable state that will cause the system to collapse. It is hardly possible to estimate the security risks that such a development would involve.

An oil supply conversion will not be possible to an equal extent in all world regions before peak oil occurs. It is likely that a large number of countries will not be able to make the necessary investments in good time and to the required extent.

Germany is one of the most globalised countries worldwide.[159] The resulting complexity of our society excellently facilitates adaption to our modern-day environment.

In view of their degree of globalisation, all industrialised countries – including Germany – face a high systemic risk, regardless of their individual energy policies.

There is a potential "risk of infection" between different subsystems that use the same infrastructures. One example is the spread of recession from one country to another. To know the transmission channels of an oil price shock as well as their interdependences is thus decisive for effective and timely government action. Complex structures must be sustained with energy (in the broadest sense of the term). In complex systems, an energy withdrawal will not necessarily lead to a proportional reduction in complexity alone but, in extreme

159 Cf. *KOF Index of Globalization*, http://globalization.kof.ethz.ch/ (accessed on 13 October 2010).

cases, to a collapse. The danger of such a loss of energy must be minimised. Against this backdrop, one possible option would be to revaluate the status of energy policy, above all in relation to environmental and climate objectives or mere economic efficiency considerations.[160] In complex systems, a systemic risk leads to unpredictable consequences. This unavoidable structural uncertainty places high demands on security policy action in the sense of preparation for challenges that cannot yet be identified today.

Germany's actionability depends on functioning infrastructures. A targeted preparation for unknown challenges is difficult but not entirely impossible. From a systemic perspective, there are approaches from various scientific areas that can to a certain extent be transferred to security policy. First of all, one option is to analyse the dependences of vital infrastructures and subsystems on the economic system and the oil market. More knowledge about and a selective reduction of these dependences in order to stabilise individual, particularly important subsystems can maintain the ability to act. Establishing platform-independent communication systems with a low level of integration can, for example, be an important control system in cases of crisis. Another suitable tool is the creation of redundancies. Very frequently, centralisation for reasons of efficiency comes at the expense of system stability. There is no doubt, for example, that one large power plant can work more efficiently than several small power plants. If it fails, however, there is no network that can replace it. A strengthening of society's self-organisation capabilities and opportunities on a local level is thus a possibility, comparable to the concept of voluntary fire brigades.

The transgressing of a tipping point and the resulting extensive systemic crisis is a special case among potential oil-related conflict constellations. The following Chapter (3.3) describes how peak oil could affect the conflict constellations detailed in Chapter 2.2.

160 Nel and Cooper come to a similar conclusion: "Our analysis proposes that the extent of global warming may be acceptable and preferable compared to the socio-economic consequences of not exploiting fossil fuel reserves to their full technical potential." Cf. Willem P. Nel and Christopher J. Cooper, "Implications of fossil fuel constraints on economic growth and global warming", in *Energy Policy 37 (1)* (January 2009), 166–180, here 166: Ugo Bardi also offers an overview of scientific debate about the role of fossil resources in climate change: "Fire or Ice? The Role of Peak Fossil Fuels in Climate Change Scenarios", *The Oil Drum: Europe* (March 2009), http://www.theoildrum.com/pdf/theoildrum_5084.pdf (accessed on 13 October 2010).

3.3 Oil-related Conflict Constellations

The oil-related conflict constellations described in Chapter 2.2 manifest themselves in different ways in the cause-effect relations described in Chapters 3.1.1 to 3.1.4. Since a detailed analysis of how exactly each conflict constellation will develop under peak oil conditions is impossible, these cause-effect relations only permit some basic statements. If oil is assumed to be the main – if not the only – conflict-generating factor in these constellations, the effects of this factor will of course intensify under peak oil conditions. This does not mean, however, that the conflicts related to it will automatically intensify as well. How constellations will develop also depends on other context factors and their interactions. All in all, it must be expected that the presented conflict constellations – (1) between oil importers and exporters, (2) between importers, (3) between exporters and (4) in exporting countries – will initially be subjected to a different dynamic by peak oil (A). In addition, factors within these constellations could fundamentally change (B). The relations among and the significance of actors within these conflict constellations could also change considerably (C). Finally, new conflict constellations could arise (D).

(A) Changed conflict dynamics

It can be assumed that conflicts already existing today within exporting countries could intensify under peak oil conditions particularly if factors such as the problem-solving capacity or the stability of the country in question are stagnant or declining. This includes socio-economic issues regarding the distribution of raw material income.[161] New conflicts could arise likewise from these constellations, quite possibly in precisely those countries that are already proving somewhat fragile and in which oil reserves have only recently started to be developed to a significant extent. Much the same applies to conflict constellations between exporting countries, which could intensify if other factors such as fragile statehood or unsolved territorial disputes come into play. In this context, increasing exploration of unconventional resources, for example in the maritime environment, could also play a role (Chapter 3.1.3).

Conflict constellations between oil importers and exporters and between oil importers would change in that the gap between supply and demand would increase if the oil demand of importing countries – including threshold countries developing on the basis of oil – were to remain constant or to increase and, at the same time, the ability of exporting countries to supply were to decline. In addition, following a regional peak oil, countries on the supply side would drop out as exporters and change over to the net importer side, while niche suppliers, exploring deposits that were unprofitable before, could become exporters with low supply capacities. The largest concentration of reserves, however, would still be in the Strategic Ellipse. With this new constellation of actors, there would thus be intensified competition for dwindling and unevenly distributed resources.

161 Cf. Matthias Basedau, "Erdölkriege – Kriege der Zukunft?", *GIGA Focus Global*, No. 6 (Hamburg 2007), 5, http://www.giga-hamburg.de/dl/download.php?d=/content/publikationen/pdf/gf_global_0706.pdf (accessed on 11 October 2010).

Conflicts can arise when the global market becomes malfunctional or prices are rising so high (cf. Chapter 3.1.1) that some importing countries can no longer afford fossil resources. In this case, the shortage could no longer be seen only as a global economic problem of distribution, but could be defined as a national security issue. Such a politicisation (or "securitisation"[162]) acts like a catalyst for the conflict potential of scarce resources.[163] With peak oil approaching, it is likely that the securitisation of access to and secure supply with strategic resources (cf. Chapter 2.1), which can already be observed today, will increase. This may also encompass an increased risk of conflict or a manifestation of conflicts that have thus far been latent.

As a general principle, resources are regarded as "divisible" conflict subjects, in contrast to conflicts of identity or values, which are indivisible conflict subjects based on ideology or ethnic-religious disputes. If these subjects of conflict meet, however, a new dynamic can be assumed for all the conflict constellations described. This new dynamic would have consequences for the finding of solutions such as amicable distribution mechanisms (cf. Chapter 3.1.1).[164]

Peace and conflict researchers point out that competition for scarce resources could also provide a promising starting point for de-escalating conflicts and that scarce resources could also create cooperation potential.[165] Given the above-mentioned basic divisibility of the subject of conflict, an amicable agreement on a fair distribution mechanism for scarce resources could give rise to cooperation and conflict solutions, which, at best, could even have spillover effects on indivisible conflict subjects.[166] Conditions under which cooperative patterns in the area of resources may have positive effects on an entire conflict dynamic as well as conditions under which the overall conflict dynamics complicate or even prevent an agreement would have to be clarified specifically for each conflict situation.

Targeted monitoring of these factors and subjects of conflict and their interplay would provide indications as to where during the period of examination potential peak-oil-induced conflict hotspots could arise. This could also contribute towards early detection. In addition to the essential divisibility of fossil resources, which can have a conflict-preventing effect in the presence of functioning distribution mechanisms that are experienced as being fair, the substitution of resources and the resulting reduced dependence on oil could also prevent conflicts.

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162 Cf. Barry Buzan, Ole Waever and Jaap de Wilde, *Security. A New Framework for Analysis* (Boulder 1998).

163 Cf. Solveig Richter and Jörn Richert, "Kooperation oder Eskalation? Warum Rohstoffknappheit nicht zwangsläufig zu Konflikten führt", in *Internationale Politik* (November/December 2009), 10-16, here 13 ff., http://www.internationalepolitik.de/ip/archiv/jahrgang-2009/earth--wind---fire/download/1dec21cc7b552a8c21c11dea75b65d7b87564156415/original_11_richter_richert.pdf (accessed on 13 October 2010).

164 Cf. Solveig Richter and Jörn Richert, "Kooperation oder Eskalation? Warum Rohstoffknappheit nicht zwangsläufig zu Konflikten führt", in *Internationale Politik* (November/December 2009), 10-16, here 15, http://www.internationalepolitik.de/ip/archiv/jahrgang-2009/earth--wind---fire/download/1dec21cc7b552a8c21c11dea75b65d7b87564156415/original_11_richter_richert.pdf (accessed on 13 October 2010).

165 The addition of new and significant importing countries such as the large threshold countries will not necessarily lead to conflicts either. Cf. Chapter 4.5. and Maximilian Mayer, "Warum Chinas 'Energiehunger' nicht zum 'Krieg um Ressourcen' führt", in *China aktuell* No. 1 (2007), 57-75.

166 Richter and Richert refer to the Middle East in this context, where an agreement on the division of water could also give new incentive to peace negotiations. Cf. Solveig Richter and Jörn Richert, "Kooperation oder Eskalation? Warum Rohstoffknappheit nicht zwangsläufig zu Konflikten führt", in *Internationale Politik* (November/December 2009), 10-16, here 15f., http://www.internationalepolitik.de/ip/archiv/jahrgang-2009/earth--wind---fire/download/1dec21cc7b552a8c21c11dea75b65d7b87564156415/original_11_richter_richert.pdf (accessed on 13 October 2010).

(B) New conflict factors as a result of substitution

Owing to new or changed factors – in particular efforts to substitute oil – the described conflict constellations could shift and thus expand their complexity. Oil as a conflict factor could be replaced in different constellations, for example by the possible factors natural gas and nuclear energy as early as within the next decades, or, in the long run, by renewable energies or resources for renewable energies (cf. Chapter 3.1.3). Since future natural gas deposits will be largely congruent with the Strategic Ellipse, most current oil producer countries would be relevant for natural gas. Specific differences in the transportability and usability of gas resources imply, however – as described in Chapter 3.1.3 – different consequences or cause-effect relations in some cases, for example with regard to the stability of supply relationships. Nuclear energy could factor in all four of the conflict constellations above, not so much regarding nuclear fuel or the energy produced, but rather regarding associated technologies or their risks such as the abuse of nuclear material.

Renewable energies are hardly ever associated with the terms "resource conflict" or "conflict resource", owing to their decentralised character and local availability, their environmentally friendly and sustainable nature. They are generally not finite, which means they can be exploited over and over again and in this regard are also "divisible", combine ecological and economic advantages under favourable conditions, and open up opportunities for economic and social development. Nevertheless, they – or rather their efficient usage – are often not distributed equally on the global or regional level. In this context – albeit in a different manner – importers and exporters could thus evolve, and, along the constellations as described above for oil, competition between them or even conflicts within exporting countries could develop. The production of bioenergy in particular is often associated today with conflicts in the relevant exporting countries. Likewise, intensified conflicts between importing countries could develop, for example when the exploration of or direct access to cultivation areas is at stake.[167] Regarding the creation of wide-ranging joint projects to harvest solar energy, there are possible points of reference with all four conflict constellations, even though the intention of such projects is often a combination of energy security for importing countries with development chances for exporting countries. For critical infrastructure relevant in connection with substitutes it would be possible to draw conclusions similar to the ones for oil-critical infrastructures, albeit of a slightly different nature (cf. Chapter 3.1.3).

(C) New player relations in conflict constellations

The potentially shifting relationship between state and non-state actors under peak oil conditions (cf. Chapter 3.1.2) could also change those conflict constellations that have so far mainly applied to state actors. The spectrum ranges from relations between state institutions and large energy companies to the actions of non-state, commercial actors in fragile statehood environments. New conflict lines could thus also emerge within these

167 Cf. Solveig Richter and Jörn Richert, "Kooperation oder Eskalation? Warum Rohstoffknappheit nicht zwangsläufig zu Konflikten führt", in *Internationale Politik* (November/December 2009), 10-16, here 10, http://www.internationalepolitik.de/ip/archiv/jahrgang-2009/earth--wind---fire/download/1dec21cc7b552a8c21c11dea75b65d7b87564156415/original_11_richter_richert.pdf (accessed on 13 October 2010).

constellations, which would be visible, for example, along the different and partly extremely divergent agendas, characters, organisational cultures, time horizons, means and objectives of state, non-state and sub-state actors.

(D) Possible new conflict constellations

In addition to a change in conflict factors and players within the constellations described above, the spectrum could also expand to include new conflict constellations under peak oil conditions. These would primarily be conflicts in importing countries, which may have to deal with a difficult process of transformation into a post-fossil society and economy, and in which this change could lead to considerable social challenges and shifts, as described in Chapter 3.1.4. In the worst case, even systemic crises in the form of tipping points as described in Chapter 3.2. could arise. These crises are likely to emanate from highly industrialised importing countries and, as a result of their global effects, to create a fundamentally new conflict constellation involving only rudimentarily analysable security policy implications.

And so, while the conflict constellations frequently discussed in connection with oil will not inevitably intensify under peak oil conditions, they will change in terms of conflict-generating factors, interaction, actors and conflict dynamics, and possibly expand to include new constellations and complexities. This may make their containment, if need be, more difficult. From the possibly changing conflict factors, players and lines, however, potential for cooperation and conflict solution may arise as well. New integration dynamics could be created, for example, if closer institutional and economic cooperation became necessary for the functioning of increasingly volatile energy markets beneficial to all market players. Although the transition towards post-fossil societies can, as described in Chapter 3.1.3 and Section (B), involve conflict potential, an acceleration of the transition to renewable energies and raw materials could nevertheless also promote cooperative approaches, for example as part of technology exchange and transfer activities, particularly under integration of non-state actors such as global companies that could considerably push forward such a process. As a result, a virtually globally supported and, to a certain extent, considerably accelerated transition towards renewable energies could be associated with “win-win” situations combining economic, social and ecological interests and which would be nourished by the involvement of many and, most importantly, cooperating players. In this context, greater involvement on the part of non-state actors might not only considerably increase the complexity but also the dynamics of relevant constellations – both in conflictive and in cooperative direction.

4. Security Policy Implications

4.1 Germany's Supply Relationships and Possible Dependences

Under peak oil conditions, oil could become a primary instrument of power projection and a determining factor of new dependences in international relations. Natural gas could perpetuate the security challenges of peak oil and thus become a second political currency. Natural gas supply relationships may therefore gain political importance.

Implications for Germany: Generally speaking, strong ties with individual countries would have to be avoided in order for Germany to cope with peak oil and, if necessary, with the loss of some of the oil supplies. It is thus sensible to diversify oil supplies as widely as possible. Both intentional and capacity-related failures to deliver by exporting countries are possible. Attempts should therefore be made to avoid at least politically motivated delivery failures by maintaining long-term delivery agreements and establishing resilient and reliable partnerships even across ideological divides.

Germany imports approximately 80% of its oil from six countries, with Russia (35%), Norway (14%) and the UK (11%) being the biggest suppliers. The remaining share is imported from Libya, Kazakhstan and Azerbaijan. At 6%, the Middle East has so far only been a niche supplier. A certain degree of diversification has thus already been achieved. It is almost impossible to determine the maximum allowable percentage of oil imports from one single country necessary to avoid a politically exploitable dependence. Failures to deliver by the three largest suppliers, however, could not be easily dealt with in the short term.

Owing to the close economic and political ties with these countries, Norway and the UK can be considered particularly reliable suppliers. It is assumed that both countries have already passed their national peak oil. However, according to assessments by the Federal Institute for Geosciences and Natural Resources, both may be able to continue producing the same annual amount of oil as in 2008 for more than another 25 years.[168] By that time at the latest, the German demand for oil would have to be lower or covered otherwise. The German demand for oil has been dropping for a few years and will likely continue to do so; however, this will hardly be enough to make up for the running dry of European production in the long term. If and under what conditions a "political peaking" may occur in the context of peak oil is impossible to predict. It can, however, be assumed that Germany's close cooperation with these two countries would be conducive to finding a consensual solution to such a challenge.

Should this happen, Russia, with its already considerable supply quantities could become the focus of attention. Although, in general, Russia's vast reserves could make up for the failure of other suppliers to deliver oil to Germany, a further increase in Russian deliveries may tip the existing relationship – which is currently emphasised as being largely mutual – in favour of Russia and put a strain on the relationship with other customers along the pipeline.

168 Cf. Bundesanstalt für Geowissenschaften und Rohstoffe (BGR), *Reserven, Ressourcen und Verfügbarkeit von Energierohstoffen* (Hanover 2009), 35 ff., http://www.bgr.bund.de/nn_324956/DE/Themen/Energie/Downloads/Energiestudie-Kurzf-2009,templateId=raw,property=publicationFile.pdf/Energiestudie-Kurzf-2009.pdf (accessed on 11 October 2010)

Germany could achieve further diversification with potential suppliers Tunisia, the Republic of the Congo, Equatorial Guinea, Turkmenistan, Uzbekistan and Sudan, since these countries still possess considerable resources. The Arabian peninsula, however, stands out as the largest potential supply area by far. The countries in what is referred to as the Strategic Ellipse would thus play a special role for oil, but also gas supply in the future.

The expected partial substitution and perpetuation of oil by gas will increase the importance of relevant supplier and transit countries. Despite the expected extension of liquefied natural gas (LNG) capacities, the mainly pipeline-based supply of natural gas causes more mutual dependences than oil. A substantial change in deliveries at short notice would thus not be easy and it can be assumed that one side will prioritise reliable supplies while the other will seek constant revenues. As a consequence, while there would be dependences, these could only to a limited extent be exploited for one-sided political conditioning owing to their reciprocity.

Current gas suppliers to Germany include almost half of its European neighbours and Russia (37% of imports). The EU partners among these are considered particularly reliable suppliers, which ensures a comfortable basic supply for Germany and does not constitute a critical dependence within the EU's tight-knit political and economic network.

The constant and fair cooperation necessary to ensure reliable deliveries of oil from Russia would also be beneficial for securing Russian gas supplies. In View of the resources of one of Germany's most important suppliers dwindling (the Netherlands with 17% of German imports), the countries of Northern Africa, the Middle East and Central Asia must nevertheless be considered as potential future gas suppliers.[169]

Owing to the large share of European suppliers, Germany's oil and gas supply has so far been based on a reliable foundation. In the long term, however, reorganisation in order to substitute declining European production as well as partnerships with non-European countries are needed. For this, the relationship with Russia is above all essential for Germany's oil and gas supply alignment. Furthermore, it must be determined to what extent energy partnerships can be established and supply relationships can be developed and consolidated with countries of the Caspian region, the Middle East and Northern Africa.[170]

169 In particular, gas-rich countries such as Iran, Qatar and Iraq in the Middle East, Algeria, Libya and Egypt in Northern Africa, Kazakhstan, Turkmenistan and Azerbaijan in the Caspian Region, as well as Nigeria qualify. Cf. *Ibid.*, 230f.

170 See the following chapter (Chapter 4.2).

Further issues / need for research:

1. How can - also regarding the EU context - a greater diversification of oil and gas imports be achieved in future? Which countries and regions will this involve in particular and what would be the effects on relationships with other importers?
2. Where do Germany's interests lie when it comes to security policy, and what actual role does the securing of resources play in this context – beyond the fairly generally phrased interests in documents like the German White Paper?
3. How must energy relationships be shaped in order to avoid one-sided dependences and a possible political exploitation?

4.2 Shaping Supply Relationships with Countries of the Strategic Ellipse

Since the remaining conventional oil reserves are concentrated predominantly within the Strategic Ellipse, a diversification involving sources outside of this region is difficult to achieve. Thus, (1) a revaluation of the oil-producing countries in these regions is likely, as well as (2) increased interference from external powers trying to secure their interests and resources in these regions. It cannot be ruled out, on the other hand, that oil-producing countries may exploit their position of power for (security) political purposes to the point where alliances are forming along ideological lines of conflict and may take a more aggressive approach to achieving their objectives.

Implications for Germany: In view of the dominant role these countries play in German imports, stable and reliable supply relationships with the "northern dimension" of the Strategic Ellipse, in particular with Russia, will continue to play a central role in shaping German energy relations.

For Germany, this involves a balancing act between stable and privileged relations with Russia on the one hand and the sensitivities of its eastern neighbours on the other hand. The enormous test of endurance for intra-European cohesion that this balancing act can entail is illustrated by the conflicts surrounding the construction of the Nord Stream, Nabucco and South Stream gas pipelines. Gaining Moscow as a partner while achieving close energy interdependence and considering an even tighter integration may prove to be decisive for the future of German and European supply security. In this context, it may be necessary to consider whether and how the European and Transatlantic security architectures could be adapted accordingly. A common European strategy towards this neighbour and its claim to superpower status as well as a concerted external energy policy could reduce the danger of Russia exploiting energy deliveries for power politics and of a corresponding intra-European potential for political division.

In principle, it can be expected that actionable alliances allowing for joint performance, thus impeding the exploitation of individual countries, will partially mitigate the weakening of Western industrialised nations presumably caused by their dependence on imports. For Germany, a self-determined, advantageous bilateral energy partnership with Russia may be an alternative to such a collective strategy. This could, however, contribute to a division of Europe, at least in terms of energy policy. In spite of some occasional tension, Germany has so far managed to combine both approaches of consolidating existing bilateral energy relations with Russia and strengthening European cohesion in difficult times. Among other things, this can be attributed to the complexity of the European multi-level system, that is, its numerous players as well as different levels and channels of relationships to third players. As long as the systemic complexity allowing these approaches' coexistence persists, a prioritisation of the approaches is unlikely, even when peak oil hits.

Given Russia's significance for German and European supply security, maintaining reliable relations with Moscow is a central task for German and European politics. Even today, it is Germany's strategy to attempt to reduce one-sided dependences by promoting

interdependences at company level. In a European context, there are two obstacles to be overcome before a similar course of action can be taken. Firstly, there is a large implementation problem at the EU level regarding a common EU energy policy, which has so far prevented the comprehensive implementation of otherwise well-thought-out concepts. Secondly, Russia installs partly or entirely state-owned companies in strategic key positions on the EU energy market by applying existing industrial policy provisions.

Unless mutual and thus stable dependences can successfully be formed, the danger of political exploitation by focusing on a few main suppliers and Russia in particular will fundamentally increase. In addition, Russia requires a considerable and growing proportion of the fuels it produces for its own population and its energy-intensive industries. Germany's interests in energy supplies from Central Asia as well as from the Middle East and North Africa (MENA) could therefore further increase. This applies to oil as well as to natural gas and in the case of the MENA countries also to renewable energies, in particular solar power.

Because of its geostrategic location and fossil resources, the Caspian Region draws the interest of different powers such as Russia, China and the United States, but also regional players like Turkey, India and Iran. The EU, in turn, is increasingly making an effort to develop closer relations with countries in this region. Kazakhstan is the country with the largest oil resources in Central Asia, and the development of the large Kashagan offshore oil field[171] could lead to a further increase in oil production and export quantities. Today, around 11% of German oil imports come from Kazakhstan and Azerbaijan. Germany could be interested in expanding supply relations with these countries, but would find itself faced with the involvement of large investors such as Russia and China.

Russia still considers itself a major regulatory power and uses its monopoly over the regional pipeline infrastructure to exert considerable influence on the countries in this region. China's involvement in the region is growing. In the first half of 2010, about 5 million tons of oil were delivered from Kazakhstan to China, which represents an increase in supply quantity of 50% compared to the same period in the previous year. The Kazakhstan-China oil pipeline, which was brought into operation in 2006, is the first pipeline between China and a foreign country. It was followed by the opening of the ambitious pipeline project between Russia and China in October 2010. For China and Russia, the Shanghai Cooperation Organisation already constitutes a discussion platform for the Central Asian region. However, the Central Asian countries are trying to avoid a one-sided external domination of the region as exercised – albeit decreasingly so – by Russia. The Georgian crisis has contributed to further damaging Russia's reputation in the region and has increased the efforts of Central Asian countries to cooperate with other players such as China and the EU. At present, China seems to be the preferred partner, since it is investing large sums in the energy sector without demanding political reforms, as the EU does. In contrast, Russia lacks economic resources and a long-

171 In addition to Kashagan, the Tengiz and Kamchagarak oil fields are also promising. While oil has been produced at Tengiz and Kamchagarak for several years, the start of extraction at Kashagan has been postponed to 2012. There are numerous problems regarding the development of the oil fields, primarily the particularly high content of sulphur in the oil, severe environmental contamination, difficult extraction conditions and correspondingly high costs. For these reasons, the British oil corporation BP, among others, has pulled out of the development consortium. Cf. Jörg Schindler and Werner Zittel, *Zukunft der weltweiten Erdölversorgung* (Berlin 2008), 64 f., http://www.energywatchgroup.org/fileadmin/global/pdf/2008-05-21_EWG_Erdoelstudie_D.pdf (accessed on 11 October 2010).

term strategy for the development of the region, which could have an advantageous effect on the growing influence of China and possibly of the EU. To achieve this, the Central Asia strategy, which was established in 2007 during Germany's EU Presidency and which has not been very successful so far, and the Eastern Partnership would have to be translated into specific initiatives with interesting incentives for the countries in this region, and investments in these countries would have to be intensified, in particular in the field of developing fossil resources. A lack of willingness to invest as well as demands for political reforms and for a human rights dialogue, which collide with the interests of current local political decision-makers who aim at maintaining the status quo, have so far severely restricted the effectiveness of the EU's regional involvement.[172]

At present, deliveries from the politically unstable Middle East only play a secondary role in Germany's total oil imports. This could, however, change with peak oil, declining production rates in other supplier countries (in particular the European ones) and the resulting pressure to compensate. The realisation that this region is becoming increasingly important for Germany in terms of energy policy has so far not been translated successfully into an appropriately active and target-oriented policy.[173] Yet, actively shaping (energy) relations with Middle East countries would have its sensitive aspects. Germany's involvement in this region is characterised by its special relationship with Israel, which has historical reasons and first of all represents a normative constant of German foreign policy. With peak oil, a new dynamic could develop in the relation between interest-based and value-based foreign policy (cf. Chapter 4.3). While the relationships with Arab countries on the one hand and Israel on the other hand are not a zero-sum game, intensifying relations with oil-producing countries like Iran and Saudi Arabia, which possess the largest conventional oil reserves in the region, for purposes of energy security could turn out to be a special challenge for German Middle East policy. The integration of Middle East policy into a European framework provides Germany with political leeway that it would not be able to create on its own or at least not without considerable political costs.

However, closer energy relationships with countries of the Middle East, in particular with countries in the Persian Gulf region, are by no means determined by German or European action options alone. Similar to the situation in Central Asia, these relations must be established in an environment that is increasingly influenced by the regional involvement of other countries such as China, Russia and India, which shape their partnerships with the region's countries mostly without demanding ethical values or political conditions and which are thus preferred as partners.[174] The intentions and interests of the increasingly influential oil-producing countries must also be taken into consideration. The largely unknown political

172 Cf. Stefan Meister, *Zentralasien – Eine Region von strategischer Bedeutung zwischen Russland, China und der Europäischen Region, Analyse* (12 February 2010), http://aussenpolitik.net/themen/eurasien/zentralasien/zentralasien-eine_region_von_strategischer_bedeutung_zwischen_russland-china_und_der_europaischen_union/ (accessed on 14 October 2010).

173 Cf. Guido Steinberg, *Deutsche Nah-, Mittelost- und Nordafrikapolitik. Interessen, Strategien, Handlungsoptionen, SWP-Studie* (15 May 2009), http://www.swp-berlin.org/common/get_document.php?asset_id=5977 (accessed on 14 October 2010).

174 Cf. Jochen Steinhilber, "Öl für China: Pekings Strategien der Energiesicherung in Nahost und Nordafrika", *Internationale Politik und Gesellschaft (IPG)* 4 (2006), http://library.fes.de/pdf-files/id/ipg/03933.pdf (accessed on 14 October 2010); Cf. Thorsten Wojczewski und Melanie Hanif, „Indiens neue Energiepolitik und ihre geostrategische Bedeutung", *GIGA Focus Asien*, No. 9 (Hamburg 2007), http://www.giga-hamburg.de/dl/download.php?d=/content/publikationen/pdf/gf_asien_0809.pdf (accessed on 13 October 2010).

future of many countries in this region represents a particular challenge. The democratisation of the regimes of some countries such as Egypt, which Western players generally consider worth supporting in the long term, could in the medium term not only lead to at first increased instability in the region, but also to a government takeover by increasingly fundamentalist powers, thus posing a special challenge for international cooperation.

Ideological differences, for example regarding the importance of religion, state, nation and country as well as the use of violence as a political instrument complicate the development of stable and trusted international relations. Peak oil is expected to lead to an increase in importance and formative power of the predominantly Islamic producer countries of the region, thus potentially enabling them to exploit their supply relationships along ideological lines of conflict. This is not to explicitly suggest the controversial idea of a potential "clash of cultures", fought by means of energy resources. However, instances of exploitation of energy relations triggered by political events such as the controversy surrounding Danish caricatures of the prophet Muhammad are indeed conceivable.[175]

Furthermore, the wealth accumulated through oil production in the Gulf States could potentially exacerbate ideological and political differences between Western, liberal-democratic industrial nations on the one side and Islamic states on the other. Various studies on the phenomenon of rentier states as well as Thomas Friedman's "First Law of Petropolitics" point out that oil prices, respectively a country's oil riches and the resulting wealth of oil-producing countries potentially correlate to slow or non-existing democratic development.[176] Based on this assumption, it could be concluded that peak oil promotes the undermining of democratic developments, which in turn could greatly invalidate the efforts of Germany and the European Union for democratisation in producer countries. In light of the demographic intermingling of Germany and Europe with Islamic countries, an increasing aggravation of ideological lines of conflict would also add to conflict potential within society, thus underlining the necessity for dialogue and the establishment of resilient partnerships.

Against this backdrop, the need for Western actors to gain a nuanced overview of the political and social structures of countries in these regions and to identify and support those powers that peacefully advocate change in their countries arises.[177] The above already points to the conflict between self-interest and ethical values in foreign policy, which will be discussed further in Chapter 4.3.

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175 In September 2005, controversy surrounding these caricatures led to violent protests and calls for boycott in parts of the Arab world. Iran severed all trade ties with Denmark. Especially in a case like this, but also in the context of increasingly selective supply relations in general, it is questionable whether liberal democratic industrial nations such as Germany would be among the favoured recipient countries. While intercultural dialogue should not be a means to an end but the end itself, this example nevertheless underlines the urgent necessity for dialogue between the "West" and the Islamic world.

176 Cf. Michael Lewin Ross, "Does Oil hinder Democracy?", *World Politics*, Vol. 53, No. 3 (April 2001), 325–361; Thomas L. Friedman, "The First Law of Petropolitics", *Foreign Policy*, Vol. 154 (May/June 2006), 28-39.

177 Volker Perthes of the German Institute for International and Security Affairs (SWP) points out that this includes accepting that civil society is not made up only of players that engage in secular discourse, but also of conservative Islamic powers. According to Perthes, without the national moderate powers of Islam, there can be no lasting political reform in the Arab world. Cf. Volker Perthes, "Perspektiven auf den radikalen Islamismus. Generationen des Zorns", *Qantara* (September 2008), http://de.qantara.de/webcom/show_article.php/_c-638/_nr-28/_p-1/i.html (accessed on 14 October 2010)

Since conventional oil resources are largely located within the Strategic Ellipse, the diversification with regards to energy resources continues to grow in importance. National idiosyncrasies and restrictions, which make an increased commitment and the establishment of close links with the countries of the Strategic Ellipse (above all Russia and the Middle East) especially demanding for Germany, thus further underline the need for a speedy energy transition.

Further issues / need for research:

1. The current situation can not be seen as one of a homogenous "alliance of suppliers" and a homogenous "alliance of importers". Which groups, alliances and strategic partnerships can be identified in the areas of policy, economy or even ideology that may be relevant in the future and which would form, consolidate or dissolve in view of global peak oil?
2. How does Germany shape its relationships with the countries of the Strategic Ellipse today and how could it face new political challenges brought on by peak oil?
3. How can partnerships with the most active importing countries within the Strategic Ellipse be shaped?

4.3 Balancing out Interest and Values in Foreign Policy

Peak oil promotes the primacy of energy security, which could foster pragmatism and self-interest in international relations to the detriment of foreign policy based on values.

Implications for Germany: Although the necessity of balancing out self-interest and ethical values in foreign policy is already relevant today, peak oil could introduce a new dynamic to the situation. The then possible new selectivity in supply relationships may lead to some countries appearing to be more convenient partners; that is, those whose foreign policy is deeply rooted in the principle of non-interference in other countries' affairs, and thus in the absence of political conditionality. In light of global peak oil and efforts to establish strong, reliable relationships with oil-producing countries, value-based concepts of foreign, security and development policy may increasingly become subject to pressure to conform to more pragmatic rival models, like those already pursued by China and India.

A security policy more strongly focused on (economic) self-interest would be subject to special restrictions in Germany and, as evidenced by the discussions surrounding Bundeswehr operations abroad and Horst Köhler's resignation as Germany's Federal President, to extensive debate in politics and society. Especially in the Middle East and North Africa, Germany struggles to define its interests, which involve an element of power politics that has strong negative connotations in Germany and is irreconcilable with recent German history. Particularly in these regions, which are most important for future global energy security, Germany is thus mindful to emphasis ethical values as an important motivation.

The possible field of tension between self-interest and ethical values based policies, often taking effect at different time horizons, becomes apparent for example in the conflicting goals of necessary short-term cooperation with authoritarian regimes in the field of energy and security on the one hand and the long-term interest in bringing about a change in these regimes on the other.[178] Depending on the energy supply situation in the affected importing countries, this could not only lead to double standards in foreign policy, but also to compromises in efforts of democratisation and political conditionality when dealing with producer countries, which would diminish the credibility of importing countries and could become tantamount to support for authoritarian regimes. However, there is evidence that policies based on self-interest and ethical values are not necessarily mutually exclusive. A combination of both approaches, however, would be a special challenge for German security policy particularly in light of peak oil, which could shift the alignment of political efforts in the short term towards a focus on achieving supply security.

Due to limited capacities in security policy actionability - which will most likely be further reduced with peak oil - a focused definition of security policy interests irrespective of enduring values is essential and the only option to establish security policy priorities, not least in view of future military operations conducted in a multilateral network. This is true both on national and European level. Given the limitations of military capacity, the

178 Cf. Guido Steinberg, *Deutsche Nah-, Mittelost- und Nordafrikapolitik. Interessen, Strategien, Handlungsoptionen, SWP-Studie* (15 May 2009), http://www.swp-berlin.org/common/get_document.php?asset_id=5977 (accessed on 14 October 2010).

uncertainty of future defence budgeting, and the insufficient definition of genuinely common interests among EU member states, an intense debate about the nature of military operations the EU is willing and able to perform is both difficult and overdue.

All things considered, the integration of economic interests and aspects of supply security into security policy and interministerial cooperation in this field is likely to be the central issue of security discourse in the years to come. In Germany, such discussions of interests have – owing to national sensitivities - so far not been proactive, open, unbiased and transparent but have rather taken the form of short-lived debates in the wake of specific events, such as following the resignation of former Federal President Horst Köhler.[179] A clear cut long-term definition of national interests and a balance between ethical values and self-interest in politics is, however, of vital importance for a coherent foreign, security and development policy promoting long-term goals that otherwise would yield to the short-term goal of supply security, compelled by problems resulting from peak oil.

179 On the difficulties of an open discussion about security policy that includes economic interests, cf. the media response to recent statements by the Minister of Defence at the 9th Congress on European Security & Defence in Berlin on 9 November 2010, http://www.behoerden-spiegel.de/Internet/nav/7e5/7e530f4b-3f71-3c21-a3b2-1717b988f2ee.htm (accessed on 11 November 2010), and: Bundesverband für Sicherheitspolitik an Hochschulen, Schwerpunkt Wirtschaft und Sicherheit, "Interessen ohne Alternativen?", *ADLAS, Magazin für Außen- und Sicherheitspolitik*, Vol. 4, No. 3/2010.

Further issues / need for research:

1. Which concepts and alternatives can be prepared and developed for the future relation between value and self-interest based foreign policy in Germany?

2. Which potential problems or dangers are inherent in the integration of economic interests such as energy security into strongly value-oriented areas of policy including, for instance, development, security and defence policy?

3. How can a society-overarching discourse on Germany's security interests be shaped, and which specific challenges will policymakers be faced with in this context?

4.4 Potential for Conflict and Cooperation in and with Producer Countries as well as other Importing Countries

Under peak oil conditions, fragile producer states being susceptible to domestic and transnational conflicts will most probably more often be set in the focus of international stabilisation efforts. The stabilisation of these states and regions could become relevant for Germany in the context of its alliances and may likewise foster new forms of cooperation given the involvement of large threshold countries.

Implications for Germany: Under peak oil conditions, traditional producer countries and regions will initially become more important. At the same time, producer countries that have so far contributed little to the world oil supply (referred to as niche countries) will also receive more attention. While this means a broader geographical and political spectrum of producer countries and regions significant to oil-importing countries, the largest oil reserves are nevertheless still concentrated in the Strategic Ellipse.[180]

On the one hand, growing oil revenues could contribute to increased national stability in many producer countries, given the presence of other economic, political and social factors, such as distributive justice. On the other, in the absence of those other factors, an increased importance of fossil oil and an associated increase in prices could potentially lead to a higher risk of instability and conflict, especially in states or regions that are already fragile or weak.[181] Besides national conflicts over the distribution of initially increasing revenues, transnational conflict over cross-border crude oil deposits or transport routes could also occur.

With weak statehood, the probability of political and administrative tasks, even including the use of force, being exercised by third-parties could increase in these countries. Relevant players could be state, non-state or sub-state actors. The spectrum of consequences could extend from displacement of or dominance over fragile state structures by non-state or sub-state actors to interventions by foreign national powers.

Stabilisation efforts, obliged to take into account non-state actors as well as the increasingly involved state actors like influential threshold countries, could thus become more important in fragile producer states and regions.

The issue of handling non-state actors, ranging from rebel groups to private military service providers, proves to be largely unresolved thus far. Special challenges would arise, for example, if non-state actors were to forcefully take over and control national resources or if private military service providers were to get involved in armed conflicts.

180 This "geographical broadening" would include Arctic regions, which could become increasingly important for oil production. Uncertainties as to the property situation regarding Arctic regions and their resources may increase tension between neighbouring states, especially when peak oil is reached. Since all of the neighbouring countries laying claim to Arctic regions with the exception of Russia are members of NATO, any event perceived by one of these member states as a threat to its national sovereignty would most likely lead to an involvement of NATO bodies. Even if in cases of low-threshold, non-violent conflict, NATO does not act in collective self-defence, Germany might be forced to take a stand as part of a decision made by NATO on the issue.

181 Context factors increasing such risks include fragile statehood, bad governance and a low level of development. Cf. Matthias Basedau, "Erdölkriege – Kriege der Zukunft?", *GIGA Focus Global*, No. 6 (Hamburg 2007), http://www.giga-hamburg.de/dl/download.php?d=/content/publikationen/pdf/gf_global_0706.pdf (accessed on 11 October 2010).

Today, possible foreign state interventions are primarily perceived in conjunction with the growing involvement of large threshold countries such as China and India in producer countries with newly gained significance and - by tendency – in transit regions and are likely to become even more important in the future (see Chapter 3.1.1). While this increasing importance and the growing demands of large import-dependent threshold countries are likely to be tangent to the interests of other importing countries, this will not necessarily lead to conflict potential in the different constellations.[182] Whether energy security is pursued in a conflictive or a cooperative manner depends, among other things, on whether it is perceived as a zero-sum situation or a win-win situation and on whether the other side is defined as an opponent or a partner, as exemplified by China's widely differing attitudes towards the United States and India in the context of energy. China and India have committed themselves to a concerted approach based on partnership.[183] Contrary to the often cited "China threat" theory, which states that China's energy policy is expansive and uncooperative and makes use of any available means, nowadays a coexistence of conflict and cooperation is visible in China's relations with other importing as well as producer countries.

Particularly when it comes to stabilising fragile producer countries and protecting transport and sea routes there is likely to be a large overlap of shared interests among importing countries, which will gain new importance under peak oil conditions. It must be considered that with peak oil, the political, economic and military resources of all importing countries are likely to decrease, which would restrict their international involvements.[184]

Especially in democratic industrial nations, a high domestic pressure to find solutions to severe economic imbalances caused by peak oil could arise. In light of this, the already selective approach to supporting international organisations, fragile states or developing countries could become even more discriminating. This could affect the entire spectrum of development policy activities, bilateral and multilateral humanitarian aid operations and UN mandated stabilisation operations secured by military. States may choose recipients of and partners for aid and support measures more selectively and minding exclusively their own interests and benefits. This could lead to bilateral support or cooperation only being achieved in areas where states can expect support for their respective own causes. Besides nations that export oil and other energy resources, certain other states that are of significance in transporting these goods would thus grow in importance.

Given the immense expenses for extensive stabilisation measures, especially combined with the pressure of cost and difficult prevailing circumstances of peak oil, a targeted development of training capabilities for security forces of supported states (military assistance / foreign internal defence) could be considered. This "stabilisation light" could potentially reduce the

182 Xuewu Gu and Maximilian Mayer, *Chinas Energiehunger: Mythos oder Realität*, (Munich 2007), 6.

183 Cf. Maximilian Mayer, "Warum Chinas 'Energiehunger' nicht zum 'Krieg um Ressourcen' führt", in *China aktuell*, No. 1 (2007), 57-75, 68.

184 Not just states, but international organisations (IO), too, could quickly reach the limits of their potential. Means for humanitarian assistance are already limited and could further decrease if donor countries have to restrict themselves more. Non-governmental organisations (NGO) could be similarly affected by economic and financial shortages induced by peak oil, which would compromise their work. Aid provided by NGOs and IOs could thus potentially become less and at the same time more selective, possibly leading to clientele politics. This narrowing of the field of activity of such organisations in the face of altogether decreasing possibilities, thus undermining the ambition and moral strength of NGOs and IOs, could lead to a change in their relevance which would have an impact on the international system.

total number of deployed armed forces and would thus be more commensurate with the Western industrial nations' potentially limited actionability under the conditions of peak oil. Considering the geographical distance to producer and transit countries, the scale of potential tasks and Germany's traditional multilateral integration, which is presumed to remain a constant of German security policy even when peak oil is reached, the support and stabilisation of fragile producer countries and their societies seems only plausible and worthwhile for Germany if carried out within existing systems of alliance.

Another domain that could trigger new types of cooperation to prevent conflict between oil-importing countries would be the transition to a post-fossil economy. In this process, technologies for the transformation of the energy industry as well as energy-efficient methods and technologies will continue to strongly gain importance, also and especially for large threshold countries. Technological expertise available in Germany and in European partner states could thus also have a positive influence on the development of bilateral relations with fast-growing economies with high energy requirements. However, since Western industrial nations by no means hold a monopoly on energy-efficient and oil-independent technologies, this could, depending on further developments, create new and more intense competitive situations, especially with regard to investments in research and development in various countries. Thus, new conflict constellations, yet also a dynamic, productive and in parts cooperative competition for post-fossil transformation may emerge.

Further issues / need for research:

1. Which are the fragile producer countries of the future and how is Germany, be it as individual state or as part of existing alliances, already involved in these countries? Which decisive priorities for action will evolve during the investigation period for the multilateral alliances that Germany is part of, especially NATO and the EU?
2. Which conditions and context factors would have to be given for peak oil to lead to energy cooperation instead of conflicts?
3. What potential for cooperation is in existence with regard to 1) producer countries and 2) import-dependent threshold countries that have been identified as particularly relevant? How can this cooperation potential be developed and used, for example in stabilising fragile producer countries or for post-fossil transformation?

4.5. The Proliferation of Nuclear Technology and Material

Consequences of peak oil may include a greater reliance on nuclear energy, which could promote the expansion and proliferation of nuclear technology and materials. This would not only increase the number of real or potential nuclear powers, but also the risk of nuclear accidents or the use of nuclear material for terrorist purposes.

Implications for Germany: Germany, as a peripheral player in matters of nuclear power, can only become involved in international treaties and mechanisms for the prevention of proliferation as part of a multinational effort. However, the impact of such non-proliferation and control regimes is very much dependent on context. A central issue is the enrichment of nuclear fuel, which can potentially lead to the development of nuclear weapons. Large nuclear powers frequently offer an exchange of enriched fuel elements to states wanting to use nuclear energy in the future, thus promoting a multilateralisation of the nuclear fuel cycle.[185] As a supplier of key technologies, which, as dual-use technologies, could be equally used to enrich nuclear material or build nuclear weapons, Germany would have to continue to fulfil its responsibility by exerting control over exports. The transfer of technological dual-use expertise is even harder to detect and prevent than the export of goods – especially in these times of global networking. Moreover, the enforcement of – usually economic – sanctions to prevent nuclear armament or proliferation will probably become ever more difficult under the conditions of peak oil. International obligations and alliance memberships are likely to be overtaken by emerging bilateral economic relations. Especially the nuclear ambitions of "problem states" may cause new dynamics of proliferation, including in cooperation with non-state actors. In this regard, the active prevention of proliferation will be even less a matter of international treaties. The pursuit of nuclear weapons and the fight for resources could turn into a self-perpetuating spiral.[186]

In light of the threat posed by terrorist attacks and accidents, comprehensive protection of a nation's own nuclear facilities and materials is an enduring obligation.[187] Since incidents involving nuclear material can easily have cross-border consequences, international cooperation in this field is becoming increasingly important. This concerns not only institutional cooperation but also the exchange of technologies and mechanisms for radiological security, in Germany's case especially with Eastern European states.[188] Assuming that the smuggling of nuclear material will increase further, Germany may in future play an even greater role as a transit country, owing to its location in Central Europe. The (cross-

185 This recently occurred between the United States and the United Arab Emirates and Jordan, as well as between Russia and Iran. Cf. Sascha Albrecht and Oliver Trähnert, "Die Multilateralisierung des nuklearen Brennstoffkreislaufs", *SWP-Aktuell 31* (April 2010), http://www.swp-berlin.org/common/get_document.php?asset_id=6948, (accessed on 14 October 2010).

186 Cf. Bundesnachrichtendienst, *Proliferation von Massenvernichtungsmitteln und Trägerraketen*, (Berlin/Pullach 2002).

187 This includes not only nuclear power plants but also enrichment and reprocessing plants, transport routes, temporary and permanent repositories and especially research reactors as well as the large number of sources of radiation for civilian and industrial use, which are even harder to monitor. In addition to active facilities, disused facilities or sources must be factored in.

188 The security of nuclear sources and facilities is generally considered to be a national responsibility. While there are few international treaties on the subject, the international harmonisation and coordination of security standards and safety measures is a continuing task. Cf. Gebhard Geiger, *Radiologische Sicherheit. Sicherheitspolitische Gefährdungspotenziale radioaktiver Materialien, SWP-Studie 24* (June 2004), 15, http://www.swp-berlin.org/common/get_document.php?asset_id=1408 (accessed on 14 October 2010). As part of international cooperation, this may involve the training of security and emergency response personnel and their cross-border cooperation.

border) control of nuclear material and the detection and investigation of relevant critical activity will thus likely become increasingly important.[189] Non-state actors, such as terrorist or sectarian groups and organised crime, which increasingly cooperate, could become more relevant.[190] A potential for blackmail, based on real or ostensible nuclear threats, might be created.

The threat to radiological security would thus not decrease, both in Germany and elsewhere. The focus is expected to be on prevention, that is, on both forestalling and investigating possible threats, and on quick intervention in the event of crises.[191] Since future threats could increasingly emanate from a non-military environment, a further strengthening of cooperation and interoperability between relevant national security institutions both in legal and practical terms would be necessary – including on an international level.

Crisis management as well as crisis aftercare capacities remain indispensable in case of damage, accident or attack in order to prevent panic and a resulting paralysis of public life and in order to preserve the state's capacity to act in the event of such a crisis. This would primarily remain a task of civil protection, but would probably also involve relevant capabilities and capacities of the Bundeswehr.

189 In Germany, this is the task of the Federal Office for Radiation Protection, but could include the use of intelligence agencies, and in case of risk events, the capacities of the German military wherever appropriate. Cf. Bundesnachrichtendienst, *Proliferation von Massenvernichtungsmitteln und Trägerraketen*, (Berlin/Pullach 2002).

190Use of nuclear weapons or terrorist attacks with larger dirty bombs cannot be ruled out but are considered to have little chance of success for logistic and technical reasons, especially because of the large amount of nuclear material that would have to be acquired. The use of radioactive chemical elements such as caesium or radium as weapons material is more relevant, as these materials are much easier to procure. Cf. Gebhard Geiger, Radiologische Sicherheit. Sicherheitspolitische Gefährdungspotenziale radioaktiver Materialien, SWP-Studie 24 (June 2004), 5, http://www.swp-berlin.org/common/get_document.php?asset_id=1408 (accessed on 14 October 2010).

191 This equally applies to irradiation, atmospheric dispersion, dispersion with explosives ("dirty bomb"), improvised nuclear weapons or sabotage of nuclear power plants. Cf. Wolfgang Rosenstock, *Nuklearterroristische Bedrohung und Gegenmaßnahmen*, Fraunhofer Institut für Naturwissenschaftlich-Technische Trendanalysen (INT) (Euskirchen 2002).

Further issues / need for research:

1. Where can special efforts to expand nuclear energy be expected in the next decades, that is, in which countries and under which (political) conditions?
2. How will this affect political systems and constellations (regional balances, alliances, etc.) and how may that in turn affect the foreign and security policy of Germany?
3. How would the scope and nature of proliferation change and how could proliferation be thwarted/prevented more effectively? Which conclusions can be drawn for cooperation within national and multilateral security institutions and which contributions should Germany make?

4.6 Critical Energy Infrastructure

Under conditions of peak oil, the appeal of energy infrastructures as targets for violent attacks or political blackmail will probably increase. These infrastructures will thus become even more critical and will require direct and indirect protective measures and therefore capital investment. Non-state actors could take on a substantial role in this scenario.

Implications for Germany: With prices and supply rates increasingly fluctuating after peak oil, an interruption of the supplies of fossil or electric energy would have profound consequences for all economic cycles. As a result of peak oil, the protection of critical energy infrastructures would thus become more important in order to prevent further disruptions that could possibly threaten the system. To prevent disruption of oil and natural gas supplies, which could influence the national economy considerably, the protection of import and delivery channels will likely become increasingly relevant to importing countries such as Germany. This would not only affect oil infrastructures – mainly sea routes and ports – but gas infrastructures, too, caused by the expected substitution effect at a later stage. Natural gas infrastructures do not only include pipelines on land and at sea, but also, owing to the spread of LNG technology, sea routes, ports and liquefaction plants. Besides protective measures for pipelines and sea routes in Germany, the support of or cooperation with trade partners in matters of security will most likely become increasingly important to ensure a steady supply of oil and natural gas. This would also bring maritime aspects into focus. Ocean-going naval forces providing escort and protection could become significantly more important for keeping open international sea routes in cases of emergency. In this context, as in the protection of transnational supply lines, international cooperation between affected states seems sensible in order to reduce the burden on individual states.

With the transition to renewable energy sources and the increasing electrification of energy supplies, the electrical energy infrastructure is becoming ever more important for modern society and will most likely be brought further into the focus of national security. Electric power grids will thus become even more critical infrastructures. This does not only concern grids on national territory.[192] To make the European electricity network more stable and resistant to disruption, mains systems are necessary that can withstand partial failures or fluctuations without major cascade effects and provide various redundancies and regulation mechanisms. Especially the further development of renewable energies requires such flexible, robust and both efficient and extensive distribution grids, including decentralised electricity storage. Given the ramified European network, close multilateral cooperation on this issue will most likely become more important. In light of the transition to renewable energies, considerable investment into the modification and expansion of energy infrastructure is expected. Considering their increasing criticality, investment into the security of these energy infrastructures will thus also be necessary, which will, however, be faced with consistently tight national budgets and economisation goals that affect national security institutions, even in Germany. The capabilities and capacities of the Bundeswehr could nevertheless become more relevant to the protection of these infrastructures.

192 To protect these grids, sensor-based remote monitoring systems for electricity pylons and stations are for instance already being developed in the United States.

Non-state actors could also increasingly play a part in securing critical, increasingly transnational infrastructures. Closer and stronger cooperation between national and private institutions regarding the security of critical infrastructures would thus be conceivable. National authorities should be prepared for this. Suitable foundations and parameters for an expanded cooperation and clear structures regarding responsibilities in and limits of cooperation are necessary, thus reinforcing the networked approach. This includes resolving legal status issues and agreeing on a frame of action for relevant meetings or cooperation.[193]

Further issues / need for research:

1. Which contributions could and should national security institutions make towards the protection of transnational energy infrastructures (sea routes, pipelines, terminals, grids, etc.) and where are relevant "hotspots"?
2. Which forms of cooperation, both between states and with domestic and foreign private institutions should be established, and which further international agreements are or will foreseeable be necessary?
3. Which contributions would national security institutions have to make in the future to cope with major incidents or disasters in critical energy infrastructures? What political and legal parameters would be necessary for cooperation between civilian and military bodies?

193 In order to prevent tactical and strategic friction and against the background of lessons learned in armed conflict during the last decade, any activities in the same areas with these players must not take place unprepared or as cooperation merely resulting from a lack of alternative options, but should be based on predetermined principles from the outset.

4.7. Extended Energy Regions

The process of creating and expanding extended energy regions based on renewable energies is not just a technological and economic challenge but is also tied to processes of (security) policy and aims at creating stable conditions in a consequently changing geopolitical context.

Implications for Germany: The expansion of renewable energies implies the existence of extended energy regions that connect energy sources and consumers through transnational and partly transcontinental energy networks. This widens the expansion and the nature of critical infrastructures (see Chapter 4.6). In the future, this may not only involve the transport of renewable energy via power lines, but also transport infrastructures for solar-produced hydrogen or processed solid or gaseous biomass. Technologically, these infrastructures resemble those for fossil energy sources and are thus located in similar geographic regions. States with the ability to contribute to and benefit from such energy networks owing to their geographical, climatic or technological situation will strive for cooperation and integration options which may increasingly affect security policy. This could create opportunities for less developed states or regions as well as for supra-regional stability, but could also draw new lines of separation and conflict. Against this background, the incorporation of states – perhaps bordering those energy regions – that are unable to participate in energy networks for lack of capabilities will be a special challenge and could carry potential for conflict in case of failure.

The cooperation of the EU with countries in North Africa and the Middle East (MENA) could develop into such an extended energy network, beginning with the DESERTEC project. The scope of this network would not only require a targeted and stable cooperation within Europe, but also cooperation on issues of security policy with partner states of the MENA region. Furthermore, depending on its intensity, stability and level of institutionalisation, the purpose-oriented cooperation of heterogeneous players (e.g. EU and MENA) in such an energy network could entail socialisation processes and spillover effects onto other areas of cooperation. Constructivists argue, for instance, that in international institutions, processes of socialisation occur that may influence the conduct, standards and even preferences of players. Institutions thus become "sites of socialisation" where, as a consequence of social interaction and cooperation, players internalise transnational norms and values (e.g. human rights and democracy).[194] Should cooperation within the context of wide-ranging energy regions become institutionalised, similar effects on cooperation in energy networks are conceivable, albeit on a different scale than in highly integrated systems such as the EU. The United States appear to be developing a continental energy network with Central and South America that is tendentially self-contained and resembles the DESERTEC project.[195]

194 Cf. Emanuel Adler, "Constructivism and International Relations", in Walter Carlsnaes, Thomas Risse and Beth Simmons, eds, *Handbook of International Relations* (London 2002), 95-118; Jeffrey Checkel, "International Institutions and Socialization in Europe: Introduction and Framework", in *International Organization 59 (4)* (2005), 801-826; Martha Finnemore and Kathryn Sikkink, "International Norm Dynamics and Political Change", in *International Organization 52 (4)* (1998), 887-917; Alastair Iain Johnston, "Treating International Institutions as Social Environments", in *International Studies Quarterly 45 (4)* (2001), 487-515.

195 Following up an invitation by President Obama of April 2009, the United States initiated the Energy and Climate Partnership of the Americas (ECPA). The aim of the ECPA is to foster cooperation between the countries of the Americas on matters of energy security and reduction of greenhouse gas emissions. Among other things,

Concentrating energy relations in large-scale alliances that, although transnational and sometimes transcontinental, are still regionally oriented at their core, would reduce the need for securing or stabilising distant access points to energy resources in remote (on a global scale) regions. This focus combined with limited capacities for international involvement caused by peak oil could promote an already visible regionalisation of international relations, thus possibly changing not only the role of traditional players in energy policy, such as OPEC, but also affecting traditional alliances. Against this background, cooperation in extended energy regions could as well change the focus and perspective of German and European foreign and security policy.

Further issues / need for research:

1. Which challenges for foreign and security policy would result from the development of extended, tendentially self-contained energy regions based on renewable energy sources (e.g. effects of the DESERTEC project on German policy)?
2. How do these developments in turn affect existing political, economic and security alliances both world-wide and in individual regions?
3. Beyond securing critical infrastructures, which contributions to the development and expansion as well as to the long-term security of these energy regions would national security institutions have to make in the next decades?

initiatives promoted by ECPA are directed at developing what is referred to as the "clean energy sector". The Office of Energy Efficiency and Renewable Energy (EERE) of the US Department of Energy "is involved in several projects currently underway, including a renewable energy center and solar power project in Chile, energy efficiency centers in Peru and Costa Rica, wind energy in Mexico, renewable energy strategy development in the Caribbean, and wind power in Dominica." Apart from this, bilateral projects with Brazil, Canada, Chile, Columbia, Costa Rica, Mexico, Peru and other countries are underway. Cf. US Department of Energy, Energy Efficiency and Renewable Energy/International Activities, http://www1.eere.energy.gov/international/printable_versions/americas.html, (accessed on 27 October 2010).

4.8. Effects of Peak Oil on Armed Forces

Severe impediments to mobility as a consequence of peak oil would have a considerable effect on all German security bodies, including the Bundeswehr.[196] *In the long run, not only all societies and economies worldwide but armed forces as well will be faced with the various and difficult challenges of transformation towards a "post-fossil" age.*

Implications for Germany: A markedly reduced mobility of the German Armed Forces would have various consequences – not only for the available equipment and training, but also for their (global) power projection and intervention capabilities. Given the size and complexity of many transport and weapon systems as well as the high standards set for qualities like robustness in operation, alternative energy and drive propulsion systems would hardly be available to the necessary extent in the short term. One of the consequences to be initially expected would be further cutbacks in the use of large weapon systems for training purposes in all services, thus raising the need for more "virtualised" training. However, effects on current and planned missions would most likely be even more severe. Deployment to the theatre of operations, the operation of bases and the mission itself are considerably more energy- and above all fuel-intensive than the mere upkeep of armed forces.[197] Rapid operations of highly mobile forces, which are regularly deployed by air, would be particularly affected, as well as air force missions, laying severe restrictions upon these types of operations. Despite being common practice, alternative solutions for deployment like increased rail transport or a markedly more efficient transport of equipment, supplies or even personnel by ship are unlikely to provide full substitution.[198] Especially with regard to deployments from railway stations and sea ports into the operations area ("the last mile") and deployments within theatres of operations lacking access to sea or railway, combustion engine based drive propulsion systems will not as easily be substitutable. The same applies to tactical mobility.

While conflicts in (remote) troubled regions could thus potentially increase with peak oil (see Chapter 3.3), the corresponding world-wide – including humanitarian – involvement of armed forces could be even further restricted in terms of resources. Such involvement could thus become even more politically and economically controversial and harder to put through – especially if it requires a relatively large commitment of equipment and personnel by the military in order to succeed. National, non-mission-related deployment over a wide area,

196 In addition to economic problems, some states could see challenged their armed forces' capacity to act.

197 Currently, especially the transport of fuel to the area of deployment ties up considerable logistic and ultimately military resources. "The example that I like to use is getting a gallon of gasoline to a Marine front line unit in Afghanistan. You have to put that gallon of gasoline on a tanker. You've got to take it across the Pacific. You have to put it into a truck, and truck it over the Hindu Kush and down through Afghanistan. Now, as you do this, you've got to guard it." Ray Mabus, SECNAV Discusses Future Of Alternative Energy Sources, Navy News Service, June 2010; "Although fuel costs represent less than 3 percent of the Defense Department budget, indirect costs such as those for transporting fuel to battlefields and distributing it to the end-user, add to the total. When the cost of the army's entire logistics network is added to the cost of delivered fuel, gas prices are $13-$19 per gallon. In the air force, these costs can be much higher, military grade jet fuel delivered through aerial refueling costs upwards of $42 a gallon." Sohbet Karbuz, "Can the U.S. military move to renewable fuels?", *Bulletin of the Atomic Scientists*, http://www.thebulletin.org/web-edition/features/can-the-us-military-move-to-renewable-fuels (accessed on 14 October 2010).

198 Such as the current relocation of US armed forces from Iraq, with partial relocation of materiel to Afghanistan by sea and rail.

which is connected with mobility and energy in various ways, could also come into question in the medium term.[199]

In order to prevent a restriction of capabilities and deployment options of the Bundeswehr, alternative solutions to oil-based fuels would be necessary in the short term. While these solutions, such as coal liquefaction or in some cases natural gas liquefaction, are possible and conceivable in principle, they would entail considerable political and economic efforts.[200] They would require considerable investments and radical industrial policy decisions. Considering the challenges society as a whole would face as a result of peak oil, it seems unlikely that this could be accomplished even in case of an emergency. Moreover, worldwide (re-)initiation particularly of coal and gas liquefaction would further expedite both the shortage of fossil fuels and climate change. Even though cooperation in international alliances may hold benefits when it comes to technologies or coal and gas reserves, it would turn coal and gas into even more important and strategic resources and make their national exploitation a priority.[201] Especially coal could potentially become a "strategic reserve" for Germany.[202] Besides ensuring the availability of alternative fuel solutions such as liquid coal or gas at least in technological terms, building up large strategic reserves of fuel for all kinds of Bundeswehr vehicles, ships and aircraft should be considered in order to bridge supply shortages for an extended period of time if necessary.

Since armed forces without mobility are utterly inconceivable, the necessity for a long-term transition to post-fossil forms of mobility is greatly increased. This may even include dimensions of technological transformation of the armed forces. In the civilian sector, the transformation of mobility systems towards post-fossil forms and renewable energy has gathered a lot of momentum – within in the armed forces it has at least begun.[203] Military systems and especially vehicles can profit from civilian developments in technology in many ways. For one, increases in efficiency and performance can be achieved through optimisation of conventional drive propulsion systems. This includes their partial electrification for combat and transport vehicles and the development of the "More-Electric Aircraft" (MEA) and the "All-Electric Ship" (AES), which contribute to reducing not only fossil-fuel consumption but maintenance expenses as well. The trend towards hybridisation of drives is evident in the military as well, although complete electrification of these drives most likely is still a distant prospect.[204] The trend towards remote operation, (partial) automation and autonomisation of reconnaissance and weapon systems (UGV, UAV, UUV) accompanied by a reduction in size and/or weight also indicates a growing potential of alternative, more electrified drive propulsion systems. Which type of alternative drive and energy storage will prevail in the very long term is yet to be determined. The broad use of hydrogen drive

199 Competition for resources with non-military transport services adds to this – they, too, need fuel.

200 In principle, procedures and technologies for coal-to-liquids and gas-to-liquids conversion are well understood and mastered. Several tests have shown that the resulting synthesised fuels are well suited for military equipment.

201 Especially natural gas would have to be largely imported, thus merely prolonging the security challenges of the "oil era".

202 Approx. 50% of worldwide coal extraction is done by China and the United States.

203 As shown (mostly abroad) by countless experiments with or prototypes of fuel cells, biofuels, etc.

204 This is mostly a consequence of the high cost of batteries and a lack of electrical energy infrastructures at locations of deployment. Nevertheless, the United States are experimenting with an "electrified brigade".

technology, for instance, which just a decade ago was propagated as the technology of the future in the civilian sector, is currently still a long way away.[205]

The major part of military mobility in the Bundeswehr will thus most likely remain dependant on fluid fuels in the next decades. In the wake of peak oil, the use of fuels derived from biomass will become increasingly attractive. The capacities of such fuels are currently being expanded all over the world. This includes classic biofuels produced from agricultural products and/or waste materials. Their further development promises considerably higher yields per hectare. However, the use of these biofuels in particular has security implications, as discussed in Chapter 3.1.3. There have also been reports of promising attempts to produce biofuel from algae.[206] Such systems could possibly have another advantage: fuel could be produced where it is required, thus reducing the need for transport into the area of deployment.[207] A further advantage of the extensive use of biofuel would be that the drive propulsion systems of numerous transport and weapon systems – from aircraft to ships to main battle tanks and infantry fighting vehicles – would not necessarily have to be changed fundamentally but would merely have to be adapted.[208]

Especially at military facilities, the post-fossil transformation of the armed forces can be advanced. Relevant pilot projects have commenced. Particularly in this context, the use of renewable energies (wind and solar energy as well as geothermics, biomass or natural gas) will probably steadily increase and offer a potential available on short call. This could provide targeted support and acceleration to a further diversification of energy sources of the German and respectively the European economies. In principle, more extensive use of wind and solar energy in deployment areas (base camps) seems possible, thus further reducing the ecological footprint of operations.

For the Bundeswehr as well as German and European armaments industries, the priority is to quickly adapt post-fossil civilian technologies and to promote important developments that are exclusive to the military environment (e.g. in ships, submarines and aircraft), both independently and as part of international cooperation. All things considered, however, the post-fossil transformation of the armed forces is not merely a technological but rather a more comprehensive process, which necessarily involves radically new system approaches and utilisation concepts.

205 Although especially Germany has a unique position when it comes to fuel cell drives for submarines.

206 Microalgae use sunlight, water and minerals for growth and bind carbon dioxide in the process of photosynthesis. They grow quickly and can be harvested daily through extraction of the water, 90% of which is reusable. 100 kg of algae biomass yield approx. 20 litres of biofuel. The use of fallow land and waste water or salt water avoids competition with food production. Cf. Daniel Wetzel, "EADS lässt Flugzeug mit Algentreibstoff fliegen", *Welt-Online* (3 June 2010), http://www.welt.de/wirtschaft/article7896708/EADS-laesst-Flugzeug-mit-Algentreibstoff-fliegen.html (accessed on 14 October 2010).

207 This would require robust, scaleable and mobile systems of fuel production from algae.

208 Regarding biofuel tolerance of motors and/or turbines, quality and long-term stability of the fuels themselves, etc.

Further issues / need for research:

1. How would a “German Green Forces Roadmap 2050”, operationalising the post-fossil transformation process of the armed forces, look like in the view of national and international climate protection guidelines and measures as well as the transformation of energy systems?
2. How could the long-term goal of a complete transition of the armed forces towards renewable energies with minimal CO_2 emissions be accomplished by the year 2100?
3. How would short-term alternative solutions such as coal and gas liquefaction or the accumulation of large strategic fuel reserves for armed forces have to be handled?

5. Conclusion

Gaining an illustrative picture of a subject is very much a matter of habit. When considering the consequences of peak oil, no everyday experiences and only few historical parallels are at hand. It is therefore difficult to imagine how significant the effects of being gradually deprived of one of our civilisation's most important energy sources will be. Psychological barriers cause indisputable facts to be blanked out and lead to almost instinctively refusing to look into this difficult subject in detail.

Peak oil, however, is unavoidable. This study shows the existence of a very serious risk that a global transformation of economic and social structures, triggered by a long-term shortage of important raw materials, will not take place without frictions regarding security policy. The disintegration of complex economic systems and their interdependent infrastructures has immediate and in some cases profound effects on many areas of life, particularly in industrialised countries.

According to the results of this study, the developments in the wake of peak oil will involve major uncertainties for Germany. While it is possible to identify specific risks, this does not conceal the fact that the majority of the challenges we are facing are still unknown. Besides adapting economic and energy supply policy at an early stage and not only in highly industrialised countries, the probably most effective solution strategies are thus not concerned with specific countermeasures but with systemic "cardinal virtues" such as independence, flexibility and redundancy. Efforts must be made on a cross-government and multi-level basis to better understand and control the complex dependences of infrastructures and highly differentiated value-added chains. In this connection, it is necessary to rethink evaluation standards. Not only efficiency but also, to an increasing extent, robustness becomes a criterion of sustainable policy.

In terms of German security policy, the most significant foreseeable change will be the increased importance of the Middle East, Africa and the Caspian Region for the country's resource security. Conducting a political dialogue with producer and transit countries, including in a multilateral framework, increases the importance of German foreign and security policy as well as its options. For this purpose, however, (1) German interests would have to be clearly defined, (2) traditionally divergent approaches within Europe, in particular in relation to the countries of the Middle East and Africa, would have to be overcome, and (3) opportunities to involve influential players such as China in the process of finding political solutions for the regions, thus ensuring their participation in negotiation forums and regional security arrangements, would have to be seized.[209] At the same time, it is necessary to exploit options of closer bilateral cooperation.

209 Cf. Jochen Steinhilber, "Öl für China: Pekings Strategien der Energiesicherung in Nahost und Nordafrika", *Internationale Politik und Gesellschaft (IPG) 4* (2006), 101, http://library.fes.de/pdf-files/id/ipg/03933.pdf (accessed on 14 October 2010).

The development of an external energy policy with regard to Russia that strikes a balance between European and national interests could assume greater importance in the wake of peak oil. Moscow should be given the option of pursuing a differentiating external energy policy towards EU countries, if the alternative for Germany were a potential deterioration of bilateral relations. At the same time, this approach must not cause Russia to unduly divide Europe when it comes to decisive energy security issues. The strategy used so far, namely to cultivate links between companies, still seems promising but should be placed in a wider European context.

Transformation towards post-fossil societies depends to a major extent on the availability of non-fossil technologies. In this context too, sustainable solutions seem problematic. Substituting one dependence for another, such as, for instance, a dependence on rare metals, is not an effective long-term approach. In any case, however, non-fossil energy and drive technologies will become a key competence in post-fossil societies.

Peak oil also holds considerable challenges to mission-critical capabilities of the armed forces. The focus of interest must be on guaranteeing strategic deployability and tactical mobility as well as on reducing general functional restrictions caused by systemic dependences. In order to maintain the armed forces' capacious operational readiness as far as possible, it is therefore not enough to optimise and further develop their existing supply chains and methods in order to achieve reduced mobility dependence on oil. **Rather, future changes must be geared towards reducing systemic dependences and, insofar as possible, at fully avoiding such dependences in new structures. Uncovering these dependences requires fundamentally new methods and implicitly needs further in-depth analysis.**

To reach conclusions about new, general conditions underlying future Bundeswehr operations based on a thematically focussed study like this one is of course not comprehensive enough. Yet, peak oil – in conjunction with the context factors described above – could reinforce or even give rise to fragile statehood and humanitarian crises. Owing to the global nature of peak oil, it is difficult to regionally localise consequences. The Middle East and parts of Africa, however, stand out in many respects: While parts of the Middle East are likely to profit from global peak oil and become more significant, particularly Central African countries that lack resources and are dependent on oil would have to counter major problems. Partial or complete breakdowns of economic cycles, undersupply, and humanitarian emergencies would very likely lead to major cross-national political upheavals. Weak national structures increase this risk even more, and the general conditions of peak oil would make it difficult even for industrialised countries to counter it. In this context, the study has (1) determined that there is a special threat in the food sector of these regions, (2) pointed out the existing political instabilities, and (3) addressed the need to develop closer relations with these regions in terms of resource policy. In addition, Northern Africa and the Middle East are located on the external

borders of NATO and EU and hence are of great importance for Germany with respect to security policy.

The results of this study provide starting points for further research (cf. Chapter 4). This, however, should not conceal the fact that the most difficult part of preparing for drastic shortages in the resource base of the German economy will probably be the task of implementing suitable preventive measures. The paradigm shift connected with this – less efficiency, more robustness – contradicts economic logic and can therefore only partly be left to market forces.

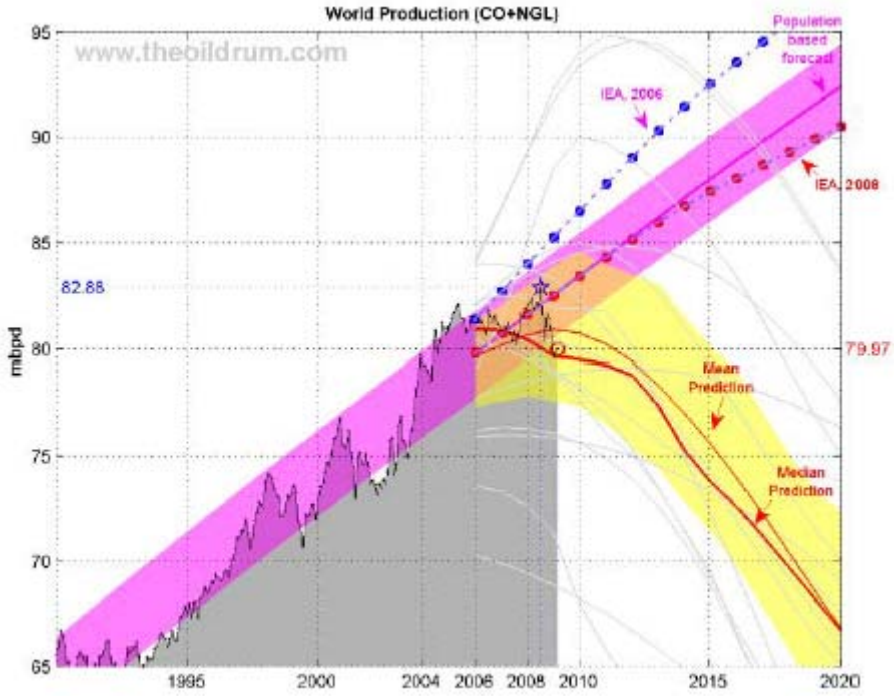
Even if the developments described in this study do not occur as depicted, it is still necessary and sensible to prepare for peak oil. The time factor may be decisive for a successful transformation towards post-fossil societies. In order to accelerate democratic decision processes in this respect, it is necessary to embed the dangers of an eroding resource basis in the public mind. This is the only way to develop the necessary problem awareness for prospective settings of the course. In general, decentralised solutions can indeed be encouraged by centralised agencies, but not developed and implemented. At the same time, Bundeswehr internal options for preparation must be evaluated and exploited.

Frequent questions

#1 What Does Peak Oil Mean?

"Peak oil" denominates the maximum oil production. It is the point in time when the production rate of a single oil field or of an entire producing region has reached its absolute maximum. This is usually the case when approximately 50% of the recoverable oil has been extracted. In order to predict global peak oil, it is necessary amongst other things to estimate how much recoverable oil, including newly discovered deposits, is available and how much, over time, can be produced per day. Using his own calculations as a basis, the US geoscientist Marion King Hubbert claimed as far back as the 1950s that the total production of several oil sources would form a curve resembling the shape of a bell – the *Hubbert curve.*

Figure 8: A Comparison of Peak Oil Predictions



Source: www.theoildrum.com

The grey area in Figure 8 shows the world-wide production of oil. The diagram shows a mean and a median prediction of 15 peak oil studies, all of which forecast that the peak will be reached before 2020. The variability of these predictions is shown by the yellow area. The magenta-coloured area represents a population-based model of the International Energy Agency (IEA), which assumes that oil production will grow in relation to the population. Peak oil critics, in particularly the IEA itself, assume that the grey curve will remain congruent with the magenta-coloured population-based predictions

and that there will therefore be no unanticipated shortages. Peak oil advocates believe that the grey area will develop within the yellow zone.

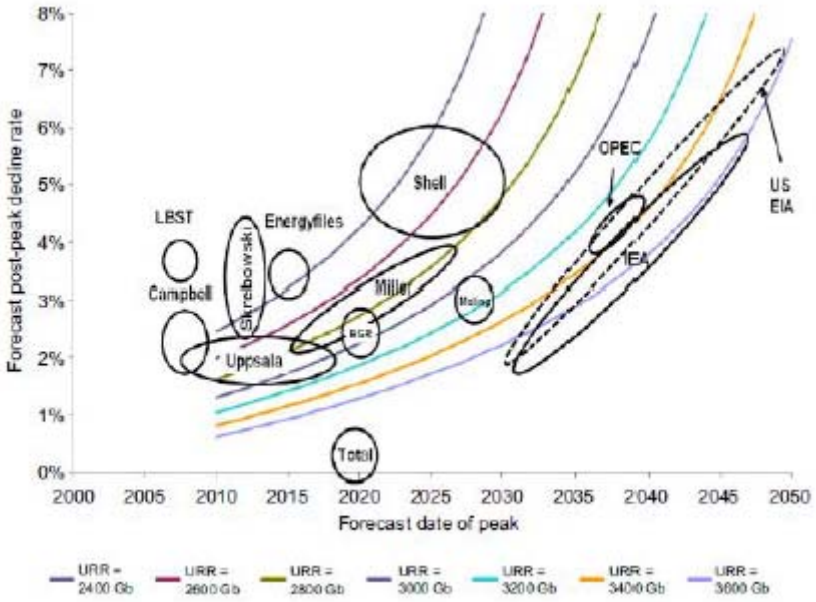
The general explanation for the existence of peak oil is the fact that fossil resources are finite. Most of the oil produced today comes from conventional oil reserves.[210] Conventional oil, however, is only available to a limited extent, because it is a finite natural resource. There is therefore no dispute that there will be a "depletion point" – at least when it comes to conventional oil. Nobody knows for certain how peak oil will take course, however. A possible initial scenario, for example, would be a prolonged plateau of oil production, a stagnant global production rate. It is suspected that increasing oil prices could result in more investments being made in recovery systems, new recovery techniques, oil substitutes and energy-saving technologies. Technical progress also has its limits, however, for example if there is not enough time available for research.

New technologies help to estimate the exploration potential, and as regards production, technical progress enables the production rate to be maintained at a higher level over a prolonged period. So far, even with new technologies, however, a large proportion of the oil that is stored in reservoirs cannot be recovered owing to capillary action. The flow is naturally restricted. In order to maximise recovery, use is made of additional methods such as the injection of steam, water, gas, surface-active agents or heat. But even these methods are not suitable for all oil fields.

A further important point in this connection is the depletion rate, that is, the rate at which oil production will shrink following peak oil. The following graph shows the relation between relevant models and the assumed point in time when peak will occur. The graph reveals that the estimations made by the various organisations differ greatly in some cases. The depletion rate will have a decisive role to play in whether there will be sufficient time for a transformation towards a post-fossil society and whether economic growth can be stabilised or not during this phase.

210 For an exact definition, see Question #4.

Figure 9: Peak Oil Predictions and Estimated Depletion Rate

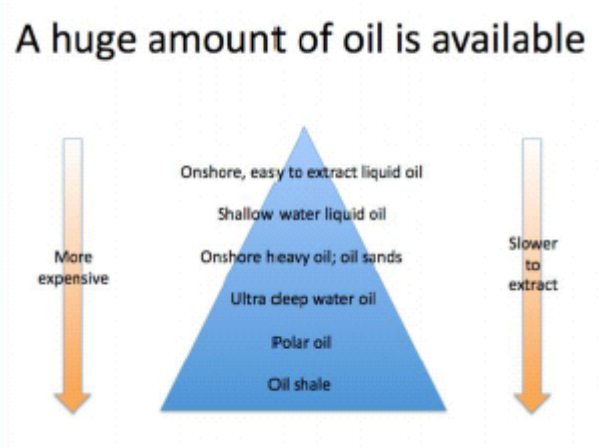


Source: Energy Policy

#2 How Do Critics Argue against Peak Oil?

One argument against peak oil is confidence in the various options for substituting oil. And indeed there are some promising approaches that seem to have the potential to reduce or even counterbalance the effects of a peak oil situation. The Pentagon, for example, recently promised that it would in future be possible to replace kerosene for combat aircraft with algae biofuels.[211] The German Research Foundation has set up a special research programme intended for developing new production methods for currently oil-based chemicals using renewable raw materials.[212]

Figure 10: Conventional and Unconventional Oil



Source: www.theoildrum.com

Especially in Canada, investments are being made in the extraction of unconventional oil from oil shale or tar sands. The quantities of oil locked up there would, in theory, suffice to allow a peak oil situation to become a marginal problem in the long run. Again, critics are expressing their doubts, however, as to whether the expected decrease in the production of conventional oil can be counterbalanced with the development of oil shale and tar sands. What is more, this alternative involves high production costs and also places a burden on the environment.

Any substitution measure and almost any cost-cutting measure initially entail technological effort and investment. Investments made under uncertainty are frequently endangered to be too small. When peak oil is reached, this could affect expensive technologies and infrastructures on which high hopes have occasionally been pinned as regards the production of unconventional oil. At the least there is a serious risk that it

211 Cf. Jason Paur, "Pentagon Researcher Promises Cheap Biofuel for Jets", blog entry (19 February 2010), http://www.wired.com/dangerroom/2010/02/pentagon-researcher-promises-cheap-biofuel-for-jets (accessed on 13 October 2010).

212 Cf. Max-Planck-Institut für Dynamik komplexer technischer Systeme, Entwicklung von ressourcenschonenden chemischen Produktionsverfahren, press release (20 November 2009), http://www.mpi-magdeburg.mpg.de/Public_Relations/Pressemitteilungen/Pressemitteilung_SFB_Integrierte_Chemische_Prozesse_201109.html, (accessed on 14 October 2010).

could take several years or even decades before the necessary investments have sufficient effect.[213]

Critics of the peak oil theory also argue that in the event of an increase in oil prices, additional reserves will become available owing to the fact that mining them will then be profitable. If the world market price of oil is lower than the production costs for a specific oil field, mining is not profitable. Such a field is not even regarded as a recoverable resource. If the price of oil exceeds the production costs, however, recovery becomes economically affordable. In the event of a decrease in oil production and an increase in price, additional oil would become available. This argument is agreeable only to a very limited extent, since it ignores the fact that this new oil will no longer be inexpensive oil. Its price will remain high and will continue to increase. As a result, electricity, fuels, plastics and food will also become more expensive. Possible consequences could be recession, increasing unemployment, and even a breakdown of the financial system. The imminent danger is not the end of oil but the end of *inexpensive* oil and thus, coincidentally, the end of our economic system, which is dependent on the use of inexpensive oil. Many critics cite past predictions that failed to come true claiming that oil supplies would already be exhausted by the end of the 20th century. This criticism, however, does not take all the relevant factors into account. On the one hand, there were predictions in the 1970s that oil reserves would be exhausted by the end of the 20th century or even before. On the other hand, however, there were also widespread predictions that oil production would not be exhausted around the end of the century but would have reached its maximum. There are even indications that this prediction would have come true if the oil crisis in the 1970s had not led to a temporary decrease in production. Many critics refer to the first statement regarding the exhaustion of oil supplies because they are not aware of the difference between peak oil and the exhaustion of oil supplies. They therefore assume that a general prediction has been made that global supplies will be exhausted by the year 2000. Table 1 contains a list of various sources whose predictions differ up to 20 years. In most cases, however, a production maximum for conventional oil has been predicted for the period beyond 2000, which means that predictions from the recent past are similar to those from the 1970s and have not, as is often argued, been adjusted in any way.

213 Cf. Robert L. Hirsch, Roger Bezdek and Robert Wendling, *Peaking of World Oil Production: Impacts, Mitigation, & Risk Management* (February 2005), http://www.netl.doe.gov/publications/others/pdf/oil_peaking_netl.pdf (accessed on 11 October 2010).

Table 2: Predictions regarding developments in oil production

Past predictions about oil production developments			
Date of prediction	**Source**	**Peak production of conventional oil**	**Assumed total production**
1972	ESSO	"Oil will become increasingly scarce after the year 2000"	2100 gigabarrels
1972	Report to the UN Conference on the Human Environment	"Likely that maximum production will have been reached by 2000"	2500 gigabarrels
1974	SPRU, University of Sussex	not specified	1800–2480
1976	British Ministry of Energy	Peak oil: "ca. 2000"	not specified
1977	Hubbert	Peak oil: 1996	2000 gigabarrels (Nehring)
1977	Ehrlich et al.	Peak oil: 2000	1900 gigabarrels
1979	Shell	"Production plateau within the next 25 years."	not specified
1979	BP ("Oil crisis… again?")	Peak oil (non-Communist world): 1985	not specified
1981	World Bank	"Production plateau around the turn of the century"	1900 gigabarrels
1995	Petroconsultants	Peak oil: 2005	1800 gigabarrels
1997	Ivanhoe	Peak oil: 2010	approx. 2000 gigabarrels
1997	Edwards	Peak oil: 2020	2836 gigabarrels
1998	IEA World Energy Outlook 1998	Peak oil: 2014	2300 gigabarrels (sample case)
1999	US Geological Survey (USGS) (Magoon)	Peak oil: ca. 2010	approx. 2000 gigabarrels
1999	Campbell	Peak oil: ca. 2010	2000 gigabarrels

			(including polar and deep-sea)
2000	Bartlett	Peak oil: 2004 or 2019	2000 or 3000 gigabarrels
2000	IEA World Energy Outlook 2000	Peak oil: "after 2020"	3345 gigabarrels (from USGS)
2000	Energy Information Administration (US Department of Energy)	Peak oil: 2016–2037	3003 gigabarrels (from USGS)
2001	Deffeyes	Peak oil: 2003–2008	approx. 2000 gigabarrels
2002	Smith	Peak oil: 2011–2016	2180 gigabarrels
2002	"Nemesis"	Peak oil: 2004–2011	1950-2300 gb equiv.

Source: www.oildepletion.org

#3 What Types of Resources are there?

- *Resources* are the total quantity of oil still available, regardless of whether it has been discovered or not and of whether it is recoverable or not.

- *Recoverable resources* are the share of oil that is considered recoverable. The quantity depends on

    1) the price of oil. It is not profitable to recover oil if the price of recovery is higher than the selling price. An increase in the price of oil, however, can make it economically profitable to recover resources that have hitherto been regarded as unprofitable, thus increasing the resources recoverable at market prices.

    2) the state of exploration and recovery technologies.

Figure 11: Ultimately Recoverable Reserves

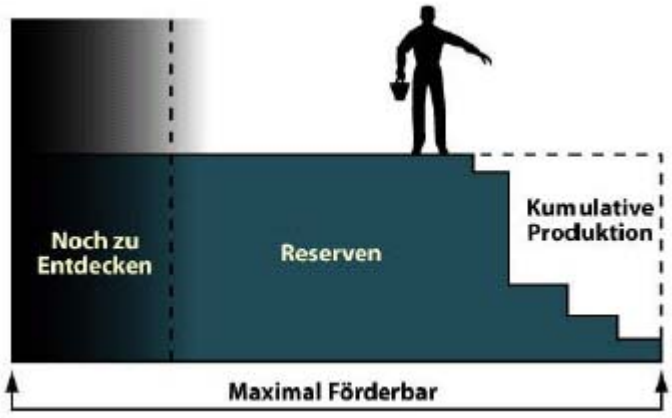


Figure 11 – Glossary

Noch zu Entdecken	yet-to-find
Reserven	reserves
Kumulative Produktion	cumulative production
Maximal Förderbar	ultimately recoverable

Source: www.wolfatthedoor.org.uk/deutsch

- *Reserves* are recoverable resources that have already been discovered but have so far remained untouched.

- *Yet-to-find reserves* are recoverable resources that have not yet been discovered.

- *Cumulative production* refers to resources that have already been recovered and have either already been consumed or are being kept in stock.

- *Ultimately recoverable reserves* are all resources that can be recovered. Thus: Ultimately recoverable resources = yet-to-find resources + reserves + cumulative production.

#4 What is the Difference between Conventional and Unconventional Oil and how Is it Recovered?

- *Conventional oil* is oil that is generally easy to recover, in contrast to oil sands, oil shale, heavy oil, deep-water oil, polar oil and gas condensate. Conventional oil reserves are extracted using their inherent pressure, pumps, flooding or injection of water or gas. Approximately 95% of all oil production comes from conventional oil reserves.

- *Unconventional oil* is oil that is technically more difficult to extract and more expensive to recover. The term unconventional refers not only to the geological formation and characteristics of the deposits but also to the technical realisation of ecologically acceptable and economical usage.

    - *Oil shale* is a sedimentary rock that is saturated with oils and bitumen and has not transformed into crude oil. The liquefaction process encompasses mining, crushing and heating the shale. Its net energy yield is rated as low and its eco-balance as poor.

    - *Oil sands* (tar sands) are sandstone containing some viscous heavy and extra-heavy oils that are recovered by surface-mining and liquefied through heating and separation. The recovery process is very elaborate but more efficient than that of oil shale.

    - *Heavy crude oil* is oil containing less than 17.5° API (API gravity) but more than 10° API (extra-heavy crude oil). Its production rate is limited by technical factors rather than by the quantity available of the resource.

    - *Deep-water oil* refers to underwater oil reserves from a water depth of 500 m. Its recovery is technically very complex and expensive.

    - *Polar oil* refers to the oil reserves along the polar circle. It is extracted mainly in Alaska and Siberia and also requires complicated techniques.

    - *Coal-to-liquid or gas-to-liquid products* are liquid hydrocarbons that are synthesised from the conversion of coal or natural gas.

#5 How Important are New Oil Discoveries?

Experts are of the opinion that it is important not to rely on finding undiscovered resources. Matthew R. Simmons, former energy adviser to the Bush government and advocate of the peak oil theory, believes that all big oil fields have already been found and are being exploited.[214] There are still new oil discoveries, but these tend to be small fields with a lower production volume. What is more, new oil fields are increasingly difficult and expensive to develop.

Discoveries of new oil reserves reached their highest in the 1960s. Since then, both the number and size of newly discovered fields have continued to decrease. There is a growing gap between discovery and consumption. In the words of geologist Colin J. Campbell, "We now find one barrel … for every four we consume". [215]

Figure 12: Annual Oil Discoveries

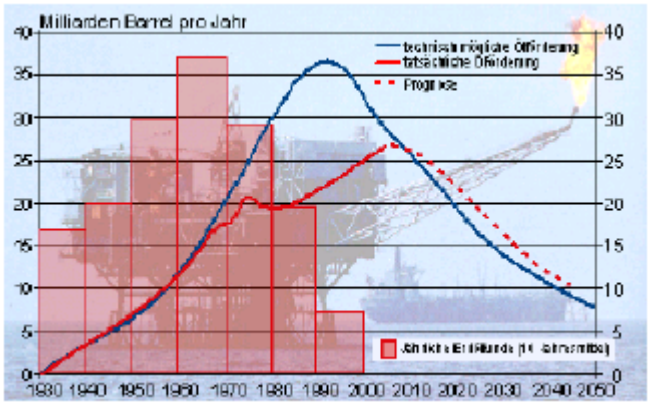


Figure 12 – Glossary

Milliarden Barrel pro Jahr	billions of barrels per year
Technisch mögliche Ölförderung	technically possible oil production
Tatsächliche Ölförderung	actual oil production
Prognose	prediction
Jährliche Erdölfunde (10 Jahresmittel)	annual oil discoveries (10-year average)

Source: www.energiekrise.de

214 The discovery trends of recent years also make clear that there will not be any major new discoveries in future.

215 Cf. Colin J. Campbell, "Die Erschöpfung der Weltölreserven", talk at Clausthal University of Technology (December 2010), www.energycrisis.org/de/vortrag.html (accessed on 14 October 2010)

#6 How Do Oil Refineries Work?

The oil that is extracted from the reservoirs is prepared for transportation to the refinery, by essentially separating it roughly from sediments and water. Following these initial processing stages, it is referred to as crude oil and delivered by ship or pipeline to the refinery. The liquid mixture is processed into saleable products using special distillation methods. Advanced technology makes it possible that none of the substances contained in crude oil remains unused.

In an oil refinery, the oil undergoes cleaning, distillation and conversion to make products such as petrol, diesel fuel, heating oil or kerosene.

Oil purification / desalting

Oil is freed of sand and water already at the reservoir site. To protect the processing facilities from corrosion, the crude oil is desalted (salt content < 10 ppm). By adding water, an emulsion of crude oil and water is produced, in which the salt dissolves. In an electrostatic desalter, the emulsion is then separated again. The saline water settles on the floor and is fed into appropriate processing systems. The desalted crude oil is pumped to the distillation unit.

Primary processing

After being desalted, the crude oil is heated to a temperature of up to 400°C. The heated oil is separated into its components using a thermal separation method (rectification) in a distillation tower (column) measuring up to 50 m in height. The crude oil enters the column in a two-phase flow (gas/liquid). The temperature decreases towards the top and, in accordance with their density, the individual components settle on the various levels in such a way that, from top to bottom, the following products are formed: liquid gas, petrol, kerosene, diesel, heating oil, bitumen and lubricants.

Conversion process

Following the primary processing phase, a series of refining processes is used to separate catalyst pollutants and to improve the quality of the intermediate products. Almost all oil products that come from the refinery have not been distilled or rectified from oil only. Various intermediate products and components are mixed together to produce for example motor fuel, diesel fuel and heating oil.

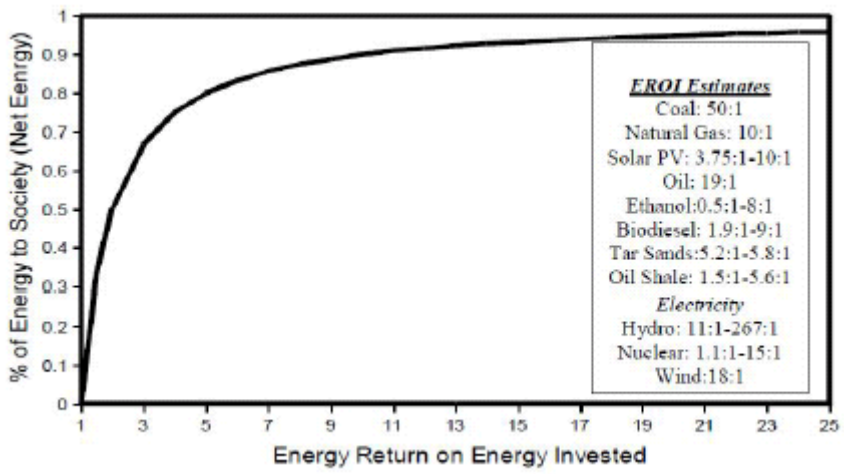
#7 What Is the Significance of EROI for the Price of Oil?[216]

To generate energy, energy is needed. EROI – Energy Return on Investment – specifies the relation between the energy generated and the energy that is used directly and indirectly for energy production. Net energy is the energy that remains after the energy production costs have been deducted. Energy production costs not only include the energy input necessary for recovering oil (direct) but also the input needed to find new sources or for the transport of energy (indirect).

The EROI is decreasing, because oil is increasingly found in reservoirs that are difficult to access, coal with lower energy content is used, and longer oil pipelines have to be built through difficult terrain. It is difficult to accurately calculate the EROI, but there are estimates that the EROI of American oil fell from 100:1 in the 1930s to 30:1 in the 1970s and eventually to between 11:1 and 18:1 today, and that the EROI of global oil and natural gas production lies at 18:1. These are average values. The value of new production facilities, however, is even lower. Oil shale, for example, has an EROI of 1.5:1 to 4:1.

With conventional oil decreasing in quantity, unconventional oils from biofuels, tar sands, etc. are used (no mutual dependences assumed). 100 joules of conventional oil with an EROI of 11:1 cost 9 joules to manufacture and provide 91 joules of usable energy. If this oil were replaced with bioethanol, 25 joules would be needed for production with an EROI of 4:1, which only yields 75 joules. The result is an even more rapid decrease in usable energy and, thus, an increase in energy costs.

Figure 13: EROI Estimation for Energy Sources



Source: cf. Heinberg, R. [217]

216 Cf. David Korowicz, *Tipping Point. Near-Term Systemic Implications of a Peak in Global Oil Production. An Outline Review*, The Foundation for the Economics of Sustainability (March 2010), 13 ff., http://www.feasta.org/documents/risk_resilience/Tipping_Point.pdf (accessed on 13 October 2010).

#8 Are there Ways for the Bundeswehr to Deal with Peak Oil?

Failsafe performance of social, political and economic systems plays a central role in security policy. Securing failsafe performance and thinking in terms of redundancies are basic components of military action. For the case of peak oil this concept has to be refined for the armed forces in order to maintain operational capability. Securing failsafe performance is particularly crucial in remote operational areas to which the major part of expendables must often be transported over long distances. Redundancies as well as local solutions for achieving partial material self-sufficiency can help satisfy resource requirements and, consequently, eliminate problems brought about by price increases or resource shortages. Particularly in most often prolonged stabilisation operations in areas with rudimentary infrastructure, meeting demands locally is preferable over a centrally homeland-managed, extensive and centralised supply.

The following examples of a community in the United States[218] can provide suggestions for and examples of a possible reduction in direct or indirect oil demand for Bundeswehr barracks and field camps and may provide a basis for further considerations.

The following is a representative, but not exhaustive, review of vulnerabilities and strategies identified by the Task Force:

Economic Context. Bloomington and Monroe County are clearly part of both national and global economies and our reliance on a steady supply of inexpensive goods from as far away as half-way around the world makes us vulnerable to a decline in inexpensive oil.
Mitigation:

- Promote economic relocalization through "Buy Local!" initiatives; encourage a Local Exchange Trading System and cooperate with *Transition Bloomington*.
- Examine sector dependence on oil.
- Develop and deploy sustainable forms of energy.
- Develop and promote green jobs.

217 Cf. Richard Heinberg, *Searching For a Miracle. Net Energy Limits & the Fate of Industrial Society*. Forum on Globalisation & The Post Carbon Institute (September 2009), 55, http://www.postcarbon.org/new-site-files/Reports/Searching_for_a_Miracle_web10nov09.pdf (accessed on 14 October 2010).

218 Cf. Dave Rollo et al., *Redefining Prosperity: Energy Descent and Community Resilience. Report of the Bloomington Peak Oil Task Force* (October 2009), http://bloomington.in.gov/media/media/application/pdf/6239.pdf (accessed on 14 October 2010).

Municipal Services. As the price of oil both becomes more volatile and more expensive, so too will the price of electricity, natural gas, and other energy resources. It will become more expensive for the City to: treat and pump drinking water; treat its wastewater; provide fuel for law enforcement and fire protection; heat and cool municipal buildings; and pick up trash and recycling. Similarly, the City will also experience a general increase in cost of just about anything that relies on energy to produce and transport it.

Mitigation:

- Explore hybrid energy (hydroelectric-solar) generation to complement existing power at the water treatment plant.
- Encourage more rainwater capture by residents and the City.
- Offer energy efficiency and water conservation incentives to residents.
- Expand water storage capacity.
- Transition all back-up generators to renewable sources of energy.
- Develop a community compost program.
- Establish waste reduction goals -- *Zero Waste Bloomington* by 2040.
- Explore sludge-to-biogas energy generation at the wastewater treatment plant.
- Develop a fuel allocation plan wherein, in the event of a fuel shortage, the Police and Fire Departments are given greatest priority.
- Replace patrol cars with electric vehicles.
- Investigate police pursuit vehicles that do not rely on fossil fuels and transition over to such vehicles as this technology improves.
- Explore alternatives to asphalt.
- Offer carpooling incentives to employees.
- Reduce the size of the City fleet though partnerships with car sharing groups.

Transportation. Of all sectors, transportation is the most petroleum dependent and the most vulnerable to a disruption resulting from declining world petroleum supplies. Ninety-seven percent of transportation energy is reliant on fossil fuel. In Monroe County, we drive approximately 2.8 million miles *per day*. That's like driving one car around the Earth at the equator 112 times in one day.

Mitigation:

- Bring daily necessities closer to where people live.
- Establish ride and car sharing programs.
- Increase connectivity & the number of planned "lengthy corridors" for bicyclists.
- Make bus transportation faster and more attractive.
- Seek funding improvements for Bloomington Transit.
- Encourage Bloomington Transit to transition its bus fleet from one relying on diesel fuel to one relying on locally-produced biogas.
- Work toward a regional Comprehensive Land Use and Transportation Plan involving the City of Bloomington, Monroe County, and Indiana University that fosters bicycle, pedestrian, and transit-friendly changes in land use.
- Encourage commuter rail between Bloomington and other cities.
- Encourage bus service between Bloomington and downtown Indianapolis.

Land Use. When it comes to land use, the physical separation of where we live from where we carry out the activities of everyday life – work, food, school, health care, and community – is by far the biggest threat posed by the end of cheap oil.

Mitigation:

- Through zoning and other land management tools, encourage the redistribution of land to bring about denser living arrangements, and a closer integration of residential and commercial activity, thus reducing the total amount of intra-city transportation required. We must restructure our community to provide high-density, multi-use arrangements friendly to transit, bicycles, and pedestrians.
- Update the City's land use documents with an eye to peak oil.
- Target public transit routes to help shape neighborhood development.

Housing. An aging grid, paired with the likelihood that more and more people will turn to electricity to power their cars, means that the grid will be increasingly taxed. In Indiana, the grid is powered by coal-generated energy. Coal relies on oil for extraction and transportation. Absent efficiency improvements, it will be ever-more expensive to heat our homes.

Mitigation:

- Engage in outreach to reduce energy demand through conservation.
- Work to retrofit 5% of homes for energy efficiency per year.
- Explore the possibility of local power generation from renewable sources.
- Establish loans and incentives for installation of renewable energy.
- Create incentives to make rental units more energy efficient.

Sustenance can be understood as the maintenance and nurturance of health and life. The elements of sustenance include: food, water, waste handling, and health care. At present, these elements are provided by private companies, government, and publicly-owned corporations and are entirely dependent on petroleum. Indeed, less than 2 percent of the food consumed by city residents is produced within the city, its surrounding region or the state.

Mitigation:

- Work closely with the private sector and Indiana University to outline a detailed plan for community food security. Adopt a *Food Security Resolution*.
- Plant edible landscapes on public property.
- Organize City-led horticultural services to include the collection, processing, and distribution of organic waste.
- Increase local food storage.
- Train and deploy more urban farmers.
- Remove or reduce legal, institutional, and cultural barriers to farming within and around the city, and open institutional markets to local food.
- Establish food-business incubator programs with access to community kitchens.
- Dedicate public land to intensive gardening and farming.
- Work toward a year-round regional farmers' market.
- Work toward the establishment of a local land trust for the banking of farmland.
- Work toward providing more local or regional organic food to Monroe County Community School Corporation, Indiana University, Ivy Tech, and Bloomington Hospital.
- Create a local, publicly-controlled seedbank.
- Encourage water conservation through outreach and incentives.
- Create community composting sites.
- While the City has little direct influence over health care, it can work with stakeholders to advocate for a health care system that is resilient even in the face of peak oil. Specifically, as a community we should: encourage a mobile medical corps for house calls; encourage more neighborhood health clinics and doctors' offices; and support a concentration of essential medical services to remain in the central city location accessible by public transit and pedestrians.

Further Recommended Reading on Peak Oil

Ranking of US federal states that depend significantly on oil as well as of those that have taken measures to free themselves from this dependence:

> **Gardiner, David et al.,** *Fighting Oil Addiction: Ranking States' Oil Vulnerability and Solutions for Change.* National Resources Defense Council, July 2008, http://www.nrdc.org/energy/states/states.pdf (accessed on 14 October 2010).

Study based on the research hypothesis that some US cities are better prepared than others for an increase in oil prices and a potential disruption in oil supply (ranking):

> **Karlenzig, Warren, Major US City Preparedness for an Oil Crisis: Which Cities and Metro Areas are Best Prepared for $4 a Gallon Gas and Beyond?, Common Current, March 2008, http://www.commoncurrent.com/pubs/OilCrisis3.4.08.final.pdf (accessed on 14 October2010).**

Description of the energy supply situation in the form of trends with a focus on implications for the American armed forces:

> **Eileen T. Westervelt und Donald F. Fournier, Energy Trends and Their Implications for U.S. Army Installations, Engineer Research and Development Center, September 2005, http://static.cbslocal.com/station/wcco/news/specialreports/projectenergy/06_0420_projectenergy_energytrendsreportfromarmycorps.pdf (accessed on 14 October 2010).**

This study, which was compiled for the US Department of Defence, identifies four areas (strategic, operational, fiscal, ecological) in which there is a gap between the practice of current energy consumption and the requirements for achieving future strategic objectives:

> **Thomas D. Crowley et al., Transforming the Way DoD Looks at Energy. An Approach to Establishing an Energy Strategy, LMI Government Consulting, April 2007, http://www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA467003&Location=U2&doc=GetTRDoc.pdf (accessed on 14 October 2010).**

Further Peak Oil Task Force Reports:

Portland, Oregon: *Descending the Oil Peak: Navigating the Transition from Oil and Natural Gas, March 2007,*
http://www.portlandonline.com/OSD/index.cfm?a=145732&c=42894 (accessed on 14 October 2010).

San Buenaventura, California: *Transforming Urban Environments for a Post-Peak Oil Future. A Vision Plan for the City of San Buenaventura, 2007,*
http://www.cityofventura.net/files/public_works/maintenance_services/environmental_services/resources/post-peakoil.pdf (accessed on 14 October 2010).

Oakland, California: *Oil Independent Oakland Action Plan, February 2008,* http://www.oaklandnet.com/oil/pdfs/OIO□ActionPlan□020608.pdf (accessed on 14 October 2010).

San Francisco, California: *San Francisco Peak Oil Preparedness Task Force Report, March 2009,*
http://www.sfenvironment.org/downloads/library/peakoil_final_report.pdf (accessed on 14 October 2010).

Berkeley, California: *Berkeley Energy Descent 2009-2020: Transitioning to the Post Carbon Era, April 2009,*
http://postcarboncities.net/files/BerkeleyEnergyDescentPlan.pdf (accessed on 14 October 2010)