

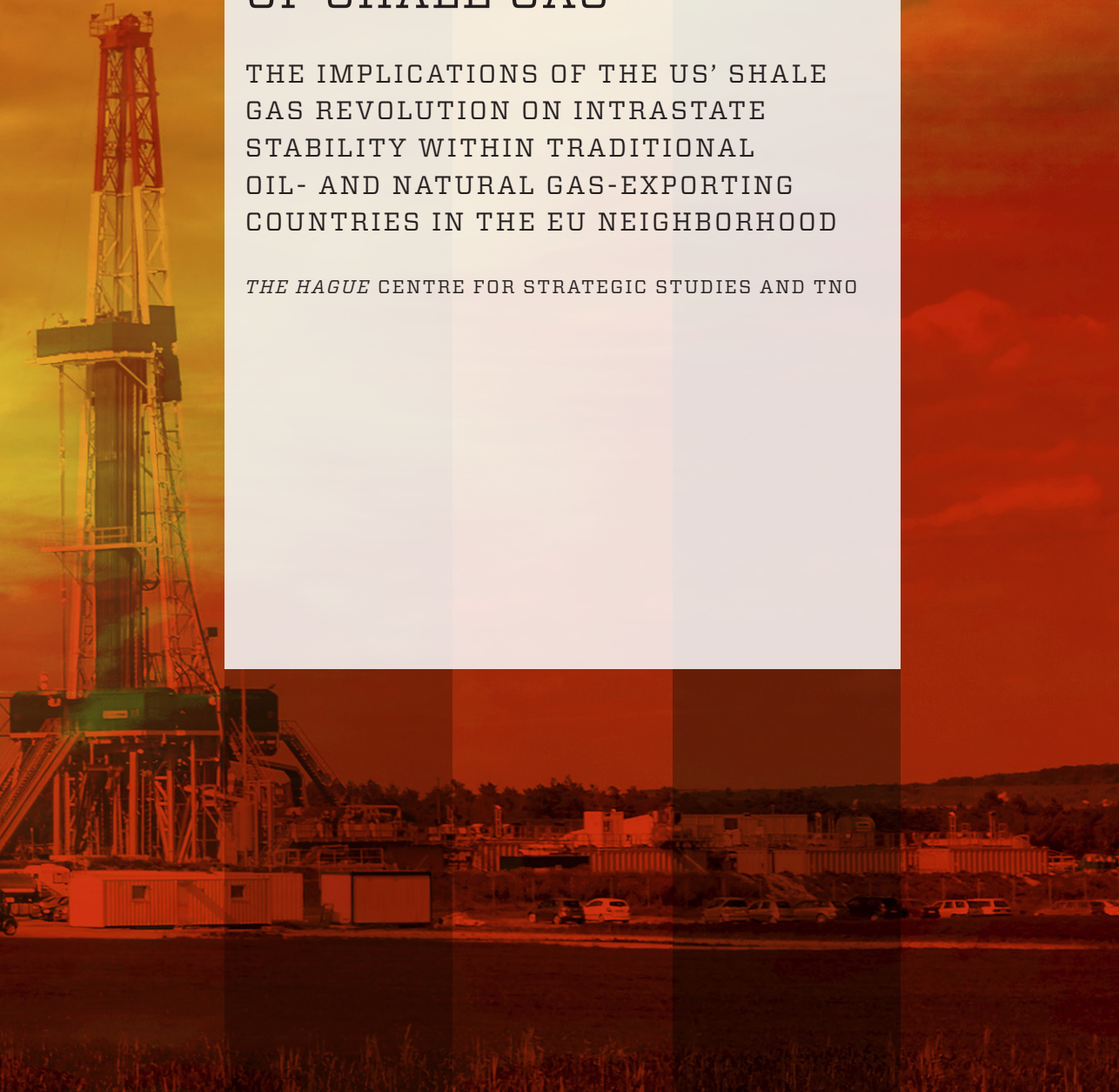


STRATEGY
& CHANGE

THE GEOPOLITICS OF SHALE GAS

THE IMPLICATIONS OF THE US' SHALE
GAS REVOLUTION ON INTRASTATE
STABILITY WITHIN TRADITIONAL
OIL- AND NATURAL GAS-EXPORTING
COUNTRIES IN THE EU NEIGHBORHOOD

THE HAGUE CENTRE FOR STRATEGIC STUDIES AND TNO





TNO and The Hague Centre for Strategic Studies (HCSS) program Strategy & Change analyzes global trends in a dynamic world affecting the foundations of our security, welfare, and well-being.

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THE GEOPOLITICS OF SHALE GAS
THE HAGUE CENTRE FOR STRATEGIC STUDIES (HCSS) AND TNO

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THE NETHERLANDS ORGANISATION FOR APPLIED SCIENTIFIC
RESEARCH (TNO)

FOREWORD

The growth in domestic natural gas production in the United States (US), led by the increased development of shale resources and a process known as hydraulic fracturing, or ‘fracking’ for short, has fundamentally altered the US energy landscape. Simultaneously, the same extraction technology is spurring the production of unconventional oil resources (shale oil and tight oil) and has set the US on course to become the world’s premier oil producer by the mid 2020s.

Where successive US Presidents since the 1970s have advocated for a lessened dependence on foreign energy supplies, the ‘shale revolution’ seems to have finally turned this dream into a reality. Globally, this development is likely to have a significant bearing on international relations. A US which is less dependent on foreign energy supplies has more freedom of maneuver in its foreign policy. Moreover, this is likely to affect the global energy mix as well as US and wider relations with traditional oil- and natural gas-exporting countries.

This study employs an innovative new computer modeling technique in an attempt to answer the extent to which, as well as how, the US’ shale gas revolution impacts on the world in all its complexity. Specifically, it focuses on how the US’ shale gas revolution may affect the stability of traditional oil- and natural gas-exporting countries near the European Union (EU). As the EU is heavily dependent on the import of oil and natural gas from countries in its immediate neighborhood, the extent to which the US shale gas revolution leaves its mark on Europe’s backyard is a very relevant question to ask.

In today’s world access to energy supplies still is a major factor in geopolitics. It is for this reason that the unprecedented changes in the US energy landscape *cannot* and *should not* be viewed in isolation.

Prof. Dr. Rob de Wijk, Director the Hague Centre for Strategic Studies

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LIST OF ABBREVIATIONS

ARA	Amsterdam Rotterdam Antwerp
Bcf	Billion cubic feet
Bcf/d	Billion cubic feet per day
BTU	British Thermal Units
Bbtu	Billion British Thermal Units
mmBtu	Million British Thermal Units
CEFIC	European Chemical Industry Council
CNPC	Chinese National Petroleum Corporation
DOE	US Department of Energy
ECT	Energy Charter Treaty
EIA	US Energy Information Administration
EMA	Exploratory Modeling and Analysis
EU	European Union
EROEI	Energy Return On Energy Invested
FTA	Free Trade Agreement
GECF	Gas Exporting Countries Forum
GRI	Gas Research Institute
HCSS	The Hague Centre for Strategic Studies
IEA	International Energy Agency
IMF	International Monetary Fund
IMO	International Maritime Organization
LNG	Liquefied Natural Gas
Mbbl	Thousand barrels per day
MMbbl	Million barrels per day
MMcf/d	Million cubic feet per day
MoU	Memorandum of Understanding
OECD	Organization for Economic Co-operation and Development
R&D	Research and Development
SD	System Dynamics
TAP	TransAdriatic Pipeline

LIST OF ABBREVIATIONS

Tcf	Trillion cubic feet
TNO	The Netherlands Organisation for Applied Scientific Research
TRRs	Technically Recoverable Shale Gas Resources
UK	United Kingdom
US	United States
VNCI	Vereniging van de Nederlandse Chemische Industrie, the national chemical association of the Netherlands

EXECUTIVE SUMMARY

GOAL AND SCOPE OF THE STUDY

This study analyzes the geopolitical impact of the spectacular rise in shale gas exploration and production in the United States (US) on Europe and its relations with important oil and gas exporting countries in its immediate neighborhood. The goal of the study is to find what implications the shale gas revolution may have on the global energy mix, oil and gas prices, and through these prices on the potential impact of shale gas on intrastate stability. It was performed in the context of the Strategy and Change program (S&C) in which the Hague Centre for Strategic Studies (HCSS) and The Netherlands Organisation for Applied Scientific Research (TNO) cooperate.

We primarily focus on the indirect geopolitical effects of the US shale gas boom, but start with a review of the literature on the direct effects on the competitive position of energy intensive industries in Europe (Figure 1).

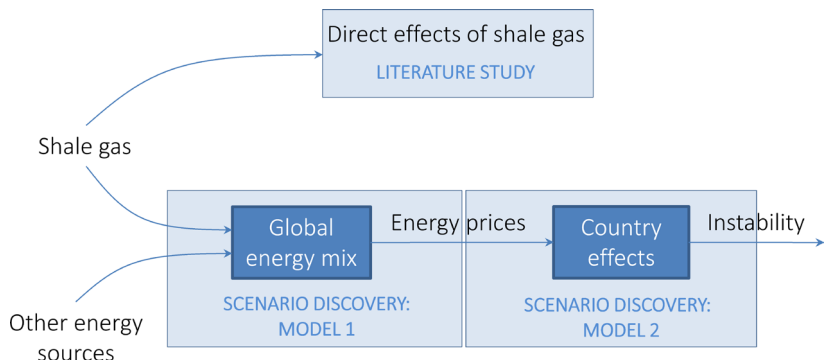


FIGURE 1. THE RESEARCH DESIGN OF THE STUDY

Following on this, we explicitly analyze the indirect, geopolitical effects of the US' shale gas revolution. We specifically look whether the development of shale gas in the US may have destabilizing effects on oil and gas exporting countries near the European Union (EU) in the long term, which in turn have an effect on the external and internal stability of EU countries and substantiate new strategic policy measures.

The indirect impact of shale gas takes place on two different levels. The first level is the global energy landscape, where the supply of different primary fuels compete, given their characteristics, for the global demand. In this landscape, we look at the interaction between energy supply, demand, prices, and the energy mix. On the second level, especially natural gas and oil prices generate resource rents for energy exporting countries, which are known to interact with social indicators, such as (youth) unemployment, purchasing power, and as a resultant of these, social unrest. To understand the effects of long delays characterizing both the global energy system, and the development of countries (e.g., demographical developments), we take a long term horizon until 2050.

Countries investigated in this study are Russia, Algeria, Egypt, Qatar, Saudi Arabia, Azerbaijan, and Kazakhstan; all important oil and gas exporters to the EU. Given that Northwestern Europe is equally home to several large natural gas and oil producing countries (i.e., the Netherlands, Norway, Denmark and the United Kingdom), and thus will also see its export revenues affected by the development of shale gas, Northwestern Europe was also included in the analysis.

RESEARCH DESIGN

The complexity of these issues makes it inadvisable to rely on mental simulation of the impact of shale gas on both indicated levels. For this reason, we make use of two System Dynamics (SD) models for Scenario Discovery, which fits in the Exploratory Modeling and Analysis (EMA) methodology. SD is a modeling method which allows the simulation of complex problems through the effects of interacting feedback loops and accumulation in a system.¹ Scenario Discovery is aimed at exploration of

1 J.W. Forrester, *Industrial Dynamics* (Cambridge, Massachusetts: MIT Press, 1961); John D. Sterman, *Business Dynamics: Systems Thinking and Modeling for a Complex World* (Boston: McGraw-Hill, 2000).

the consequences of deep uncertainty through quantitative (simulation) models.² Using SD models for Scenario Discovery allows the consequences of plausible combinations of assumptions about the functioning of the energy system and country stability, including parameter values, to be explored. By combining the two models for Scenario Discovery, this study thus poses an extended 'what-if' analysis of the different combinations of examined assumptions.

The first model in this study is a regionalized global model regarding the supply and demand of natural gas and oil, in relation to coal, nuclear, hydro, and renewable energy. A resultant and major influence on the regional energy mixes in Europe and adjacent regions, North America, the Far East, and the rest of the world, are global and regional energy prices. As the global energy system is characterized by long delays, both with regard to supply and demand, we simulated the system for the period until 2050. These price dynamics thus form internally consistent transient scenarios together with the composition of the energy mix for the period between now and 2050.

For the selection of relevant natural gas and oil price scenarios, two different methods were applied. First, we looked at individual fuel types (natural gas, coal, oil and renewables) and, out of the total number of dynamic scenarios, we selected those scenarios whereby an individual fuel type had reached its highest share among Europe's energy mix. Second, we selected those scenarios which experience the greatest volatility in oil prices in all regions investigated. The reason for doing so is our interest in extreme scenarios: scenarios which show price changes potentially outside the coping capacity of countries. Such scenarios represent a 'stress test' of country stability.

Selected price scenarios for natural gas (regional) and oil (global) subsequently act as input for the second model, the Country Stability Model. That model simulates the economic development of countries, dependent on the development of resource rents, other economic

2 Steven C. Bankes, 'Exploratory Modeling for Policy Analysis,' *Operations Research* 41, no. 3 (1993): 435-449, <http://www.jstor.org/stable/10.2307/171847>.

developments, related population growth, and connected to that, the development of purchasing power and (youth) unemployment. Within the 'greed and grievance' paradigms, the model thus follows the greed side of causes for instability, as it focusses on economic effects, while identity related causes for discontent, or 'grievance', are not considered. By doing so, we were able to assess whether the price scenarios will have a desirable or undesirable effect on the country's stability compared to a situation of stable prices. By doing so, we were able to assess whether the price scenarios will have a desirable or undesirable effect on the country's stability compared to a situation of stable prices.

FINDINGS: POTENTIAL DIRECT EFFECTS

The 'shale gas revolution' is dramatically changing the US' energy landscape. The technological advances of horizontal drilling in combination with a process known as hydraulic fracturing, or 'fracking' for short, have greatly expanded the ability for US' producers to profitably extract natural gas and oil from low-permeability geological plays, shale plays in particular. Despite consistently having been projected to remain an energy importer for the long term, the tables for the US now seem to have turned. Almost all of the demand for natural gas in the US can be met by domestic production, while a surge in oil output has set America on course to become the world's largest oil producer, overtaking Saudi Arabia by the mid-2020s.

This development has a number of direct effects. Natural gas prices in the US have declined sharply as a result of shale gas exploration. The abundance of cheap gas caused electricity prices to go down. We observe that investments in energy intensive industries in the US have gone up as a result. This economic success, coupled with a greater independence from what is seen as unreliable energy exporting countries, has caused other countries around the world (including China, India, Argentina, Poland, Ukraine, and many others) to explore their own shale formations for their economic viability.

However, we acknowledge that shale gas is unlikely to be a 'game changer' worldwide, in the same way as it is in the US. This is due to a variety of reasons, including the different way in which land-ownership rights are organized outside the US, local opposition and environmental concerns,

stricter regulatory and environmental standards, the often more challenging geology outside the US and the long lead times required for the assessment of commercially viable quantities of shale gas. However, despite the fact that the 'shale gas revolution' is as such still primarily an American phenomenon, it is not without consequences for Europe.

FINDINGS: POTENTIAL INDIRECT EFFECTS

The impact of these direct effects notwithstanding, the indirect effects of the US' shale gas revolution are likely to be far greater and long-lasting. Since the advent of shale gas, US' demand for imported Liquefied Natural Gas (LNG) has dropped significantly. LNG exports have since been partly rerouted to Europe and notably Japan, who since the Fukushima incident was in great need of replacing lost nuclear power. Equally, coal no longer needed in the US is also finding its way to other markets. These redirected energy flows caused natural gas prices on European spot markets to drop, leading to Europe becoming a buyers-market. This development puts stress on the traditional construction in European and Asian markets, whereby natural gas contracts are long term, pegged to the price of oil, and coupled with a 'take-or-pay' clause which obliges the client to purchase a minimum amount of gas irrespective of market demand. With demand in Europe low due to the economic crisis, and natural gas prices dropping due to the influx of LNG and coal, many consuming countries and energy companies entered into negotiations with natural gas producers to break open their long term contracts, opening up a larger share of the contract to spot pricing.

On a strategic level, as US energy import dependency is greatly decreasing, a 'rebalancing' of US foreign policy is taking place from the Middle East toward other regions, notably the Asia/Pacific. Any void left by the US in the Middle East in terms of oil and natural gas demand, is likely to be filled by emerging economies, China and India in particular. It is not unimaginable that this brings about increased competition between China and India in an already politically unstable region. This development could render the old 'Pax Americana' a thing of the past, while no other parties are willing to take over America's role.

Traditionally, in countries heavily dependent on resource rents, these rents are used as part of the social contract between government and society.

This can take different forms, either job creation or enhancing purchasing power by food or fuel subsidies. Either way, the advent of shale gas and other unconventional energy sources could have as a consequence that this precarious social contract becomes unsustainable in the long term, leading to popular resentment and instability in important gas and oil exporting countries.

A SLOWDOWN IN OIL DEMAND GROWTH

Shale gas and other unconventional energy sources in essence show that the amount of extractable natural gas and oil are not a fixed stock. Hence the world without shale gas would be the real revolution, as higher energy prices would not have led to an increase in supply of more expensive resources, leaving the world without its present most important energy sources. However, as unconventional energy sources do not pose free forms of energy, but rather expensive energy sources, the extraction of these resources will only take place when price levels are high enough.

Hence, the development of shale gas is unlikely to take off at a similar rate globally as witnessed in the US. However, the onset of American shale gas is likely to cause the global available supply of natural gas to increase, as more extraction capacity for natural gas came available in the US. Taking into account that worldwide demand for natural gas is projected to increase strongly, the mix between natural gas and other fuels is thus set to change. In the short term (until 2020), this already takes place in North America, but in the medium (2020 till 2030) to long term, this will have effects globally.

The analysis points in particular to shifts in the European energy mix which displace oil in the medium term, putting oil prices under pressure, as a strong factor in determining whether instability occurs in the oil and gas exporting countries investigated in this study. This point touches at the heart of the matter: the increase in the use of natural gas at the expense of oil which is gradually taking place in certain economic sectors.

The greater availability of LNG worldwide has prompted transportation companies, as well as governments to look at ways in which LNG can be used in commercial transport, partially as a way to cut down on pollution and partly because prices have come down due to an abundance of supply. Moreover, as typically one-third of a transportation company's cost base is

fuel, the cost saving argument tilts favorably toward LNG in light of the low gas price in the US and increased price levels of gasoline and diesel. Heavy duty vehicles, buses and particularly shipping are thought to have great potential. Moreover, gas can also substitute oil for use in power stations, (petro)chemical plants and domestic and industrial heating systems. The onset of shale gas could thus act as a catalyst for accelerating the shift from oil to natural gas in energy-intensive sectors of the economy.

Furthermore, in particular decoupling is a factor to watch. In all scenarios with significant decoupling, this caused substantially lower oil and gas prices, and a higher level of instability compared to the reference scenario. Within OECD countries, decoupling is already a cornerstone of the policy toolkit to enhance energy security and reduce harmful impacts on the environment. In view of this conclusion, it is important to stress that emerging economies are also moving step-by-step towards tougher fuel-efficiency standards on vehicles – although not (yet) up to the level of developed economies. The fuel-efficiency measures implemented by China in March 2013 are a good example of this, restricting average fuel consumption among passenger vehicles to 6.9 liters per 100 kilometers by 2015, with a further reduction to 5.0 liters by 2020. Although energy demand is still growing, such developments are likely to also contribute to a slowdown in the projected demand for oil in the coming years. All of the above may lead to a slowdown in the growth of demand for oil worldwide. The advent of shale gas adds to this potential.

POTENTIAL FOR INSTABILITY AROUND EUROPE

Not all of the countries in our study emerge as equally vulnerable to declining oil and gas prices as a consequence of a slow down in oil demand growth. Factors that emerge as critical are the regime type in place, unemployment, and financial buffers. Countries particularly exposed are those which are of an anocratic regime-type, suffer from high youth unemployment, and possess limited financial reserves (in the form of sovereign wealth funds) to compensate for a reduction in export earnings caused by a lower oil price. Out of all countries investigated, Algeria and Russia score worst on these variables, and thus emerge as particularly vulnerable. This is not least due to both countries' sheer addiction to resource rents misallocated in their economies. This renders them highly exposed to oil price fluctuations.

Europe could thus be confronted with heightened instability in two of its most important natural gas- and oil-providing countries when indeed oil demand growth slows down in the long term. This could potentially lead to situations in which reduced oil rents cause a worsening of national economic circumstances, leading to a rise in youth unemployment and strongly reducing the purchasing power of the population. In specific cases, a worsening of these variables has led to severe internal unrest, eventually leading to regime change.

This observation sheds light on existing EU policies of energy diversification geared toward greater security of supply. The direct effect of lower natural gas prices in the US is prompting many EU countries to advocate in favor of the exploration of shale gas in Europe, in a bid to increase the competitiveness of the European economy, and lower the dependence on imported energy from unstable and unreliable producer countries (c.f., the Country Stability Model). We found that the pursuit of greater energy security, leading to such lower import dependency, is not without consequences for the stability in Europe's neighborhood. Our analysis makes it clear that shifts in the energy mix that displace oil in the medium term can put oil prices under pressure, contributing to a heightened risk of instability in oil- and gas-exporting countries which score badly on our criteria for vulnerability; more specifically Algeria and Russia.

This means that policies geared toward greater energy self-sufficiency, either in the form of greater domestic production of fossil fuels (e.g., shale gas), increases in energy efficiency, a transition from fossil fuels toward a larger share of renewable sources or nuclear in the energy mix, or a combination thereof, impacts the stability of Europe's neighborhood. Europe could be faced with incidences of social unrest in two of the most important oil- and gas-exporting countries in its vicinity. The lessons learnt from the 2011 Arab uprisings make painfully clear what worsening economic circumstances, coupled with lingering popular resentment can cause.

Therefore, it is important that any future EU strategy on external energy relations firmly takes into account the impact of existing and planned policy choices with respect to Europe's energy mix on oil and gas exporters in the EU neighborhood. Energy security implies the fostering of a sustainable and trustworthy partnership between both energy consumer

and supplier. If this is not taken seriously, the energy partnership that the EU holds with both countries could be susceptible to distrust.

In sum, we believe that the indirect impact of the US' shale gas revolution on Europe could be far greater and long-lasting than the direct effects on both the EU energy mix, and the competitiveness of European energy-intensive industries. The onset of shale gas can have destabilizing effects on important oil and gas exporters to the EU, particularly in the case of Russia and Algeria. The other countries in our study are not as vulnerable as Russia and Algeria, owing either to larger buffer capacities, a more diversified economy, lower unemployment figures, a more stable regime type, or a combination. However, they do share many of the same characteristics that render them fragile to long term changes in the global energy mix in so far as this puts pressure on oil prices and consequently on resource rents.

In anticipation of instability and to balance out the effects of European policy choices aimed at greater energy self-sufficiency, the EU should therefore more actively support economic diversification efforts in hydrocarbon exporting countries in its neighborhood, so as to create robust economies which can successfully weather oil price fluctuations.

Doing so warrants the creation of new energy interdependencies between Europe and the hydrocarbon exporting countries in its neighborhood. One avenue along which this could be established is via the path of energy transition. Existing EU policy is aimed at 'greening' the European economy: a process which requires significant investments. However, Europe is going through a profound economic crisis which undermines the ability to invest on a large scale. At the same time, the oil- and gas-exporting countries in the MENA region are faced with the pressures of expanding populations, a growing domestic energy demand and the possibility that long term changes in the global energy mix may negatively affect their export revenues. This places stress on their existing model of wealth creation and warrants a need for their economies to diversify in the direction of other, particularly non-hydrocarbon, sectors.

European governments and companies have the technology and know-how to foster such a transition to alternative sources of energy. On the

other hand, countries such as Qatar and Saudi Arabia are home to sizeable sovereign wealth funds, yet lack the technology and expertise to embark on a sustainable energy transition. One way of fostering a new kind of energy interdependence could be for countries such as Qatar and Saudi Arabia to invest in the greening of Europe, in exchange for the transfer of technology and expertise to diversify their own economies. This would enable them to diversify away from their over-reliance on hydrocarbon exports and potentially better equip them to deal with oil price fluctuations in the future.

1 INTRODUCTION

In 2011, roughly 95% of all natural gas consumed in the United States (US) was produced domestically, making the US almost independent of foreign suppliers when it comes to natural gas.³ Indeed, the US' natural gas import dependency has been declining steadily throughout the past years as a result of the large-scale extraction of shale gas. At the same time, the US is projected to become the world's largest producer of oil by around 2020, overtaking Saudi Arabia until the mid-2020s as a result of the large-scale extraction of light tight oil resources.⁴

Shale gas, tight oil, shale oil and tight gas are unconventional types of energy which, due to technological advances of horizontal drilling in combination with a process known as hydraulic fracturing, or 'fracking' for short, have greatly expanded the ability for US producers to profitably extract natural gas and oil from low-permeability geological plays; shale plays in particular. The availability of large quantities of shale gas and tight oil endow the US with a large supply of domestically supplied energy for many years to come and potentially enable it to orient some of its supplies to other countries for export.⁵

The 'shale gas revolution' in the US has had profound implications for the price of natural gas in America. Large-scale extraction caused US' natural gas prices to decrease and reach a record low of US\$ 1.95 per million British Thermal Units (mmbtu) in April 2012. Currently the price hovers around

3 'What Is Shale Gas and Why Is It Important?,' *US Energy Information Administration*, December 5, 2012, http://www.eia.gov/energy_in_brief/article/about_shale_gas.cfm.

4 *World Energy Outlook 2012*, World Energy Outlook (Paris: International Energy Agency (IEA), 2012), 23.

5 'What Is Shale Gas and Why Is It Important?.'

US\$ 3.50 – 4 per mmbTU.⁶ This low price of natural gas is spurring economic activity in the US – with lower gas and electricity prices giving industry a competitive edge – and steadily changing the role of North America in global energy trade. More and more energy-intensive companies that had left the US because of high energy prices are gradually finding their way back to America.⁷

The surge in US oil production aside, it is the great success of the ‘shale gas revolution’ in the US in particular that makes other countries keen to replicate the American experience and explore the potential of their own resources. Notable deposits of shale gas are believed to exist in China, Poland, France and Ukraine, among others. Next to being a possible supply of cheap energy and hence a competitive boost to the sluggish European Union (EU) economy, European countries view shale gas as a possible way to lessen their dependence on external natural gas suppliers, notably Gazprom. By the same token, China is keen to explore its vast shale gas resources as a way to improve its security of energy supply. At this point in time, it is still unclear to what extent the US’ experience can be replicated in other countries, as more test drilling and research should be carried out to determine the genuine potential of shale plays outside the US.

Irrespective of the possible success of shale gas drilling outside the US, the experience in America has already impacted global energy markets. Prior to the US’ shale gas revolution, America was projected to remain a net importer of natural gas for a long time. In anticipation of the growing import dependency many Liquefied Natural Gas (LNG) regasification plants were constructed along US shores, only to be mothballed now that they are no longer needed. As a consequence LNG-exporting countries are trying to reroute their supplies to Europe and Asia. Given the abundance of natural gas in the US and LNG overcapacity, natural gas markets currently find themselves in a situation of oversupply. Moreover, coal which is currently no longer needed in the US due to the competition from low-priced natural gas is finding its way to other parts of the world, notably Europe.

6 ‘Henry Hub Gulf Coast Natural Gas Spot Price (Dollars/Mil. BTUs),’ *US Energy Information Administration*, August 14, 2013, <http://www.eia.gov/dnav/ng/hist/rngwhhdm.htm>.

7 *World Energy Outlook 2012*, 23.

This situation places pressure on the dominant way in which gas is traded on the European market. Traditionally, natural gas deliveries in Europe are embedded in long-term contracts whereby the price of natural gas is pegged to a mix of competing fuels, fuel oil and gas oil in particular, and there is an obligation on the importing country to take a set amount of natural gas irrespective of market demand. With the price of natural gas in the US at a low point and oversupply in natural gas markets, the pressure on energy companies to lower the price of natural gas in their contracts is mounting. Companies such as Gazprom and Statoil are increasingly forced to hand out discounts, or open up their long-term contracts and expose a certain percentage to spot market pricing. It is likely that this development will also have an impact on Dutch long-term natural gas contracts.

In the long term, as the supply of different fuels compete for global demand, substitution affects the shares of gas and oil in the global energy mix. When substitution negatively affects demand for natural gas or oil, this can bring about a decline in price levels, resulting in lower export revenues for natural gas- and oil-exporting countries. A decline in export revenues for hydrocarbon-exporting countries is not an insurmountable problem if the countries in question possess a sufficiently diversified economic structure and are thus not to a great extent reliant on oil and gas export revenues to balance their budgets. This may be the case in Norway, but it is certainly not the case in Russia, Qatar, Azerbaijan, or Algeria. If one takes into account that many countries reliant on the extraction of oil and gas as their main source of government revenue also heavily subsidize fuel and other goods domestically, then the risk of having to lower such subsidies increases if the budget balance worsens. Such a development heightens the risk of socio-political unrest; a feat often witnessed in oil- and gas-exporting countries which lowered subsidies on basic goods.

This study analyzes the geopolitical impact of the spectacular rise in shale gas exploration and production in the US on Europe and its relations with important oil- and gas-exporting countries in its immediate neighborhood. We primarily focus on the indirect geopolitical effects of the US shale gas boom, but start with looking at its direct effects on the competitive position of energy-intensive industries in Europe (see Figure 2). Following on this, we explicitly turn to the indirect effects of the US' shale gas revolution. We specifically look whether the development of shale gas in the US may have

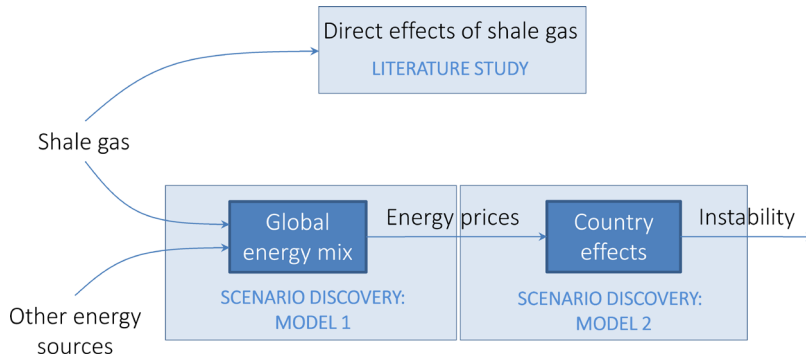


FIGURE 2. THE RESEARCH DESIGN OF THE STUDY

destabilizing effects on oil- and gas-exporting countries near the EU in the long term (until 2050), which in turn have an effect on the external and internal stability of EU countries and substantiate new strategic policy measures.

The complexity of these issues makes it inadvisable to rely on mental simulation of the impact of shale gas on both indicated levels. For this reason, we make use of two System Dynamics (SD) models for Scenario Discovery, which fits in the Exploratory Modeling and Analysis (EMA) methodology. SD is a modeling method which allows the simulation of complex problems through the effects of interacting feedback loops and accumulation in a system.⁸ Scenario Discovery is aimed at exploration of the consequences of deep uncertainty through quantitative (simulation) models.⁹ Using SD models for Scenario Discovery allows the consequences of plausible combinations of assumptions about the functioning of the energy system and country stability, including parameter values, to be explored. By combining the two models for Scenario Discovery, this study thus poses an extended ‘what-if’ analysis of the different combinations of examined assumptions.

8 Forrester, *Industrial Dynamics*; Sterman, *Business Dynamics: Systems Thinking and Modelling for a Complex World*.

9 Steven C. Bankes, ‘Exploratory Modeling for Policy Analysis,’ *Operations Research* 41, no. 3 (1993): 435–449, <http://www.jstor.org/stable/10.2307/171847>.

The first model in this study is a regionalized global model that looks at the supply and demand of natural gas and oil in relation to coal, nuclear, hydro, and renewable energy. Global and regional energy prices are a resultant and major influence on the regional energy mixes in Europe and adjacent regions, North America, the Far East, and the rest of the world. These price dynamics thus form internally consistent transient scenarios together with the composition of the energy mix for the period between now and 2050. Such a long period of analysis was chosen to account for the fact that the global energy system is characterized by long delays, both with regard to supply and demand.

As part of the selection of relevant natural gas and oil price scenarios for a 'stress test' of country stability, two different methods were applied. First, we looked at individual fuel types (natural gas, coal, oil and renewables) and, out of the total number of dynamic scenarios, we selected those scenarios whereby an individual fuel type had reached its highest share among Europe's energy mix. Second, we selected those scenarios which experience the greatest volatility in oil prices in all regions investigated. The reason for doing so is our interest in extreme scenarios: scenarios which show price changes potentially outside of the coping capacity of countries. Such scenarios represent a 'stress test' of country stability.

Selected price scenarios for natural gas (regional) and oil (global) subsequently act as input for the second model, the Country Stability Model. That model simulates the economic development of countries, dependent on the development of resource rents, other economic developments, related population growth, and connected to that, the development of purchasing power and (youth) unemployment. Within the 'greed and grievance' paradigms,¹⁰ the model thus follows the greed side of causes for instability, as it focuses on economic drivers, while identity-related causes of discontent, or 'grievance', are not considered. By doing so, we were able to assess whether the price scenarios will have a desirable

10 Paul Collier and Anke Hoeffler, 'Greed and Grievance in Civil War,' *Oxford Economic Papers* 56, no. 4 (October 1, 2004): 563-595, doi:10.1093/oeq/gpf064; Michael L. Ross, 'What Do We Know About Natural Resources and Civil War?,' *Journal of Peace Research* 41, no. 3 (May 1, 2004): 337-356, doi:10.1177/0022343304043773.

or undesirable effect on the country's stability compared to a situation of stable prices.

Countries investigated in this study are Russia, Algeria, Egypt, Qatar, Saudi Arabia, Azerbaijan, and Kazakhstan; all important oil and gas exporters to the EU. Given that Northwestern Europe is itself home to several large natural gas- and oil-producing countries (i.e., the Netherlands, Norway, Denmark and the United Kingdom), and thus will see its own export revenues affected by the development of shale gas, Northwestern Europe was also included in the analysis.

The report is structured around seven main chapters. Chapter 2 provides an overview of the size of today's market in shale gas, which countries have notable shale gas deposits, and the direct effects that shale gas development has on both security of supply and the competitiveness of energy-intensive industries.

Chapter 3 builds on the information provided in the second chapter in two ways. First, we examine the role that geopolitical events play in explaining price fluctuations in oil and natural gas markets. Second, we turn to the indirect effects of shale gas development from a geopolitical perspective. The chapter provides a contextual analysis of the potential geopolitical impact that shale gas may have on traditional hydrocarbon-exporting countries, as well as on the relations that Europe has with the oil- and gas-exporting countries located in its neighborhood.

Chapter 4 details the two sets of models which were used throughout the study and explains the applied methodology. The Energy Price Scenarios Model (see section 4.3) was used to generate a total set of fourteen different price scenarios reflecting the possible development of natural gas markets in Europe, the Far East and North America, as well as the international oil market with a view to 2050. The Country Stability Model (see section 4.4) subsequently uses these price scenarios as input, which allows us to analyze the impact of price developments on intra-state stability. In other words, the Country Stability Model performs a kind of 'stress-test' on the ability of traditional oil and gas exporting countries to cope with these price fluctuations.

Chapter 5 presents and analyzes the results of the modeling analysis along two lines. Section 5.1 identifies a number of paradigm shifts that can be observed in natural gas markets today as a result of the shale gas revolution in the US. Section 5.2 analyzes the fourteen energy price scenarios, highlighting the most important findings, taking into account the structural changes noted in the first section of this chapter where appropriate.

Chapter 6 builds on the findings from the price scenarios and discusses the effects of the price developments in the various scenarios on intra-state stability in the selected countries and region investigated in this study.

Finally, chapter 7 distills a number of important conclusions on the possibility that shale gas extraction in the US, and the effects that this has on the global energy landscape, may cause instability within traditional hydrocarbon-exporting countries. Specific attention is given to the implications that such instability might have for Europe and its relations with the oil- and gas-exporting countries investigated in this study.

2 TODAY'S MARKET IN SHALE GAS

The prospect of the United States (US) becoming a net exporter of natural gas as a result of the large discoveries of shale gas on its territory carries profound consequences for global energy markets as a significant share of global gas trade flows will be affected by this development. By the same token, the possible extraction of shale gas deposits in Europe has the potential to alter the continent's relationship with traditional gas-exporting countries in its neighborhood. In order to shed light on the magnitude, significance and potential impact of worldwide shale gas discoveries, the present chapter provides an inventory of the size and composition of the global market in shale gas. The chapter consists of four sections. Section one provides an overview of the definitions and terms used with respect to shale gas, the history of shale gas development and the technologies used for its extraction (2.1). Section two maps out the availability of shale gas resources worldwide, as well as production currently underway (2.2). The chapter ends with a brief discussion of the direct effects of shale gas extraction in the US and in Europe (2.3).

2.1 DEFINITIONS AND TERMINOLOGY

Shale gas is classified as an unconventional type of gas. It is named after the impermeable shale rock in which it is trapped below the earth's soil. Shale gas is but one specific type of unconventional gas, other types can be found trapped in underground rocks such as coal and sandstone. Their characteristics are different from shale gas and, in some cases, require a different way of extraction.¹¹

¹¹ International Energy Agency (IEA), 'International Energy Agency (IEA), About Us,' *FAQ's: Natural Gas*, accessed January 29, 2013, <http://www.iea.org/aboutus/faqs/gas/>.

When judging the availability of shale gas, a distinction should be made between risked shale gas resources, technically recoverable shale gas resources (TRRs) and reserves. Risked shale gas resources are a rough estimate of the amount of gas in place at any certain basin. TRRs comprise reserves “and that [amount of] natural gas which is inferred to exist, as well as undiscovered, and can technically be produced using existing technology”.¹² Reserves, which form a subset of TRRs, are defined as gas “that is known to exist and readily producible”.¹³ To illustrate the difference, as of 2013 the US Energy Information Administration (EIA) gauges the world’s risked shale gas resources at 35,782 trillion cubic feet (Tcf) and TRRs at 7,795 Tcf. The world’s conventional gas reserves by comparison were estimated at 6,839 Tcf.¹⁴

Application of hydraulic fracturing techniques – more commonly known as ‘fracking’ (see also *infra*, this section) – used in order to extract shale gas, have been in experimental use since the early 1950s. These efforts were continued and enhanced during the 1970s when the US Department of Energy (DOE) and the Gas Research Institute (GRI), a Research and Development (R&D) institute established by private industry, actively sought to develop these techniques for commercial use in relatively shallow shale rock formations.¹⁵ The first successful commercial shale gas extraction was in the Barnett shale formation in Texas, US.¹⁶ Encouraged by the results from the Barnett shale extraction and the discovery of a second basin in North Arkansas, companies started to actively target shale gas formations throughout the US.

12 U.S. Energy information Administration, *World Shale Gas Resources: An Initial Assessment of 14 Regions Outside the United States* (U.S. Energy information Administration, April 2011), 3.

13 *Ibid.*, 3.

14 *Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States* (Washington, D.C.: US Energy Information Administration, June 2013), 7 and 1-3.

15 U.S. Energy information Administration, *World Shale Gas Resources: An Initial Assessment of 14 Regions Outside the United States*, 1.

16 *Ibid.*

The extraction of shale gas has become technologically possible and economically viable because of two technological findings: (i) hydraulic fracturing and (ii) horizontal drilling.

- i *Hydraulic fracturing* consists of drilling a well into a shale rock formation through which large volumes of high pressured water, mixed with sand and chemicals, are injected. The high pressured water creates cracks in the shale rock formation which are then kept open by the sand and accompanying chemical mix. This process allows the trapped shale gas enough time to escape into the well where it is collected.¹⁷
- ii *Horizontal drilling* is an important aspect in making the above described process of extraction economically viable. By drilling horizontally instead of vertically, wells are capable of penetrating a significantly wider area of shale gas containing rock; thereby increasing the chance that gas will flow back into the well (see Annex 1: Horizontal Drilling for a visual representation).¹⁸

Commercial shale gas production in the US has resulted in a worldwide search for the location of shale gas basins with the desire to replicate the US' experience. The next section provides an overview of recent estimates into globally available risked shale gas resources and technically recoverable resources.

2.2 GLOBAL RESOURCES AND PRODUCTION OF SHALE GAS

The potential for successful commercial shale gas drilling, as well as the location of future test sites, is heavily influenced by available data on the whereabouts and size of shale gas basins. The EIA published an assessment of shale gas deposits for 14 regions outside the US in April 2011 which provides a first estimate of the possibility of the US' shale gas experience to be replicated elsewhere. In June 2013, this estimate was revised and complemented by additional analysis now comprising a total of 41 countries.

¹⁷ 'What Is Shale Gas and Why Is It Important?'

¹⁸ *Ibid.*

GLOBAL RESOURCES AND TECHNICALLY RECOVERABLE RESOURCES

The 2013 EIA report estimates globally available risked shale gas resources at 35,782 Tcf, which includes 4,644 Tcf (14.9%) within the US itself. Worldwide TRRs are estimated at 7,795 Tcf.¹⁹ It should be noted that this number covers only the 41 countries investigated in the report. Additional country-specific research in the future will most likely change the estimated available amount of TRRs worldwide. Figure 3 graphically depicts the global distribution of TRRs on the basis of the data used in the 2013 EIA report.

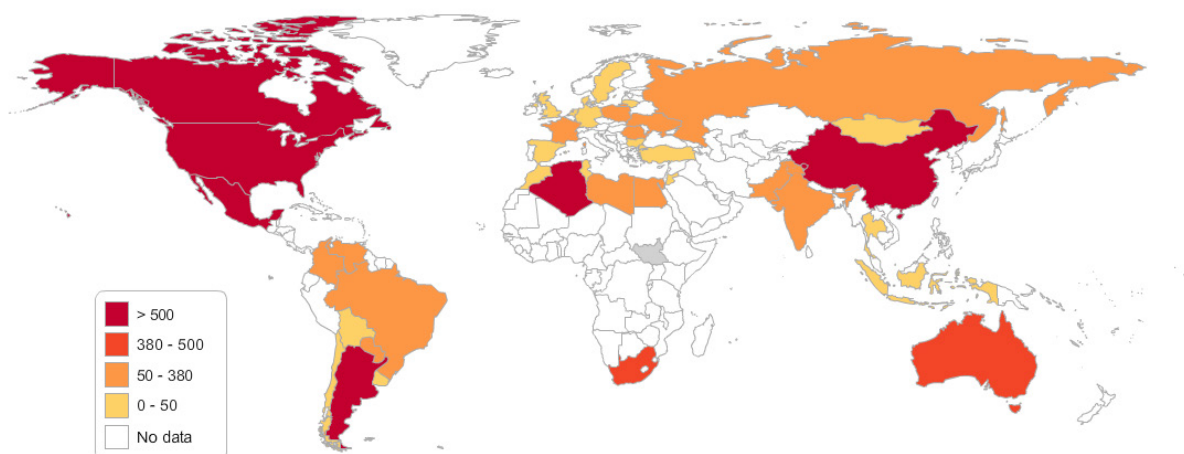


FIGURE 3. WORLDWIDE TECHNICALLY RECOVERABLE SHALE GAS RESOURCES (TRILLION CUBIC FEET, TCF) (GRAPHIC DESIGN, JORIS FISELIER).²⁰

As can be seen from Figure 3 the world's largest TRRs are located in North America²¹ (2,273 Tcf; 29.2%), China (1,115 Tcf; 14.3%) and Argentina (802 Tcf; 10.2%).²² The largest deposits of TRRs in Europe (Russia not included) are located in Poland, France, Ukraine, Southeastern Europe, the United

19 *Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States*, 1-3 and 1-4.

20 *Ibid.*, 1-7.

21 US, Canada and Mexico combined.

22 *Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States*, 1-6 and 1-7.

Kingdom (UK), Denmark and the Netherlands (see also Annex 2: Country Specific Information). Traditional hydrocarbon exporting countries Algeria (707 Tcf; 9.1%), Saudi Arabia (600Tcf; 7.7%), Russia (285 Tcf; 3.7%), Libya (122 Tcf; 1.6%) and Egypt (100 Tcf; 1.3%) are believed to hold significant shale gas resources as well.²³ Jordan, a country without significant conventional oil or gas reserves, is said to be home to significant shale oil resources, which have the potential to boost the country's hydrocarbon reserves significantly. Although overall exploration activity is progressing slowly, plans exist to begin the construction of the country's first shale oil fired power plant in 2014.²⁴ Jordanian shale gas TRRs are estimated at 7 Tcf (0.01%).²⁵

Of the aforementioned countries, Algeria looks to be the most promising. In February 2013 the Algerian government passed new laws governing foreign investment in the country's shale gas, easing the tax regime. Algeria is keen on importing hydraulic fracturing techniques to tap the potential of shale gas, allowing the country to maximize export revenues whilst satisfying a growing domestic demand. With its conventional reserves already having reached peak output, the opportunity lies in shale resources. Italian ENI and Royal Dutch Shell have already signed exploration accords with Algeria. That said, estimates are that Algeria will not be able to produce commercially viable unconventional gas before 2020.²⁶

23 Ibid.; Aibing Guo and Wael Mahdi, 'Saudi Arabia to Drill Seven Shale Gas Wells: Al-Naimi,' Bloomberg, March 18, 2013, <http://www.bloomberg.com/news/2013-03-18/saudi-arabia-to-drill-seven-shale-gas-test-wells-al-naimi-says.html>; Simon Hall, 'Saudi Arabia to Drill for Shale Gas This Year,' Rigzone, March 18, 2013, http://www.rigzone.com/news/oil_gas/a/125105/Saudi_Arabia_to_Drill_for_.

24 'Jordan Country Profile,' *US Energy Information Administration*, March 2013, <http://www.eia.gov/countries/country-data.cfm?fips=JO>; 'Jordan's First Oil Shale-fired Power Plant Receives Six International Bids,' *Oil Review Middle East*, April 23, 2013, <http://www.oilreviewmiddleeast.com/industry/jordan-s-first-oil-shale-fired-power-plant-gets-six-international-bids>.

25 *Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States*, 1-7.

26 Ladka Bauerova and Tara Patel, 'Europe's Shale Boom Lies in Sahara as Algeria Woos Exxon - Bloomberg,' *Bloomberg*, November 26, 2012, <http://www.bloomberg.com/news/2012-11-26/europe-s-shale-boom-lies-in-sahara-as-algeria-woos-exxon.html>; 'Algeria: Leveling the Playing Field for Shale Gas Exploration,' *Oilprice.com*, March 12, 2013, <http://oilprice.com/Energy/Natural-Gas/Algeria-Leveling-the-Playing-Field>

Similar uncertainties exist in Saudi Arabia, where despite impressive TRRs, it remains unclear how quickly the resources may achieve commercial status and how Saudi Arabia will supply the large amounts of water used in fracking. Saudi Arabia's goal may, however, be different from that of Algeria. Riyadh appears interested in letting shale gas replace crude oil currently burned by the country's power plants; a very expensive way of providing fuel for the domestic power market, as this removes additional crude oil export volumes from the market. A barrel of crude oil generates more revenues than the export of natural gas.²⁷

At this moment in time, exact figures on globally available reserves of shale gas are unavailable; this would require the systematic drilling of exploration wells at all of the identified basins. It should equally be stressed that the estimated amount of TRRs is dependent on the extraction capabilities of existing technology. Thus, it should not be ruled out that as a result of technological improvements, changing market conditions, or a combination thereof, additional resources may become commercially viable for extraction.

PRODUCTION OF SHALE GAS AND TEST DRILLING UNDERWAY

Commercial production of shale gas is currently limited to North America. Companies in the US, Canada, and Mexico, have – to varying degrees – begun commercial production of shale gas. Projects intended to replicate North American operations are underway on a global scale and range from exploration or test well drilling to issuing exploration permits. Successful shale gas production in North America and the positive effects thereof has encouraged countries around the world to begin a (public) discussion on the assessment of their own shale gas resources. Figure 4 presents a worldwide overview of the various stages of development in shale that can be discerned. Roughly, countries can be classified according to four different stages: those countries where a ban on fracturing is in place;

-for-Shale-Gas-Exploration.html; Manzoor Roome, 'Unsung Heroes of the Shale Gas Revolution,' *The Energy Collective*, April 6, 2013, <http://theenergycollective.com/manzoorroome/206376/unsung-heroes-shale-gas-revolution-india-thailand-indonesia>.

27 Roome, 'Unsung Heroes of the Shale Gas Revolution'; Hall, 'Saudi Arabia to Drill for Shale Gas This Year.'

those who have issued/are issuing exploration permits; those countries where exploration and test drilling is currently underway; and lastly, those countries who actually produce shale gas.

The US, with a production of 5.3 Tcf in 2010, is currently world leader in shale gas production.²⁸ Development of shale gas production in Canada has closely followed the US' experience and production rapidly increased from 2004 onwards. Canadian production is centered around the Horn River (392 Million cubic feet per day, MMcf/d; 98 wells), Cordova Embayment (2 Bcf annually; 5 wells), and the Montney Play (1.6 Bcf/d; 1,100 wells) all located in Western Canada. Future investments to increase the total production of shale gas will largely depend on gas price developments.²⁹

Mexico began producing shale gas in 2011 at the Eagle Ford formation, a geographical area which spans across the US-Mexican border and has proven highly successful in the US. The first exploration well produced 3.0 MMcf/d and has since been used for commercial production together with an additional three wells.³⁰ Just as in Canada, future investments will largely depend on gas price developments. Additional factors that are likely to determine the success of these developments are the fiscal terms for investors, safety concerns, and the availability of water – needed in high quantities for the drilling of wells and 'fracking' – at shale gas production sites.³¹

International interest in Algeria's shale gas resources is growing, and in 2014 Algeria is reportedly going to open a bidding round for its shale gas resources.³² At this stage however, exploration has been delayed due to

28 U.S. Energy Information Administration, 'Natural Gas,' *Shale Gas Production*, accessed March 8, 2013, http://www.eia.gov/dnav/ng/ng_prod_shalegas_s1_a.htm.

29 National Energy Board, *Short-term Canadian Natural Gas Deliverability 2012-2014, An Energy Market Assessment* (Calgary, April 2012).

30 David A. Garcia and Adriana Barrera, 'Mexico's Pemex Sees Profits from Shale Gas on Rising Prices,' *Reuters*, October 1, 2012, <http://www.reuters.com/article/2012/10/02/mexico-gas-idUSL1E8L1WD320121002>.

31 U.S. Energy Information Administration, *Mexico, Country Analysisbrief* (U.S. Energy Information Administration, October 17, 2012), 10-11.

32 'Eni Expresses Interest in Algerian Energy,' *UPI.com*, July 19, 2013, <http://www>.

disagreement over the investment scheme and security terms offered by the Algerian government.³³ Countries such as Colombia, Venezuela and Brazil – as large hydrocarbon producers – are currently in no rush to develop their domestic shale gas resources.

The extent to which the US 'shale gas revolution' can be replicated in other parts of the world will depend to a large extent on the success of the aforementioned test drillings underway. Many believe however that a full-scale replication will be difficult, *inter alia*, due to local opposition and environmental concerns, stricter regulatory and environmental standards, the often more challenging geology outside the US and the long lead times required for the assessment of commercially viable quantities of shale gas.³⁴ In spite of the above, China has nonetheless set itself the ambitious target of reaching 0.23 Tcf of shale gas production by 2015.³⁵ In Europe, despite great optimism about the ability to do away with the dependence on Russian natural gas supplies, initial results from test wells in Poland and

upi.com/Business_News/Energy-Resources/2013/07/19/Eni-expresses-interest-in-Algerian-energy/UPI-15281374231659/; 'Algeria Drums Up Interest Ahead Of Bid Round,' *Review of Middle East Energy*, July 1, 2013, <http://www.mees.com/en/articles/7942-algeria-drums-up-interest-ahead-of-bid-round>.

33 Julia Payne and Peg Mackey, 'BP Delays Algeria Projects as Security, Terms Deter Investors,' May 2, 2013, <http://www.cnn.com/id/100701073>.

34 Paul Stevens, *The 'Shale Gas Revolution': Developments and Changes* (Chatham House, August 2012); Roderick Kefferpütz, 'Shale Fever: Replicating the US Gas Revolution in the EU?' (Centre for European Policy Studies (CEPS), June 17, 2010), 5–6; Florence Gény, 'Can Unconventional Gas Be a Game Changer in European Gas Markets?' (The Oxford Institute for Energy Studies, December 2010), 99–100; 'Unconventional Gas in Europe: Frack to the Future,' *The Economist*, February 2, 2013, <http://www.economist.com/news/business/21571171-extracting-europes-shale-gas-and-oil-will-be-slow-and-difficult-business-frack-future>.

35 Leslie Hook, 'China Sets Target for Shale Gas Development,' *Financial Times*, March 16, 2012, <http://www.ft.com/intl/cms/s/0/2e7a77ac-6f59-11e1-9c57-00144feab49a.html#axzz2KgrpAAiZ>.

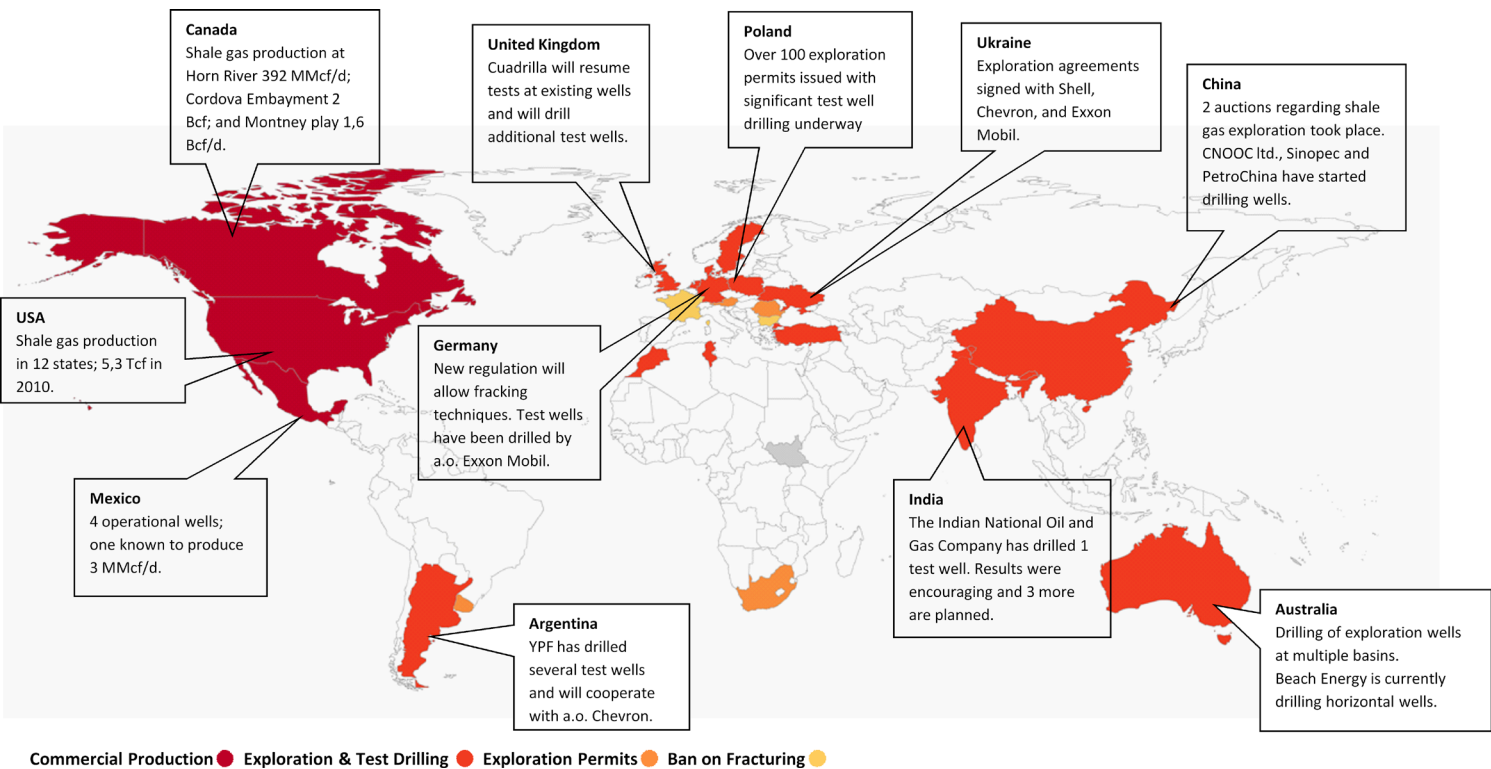


FIGURE 4. GLOBAL SHALE GAS PRODUCTION AND CURRENT PROJECTS.³⁶

36 U.S. Energy information Administration, *World Shale Gas Resources: An Initial Assessment of 14 Regions Outside the United States; Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States*; Chuck Boyer et al., 'Shale Gas: A Global Resource,' *Oilfield Review* 23, no. 3 (Autumn 2011).

Hungary have been somewhat disappointing.³⁷ A full-scale ban on fracking is still in place in France, although there are signs that opposition may be weakening given the worsening economic situation in the country.³⁸ Fracking is equally banned in Bulgaria and a recent revocation of the ban in Romania has sparked protests.³⁹ Public perception of shale gas appears to be more favorable in the UK, compared to Germany and the Netherlands where opposition is more pronounced (see Annex 2: Country Specific Information for a detailed overview of the conditions per country).⁴⁰

2.3 DIRECT EFFECTS OF SHALE GAS EXTRACTION

The willingness of European governments to allow or support commercial extraction of shale gas on their territory is influenced by two factors which could be considered 'direct' effects of incorporating shale gas into their energy mix. First, many European countries are heavily dependent on imported natural gas and this dependence is often seen in negative terms. Shale gas is thus viewed by European governments as a way to lessen their dependence on external suppliers and create greater 'energy autonomy'.

37 Tim Boersma and Corey Johnson, *Risks and Potentials of the Shale Gas Revolution*, SWP Comments 39 (Stiftung Wissenschaft und Politik, December 2012), 5; 'Results 'Humble' so Far for Polish Shale Gas, Minister Says,' *Reuters*, November 28, 2012, <http://www.reuters.com/article/2012/11/28/poland-shale-idUSL5E8MS5YZ20121128>; Vlad Ivanenko and Benjamin K. Schlesinger, 'Political Economy of Shale Gas Industry in Eastern Europe,' *International Association for Energy Economics*, First Quarter 2012, 9.

38 'France's Economy: Austerity Stakes,' *The Economist*, March 2, 2013, <http://www.economist.com/news/europe/21572806-reluctant-government-faces-imperative-public-spending-cuts-austerity-stakes?fsrc=rss%7Ceur>.

39 Tomasz Daborowski and Jakub Groszkowski, *Shale Gas in Bulgaria, the Czech Republic and Romania* (Warsaw: OSW Centre for Eastern Studies, September 2012), 13; Silviu Molnar, 'Granting of Exploration Licenses Spurs Romanian Protests,' March 6, 2013, <http://www.naturalgaseurope.com/shale-gas-exploration-licenses-spurs-romanian-protests>.

40 'Shale Gas: Shale and Hearty Welcome,' *The Economist*, December 8, 2012, <http://www.economist.com/news/britain/21567976-george-osborne-loves-shale-gas-he-needs-court-it-better-shale-and-hearty-welcome>; 'Een Geschenk Uit de Diepte,' *Elsevier*, March 16, 2013; Christian Wüst, 'Fear of Fracking: Germany Balks on Natural Gas Bonanza,' *Spiegel Online*, October 5, 2012, <http://www.spiegel.de/international/business/safety-worries-lead-germany-to-shun-fracking-for-natural-gas-a-859446.html>.

Second, the low price of natural gas in the US has spurred economic activity and enabled a return of energy-intensive industry which had originally left due to high domestic energy prices. Shale gas is thus viewed by (some) European politicians and industry representatives as a means to spur the competitiveness of the EU economy.

REDUCING IMPORT DEPENDENCY

Data on gas import dependency are available for most European countries. Figure 5 illustrates the gas import dependency for several EU Member States. It also lists the cumulative dependency of the EU-27. What is clear from the figure is that most of the depicted EU countries could gain significantly if shale gas extraction could take place on a grand scale. The UK, which until six years ago was still a net exporter of natural gas, has seen its dependency on imported gas steadily increase, as has the EU as a whole. The Netherlands, although still a net producer of natural gas, could over time see its dependency ratio worsen due to the depletion of its natural gas fields. The direct effect on the Netherlands of extracting shale gas thus comes in the form of a prolonged status as a natural gas-producing state.

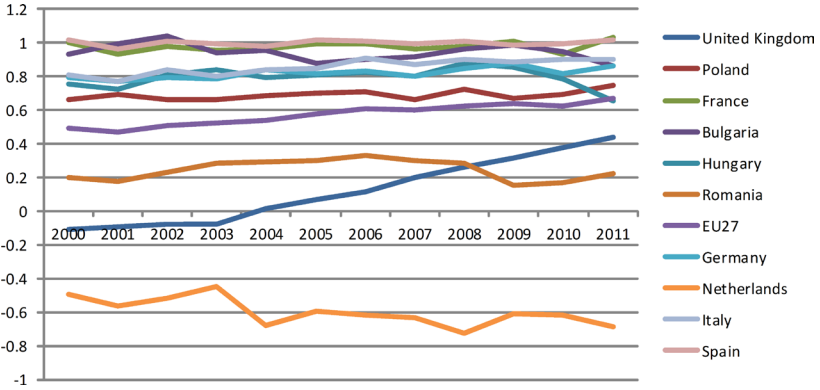


FIGURE 5. DEPENDENCY ON NATURAL GAS IMPORTS IN THE EU, 2000-2011.⁴¹

41 Eurostat, 'Energy Dependence,' accessed March 1, 2013, <http://epp.eurostat.ec.europa.eu/tgm/refreshTableAction.do?sessionId=9ea7d07e30dea43c3d70621344abb4b1c0cb5297ad6a.e34MbxSahmMa40LbNiMbxMbxRe0?tab=table&plugin=1&pcode=tsdcc310&language=en>.

The effects that shale gas extraction can have on natural gas import dependency can be illustrated by developments in the US. Figure 6 gives an overview of US natural gas imports - differentiated according to the share of natural gas imports by pipeline, as well as LNG - and US shale gas production for the period 2006-2011.⁴²

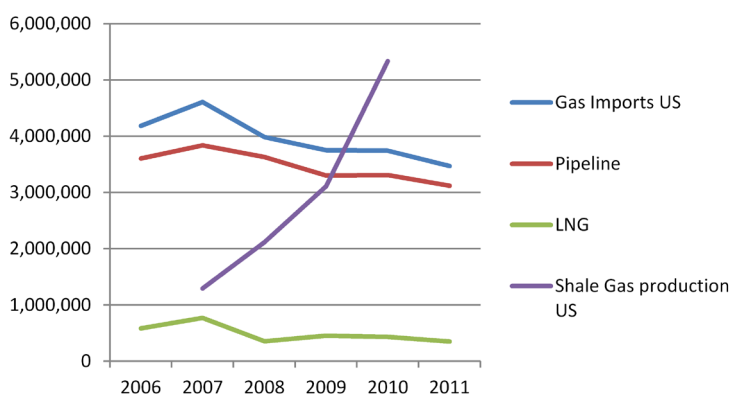


FIGURE 6. US GAS IMPORTS VS. SHALE GAS PRODUCTION, 2006-2011.⁴³

Whereas US gas consumption grew from 21.6 to 24.4 Billion cubic feet (Bcf), during the period 2006-2011 gas imports simultaneously declined from 4.1 to 3.4 Bcf.⁴⁴ The increase in domestic consumption and decline in natural gas imports coincided with an increase in US shale gas production from 1.2 Bcf in 2007 to 5.3 Bcf in 2010.⁴⁵ Figure 6 thus seems to illustrate that the increase in US shale gas production - for the time being - was able

42 The U.S. Energy Information Administration data on shale gas production only covers the period 2007-2010.

43 U.S. Energy Information Administration, 'International Energy Statistics,' Natural Gas, Exports, accessed March 1, 2013, <http://www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=3&pid=26&aid=4&cid=regions&syid=2006&eyid=2011&unit=BCF>.

44 U.S. Energy Information Administration, 'International Energy Statistics,' Natural Gas, Consumption, accessed March 5, 2013, <http://www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=3&pid=26&aid=2&cid=US,&syid=2007&eyid=2011&unit=BCF>.

45 U.S. Energy Information Administration, 'Natural Gas.'

to satisfy an increased domestic demand for natural gas, whilst at the same time reduce the nation's import dependency.

If the above process is replicated in Europe, it will significantly influence the countries that traditionally service the European gas market. Figure 7 identifies the origins of EU gas imports and illustrates the percentage of the EU import market held by the various natural gas-producing countries currently servicing Europe. It should be noted that the figure below only illustrates natural gas flows between EU and non-EU member countries. EU Member States Denmark and The Netherlands, who equally export large volumes of gas to other European countries, but who are not included in Figure 7, will also be affected if large scale shale gas extraction takes off in Europe.

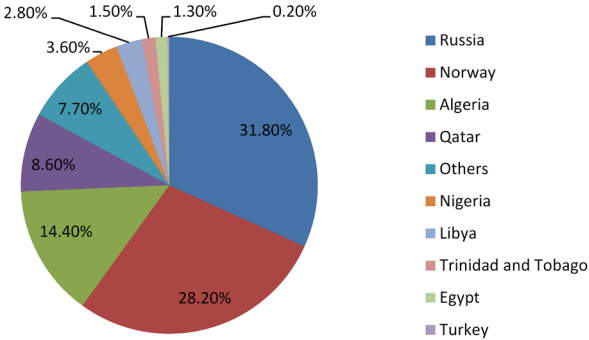


FIGURE 7. ORIGIN OF EU GAS IMPORTS, 2010.⁴⁶

Imports can be divided into three categories (i) imports exclusively via pipeline, i.e. Russia and Turkey; (ii) both LNG imports and imports via pipeline, i.e. Norway, Algeria, and Libya; (iii) LNG imports only, notably Qatar and Nigeria, and to a smaller extent Trinidad and Tobago, and Egypt.

⁴⁶ Eurostat, 'Main Origin of Primary Energy Imports,' accessed March 1, 2013, http://epp.eurostat.ec.europa.eu/statistics_explained/images/2/26/Main_origin_of_primary_energy_imports%2C_EU-27%2C_2002-2010_%28%25_of_extra_EU-27_imports%29.png.

It should be pointed out that at present due to the ongoing unrest in Egypt only very small volumes of Egyptian LNG reach the European market. What stands out from Figure 7 is the strong reliance on natural gas imports from Russia, Norway and Algeria.

Natural gas flows in Europe traditionally go from Russia in the east toward consumers in the west, as well as southward from natural gas producers in the North Sea region and the Netherlands, across Switzerland onward to Italy. There is more and more interest however to expand these routes with a South - North flow via Italy, which aims to bring North African gas to markets in Northwest Europe.⁴⁷ In August 2012, Italian gas network operator Snam Rete Gas and its Belgian counterpart Fluxys signed a Memorandum of Understanding (MoU) to develop reverse flow capacities from South to North between Italy and the UK. This decision was followed a few months later, in December 2012, by the acquisition of a 20% stake in the Medgaz pipeline which runs between Algeria and Spain.⁴⁸

Current EU policy speaks of partnerships with key-energy suppliers that should address, *inter alia*, energy security and safety, market access and investment protection, regulatory cooperation, and many other issues. The European Commission also points out that such a policy should be extended to the efficient use of available resources, as well as joint assessment of long-term energy supply and demand perspectives.⁴⁹ In a September 2013 Communication, the European Commission speaks of ongoing diversification efforts within the EU in light of shale gas and oil production in the US.

47 Alex Froley, 'A New Direction for European Natural Gas?', Platts, February 19, 2013, <http://blogs.platts.com/2013/02/19/euro-gas/>.

48 'Coordinated Market Process for Booking Long-term Gas Transmission Capacity Between Italy, Switzerland, Germany and Belgium,' *Fluxys*, December 20, 2012, [http://www.fluxys.com/group/en/NewsAndPress/2012/121220_News_ReverseFlow](http://www.fluxys.com/group/en/NewsAndPress/2012/121220_News_ReverseFlow;); 'Iberdrola SA Sells Medgaz Stake to Fluxys Belgium NV for EUR 146 Million,' *Reuters*, December 28, 2012, <http://www.reuters.com/finance/stocks/FLUX.BR/key-developments/article/2667350>.

49 'Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - on Security of Supply and International Cooperation - 'The EU Energy Policy: Engaging with Partners Beyond Our Borders' (European Commission, September 7, 2011), 9.

The document stresses that the new potential shale gas resources, both in Europe and elsewhere, may play a growing role in the EU's diversification strategy in the medium-term future.⁵⁰

COMPETITIVENESS OF EUROPEAN ENERGY-INTENSIVE INDUSTRY

The high natural gas prices in Europe compared to those in the US are viewed with concern by Europe's energy-intensive industry. In its 2013 World Energy Outlook, the IEA predicts a strong decline in the share of energy-intensive goods in exports from the EU and Japan of up to a combined loss of one-third of their current share.⁵¹ Ultimately, cheap energy may also impact upon manufacturers' location decisions and make it more appealing to produce in the US, rather than Europe.⁵² As a result, sectors such as chemicals, petrochemicals and aluminum are worried that they may lose jobs and market share to US companies.⁵³

The Confederation of Netherlands Industry and Employers (VNO-NCW) sounded the alarm in February 2013 that EU competitiveness is adversely affected by the high gas prices in Europe, thus pleading in favor of shale gas development within the EU.⁵⁴ European heavy industry representatives are equally making the case for shale gas to take root in Europe. The European Chemical Industry Council (CEFIC) released a position paper in March 2013, citing the significant competitive advantages from shale gas in

50 'Report from the European Commission to the European Parliament, the Council and the European Economic and Social Committee - Implementation of the Communication on Security of Energy Supply and International Cooperation and of the Energy Council Conclusions of November 2011' (European Commission, September 13, 2013), 2 and 4.

51 *World Energy Outlook 2013 Executive Summary* (Paris: International Energy Agency (IEA), 2013), 2.

52 'Shale Gas: What Are the Implications for Europe's Competitiveness?,' *German Marshall Fund of the United States (GMFUS)*, August 20, 2013, <http://www.gmfus.org/archives/shale-gas-what-are-the-implications-for-europes-competitiveness/>.

53 David Buchan, *Can Shale Gas Transform Europe's Energy Landscape?* (London: Centre for European Reform, July 2013), 8.

54 'Winning Schaliegas in VS Raakt Nederland Ook,' *VNO NCW*, February 14, 2013, http://www.vno-ncw.nl/publicaties/Forum/Pages/Winning_schaliegas_in_VS_ raakt_Nederland_ook_17939.aspx#.UjcT7z_O7mg.

the US and pleading for an acceleration of exploration and production of indigenous shale gas.⁵⁵

An October 2013 study by Deloitte and the 'Vereniging van de Nederlandse Chemische Industrie' (VNCI), the national chemical association of the Netherlands, highlights that the ethylene, ammonia and chlorine and caustic soda chains will be negatively affected in the short and long term, impacting about 29% of the Dutch chemical industry employment and 48% of revenue. The study claims ripple effects throughout the cluster may occur over time, putting 8% of Dutch national output, 20% of export value and nearly half a million jobs at risk in the Dutch economy as a whole.⁵⁶

The question of rising energy costs is finding its way to the political agenda in Europe.⁵⁷ Whilst on a trade mission in the US state of Texas, Dutch Prime Minister Mark Rutte and his Flemish counterpart Kris Peeters, received a clear message from Exxon Mobil that if the Netherlands and Flanders (home to the major ports of Rotterdam and Antwerp) wish to be able to continue to lure foreign investors, steps must be undertaken to improve their competitive positions. Although, both political leaders did not view this message as a threat, they promptly advocated for a revision of EU policy on shale gas, citing reasons of competitiveness.⁵⁸

55 'The Implications of the Shale Gas Revolution for the European Chemical Industry' (European Chemical Industry Council (CEFIC), March 15, 2013).

56 *The Shale Gas Revolution and Its Impact on the Chemical Industry in the Netherlands Addendum to VNCI Vision 2030-2050* (Deloitte and the Vereniging van de Nederlandse Chemische Industrie (VNCI), October 2013), 5.

57 Guy Chazan, 'Energy Costs Widen Gap in Competitiveness,' *Financial Times*, October 14, 2013, <http://www.ft.com/intl/cms/s/0/23cd358e-252d-11e3-b349-00144feab7de.html#axzz2ll1mjaWG>.

58 'Zware Industrie Krijgt Klappen,' *Het Financieele Dagblad*, accessed November 21, 2013, <http://fd.nl/economie-politiek/920061-1311/zware-industrie-krijgt-klappen>; 'Amerikaanse Schaliegas Vreet Aan Europese Concurrentievermogen,' *Vandaag.be*, July 8, 2013, http://m.vandaag.be/help-het-nieuws-verspreiden/kies/130050_amerikaanse-schaliegas-vreet-aan-europese-concurrentievermogen.html; 'Europa Moet Beleid Schaliegas Herzien' - *Het Nieuwsblad*, *Het Nieuwsblad*, July 9, 2013, http://www.nieuwsblad.be/article/detail.aspx?articleid=DMF20130709_00652293.

The next chapter takes a closer look at the indirect effects of shale gas, specifically from a geopolitical point of view. The chapter focuses on how natural gas markets and the international oil market are affected by geopolitical turmoil, with a particular focus on how the surge in shale gas production in the US can act as a potential catalyst for geopolitical tension.

3 ENERGY MARKETS AND GEOPOLITICS

Oil markets and natural gas markets have different characteristics. Oil, with its ability to be pumped, refined and transported in barrels across the world does not require a physical link between producer and consumer. In other words, a shipment of oil from for example the Middle East to Europe can just as easily be transported elsewhere as oil transportation is – relatively speaking – not a costly endeavor. In this respect, the international oil market constitutes a truly global market. This also means that a significant disruption in oil supply in one part of the world has potential global ramifications as prices fluctuate as a result of the changing availability of oil, as the Libyan crisis has shown.

The same cannot be said about natural gas. Transportation of natural gas is more costly compared to oil transport and often requires the presence of physical infrastructure, i.e. pipelines and distribution points to make its way from producer to consumer. However, the advent of LNG has gone some way to change this as – once liquefied – natural gas can be transported to any location which has regasification facilities. Increasingly, LNG shows promise as a transport fuel. Energy and transportation companies, as well as governments are looking at ways in which to use LNG in commercial transport, partially as a way to cut down on pollution and partly because prices have come down due to an abundance of supply. Moreover, as typically one-third of a transportation company's cost base is fuel, the cost saving argument tilts favorably toward LNG in light of the low gas price in the US and increased price levels of gasoline and diesel. Heavy duty vehicles, buses and particularly shipping are thought to have great potential. Furthermore, as of January 2015, ship owners face strict sulfur emission regulations by the International Maritime Organization (IMO) in so-called emission control areas in the Baltic Sea and North Sea (Amsterdam Rotterdam Antwerp, (ARA) region), and the English Channel. The new regulations will cut sulfur content in bunker fuel from 1 per cent to

0.1 per cent and will affect the whole shipping industry within the emission control area. With the majority of the global marine bunker fuel market currently supplied by oil, LNG offers a good potential for emission reduction.⁵⁹ Opening vehicles and ships to fuel competition would pit cheap and abundant commodities such as natural gas against oil, possibly (to an extent) displacing oil and driving global prices down.⁶⁰

Moreover, transport is not the only area where natural gas can potentially (to an extent) displace oil. Gas can also act as a substitute for oil use in power stations, (petro)chemical plants and domestic and industrial heating systems. Similarly, improvements in automotive technology, notably engine and vehicle design, all contribute to the greater fuel-efficiency of cars and trucks. All this can lead to a displacement in the number of barrels per day demanded worldwide.⁶¹ Moreover, emerging economies are also moving step-by-step towards tougher fuel-efficiency standards on vehicles – although not (yet) up to the level of developed economies. The fuel-efficiency measures implemented by China in March 2013 are a good example of this, restricting average fuel consumption among passenger vehicles to 6.9 liters per 100 kilometers by 2015, with a further reduction to 5.0 liters by 2020.⁶²

59 Sylvia Pfeiffer, 'LNG Potential as Transport Fuel Explored,' *Financial Times*, March 18, 2013, <http://www.ft.com/intl/cms/s/0/7e30cc94-8969-11e2-92a0-00144feabdc0.html#axzz2PrfuWjNn>.

60 Gal Luft and Anne Korin, 'The Myth of U.S. Energy Dependence,' *Foreign Affairs*, October 15, 2013, http://www.foreignaffairs.com/articles/140172/gal-luft-and-anne-korin/the-myth-of-us-energy-dependence?cid=soc-facebook-in-snapshots-the_myth_of_us_energy_independence-101613.

61 'The Future of Oil: Yesterday's Fuel | The Economist,' *The Economist*, August 3, 2013, <http://www.economist.com/news/leaders/21582516-worlds-thirst-oil-could-be-nearing-peak-bad-news-producers-excellent>; *Technology, Markets & Policies: Bringing Peak Oil Demand Ever Closer* (Ricardo, 2011), 3-4; Dan Strumpf, 'Oil Demand Could Peak by End of Decade, Citi Analysts Say,' March 27, 2013, <http://online.wsj.com/news/articles/SB10001424127887324685104578386694201176684>.

62 'China Imposes Strict Fuel Economy Standards on Auto Industry | Reuters,' March 20, 2013, <http://www.reuters.com/article/2013/03/20/china-auto-fuel-idUSL3N0CC2EK20130320>; 'Strict Fuel Economy Standards Placed On Chinese Auto Industry,' *CleanTechnica*, March 22, 2013, <http://cleantechnica.com/2013/03/22/strict-fuel-economy-standards-placed-on-chinese-auto-industry/>.

The onset of LNG notwithstanding, piped natural gas is still the dominant mode of gas transit and, once converted back to its gaseous state, natural gas still requires pipeline infrastructure. Gas development in a particular country or region is thus often isolated from other regions because of a lack of capabilities to switch easily between supply routes. In March 2010, in order to improve this situation, the EU allocated € 1.39 billion (out of € 4 billion) to the development of bilateral pipeline infrastructure, including the modification of existing pipelines to allow for reverse flows. Several improvements were realized at the beginning of 2012.⁶³

The high capital costs associated with pipeline construction and their long earn-back period render long-term contracts the norm in Europe.⁶⁴ The inflexibility and isolated nature of gas development implies that as a consequence the market in natural gas does not constitute a global market, but is rather (supra-)regional in scope. The regional impact of a gas pipeline disruption in supply notwithstanding, such an event does not necessarily have global ramifications.⁶⁵ The same does not hold true however for LNG supply, which could be seriously affected by blockades of sea lanes.

What influence do geopolitical events exert on global energy markets? And, conversely, what impact do price fluctuations have on the origin of geopolitical turmoil and socio-political instability? These two questions are

63 Two gas interconnections were constructed connecting Hungary to both Croatia and Romania, fostering market integration and development in the region. The Belgian gas pipelines on the Germany-United-Kingdom axis were reinforced, enabling also reverse flow capacity from the Dutch/German border to Zeebrugge in Belgium and towards the UK. Seven gas reverse flow projects were completed, of which four in Austria and two in Slovakia and one Czech Republic. The projects provide better access to the Austrian storage facilities in Baumgarten to all the neighboring countries. See 'Report from the Commission to the European Parliament and the Council on the Implementation of the European Energy Programme for Recovery COM(2012) 445 Final' (European Commission, August 8, 2012), 4.

64 Mel Ydreos and Clingendael International Energy Programme, 'Geopolitics and Natural Gas' (Kuala Lumpur, Malaysia: Task Force 3 International Gas Union, 2012), 35; Ernest Moniz et al., *The Future of Natural Gas - An Interdisciplinary MIT Study* (Cambridge, Massachusetts: Massachusetts Institute of Technology (MIT), 2011), 147.

65 Sanam S. Haghighi, *Energy Security: The External Legal Relations of the European Union with Major Oil and Gas Supplying Countries*, vol. 16, Modern Studies in European Law (Oxford and Portland, Oregon: Hart Publishing, 2007), 13.

the central focus of this chapter. The chapter consists of three sections. Section one (3.1) provides an overview of historical price developments within the oil market, set against the occurrence of major geopolitical events. Section two (3.2) continues this analysis and explains the different geopolitical situation faced by natural gas markets. Finally, section three (3.3) discusses the potential geopolitical consequences of a 'shale gas revolution' taking root outside the US.

3.1 GEOPOLITICS AND THE INTERNATIONAL OIL MARKET

Volatility in oil prices as a result of (geo)political events has often occurred throughout history and it has become widely accepted that large price shocks have significant (but temporary) macroeconomic effects on the global economy.⁶⁶ Figure 8 presents an overview of the price of a barrel of crude oil (Western Texas Intermediate) in nominal US\$ from 1970 until 2012, set against important (geopolitical) events. Clear examples where the price of oil spiked can be witnessed in the aftermath of the 1973 Arab oil embargo and the 1979 Iranian revolution. The crises of the 1970s (Arab oil embargo and the Iranian revolution) sent the oil price soaring. Despite production being concentrated in the hands of national oil companies (NOCs), oil supplies were able to cope, as most of the trading and shipping at this time was handled by international oil companies. The latter has been changed dramatically as, after the 1990s, NOCs have also entered the transportation segment.

Similar spikes in oil price can be observed after the 1990 Iraqi invasion of Kuwait, the re-emergence of tensions in Iraq in the late 1990s, the outbreak of the second Gulf War in 2003 and the revolutions in North Africa beginning in late 2010. It should be pointed out here that the steady rise in the oil price beginning in 2009 was to a large extent also caused by economic recovery in many parts of the world. On top of this, higher production costs and a general investment drive of national oil companies in their home countries contributed to an upward pressure on oil prices. Moreover, the increased financialization of energy markets driven by investments in oil/gas futures is also a major factor in oil pricing.⁶⁷

66 J.D. Hamilton, 'Causes and Consequences of the Oil Shock of 2007-2008' (NBER Working Paper 15002, May 2009).

67 Bassam Fattouh, Lutz Kilian, and Lavan Mahadeva, 'The Role of Speculation in Oil

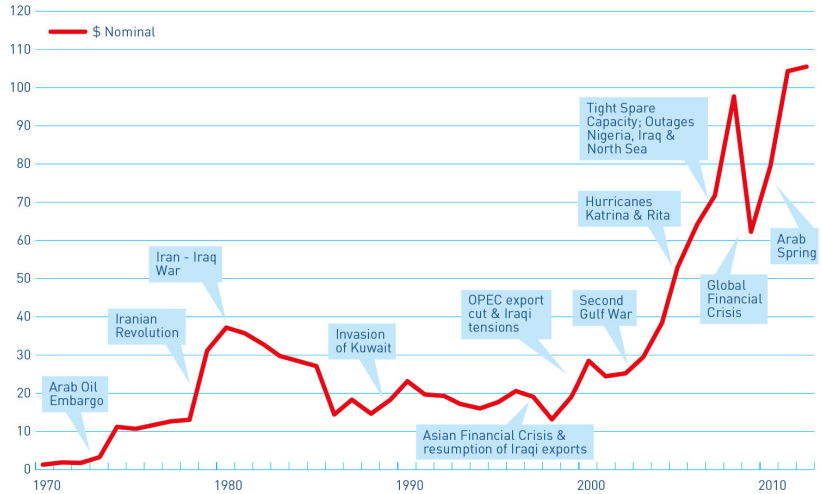
OIL PRICE (WEST TEXAS INTERMEDIATE) AND IMPORTANT (GEOPOLITICAL) EVENTS
1970-2012

FIGURE 8. SPOT CRUDE OIL (WESTERN TEXAS INTERMEDIATE) PRICES (IN NOMINAL US\$ PER BARREL) AND IMPORTANT (GEOPOLITICAL) EVENTS 1970-2012 (GRAPHIC DESIGN, JORIS FISELIER).⁶⁸

Finally, it should be stressed that the post-Arab uprising era budgets of OPEC countries often no longer allow the price of oil to drop below US\$ 100 per barrel due to increases in social spending (see also *infra*, 3.3 and Conclusions).⁶⁹

Markets: What Have We Learned So Far?' (Oxford Institute for Energy Studies, July 30, 2012), 27.

68 World Bank, 'Prospects - Commodity Markets. Historical Data.,' January 8, 2013, <http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTDECPROSPECTS/0,,contentMDK:21574907-menuPK:7859231-pagePK:64165401-piPK:64165026-theSitePK:476883,00.html>.

69 Glen Cary, 'The Saudis Need Those High Oil Prices - Businessweek,' Businessweek, February 23, 2012, <http://www.businessweek.com/articles/2012-02-23/the-saudis-need-those-high-oil-prices>; 'Oil Supplies Are Sufficient and Fair, Says Minister,' International Energy Forum, March 13, 2012, <http://www.ief.org/news/news-details.aspx?nid=749>.

In the context of fluctuating oil prices, the Organization of Petroleum Exporting Countries (OPEC) has played a prominent role. OPEC aims to maintain a stable price of oil by means of direct interventions on the oil market based on a production quota system that is designed to manipulate the supply of oil to the market and stabilize price levels.⁷⁰ The results of this strategy have, however, been rather mixed. Whereas OPEC achieved two production cuts during the 1990s – designed to counter drastically falling oil prices – its strategy has been undermined by the non-cooperative behavior of some of its members.⁷¹ Enticed by high oil prices and the prospect of securing quick profits smaller members – measured in terms of the size of their oil reserves – tend to increase their oil production above the agreed quota whenever prices are high. This has led to claims that OPEC merely acts as a price taker or that other factors – such as the inadequate growth of production capacity – have had more influence on determining oil prices.⁷² OPEC is also currently feeling the negative impact of non-OPEC crude production increases. The overall demand for OPEC crude is under pressure, the cartel is losing market share but still performs its main tasks as price regulator and oil market stabilizer.

The effects of OPEC's policies on the global oil price therefore remain disputed but should not be underestimated. As long as OPEC is the only organization holding spare-production capacity (at present 2.5 million barrels per day (MMbbl)) its role is still obvious. Analysts also warn that when Iraq and Iran re-enter the market in full as OPEC producers, the power of the oil cartel will increase substantially again.

The Arab oil embargo and the role of OPEC prompted an institutional response. The member states of the Organization for Economic Co-operation and Development (OECD) reacted through the creation of the International Energy Agency (IEA) and its emergency oil stock sharing

70 Marian Radetzki, 'Politics - Not OPEC Interventions - Explain Oil's Extraordinary Price History,' *Energy Policy* 46 (July 2012): 383.

71 Kaushik R. Bandyopadhyay, 'OPEC's Price-Making Power,' *Economic and Political Weekly* 43, no. 46 (November 2008): 18.

72 Radetzki, 'Politics - Not OPEC Interventions - Explain Oil's Extraordinary Price History,' 385; Vincent Brémond, Emmanuel Hache, and Valérie Mignon, 'Does OPEC Still Exist as a Cartel? An Empirical Investigation,' *Energy Economics* 34 (March 2011): 131.

mechanisms in 1974.⁷³ On three occasions this emergency mechanism was put to use; during the first Gulf War in 1991, in the aftermath of hurricane Katrina in 2005 and during the Arab revolutions in 2011 which caused the shutdown of Libyan crude oil exports.⁷⁴ Other important events – albeit not of a geopolitical nature – that caused the price of oil to fluctuate were the loss in available capacity in the Gulf of Mexico as a result of damage to installations caused by hurricanes Katrina and Rita in 2005, the Asian financial crisis in 1997, tight spare capacity and the crude outages in Nigeria, Iraq and the North Sea in 2007, and the advent of the global financial crisis in 2008.

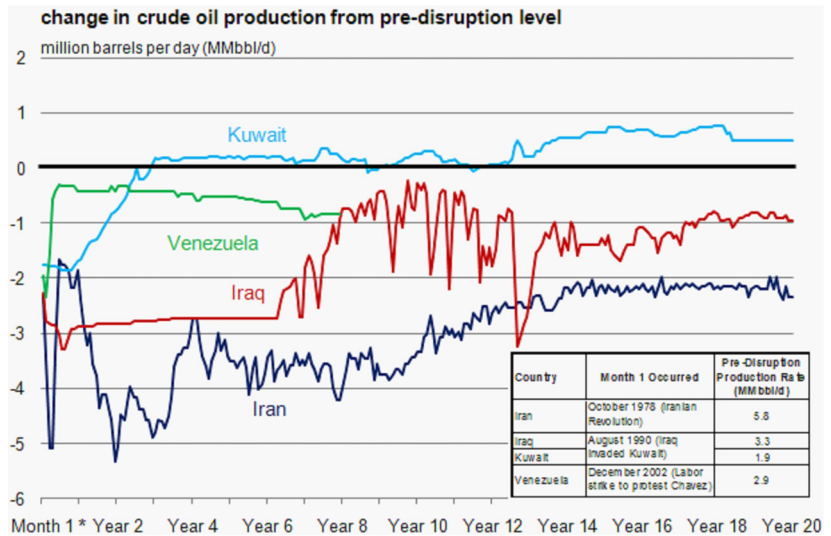


FIGURE 9. RECOVERY TIME OF OIL-EXPORTING COUNTRIES AFTER A DISRUPTION IN CRUDE OIL SUPPLY.⁷⁵

73 Andreas Goldthau and Jan Martin Witte, 'The Role of Rules and Institutions in Global Energy: An Introduction,' in *Global Energy Governance: The New Rules of the Game*, ed. Andreas Goldthau and Jan Martin Witte (Global Public Policy Institute / Brookings Institution, 2010), 3-4.

74 International Energy Agency, 'IEA Response System for Oil Supply Emergencies,' February 2012, 11.

75 U.S. Energy Information Administration, 'Effects of Crude Oil Supply Disruptions: How Long Can They Last?,' March 30, 2011, <http://www.eia.gov/todayinenergy/detail.cfm?id=730>.

Looking at the long term, disruptions to oil supply can have a profound impact. Research carried out by the EIA (see Figure 9) illustrates that recovery to pre-disruption output levels can often take many years.⁷⁶

3.2 GEOPOLITICS AND THE MARKET FOR NATURAL GAS

The market for natural gas has traditionally been divided into three main regions: the Asia-Pacific markets, the North American market and the European markets. A fourth, though much smaller market, is South America. This relative isolation of the various gas markets has also meant the development of different prices for natural gas in the various regions (see Figure 10).

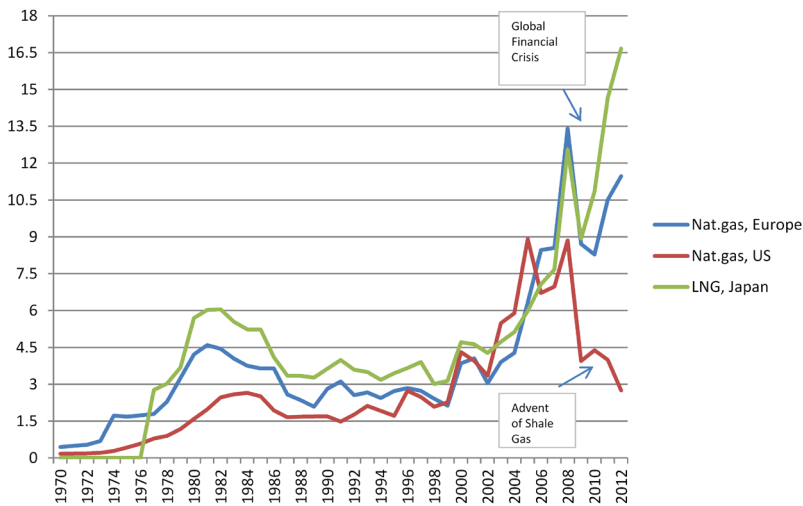


FIGURE 10. NATURAL GAS PRICES (IN NOMINAL US\$) PER MILLION BRITISH THERMAL UNITS (MMBTU)

76 Hakim Darbouche and Bassam Fattouh, 'The Implications of the Arab Uprisings for Oil and Gas Markets' (The Oxford Institute for Energy Studies, September 2011), 13-14.

Countries in the Asia-Pacific region, industrialized Asia and the emerging economies in particular, possess limited conventional natural gas resources of their own. As a consequence, they are almost entirely dependent on imported LNG from Southeast Asia and the Middle East. This lack of competition makes security of supply an expensive endeavor, which is reflected in the region's dependence on long-term, relatively high-priced contracts indexed to oil.⁷⁷ This situation is likely to change with the advent of large scale Australian LNG exports. The Sunrise natural gas project which runs across the Australian-Timor-Leste border is said to hold eight trillion cubic feet of gas and 300 million barrels of condensate. However, since the independence of Timor-Leste in 2002, the development of the field has been slow. Timor-Leste demands gas to be piped to the country for processing and transshipment, to allow it to maximize the country's economic benefit from the project over concerns that the project's riches would otherwise accrue mainly outside Timor-Leste's borders.⁷⁸

In Europe the trade in natural gas has traditionally been characterized by restricted pipeline access (for example, many Central and Eastern European countries only possess one East-West pipeline connection) and was conducted through long-term contracts with pricing mechanisms tied to a mix of competing fuels, fuel oil and gas oil in particular. Although spot markets exist in Europe in the UK, the Netherlands and Belgium, long-term contracts are dominant. By contrast, in North America, short-term supply and demand set the price on a robust spot market, which as a result moves independently from those of other fuels.⁷⁹

77 Moniz et al., *The Future of Natural Gas - An Interdisciplinary MIT Study*, 147 and 152.

78 John Daly, 'Australia Looks to Raise LNG Production by Nearly 30 Percent,' *Oilprice.com*, April 10, 2013, <http://oilprice.com/Energy/Natural-Gas/Australia-Looks-to-Raise-LNG-Production-by-Nearly-30-Percent.html>; Bryan Robins, 'Sunrise Deal May Finally See Light,' *The Sydney Morning Herald*, November 19, 2011, <http://www.smh.com.au/business/sunrise-deal-may-finally-see-light-20111118-1nne5.html#ixzz2Pnmn28TZ>.

79 Ydreos and Clingendael International Energy Programme, 'Geopolitics and Natural Gas,' 32-33; Moniz et al., *The Future of Natural Gas - An Interdisciplinary MIT Study*, 149-150 and 152; Jonathan Stern and Howard Rogers, 'Oxford Energy Comment. The Transition to Hub-Based Pricing in Continental Europe: A Response to Sergei Komlev of Gazprom Export,' February 2013, 3.

In 2001, the Gas Exporting Countries Forum (GECF) was founded in Tehran and is now headquartered in Doha, Qatar. With its 13 member states accounting for roughly 68% of the world's proven natural gas reserves, it could be seen as an attempt by gas exporting countries to establish an organization similar to OPEC.⁸⁰ GECF intentions were underlined at the 12th Ministerial Meeting in Cairo, where members spoke of the importance of 'long-term contracts and fair pricing for natural gas, at levels reflecting market fundamentals and parity with oil prices'.⁸¹ Currently, most gas sales are still conducted via long-term contracts. However, redirected LNG exports originally destined for the US market are causing more and more pressure on this type of construction (see *infra* this section).

As highlighted in the introduction to this chapter, gas markets are primarily regional in scope as opposed to the oil market. The effects of a cartelization of the gas market are thus not felt equally between regions.⁸² Moreover, it is interesting to point out that research carried out by Gabriel et al., suggests that Russia – the biggest gas producing country in the GECF – may not benefit from cartelization within the framework of the GECF.⁸³ Only when the cartel is expanded to include gas-producing countries from the Caspian region, as well as Saudi Arabia – a notable absentee from the GECF – will cartelization prove profitable for all its members, including Russia.⁸⁴

The indexing of natural gas prices to the price of oil in both Europe and in Asia is reflected in the price development over time, which shows similar 'peaks' to when the oil price was affected by geopolitical turmoil (see Figure 8). Of particular interest is the sharp drop in the price of natural gas

80 GECF member states are Algeria, Bolivia, Egypt, Equatorial Guinea, Iran, Libya, Nigeria, Oman, Qatar, Russia, Trinidad and Tobago, United Arab Emirates, and Venezuela. The most recent data concerning their proven natural gas resources is from 2011. U.S. Energy Information Administration, 'International Energy Statistics, Natural Gas, Reserves,' *EIA*, accessed April 4, 2013, <http://www.eia.gov/cfapps/ipdbproject/IEDIndex3.cfm?tid=3&pid=3&aid=6>.

81 Gas Exporting Countries Forum, 'GECF History,' 2, accessed April 4, 2013, <http://www.gecf.org/aboutus/gecf-history>.

82 S.A. Gabriel et al., 'Cartelisation in Gas Markets: Studying the Potential for a 'Gas OPEC', ' *Energy Economics* 34, no. 1 (January 2012): 138 and 146.

83 *Ibid.*, 148.

84 *Ibid.*, 149.

in the US after 2008, compared to the sharp increase in prices in both Europe and Japan around the same time. Whereas Europe and Asia entered a period of economic recovery following the global financial crisis and saw their gas demand rising, the advent of shale gas in the US caused domestic prices to dwindle.⁸⁵ This development led the IEA – and some commentators alike – to question whether the world was entering a ‘golden age of gas’.⁸⁶ Geopolitical tension impacts the price of natural gas in a similar fashion to oil insofar as their prices are linked. However, important differences exist with respect to the specific nature of geopolitical risks affecting natural gas markets. One manifestation of geopolitical risk lies in the differences between legal and regulatory regimes to which a pipeline is subjected when it crosses the territory of multiple states.⁸⁷ Also, the interests of transit-states through whose territory a pipeline intersects on its way to its final destination do not always correspond to the interests of producing and consuming nations.

The Energy Charter Treaty (ECT)⁸⁸ is a legally binding multilateral energy agreement that aims to strengthen the rule of law on energy issues and mitigate risks associated with energy-related investment and trade. The Treaty prescribes detailed rules on energy transit, including an obligation not to let transit be interrupted as a result of a conflict with another member. Members include all EU Member States, as well as Ukraine and the Central Asian producers. Russia, although originally having signed the Treaty, always refused ratification due to opposition to opening up its

⁸⁵ Stevens, *The ‘Shale Gas Revolution’: Developments and Changes*, 3.

⁸⁶ International Energy Agency, *Are We Entering a Golden Age of Gas? IEA Special Report* (International Energy Agency (IEA), 2011), <http://www.worldenergyoutlook.org/goldenageofgas/>; Daniel Yergin, ‘America’s New Energy Reality,’ *New York Times*, June 9, 2012, <http://www.nytimes.com/2012/06/10/opinion/sunday/the-new-politics-of-energy.html?pagewanted=all&r=0>; Martin Wolf, ‘Prepare for a Golden Age of Gas,’ *Financial Times*, accessed January 30, 2013, <http://www.ft.com/intl/cms/s/0/7d298f50-5c85-11e1-8f1f-00144feabdc0.html#axzz2JRy9QvIY>; Greg Ebel, ‘Golden Age of Natural Gas: Canada’s Opportunity. Let’s Get ‘Er Done’ (presented at the The Economic Club of Canada, Ontario, 2012).

⁸⁷ Moniz et al., *The Future of Natural Gas - An Interdisciplinary MIT Study*, 147.

⁸⁸ ‘The Energy Charter Treaty and Related Documents - A Legal Framework for International Energy Cooperation’ (Energy Charter Treaty Secretariat, September 2004).

network to lower-cost gas from Central Asian countries, a lack of access to the European market and the fact that the ECT's Transit Protocol would not apply between European countries (the EU being defined as a single economic space), which Russia saw as a discriminatory practice.⁸⁹ The Treaty was however applied provisionally until 20 August 2009, when Russia officially stated it intended to terminate provisional application.

Notwithstanding the obligation of uninterrupted transit, the ECT was unable to prevent interruptions to the transit of natural gas from Russia to Europe via Ukraine in 2006 and 2009 from escalating.⁹⁰

Similarly, the socio-political unrest in Tunisia during the Arab uprisings, a crucial transit country for gas supplies from Algeria to Italy, caused a (admittedly minor) drop in gas shipments through the Tunisia-Sicily stretch of the Trans-Mediterranean gas pipeline. Nevertheless, this event again signaled the precarious role played by transit countries.⁹¹ Finally, terrorist attacks on pipeline infrastructure and energy facilities serve as a constant

89 Sijbren de Jong, 'Towards Global Energy Governance : How to Patch the Patchwork,' in *Energy and Development*, ed. Gilles Carbonnier, International Development Policy (Basingstoke / Geneva: Palgrave Macmillan / Graduate Institute Geneva, 2011), 34–35.

90 Note that during the January 2009 crisis, the EU could in fact have referred to Art. 45 of the Energy Charter Treaty in its attempts to mitigate the crisis, which states that even without ratification, the Treaty is provisionally applicable, provided that it does not contradict existing domestic legislation. This in turn implies that referral to the Article in relation to both Russia *and* Ukraine would have been possible. In fact, this was confirmed by a special international commercial tribunal, set up for the Yukos case, that on 30 November 2009 ruled that the ECT is binding on Russia. See 'Court Rules Against Russia in Yukos Case,' *Euractiv*, December 1, 2009, <http://www.euractiv.com/energy/court-rules-russia-yukos-case-news-223133>. See also Sijbren de Jong, 'The EU's External Natural Gas Policy - Caught Between National Priorities and Supranationalism' (PhD Thesis, KULeuven, 2013), 35–37; Jonathan Stern, 'The Russian-Ukrainian Gas Crisis of 2006' (The Oxford Institute for Energy Studies, 2006); Sijbren de Jong, Jan Wouters, and Steven Sterkx, 'The 2009 Russian-Ukrainian Gas Dispute: Lessons for European Energy Crisis Management after Lisbon,' *European Foreign Affairs Review* 15, no. 4 (2010): 511–538; de Jong, 'Towards Global Energy Governance : How to Patch the Patchwork,' 24; Moniz et al., *The Future of Natural Gas - An Interdisciplinary MIT Study*, 147.

91 Darbouche and Fattouh, 'The Implications of the Arab Uprisings for Oil and Gas Markets,' 27.

reminder to the risk of gas shipments through politically unstable regions such as Algeria, Eastern Turkey and the Caucasus.⁹² The hostage crisis on the BP natural gas plant at In Amenas/Tiguentourine in Algeria in January 2013 which left 29 insurgents and at least 37 hostages dead again served to exemplify that this threat is real.⁹³

3.3 INDIRECT EFFECTS OF SHALE GAS: SHALE GAS AS A GEOPOLITICAL DOMINO?

As indicated by Figure 3 shale gas deposits can be found in many countries worldwide. However, outside the US, the extraction of shale gas resources is currently still in its infancy.

Only a few years ago the common view was that the US would need to increase its natural gas imports, leading to large investments in LNG regasification plants. The advent of shale gas in the US caused a serious reduction in LNG capacity utilization. As a result, many investors were left with surplus capacity and suffered financially.⁹⁴ Although, a reorientation of LNG exports to Europe and a growing demand from China and Japan after the Fukushima incident has absorbed some of this 'excess supply', it is expected that surplus capacity will exist for several years.⁹⁵

Some commentators question whether the US is interested in exporting natural gas on a large scale, as doing so would inevitably lead to higher domestic prices of natural gas, potentially affecting the 're-shoring' of American industry which came back precisely because of low domestic

92 'Pipeline Explosion Suspends Azerbaijani Gas Flow to Turkey,' *Today's Zaman*, May 30, 2012, http://www.todayszaman.com/newsDetail_getNewsById.action?newsId=281920; 'Two Killed in 'Militant Attack' on Algeria Pipeline,' *BBC News Africa*, January 28, 2013, <http://www.bbc.co.uk/news/world-africa-21235628>.

93 'Algeria Reopens Tiguentourine Hostage Crisis Gas Plant,' *BBC News*, February 21, 2013, <http://www.bbc.co.uk/news/world-africa-21568475>.

94 Paul Stevens, *The 'Shale Gas Revolution': Hype and Reality* (Chatham House, September 2010), vi; Stevens, *The 'Shale Gas Revolution': Developments and Changes*, 3; Andrey Konoplyanik, 'The Economic Implications for Europe of the Shale Gas Revolution,' *Europe's World* (January 13, 2011).

95 Ydreos and Clingendael International Energy Programme, 'Geopolitics and Natural Gas,' 34.

energy prices.⁹⁶ A study undertaken by the Brookings Institution concludes that LNG exports from the US would indeed affect domestic prices, raising them slightly, but overall the impact on the competitiveness of US industry and job creation would be limited.⁹⁷ Support for LNG exports is growing, as indicated by the August 2013 decision by the Obama administration (subject to environmental review and final regulatory approval) to allow the export of LNG to countries that do not have a Free Trade Agreement (FTA) with the United States from the Lake Charles Terminal in Lake Charles, Louisiana. The operator of the plant previously received approval to export LNG from this facility to FTA countries on July 22, 2011. The quantity is conditionally set at up to 2 Bcf per day (Bcf/d) for a period of twenty years. The US DOE granted the first authorization to export LNG to non-FTA countries in May 2011 from the Sabine Pass LNG Terminal in Cameron Parish, Louisiana at a rate of up to 2.2 Bcf/d, and the second authorization in May 2013 from the Freeport LNG Terminal in Quintana Island, Texas at a rate of up to 1.4 Bcf/d.⁹⁸

Other companies are keen to cash in on this development. On 10 May 2013, Exxon Mobil and Qatar Petroleum announced a deal to ship LNG from their proposed US-based export plant to the UK. Under the agreement, the companies would ship up to 15.6 million tons of LNG per year to their South Hook terminal in Wales from the Golden Pass plant in Texas, pending US government approval to build the plant and export LNG.⁹⁹ Given current

96 'United States: To Drill or Not to Drill,' *The Economist*, November 21, 2012, <http://www.economist.com/news/21566349-energy-independence-coming-closer-drill-or-not-drill/>; Aviezer Tucker, 'The New Power Map: World Politics After the Boom in Unconventional Energy,' *Foreign Affairs*, December 19, 2012, <http://www.foreignaffairs.com/articles/138597/aviezer-tucker/the-new-power-map>.

97 Charles Ebinger, Kevin Massy, and Govinda Avasarala, *Liquid Markets: Assessing the Case for U.S. Exports of Liquefied Natural Gas*, Policy Brief 12-1 (Brookings Institution, May 2012), vi.

98 'Energy Department Authorizes Third Proposed Facility to Export Liquefied Natural Gas | Department of Energy,' *Energy.gov*, August 7, 2013, <http://energy.gov/articles/energy-department-authorizes-third-proposed-facility-export-liquefied-natural-gas-1>.

99 'Exxon and Qatar Plan to Ship US Natural Gas to Britain | Reuters,' *Reuters*, May 10, 2013, <http://www.reuters.com/article/2013/05/10/Ing-goldenpass-idUSL2N0DR33E20130510?feedType=RSS&feedName=rbssEnergyNews>.

price settings (taking into account regasification, transportation and profits), the commercial attractiveness of US LNG exports to Europe is however at present still unclear.

CURRENT DEVELOPMENTS

The possible extent to which the US' experience is replicated elsewhere aside, the US shale gas revolution is already impacting international energy markets. In 2009, whilst Russia was still battling a drop in demand caused by a prolonged economic recession in Europe, US gas production surpassed Russian production for the first time since 2001.¹⁰⁰ Redirected LNG exports originally destined for the US caused natural gas prices on spot markets to drop significantly, causing Europe to become a buyers-market.¹⁰¹

This development had two effects. One, major European utilities bound by long-term 'take-or-pay' contracts which oblige the purchase of a minimum amount of gas at a price pegged to the price of oil, came under stress. Because of slowing demand in Europe due to the financial crisis, and lower alternative fuel prices, such as coal or alternative energy (Germany), it became difficult for importers to continue to abide by their side of the contract prompting a desire to renegotiate the terms and conditions, opting for short term spot purchases where the price is determined by supply and demand, in the anticipation that gas prices will fall further.¹⁰² Second, a natural gas producer such as Gazprom saw its negotiating position vis-à-vis European states worsen due to competition from LNG, causing uncertainty over long-term demand, cost margins and a decline in market share.¹⁰³

100 'Russian Minister Says Shale Gas a Problem for Gazprom,' *Reuters*, April 19, 2010, <http://www.reuters.com/article/2010/04/19/gas-russia-idUSLDE6311LS20100419>.

101 A. Goldthau, 'Emerging Governance Challenges for Eurasian Gas Markets after the Shale Gas Revolution,' in *Dynamics of Energy Governance in Europe and Russia*, ed. A. Goldthau et al., International Political Economy (Basingstoke: Palgrave Macmillan, 2012), 213.

102 Ibid.; Stern and Rogers, 'Oxford Energy Comment. The Transition to Hub-Based Pricing in Continental Europe: A Response to Sergei Komlev of Gazprom Export'; Tucker, 'The New Power Map: World Politics After the Boom in Unconventional Energy'; Andreas Goldthau and Wade Hoxtell, *The Impact of Shale Gas on European Energy Security* (Berlin: Global Public Policy Institute, February 2012), 11; Stevens, *The 'Shale Gas Revolution': Developments and Changes*, 3.

103 Stern and Rogers, 'Oxford Energy Comment. The Transition to Hub-Based Pricing in

In February 2010, German energy company E.ON Ruhrgas stated it completed talks with Gazprom allowing a part of its contracted gas to be supplied at spot prices.¹⁰⁴ In June 2013, rumors emerged that E.ON would want to phase out its contracts with Gazprom altogether.¹⁰⁵ Forced to grant discounts to its key clients in Europe, the Russian government rightfully views this development as problematic for Gazprom, not least because – unlike with shale gas – wells cannot be shut down once demand or prices drop below competitive levels. Volumes would have to be flared, stored at high costs, or redirected elsewhere, which is often impossible due to unavailable infrastructure.¹⁰⁶ The negative impact this has on investment as well illustrated by Russia's recent decision to indefinitely postpone the development of the Shtokman field in the Barents Sea.¹⁰⁷

This change in the contractual relations between consumer countries and producer countries due to shale gas has suppliers such as Gazprom worried (see also *infra*, section 5.1).¹⁰⁸ Turning eastwards to offset losses in the European market through burgeoning sales in the Far East has proven cumbersome as illustrated by the lengthy negotiations between Gazprom

Continental Europe: A Response to Sergei Komlev of Gazprom Export,' 8; Goldthau, 'Emerging Governance Challenges for Eurasian Gas Markets after the Shale Gas Revolution,' 213-214 and 216.

104 'UPDATE 2-Gazprom Adjusts Gas Pricing to Defend Market Share | Reuters,' *Reuters*, February 19, 2010, <http://uk.reuters.com/article/2010/02/19/gazprom-pricing-idUKLDE6111M320100219>.

105 'E.on Wil Af van Contracten Met Gazprom,' *Het Financieele Dagblad*, June 1, 2013, <http://fd.nl/ondernemen/447673-1306/e.on-wil-af-van-contracten-met-gazprom?visited=true>.

106 'Russian Minister Says Shale Gas a Problem for Gazprom'; Goldthau, 'Emerging Governance Challenges for Eurasian Gas Markets after the Shale Gas Revolution,' 216; Paul Waldie, 'How Fracking Weakens Gazprom, the Bedrock Beneath Putin's Feet,' *The Globe and Mail*, February 18, 2013, <http://www.theglobeandmail.com/report-on-business/industry-news/energy-and-resources/how-fracking-weakens-gazprom-the-bedrock-beneath-putins-feet/article8791722/>.

107 James Marson, 'Gazprom Postpones Development of Shtokman Field,' *Wall Street Journal*, August 30, 2012, <http://online.wsj.com/article/SB10000872396390444914904577620733220528246.html>.

108 Spiegel Staff, 'Full Throttle Ahead: US Tips Global Power Scales with Fracking,' *Spiegel Online*, February 1, 2013, <http://www.spiegel.de/international/world/new-gas-extraction-methods-alter-global-balance-of-power-a-880546.html>.

and China. Throughout the past decade as many as six agreements for the delivery of gas were signed, yet a single cubic meter of gas is yet to find its way to China. The greatest point of contention, the price, remained unresolved as China is well aware of the competition that Gazprom faces from Australia, the Gulf countries, Malaysia (all LNG) and pipeline gas from Central Asia.¹⁰⁹ A potential breakthrough could be the agreement that Gazprom and the China National Petroleum Corporation (CPNC) signed on 5 September 2013. The deal defines the volumes, start of deliveries, payments, 'take-or-pay' amendment and other issues for Russian gas to flow eastwards. Although not many details of the agreement were made public, it is evident from the press releases that a final deal on the price is as of yet forthcoming. Interestingly, Gazprom acknowledged that the price formula may include a spot part to reflect more flexible liquefied gas market prices, though that would not be connected to US prices, which are much lower than the European and Asian natural gas price.¹¹⁰ At this point it thus remains to be seen whether China and Russia will actually manage to agree on the final terms and conditions.

GEO-STRATEGIC CONSIDERATIONS

On a strategic level, as US energy import dependency is greatly decreasing, a 'rebalancing' of US foreign policy is taking place from the Middle East toward other regions, notably the Asia/Pacific.¹¹¹ However, taking into account the important relationship with Israel and that maintaining stable

109 Fiona Hill and Bobo Lo, 'Putin's Pivot - Why Russia Is Looking East,' *Foreign Affairs*, July 31, 2013, http://www.foreignaffairs.com/articles/139617/fiona-hill-and-bobo-lo/putins-pivot?cid=rss-rss_xml-putins_pivot-000000; Maité Boncourt and Laura Parmigiani, 'How Is Russia Adapting to a Threatening New Energy World?' (Institut Français des Relations Internationales (IFRI), July 26, 2013).

110 'Gazprom, CNPC Agree Basic Terms of Long-awaited Gas Deal,' *Reuters*, September 5, 2013, <http://www.reuters.com/article/2013/09/05/us-gazprom-cnpc-export-idUSBRE9840FX20130905>.

111 Spiegel Staff, 'Full Throttle Ahead: US Tips Global Power Scales with Fracking'; Mark E. Manyin et al., *Pivot to the Pacific? The Obama Administration's 'Rebalancing' Toward Asia* (Congressional Research Service, March 28, 2012); Jonathan Pearlman, 'US Will Shift Focus from Middle East to Asia Pacific, Barack Obama Declares,' *The Telegraph*, November 17, 2011, <http://www.telegraph.co.uk/news/worldnews/barackobama/8895726/US-will-shift-focus-from-Middle-East-to-Asia-Pacific-Barack-Obama-declares.html>.

global energy prices will remain a priority, a total US disengagement from the Middle East will be unlikely.¹¹² In this context, it is important to stress that a US less dependent on foreign energy will allow emerging economies to fill the void left by a lower US demand for energy imports, at potentially lower prices.¹¹³ Supply side illustrations of this potential trend are the attempts by Qatar to pursue new contracts with China and India now that US demands for LNG have dropped.¹¹⁴

A gradual withdrawal from the US on its foreign policy and energy commitments in the Middle East and North Africa could also impact Europe's energy security as other countries may take the US' place. Of the BRIC countries, China and India are most likely to try and fill the void left by diminishing US energy demand.¹¹⁵ Chinese energy import dependency (the bulk of which is oil-related) is expected to continue its two decade-long growth, with the IEA projecting an import dependency of 84.6% in 2035.¹¹⁶ In order to secure the country's future supply of energy, Chinese national energy companies have started acquiring substantial resources abroad. China has also diversified its supply with imports from Africa now constituting 30.1% (2009) of total imports, up from 0% in 1989.¹¹⁷ India has seemed to follow a similar strategy which is illustrated by competition between Chinese and Indian energy companies with respect to potential foreign takeovers.¹¹⁸ India has also shown an active interest in importing LNG

112 Javier Solana, 'America's Perilous Pivot,' *Oxford Energy Forum* no. 91 (February 2013): 3.

113 Anilesh S. Mahajan, 'The Pipe Runneth Over,' *Business Today*, January 20, 2013, <http://businesstoday.intoday.in/story/energy-security-india/1/191045.html>.

114 U.S. Energy Information Administration, 'Country Analysis, Qatar,' January 30, 2013, <http://www.eia.gov/countries/cab.cfm?fips=qa>.

115 Brazil and Russia both have an abundance in energy resources. The former in hydraulic and renewable energy resources, the latter in gas and oil reserves.

116 ZhongXiang Zhang, 'The Overseas Acquisitions and Equity Oil Shares of Chinese National Oil Companies: A Threat to the West but a Boost to China's Energy Security?,' *Energy Policy* 48 (2012): 698.

117 Wensheng Cao and Christoph Bluth, 'Challenges and Counter Measures of China's Energy Security,' *Energy Policy* 53 (2013): 384.

118 Indrajit Basu, 'India Discreet, China Bold in Oil Hunt,' *Asia Times*, September 29, 2005, http://www.atimes.com/atimes/South_Asia/GI29Df01.html.

from the US, Canada, and to a lesser extent Australia in order to diversify its energy supply.¹¹⁹ Illustrative is the March 2013 approval by the Canadian government to allow Mitsubishi Corp. and three other companies to export shale gas from western Canada to Japan and other parts of Asia.¹²⁰

It should be pointed out here that although the acquisition of foreign resources by either Chinese or Indian companies is at times viewed as potentially threatening to Europe's energy security, additional production capacity generated by their extra investment will not necessarily be diverted back to the company's 'home country'.¹²¹ What is important however is whether China and India will also seek to gain a greater stake in regional security in order to protect their economic interests.¹²² This could dampen fears of supply disruptions and potentially bring down oil prices.¹²³ However, it will take decades before the Chinese and Indian navies can be a matching force, when at all. Therefore, it is not unimaginable that increased competition between China and India could destabilize the region. This pessimism is justified in part by several recent developments. First, after a series of pricing disputes between China and Iran prompted Beijing to reduce its imports of Iranian oil, India decided to substantially increase its imports of Iranian crude, thus effectively scooping up China's share.¹²⁴

119 Mahajan, 'The Pipe Runneth Over.'

120 'Mitsubishi Among Firms OK'd by Canada to Export Shale Gas,' *The Japan Times*, March 5, 2013, <http://www.japantimes.co.jp/news/2013/03/05/business/mitsubishi-among-firms-okd-by-canada-to-export-shale-gas/#.UT8sxMXoomB>; *Japan Country Profile* (US Energy Information Administration, June 4, 2012).

121 Much of the oil produced by Chinese national oil companies abroad has subsequently been traded on the international market thus benefiting consumers worldwide. It should be stressed however that the extent to which this happens depends on the country in question where investments are made, given that OPEC countries are bound by quotas independent of investments and production capacity. Zhang, 'The Overseas Acquisitions and Equity Oil Shares of Chinese National Oil Companies: A Threat to the West but a Boost to China's Energy Security?,' 700.

122 Mahajan, 'The Pipe Runneth Over.'

123 Ibid.

124 'China's Persian Gulf Diplomacy Reflects Delicate Balancing Act,' *The Jamestown Foundation*, February 21, 2012, http://www.jamestown.org/single/?no_cache=1&xttnews%5Btt_news%5D=39029.

Second, coinciding with its increase in energy-related investment in the region, India has already increased its military presence by inaugurating a new naval and air base in the southern tip of the Andaman and Nicobar Island in August 2012. China similarly stepped up its presence through a string of ports and bases around India's southern periphery.¹²⁵ Finally, the decision which really set alarm bells ringing in India was the decision by the government of Pakistan to transfer the management of the Pakistani port of Gwadar to China, a location en route to key Strait of Hormuz shipping lanes.¹²⁶ Meanwhile, India is eyeing the Iranian port of Chabahar for direct access to Central Asia, a mere 76km away from the Chinese operated port in Gwadar.¹²⁷

POTENTIAL FOR INSTABILITY

A development related to the possible gradual US withdrawal is the potential for instability in the region, affecting global oil prices, as well as European energy security. Important in this context is the concern that in many oil- and gas-exporting countries fuel, food, health, education, as well as other goods and services are traditionally heavily subsidized and form part of the 'social contract' that governs society.¹²⁸ With effectively no money made on domestic fuel sales as these are sold below market rates, these subsidies place an enormous drain on the potential revenue earned

125 'Energy Resources: China, India Spar over Persian Gulf Oil,' *Stratrisks*, April 27, 2013, <http://stratrisks.com/geostrat/12124>.

126 'Pakistan Hands Management of Strategic Gwadar Port to China,' *Reuters*, February 18, 2013, <http://www.reuters.com/article/2013/02/18/us-pakistan-port-idUSBRE91H0IU20130218>.

127 Dipak K Dash, 'India Eyeing Iran's Chabahar Port for Direct Access to Central Asia,' *Times of India*, August 26, 2012, [http://articles.timesofindia.indiatimes.com/2012-08-26/india/33401506_1_direct-access-iran-s-chabahar-indian-ports-association; 'Salman Khurshid to Leave for Iran; India Looks for Access to Chabahar Port,' *The Economic Times*, May 3, 2013, <http://economictimes.indiatimes.com/news/politics-and-nation/salman-khurshid-to-leave-for-iran-india-looks-for-access-to-chabahar-port/articleshow/19849693.cms>.](http://articles.timesofindia.indiatimes.com/2012-08-26/india/33401506_1_direct-access-iran-s-chabahar-indian-ports-association; Salman Khurshid to Leave for Iran; India Looks for Access to Chabahar Port,)

128 Darbouche and Fattouh, 'The Implications of the Arab Uprisings for Oil and Gas Markets,' 34; Bill Law, 'Gulf States Face Hard Economic Truth About Subsidies,' *BBC News Middle East*, December 18, 2012, <http://www.bbc.co.uk/news/world-middle-east-20644964>; Amy Myers Jaffe and Ronald Soligo, 'State-Backed Financing in Oil and Gas Projects,' in *Global Energy Governance: The New Rules of the Game*, ed. Andreas Goldthau and Jan Martin Witte, 2010, 114-115.

from exports.¹²⁹ For example, Russian Gazprom sells 60% of its natural gas on the domestic market at a loss. It therefore comes as no surprise that the bolstered negotiating position of European countries, coupled with EU plans to diversify supply routes and possibly extract their own shale gas resources has the Kremlin worried it may no longer be able to offset the domestic losses by high profit margins from sales on the European market unless this gap is filled by other clients.¹³⁰

Subsidies also play a vital role in ensuring domestic stability. For example, during the Arab revolutions in 2011, many Gulf States heavily increased their social spending out of fear of a spillover of socio-political unrest from North Africa, including individual grants to inhabitants, free food staples, and large increases in minimal wages.¹³¹ With domestic natural gas sales generating losses and subsidies still widespread, steady export revenues are of vital concern to the long-term survival of governments in the region. These export revenues are placed under additional stress in light of growing domestic demand for natural gas in the Middle East and North Africa. Natural gas consumption in countries such as Algeria, Egypt, Libya, Iran and Iraq has indeed been increasing steadily over the years, and is projected to continue to do so in the foreseeable future.¹³² This situation is no different in major oil-producing states such as Saudi Arabia, which experience an alarmingly high domestic oil-consumption rate, set against equally costly domestic fuel subsidies.¹³³

129 Tucker, 'The New Power Map: World Politics After the Boom in Unconventional Energy.'

130 'Russia's Natural Gas Dilemma,' *EurActiv*, April 11, 2012, <http://www.euractiv.com/energy/russias-natural-gas-dilemma-analysis-512092>; Spiegel Staff, 'Full Throttle Ahead: US Tips Global Power Scales with Fracking.'

131 Darbouche and Fattouh, 'The Implications of the Arab Uprisings for Oil and Gas Markets,' 18.

132 'BP Statistical Review of World Energy' (BP, June 2012), 23; *Iraq Energy Outlook* (International Energy Agency (IEA), October 9, 2012), 12; 'Libya Dry Natural Gas Consumption by Year (Billion Cubic Feet),' *Index Mundi*, accessed April 24, 2013, <http://www.indexmundi.com/energy.aspx?country=ly&product=gas&graph=consumption>.

133 John Sfakianakis, 'Oil Kingdom,' *Foreign Policy*, August 7, 2013, http://www.foreignpolicy.com/articles/2013/08/07/why_saudi_arabia_still_rules_global_energy_oil.

A view held by several commentators is that this situation is untenable in the long run, simply because declining world prices as a result of shale gas development (and other unconventional fuels) mean that regimes dependent on oil and gas exports (for example Qatar, Russia, Saudi Arabia and Algeria) will no longer be able to abide by their side of this precarious 'social contract'.

In other words, subsidies may have to be lessened and (partly) replaced by taxes in order to balance their budgets. Failing to do so, could result in popular resentment and instability.¹³⁴

IMPLICATIONS FOR EUROPE

The indirect effects of shale gas carry profound geopolitical implications for global energy markets. Important for Europe is that if shale gas were to negatively affect export revenues in traditional oil- and gas-exporting countries, the security situation in Europe's neighborhood may deteriorate. Geo-strategically, we could be faced with a redrawing of existing energy relations in the Middle East. A relevant issue in this context is the extent to which shale gas could worsen economic conditions in the Middle East and North Africa, particularly in countries already affected by the Arab Spring. Also, given Europe's extensive energy ties to Russia, the impact that shale gas development might have on the economic climate and stability in Russia and other oil- and gas- exporting countries belonging to the former Soviet Union is a factor to take into account.

Notwithstanding the direct effects of shale gas (see section 2.3), we are particularly interested in the indirect effect of potential instability within oil- and gas-exporting countries located in Europe's neighborhood.

134 Thomas L. Friedman, 'The First Law of Petropolitics,' *Foreign Policy*, May 1, 2006, http://www.foreignpolicy.com/articles/2006/04/25/the_first_law_of_petropolitics; Spiegel Staff, 'Full Throttle Ahead: US Tips Global Power Scales with Fracking'; Tucker, 'The New Power Map: World Politics After the Boom in Unconventional Energy'; Darbouche and Fattouh, 'The Implications of the Arab Uprisings for Oil and Gas Markets,' 18; Waldie, 'How Fracking Weakens Gazprom, the Bedrock Beneath Putin's Feet'; Amy Myers Jaffe and Edward L. Morse, 'Liquefied Natural Profits,' *Foreign Affairs*, September 16, 2013, <http://www.foreignaffairs.com/articles/139932/amy-myers-jaffe-and-edward-l-morse/liquefied-natural-profits>.

Important oil- and gas-exporting countries/regions which come into question are Russia, Algeria, Egypt, Qatar, Saudi Arabia, Azerbaijan, Kazakhstan and Northwestern Europe itself. To test the extent to which instability could arise, a specific methodology was used. The next chapter focuses in detail on how System Dynamics (SD) models, in combination with Exploratory Modeling and Analysis (EMA) methodology, was applied throughout this study.

4 METHODOLOGY

In this chapter, we discuss the models used for analyzing the impact of shale gas extraction on the stability of traditional oil- and gas-producing countries and Northwestern Europe. The specifics of the modeling method and Exploratory Modeling & Analysis (EMA) is discussed in section 4.1, while the general modeling assumptions, as well as a discussion on general model validity are given in section 4.2.

The first issue to be addressed is the influence of shale gas on both global and regional energy prices. For this reason we developed a simulation model, described in section 4.3, which we used for exploring potential, plausible energy price scenarios. We did so because only simple and quite conservative future price projections are currently available, yet more extreme or volatile scenarios which take account of the effects of unconventional energy sources such as shale gas, are as of yet unavailable. The second issue is the uncertain effect that different price scenarios will have on the state stability. It is widely believed that a reduction in resource rents may (indirectly) cause instability, but it is always uncertain to what extent a fluctuation in a resource price might actually cause instability. This is why we built a second simulation model, described in section 4.4, which allows us to assess the effects of plausible price scenarios on state stability under conditions of uncertainty.

4.1 SYSTEM DYNAMICS AND SCENARIO DISCOVERY

SYSTEM DYNAMICS

In this study, two different simulation models are used. These simulation models were made using the System Dynamics (SD) method.¹³⁵ SD is a quantitative modeling method which allows us to make causal relations between different factors explicit as mathematical equations and, as such, replicate feedback structures similar to the feedback mechanisms seen in real complex issues. An example of such a feedback system is the balancing of demand and supply in the energy mix (see Figure 11).

SD models allow us to simulate the simultaneous interactions of different feedback mechanisms, generating non-linear dynamic scenarios for the system elements represented in the model. One run with an SD model is thus an internally consistent set of dynamic scenarios for each system element modeled.

SCENARIO DISCOVERY

Many complex systems are characterized by deep uncertainty about their functioning. Deep uncertainty can be defined as: ‘where analysts do not know, or the parties to a decision cannot agree on, (1) the appropriate conceptual models that describe the relationships among the key driving forces that will shape the long-term future, (2) the probability distributions used to represent uncertainty about key variables and parameters in the mathematical representations of these conceptual models, and/or (3) how to value the desirability of alternative outcomes.’¹³⁶

A method which allows for the development of scenarios for these systems, is Scenario Discovery.¹³⁷ Scenario Discovery builds on the intuitive logic

¹³⁵ Forrester, *Industrial Dynamics*; Sterman, *Business Dynamics: Systems Thinking and Modelling for a Complex World*.

¹³⁶ Robert J. Lempert, Steven W. Popper, and Steven C. Bankes, *Shaping the Next One Hundred Years : New Methods for Quantitative, Long-term Policy Analysis* (Santa Monica: RAND, 2003), http://www.rand.org/pubs/monograph_reports/2007/MR1626.pdf.

¹³⁷ Benjamin P. Bryant and Robert J. Lempert, ‘Thinking Inside the Box: A Participatory, Computer-assisted Approach to Scenario Discovery,’ *Technological Forecasting & Social Change* 77 (2010): 34–49, doi:10.1016/j.techfore.2009.08.002.

scenario techniques and allows for the exploration of the consequences of deep uncertainty with quantitative (simulation) models. As such, Scenario Discovery fits within the broader Exploratory Modeling & Analysis (EMA) methodology.¹³⁸ The application of Scenario Discovery with SD models, which methodologically can be referred to as Exploratory System Dynamics Modeling & Analysis (ESDMA),¹³⁹ allows the exploration of dynamic scenarios of systems that are both complex and uncertain.¹⁴⁰ As each scenario generated in the set corresponds to an individual SD model run, each scenario is internally consistent.

4.2 GENERAL MODELING ASSUMPTIONS

In essence, all assumptions made in the modeling process are uncertain. The extent to which the assumption is uncertain depends on the amount of consensus (e.g., in the literature) about the assumption. However, for many of these assumptions no direct literature is available and where literature is available, this does not always indicate an absence of uncertainty. In this case, and also when no alternative assumptions are available, we assume that all assumptions are uncertain.

METHOD ASSUMPTION

The first level of uncertainty, and consequentially, in the assumptions lies in choosing the simulation modeling method. As each method has both limitations and strengths, choosing a specific method influences the outcomes the model can generate. As such, it is important to choose a method that fits the characteristics of the problem.

The modeling method used in this study, SD, has several implicit and explicit method assumptions. SD can be used for forecasting scenarios based on input. The transformation of input to output in SD happens by focusing on the internal causal relations within a system. Another, contrasting method in this respect, is econometrics. In extremis, econometrics focuses on estimating the correlation between input and output variables. SD is thus

138 Steven C. Bankes, 'Exploratory Modeling for Policy Analysis,' *Operations Research* 41, no. 3 (1993): 435–449, <http://www.jstor.org/stable/10.2307/171847>.

139 Ibid.

140 Kwakkel, J.H., Auping, W.L., and Pruyt, E., 'Dynamic Scenario Discovery Under Deep Uncertainty: The Future of Copper,' *Technological Forecasting and Social Change* 80, no. 4 (2013): 789–800, doi:<http://dx.doi.org/10.1016/j.techfore.2012.09.012>.

more a white box method, while econometrics is a black box method. As was indicated above, SD is a modeling method specifically suitable for complex problems. It functions by top-down unraveling the causal structure of the system of the research problem. It can thus be contrasted with Agent Based Modeling (ABM)¹⁴¹, which is characterized by a strict bottom-up approach: the agents in the system are modeled and the top-down behavior is considered emergent. A final characteristic of SD modeling is the assumption of gradual or continuous change in the model variables. Discrete events or shocks can thus be modeled exogenously, but this is, in SD literature, generally considered to be undesirable.

The limitations of a particular modeling method can, from an uncertainty perspective, be overcome most elegantly by using multiple types of modeling, which complement each other in this perspective. However, it should be noted that choosing multiple methods makes the modeling phase in a research program longer, and generally requires multiple analysts from different modeling backgrounds to overcome biases attached to having a dominant field of work per analyst.

MODEL ASSUMPTIONS AND UNCERTAINTIES

After the choice has been made to use a specific modeling method, the first issue is the perspective from which the model is built. This can be seen as perspective uncertainty. A simple example may be the difference between a top-down and a bottom-up approach to calculating demand. Top-down, demand is calculated by looking at the economic development level of the population (GDP per capita) and the size of the population. Via a correlation between resource use and GDP per capita, the demand for a specific resource can be calculated. Bottom-up, one could look at the demand for specific uses of a resource and how far this demand has been met. Depending on an autonomous demand growth for each use, the aggregated demand can be calculated. When specific resource uses are considered, this may

141 Michael Wooldridge, 'Agent-Based Software Engineering' (Mitsubishi Electric Digital Library Group, September 1997), <http://www.cs.ox.ac.uk/people/michael.wooldridge/pubs/iee-se.pdf>; Nicholas R. Jennings, 'Agent-Oriented Software Engineering,' in *Multiple Approaches to Intelligent Systems*, ed. Ibrahim Imam et al., Lecture Notes in Computer Science 1611 (Springer Berlin Heidelberg, 1999), 4-10, http://link.springer.com/chapter/10.1007/978-3-540-48765-4_2.

have a profound impact on other elements in the model as well. The perspective choice may thus influence the complete structure of a model, in essence leading to two different models. On a slightly lower aggregation level, assumptions have been made about structural (formula) and parametric value uncertainties. Structural uncertainties are in essence modeling choices about formulas. Every model formula is thus an assumption. The majority of formulas can be derived using common sense, but specific formulas and model structures are not trivial.

The parametric uncertainty (with, as special variant, trend uncertainty) is the most concrete version of uncertainty encountered in the modeling process. All parameters in the model, except the definitions of specific parameter boundaries, are assumed to be uncertain. For a complete overview of all relevant assumptions within the energy price scenarios model and the country stability model, see sections 4.3 and 4.4.

MODEL VALIDITY AND LIMITATIONS

A model is generally considered valid when it is suitable for the purpose intended.¹⁴² Often this state of the model is referred to as model validity. Validating models used for scenario discovery, as in this study, is somewhat different compared to models that can rely on one reference run, as is done in traditional modeling. The absence of a reference run and the focus on different plausible dynamics in the system, renders historic comparison largely obsolete. However, the issue of validation can, although only partly, be overcome by specific techniques, aiming at *ex ante* correct construction of the model, and *ex post*, face validation of the behavior shown by the model. All techniques described below were performed for both models in this research.

The *ex ante* validation contains basically three different checks and best practices. First, all variables in an SD model have units as well as values or formulas. A unit check can be performed in order to check whether the model is constructed consistently with regard to the units. A second check is to see whether literature exists with regard to specific relations between variables. Given the fact that correlations are only seldom useful in an SD model and statistic causal relations are not always translatable into a

¹⁴² Sterman, *Business Dynamics: Systems Thinking and Modelling for a Complex World*.

simulation model, this is however seldom possible. The third check is a sanity check, to see whether model relations make sense. We performed this in model construction workshops with energy experts.

Ex post, after model construction, it is possible to check whether the behavior of the model satisfies plausibility or extreme condition checks, for example, negative values for stockpiled resources should not be possible. Even if only one run in the whole set of scenarios generated with the model shows impossible behavior, this indicates model errors that need to be corrected. Further, the uncertainty analysis helps to detect these errors. A final check is whether the behavior shown by the model at least contains the expected behavior in the set of generated scenarios. If this is not the case, it should become clear why this does not happen and whether this is a plausible explanation for the impossibility of the initially expected behavior. In this study we used peer review sessions with energy experts for this purpose.

4.3 ENERGY PRICE SCENARIOS MODEL

The first model used in this study is the price scenario model. In short, this model dynamically calculates the balance between supply and demand for different primary energy sources. Essential elements of this continuous balancing are the different energy prices.

The balancing of supply and demand can be seen as the combination of two balancing feedback loops (Figure 11). One of the feedback mechanisms is between supply and price. With a price increase, more supply will become available, while with an increase in supply, the price will decrease. Another feedback is between demand and price, where more demand will generally result in a higher price, while a higher price eventually leads to a decline in demand. Eventually, as the reaction of both demand and supply on the price is delayed, supply and demand will adjust according to the witnessed price levels.

In modeling efforts it is sometimes necessary to introduce exogenous trends, which are almost without exception deeply uncertain. It is thus necessary to explore the consequences of their different plausible evolutions. In this case the only trend we needed was a set of evolutions for the exogenous development of GDP. This growth is thus an external driver

of the GDP growth. However, as energy is vital to economic functioning, we assumed that energy prices may also influence GDP growth, which is an endogenous effect. The overall GDP growth is thus partly endogenous. Given the functioning of SD models, economic growth will lead to exponential growth of the energy demand, as energy intensity forms a linear relation between GDP and energy demand. Hence, a gradual decrease in energy intensity leads to uncoupling of that effect.

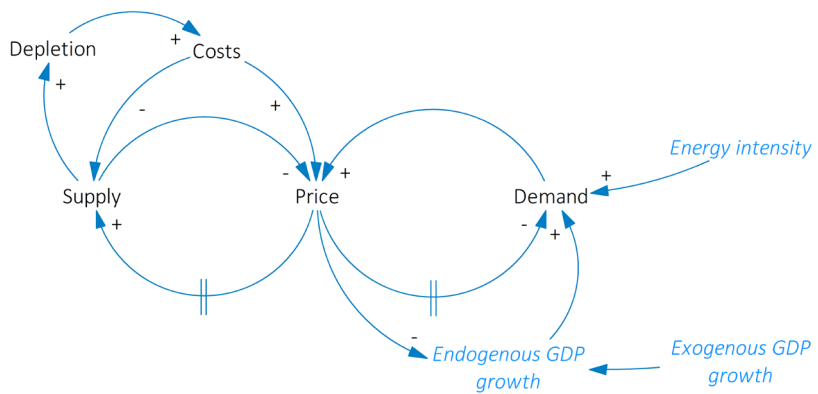


FIGURE 11. BALANCING SUPPLY AND DEMAND

As GDP growth is the most important exogenous trend, the effects of political instability, a potential feedback from the instability models, is not considered here. Furthermore, policy measures aimed at changing the composition of the energy mix - in essence the definition of an energy transition - are not considered, besides one driver for the development of renewable energy capacity.

The fully quantified energy prices model is subdivided into five sub-models, which are mutually linked (see Figure 12). As is visible in this diagram, we look in particular at the development of demand, the development of supply, different primary energy source prices, costs development of supply, and trade between the different regions. The first three are important given the feedbacks between supply and demand via the price effect. The costs extraction sub-model is important for modeling the effects of depletion on extraction costs. Finally, as a greater availability of

gas may lead to a larger share of LNG on the market, it is important to consider trade between the different regions of the tradable resources, in this case gas (LNG), oil, coal, and renewables. Trade of the two remaining primary energy sources, nuclear and hydro, is thus not considered.

In the model, four different regions are defined: Northern America (US and Canada), Europe and adjacent regions (Europe, non-European CIS, Middle East, and North Africa), Far East (China, India, Japan, and South Korea), and the rest of the world. The first two regions are defined with in mind the availability of overland gas pipelines. The third region is presently a major user of LNG. In next sections, the composition of this model is discussed in more detail. The regions thus form a unity from a gas trading perspective.

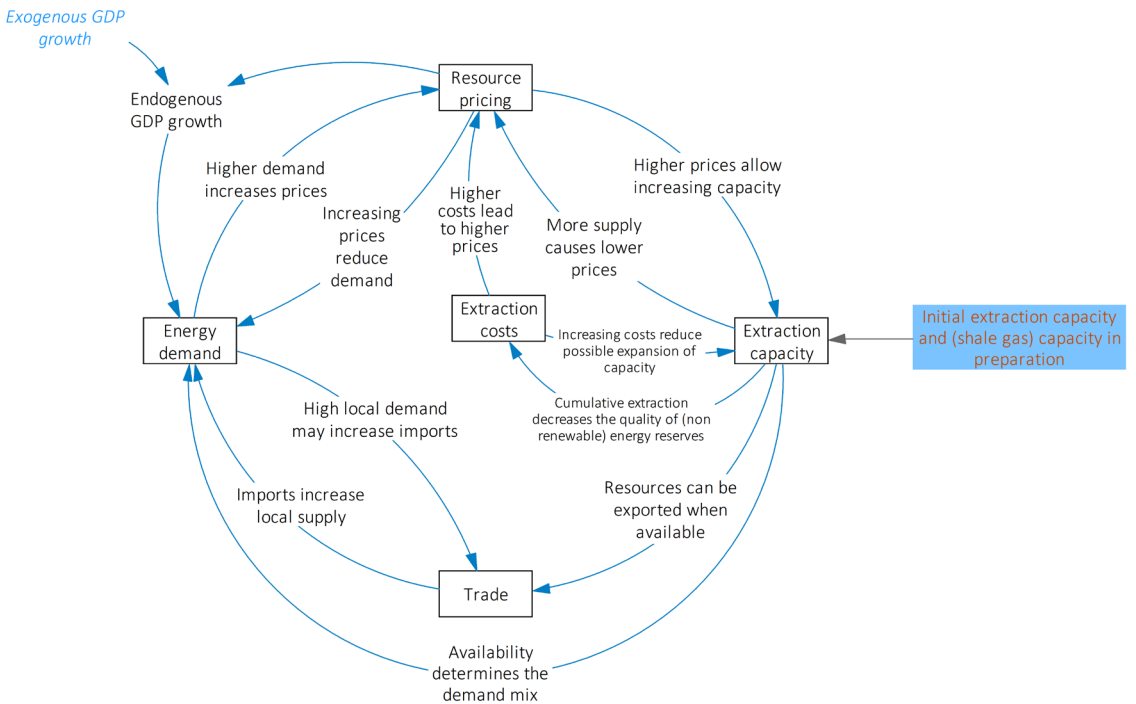


FIGURE 12. SECTOR DIAGRAM OF THE ENERGY PRICES MODEL. SUB-MODELS ARE DISPLAYED IN A BOX. RELEVANT INITIAL CONDITIONS IN BLUE. EXTERNAL TRENDS ARE SHOWN IN BLUE AND ITALICS.

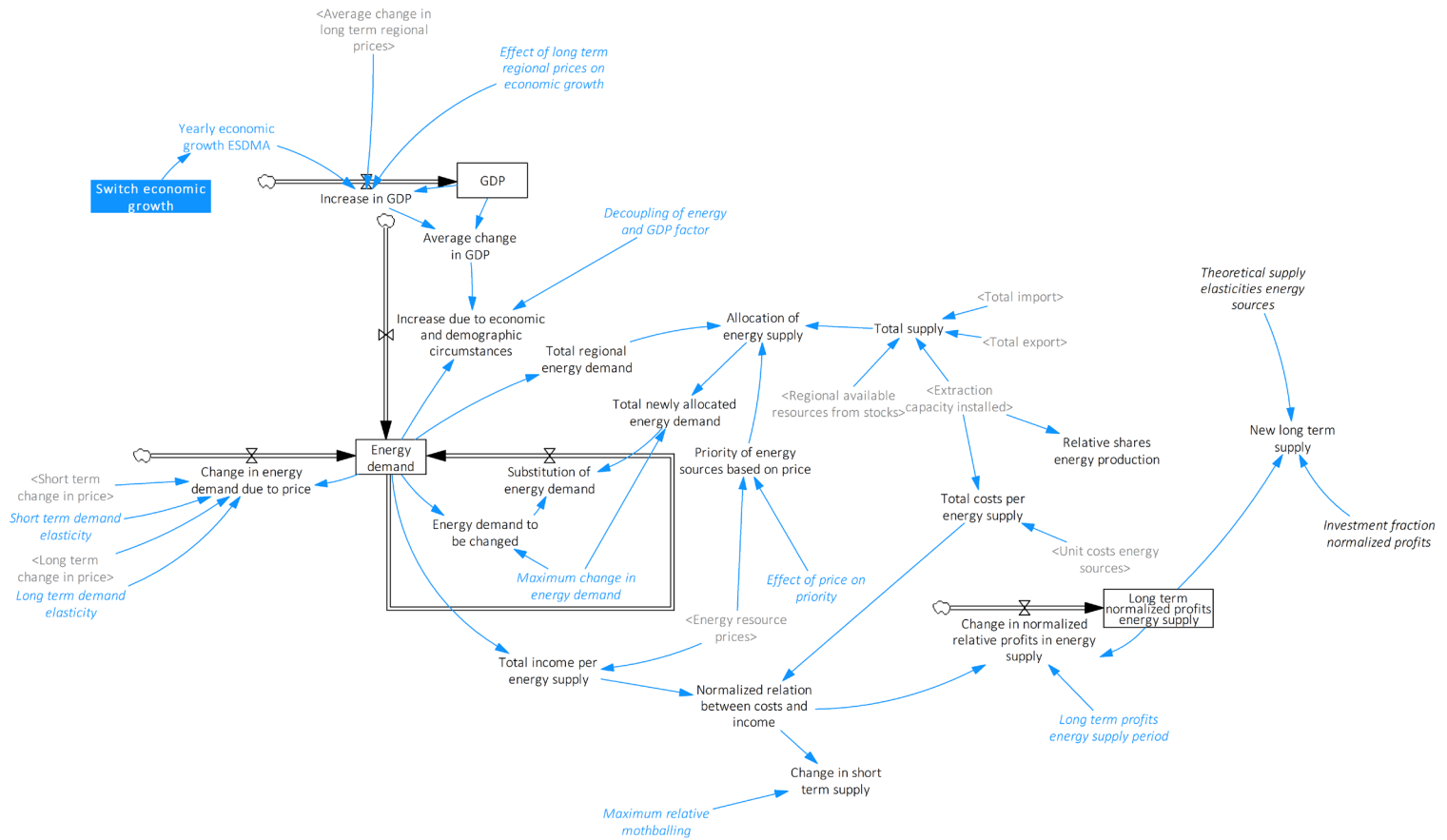


FIGURE 13. VIEW OF THE DEMAND SUB-MODEL

ENERGY DEMAND

In the demand sub-model (see Figure 13), demand is calculated for different energy sources. In total, we distinguish six different types of energy: oil, gas, coal, hydro, nuclear, and renewables. Demand fluctuates as a result of three different drivers:

- 1. Substitution:** supply, allocated on the basis of absolute prices, determines an ideal energy demand mix. Part of the energy demand is then substituted to let the energy mix change in the direction of the calculated 'ideal' energy mix. However, this effect has a large delay due to lock-in effects such as the technical issues involved in replacing one fuel by another, and thus has its largest effect in the medium- to long-term, even when occurring continuously.
- 2. GDP:** energy demand is directly affected by a change in GDP. Decoupling leads us to apply a small discount on this change. Again, this small discount translates into exponential growth, or in this case more specifically, exponential decay.
- 3. Relative price changes:** if prices go up, demand decreases and vice versa. Going from the short term to the long term, this effect becomes more pronounced. However, this effect is faster to react to price change than the economic growth reduction effect mentioned above.

As was mentioned earlier, economic growth is viewed as at least partly exogenous to the system. More specific, potential economic growth trends are explored with a quasi-random set of waves, which when superposed form the exogenous part of the economic growth variable. The potential feedback of energy prices is added to this dynamic value. In the case of rising energy prices, this means that economic growth is negatively affected.

EXTRACTION CAPACITY

The (extraction) capacity sub-model (see Figure 14) calculates capacities for (extraction) of each of the six energy types. If long-term profit margins allow, new capacity is developed and added. Profit margins are calculated by subtracting the costs from the price, and both have their own dynamics. However, this capacity will only become available after a delay. Short-term price effects lead to capacity being either mothballed or brought back online.

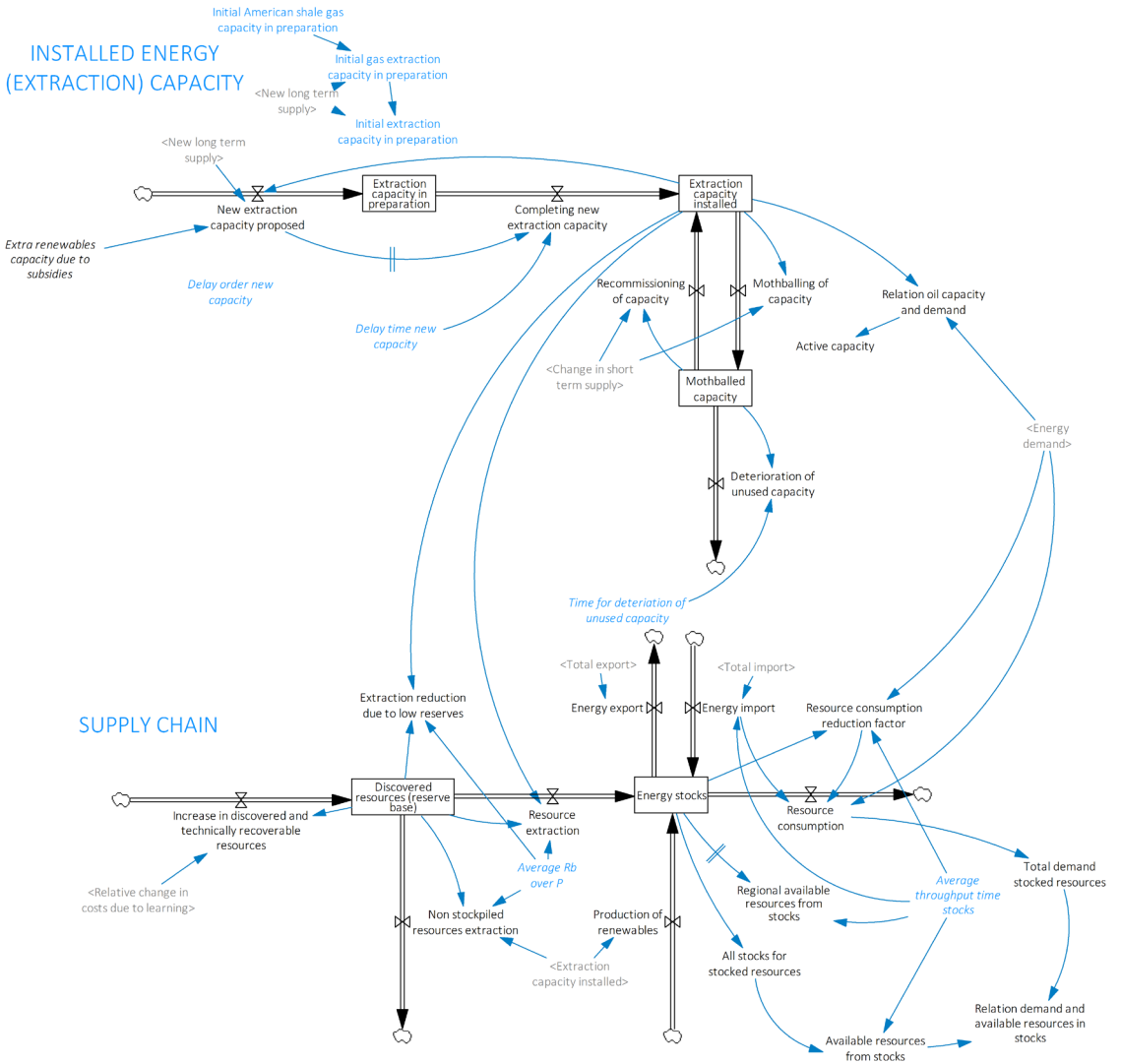


FIGURE 14. VIEW OF THE (EXTRACTION) CAPACITY SUB-MODEL

For energy sources that are stockpiled on energy markets (oil, coal, and to some extent renewables), stocks are calculated. These stocks are then used to determine the relative scarcity of the resource in question, and through that, its price. The difference in price dynamics between stockpiled resources and non-stockpiled resources is considerable. When stockpiling is possible, overcapacity can be accumulated. The consequence of this accumulation of resources is that the throughput time of stocks increases. As market stockpiles are expensive, this has a downward effect on the price. This effect is easily much larger than the actual relative overcapacity which can be calculated by comparing production (or extraction) capacity with the demand, especially as both demand and supply have a delayed reaction on price changes. Hence, it is to be expected that resources sold from stockpiles show larger volatility than resources for which essentially production or transport capacity is sold.

The availability of shale gas in the US is incorporated in the model by changing the proposed new gas extraction capacity in Northern America proportional to the increase in shale gas capacity witnessed in the past years. In other regions, the proposed new capacity is within normal proportions, relative to present price levels. As such, we assume that the American situation is part of the initial situation in which we start simulating the primary energy sources system. Other potential non-conventional fossil energy sources are considered to be part of the normal continuum of increasing availability at higher prices. This is in line with the discussion at the end of section 2.2.

EXTRACTION COSTS

Costs are influenced by two drivers: (i) the Energy Return On Energy Invested (EROEI) in the case of non-renewable resources, which decreases when reserves are depleted; and (ii) learning effects in the case of all resources (see Figure 15). Both are calculated via the 'cumulative extracted fuel' (or, 'other energy resources'). Non-renewable sources will thus initially become cheaper, only to become more expensive after depletion sets in. In the case of renewable resources, learning effects will cause costs to decrease as they are used more often.

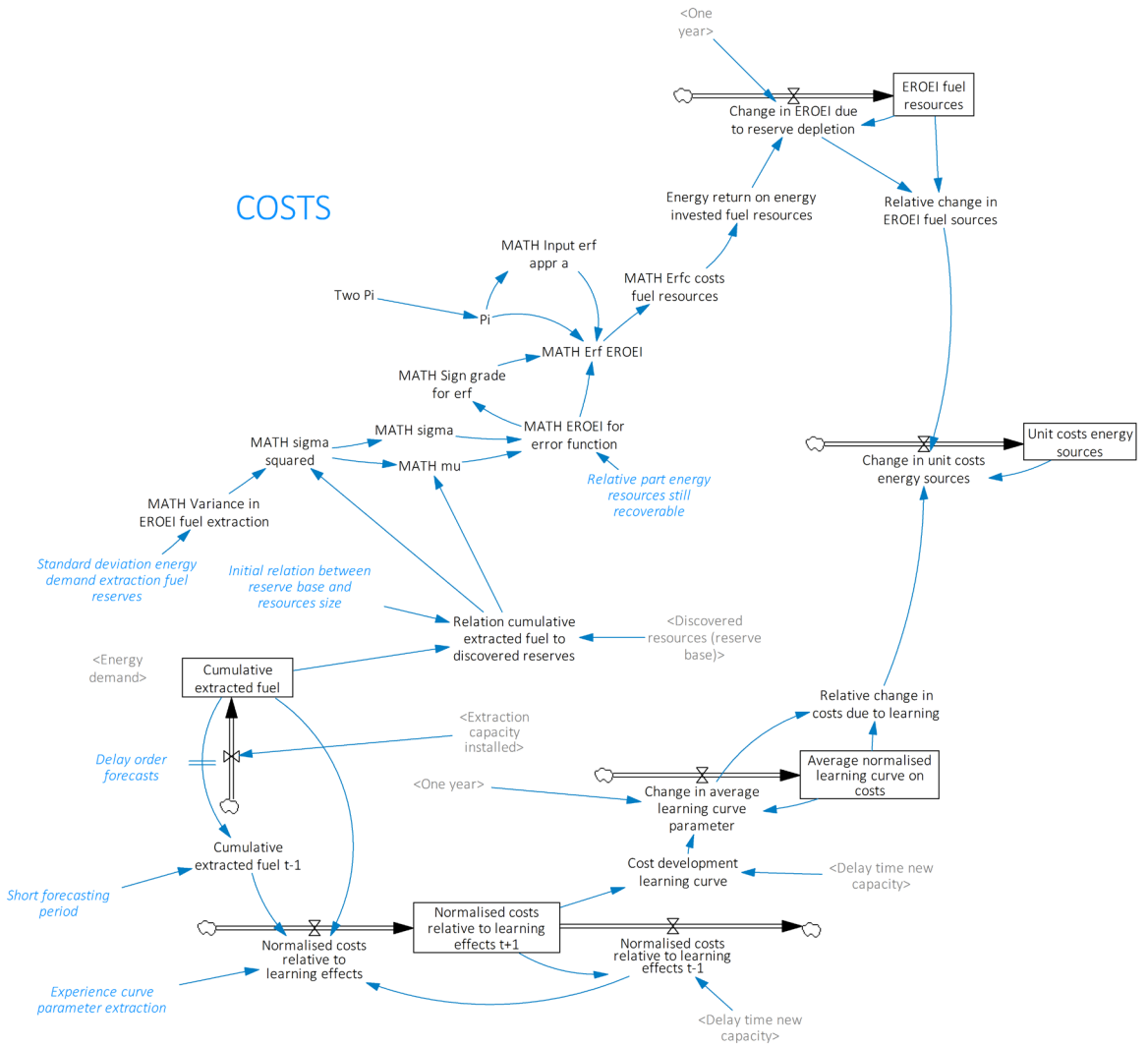


FIGURE 15. VIEW OF THE COSTS SUB-MODEL

ENERGY PRICING

Prices are calculated in different ways, depending on the region and the type of energy. See Figure 16 for a graphic representation. For stockpiled resources, stocks are compared to the energy demand by dividing the stock by the shortest throughput time, in order to calculate the available capacity of the stock. The resultant relative shortage or surplus is subsequently multiplied by the unit costs in order to calculate a price. Another mechanism for calculating the price is comparing the (extraction) capacity of the energy source to the demand. The last option is known as a 'cost-plus' mechanism, which adds a percentage to the unit cost of the production capacity.

TRADE

In this model (see Figure 17), a local surplus and/or shortage of tradable resources (oil, gas, coal, and to some extent renewables) in one region is matched to the existence of a surplus and/or shortage in other regions, causing ex- and imports. The availability of (LNG) infrastructure is considered to be a limiting factor only with respect to gas.

VALIDITY AND LIMITATIONS

As most of this model consists of the simulation of physical flows of resources, which draws on a large body of knowledge which fits the modeling method particularly well, we have good confidence in the validity of this model. We also performed the tests mentioned in section 4.2 in several iterations, more specific, *ex ante* unit checks, literature reviews, model construction workshops with experts, *ex post* plausibility or extreme condition tests, and face validation peer review.

Although the price setting gives generally good results, this part of the model was the most difficult to construct. As such, the prices form an indication of what could happen to resource prices, if all assumptions underlying the model and model parameters would be correct. Finally, we only consider the model to be valid within the parameter bounds between which the tests and scenario runs have been performed.

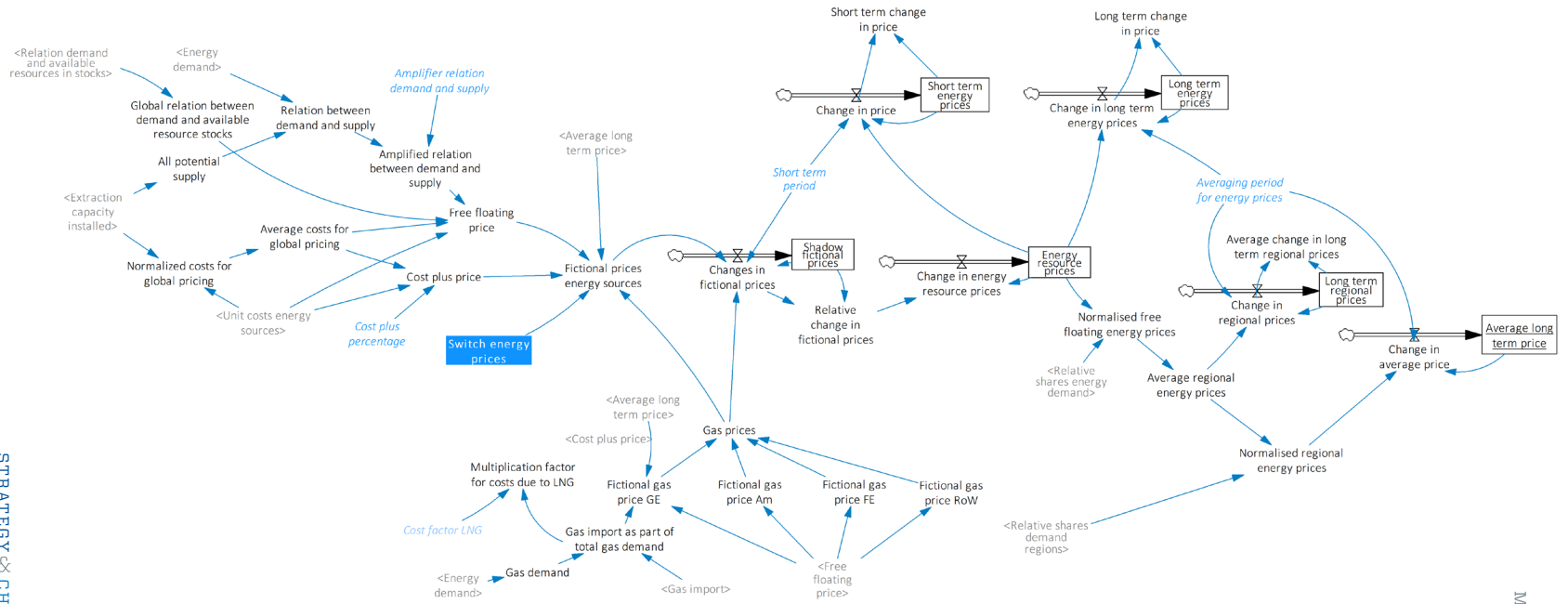


FIGURE 16. VIEW OF THE PRICES SUB-MODEL

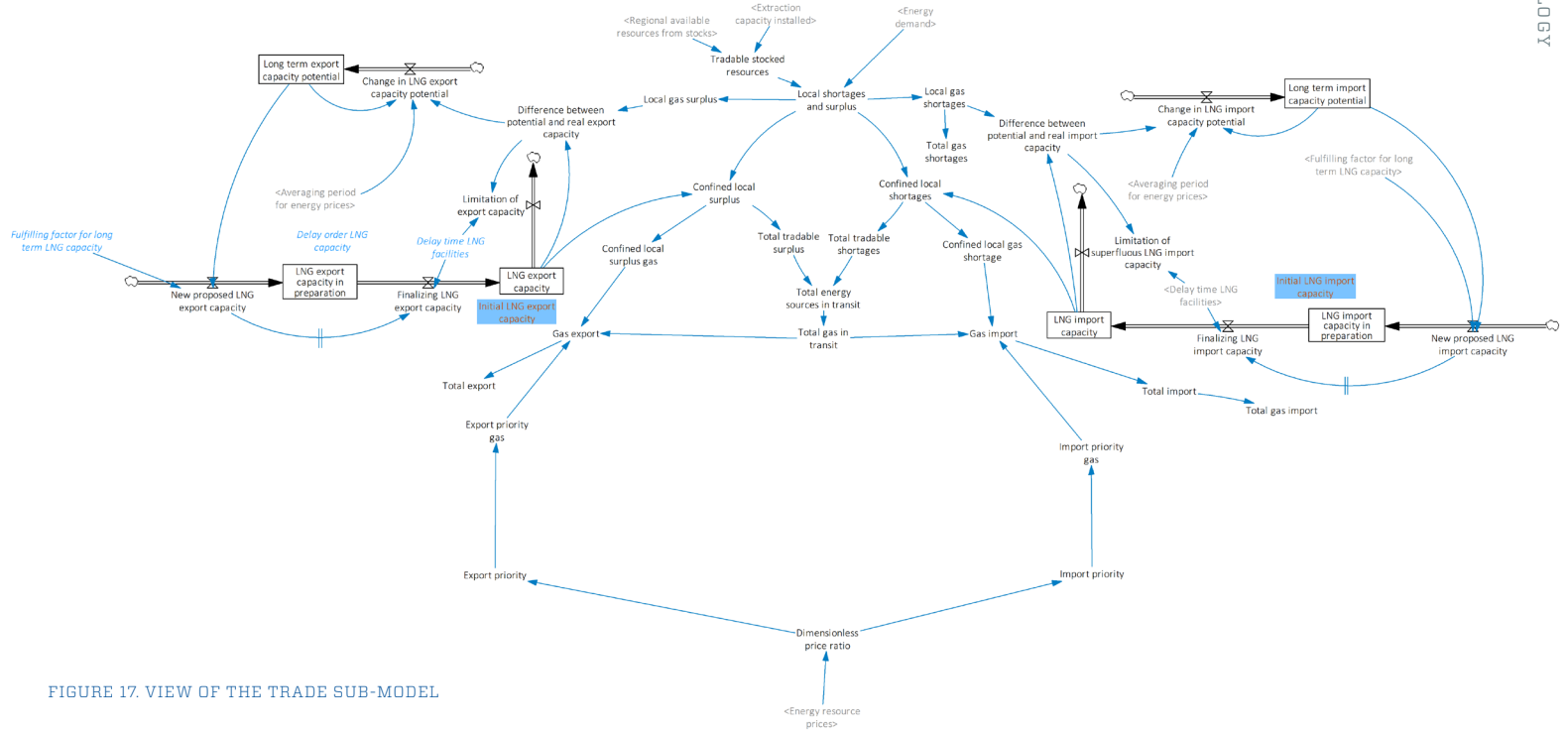


FIGURE 17. VIEW OF THE TRADE SUB-MODEL

4.4 COUNTRY STABILITY MODEL

The impact of oil and gas prices on country stability is largely a one way process (see Figure 18). However, as instability will impact the development of GDP and the resource extraction capacity, the effect is self-enforcing. Some other, minor feedbacks occur in the impact on stability of resource prices. Examples are the effects of population size on fertility and mortality levels, which may cause a deadlock situation with high population and little development. Another example is the effect that labor immigration will have on the workforce, and the effect the available workforce has on immigration. A last feedback may occur when the regime is susceptible to experience a discrepancy on the one hand between the democratic expectations that the population may have, and the present regime type on the other. However, instability may again counteract this development when the government reacts in a more autocratic way to a crisis in the country. Within the 'greed and grievance' debate, this model fits the theories about greed, as it focuses mostly on the effects of economic indicators (i.e., 'greed')¹⁴³, and does not focus on identity as motivator for instability and intrastate conflict (i.e., 'grievance')¹⁴⁴.

Within the process of prices influencing instability, however, many factors counteract each other in either making prices increase or decrease. Price increases will have a positive effect on government finances and create more employment, but they have an adverse effect on purchasing power. Whether the positive or the negative effects will be dominant depends on the specific conditions in a country.

143 Collier and Hoeffler, 'Greed and Grievance in Civil War.'

144 Ross, 'What Do We Know About Natural Resources and Civil War?.'

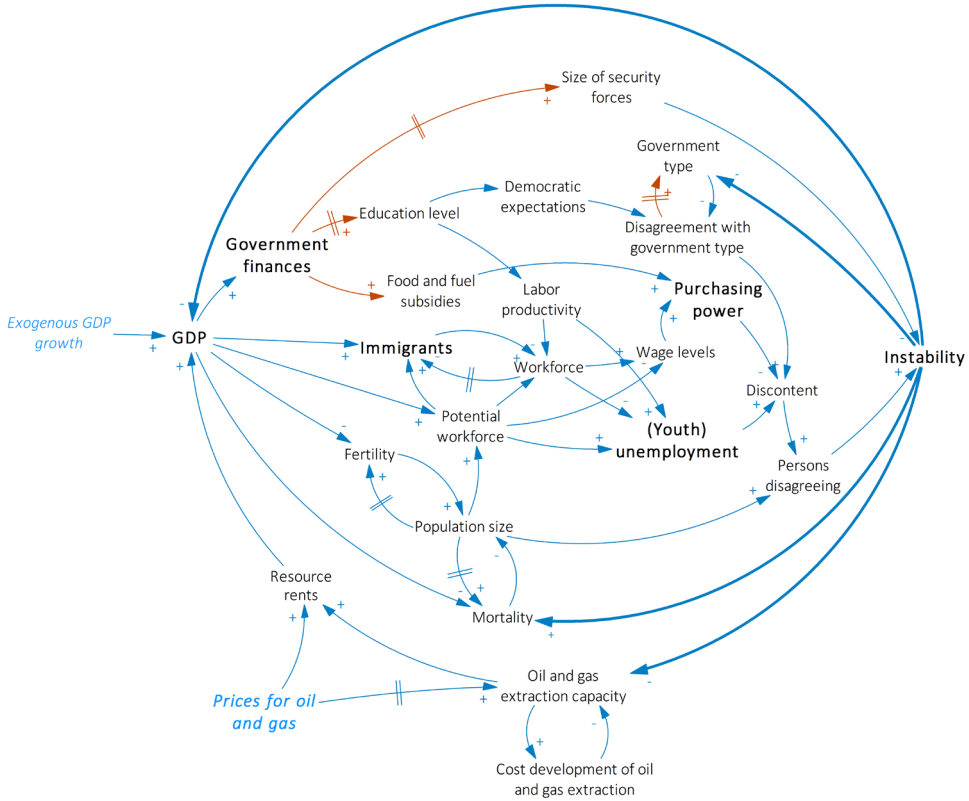


FIGURE 18. THE IMPACT OF RESOURCE PRICES ON INSTABILITY. GOVERNMENT DECISIONS HAVE BROWN ARROWS, IMPORTANT UNCERTAIN RELATIONS HAVE DOTTED ARROWS, FEEDBACKS FROM INSTABILITY HAVE BOLD ARROWS, AND IMPORTANT VARIABLES HAVE BOLD TYPEFACE.

Several factors may act as buffers for avoiding potential instability, especially in the case of decreasing price levels. The first one is the availability of financial reserves for the government. When governments use resource rents to build up large financial buffers, these will allow them to maintain fuel and food subsidies during periods of low prices. Not maintaining these subsidies may lead to an unstable situation in the country. Another buffer is the availability of immigrants in the country. With many immigrants, the government may have the opportunity to repatriate the immigrants in order to reduce the unemployment among the domestic workforce.

The fully quantified energy prices model is subdivided into 5 sub models, which are mutually linked (Figure 19). These sectors generally contain several of the factors visible in Figure 18, and as intra-sector feedbacks are not shown in the sector diagram, less feedbacks are visible. The sector diagram makes clear that we do not take the effects of nationalism and ethnic conflict into account. We chose to focus solely on the direct and indirect effects caused by resource rents in society, instead of taking all potential causes of instability into account.

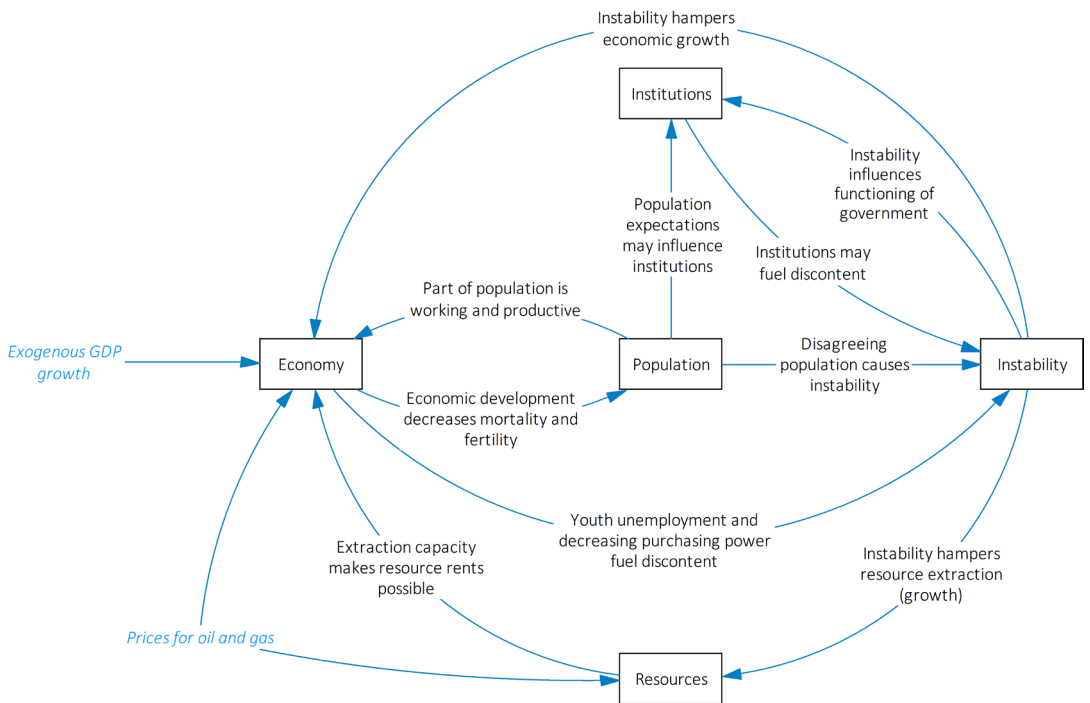


FIGURE 19. SECTOR DIAGRAM OF THE INSTABILITY MODEL

ECONOMIC SUB-MODEL

In this sub-model (see Figure 20), the economic effect is calculated. First, the GDP is calculated by means of an exogenous economic growth structure representing the effects of external economic circumstances on the national economy. Second, we look at the effects of the changes in resource rents on economic growth. Growth is thus partly endogenously influenced. Resource rents are calculated by multiplying available fuel resources (limited to oil and gas in this model) with the relevant price scenarios. The availability of fuel resources (in this case restricted to oil and gas) is calculated by using a resource supply chain from undiscovered resources to the extraction and finally internal use or export.

The effect on the workforce is calculated through the GDP. This has consequences for both youth unemployment and wage levels. Finally, purchasing power is calculated by looking at the relative change in food and fuel dependency.

RESOURCES SUB-MODEL

Two things are calculated in the resources sub-model (see Figure 21). First, the development of extraction capacity for both oil and gas is modeled with a delay on proposed new capacity. Further, the costs of extraction (energy return on energy invested) are calculated in order to mimic the depletion of resources. Compared with the price scenarios, this will determine how much new capacity is being developed.

POPULATION SUB-MODEL

In the population sub-model (see Figure 22), the demographics of the country are modeled. The population is influenced by births, deaths and migration, and is subdivided in age cohorts of 5 years each in order to create some precision in the population development. The fertility of women is modeled endogenously with a correlation to the GDP per adult. The death rate is calculated relative to the changes in life expectancy. This variable is influenced both by an exogenous trend factor, as well as by the negative influence that (severe) instability has on life expectancy.

Further, the education level of the population is modeled in order to calculate democratic expectations, related to the level of education. This is done both for the total population, as well as the youth. Since the youth was found to be higher educated than the average population in all countries we investigated, this is likely to generate potential for youth frustration.

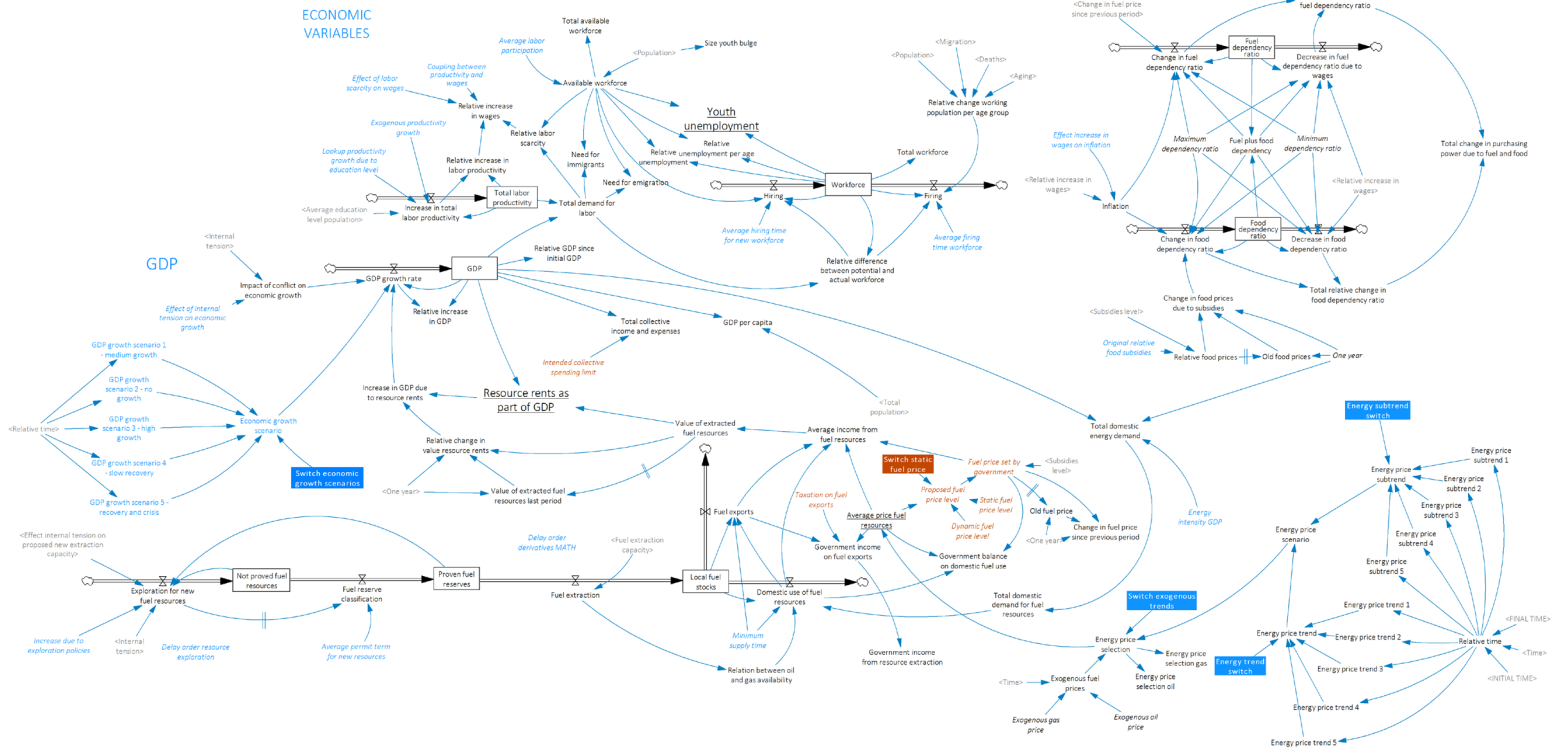


FIGURE 20. VIEW OF THE ECONOMIC SUB-MODEL

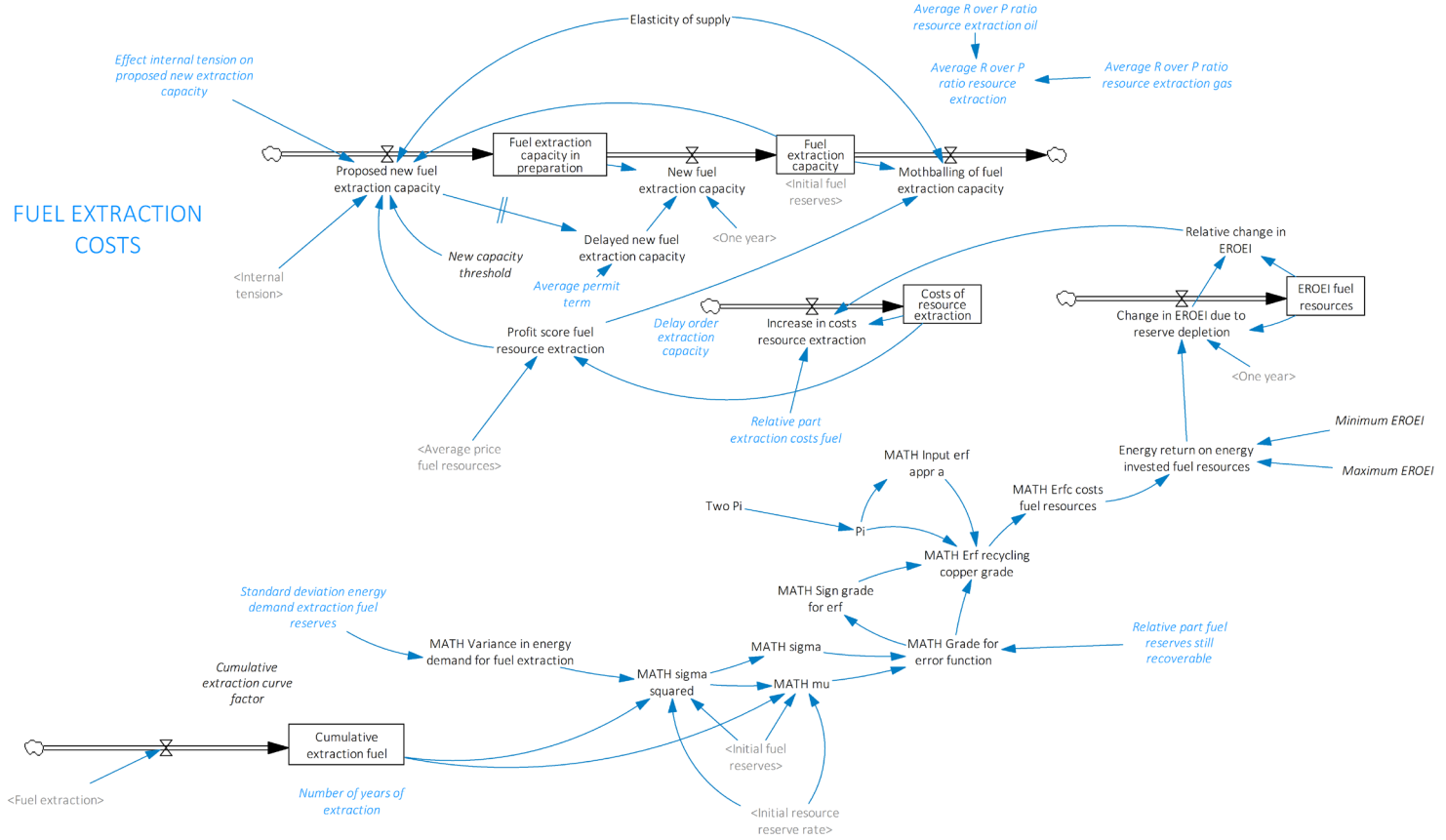


FIGURE 21. VIEW OF THE RESOURCES SUB-MODEL

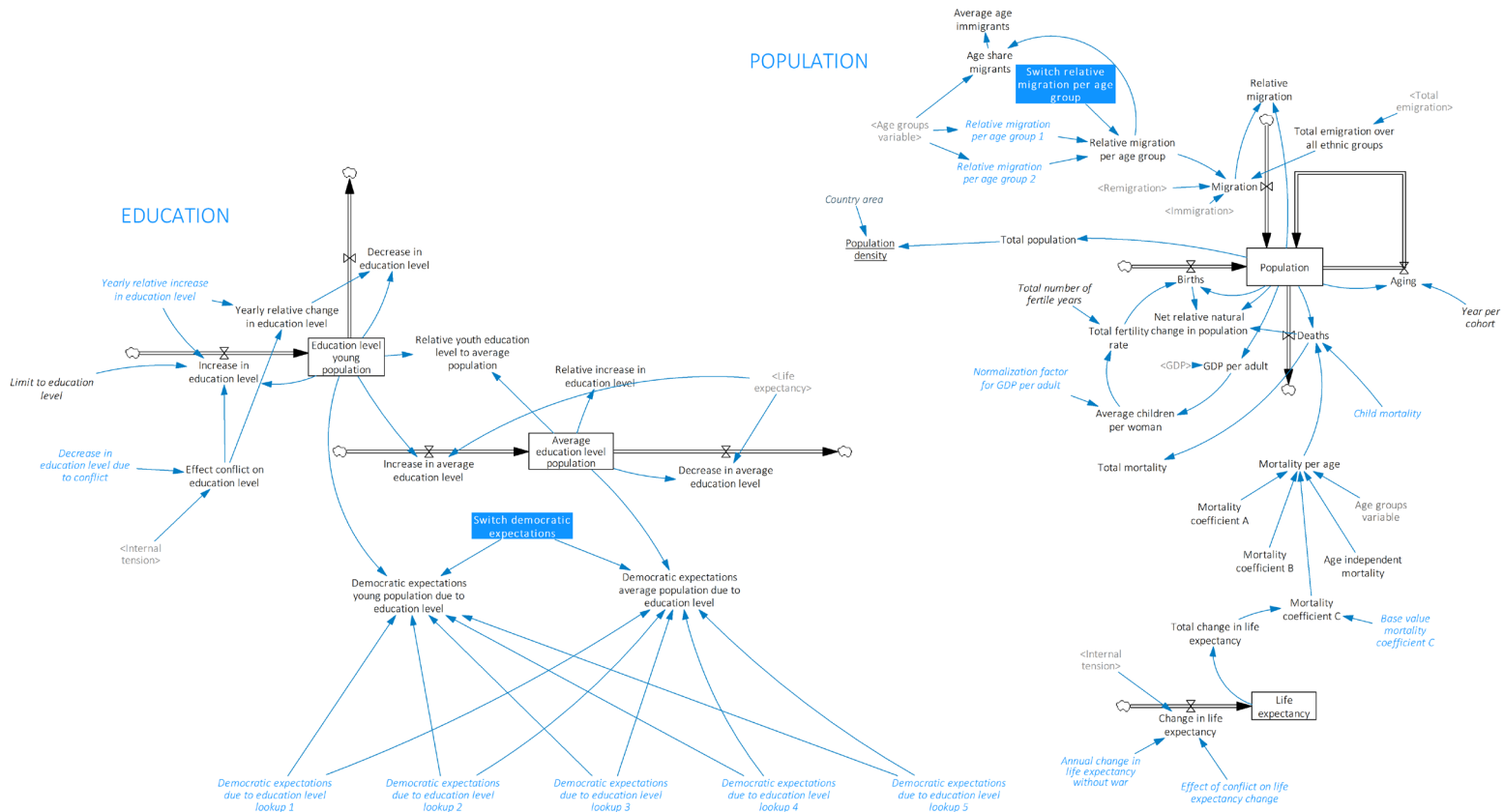


FIGURE 22. VIEW OF THE POPULATION SUB-MODEL

INSTABILITY SUB-MODEL

The instability sub-model (see Figure 23) calculates the amount and level of disagreement with the current situation among the population. The main factors for calculating disagreement are unemployment, purchasing power changes, and changes in the difference between the government type and the expectations of the government type. The amount of disagreement at the highest level (i.e., willingness to use violence against the government) is compared to the size and force of military capabilities.

INSTITUTIONS SUB-MODEL

In the institutions sub-model (see Figure 24), we calculate potential shifts in the country's state form. The model follows the polity scores between -10 (pure autocracy, e.g., Saudi Arabia) and +10 (pure democracy, e.g., Northwestern European countries). Governments may, or may not, decide to respond to the democratic expectations of the population. The polity score has an influence on the stability of the government. Furthermore, the absence of violence decreases in the case of instability. A lower value for the absence of violence leads consequentially to a lower value for government legitimacy. Finally, government finances are calculated in order to be able to know when for example fuel subsidies will become untenable.

VALIDITY AND LIMITATIONS

Just as with the energy price scenarios model, we performed several iterations of *ex ante* unit checks, literature reviews, model construction workshops with experts, *ex post* plausibility or extreme condition tests, and face validation peer review. In regards to the literature research, it is important to notice the difference between underlying SD modeling assumptions (i.e., continuity, accumulation, and causality). Literature about resources fits these assumptions very well, while literature about country instability often generates a rather discrete focus (e.g., crisis or no crisis), while mostly focusing on correlational effects. As a consequence, we were able to largely follow, or easily interpret, available literature in the resource parts of the model. However, for the factors necessary for calculating instability, this was not the case. These factors thus needed more translation before fitting the SD paradigm, causing the operationalization of the different instability to be further away from literature. Hence we made a qualitative assessment of the results of these indicators for the ease of interpretation.

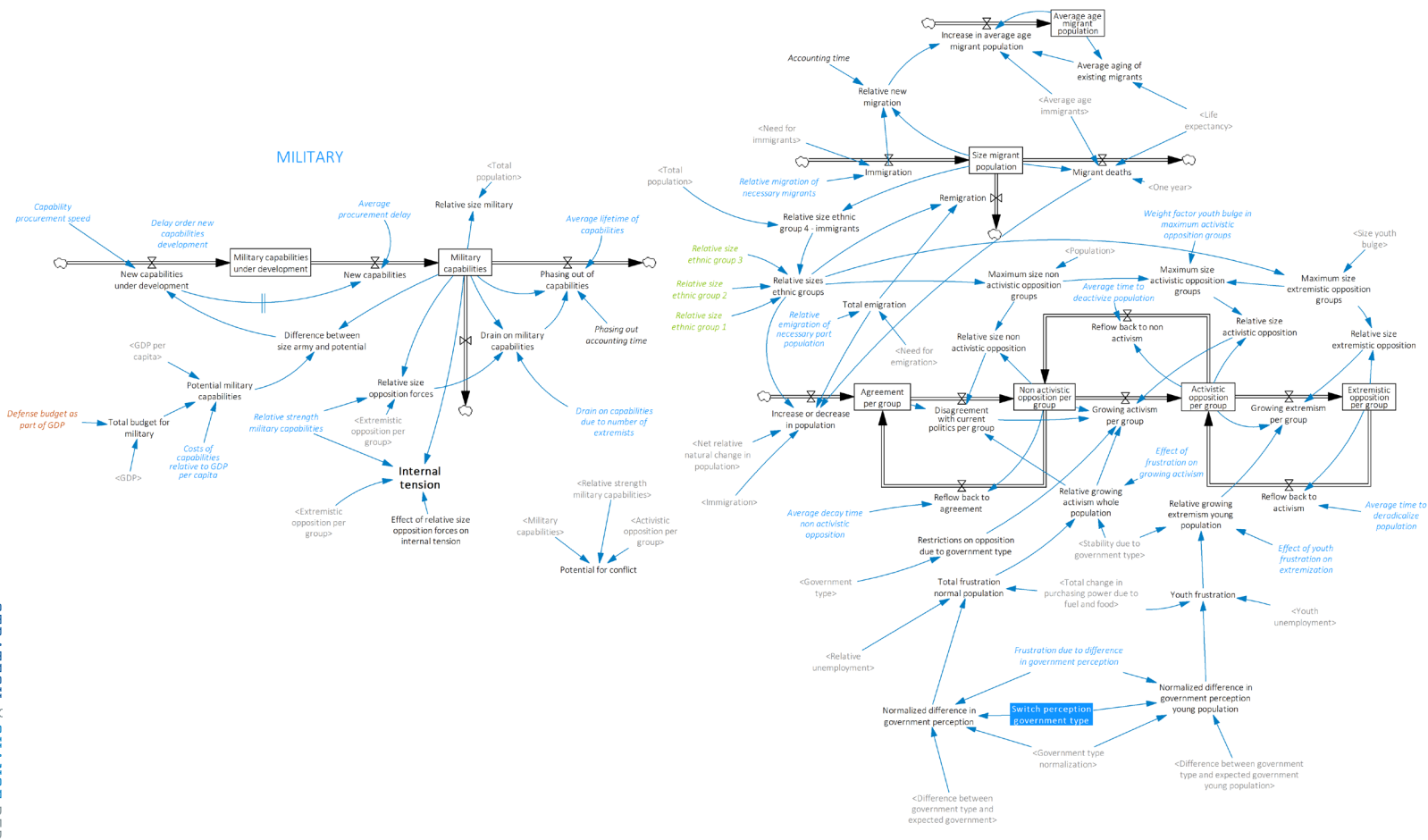


FIGURE 23. VIEW OF THE INSTABILITY SUB-MODEL

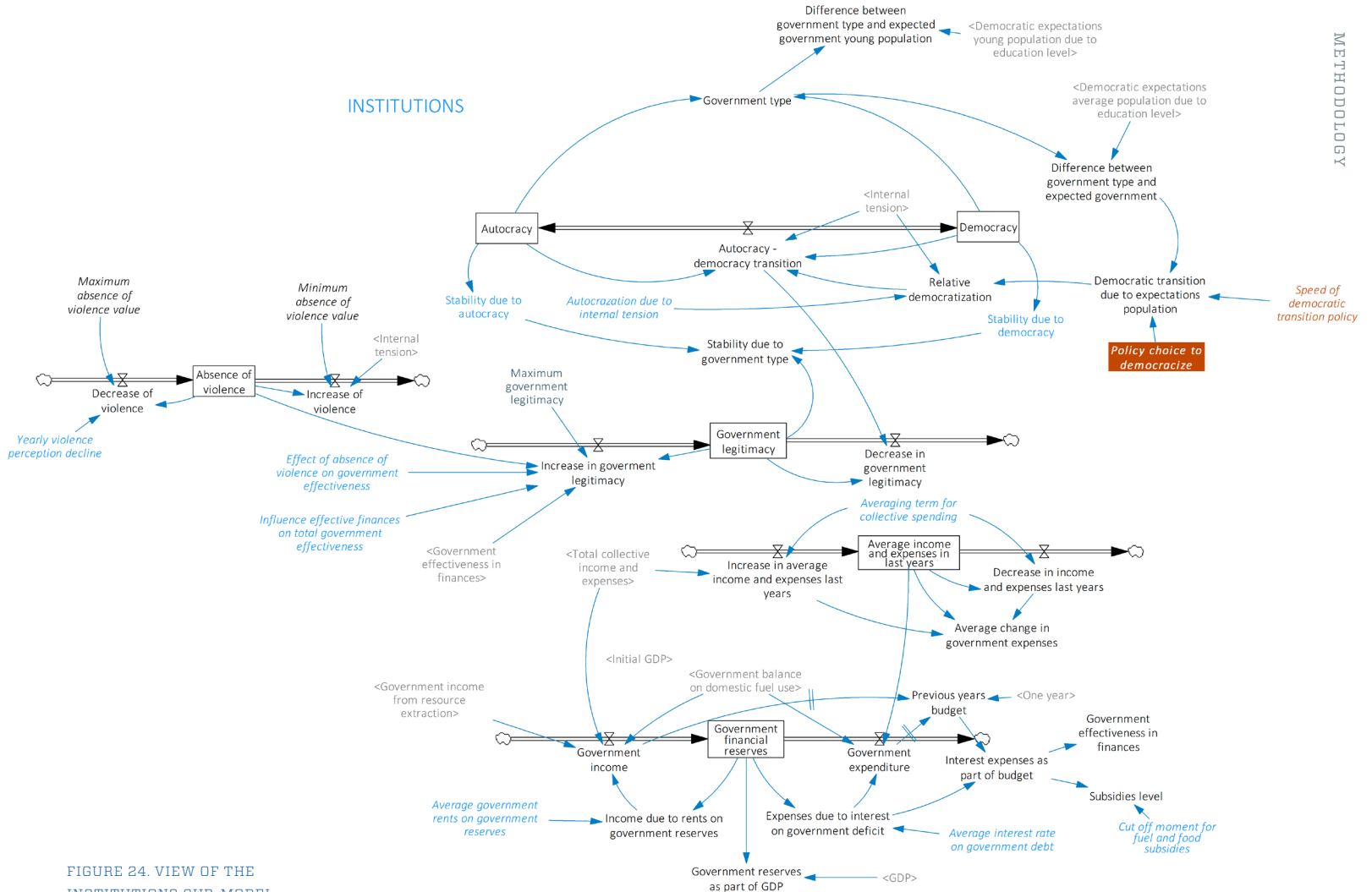


FIGURE 24. VIEW OF THE INSTITUTIONS SUB-MODEL

5 TYPICAL FUTURE PRICE SCENARIOS

As explained in the previous chapter, the main contribution of this study lies in a modeling exercise which analyzes the extent to which traditional hydrocarbon-exporting countries may experience socio-political instability as a result of declining export revenues due to onset of shale gas. Key input variables of this exercise are a number of future price trends for energy markets which take into account the potential availability of shale gas resources worldwide, each of which will affect export revenues in a different way. This information is subsequently fed into a model which analyzes the likelihood of internal instability as a result of affected export revenues.

Scenarios which include demand projections for different types of energy are a common feature of global energy market forecasts. Examples of such exercises include the scenarios compiled by BP, Shell and the IEA.¹⁴⁵ Two things are striking about these forecasts however, as can be illustrated by the 2012 IEA World Energy Outlook's oil forecasts. First, the extrapolations show much less to no volatility, in contrast with the historical data.¹⁴⁶ Admittedly price volatility can be difficult to forecast up front, but as Figure 8 and Figure 10 illustrate clearly (see sections 3.1 and 3.2) it is a fundamental characteristic of oil and gas markets.

Second, besides not taking price volatility into account, most forecasts are very conservative. Yet, if twenty years ago one would have predicted that the price of oil would reach US\$ 100 per barrel, this would have been denounced by many market analysts as an outrageous long-term projection. However, it is precisely these 'outlier' forecasts that send

¹⁴⁵ *Energy Outlook 2013* (BP, 2013); *New Lens Scenarios. Exploring How Economic, Political and Social Forces Might Shape the Global Energy System and Environment over the 21st Century* (Shell, 2013); *World Energy Outlook 2012*.

¹⁴⁶ *World Energy Outlook 2012*, 82.

shockwaves through the global economy, causing economic slowdowns and fiscal deficits in energy-exporting countries.¹⁴⁷ For this reason, overly ‘cautious’ extrapolations of energy prices are of limited interest in this particular exercise. Instead, we also want to find out what consequences ‘outlier’ forecasts (for example either a very low or a very high price of natural gas due to the onset of shale gas, potentially in combination with volatility) could have for the positions of traditional hydrocarbon-exporting countries in Europe’s neighborhood.

Two different methods for the selection of relevant scenarios were applied. First, we looked at individual fuel types (natural gas, coal, oil and renewables) and, out of the total number of dynamic scenarios, we selected those scenarios whereby one of these individual fuel types had reached its highest share in Europe’s energy mix. This is graphically illustrated in Figure 25, which depicts a scenario where coal reached its largest relative share in Europe’s energy mix among all the dynamic scenarios explored.

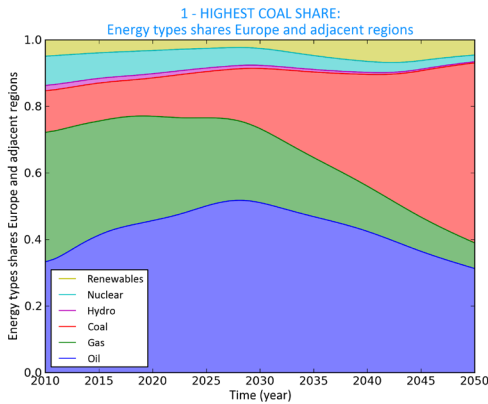


FIGURE 25. STACK GRAPH OF ENERGY INPUT SHARES

147 Tommy J. Trask, Kai Stukenbrock, and Simon Redmond, *Credit FAQ: How Do Middle Eastern Sovereigns’ Fiscal Breakeven Oil Prices Affect Credit Ratings and Oil Prices?* (Standard & Poor’s, February 1, 2013), 3-4; Sfakianakis, ‘Oil Kingdom.’

Second, we selected those scenarios which experience the greatest volatility in natural gas and oil prices in all regions selected. For example, Figure 26 graphically illustrates a scenario whereby the price of natural gas in Europe shows considerable volatility.

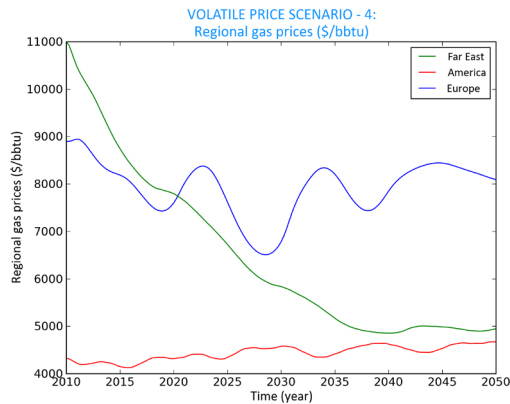


FIGURE 26. PRICES OF NATURAL GAS

This chapter consists of two sections. Section 5.1 discusses several structural changes in natural gas markets which occur as a result of production of shale gas in the US, irrespective of whether shale gas production will see a similar development elsewhere in the world or not. Section 5.2 discusses different price scenarios, each with their own implications for the international oil market and natural gas markets in a number of selected regions.

5.1 PARADIGM SHIFTS IN NATURAL GAS MARKETS

As section 3.3 highlighted, the large-scale extraction of shale gas in the US causes LNG supplies originally destined for North America to partially flow to Europe and Asia instead. This development is putting pressure on the existing contractual arrangements in Europe, which tend to be long-term contracts with 'take-or-pay' clauses, where the price of natural gas is pegged to the price of oil. This development brings about a number of important challenges for gas markets in Europe and Russia/Central Asia.

First, as contracts are more likely to be characterized by a shorter-term orientation, based on spot market prices, rather than long-term oriented and oil indexed, Eurasian gas markets are facing a true paradigm shift.¹⁴⁸ The prevalent ‘take-or-pay’ clauses enshrined in long-term gas contracts served to cover the risks associated with gas trade and investment both with respect to gas volumes, as well as prices. The consumer obliged itself to purchase a set amount of gas irrespective of whether market demand would meet this obligation. Conversely, the exporting country had to deal with the price risk, as it was unable to influence the price of oil. With this construction now gradually being broken, uncertainty among both producers and established major importers is increasing.¹⁴⁹

Second, if oil indexation is abandoned in favor of spot market pricing, greater volatility of gas markets should be taken into account. Indeed, research undertaken by Asche et al. on the gas market in the UK, underlines the fact that more liquid gas spot markets in Europe are experiencing a higher degree of volatility. Moreover, buyers are subject to considerably more price risk compared to buying by means of long-term contracts where the take-or-pay construction acts as a means for risk reduction.¹⁵⁰ Coupled with oil indexation, this system plays an important role in smoothing out this volatility, as adjustments come after a certain time lag.¹⁵¹

Third, as already highlighted in section 3.3, the increased volatility and uncertainty in gas markets puts negative pressure on the willingness to invest in gas infrastructure projects, which often require a long time horizon. The decision by Russia to indefinitely postpone the development

148 Amy Myers Jaffe and Megan L. O’Sullivan, *The Geopolitics of Natural Gas. Report of Scenarios Workshop of Harvard University’s Belfer Center and Rice University’s Baker Institute Energy Forum.*, July 2012, 9; Goldthau and Hoxtell, *The Impact of Shale Gas on European Energy Security*, 6–7.

149 Goldthau, ‘Emerging Governance Challenges for Eurasian Gas Markets after the Shale Gas Revolution,’ 215–216; Goldthau and Hoxtell, *The Impact of Shale Gas on European Energy Security*, 8.

150 Frank Asche, Petter Osmundsen, and Ragnar Tveteras, ‘Volatility and Risk Sharing in European Gas Markets’ (presented at the International Association for Energy Economics, Florence, Italy, 2007), 15.

151 Goldthau, ‘Emerging Governance Challenges for Eurasian Gas Markets after the Shale Gas Revolution,’ 215; Goldthau and Hoxtell, *The Impact of Shale Gas on European Energy Security*, 9.

of the Shtokman field in the Barents Sea is illustrative in this regard. By the same token, consuming countries may be less willing to commit themselves to contracting large volumes over a long time period.¹⁵²

These three developments increase the level of uncertainty in Eurasian gas markets and pose important challenges to both consuming, as well as producing countries. The next section focuses in detail on a number of different natural gas and oil price scenarios, taking the structural changes discussed in this section into account where appropriate.

5.2 PRICE DEVELOPMENTS IN ENERGY MARKETS IN SELECTED REGIONS

As explained in the introduction to this chapter, relevant scenarios were selected on the basis of two distinct sets of criteria, with each scenario spanning forty years from 2010 until 2050. Two decisions with respect to the models that underpin this scenario deserve specific attention at this stage of the report. First, in many of the scenarios, a downward trend in overall energy demand can be observed (see Annex 3: Shale Gas Scenarios). This is partially due to the fact that in constructing the models, we incorporated the possibility that the world wishes to arrive at a low carbon society (in whichever degree or form). To obtain this, decoupling – or the ability to grow economically without increasing your energy demand by the same degree – is a necessary precondition. Second, we are particularly interested in outlier scenarios. Many of the more extreme scenarios arise in a situation of decoupling, which thus served as an additional reason to incorporate this feature into the modeling exercise.

This section consists of two sub-paragraphs. First we discuss the results of those scenarios whereby an individual fuel type reached its highest share among Europe's energy mix out of all the dynamic scenarios explored. Next, we discuss the results of those scenarios which experience the highest degree of volatility in the price of natural gas across selected regions.

¹⁵² Goldthau and Hoxtell, *The Impact of Shale Gas on European Energy Security*, 10; Goldthau, 'Emerging Governance Challenges for Eurasian Gas Markets after the Shale Gas Revolution,' 217.

HIGH SHARE OF AN INDIVIDUAL FUEL TYPE IN EUROPE’S ENERGY MIX

A total number of nine dynamic scenarios were selected on the basis of this selection criterion (see Figure 27 and Figure 28 for an overview of both the gas and oil price scenarios). The scope of this section is limited to a discussion of the key price developments. For a complete overview of all scenarios, see Annex 3: Shale Gas Scenarios).

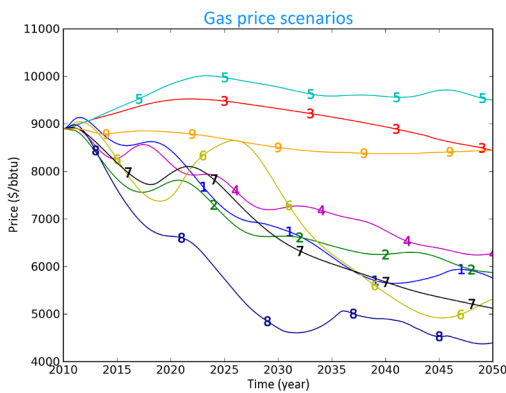


FIGURE 27. GAS PRICE SCENARIOS
'HIGH SHARE OF INDIVIDUAL FUEL TYPE'

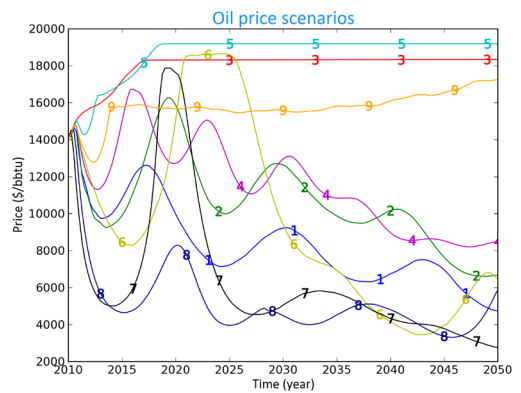


FIGURE 28. OIL PRICE SCENARIOS
'HIGH SHARE OF INDIVIDUAL FUEL TYPE'

In the case that coal reaches its highest share in Europe’s energy mix, natural gas is largely displaced in favor of (cheaper) coal (see Scenario 1, p. 188). This shift in the energy mix causes the price of natural gas in Europe to decline throughout the entire period, losing a third of its initial value along the way. The natural gas price in the Far East shows a similar development, losing almost half of its initial value by 2050. The North American gas price, by contrast, shows a small increase. The oil price shows an overall downward trend accompanied by significant price shocks (roughly every five years), losing almost 80% of its value by 2050.

In Scenario 2 (see p. 190), coal reaches its lowest share in Europe’s energy mix out of all dynamic scenarios. As a consequence, oil becomes the dominant source of energy in Europe. This shift is reflected in the natural gas price, which loses almost a third of its value by 2050. Whereas, the

European natural gas price shows a similar decline as in Scenario 1, the Far Eastern gas price does not. The price of natural gas in the Far East does decline, however it does so at a much slower rate than in Scenario 1, losing roughly 15% of its initial value by 2050. The North American natural gas price remains largely constant throughout the observed period. It should be stressed that although the decline in price both in Europe and the Far East in this scenario is significant, the overall reduction proceeds much more gradually than in Scenario 1. With respect to oil, the price exerts significant volatility throughout the entire period, though with time these swings become less pronounced. An overall downward price trend can be discerned, with the price of oil losing approximately 50% of its initial value by 2050. Such a loss is significant, yet the decline is not immediate and is interrupted by price peaks and troughs.

In the event that natural gas reaches its highest share in Europe's energy mix, the share of oil simultaneously reaches its lowest point out of all dynamic scenarios explored (see Scenario 3, p. 192). With European demand for natural gas increasing rapidly after 2015, natural gas prices remain consistently high. However, the same can not be said for the Far East. The natural gas price in the Far East shows a steep decline, falling far below the European price and from 2030 onwards even undercutting the price charged in North America. The North American price shows a gradual increase, possibly hinting at an increase of LNG exports. The main implication in terms of natural gas in this scenario is that it brings sustained high natural gas prices in Asia to an end. Looking at the oil price, an immediate and steep rise can be discerned until 2015, after which the price plateaus at roughly 128% of its initial value throughout the observed period. When natural gas has its lowest share in Europe's energy mix, this causes an increase in the share of oil (see Scenario 4, p. 194). As a result, the natural gas price in Europe declines gradually, losing approximately 23% of its initial value by 2050. The price of natural gas in the Far East declines more rapidly, even temporarily undercutting the European price. Some degree of price convergence between the European and Asian market can thus be discerned. Despite a short-lived recovery, the Far Eastern natural gas price loses around 33% of its initial value by 2050. The North American price, by contrast, increases only marginally. With respect to oil, the price shows considerable volatility and an overall downward trend. Price shocks are a regular occurrence, although the bandwidth (in terms of high/low)

shrinks with time, possibly indicating that supply and demand become better 'matched' and situations of (severe) over- or under-capacity are avoided. The oil price levels off at approximately 66% of its initial value by 2050.

In Scenario 5 (see p. 196), renewable energy reaches its highest share in Europe's energy mix. The price of natural gas in Europe shows a general upward trend until 2023, before leveling off at roughly a few hundred US\$/bbtu higher than its initial value. Until 2030, prices in the Far East fall far below the European price level. After 2030, the price stabilizes at roughly 63% of its 2010 value. American natural gas prices experience a steady rise, most likely due to exports. Similar to Scenario 3, the oil price rises steeply and plateaus from 2020 onwards at approximately 135% of its initial value. What is noticeable from this scenario is that the increase in the share of renewables coincides with sustained high prices for both natural gas, as well as oil.

The share of renewable energy reaches its lowest share in Scenario 6 (see p. 198). Much like today, Europe's energy mix is dominated by a combination of oil, natural gas and coal. The natural gas price in Europe shows a clear downward trend, albeit with some volatility, losing roughly a third of its value by 2050. The price of natural gas in the Far East drops significantly, losing 65% of its value by 2050, undercutting the European and the North American gas price. The North American natural gas price remains largely unchanged throughout the entire period. Looking at oil, the price drops significantly at first, losing a good 42% of its initial value by 2015. A quick recovery follows whereby the price climbs to 128% of its initial value by 2026. A steep decline sets in afterwards, which lasts until 2045. In this period, the oil price loses close to 80% of its 2026 peak value.

When oil is at its highest share in Europe's energy mix, natural gas prices in the region show a steady downward trend throughout the observed period, losing close to 40% of their initial value by 2050 (see Scenario 7, p. 200). The decline of the natural gas price in the Far East is much more pronounced than in Europe, losing almost 80% of its initial value by 2050. In its path, it undercuts both the European, as well as the North American gas price by a considerable margin. The natural gas price in North America instead increases gradually. The price of oil shows a sharp decline between

2010 and 2015, losing 65% of its initial value, only to bounce back to 128% of its initial value by 2020. Immediately afterwards a period of decline sets in which lasts until 2050 whereby the price of oil drops to a mere 1/6th of its 2020 peak value.

The share of LNG imports in Europe's energy mix reaches its highest share in Scenario 8 (see p. 202). After 2020, coal starts to gradually displace natural gas. The natural gas price in Europe shows a clear downward trend throughout the entire period, losing roughly 45% of its initial value by 2030. Following this period of decline, prices stabilize at this level. The natural gas price in the Far East drops with a similar pace and even temporarily undercuts the European price between 2022 and 2024, after which it starts to stabilize and gradually climb to roughly 52% of its initial value by 2050. The Far Eastern natural gas price thus converges to the European level, yet remains consistently higher. The American natural gas price remains largely unchanged throughout the entire period. The price of oil also shows a downward trend similar to that of the price of natural gas in Europe and the Far East, losing approximately 58% of its initial value by 2050. Increases in the price of oil do occur throughout the observed period, yet the price never reaches its 2010 peak level again and the general trend is downwards. In the final scenario belonging to this category (see Scenario 9, p. 204), the share of LNG imports in Europe's energy mix is the lowest out of all scenarios. Oil gradually displaces natural gas in this scenario. However, this is at best only marginally reflected in the natural gas price in Europe, which shows only a minimal decline over time. This situation is very different in the Far East, where the price of natural gas loses close to 40% of its initial value by 2050. In its path, the Far Eastern price appears to converge to the North American price level, firmly undercutting the European price. The natural gas price in North America shows a gradual upward trend, most likely due to an increase in LNG exports. The oil price can be seen to plateau at roughly 113% of its initial value between 2015 and 2030. Within this period, there is only a marginal degree of price volatility. The oil price increases gradually after 2030.

SCENARIOS OF HIGH PRICE VOLATILITY

A total number of five dynamic scenarios were selected on the basis of this selection criterion (see Figure 29 and Figure 30 for an overview of both the gas and oil price scenarios). Again, the scope of this section is limited to a discussion of the key price developments. For a complete overview of all scenarios, see Annex 3: Shale Gas Scenarios).

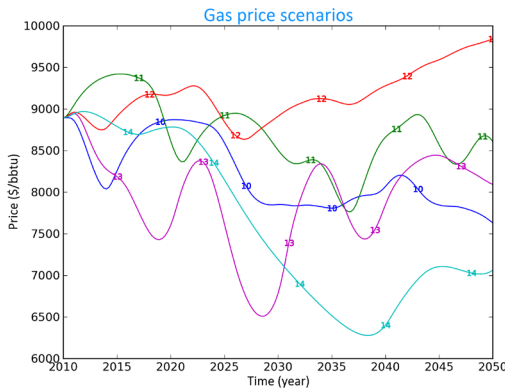


FIGURE 29. GAS PRICE SCENARIOS OF HIGH VOLATILITY

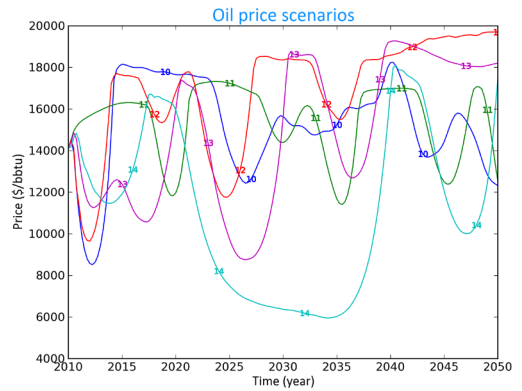


FIGURE 30. OIL PRICE SCENARIOS OF HIGH VOLATILITY

In the first of five scenarios (see Scenario 10, p. 206), the share of oil and coal steadily increase in Europe's energy mix. This change is only weakly reflected in the price of natural gas in Europe, which shows a marginal downward trend. Although volatility can be discerned, the bandwidth (in terms of high/low) is decidedly narrow. The natural gas price in the Far East declines gradually throughout the entire period, losing roughly 28% of its initial value. The Far Eastern gas price thus converges to European-level pricing. The North American natural gas price shows a marginal upward trend, most likely caused by an increase in LNG exports. The oil price shows a high degree of volatility throughout the observed period, particularly after 2025. A clear general upward or downward trend cannot be discerned however.

Scenario 11 (see p. 208) shows an energy mix in Europe that is largely based on oil and natural gas, with minimal use of coal. Similar to under Scenario 10, natural gas prices in Europe remain largely consistent and hover along a narrow bandwidth (in terms of high/low) over time, albeit with greater volatility. It is thus more likely that a greater share of natural gas contracts is based on spot pricing (see also section 5.1). The natural gas price in the Far East declines gradually throughout the observed period, converging toward and even undercutting the European price. In its path, the price charged in the Far East is reduced by approximately 30% by 2050. Volatility is minimal. The North American natural gas price hovers around its initial value throughout the observed period with minimal signs of volatility. The price of oil experiences a high degree of volatility throughout the observed period, oscillating along a broad bandwidth (in terms of high/low). Price shocks are significant and frequent. Oil price volatility in this scenario can be considered extreme.

The third scenario (see Scenario 12, p. 210) sees the share of oil in Europe's energy mix gradually increase until 2025. This increase causes a displacement of natural gas. After 2025, the share of coal shows a marginal increase, yet nuclear energy and renewables in particular reduce the share of natural gas even further. This displacement is not reflected in the price of natural gas charged in Europe, which instead shows a gradual upward trend (10% increase compared to its initial value) with only limited volatility. This limited volatility could indicate that a smaller share of natural gas contracts is based on spot pricing than in Scenario 12 (see also section 5.1). The price of natural gas in the Far East declines throughout the entire period, undercutting the European price and losing approximately 44% of its initial value. The American natural gas price shows a gradual increase throughout the observed period, possibly hinting at greater exports and price convergence between US and Asian market. What stands out from this scenario is the firm decrease in the Far Eastern natural gas price, set against the backdrop of gradual increases in the natural gas prices charged in Europe and North America. The oil price is characterized by significant volatility and price shocks throughout the entire period. Fluctuations of 30% or higher in both directions are no exception. Illustrative is that the oil price suffers from an almost 35% contraction between 2020 and 2025, only to bounce back in the long term, reaching as much as 139% of its initial value.

In Scenario 13 (see p. 212), the natural gas price in Europe shows considerable volatility throughout the entire period. The price does not show a clear downward or upward trend, yet price swings in both directions are a regular occurrence. Also, the price bandwidth (in terms of high/low) is slightly larger than in the previous three volatility scenarios, possibly indicating that a greater share of European gas contracts in this scenario are based on spot pricing (see also section 5.1). Price volatility in the Far East is minimal throughout the entire period. However, the natural gas price shows a clear downward trend, undercutting the European price in 2020 and leveling off just above the North American price at a mere 45% of its initial value. The North American natural gas price shows only a marginal increase throughout the observed period, with minimal volatility. The oil price shows a high degree of volatility along a large bandwidth throughout the entire period. Price swings of over 40% in both directions are no exception.

The final scenario (see Scenario 14, p. 214) sees the share of oil in Europe's energy mix expand rapidly throughout the observed period. The share of coal equally increases, thus further squeezing out natural gas. This shift is reflected in the natural gas price in Europe, which shows an overall downward trend, losing roughly 20% of its initial value by 2050. Price volatility is however rather low. The natural gas price in the Far East descends much more rapidly, undercutting the European price between 2017 and 2034, before increasing to approximately the European level by 2050. Price volatility is low, yet the overall loss in price measured over the entire period is significant at almost 37%. The natural gas price in North America shows a marginal increase throughout the observed period against minimal volatility, most likely caused by additional LNG exports. The oil price shows a number of fluctuations over time. Worth noting is the decade long 'intermezzo' of low prices between 2025 and 2035, which is both preceded and succeeded by a price shock. When fluctuations occur in this scenario, shocks tend to be severe and sudden.

The next chapter uses these fourteen price scenarios as input for a 'Country Stability Model' which analyzes the effects of each scenario on the internal stability of traditional oil- and gas-exporting countries in Europe's neighborhood. These fourteen scenarios are complemented by three

scenarios of the 2012 IEA World Energy Outlook, which show a continuation (i.e., stabilization of prices is assumed) of the current price level, a gradual increase, as well as a gradual decrease.¹⁵³ The stable price scenario is used as a reference to indicate whether a scenario improves or worsens a country's stability. The next chapter discusses the key-results of this exercise.

¹⁵³ *World Energy Outlook 2012*, 82.

6 INTRASTATE STABILITY IN EUROPE'S NEIGHBORHOOD

The scope of this chapter is limited to a discussion of the key results which were found across *all* scenarios and can (to an extent) be generalized across the populations of countries investigated in this study. For a full overview of the initial conditions in all countries, as well as the instability dynamics which each scenario generates, see Annex 4: Impact on Traditional Hydrocarbon-Exporting Countries.

This chapter consists of two sections. Section 6.1 discusses the extent to which the countries in this study possess similar characteristics and whether this allows instability dynamics encountered in one type of country to be generalized to another state. Section 6.2 analyzes the impact of the price scenarios on intrastate stability within the oil- and gas-exporting countries and regions investigated in this study.

6.1 COMPARABILITY OF COUNTRIES

The causal mechanisms which influence the onset of social unrest in the state stability model function in a similar way in all the countries examined in this study. However, the extent to which a shift in an individual variable causes more or less social unrest to occur (relative to the reference scenario) depends on both the initial conditions in an individual country, as well as on the development of other variables within the country.

Focusing on the regime type in place, the population of countries researched in this study comprises autocracies, democracies and anocracies; the latter being a form of government which has both democratic and autocratic characteristics.¹⁵⁴ Table 1 classifies the countries

¹⁵⁴ Anocracies are defined as regimes which are characterized by an often incoherent combination of democratic, as well as autocratic characteristics: parliamentary elections exist, yet not for the president; free press exists, yet there is no independent judiciary, etc.

in this study according to regime type on the basis of the Polity IV scores from the Center for Systemic Peace.

TABLE 1: CLASSIFICATION OF COUNTRIES ACCORDING TO REGIME TYPE¹⁵⁵

COUNTRY / REGION	POLITY IV SCORE	REGIME TYPE
Algeria	2	Anocracy
Azerbaijan	-7	Autocracy
Egypt	4	Anocracy
Kazakhstan	-6	Autocracy
Northwestern Europe ¹⁵⁶	10	Democracies
Qatar	-10	Autocracy
Russia	4	Anocracy
Saudi Arabia	-10	Autocracy

This classification is important in light of the research undertaken by the Center for Systemic Peace. Their findings underlines that, in the past fifty years, the chance of instability in an anocracy was ten times higher than the chance of instability in a democracy and five times higher than in an autocracy (see *infra*, 6.2).¹⁵⁷

In the context of this study, we are particularly interested in the oil- and gas-exporting autocracies and anocracies in Europe's neighborhood. It is sometimes assumed that it is impossible to make conclusions about the impact of a particular price scenario on a particular population without conducting an in-depth case study. However, using regime classifications

155 Countries are ranked on a scale from -10 to +10. Countries which score between -10 and -6 are classified as an autocracy. Countries which score between -6 and +6 are qualified as an anocracy. Finally, countries which score between +6 and +10 are classified as a democracy. For full details, see 'Polity IV Project: Home Page,' *Center for Systemic Peace*, June 10, 2013, <http://www.systemicpeace.org/polity/polity4.htm>.

156 Northwestern Europe includes The Netherlands, Norway, Denmark and the United Kingdom.

157 'CSP Global Conflict Trends,' Center for Systemic Peace, July 3, 2013, fig. 13, <http://www.systemicpeace.org/conflict.htm>.

as a guideline it is possible to make generalizations about certain instability characteristics that are likely to be shared by other countries of the same polity type¹⁵⁸). For that reason, we sought to examine particular countries which were exemplary of the state-forms of the other countries under investigation. To that effect, two countries were examined in detail: Qatar and Russia. Whereas Russia shares important characteristics with anocracies such as Algeria and Egypt;¹⁵⁹ Qatar has a polity profile comparable to that of autocracies such as Saudi Arabia, Azerbaijan, and Kazakhstan. Both Russia and Qatar can thus serve as a proxy for determining the kind of instability dynamics that occur as a result of the price scenarios analyzed in this study.

Up front, our analysis took a number of factors into account which could mitigate the extent to which a scenario of declining oil and/or natural gas prices negatively affects a country's stability (see section 4.4). First, the extent to which a country possesses a diversified economy determines whether sectors other than the energy-related industries can compensate for a decline in resource rents. Second, accumulated financial reserves can act as a buffer to account for any loss in export revenue as a result of declining prices. Saudi Arabia, Qatar and Azerbaijan in particular are home to enormous sovereign wealth funds.¹⁶⁰ A third factor to take into account is the share of migrant workers active in the national economy. In the Middle East and North Africa for example these workers are often employed under poor conditions and with limited rights, making it easy for a

158 Jeffrey Dixon, 'What Causes Civil Wars? Integrating Quantitative Research Findings,' *International Studies Review* 11, no. 4 (2009): 718, doi:10.1111/j.1468-2486.2009.00892.x; Jack A. Goldstone et al., 'A Global Model for Forecasting Political Instability,' *American Journal of Political Science* 54, no. 1 (2010): 197, doi:10.1111/j.1540-5907.2009.00426.x.

159 Frank Bekkers et al., *De Toekomst in Alle Staten - HCSS Strategische Monitor 2013* (The Hague Centre for Strategic Studies (HCSS), March 2013), 23.

160 In relative terms, Saudi Arabia's sovereign wealth fund measures over 160% of its GDP (2010); Qatar's assets account for 90% of the country's GDP (2010) and Azerbaijan's assets measure 67% of its GDP (2010). Kazakhstan and Algeria are home to financial assets comprising less than 50% of their GDP, at 47% and 48% respectively in 2010. Russia's assets comprise a mere 11% of the GDP (2010) and Egypt does not feature in the ranking at all. Sovereign wealth fund holds assets in excess of 100% of its GDP. Qatar's sover 'Sovereign Wealth Fund Rankings,' *Sovereign Wealth Fund Institute*, September 2013, <http://www.swfinstitute.org/fund-rankings/>.

government to revoke working permits in case economic conditions worsen.¹⁶¹ Put differently, if unemployment rises, the government can decide to expel these migrant workers in an attempt to dampen the increase in domestic unemployment. Such a measure could mitigate instability in the host country, yet it is likely to do the opposite in the receiving country. A recent example is the decision by the Saudi Arabian government to expel thousands of Yemeni workers in April 2013, further pressurizing income in an already-impooverished Yemen.¹⁶² A final factor which can mitigate internal dissent, once it erupts, is the relative strength of a country's security forces. Illustrative in this regard was the March 2011 decision by the Gulf Cooperation Council to send a contingent of armed forces from Saudi Arabia and the United Arab Emirates into Bahrain to aid the government in Manama to suppress the growing internal unrest.¹⁶³

6.2 IMPACT ON STATE STABILITY

Looking at the full range of instability scenarios, numerous observations can be made. First, high volatility, measured in terms of upward/downward price swings, appears much less a cause of instability than scenarios where high volatility coincides with long intervals of either low or high oil and natural gas prices. Furthermore, whereas long periods of low oil and natural gas prices negatively affect stability in traditional energy-exporting countries due to a decrease in GDP and resource rents, long periods of high prices negatively affect purchasing power in regions which import more energy such as Northwestern Europe, causing recessions. Having said that, investment into (capital intensive) energy projects (e.g., the Shtokman natural gas field in the Barents Sea, see section 3.3) are likely to be postponed during periods of high upward/downward price volatility. As noted in section 5.1, the increase in the number of natural gas contracts based on spot pricing, rather than an oil-based pricing formula is likely to

161 *World Report 2013*, World Report (Human Rights Watch, 2013), 30, 39, 467 and 525.

162 Ian Black, 'Saudi Arabia Expels Thousands of Yemeni Workers | World News | Theguardian.com,' *The Guardian*, April 2, 2013, <http://www.theguardian.com/world/2013/apr/02/saudi-arabia-expels-yemeni-workers>.

163 Ethan Bronner and Michael Slackman, 'Saudi Troops Enter Bahrain to Put Down Unrest,' *New York Times*, March 14, 2011, http://www.nytimes.com/2011/03/15/world/middleeast/15bahrain.html?pagewanted=all&_r=0.

lead to an increase in such upward/downward volatility in light of prior experiences in the UK natural gas market.

Second, to balance their fiscal budgets, the analysis makes clear that countries which export relatively more natural gas than oil, such as Egypt and Qatar, are nonetheless heavily reliant on oil sales given the much higher price of oil per energy content compared to natural gas. Major natural gas producers such as Russia and Algeria (whose balance between oil and natural gas sales is closer to 50/50) equally see their resource rents affected more strongly by a reduction in the price of oil than by a drop in the price of natural gas. As a result, internal stability is much more strongly influenced by fluctuations in the price of oil than by fluctuations in the price of natural gas. This observation is important given that global energy markets are moving in a direction whereby natural gas usage is increasing in certain economic sectors at the expense of oil (see also *infra*, Conclusions).¹⁶⁴

Third, many of the more extreme price scenarios arose in a situation of decoupling (see section 5.2). Upon close inspection, decoupling emerges as a particularly powerful factor that can put pressure on oil and natural gas prices. So powerful in fact that when decoupling was 'switched off' in the analysis, oil and natural gas prices were substantially higher and the level of instability was much lower compared to the reference scenario.

Fourth, the analysis clearly demonstrates that in scenarios which experience a gradual decrease in the price of oil and natural gas over time (c.f., IEA scenarios), instability in traditional oil- and gas-exporting countries often increases (outcome: 'mostly undesirable') compared to situations in which the price of these fuel types experience a gradual increase (outcome: 'mostly desirable', see Figure 31 for the Russian example).

¹⁶⁴ Paul Stevens, 'The World Might Be Drifting into an Oil Price Shock,' July 25, 2013, <http://www.ft.com/intl/cms/s/0/fb0dd938-f493-11e2-a62e-00144feabdc0.html>; Leonardo Maugeri, 'An Uphill Climb for the Oil Giants - NYTimes.com,' *New York Times*, September 30, 2013, <http://www.nytimes.com/2013/10/01/business/energy-environment/an-uphill-climb-for-the-oil-giants.html>.

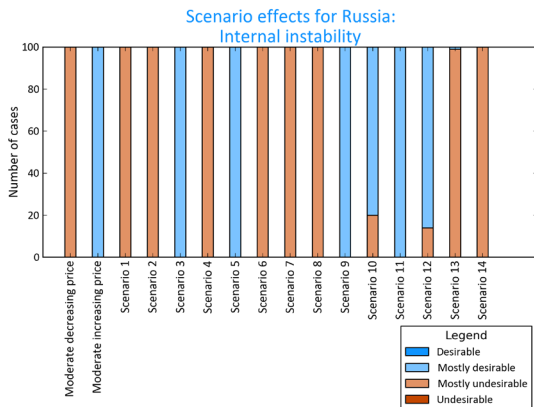


FIGURE 31. SCENARIO EFFECTS FOR RUSSIA

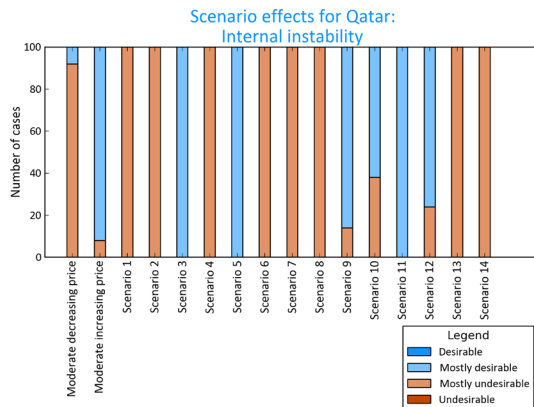


FIGURE 32. SCENARIO EFFECTS FOR QATAR

The most likely reason for this is that decreasing oil and natural gas prices mean that resource rents as a percentage of GDP decrease. In the above example of Russia, this then causes the GDP itself to decrease. A lower GDP has a negative effect on employment, causing the number of jobless Russians to increase. This becomes particularly problematic when youth unemployment starts to rise; an important factor in causing internal dissent (see also *infra*, this section). In March 2010, protests took place in Russia as the end of a 10 year period of economic growth was beginning to hit large tracts of the population.¹⁶⁵ In its 2013 report, the International Labour Organization (ILO) indicates that the potential for social unrest in Russia has risen compared to the previous year, mainly due to a worsening of youth unemployment.¹⁶⁶ This combination of factors causes the level of instability in this particular scenario to be almost always higher than in the

165 'Anti-Putin Protesters Rally Amid Rising Unemployment,' *France24*, March 20, 2010, <http://www.france24.com/en/20100320-anti-government-day-protests-russia-unemployment-putin>.

166 *World of Work Report 2013. Repairing the Economic and Social Fabric* (Geneva: The International Labour Organization (ILO) / International Institute for Labour Studies, 2013), 14; 'ILO Warns Europe About Growing Risk of Social Unrest,' *Euractiv*, June 4, 2013, <http://www.euractiv.com/socialeurope/ilo-warns-europe-growing-risk-so-news-528277>.

reference scenario. Conversely, when prices increase, instability often decreases compared to the reference scenario as the above logic is inverse. Fifth, although the above situation makes intuitive sense, what can be seen in Qatar (see Figure 32) is that situations are possible in which the exact opposite occurs. For example, when oil and natural gas prices decrease this can also cause the average fuel dependency of the population to decrease. If this price decrease is not very strong, this could lead to an improvement of the purchasing power of the population. This explains the small number of cases in Qatar in which such a scenario can be viewed positively. It is clear however, that this occurs only in a limited number of cases and that the vast number of cases triggers the same causal mechanisms as in the example of Russia, leading to situations where instability increases compared to the reference scenario. Conversely, in a situation of moderately increasing prices it is possible that fuel resources become more expensive, thus negatively affecting purchasing power of the population and causing resentment. However, it should again be stressed that in the vast number of cases where prices increase moderately, in both Russia and Qatar, the effect on stability is largely positive. This is due to the increase in resource rents and the corresponding rise of GDP.

Sixth, youth unemployment appears as one of the most critical factors in determining whether instability may arise. As soon as a scenario with declining energy prices triggers a rise in youth unemployment (this is in particular the case in Scenarios 1 and 8, see Figure 27 and pages 188 and 202), the number of cases where instability was much greater than in the reference scenario increased rapidly. A decline in oil and natural gas prices causes a decline of resource rents and a general worsening of economic conditions, fuelling unemployment as a result. In countries which already experience significant levels of youth unemployment, notably Algeria, Egypt and Saudi Arabia (see Initial Conditions, p. 217-223); this leads to a further exacerbation of this situation. An oft-used measure as a 'counterweight' to rising levels of unemployment is to expel a portion of the migrant worker population. Such cases have been frequently reported in Algeria and Saudi Arabia.¹⁶⁷

167 Black, 'Saudi Arabia Expels Thousands of Yemeni Workers | World News | Theguardian.com'; 'Algeria - Amnesty International Report 2010,' *Amnesty International*, 2010, <http://www.amnesty.org/en/region/algeria/report-2010>.

Seventh, due to these circumstances fuel and/or food subsidies often have to be lessened or halted, causing a sharp decline in purchasing power and a steep increase in the observed number of cases where instability is notably higher than in the reference scenario. Slashing subsidies thus acts as a major catalyst of social unrest. An interesting example thereof was the May 1998 decision by the Indonesian President Suharto to cut fuel subsidies, under pressure of the International Monetary Fund (IMF). The move added to ongoing unrest over inflation and food shortages. Eventually by 12-13 March 1998, the situation exploded and widespread rioting broke out, leading to an estimated 1,200 deaths in Indonesia. President Suharto stepped down on 21 March 1998.¹⁶⁸

Another, more recent example, was the September 2013 decision by the Sudanese government to halt fuel subsidies in light of ongoing economic difficulties. This move resulted in widespread riots, killing and injuring dozens of civilians in what was seen as the worst unrest in years. Sudan was a country experiencing an oil-fuelled economic boom until South Sudan became independent, taking 75% of Sudan's oil reserves.¹⁶⁹ Although such a disproportional reduction in associated energy wealth is unlikely to take place in the countries under investigation, oil and natural gas price decreases and/or worsening economic conditions are likely to trigger similar causal mechanisms as witnessed in Sudan.

In this respect, it should be borne in mind that the causes of the 2011 Arab revolutions related primarily to unemployment, notably youth unemployment; poverty; widening inequality; rising food prices; and increasingly visible evidence of corruption and the enrichment of elites.¹⁷⁰

168 'FACTBOX - Indonesia's Struggle with Sensitive Fuel Subsidies,' *Reuters*, May 24, 2008, <http://uk.reuters.com/article/2008/05/24/uk-indonesia-fuel-idUKJAK20951020080524>.

169 'Sudan Fuel Unrest: Many Die in Khartoum as Riots Continue,' *BBC News*, September 25, 2013, <http://www.bbc.co.uk/news/world-africa-24272835>; 'Ambassade Adviseert Nederlanders in Soedan Binnen Te Blijven,' *NRC Handelsblad*, September 25, 2013, <http://www.nrc.nl/nieuws/2013/09/25/ambassade-adviseert-nederlanders-in-soedan-binnen-te-blijven/>.

170 'House of Commons - British Foreign Policy and the 'Arab Spring' - Foreign Affairs Committee,' *UK Parliament*, July 19, 2012, <http://www.publications.parliament.uk/pa/cm201213/cmselect/cmfa/80/8006.htm>.

In the wake of the unrest many Gulf States heavily increased their social spending, fearing a spillover of instability from North Africa. As a result, some analysts claim the threshold for active involvement in the international oil market now lies some US\$ 20-25 higher than before the Arab Spring, thus lending support to an oil price of US\$ 100 per barrel.¹⁷¹ This US\$100 per barrel has since become somewhat of a magic threshold.¹⁷² In 2013, Algeria required a fiscal break-even price of almost US\$ 125 a barrel; well above the US\$ 107.94 charged for a barrel of Brent oil in early October 2013.¹⁷³ Saudi Arabia saw its fiscal break-even oil price increase from US\$ 94 in 2012 to US\$ 98 per barrel in 2013. During the same time period, the OPEC weighted average break-even price rose from US\$ 99 to US\$ 105. Similarly, Russia's federal budget requires the international oil price to lie above US\$ 100 a barrel.¹⁷⁴ In this respect, the strong reliance on high oil prices to balance the budget poses a significant risk if the oil price were to decrease, especially given that many countries in our study suffer from conditions comparable to the countries which experienced the Arab Spring; with corruption and cronyism widespread, high levels of inequality and high youth unemployment (see also, *infra* Conclusions).¹⁷⁵

Finally, building on this observation, the modeling exercise makes clear that the degree to which the democratic expectations of the population in a country differ from the regime type in place matter a great deal in

171 Darbouche and Fattouh, 'The Implications of the Arab Uprisings for Oil and Gas Markets,' 18.

172 Luft and Korin, 'The Myth of U.S. Energy Dependence.'

173 'Fiscal Break-Even Oil Prices (U.S. Dollars a Barrel)' (International Monetary Fund (IMF) World Economic Outlook, 2013), http://www.imf.org/external/pubs/ft/weo/2013/01/c2/fig2_12.pdf; 'Crude Oil and Commodity Prices,' *Oil-Price.Net*, October 2, 2013, <http://www.oil-price.net/>; Ali Aissaoui, 'Modeling OPEC Fiscal Break-Even Oil Prices: New Findings and Policy Insights,' *APICOR Research* 8, no. 9-10 (October 2013): 2.

174 'Moody's Downgrades Russia's 3 Top Lenders,' *Russia Today Business*, July 8, 2013, <http://rt.com/business/moody%27s-sberbnak-vtb-rosselkhozbank-767/>; Al Fin, 'What Would Falling Oil Prices Do to Russia's Geopolitical Ambitions?,' *Oilprice.com*, December 10, 2012, <http://oilprice.com/Energy/Oil-Prices/What-Would-Falling-Oil-Prices-do-to-Russias-Geopolitical-Ambitions.html>; 'Let's Make A Deal: Russia and Saudi Arabia Exploring Grand Oil Bargain?,' *Energy Policy Information Center*, August 30, 2013, <http://energypolicyinfo.com/2013/08/let%E2%80%99s-make-a-deal-russia-and-saudi-arabia-exploring-grand-oil-bargain/>.

175 Bekkers et al., *De Toekomst in Alle Staten - HCSS Strategische Monitor 2013*, 37.

determining the dynamics of instability. Recalling the classification provided in Table 1 (see p. 116), the population of countries under investigation in this study comprises democracies, autocracies and anocracies. The way the population in a particular polity type reacts/is able to react to worsening economic conditions as a result of declining oil and natural gas prices differs greatly. Also, the reaction of the government to social unrest differs per polity type. Strong democracies such as The Netherlands, Denmark, Norway and the United Kingdom can sustain energy price fluctuations fairly well given that there is very little difference between how societies are governed and how the population expects countries to be ruled. However, if economic conditions worsen, purchasing power is still likely to be negatively affected, giving rise to popular resentment. The difference with the other countries in this population however is that in a democracy protesting against the government is a basic right. Moreover, governments can ultimately be voted out of office via the ballot box if the population feels they were unsuccessful in improving the country's economic performance. By contrast, in autocracies such as Saudi Arabia, Kazakhstan, Azerbaijan and Qatar the ruling elite is more likely to crack down on emerging civil unrest out of fears that it may destabilize the regime, or interfere in nearby countries affected by civil unrest.¹⁷⁶ Moreover, their extensive financial reserves (at least in the case of Saudi Arabia, Qatar and Azerbaijan) can – for a number of years – act as a buffer against a

¹⁷⁶ Examples include, *inter alia*, the January 2013 protests in Northern Azerbaijan and in the capital city Baku and the violent crackdown by the security forces; the December 2011 suppression of the protests in the Kazakh town of *Zhanaozen*; the sectarian tensions in Saudi Arabia and ensuing governmental crackdown after the killing of a Shia protester in September 2012; and the support by the government of Qatar of the Muslim Brotherhood and other Islamist opposition groups in the countries affected by the Arab Spring. See Gunel Ahmed, 'Azerbaijan: Police Crack Down on Baku Protesters,' *Eurasianet.org*, January 26, 2013, <http://www.eurasianet.org/node/66454>; 'Dozens Arrested after Azerbaijan Protests,' *Aljazeera*, January 26, 2013, <http://www.aljazeera.com/news/asia/2013/01/201312623135907244.html>; Kevin Sullivan, 'Saudi Arabia's Secret Arab Spring,' *The Independent*, October 23, 2012, <http://www.independent.co.uk/news/world/middle-east/saudi-arabias-secret-arab-spring-8223550.html>; Daisy Sindelar and Sania Toiken, 'A Year After Deadly Riots, Zhanaozen Is Quiet But Angry,' *Radio Free Europe Radio Liberty*, October 3, 2013, <http://www.rferl.org/content/zhanaozen-a-year-after-the-riots/24798726.html>; Guido Steinberg, *Qatar and the Arab Spring* (Stiftung Wissenschaft und Politik, February 2012).

decline in the price of oil and/or natural gas. That said, capital-intensive investments are likely to be negatively affected and – if the period of low oil and/or natural gas prices is long enough – ultimately the budgets of these countries will suffer. If protests emerge as a result of worsening economic conditions, it is likely that these will be violently suppressed.

THE PROBLEM OF ANOCRACIES

A much more acute problem however manifests itself in anocracies, rather than autocracies, given the much higher chance of instability in an anocracy (see also section 6.1).¹⁷⁷ Russia, Algeria and Egypt are classified as anocracies. In 2013 Egypt already fell victim to the instability proneness of an anocracy, albeit for reasons other than a decline in oil and/or natural gas prices. That said, the emergence of shale gas is unlikely to lead to an improvement of the current situation. The two anocracies in the study which emerge as particularly vulnerable to fluctuations in oil and natural gas prices are Algeria and Russia. Contrary to the countries in the Gulf region, Russia and Algeria do not possess financial buffers that can withstand a price decrease for many years; this is particularly problematic in the case of Russia.¹⁷⁸ Much of Russia and Algeria's vulnerability stems from the particular way in which resource rents are managed.

Gaddy and Ickes speak of a Russian 'addiction' to resource rents, which has its roots in the Soviet period. When rents grew in Soviet times, these were simply claimed by inefficient production sectors. Contrary to a market economy, such a misallocation in an addicted economy is not self-correcting. The reason for this is that misallocation in a rent-addicted economy such as Russia is difficult to detect due to the opaque nature in which the rents are misused.¹⁷⁹ In market economies, windfall profits from resource booms are at times channeled into prestige projects. However, when the resource boom ends, these projects are often abandoned. The market thus corrects this problem. This is not the case in addicted economies such as Russia, where the rents are channeled into production. This means that if rents dry up, it is unclear where the 'excess' was spent.

177 'CSP Global Conflict Trends,' fig. 13.

178 'Sovereign Wealth Fund Rankings.'

179 Clifford G. Gaddy and Barry W. Ickes, 'Russia after the Global Financial Crisis,' *Eurasian Geography and Economics* 51, no. 3 (2010): 293–294.

Often, windfall profits were simply used to do more of what was being done before, perhaps only on a grander scale. This spending was certainly not concentrated in a specific project, a specific region, or targeted at specific groups of the population. Significant portions of windfall profits in Russia have been invested into the production sector, often for the purchase of new equipment abroad. Important in this respect is that, rather than investing to replace old obsolete plants or invest in preparing new natural gas and oil fields for that matter (see section 3.3 on the discussion on the Shtokman field for example), these investments merely added to total capacity. This results in an increase in the total number of recipients and claimants of resource rents, making it much more difficult to implement policies when the resource boom ends. What happened in Russia during the financial crisis is that the rents that were invested in fact helped preserve the country's aging industries, rather than adapt to the new reality of economic hardship.¹⁸⁰ Following this chain of thought, shale gas and other unconventionals can erode the basis of the Putin regime in a similar fashion as the oil price collapse did after 2008.

Similarly to Russia, Algeria used oil windfalls to build an enormously inefficient public sector, while pursuing policies that inhibited productive growth in the private sector.¹⁸¹ A staggering 92% of the 1974-1978 windfall profits went into investments in capital-intensive public sector projects, mainly heavy industry.¹⁸² Resource rents were widely misallocated. In the 1970s and 1980s these problems were masked by periods of high oil prices, yet when hydrocarbon prices went down in late 1985, the Algerian economy went into crisis. Following the oil price collapse, the Algerian government accelerated the destructive state-business relationship in spite of at least on paper adhering to liberal policies.¹⁸³ When oil rents fell, unemployment and debt rose to high levels, demanding rent rationing. However, this did

180 Ibid., 294-295.

181 Bradford L Dillman, *State and Private Sector in Algeria: The Politics of Rent-seeking and Failed Development* (Boulder: Westview Press, 2000), 3.

182 P. Conway, 'Algeria: Windfalls in a Socialist Economy,' in *Oil Windfalls: Blessing Or Curse?*, ed. Alan H. Gelb (Oxford University Press, 1988), 147-169.

183 Dillman, *State and Private Sector in Algeria*, 3-4; George Joffé, 'The Role of Violence Within the Algerian Economy,' *The Journal of North African Studies* 7, no. 1 (March 2002): 10, doi:10.1080/13629380208718456.

not take place as political cronies within the armed forces, public sector and politically connected business entities remained large recipients of resource rents. In 1987, the Algerian debt rose to over 100% of its GDP. Subsequent rent rationing led to street protests.¹⁸⁴ Overall, total factor productivity in Algeria showed an annual decline rate of 3% during 1971-1996, remaining negative well into the mid-2000s.¹⁸⁵ Conversely, when oil rents rose again by the mid-2000s, Algeria's appetite for rent reform quickly vanished.¹⁸⁶ The oil price collapse after 2008 prompted OPEC to consider a severe production cut to stabilize the oil market.¹⁸⁷ Algeria's GDP growth remains primarily oil-driven and in the absence of further reform, it is likely to slow down when oil prices fall, causing unemployment to rise again.¹⁸⁸ As in the case of Russia, the onset of shale gas and other unconventional resources thus poses a serious risk to the stability of the regime in Algeria.

184 Richard M. Auty, 'Rent, Ethnicity, Ideology and Political Incentives: Explaining Rent Cycling in Algeria, Nigeria and Indonesia' (presented at the Conference on Economic Development in Africa, Centre for the Study of African Economies, St Catherine's College Oxford, 2008), 10.

185 Amer Bisat, Mohamed El-Erian, and Thomas Helbling, 'Growth, Investment, and Saving in the Arab Economies' (International Monetary Fund (IMF), July 1997); 'Algeria: Selected Issues' (International Monetary Fund (IMF), March 2006).

186 'Algeria: Selected Issues,' 24.

187 Jad Mouawad, 'OPEC Seeks Ways to Stabilize Declining Oil Prices,' *New York Times*, December 15, 2008, http://www.nytimes.com/2008/12/16/business/worldbusiness/16opec.html?_r=0.

188 Auty, 'Rent, Ethnicity, Ideology and Political Incentives: Explaining Rent Cycling in Algeria, Nigeria and Indonesia,' 11.

7 CONCLUSIONS AND RECOMMENDATIONS

The goal of this study was to analyze the geopolitical impact of the spectacular rise in shale gas exploration and production in the US on Europe and its relations with important oil- and gas-exporting countries in its immediate neighborhood. We specifically looked at whether the development of shale gas in the US may have destabilizing effects on oil- and gas-exporting countries near the EU in the long term (until 2050), which in turn have an effect on the external and internal stability of EU countries and substantiate new strategic policy measures.

We acknowledge that shale gas is unlikely to be a ‘game changer’ worldwide, in the same way as it is in the US. However, despite the fact that the ‘shale gas revolution’ is as such still primarily an American phenomenon, it does not come without consequences for Europe.

The onset of American shale gas is likely to cause the globally available supply of natural gas to increase, as more extraction capacity for natural gas came available in the US. Taking into account that worldwide demand for natural gas is projected to increase strongly, the mix between natural gas and other fuels is thus set to change. In the short term (until 2020), this will already take place in North America, but in the medium (2020 till 2030) to long term, this will have effects globally.

The analysis points in particular to shifts in the European energy mix which displace oil in the medium term, putting oil prices under pressure, as a strong factor in determining whether instability occurs in the oil- and gas-exporting countries investigated in this study. This point touches at the heart of the matter: the increase in the use of natural gas at the expense of oil which is gradually taking place in certain economic sectors.

The greater availability of LNG worldwide has prompted transportation companies, as well as governments to look at ways in which LNG can be used in commercial transport, partially as a way to cut down on pollution and partly because prices have come down due to an abundance of supply. Moreover, as typically one-third of a transportation company's cost base is fuel, the cost saving argument tilts favorably toward LNG in light of the low gas price in the US and increasing price levels of gasoline and diesel. Heavy duty vehicles, buses and particularly shipping are thought to have great potential. Moreover, gas can also substitute oil for use in power stations, (petro)chemical plants and domestic and industrial heating systems. The onset of shale gas could thus act as a catalyst to accelerate the shift from oil to natural gas in energy-intensive sectors of the economy.

Furthermore, in particular decoupling is a factor to watch. In all scenarios with significant decoupling, this caused substantially lower oil and gas prices, and a higher level of instability compared to the reference scenario. Within OECD countries, decoupling is already a cornerstone of the policy toolkit to enhance energy security and reduce harmful impacts on the environment. In view of this conclusion, it is important to stress that emerging economies are also moving step-by-step towards tougher fuel-efficiency standards on vehicles - although not (yet) up to the level of developed economies. The fuel-efficiency measures implemented by China in March 2013 are a good example of this, restricting average fuel consumption among passenger vehicles to 6.9 liters per 100 kilometers by 2015, with a further reduction to 5.0 liters by 2020. Although energy demand is still growing, such developments are likely to also contribute to a slowdown in the projected demand for oil in the coming years. All of the above may lead to a slowdown in the growth of demand for oil worldwide. The advent of shale gas adds to this potential.

Not all of the countries in our study emerge as equally vulnerable to declining oil and gas prices as a consequence of a slow down in oil demand growth. Factors that emerge as critical are the regime type in place, unemployment, and financial buffers. Countries particularly exposed are those which are of an anocratic regime-type, suffer from high youth unemployment, and possess limited financial reserves (in the form of sovereign wealth funds) to compensate for a reduction in export earnings caused by a lower oil price. Out of all countries investigated, Algeria and

Russia score worst on these variables, and thus emerge as particularly vulnerable. This is not least due to both countries' sheer addiction to resource rents misallocated in their economies. This renders them highly exposed to oil price fluctuations.

Europe could thus be confronted with heightened instability in two of its most important natural gas- and oil-providing countries when indeed oil demand growth slows down in the long term. This could potentially lead to situations in which reduced oil rents cause a worsening of national economic circumstances, leading to a rise in youth unemployment and strongly reducing the purchasing power of the population. In specific cases, a worsening of these variables has led to severe internal unrest, eventually leading to regime change.

This observation sheds light on existing EU policies of energy diversification geared toward greater security of supply. The direct effect of lower natural gas prices in the US is prompting many EU countries to advocate in favor of the exploration of shale gas in Europe, in a bid to increase the competitiveness of the European economy, and lower the dependence on imported energy from unstable and unreliable producer countries (c.f., the Country Stability Model). We found that the pursuit of greater energy security, leading to such lower import dependency, is not without consequences for the stability in Europe's neighborhood. Our analysis makes it clear that shifts in the energy mix that displace oil in the medium term can put oil prices under pressure, contributing to a heightened risk of instability in oil- and gas-exporting countries which score badly on our criteria for vulnerability; more specifically Algeria and Russia.

This means that policies geared toward greater energy self-sufficiency, either in the form of greater domestic production of fossil fuels (e.g., shale gas), increases in energy efficiency, a transition from fossil fuels toward a larger share of renewable sources or nuclear in the energy mix, or a combination thereof, impacts the stability of Europe's neighborhood. Europe could be faced with incidences of social unrest in two of the most important oil- and gas-exporting countries in its vicinity. The lessons learnt from the 2011 Arab uprisings make painfully clear what worsening economic circumstances, coupled with lingering popular resentment can cause.

Therefore, it is important that any future EU strategy on external energy relations firmly takes into account the impact of existing and planned policy choices with respect to Europe's energy mix on oil and gas exporters in the EU neighborhood. Energy security implies the fostering of a sustainable and trustworthy partnership between both energy consumer and supplier. If this is not taken seriously, the energy partnership that the EU holds with both countries could be susceptible to distrust.

In sum, we believe that the indirect impact of the US' shale gas revolution on Europe could be far greater and long-lasting than the direct effects on both the EU energy mix, and the competitiveness of European energy-intensive industries. The onset of shale gas can have destabilizing effects on important oil and gas exporters to the EU, particularly in the case of Russia and Algeria. The other countries in our study are not as vulnerable as Russia and Algeria, owing either to larger buffer capacities, a more diversified economy, lower unemployment figures, a more stable regime type, or a combination. However, they do share many of the same characteristics that render them fragile to long term changes in the global energy mix in so far as this puts pressure on oil prices and consequently on resource rents.

In anticipation of instability and to balance out the effects of European policy choices aimed at greater energy self-sufficiency, the EU should therefore more actively support economic diversification efforts in hydrocarbon exporting countries in its neighborhood, so as to create robust economies which can successfully weather oil price fluctuations.

Doing so warrants the creation of new energy interdependencies between Europe and the hydrocarbon exporting countries in its neighborhood. One avenue along which this could be established is via the path of energy transition. Existing EU policy is aimed at 'greening' the European economy: a process which requires significant investments. However, Europe is going through a profound economic crisis which undermines the ability to invest on a large scale. At the same time, the oil- and gas-exporting countries in the MENA region are faced with the pressures of expanding populations, a growing domestic energy demand and the possibility that long term changes in the global energy mix may negatively affect their export revenues. This places stress on their existing model of wealth creation and

warrants a need for their economies to diversify in the direction of other, particularly non-hydrocarbon, sectors.

European governments and companies have the technology and know-how to foster such a transition to alternative sources of energy. On the other hand, countries such as Qatar and Saudi Arabia are home to sizeable sovereign wealth funds, yet lack the technology and expertise to embark on a sustainable energy transition. One way of fostering a new kind of energy interdependence could be for countries such as Qatar and Saudi Arabia to invest in the greening of Europe, in exchange for the transfer of technology and expertise to diversify their own economies. This would enable them to diversify away from their over-reliance on hydrocarbon exports and potentially better equip them to deal with oil price fluctuations in the future.

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ANNEX 1: HORIZONTAL DRILLING

The below figure illustrates the different geological conditions in which gas resources can be found. Conventional gas resources are situated in sandstone formations and are easily accessible through vertical wells that allow the gas to flow to the surface.

Shale gas however is trapped inside shale rock formations and requires hydraulic fracturing techniques to 'free' the trapped gas. Horizontally drilled wells are capable of 'fracturing' a significantly larger area as opposed to vertically drilled wells. This process enables companies to drill fewer wells thus making the production of shale gas economically viable.

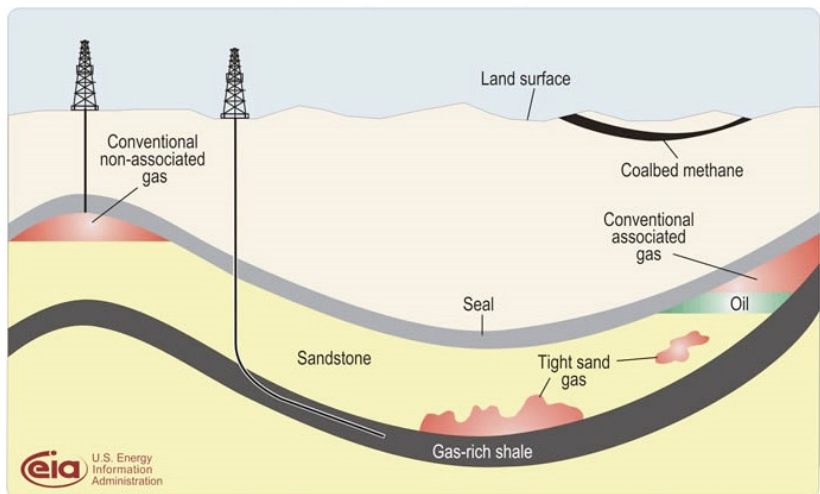


FIGURE 33. SCHEMATIC GEOLOGY OF NATURAL GAS RESOURCES.¹⁸⁹

189 U.S. Energy Information Administration, 'Schematic Geology of Natural Gas Resources,' January 27, 2010, http://www.eia.gov/oil_gas/natural_gas/special/ngresources/ngresources.html.

ANNEX 2: COUNTRY SPECIFIC INFORMATION

CHINA

Out of all the countries endowed with shale gas, China has some of the biggest potential (1.115 Tcf, see Figure 3¹⁹⁰). Although extraction is still in its infancy and only a handful of test wells have been drilled, the Chinese government has set itself an ambitious target. It aims to reach 0.23 Tcf of shale gas production by 2015, equivalent to 2-3 percent of the projected natural gas production China in 2015, and more than 2.11 Tcf of shale gas production by 2020.¹⁹¹

However, experts say China's plans will be difficult to realize as the country's geology is likely to make it more difficult to extract the gas than in the US, and a lack of freshwater resources and domestic foreign expertise are also likely to hamper a quick development of shale resources.¹⁹² That said, the reality is that gas demand in China is on the rise. The share of natural gas in

190 International Energy Agency, *Oil & Gas Security Emergency Response of IEA Countries. People's Republic of China*, 2012, 14; *Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States*, 1-7.

191 Hook, 'China Sets Target for Shale Gas Development.'

192 'Global Reserves: A World of Plenty,' *The Economist*, accessed February 12, 2013, <http://www.economist.com/node/21558457>; Kevin Bullis, 'China Has Plenty of Shale Gas, But It Will Be Hard to Mine,' *MIT Technology Review*, December 11, 2012, <http://www.technologyreview.com/news/508146/china-has-plenty-of-shale-gas-but-it-will-be-hard-to-mine/>; Wayne Ma, 'China's Shale-Gas Boom Slow to Start,' *Wall Street Journal*, December 3, 2012, <http://online.wsj.com/article/SB10001424127887323401904578156710038647662.html>; Jane Nakano and Ksenia Kushkina, 'China Awards More Shale Gas Blocks Although Much Remains to Be Seen | Center for Strategic and International Studies,' *Center for Strategic and International Studies*, January 29, 2013, <http://csis.org/publication/china-awards-more-shale-gas-blocks-although-much-remains-be-seen>; Fan Gao, *Will There Be a Shale Gas Revolution in China by 2020?* (Oxford Institute for Energy Studies, April 2012), 35-36.

total energy consumption in China doubled from 2% in 2000 to 4% in 2009. Moreover, as natural gas use grew, China increased its imports of LNG in 2006 and became a net importer in 2007.¹⁹³ The latest five-year plan foresees an increase in the share of gas in the country's total primary energy consumption to 8% by 2016, up from 4% today. To meet this demand, China will need imports. However, given its size, an increase in natural gas consumption will have a tremendous impact on global gas markets. LNG imports have already increased and in recent years China completed a natural gas pipeline from Turkmenistan to China's western border.¹⁹⁴ Additional demand for LNG is likely to be met by Australia, which according to a recent study by British maritime classification society Lloyd's Register, is said to overtake Qatar as the world's largest producer of LNG by 2020 (see also *supra*, 3.2).¹⁹⁵

A second part of China's strategy on natural gas security rests on the development of its own conventional, as well as unconventional resources.¹⁹⁶ The need for foreign expertise has prompted the involvement of western companies, including Shell, BP, Chevron and ConocoPhillips in exploration joint ventures with Chinese companies.¹⁹⁷ Recently, China awarded sixteen companies acreage in nineteen shale blocks. Among the winners were six state-owned entities mostly affiliated to big utility and coal firms – including Huadian Group, Shenhua Coal Group and China Coal Group. Eight of the firms are energy investment corporations recently formed under the auspice of local governments. Two are little-known private firms. What the companies have in common is that actually none of them has drilled a gas

193 In 2010, gas demand reached around 3,74 Tcf, or roughly 0,01 Tcf per day, while it is estimated to have increased to 4,59 Tcf in 2011.

194 'Global Reserves: A World of Plenty'; 'China President Opens Turkmenistan Gas Pipeline,' *BBC News*, December 14, 2009, <http://news.bbc.co.uk/2/hi/asia-pacific/8411204.stm>.

195 'Australia Could Overtake Qatar as Top LNG Exporter by 2020 - Study,' *Platts*, April 9, 2013, <http://www.platts.com/RSSFeedDetailedNews/RSSFeed/NaturalGas/27850026>.

196 International Energy Agency, *Oil & Gas Security Emergency Response of IEA Countries. People's Republic of China*, 2-3.

197 Hook, 'China Sets Target for Shale Gas Development'; Ma, 'China's Shale-Gas Boom Slow to Start.'

well before, making the need for foreign expertise higher than ever.¹⁹⁸ In a bid to attract foreign expertise, the Chinese government approved a production sharing agreement between Shell and China National Petroleum Corporation (CNPC) on 26 March 2013. Under the agreement, Shell announced it will explore, develop, and produce shale gas in cooperation with CNPC, at a total investment worth US\$ 1 billion a year. Additional details to the agreement, including the duration of the contract were not made public.¹⁹⁹

POLAND

In its 2011 report, the US Energy Information Administration singled out Poland as one of the countries currently highly dependent on natural gas imports, which could see its future gas balance significantly altered by shale gas.²⁰⁰ Indeed, the Polish government wholeheartedly embraces shale gas exploration as a possible 'path to energy independence' and a break-away from its reliance on Gazprom.²⁰¹ Since 2007, a total of 111 exploration concessions were issued. The Polish Geological Institute in March 2012 reduced earlier EIA estimates of TRRs to a range from 12.22 Tcf to 27.18 Tcf, or a mere 1/10th of the original estimate. In its 2013 report, the EIA estimates

198 'China Firms to Invest \$2bn Exploring Shale Gas Reserves,' *BBC News Business*, January 22, 2013, <http://www.bbc.co.uk/news/business-21137349>; Nakano and Kushkina, 'China Awards More Shale Gas Blocks Although Much Remains to Be Seen | Center for Strategic and International Studies'; Chen Aizhu, 'China's Ragtag Shale Army a Long Way from Revolution,' *Reuters*, March 10, 2013, <http://www.reuters.com/article/2013/03/10/us-china-shale-idUSBRE9290GR20130310>.

199 Sarah Chen, 'Shell Plans to Spend \$1 Billion on China Shale Gas Development,' *Bloomberg*, March 26, 2013, <http://www.bloomberg.com/news/2013-03-26/shell-plans-to-spend-1-billion-on-china-shale-gas-development.html>.

200 U.S. Energy Information Administration, *World Shale Gas Resources: An Initial Assessment of 14 Regions Outside the United States*, 5.

201 Dimiter Kenarov, 'Poland's Shale Gas Dream,' *Foreign Policy*, December 26, 2012, http://www.foreignpolicy.com/articles/2012/12/26/polands_shale_gas_dream; Geoffrey Kemp, Corey Johnson, and Tim Boersma, *The Shale Gas Boom: Why Poland Is Not Ready*, Analysis (Transatlantic Academy, June 2012); Jacques Jong de et al., 'A New EU Gas Security of Supply Architecture?,' *European Energy Journal* 2, no. 3 (July 2012): 33; Gény, 'Can Unconventional Gas Be a Game Changer in European Gas Markets?,' 50; Kefferpütz, 'Shale Fever: Replicating the US Gas Revolution in the EU?,' 1.

Polish TRRs at 148 Tcf (see also Figure 3). Though much lower than initial estimates, faith in shale gas remains solid nonetheless.²⁰²

Although having a high dependency on natural gas imports, Poland has never been a large user of natural gas relative to its total primary energy consumption. This is set to change however. In July 2009, the Polish government signed a 20-year contract with Qatar for the purchase of 0.049 Tcf of LNG per year. To accommodate these imports, Poland is constructing a LNG terminal at Swinoujscie at the Baltic Sea coast which is scheduled for completion by mid-2014. In recent months however, this deadline has been called into question due to delays and the bankruptcy of one of the contractors.²⁰³

As for aspirations that shale gas might act as the 'breaker' of Polish dependency on Gazprom, analysts remain doubtful.²⁰⁴ Uncertainty exists about the amount of gas available, as witnessed by the differing estimates, and drilling has so far generated humble results at best.²⁰⁵ Moreover, Poland's regulatory system – although suitable for the current state of exploration – may not be adequate to cope with large-scale commercial extraction as for example no requirements currently exist with respect to the prevention of contamination of ground water.²⁰⁶

202 Polish Geological Institute National Research Institute, *Assessment of Shale Gas and Shale Oil Resources of the Lower Paleozoic Baltic-Podlasie-Lublin Basin in Poland - First Report* (Warsaw, March 2012), 25; Kenarov, 'Poland's Shale Gas Dream'; *Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States*, 1-7.

203 'Poland Seeks to Renegotiate Long-term LNG Contract with Qatar to Achieve 'Market Price'; *Natural Gas Europe*, November 23, 2012, <http://www.naturalgaseurope.com/poland-to-renegotiate-lng-contract-with-qatar>; 'Lack of Vision, Indecisiveness Impair Polish Natural Gas Promise'; *Natural Gas Europe*, August 13, 2012, <http://www.naturalgaseurope.com/poland-doubts-grow-over-natural-gas-challenges>.

204 Stevens, *The 'Shale Gas Revolution': Hype and Reality*, 5 and 9; Kemp, Johnson, and Boersma, *The Shale Gas Boom: Why Poland Is Not Ready*, 3-4.

205 Boersma and Johnson, *Risks and Potentials of the Shale Gas Revolution*, 5; 'Results 'Humble' so Far for Polish Shale Gas, Minister Says'; Stevens, *The 'Shale Gas Revolution': Developments and Changes*, 10.

206 Kemp, Johnson, and Boersma, *The Shale Gas Boom: Why Poland Is Not Ready*, 4; Boersma and Johnson, *Risks and Potentials of the Shale Gas Revolution*, 6; Kenarov, 'Poland's Shale Gas Dream.'

More important perhaps is the fact that Poland suffers from a lack of gas infrastructure. Pipeline capacity for domestic use is almost fully booked. Meanwhile, talks on the construction of a second pipeline, parallel to the existing Yamal-Europe gas pipeline, a pipeline which runs from Siberia to Germany via Poland, are progressing only slowly as Poland is reluctant towards Gazprom participation and favors ownership by a Polish state-owned enterprise. Nevertheless, a Memorandum of Understanding (MoU) for a feasibility study on the Yamal II pipeline was announced between Gazprom and EuRoPol Gaz on 5 April 2013. Within hours, the existence of the MoU was denied by Polish Prime Minister Donald Tusk. The MoU caused such consternation that it led Tusk to conduct a formal inquiry. The inquiry led to the decision to fire the treasury minister, Mikolaj Budzanowski, who oversees all companies in which the government holds stakes and as such was deemed responsible.²⁰⁷ At the same time, the EU is putting pressure on Poland to lower its overall CO₂ emissions to reach the Union's 2020 goals. Meanwhile substitution of natural gas for coal is difficult, owing to price competition from cheap coal (no longer used in the US) and concerns about unemployment if substitution were to take place.²⁰⁸

UKRAINE

Ukraine is important to European energy security, as a significant portion of Russian natural gas supplies to Europe are transited through Ukraine via pipeline.²⁰⁹ Relations between Ukraine and Russia are troubled however and Ukraine saw its natural gas supplies cut off in 2006 and 2009 due to

207 Marynia Kruk, 'Polish Prime Minister Shoots Down Gazprom's New Pipeline Idea,' *Wall Street Journal*, April 5, 2013, <http://blogs.wsj.com/emerging europe/2013/04/05/polish-prime-minister-shoots-down-gazproms-new-pipeline-idea/>; Marynia Kruk, 'Polish Minister Sacked over Gas Pipeline Confusion,' *Wall Street Journal*, April 19, 2013, <http://blogs.wsj.com/emerging europe/tag/mikolaj-budzanowski/>.

208 'Europe's Dirty Secret: The Unwelcome Renaissance,' *The Economist*, January 5, 2013, <http://www.economist.com/news/briefing/21569039-europes-energy-policy-delivers-worst-all-possible-worlds-unwelcome-renaissance/>; 'Gas Industry Chief: We Cannot Wait for a More Ambitious Energy Policy,' *Euractiv*, May 16, 2013, http://www.euractiv.com/energy/gas-industry-chief-wait-ambitiou-interview-519775?utm_source=RSS_Feed&utm_medium=RSS&utm_campaign=EurActivRSS.

209 'IEA - Ukraine,' *International Energy Agency (IEA)*, accessed March 1, 2013, <http://www.iea.org/countries/non-membercountries/ukraine/>.

price disputes.²¹⁰ To reduce reliance on gas transit through Ukraine, Russia initiated the construction of several pipelines which bypass the country. The Blue Stream pipeline, a direct pipeline between Russia and Turkey came online in 2005 and construction on the Nord Stream pipeline between Russia and Germany was finished in 2012. The South Stream pipeline, currently under construction, will run from Russia underneath the Black Sea to Bulgaria and further to Greece, Italy and Austria. On April 4 2013 Gazprom announced a feasibility study on the Yamal II pipeline which intends to supply Poland, Slovakia and Hungary; it too would bypass Ukraine.²¹¹

For its own energy needs, Ukraine is highly dependent on Russian natural gas imports (around 64% in 2010) and Kiev is keen to see that dependency reduced.²¹² Ukraine's TRRs are significant (128 Tcf, see Figure 3) and - anxious to break its dependence on Gazprom - Kiev signed an exploration and production agreement with Royal Dutch Shell in January 2013 to begin exploration of the country's shale gas resources.²¹³ US Company Chevron is the other firm involved in shale gas exploration in Ukraine, having won a tender for exploration in the western part of the country, whereas ExxonMobil and Shell were chosen to explore off Ukraine's Black Sea

210 Stern, 'The Russian-Ukrainian Gas Crisis of 2006'; de Jong, Wouters, and Sterkx, 'The 2009 Russian-Ukrainian Gas Dispute: Lessons for European Energy Crisis Management after Lisbon.'

211 'MOU Signed for Yamal-Europe 2 Gas Pipeline,' *Oil and Gas Journal*, April 5, 2013, <http://www.ogj.com/articles/2013/04/mou-signed-for-yamal-europe-2-gas-pipeline.html>.

212 'Energy Delta Institute Country Gas Profiles: Ukraine,' *Energy Delta Institute*, accessed March 1, 2013, <http://www.energydelta.org/mainmenu/energy-knowledge/country-gas-profiles/ukraine>; 'Ukraine Wants to Become 'energy Hub' for Europe,' *EurActiv*, May 6, 2013, <http://www.euractiv.com/energy/ukraine-energy-hub-europe-news-519540>.

213 U.S. Energy information Administration, *World Shale Gas Resources: An Initial Assessment of 14 Regions Outside the United States*, 4; Roman Olearchyk and Neil Buckley, 'Ukraine to Sign Landmark Shale Gas Deal - FT.com,' January 23, 2013, <http://www.ft.com/intl/cms/s/0/f2e095d4-6578-11e2-a3db-00144feab49a.html>; Roman Olearchyk and Neil Buckley, 'Ukraine Gas Deal Loosens Russia's Grip - FT.com,' January 24, 2013, <http://www.ft.com/intl/cms/s/0/f5decc00-6641-11e2-b967-00144feab49a.html>.

coast.²¹⁴ On top of this, Ukraine is actively seeking conventional natural gas imports from countries other than Russia. Ukraine started to import gas from Germany via Poland in late 2012 and is currently seeking to buy additional supplies from Germany via Slovakia. Ukraine is in this sense trying to make use of the potential under-utilization of the gas transit systems in nearby countries which also stand to suffer if supplies transited through Ukraine will lessen as a result of the aforementioned pipeline developments.²¹⁵ Ukraine is also said to be in negotiations with Turkey over the import of natural gas supplies, which is likely to concern transited supplies from Azerbaijan or Turkmenistan.²¹⁶ Equally, Ukraine has shown interest in the purchase of natural gas from both Iraq and Iran.²¹⁷

214 Roman Olearchyk, 'Kiev to Opt for ExxonMobil and Shell Bid,' *Financial Times*, August 14, 2012, <http://www.ft.com/intl/cms/s/0/72e3de68-e620-11e1-bece-00144feab49a.html#axzz2MC6iUDOk>.

215 Vladimir Socor, 'Ukraine Importing Gas from Germany via Hungary and Poland,' *The Jamestown Foundation*, April 1, 2013, http://www.jamestown.org/single/?no_cache=1&tx_ttnews%5Btt_news%5D=40677&tx_ttnews%5BbackPid%5D=7&cHash=8e833c1eb0de7a4c8a8fca133d9d019e8; 'Ukraine Considers Importing Gas From Slovakia,' *ANP Pers Support*, January 22, 2013, <http://perssupport.nl/apssite/persberichten/full/2013/01/22/Ukraine+Considers+Importing+Gas+From+Slovakia>; 'Ukraine to Expand Gas Imports from Europe,' *RIA Novosti*, February 7, 2013, <http://en.rian.ru/business/20130207/179280278.html>.

216 'Turkey, Slovakia, Poland Help Diversify Gas For Ukraine,' *Natural Gas Europe*, January 22, 2013, <http://www.naturalgaseurope.com/ukraine-considers-gas-from-slovakia>; 'Ukraine in Energy Talks with Turkey, Azerbaijan,' *Hürriyet Daily News*, January 28, 2012, <http://www.hurriyetdailynews.com/ukraine-in-energy-talks-with-turkey-azerbaijan.aspx?pageID=238&nid=12451>; Marat Gurt, 'Ukraine, Turkmenistan Talk on Reviving Gas Supply,' *Reuters*, February 13, 2013, <http://uk.reuters.com/article/2013/02/13/turkmenistan-ukraine-gas-idUKL5N0BD71620130213>.

217 'Iraq's Ambassador to Ukraine Participates in Kharkov International Investment Forum,' *Embassy of the Republic of Iraq in Kiev*, September 12, 2012, <http://www.mofamission.gov.iq/ukr/en/articledisplay.aspx?gid=1&id=7940>; 'Gas Opportunities for Ukraine: Azerbaijan, Iraq, Norway, Romania, Turkey,' *Worldwide News Ukraine*, January 26, 2012, <http://wnu-ukraine.com/news/economy-business/?id=1309>; 'Ukraine Keen to Invest in South Pars,' *Press TV*, February 28, 2012, <http://www.presstv.com/detail/168241.html>; 'Envoy Stresses Iran, Ukraine's Key Role in Fostering Regional, Int'l Cooperation,' *Fars News Agency*, February 9, 2013, <http://english.farsnews.com/newstext.php?nn=9107143060>.

At the same time, owing to prolonged low industrial activity due to the financial crisis, Ukraine consumed less gas in 2012 than contractually obliged in accordance with the ‘take-or-pay’ construction it has with Gazprom, and is thus seeking a reduction of its Russian gas imports for 2013.²¹⁸ In a move that Gazprom denied was related to the contract with Shell or Ukraine’s refusal to join a customs union with Russia, Belarus and Kazakhstan, the Russian company subsequently issued a massive US\$ 7 billion fine to Ukraine’s national gas company, for failing to live up to their side of the contract. Worth mentioning in this regard is that Ukraine’s gas transmission infrastructure was previously valued at US\$ 7 billion – a possible proposition by Gazprom to conduct an asset swap which would allow Naftogaz to pay off its debt should as such not be ruled out a priori.²¹⁹ Commentators however expect Gazprom’s move to have been firmly influenced by Ukraine’s indecisiveness about whether to join Russia’s custom union, while contemplating to sign an Association Agreement with the EU instead, as well as Kiev’s strong interest in developing its domestic shale gas resources.²²⁰ At the time of writing, neither agreement is yet signed. Disgruntlement among the population with the inability of the country’s leadership to integrate Ukraine in Europe is increasing however and daily protests are taking place in Kiev.

It is however highly unlikely that Ukraine will ever agree to such a proposition as it would effectively hand Gazprom back a quasi-monopoly over all the gas which passes through Ukraine. The EU, although publicly stating it would welcome co-ownership, is at the same time keen to point

218 ‘Russia to Cut Ukraine, EU Gas in ‘Next Few Days,’ Expert Predicts,’ *EUobserver*, January 28, 2013, <http://euobserver.com/foreign/118874>; ‘Ukraine Reducing Russian Gas Imports,’ *Radio Free Europe Radio Liberty*, March 1, 2013, http://www.rferl.org/content/ukraine_russia_gas_europe_azerbaijan/24773468.html.

219 ‘Russia to Cut Ukraine, EU Gas in ‘Next Few Days,’ Expert Predicts.’

220 Roman Olearchyk and Neil Buckley, ‘Russia Hands Ukraine \$7bn Gas Bill - FT.com,’ January 25, 2013, <http://www.ft.com/intl/cms/s/0/6c1111ae-6718-11e2-8b67-00144feab49a.html#axzz2JG8Jp8BG>; ‘Russia to Cut Ukraine, EU Gas in ‘Next Few Days,’ Expert Predicts’; ‘EU Keeps Cool in Fresh Russian-Ukrainian Gas Dispute,’ *EurActiv*, January 29, 2013, http://www.euractiv.com/energy/commission-hopes-best-new-russia-news-517410?utm_source=RSS_Feed&utm_medium=RSS&utm_campaign=EurActivRSS.

out that a tripartite structure involving European companies would be the preferred modus operandi.²²¹

SOUTHEAST EUROPE

Two major shale gas basins can be discerned in Southeast Europe, the Pannonian-Transylvanian and Carpathian Balkanian Basin. Together, they cover Austria, Bosnia and Herzegovina, Bulgaria, Croatia, Hungary, Romania, Serbia, Slovakia, and Ukraine. Unfortunately, insufficient data is currently available to assess the individual shale gas resources in place at these two basins.²²² The EIA estimates Bulgaria's TRRs at 17 Tcf and those of Romania at 51 Tcf in its 2013 report. No individual estimate is provided for Hungary however.²²³

These three countries have similar characteristics. They either are highly dependent on natural gas imports to satisfy domestic demand (Bulgaria and Hungary), or are becoming increasingly so (Romania). When it comes to reducing this dependency, these countries thus can potentially benefit from local shale gas production. International energy companies have shown an active interest in exploring the shale gas potential of the region. These developments led to a heightened interest of international fund managers to invest in these countries.²²⁴ Local concerns about the environmental consequences of fracturing techniques have however resulted in popular campaigns seeking to ban the use of fracturing techniques.²²⁵

221 Andrew Rettman, 'Gazprom Welcome to Co-own Ukraine Gas Pipes, EU Says,' *EUobserver*, March 5, 2013, <http://euobserver.com/foreign/119282>.

222 U.S. Energy Information Administration, *World Shale Gas Resources: An Initial Assessment of 14 Regions Outside the United States*, VI 17-21.

223 *Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States*, 1-7.

224 Carolyn Cohn, 'Analysis: Shale Gas Redraws Emerging Market Investment Map,' December 10, 2012, <http://www.reuters.nl/article/2012/12/10/us-emerging-shale-idUSBRE8B90SN20121210>.

225 Neil Buckley, 'Resources: Shale Gas Will Have Its Day in Europe - but Not Just Yet,' November 8, 2012, <http://www.ft.com/intl/cms/s/0/3b56d8b2-1c42-11e2-a63b-00144feabdc0.html#axzz2PrfuWjNn>; Ioana Patran, 'Thousands Protest Chevron's Shale Gas Plans in Romania,' *Reuters*, April 4, 2013, <http://uk.reuters.com/article/2013/04/04/uk-romania-shale-chevron-idUKBRE9330S920130404>.

In Bulgaria, these campaigns led to a complete ban on the use of fracturing techniques in early 2012.²²⁶ Prior to the ban, several companies (among others, Chevron) expressed their interest in extracting shale gas in Bulgaria and were in the process of acquiring the necessary permits. Despite US encouragements directed at the Bulgarian government to develop their shale gas resources, the current debate focuses primarily on the ability of current legislation to prevent future shale gas extraction.²²⁷ A revocation of the fracking ban is thus unlikely in the foreseeable future.²²⁸

Hungary did not experience similar public pressure against the use of fracturing techniques. In order to diminish the country's gas import dependence and encourage the production of unconventional resources, the Hungarian government lowered the imposed royalty rate from 30% – customary for conventional gas production – to 12%.²²⁹ The exploration of shale gas in Hungary has nevertheless generated only mixed results so far. ExxonMobil withdrew its operations in 2010 after multiple exploration wells failed to discover commercial quantities of shale gas. RAG Rohol-Aufschungs, an oil and gas company based in Austria, has however claimed some success in the field.²³⁰

The potential for shale gas in Romania has attracted the interest of several companies, notably Chevron. Exploration licenses issued to Chevron in March 2012 triggered substantial protest in the east of Romania where exploration was due to take place.²³¹ A national campaign against fracturing techniques ensued. Efforts by the Romanian government to impose a

226 Daborowski and Groszkowski, *Shale Gas in Bulgaria, the Czech Republic and Romania*, 8.

227 EurActiv, 'US Tells Bulgaria Shale Gas Is Safe,' February 7, 2012, <http://www.euractiv.com/energy/us-tells-bulgaria-shale-gas-safe-news-510616>.

228 Daborowski and Groszkowski, *Shale Gas in Bulgaria, the Czech Republic and Romania*, 13.

229 Michiel Soeting et al., *Central and Eastern European Shale Gas Outlook* (KPMG Global Energy Institute, 2012), 69; Patran, 'Thousands Protest Chevron's Shale Gas Plans in Romania.'

230 Ivanenko and Schlesinger, 'Political Economy of Shale Gas Industry in Eastern Europe,' 9.

231 Daborowski and Groszkowski, *Shale Gas in Bulgaria, the Czech Republic and Romania*, 23.

complete ban – similar to the one imposed in Bulgaria – were rejected by the Romanian senate.²³² In January 2013, the Romanian government altered its policy regarding shale gas and allowed Chevron to continue its exploration efforts.²³³ Since then, five additional exploration licenses have been issued, including to the East West Petroleum Corporation, a Canadian based exploration and production company. Their planned exploration activities too have caused local concern and protest.²³⁴

For the region as a whole, it should be pointed out that any attempts at shale gas extraction are likely to be affected by the EU's plans to acquire natural gas from the Caspian Sea region as a means to diversify its natural gas supplies away from Russia. Out of the original three pipelines proposed, one was chosen: the TransAdriatic Pipeline (TAP).²³⁵ The TAP pipeline was competing with the Nabucco West pipeline for a natural gas contract from Azerbaijan's offshore natural gas field, Shah Deniz. TAP is designed to transport gas from the Caspian region via Greece and Albania and across the Adriatic Sea to southern Italy and further into Western Europe.

FRANCE

Based on the EIA's estimates (see Figure 3), France holds the second largest TRRs in Europe (137 Tcf), just after Poland.²³⁶ Shale gas has been controversial from the start however, with environmentalists taking a particular dislike to 'fracking'. A moratorium on fracking was installed under the former French President Sarkozy in 2011.²³⁷ France's current President, François Hollande has promised that the ban remains in place for his entire

232 Ibid., 25.

233 'Romania Reverses Course on Shale Gas,' *EurActiv*, February 1, 2013, http://www.euractiv.com/energy/romania-turn-shale-gas-news-517514?utm_source=RSS_Feed&utm_medium=RSS&utm_campaign=EurActivRSS.

234 Molnar, 'Granting of Exploration Licenses Spurs Romanian Protests.'

235 For a detailed discussion on the EU's plans to acquire natural gas from the Caspian Sea region, see de Jong, 'The EU's External Natural Gas Policy - Caught Between National Priorities and Supranationalism,' 25–29.

236 *Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States*, 1–7.

237 Sophie Pilgrim, 'French Lawmakers Ban Controversial Shale Gas Drilling,' *France24*, May 11, 2011, <http://www.france24.com/en/20110511-france-votes-ban-shale-gas-drilling-fracking-ump-sarkozy>.

five-year term.²³⁸ However, as France's economic situation worsens and unemployment reached a record high, the pressure from industry and from within Hollande's own administration is mounting to reverse the ban and allow shale gas to act as a kick-starter to France's sluggish economy.²³⁹ A similar 'thawing' of resistance to fracking can be observed in Germany, which is seeking ways to compensate for its planned phase-out of nuclear power.²⁴⁰

NORWAY

Norway, Europe's largest holder of oil and natural gas reserves, is a key supplier to countries on the continent. In fact, Norway is the world's second largest exporter of natural gas, just after Russia and as such of vital importance to European energy security, with the majority share of its exports destined for Germany, the UK and France.²⁴¹ Norway is home to significant conventional gas reserves (73 Tcf, as of January 2013). In its 2011 report, the EIA estimate Norway to hold also significant offshore shale TRRs (83 Tcf), thus almost doubling the country's existing resource base.²⁴² The EIA recently revised this estimate to 0 Tcf. however because of the disappointing results obtained from three Alum Shale wells drilled by Shell

238 'Unconventional Gas in Europe: Frack to the Future'; 'Shale Gas: Shale and Hearty Welcome.'

239 'French Unemployment Hits Record High,' *EUobserver*, February 27, 2013, <http://euobserver.com/tickers/119214>; 'France's Economy: Austerity Stakes'; 'Niche French Chemical Firms Ride U.S. Shale Gas Wave,' *Reuters*, December 5, 2012, <http://www.reuters.com/article/2012/12/05/france-shale-polymer-idUSL5E8N410J20121205>; Tara Patel, 'French Drillers Fight Back in Defense of Shale Gas Fracking,' *Bloomberg*, December 5, 2012, <http://www.bloomberg.com/news/2012-08-21/french-drillers-fight-back-in-defense-of-shale-gas-fracking.html>; Tara Patel, 'French Senate Orders Study on Alternatives to Shale Fracking,' *Bloomberg*, November 15, 2012, <http://www.bloomberg.com/news/2012-11-15/french-senate-orders-study-on-alternatives-to-shale-fracking.html>.

240 'Gas Bonanza for Germany?: Berlin Wants to Fast-Track Fracking,' *Spiegel Online*, February 8, 2013, <http://www.spiegel.de/international/germany/berlin-wants-to-end-moratorium-on-fracking-in-germany-a-882313.html>; 'Shale Gas Debate Intensifies in Germany Ahead of Election,' *Euractiv*, February 19, 2013, http://www.euractiv.com/energy/shale-gas-debate-intensifies-ger-news-517900?utm_source=RSS_Feed&utm_medium=RSS&utm_campaign=EurActivRSS.

241 US Energy Information Administration, *Norway Country Profile* (US Energy Information Administration, December 17, 2012).

Oil Company in 2011.²⁴³ Norway's majority state-owned oil and gas company Statoil however is active internationally when it comes to shale gas exploration. In late 2012, the company purchased 70,000 acres of land rich in shale in West Virginia and Ohio, US, in a deal valued US\$ 590 million.²⁴⁴

DENMARK

According to the 2013 EIA report, Denmark possesses 32 Tcf worth of TRRs.²⁴⁵ Currently, only minor exploration activities are taking place on Danish soil. French company Total E&P Denmark and the Danish state-owned Nordsøfonden were granted two exploration licenses in 2010 to search for shale gas in the northern part of the Jutland peninsula. Approximately D 27 million has been invested in 2012.²⁴⁶ In light of the ongoing debate about shale gas production and its environmental effects, the Danish Minister for Climate, Energy and Building has stopped granting permits for exploratory drilling until the environmental impacts have been identified.²⁴⁷

UNITED KINGDOM

The UK is the largest producer of oil and second largest producer of natural gas within the EU. After having been a net exporter of both oil, as well as natural gas for many years, the UK became a net importer of natural gas and oil in 2004 and 2005, respectively.²⁴⁸ According to the 2013 EIA report,

242 Ibid.; U.S. Energy information Administration, *World Shale Gas Resources: An Initial Assessment of 14 Regions Outside the United States*, 4, VII-36.

243 *Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States*, 1-7, 14.

244 'Statoil Acquires US Shale Gas Acreage,' *The Norway Post*, December 20, 2012, <http://www.norwaypost.no/index.php/business/15-oil-a-gasshipping/27865-satoil-acquires-us-shale-gas-field>.

245 *Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States*, 1-7.

246 'Shale Gas in Denmark,' *Total E&P Denmark B.V.*, accessed June 24, 2013, <http://en.skifergas.dk/shale-gas-in-denmark.aspx>; 'Denmark Hoping for Shale Gas,' January 25, 2012, <http://www.naturalgaseurope.com/denmark-hoping-for-shale-gas-4588>.

247 'Shale Gas Potential in Denmark,' *Energinet.dk*, January 30, 2013, <http://energinet.dk/EN/GAS/Aktuelle-temaer/Skifergaspotentiale-i-Danmark/Sider/default.aspx>.

248 *United Kingdom Country Profile* (US Energy Information Administration, September 2011).

the UK possesses 26 Tcf worth of TRRs.²⁴⁹ Like elsewhere in Europe, ‘fracking’ in the UK has been controversial from the start. Cuadrilla, an independent UK energy company, was forced to halt its test drillings after it seemed to cause a couple of minor tremors.²⁵⁰ In response, new controls were imposed by the UK Department of Energy and Climate Change, including a requirement to carry out a seismic survey before work starts, and the ban was lifted.²⁵¹

Optimism about the potential for shale gas development remains firm, both within industry, as well as the UK government; and the UK Treasury is considering granting tax breaks to the shale gas industry so that the UK is not left out of the worldwide hunt for gas.²⁵² Doubts regarding this optimism are equally voiced however, given the tighter (environmental) regulation in place in Europe and the fact that, unlike in the US, individual landowners do not own mineral rights, making opposition to drilling more likely (see also *supra*, 3.3).²⁵³

Uncertainty over whether shale gas production will take off in Europe and the US’ haggling over the decision to export or not aside, the UK became the first EU country to sign a deal for the import of US LNG. On 28 March 2013 Centrica (a UK based energy company) signed a twenty-year contract with Cheniere (a US-based provider of LNG) for the annual purchase of 1.75

249 *Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States*, 1–7.

250 ‘Shale Gas: Shale and Hearty Welcome.’

251 Laura Smith-Spark and Jim Boulden, ‘UK Lifts Ban on Fracking to Exploit Shale Gas Reserves,’ *CNN*, December 14, 2012, <http://edition.cnn.com/2012/12/13/business/uk-fracking>.

252 Jim Pickard, Sylvia Pfeiffer, and Piliita Clark, ‘Osborne Signals Shale Gas Tax Breaks,’ *Financial Times*, October 8, 2012, <http://www.ft.com/intl/cms/s/0/da4172e2-113f-11e2-8d5f-00144feabdc0.html#axzz2NK6L3HNd>; ‘Shale Gas: Shale and Hearty Welcome.’

253 Andrew Bounds, ‘UK Will Miss US-style Shale Gas Transformation,’ *Financial Times*, September 25, 2012, <http://www.ft.com/intl/cms/s/0/287378ee-0708-11e2-92ef-00144feabdc0.html#axzz2NK6L3HNd>.

million metric tons of LNG.²⁵⁴ The contract has an option to be extended with another ten years. Deliveries are due to start in September 2018.²⁵⁵

NETHERLANDS

Shale gas resources in the Netherlands are located in the Carboniferous Namurian Shale in the southern part of the country. The available TRRs are estimated at 26 Tcf.²⁵⁶ Logs and other geophysical data on the prospective areas collected by conventional drilling exist, but there is still uncertainty about the quality and the possibility of successful commercial production.²⁵⁷ The Dutch government stated in 2011 that it seeks to maintain stable gas production output for the upcoming decades and that shale gas production can potentially play an important role in achieving that.²⁵⁸ As of 2011, two companies – Quadrilla Resources and DSM Energie – have been issued licenses to execute shale gas explorations. DSM Energie later sold its permit to the Abu Dhabi National Energy Company (TAQA).²⁵⁹ However, due to public concern and strong opposition from the environment movement against the possible effects of fracturing techniques, no drilling is as of yet taking place. Opposition is so strong in fact, that close to 40 municipalities declared themselves part of a ‘zone’ which is free from shale gas exploration/production.²⁶⁰ In response, the Dutch government commissioned a study to assess the risks related to shale gas production which will be scheduled to be delivered on 1 July 2013.²⁶¹

254 Marc Hall, ‘Big Shale Gas Deal May Not Spark EU Energy Revolution,’ *EurActiv*, March 28, 2013, http://www.euractiv.com/energy/shale-gas-faces-uncertain-future-news-518765?utm_source=RSS_Feed&utm_medium=RSS&utm_campaign=EurActivRSS.

255 Oleg Vukmanovic and Lorraine Turner, ‘Centrica Seals First U.S. Natural Gas Deal,’ *Reuters*, March 25, 2013, <http://uk.reuters.com/article/2013/03/25/uk-centrica-idUKBRE92007020130325>.

256 *Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States*, 1–7.

257 U.S. Energy Information Administration, *World Shale Gas Resources: An Initial Assessment of 14 Regions Outside the United States*, VII–12.

258 M.J.M. Verhagen, ‘Brief Stand van Zaken Winning van Schaliegas’ (Ministry of Economic Affairs, Agriculture and Innovation, June 8, 2011), 1.

259 ‘Country Gas Profiles: Netherlands,’ *Energy Delta Institute*, accessed April 8, 2013, <http://www.energydelta.org/mainmenu/energy-knowledge/country-gas-profiles/country-gas-profile-netherlands>.

260 ‘Een Geschenk Uit de Diepte,’ 52.

261 H.G.J. Kamp, ‘Kamerbrief Gunning Aanbesteding Schaliegas Onderzoek’ (Ministry of Economic Affairs, Agriculture and Innovation, March 11, 2013), 2.

The results of the study were published in late August 2013. The report finds the safety risks associated with shale gas exploration do not differ much from those associated with conventional gas exploration. The risk of contamination of groundwater by methane gas to be negligible, provided proper safety measures and precautions are applied. Moreover, given the depth at which shale gas is located in the Netherlands, the chance that leakage of 'fracking' fluids would occur is small and controllable. The existing legal framework is deemed adequate to deal with the risks associated with shale gas exploration.²⁶²

The occurrence of earthquakes provoked by shale gas exploration cannot be ruled out, however the maximum force of these tremors will not exceed 3.0 on the Richter scale and will not be more powerful than in the case of conventional gas exploration. 'Fracking' itself is unlikely to cause seismic activity that is measurable at the surface level and which exceeds 1.0 on the Richter scale. Shale gas exploration does require a larger amount of surface space for its activities, *inter alia*, because multiple drilling locations are required. The report advises that additional research is carried out into the 'claim on space' of shale gas exploration. The Dutch Ministry of Economic Affairs expects a decision with respect to test drilling to be made by mid 2014 at the earliest.²⁶³

GERMANY

Known German shale gas resources are primarily situated in the North Sea-German Basin and estimated to contain 17 Tcf of TRRs.²⁶⁴ Several companies have shown interest in exploring Germany's shale gas potential. Of those, Exxon Mobil has been the lead company leasing prospective shale acreage in Germany. The company has drilled five test wells on its exploration

262 H.G.J. Kamp, 'Brief Aan de Tweede Kamer - Schaliegas: Resultaten Onderzoek En Verdere Voortgang' (Ministerie van Economische Zaken, August 26, 2013), 3-4; *Aanvullend Onderzoek Mogelijke Risico's En Gevolgen Opsporing van Schalie- En Steenkoolgas in Nederland* (Amsterdam: Witteveen & Bos, Arcadis & Fugro, August 26, 2013), 5-7.

263 Kamp, 'Brief Aan de Tweede Kamer - Schaliegas: Resultaten Onderzoek En Verdere Voortgang,' 3-5; *Aanvullend Onderzoek Mogelijke Risico's En Gevolgen Opsporing van Schalie- En Steenkoolgas in Nederland*, 5-7.

264 *Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States*, 1-7.

leases, with at least three of these reportedly testing for shale gas potential. In 2011, Exxon Mobil decided to drill an additional ten test wells.²⁶⁵ However, environmental concerns and public pressure have since then made state mining agencies reluctant to approve the necessary permits. The resistance against fracturing techniques in Germany is remarkable given that historically the technique has been applied at over 300 wells since the 1960s in order to prevent domestic natural gas production from drying up.²⁶⁶ Under pressure to find additional energy sources to replace Germany's nuclear power plants in 2022, the government has proposed federal legislation to allow the use of fracturing techniques under certain circumstances. The draft legislation foresees environmental safeguards by banning fracking in protected areas and near drinking wells. Concretely, such a ban would apply to 14% of German territory. In addition, environmental impact studies will be mandatory for any projects.²⁶⁷

Such action finds support from the European Commissioner for Energy, who claimed if shale gas exploration is allowed to take place, this will allow European companies to gain a knowledge advantage and a greater understanding of the costs; a feat very beneficial to an engineering country such as Germany.²⁶⁸ The issue is dividing Europe's leaders however with Britain, Romania and Poland said to lead the charge for shale gas and countries such as France, Bulgaria and the Netherlands being more reluctant.²⁶⁹

265 U.S. Energy Information Administration, *World Shale Gas Resources: An Initial Assessment of 14 Regions Outside the United States*, VII-16.

266 Wüst, 'Fear of Fracking: Germany Balks on Natural Gas Bonanza.'

267 'Germany Moves to Allow Controversial Shale Gas Drilling,' *EurActiv*, February 28, 2013, http://www.euractiv.com/energy/germany-tables-draft-law-allow-f-news-518131?utm_source=RSS_Feed&utm_medium=RSS&utm_campaign=EurActivRSS.

268 'EU Energy Chief Says Brussels to Look at Fracking This Year,' *EurActiv*, May 20, 2013, http://www.euractiv.com/energy/eu-energy-chief-brussels-look-fr-news-519844?utm_source=RSS_Feed&utm_medium=RSS&utm_campaign=EurActivRSS.

269 'Leaders Hesitate Between Common EU Response and 'silver Bullets' on Energy,' *Euractiv*, May 23, 2013, http://www.euractiv.com/energy/eu-hesitates-common-energy-polic-news-519939?utm_source=RSS_Feed&utm_medium=RSS&utm_campaign=EurActivRSS; European Council, *European Council Conclusions* (Brussels, May 22, 2013), 1-5.

ANNEX 3: SHALE GAS SCENARIOS

As explained in the introduction to Chapter 3, two sets of scenarios were explored: (i) those scenarios where an individual fuel type (natural gas, coal, oil and renewables) had reached its highest share among Europe's energy mix out of the total number of dynamic scenarios explored; and (ii) those scenarios which experience the greatest volatility in natural gas prices in all regions selected. This Annex is structured according to this logic. Scenarios 1 up to and including scenario 9 are scenarios of individual fuel types' energy mix shares. Scenarios 10 up to and including 14 are scenarios which proved the most volatile with respect to the price of natural gas.

As a guideline for understanding the measurements used in this chapter: US\$ 100 per barrel, equals 17241.38 dollar per billion British Thermal Units (Bbtu).

SCENARIO 1

In this scenario, the share of coal in the energy mix of Europe and its adjacent regions is the highest among all dynamic scenarios.

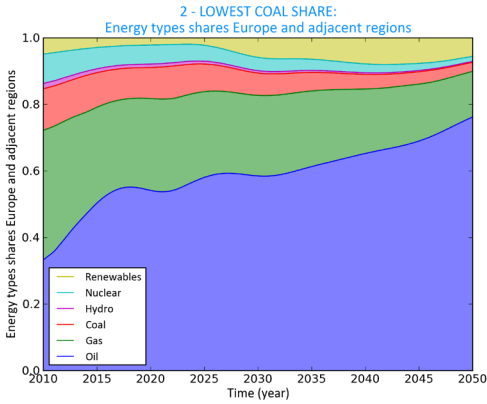


FIGURE 34. STACK GRAPH OF ENERGY INPUT SHARES

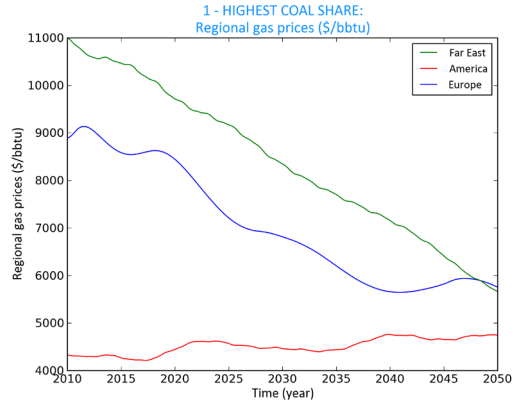


FIGURE 35. PRICES OF NATURAL GAS

In this scenario, oil as a share of the energy mix in Europe and its adjacent regions peaks around 2030 (See Figure 34), after which oil is steadily displaced by (cheaper) coal. Until 2030 natural gas is gradually displaced by oil, after which the share of natural gas narrows down in favor of (cheaper) coal. Renewables increase only marginally in the long term.

Prices of natural gas drop significantly in the Far East and in Europe (see Figure 35). In Europe, this is largely due to a drop in the share of natural gas in the energy mix. Gas prices go up slightly in the United States, most likely due to an increased in demand for natural gas, as well as the export of LNG.

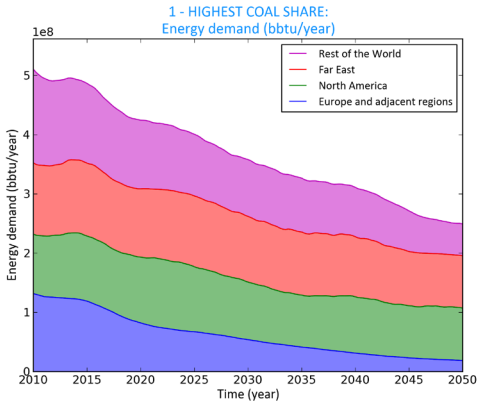


FIGURE 36. ENERGY DEMAND OF THE REGIONS

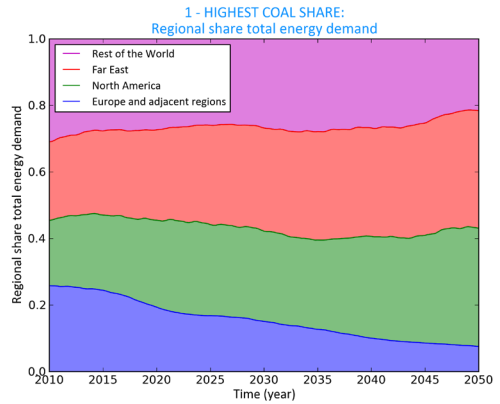


FIGURE 37. ENERGY DEMAND SHARES OF THE REGIONS

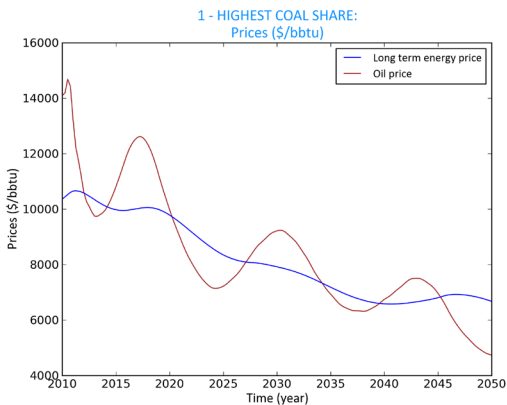


FIGURE 38. OIL AND AVERAGE ENERGY PRICES

Overall energy demand drops across all regions in absolute terms (see Figure 36). This could be due to a variety of reasons, including increased fuel efficiency or a slowdown in economic growth. In the long run, the drop in demand is the most pronounced in Europe and its adjacent regions.

Despite an overall downturn in energy demand, in relative terms the Far East continues to hold the largest share in overall energy demand compared to other regions (see Figure 37). The largest relative drop in demand is experienced in Europe and its adjacent regions. The relative share in

energy demand from the United States increases slightly over time, despite an overall shrinking absolute energy demand.

The oil price (see Figure 38) shows an overall downward trend until 2050. This downward trend is accompanied by significant price shocks roughly every five years.

SCENARIO 2

In this scenario, the share of coal in the energy mix of Europe and its adjacent regions is the highest among all dynamic scenarios.

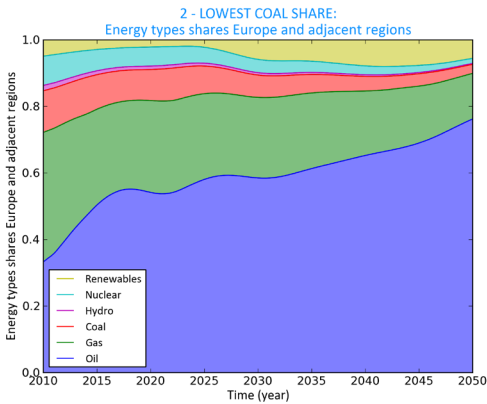


FIGURE 39. STACK GRAPH OF ENERGY INPUT SHARES

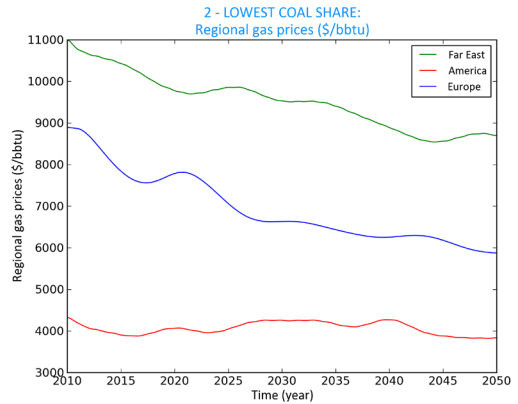


FIGURE 40. PRICES OF NATURAL GAS

From around 2015 onwards, the share of oil in the energy mix of Europe's and its adjacent regions steadily increases at the expense of natural gas and coal (see Figure 39). Possibly this is due to large scale discoveries of unconventional oil, which cause a drop in oil prices (see also Figure 43).

Natural gas prices experience a steady decline in the Far East and Europe until 2050 (see Figure 40). This is likely due to a lower overall energy demand (see Figure 41), as well as, in the case of Europe, due to a declining share of natural gas in its energy mix over time (see Figure 50). The prices for natural gas in North America shows minor fluctuations, yet does not significantly in- or decrease until 2050. The decline in natural gas prices in Europe and the Far East – although significant – proceeds more gradually than in Scenario 1.

Overall energy demand declines across all regions until 2050 (see Figure 41), with a brief resurgence between 2020 and 2025. Further decline sets in afterwards. As with the previous scenario, this is likely due to increases in fuel efficiency or slowdowns in economic growth.

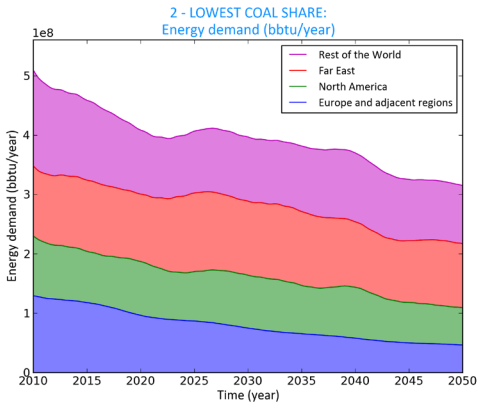


FIGURE 41. ENERGY DEMAND OF THE REGIONS

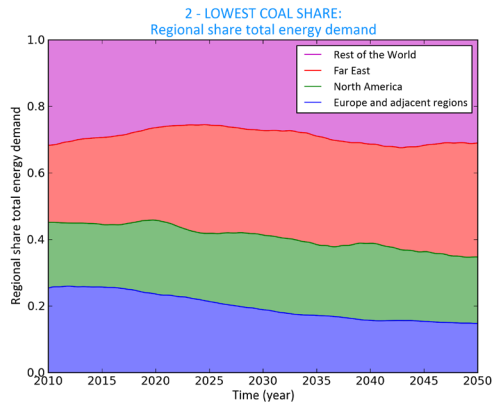


FIGURE 42. ENERGY DEMAND SHARES OF THE REGIONS

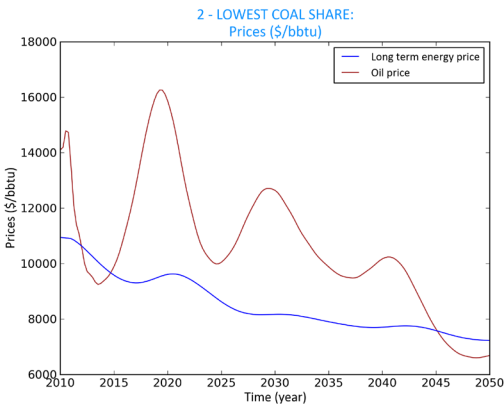


FIGURE 43. OIL AND AVERAGE ENERGY PRICES

The Far East continues to hold the largest relative share of overall energy demand and even sees this share expand compared to the other regions, despite an overall downturn in overall energy demand (see Figure 42). As in scenario 1, the largest relative drop in demand is experienced in Europe and its adjacent regions.

The oil price demonstrates significant swings until 2050 (see Figure 43). Oil price peaks at over US\$ 16000/bblu in 2020, after which price shocks are experienced in 2030 and again in 2040, although these never reach the highs of 2020. A sharp decline

sets in after 2040, possibly hinting at either an oversupply in the market or a drop in the price of competing fuels, reaching roughly US\$ 7000/bblu (less than half of the 2020 value). Whereas, Figure 40 demonstrates a drop in the price of natural gas in America after 2040, prices in Europe increase slightly at first, only to drop gradually thereafter. In the Far East prices increase in this period. This means that is in fact more likely that after 2040, the price of coal, rather than natural gas, significantly reduces relative to the price of oil.

SCENARIO 3

In this scenario, the share of natural gas in the energy mix in Europe and its adjacent regions is the highest among all dynamic scenarios. In this particular scenario, the share of oil in the energy mix in Europe and its adjacent regions also came out the lowest out of all dynamic scenarios explored. It is for this reason that scenario 3 represents a combined scenario.

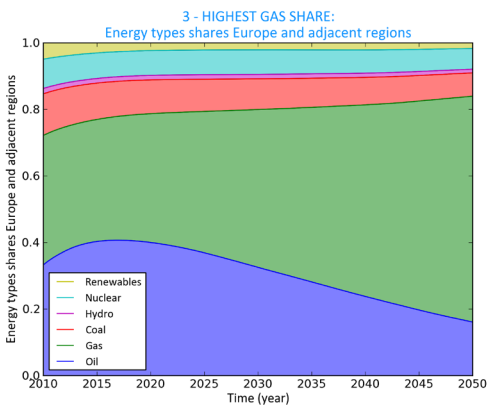


FIGURE 44. STACK GRAPH OF ENERGY INPUT SHARES

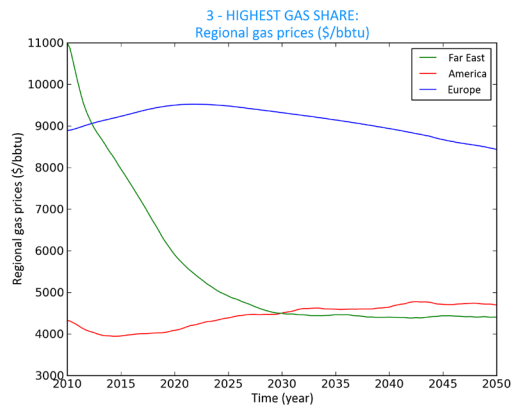


FIGURE 45. PRICES OF NATURAL GAS

In this scenario, the energy mix in Europe and its adjacent regions becomes primarily gas-oriented (see Figure 44). Whereas the share of natural gas in the energy mix initially declines in favor of oil, this changes dramatically after 2015, after which the share of natural gas starts to increase rapidly.

The effect on natural gas prices is that the price for natural gas in Europe remains consistently high (see Figure 45). It is interesting to point out that whereas in Europe the price of natural gas remains high, the price in the Far East drops far below the European price and from 2030 onwards even undercuts the price charged in North America. Such a development brings sustained high natural gas prices in Asia to an end. This can either be explained due to a large influx of additional LNG supplies (for example, from the US), due to a significant drop in demand, or due to a large scale switch in demand from LNG to coal. The North American natural gas price shows a gradual increase climbing several hundred US\$/bbtu over the observed time period, most likely due to an increase in exports.

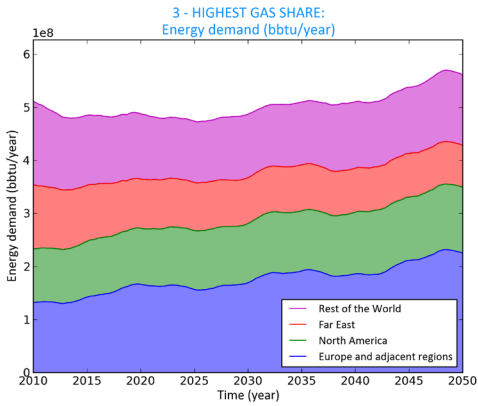


FIGURE 46. ENERGY DEMAND OF THE REGIONS

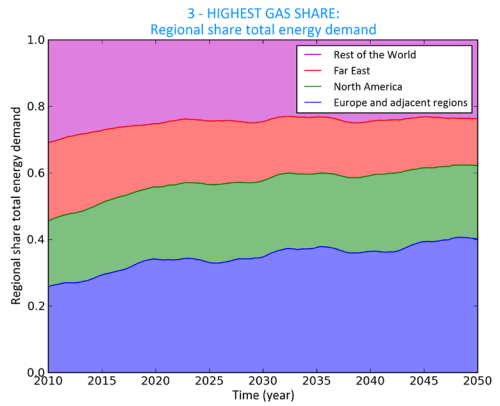


FIGURE 47. ENERGY DEMAND SHARES OF THE REGIONS

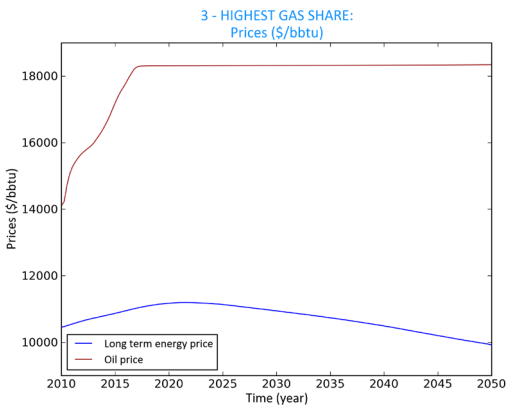


FIGURE 48. OIL AND AVERAGE ENERGY PRICES

Overall energy demand across all regions shows a gradual increase until 2050. Demand for energy increases significantly in Europe and its adjacent regions, yet remains largely unchanged in the Far East (only a small decrease can be observed, see Figure 46). In relative terms, Europe sees its share of overall energy demand increasing the most. North American demand also increases slightly. In the Far East, the share of total energy demand drops slightly towards 2050 (see Figure 57). The explanation for the drop in natural gas prices in Asia must thus either be sought on the supply side or in demand for alternative fuels to natural gas, as explained above.

In this scenario, the price of oil rises steeply in the period 2010-2018 and reaches a plateau at over US\$ 18000/bbl there-after (see Figure 48).

SCENARIO 4

In this scenario, the share of natural gas in the energy mix in Europe and its adjacent regions is the lowest of all dynamic scenarios.

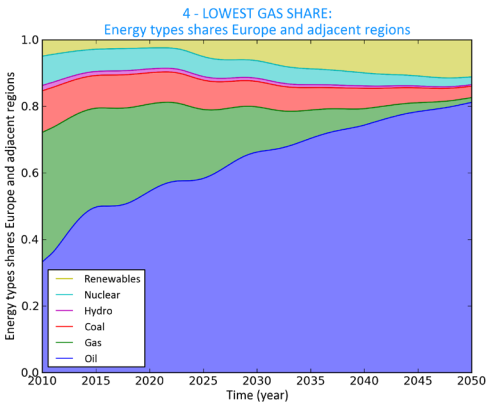


FIGURE 49. STACK GRAPH OF ENERGY INPUT SHARES

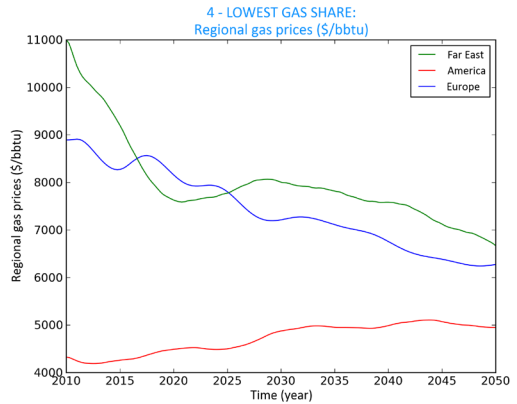


FIGURE 50. PRICES OF NATURAL GAS

In this scenario, the energy mix in Europe and its adjacent regions becomes much more focused on oil, rather than natural gas (see Figure 49). The relative shares of coal and nuclear in Europe and its adjacent regions’ energy mix remains largely unchanged, yet the drop in the share of natural gas can be called significant. Renewables gain slightly from 2030 to 2050, yet this pales in comparison to the increase in the share of oil. What is noticeable about this scenario is that the increase in the share of renewables coincides with an increase in the share of a competing fuel, in this case oil, thus raising the price of the latter.

The increase in the share of oil in Europe’s energy mix is reflected in the gradual decline of the natural gas price in Europe and its adjacent regions (see Figure 50). The price for natural gas the Far East equally goes down, though initially at a much higher pace (until 2020) than it does in Europe. After 2020, natural gas prices in the Far East increase and surpass the European price in 2025. After 2030, both the European and Far Eastern natural gas price declines at a more or less equal rate of decline. Natural gas prices in North America increase marginally, likely caused by the export of LNG.

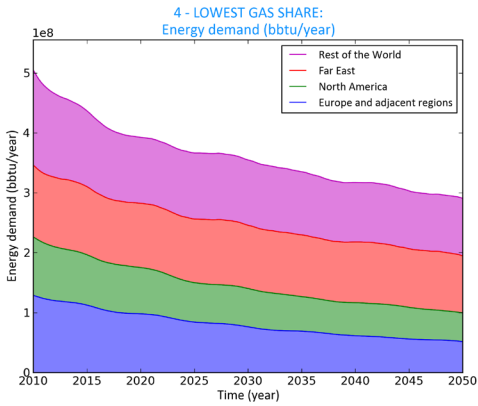


FIGURE 51. ENERGY DEMAND OF THE REGIONS

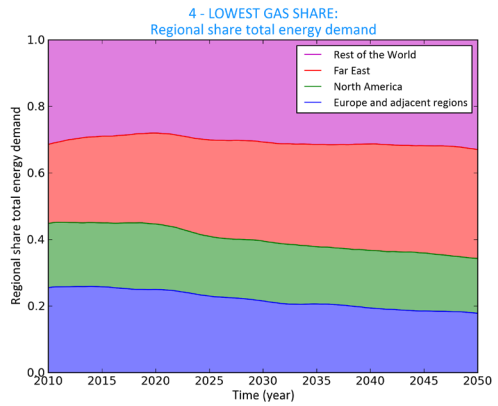


FIGURE 52. ENERGY DEMAND SHARES OF THE REGIONS

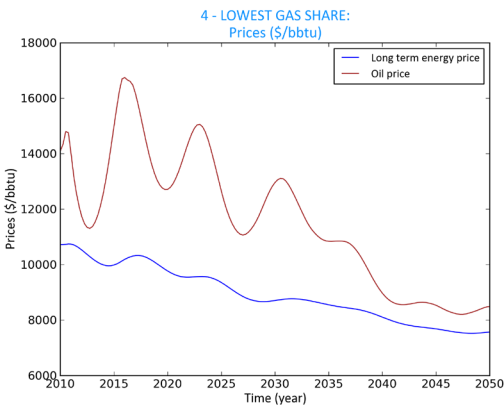


FIGURE 53. OIL AND AVERAGE ENERGY PRICES

Overall energy demand gradually declines until 2050 (see Figure 62). This could be due to a variety of factors, including increased fuel efficiency or slowdowns in economic growth. What stands out from the graph is that this decline becomes less pronounced over time. In relative terms, the share of overall demand of Europe and North America decreases, whereby Europe has the greatest relative decline in energy demand. The Far East on the other hand sees its relative share increase (see Figure 52).

In this scenario, the oil price shows an overall downward trend, indicating less revenue on oil exports (see Figure 53).

Moreover, to make matters worse in terms of budgetary planning, this decline takes place under conditions of considerable volatility. Price shocks are a regular occurrence, whereby a single oscillation takes roughly five years at a time. That said, the bandwidth of these price shocks shrinks over time. This could indicate that supply and demand become better ‘matched’ and situations of (severe) over- or under capacity are avoided.

SCENARIO 5

In this scenario, the share of renewable energy in the energy mix in Europe and its adjacent regions is the highest among all dynamic scenarios.

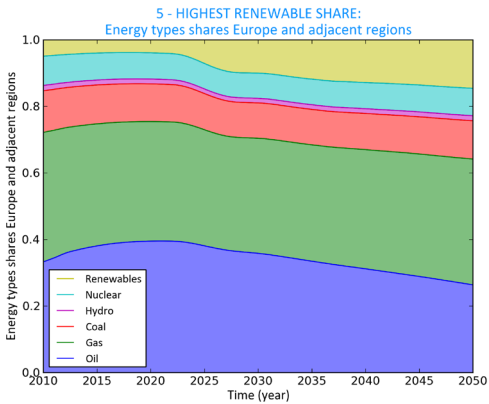


FIGURE 54. STACK GRAPH OF ENERGY INPUT SHARES

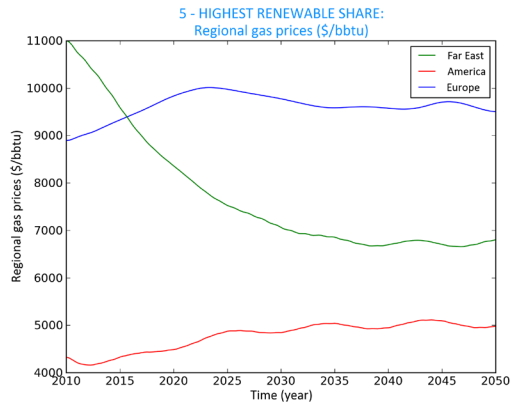


FIGURE 55. PRICES OF NATURAL GAS

In this scenario, the share of oil in the energy mix of Europe and its adjacent regions increases slightly until 2020. After this point in time, the share of oil starts to decline gradually in favor of renewable energy and to a small extent natural gas. The uptake in share is most pronounced with respect to renewable energy.

Natural gas prices in Europe and its adjacent regions increase steadily until 2023, after which a minor decline sets in, causing prices to reach US\$ 9500/bbtu in 2050 (see Figure 55). Until 2030, prices in the Far East fall to far below the European price level. After 2030 they begin to stabilize. This drop in price is best explained by either an influx of additional LNG supplies (possibly from North America, see below) or a rise in demand for competing fuels, such as coal. American natural gas prices experience a steady rise, most likely due to exports.

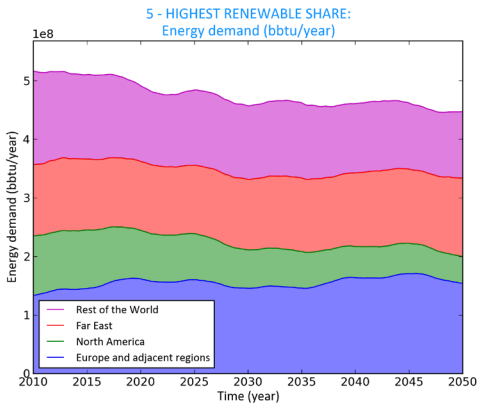


FIGURE 56. ENERGY DEMAND OF THE REGIONS

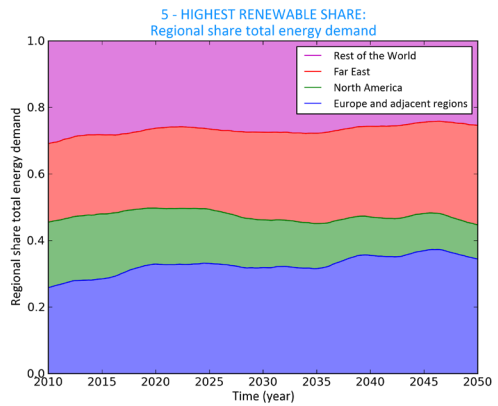


FIGURE 57. ENERGY DEMAND SHARES OF THE REGIONS

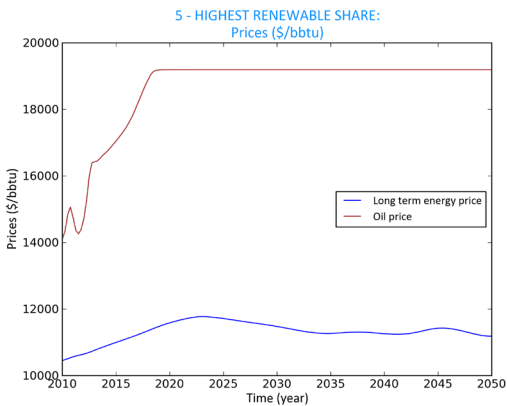


FIGURE 58. OIL AND AVERAGE ENERGY PRICES

Overall energy demand shows a gradual decline until 2050 (see Figure 56). This decline becomes more pronounced between 2020 and 2038. Afterwards, a slight increase in demand can be noticed, which subsequently levels off and declines. Energy demand in Europe increases marginally over the observed period. North American energy demand declines.

In relative terms, the demand share of Europe increases slightly, despite the overall downward trend in energy demand (in absolute terms). The North American demand share decreases to roughly half its

2010 share. The relative share of total energy demand taken up by the Far East increases slightly toward 2050 (see Figure 57).

Roughly similar to scenario 3, the price of oil rises steeply in the period 2013-2020 to around US\$ 19000/bbltu. After 2018, the oil price plateaus at this level causing a period of sustained high oil prices. What can be observed in this scenario is that the increase in the share of renewables coincides with sustained high prices for both natural gas, as well as oil (see Figure 55 and Figure 58).

SCENARIO 6

In this scenario, the share of renewable energy in the energy mix in Europe and its adjacent regions is the lowest among all dynamic scenarios.

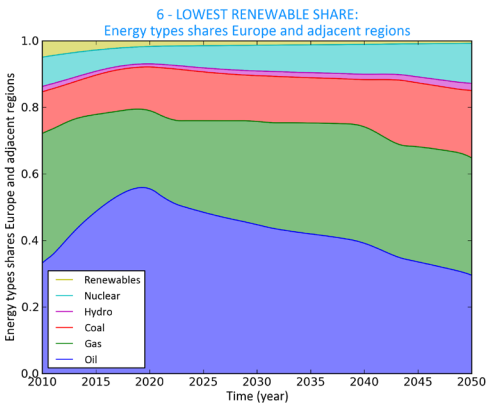


FIGURE 59. STACK GRAPH OF ENERGY INPUT SHARES

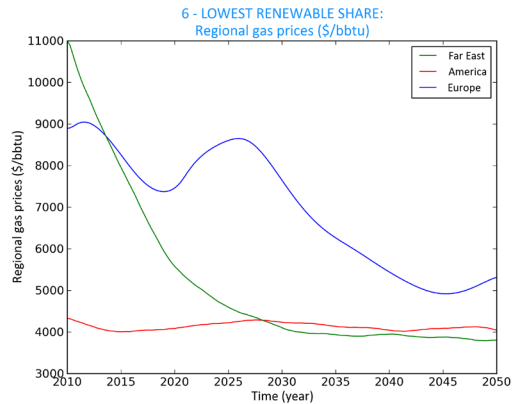


FIGURE 60. PRICES OF NATURAL GAS

In this scenario, the share of oil in the energy mix of Europe and its adjacent regions increases sharply until 2020, mainly at the expense of coal, nuclear and natural gas (see Figure 59). After 2020, the share of oil decreases, in favor of natural gas and coal. Nuclear energy also increases moderately. The share of renewables decreases throughout the entire period.

The natural gas price in Europe and its adjacent regions shows an overall downward trend, however this trend is interrupted by a rise in the price of natural gas in the period 2020-2030. During this period, the price almost reaches its 2010 level. After 2030 however, a sharp decline sets in. The North American natural gas price remains largely unchanged throughout the entire period. The price of natural gas in the Far East drops significantly; undercutting the European gas price around 2014 and the American gas price around 2027 (see Figure 60). This is largely due to a drop in overall energy demand (see Figure 61).

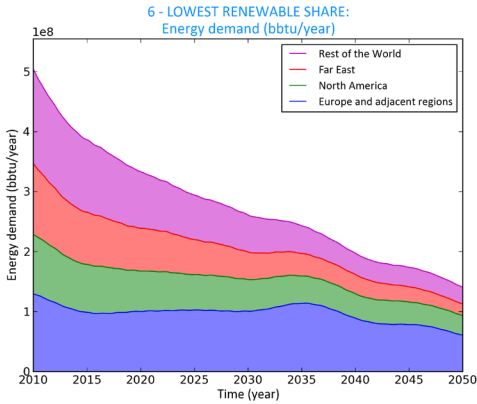


FIGURE 61. ENERGY DEMAND OF THE REGIONS

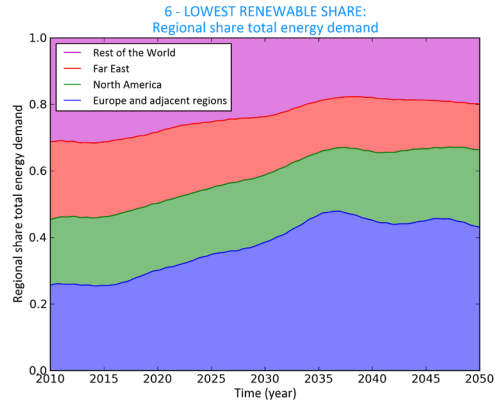


FIGURE 62. ENERGY DEMAND SHARES OF THE REGIONS

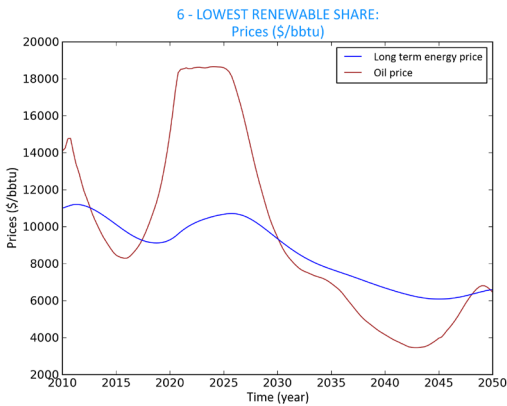


FIGURE 63. OIL AND AVERAGE ENERGY PRICES

In this scenario, overall energy demand declines decisively, to less than half of its 2010 value by 2050 (see Figure 61). This could be explained by increases in fuel efficiency or slowdowns in economic growth. In relative terms, there is also a redistribution of demand shares taking place (see Figure 62), whereby the European share of overall energy demand increases from 2015 until 2050. The share of the Far East in overall energy demand on the other hand decreases slightly. The North American share remains virtually unchanged.

The oil price drops initially from 2010 until 2016 to about half its 2010 value (see Figure 63). From 2016 onwards, the price rises sharply and more than doubles compared to its 2016 value, subsequently reaching a plateau of over US\$ 18000/bbltu between 2020 and 2026. However, after 2026, the price of oil drops considerably reaching a low point of less than US\$ 4000/bbltu in 2043.

SCENARIO 7

In this scenario, the share of oil in the energy mix in Europe and its adjacent regions is the highest among all dynamic scenarios.

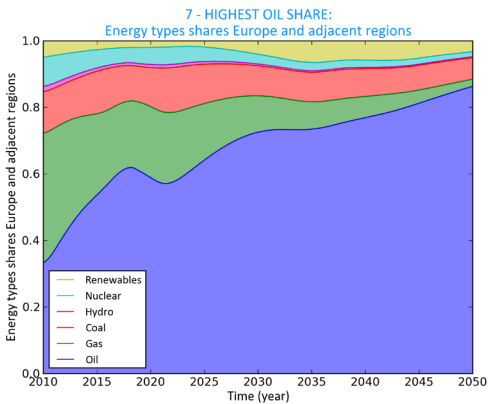


FIGURE 64. STACK GRAPH OF ENERGY INPUT SHARES

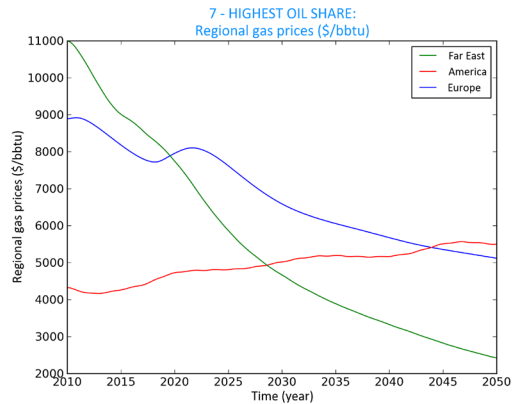


FIGURE 65. PRICES OF NATURAL GAS

In this scenario, the share of oil in the energy mix of Europe and its adjacent regions picks up from 2010 onwards at the expense of all other fuel types (see Figure 64). Only in the period 2015-2020 does the share of oil in the energy mix decline in favor of natural gas, coal and to some extent nuclear energy. This however turns around again from 2022 onwards, whereby the oil share keeps growing steadily.

This high share of oil is reflected in the natural gas price in Europe and its adjacent regions, which shows a steady downward trend throughout the entire period (see Figure 65). Interestingly, in the Far East, the price of natural gas drops much more decisively than it does in Europe and shows no signs of slowing down, even after 2050. In its path, it undercuts both the European, as well as the North American gas price by a considerable margin. The downward trends in both regions could on the one hand be explained due to a drop in overall energy demand (see Figure 66), and by a gradual decline in the price of oil after 2020 (see Figure 68). The natural gas price in North America increases gradually. This steady increase in the price of natural gas is likely caused by an increase in the amount of LNG exported, as well as by an increase in American energy demand (see Figure 66).

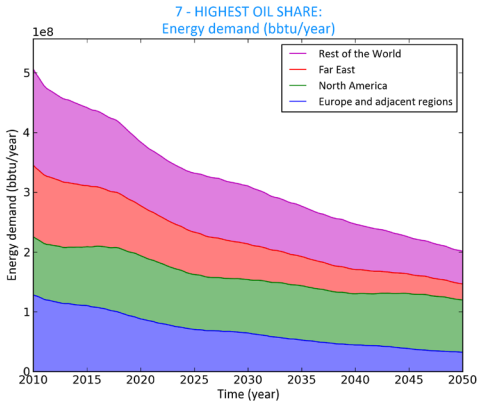


FIGURE 66. ENERGY DEMAND OF THE REGIONS

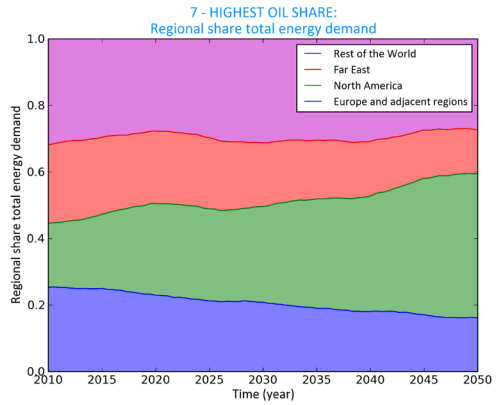


FIGURE 67. ENERGY DEMAND SHARES OF THE REGIONS

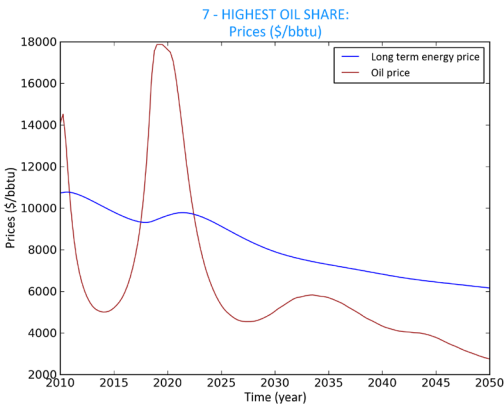


FIGURE 68. OIL AND AVERAGE ENERGY PRICES

Overall energy demand shows a downward trend for all regions (see Figure 66). This reduction in demand is most pronounced in the Far East and in Europe and its adjacent regions. Energy demand in North America increases however. In relative terms, North America equally sees the greatest increase in its share of total energy demand measures across all regions (see Figure 67). The relative share of the Far East and Europe on the other hand declines.

The oil price declines sharply between 2010 and 2015, only to skyrocket immediately thereafter, reaching its absolute peak in 2020 at US\$ 18000/bblu (see Figure 68). The price of oil subsequently falls sharply to below its 2015 value by 2025.

SCENARIO 8

In this scenario, the share of LNG imports in the energy mix in Europe and its adjacent regions is the highest among all dynamic scenarios.

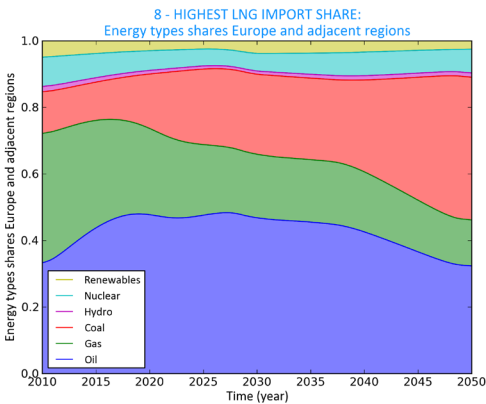


FIGURE 69. STACK GRAPH OF ENERGY INPUT SHARES

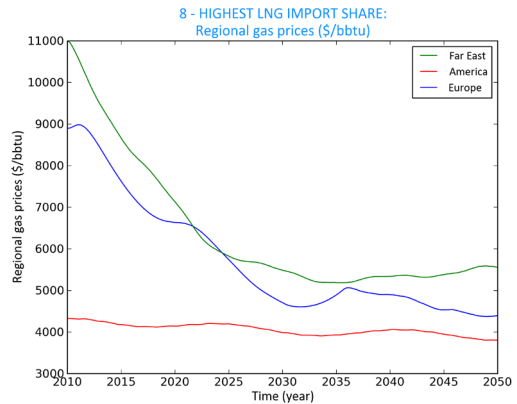


FIGURE 70. PRICES OF NATURAL GAS

In this scenario, the share of oil in the energy mix of Europe and its adjacent regions shows a steady increase until 2027, after which it starts to gradually decline (see Figure 69). The initial increase in oil share comes mainly at the expense of natural gas. The share of coal starts to expand after 2020, equally at the expense of natural gas. Renewables and nuclear energy play a minimal role throughout the entire period.

The decline in the share of natural gas in favor of coal in the long term is reflected in the natural gas price in Europe, which shows a clear downward trend throughout the entire period, reaching approximately US\$ 4300/bbtu by 2050 (Figure 70). The natural gas price in the Far East drops with a similar pace and even temporarily undercuts the European price between 2022 and 2024, after which it starts to stabilize and gradually climb to roughly US\$ 5700/bbtu by 2050. The American natural gas price remains largely unchanged throughout the entire period.

What stands out from Figure 70 is the decline in natural gas prices in Europe and the Far East by 2050 to roughly half their 2010 level.

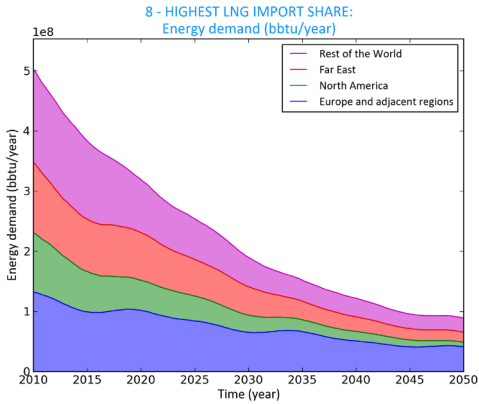


FIGURE 71. ENERGY DEMAND OF THE REGIONS

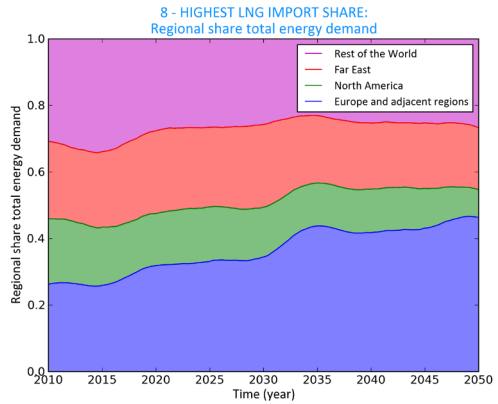


FIGURE 72. ENERGY DEMAND SHARES OF THE REGIONS

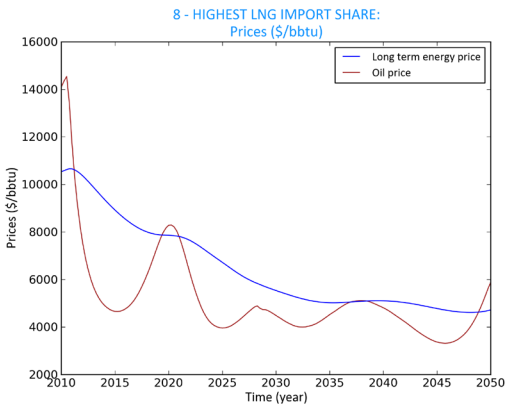


FIGURE 73. OIL AND AVERAGE ENERGY PRICES

The drop in natural gas prices witnessed in Europe and its adjacent regions, as well as in the Far East should also be seen in light of an overall drop in energy demand across all regions over time (see Figure 71). Despite an overall decrease in energy demand, the relative demand share of Europe increases relative to that of other regions. In the Far East, as well as in North America the relative share of energy demand decreases (see Figure 72).

The price of oil also shows a downward trend similar to that of the price of natural gas in Europe and the Far East (see Figure 73). Between 2010 and 2015 we observe a sharp decline in the price of oil to less than a quarter of its 2010 value at a little over US\$ 4200/bbtu in 2015. After 2015, the price starts to recover and almost doubles by 2020, only to drop again thereafter to just under its 2015 value.

In the decades that follow, price shocks become less pronounced and there is a gradual downward trend. Beyond 2045 however, oil prices begin to rise substantially again.

SCENARIO 9

In this scenario, the share of LNG imports in the energy mix in Europe and its adjacent regions is the lowest among all dynamic scenarios.

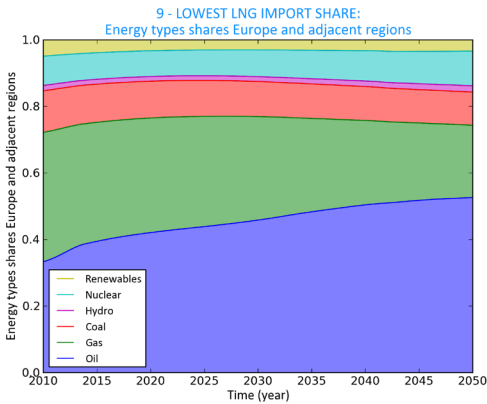


FIGURE 74. STACK GRAPH OF ENERGY INPUT SHARES

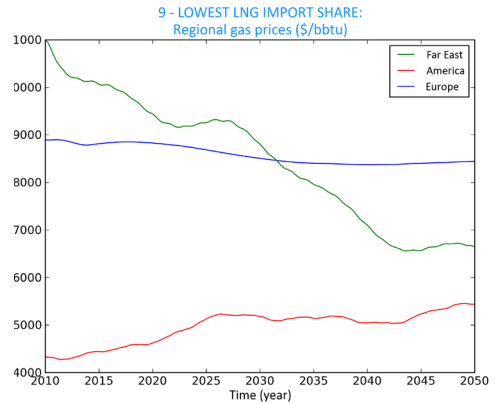


FIGURE 75. PRICES OF NATURAL GAS

In this scenario the share of oil steadily increases in the energy mix of Europe and its adjacent regions. This increase comes mainly at the expense of natural gas. Coal, renewables, nuclear energy and hydro remain largely unchanged throughout the entire period (see Figure 74).

The lowering of the share of natural gas in favor of oil is only marginally visible in the natural gas price in Europe, which shows a minimal decline over time (see Figure 75). The price of natural gas in the Far East also shows a downward trend, though at a much faster rate than in Europe. In its path, the Far Eastern price appears to converge to the North American price level, firmly undercutting the European price. This could be due to the adoption of greater fuel efficiency standards or an increase in the supply of natural gas to the Asian market. The natural gas price in North America shows a gradual upward trend, most likely due to an increase in LNG exports.

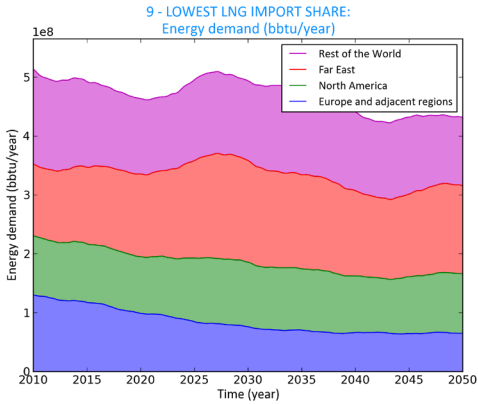


FIGURE 76. ENERGY DEMAND OF THE REGIONS

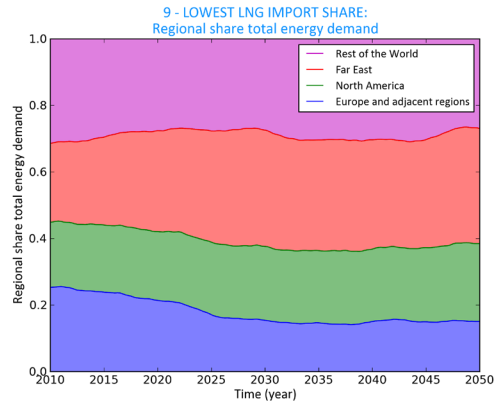


FIGURE 77. ENERGY DEMAND SHARES OF THE REGIONS

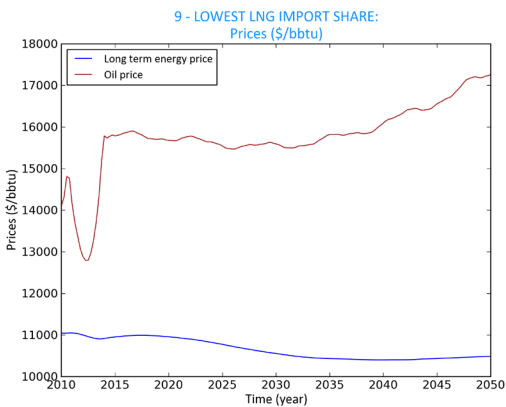


FIGURE 78. OIL AND AVERAGE ENERGY PRICES

Overall energy demand drops slightly in the period 2010-2050, yet there is quite some degree of volatility. In Europe and its adjacent regions, demand gradually declines. A similar pattern can be observed in North America. In the Far East, demand increases from 2010 until 2030, after which a gradual decline sets in (see Figure 76).

Despite a drop in overall demand in absolute terms, the relative share of overall energy demand taken up by the Far East expands in the observed period. Europe on the other hand sees its share decline. North America's share remains largely unchanged.

A sharp decline in the price of oil from 2011 until 2013/14 notwithstanding, the actual change in price remains limited to approximately US\$ 1000/bblu below its 2010 value (see Figure 78). The oil price subsequently rises to just under US\$ 16000/bblu and plateaus between 2015 and 2030 with some degree of volatility. A gradual increase can be discerned after 2030.

PRICE VOLATILITY SCENARIOS

The following five scenarios (10-14) represent scenarios in which the observed volatility of the natural gas price was the highest among all dynamic scenarios.

SCENARIO 10

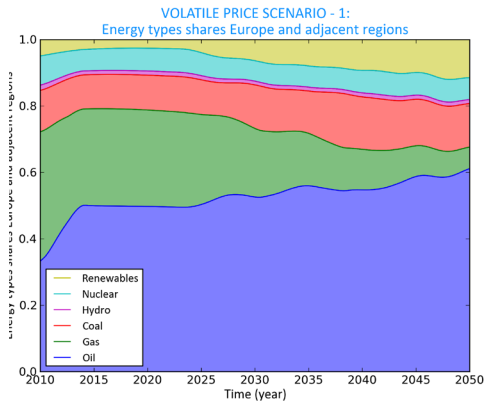


FIGURE 79. STACK GRAPH OF ENERGY INPUT SHARES

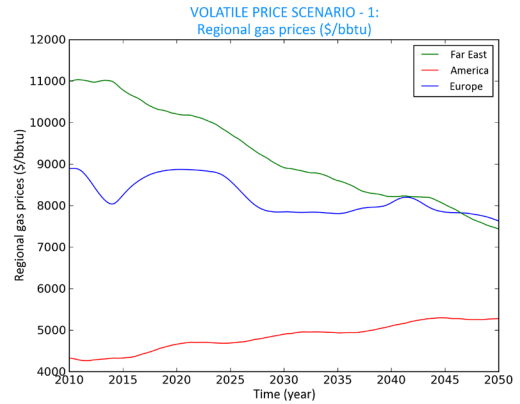


FIGURE 80. PRICES OF NATURAL GAS

In this scenario, the share of oil and coal steadily increase in the energy mix of Europe and its adjacent regions. This increase comes mainly at the expense of natural gas. Renewables grow only slightly over time. The shares of nuclear energy and hydro remain largely unchanged throughout the entire period (see Figure 79).

The natural gas price in Europe hovers between US\$ 8000 and US\$ 9000/bbtu throughout the observed period. It does so with some degree of volatility (hinting at the expansion of natural gas spot markets, see section 5.1), however the bandwidth (at US\$ 1000/bbtu) can be called narrow (see Figure 80).

That said, the gradual decline of the natural gas price in the Far East is in fact a cause for concern for those (state) energy companies who have invested heavily in Asian gas exports. The price declines gradually throughout the entire period, going from US\$ 11000/bbtu in 2010 to just below US\$ 8000/bbtu in 2050, thus converging to European level pricing. This drop in price is likely caused by either an influx of additional LNG supplies (for example from the US; see below), or a decline in natural gas demand caused by changes in the price of competing fuels. The North American natural gas price shows a marginal upward trend, most likely caused by an increase in LNG exports. These exports could be oriented towards Asia, thus (partly) explaining the drop in natural gas price observed in the Far East.

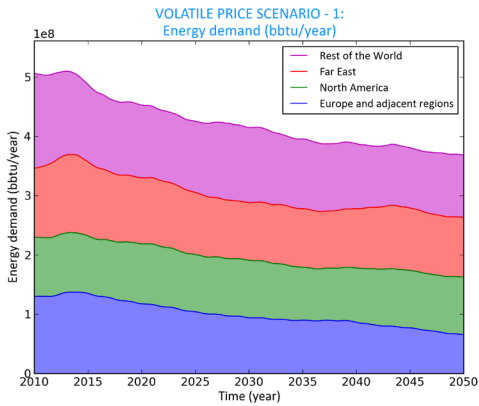


FIGURE 81. ENERGY DEMAND OF THE REGIONS

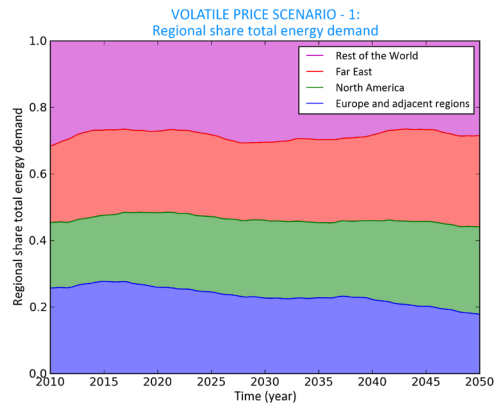


FIGURE 82. ENERGY DEMAND SHARES OF THE REGIONS

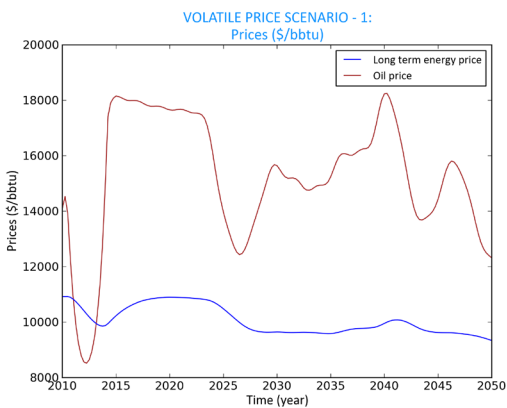


FIGURE 83. OIL AND AVERAGE ENERGY PRICES

Overall energy demand drops slightly throughout the observed period. Demand in Europe and its adjacent regions gradually declines. Energy demand in the Far East and North America remains largely unchanged (see Figure 81).

Despite a drop in overall energy demand in absolute terms, the relative share taken up by the Far East expands in the observed period. Whereas, the relative share of Europe drops slightly and that of the rest of the world and North America remains largely unchanged (see Figure 82).

The oil price shows a high degree of volatility in the observed period, particularly after 2025 (see Figure 83). Initially, the price of oil price plummets from just over US\$ 14000/bbtu in 2010 to less than half this value in 2013/14.

The oil price rises sharply thereafter. It subsequently plateaus around US\$ 18000/bbtu in the period 2015-2023, showing only a marginal decline throughout this period. From 2024 onwards until 2050 however considerable volatility can be observed as the oil price reaches both its 2015 peak, as well as dives below its 2010 value. A clear general upward or downward trend cannot be discerned and price volatility is high.

SCENARIO 11

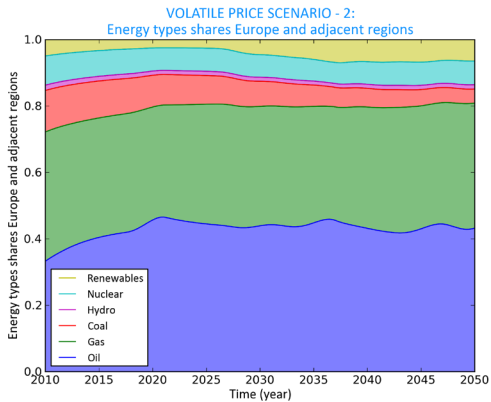


FIGURE 84. STACK GRAPH OF ENERGY INPUT SHARES

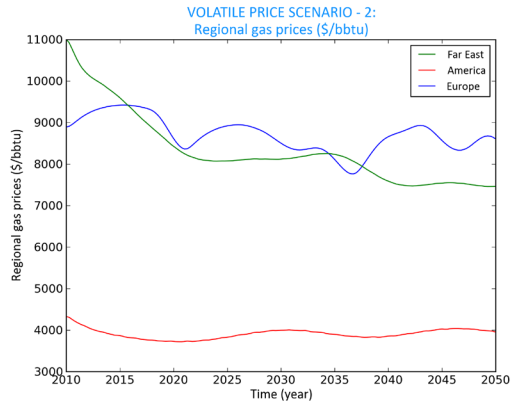


FIGURE 85. PRICES OF NATURAL GAS

In this scenario, the share of coal in the energy mix of Europe and its adjacent regions declines gradually over time in favor of oil and natural gas (see Figure 84). Similar to scenario 10, natural gas prices in Europe remain largely consistent and hover along a narrow bandwidth between US\$ 9000/bbtu and US\$ 8000/bbtu. In this scenario, price volatility is more pronounced however, with more frequent price swings occurring throughout the observed period. In this scenario it is therefore more likely that a greater share of natural gas contracts is based on spot pricing (see also section 5.1). Nevertheless, fact remains that also here the bandwidth stays narrow.

The natural gas price in the Far East shows a gradual decline from 2010 until 2050, converging toward and even undercutting the European price. Similar to scenario 10, this gradual drop in price can be a cause for concern for those energy companies who have invested heavily in Asian gas exports. The North American natural gas price remains stable, hovering around its 2010 level of roughly US\$ 4200/bbtu throughout the observed period with minimal volatility.

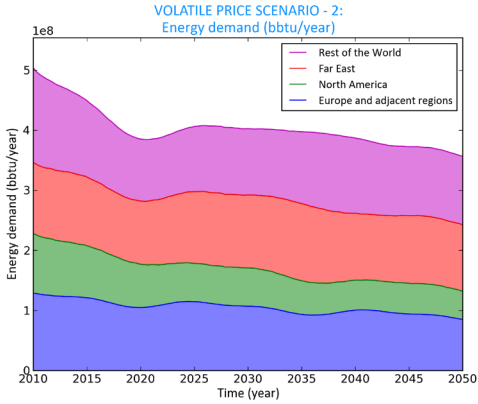


FIGURE 86. ENERGY DEMAND OF THE REGIONS

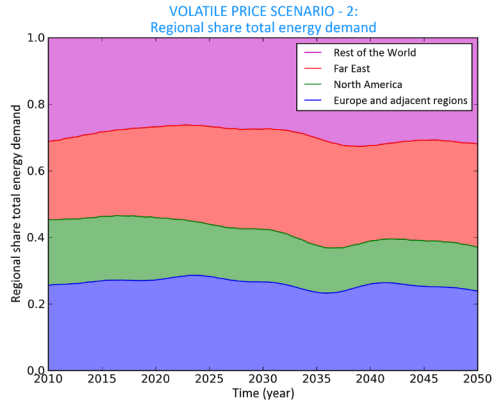


FIGURE 87. ENERGY DEMAND SHARES OF THE REGIONS

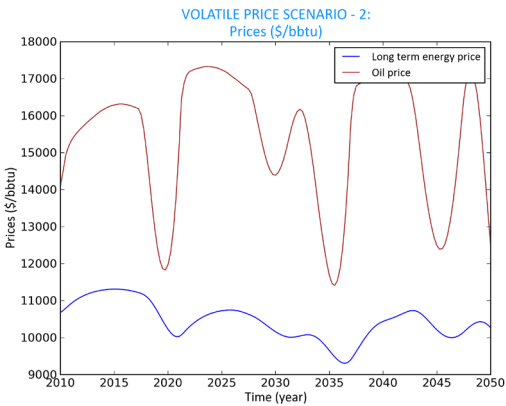


FIGURE 88. OIL AND AVERAGE ENERGY PRICES

Overall energy demand shows a decline throughout the observed period. Energy demand in North America contracts slightly. Demand in Europe and its adjacent regions remains largely unchanged and the Far East experiences a marginal expansion (see Figure 86). The relative share of total energy demand in the observed period expands in the Far East and contracts slightly in North America. The share taken up by Europe and its adjacent regions remains largely unchanged (see Figure 87).

The oil price shows a high degree of volatility (see Figure 88). The price consistently oscillates between roughly US\$ 17000/bbltu and US\$ 12000/bbltu throughout the observed period. Price shocks are significant and frequent.

SCENARIO 12

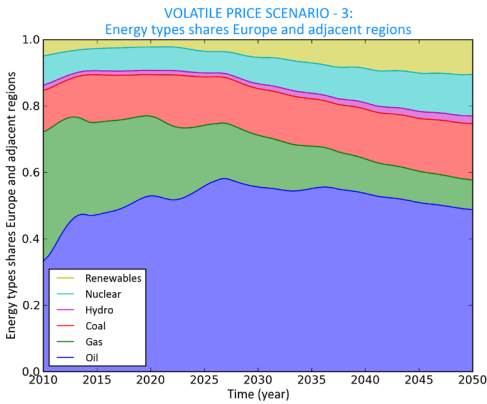


FIGURE 89. STACK GRAPH OF ENERGY INPUT SHARES

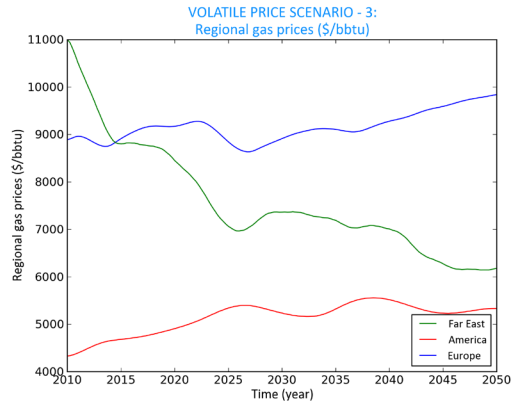


FIGURE 90. PRICES OF NATURAL GAS

In this scenario, the share of oil in the energy mix of Europe and its adjacent regions increases gradually until 2025. This increase comes mainly at the expense of natural gas. After 2025, the share of coal shows a marginal increase, but nuclear energy and renewables in particular reduce the share of natural gas even further (see Figure 89).

Interestingly, the decline in the share of natural gas in the energy mix is not reflected in the natural gas price in Europe. Instead the price exerts a gradual upward trend (10% increase compared to initial value) with only limited volatility (see Figure 90). Volatility is much less pronounced than in the previous scenario, possibly indicating that a smaller share of natural gas contracts is based on spot pricing (see also section 5.1). Since the rise in price is not caused by a greater demand for natural gas in Europe (see Figure 90 and Figure 91), an alternative explanation could be constraints on the supply side, whereby natural gas exports are oriented to markets other than Europe.

The price of natural gas in the Far East shows a decline throughout the entire period, going from US\$ 11000/bbtu to roughly US\$ 6500/bbtu in 2050 and undercutting the European price in its path (see Figure 90). This could be an indication of oversupply in the market, caused by an additional

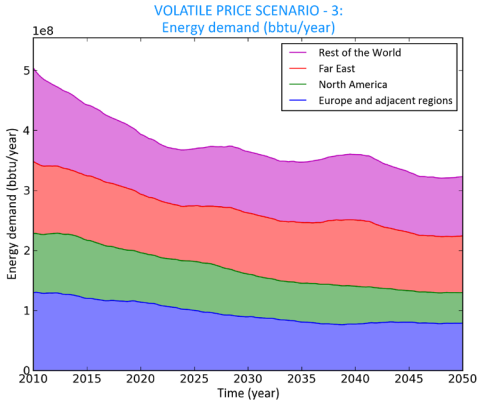


FIGURE 91. ENERGY DEMAND OF THE REGIONS

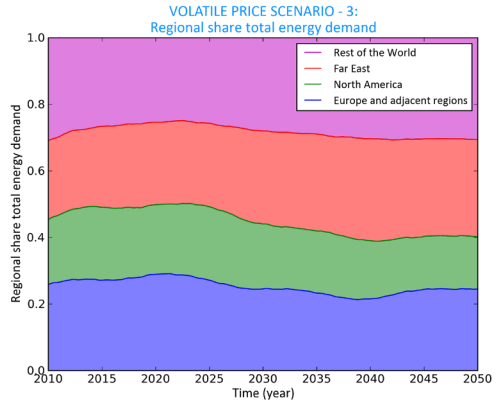


FIGURE 92. ENERGY DEMAND SHARES OF THE REGIONS

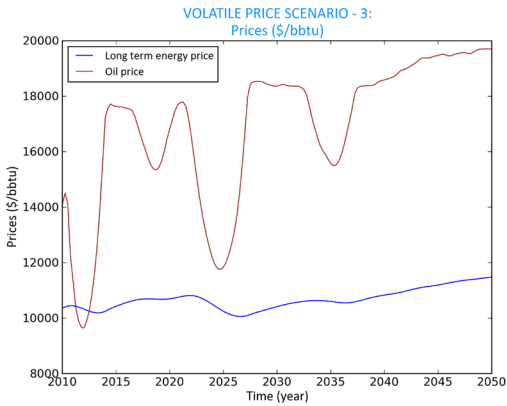


FIGURE 93. OIL AND AVERAGE ENERGY PRICES

influx of LNG supplies. The American natural gas price shows a marginal increase throughout the observed period, possibly hinting at greater exports and contributing to price convergence between the US' and Asian market.

Overall energy demand declines throughout the observed period (see Figure 91). In relative terms, the North American share of total energy demand contracts slightly. In Europe change is minimal and the Far East sees its share expand by roughly the same margin as the US' share declines.

The oil price shows considerable volatility (see Figure 93). Price shocks occur regularly throughout the entire period. Deep plunges are subsequently followed by a steep rise in the price of oil. In the long term the price of oil shows an increase, though coupled with some heavy downward volatility.

SCENARIO 13

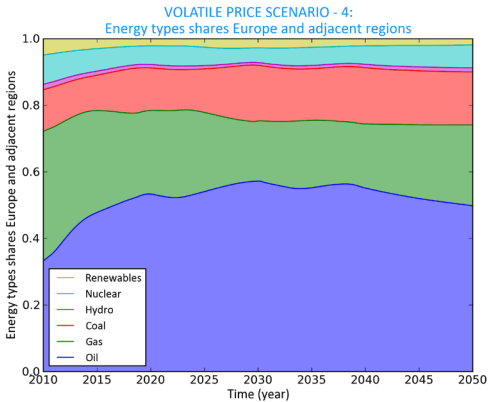


FIGURE 94. STACK GRAPH OF ENERGY INPUT SHARES

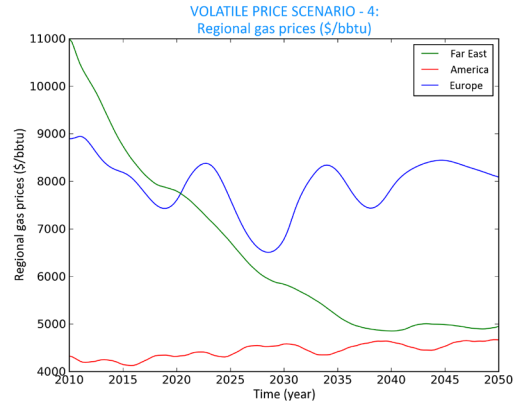


FIGURE 95. PRICES OF NATURAL GAS

In this scenario, the share of oil in the energy mix of Europe and its adjacent regions gradually increases until 2040, after which it experiences a gradual decline (see Figure 94). The expansion of oil comes at the expense of natural gas, which contracts slightly throughout the observed period. Coal on the other hand shows a small increase. The shares of renewables, nuclear energy and hydro remain largely unchanged.

The price of natural gas in Europe and its adjacent regions declines during the first decades, with some volatility. During the last decades, the price increases again to a level still under the present price (see Figure 95). In this scenario, it is likely that a large share of gas contracts in Europe is based on spot pricing (see also section 5.1). The bandwidth in which the price swings occur is slightly larger than in the previous scenarios, oscillating between just under US\$ 9000/bbtu and roughly US\$ 6800/bbtu. The natural gas price in the Far East experiences a rapid decline virtually throughout the entire period before it levels off at roughly US\$ 5000/bbtu around 2038 – less than half of its 2010 value of US\$ 11000/bbtu. In contrast to the price developments in Europe and the Far East, does the natural gas price in North America experience only a small gradual increase, with only minor volatility.

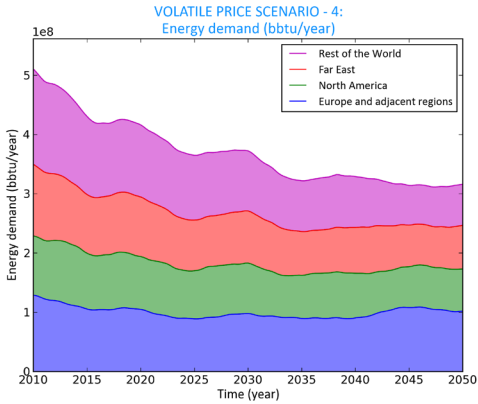


FIGURE 96. ENERGY DEMAND OF THE REGIONS

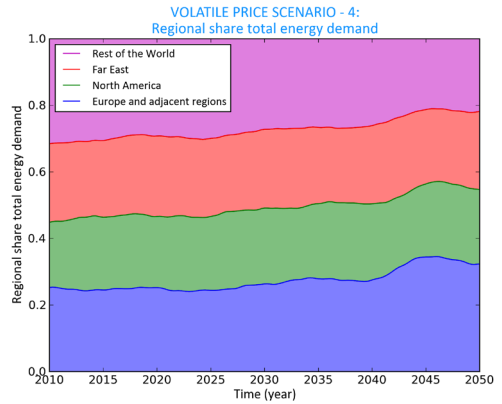


FIGURE 97. ENERGY DEMAND SHARES OF THE REGIONS

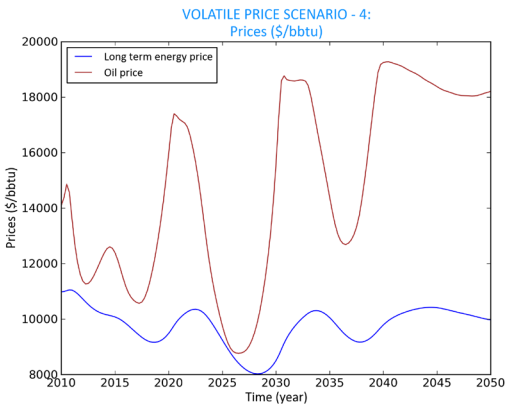


FIGURE 98. OIL AND AVERAGE ENERGY PRICES

Overall energy demand shows a downward trend (see Figure 97). Energy demand in the Rest of the World sees the largest contraction compared to the other regions. Whereas the Far East sees its energy demand diminish only slightly, demand remains largely unchanged in Europe and North America. In relative terms, the picture is largely similar, with few changes taking place. What stands out is the small decline in relative demand share of the Rest of the World and the minor increase in the share which Europe takes up (see Figure 97).

The oil price exerts a high degree of volatility in this scenario (see Figure 98). With a peak at around US\$ 19000/bbtu and a low point of under US\$ 10000/bbtu, the bandwidth can be called considerable. Moreover, significant price shocks are a regular occurrence, taking place almost continuously. In the last decades the oil price seems to stabilize at a higher price level compared to present prices.

SCENARIO 14

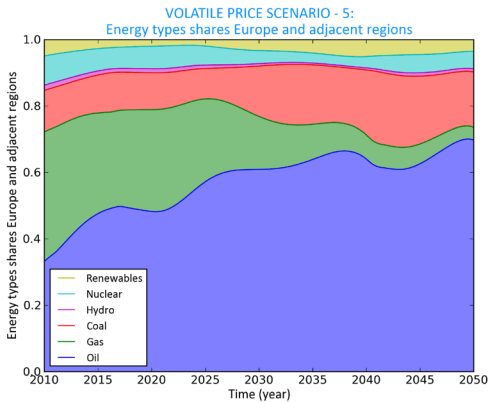


FIGURE 99. STACK GRAPH OF ENERGY INPUT SHARES

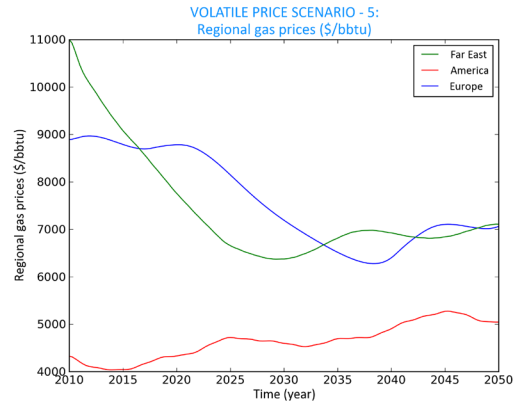


FIGURE 100. PRICES OF NATURAL GAS

In this scenario, the share of oil in the energy mix of Europe and its adjacent regions increases rapidly over the observed period (see Figure 99). The increase in the share of oil comes mainly at the expense of natural gas. The share of coal also increases, thus further amplifying the ‘squeeze’ on natural gas. Renewables, nuclear energy and hydro remain largely unchanged.

This reduction in the share of natural gas in Europe’s energy mix is reflected in the price for natural gas. The natural gas price in Europe and its adjacent regions shows an overall downward trend (see Figure 100). The decline in the price of natural gas in Europe is most pronounced during the period 2020-2037. Price volatility is rather low however. From 2037 onwards, the European price starts to increase again, leveling out at just over US\$ 7000/bbtu by 2050; down from just under US\$ 9000/bbtu in 2010. The natural gas price in the Far East, although initially much higher, declines rapidly until it picks up again around 2030 and reaches roughly US\$ 7000/bbtu by 2050. The natural gas price in North America shows a marginal increase throughout the observed period, climbing from around US\$ 4300/bbtu in 2010 to just under US\$ 5000/bbtu by 2050. This increase is most likely caused by an increase in LNG exports.

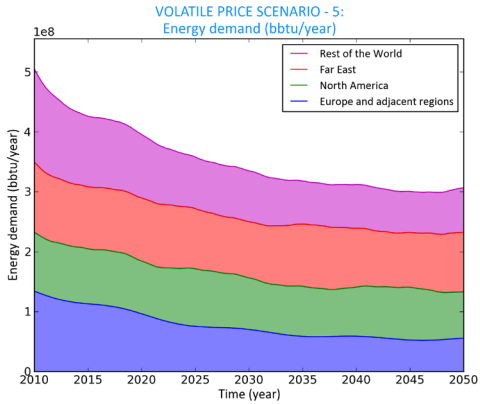


FIGURE 101. ENERGY DEMAND OF THE REGIONS

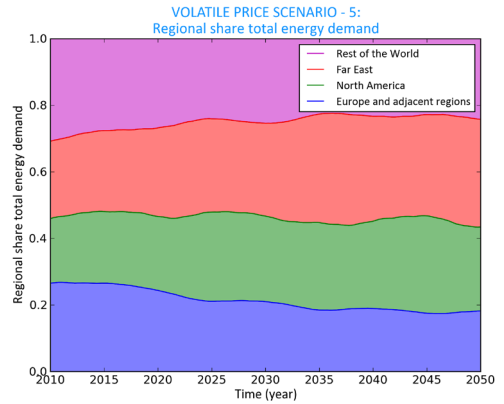


FIGURE 102. ENERGY DEMAND SHARES OF THE REGIONS

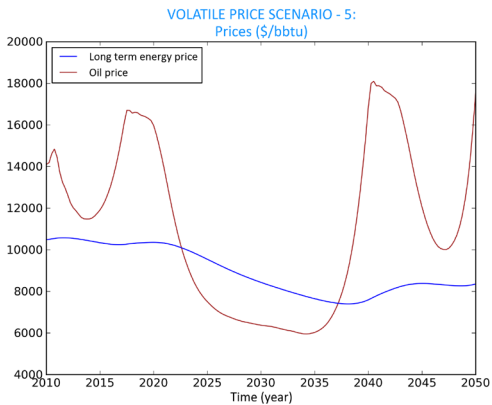


FIGURE 103. OIL AND AVERAGE ENERGY PRICES

Overall energy demand shows a downward trend (see Figure 101). Energy demand in Europe and its adjacent regions contracts the most out of all regions considered. Energy demand in the Far East and North America remains largely unchanged throughout the entire period. Demand in the rest of the world shows a slight decline. In relative terms, the Far East sees its share of total energy demand increase, at the expense of Europe and the Rest of the World. The share taken up by North America increases slightly in the observed period (see Figure 102).

The oil price shows a number of fluctuations throughout the observed period (see Figure 103). Of interest is the relatively long 'intermezzo' of low prices between 2025 and 2035 which is both preceded and succeeded by a price shock. Observable from this scenario therefore is that when the oil price fluctuates, it tends to do so strongly and suddenly.

ANNEX 4: IMPACT ON TRADITIONAL HYDROCARBON- EXPORTING COUNTRIES

As explained in the introduction and in Chapter 6 this study focuses on the extent to which shale gas extraction could potentially lead to socio-political unrest in traditional hydrocarbon exporting countries. Countries which are assessed are Russia, Algeria, Egypt, Qatar, Saudi Arabia, Azerbaijan, and Kazakhstan. Given that Northwestern Europe is equally home to several large natural gas producing countries (i.e., the Netherlands, Norway and the United Kingdom), and thus may also see its export revenues affected by the development of shale gas, Northwestern Europe is also included in the model analysis.

In order to obtain the correct data for each country and parameter, 2010 was chosen as the year on which to base the analysis. This was the most recent year available for which we could provide a complete set of data. This Annex consists of three sections. Section one provides an overview of a selected number of initial conditions in all of the analyzed countries. Section two analyzes the dynamics behind each scenario and how these have affected the countries within the study. Section three finally provides a full graphical overview of the effects on internal stability within the selected countries for each individual price scenario.

INITIAL CONDITIONS

The impact of the price scenarios on the stability within a country depends to a large extent on the initial conditions within the country in question. For example, it makes intuitive sense that an oil price decrease will impact less negatively (in terms of instability) on a region such as Northwest Europe than it does on the Middle East given the former's lower dependence on oil revenues and greater economic diversification and the inverse of this situation in the latter region. The analysis conducted in the country stability model comprises a wide range of variables (see section 4.4). However, it would go beyond the scope of this annex to discuss every single variable

up front. For this reason, this section is limited to a selection of initial conditions we deem important in measuring the impact of the price scenarios discussed in the report. For each country we briefly discuss the extent to which it is endowed with conventional oil and/or natural gas reserves, the ratio between natural gas and oil extraction capacity (production) out of total fuel extraction capacity (i.e., the relative exposure to price shocks), its GDP per capita, the level of youth unemployment (a key indicator of popular resentment), the share of resource rents within a country's GDP, and finally whether a country can be classified as a democracy, autocracy or anocracy.²⁷⁰

ALGERIA

Algeria is home to significant oil reserves. Oil reserves measured just over 30% of total fuel reserves, at 12.2 Thousand Million Barrels (TMB) at the end of 2010.²⁷¹ Its natural gas reserves constitute a much larger share of total fuel reserves (just under 70%, at 159.1 Tcf at the end of 2010).²⁷² Despite having greater gas than oil reserves, initial oil extraction capacity took up

270 Resource rents were obtained by multiplying the annually available extraction capacity of a country with the price of fuels (oil and natural gas) and dividing the outcome by the GDP. The resultant resource rents as a share of GDP indicate the extent to which a country is reliant on the income generated by fuel exports. It should be pointed out, however, that for a number of reasons this value may be lower in reality. First, the available extraction capacity is rarely used in full. Second, data on both energy production and GDP could prove unreliable at times. Third, not all (bilateral) energy trade takes place against market prices. Geopolitical considerations frequently come into play which could be reflected in a lower price, thus rendering the values used in this study too high. However, this does not distort the analysis. In this study we look at changes in intra-state stability that occur as a result of the various price scenarios, relative to a reference scenario consisting of stable natural gas and oil prices. The distinction between whether a country can be qualified as an autocracy, democracy or anocracy is based on the Polity IV score of the Center for Systemic Peace which ranges from -10 to +10. Countries which score between -10 and -6 are classified as an autocracy. Countries which score between -6 and +6 are qualified as an anocracy. Finally, countries which score between +6 and +10 are classified as a democracy. See 'Polity IV Project: Home Page.' Results from the Polity IV scores are complemented by insights from the HCSS Strategic Monitor where appropriate.

271 *BP Statistical Review of World Energy 2010* (BP, June 2010), 6.

272 *Ibid.*, 6 and 22.

57% of total fuel production in 2010 compared to 43% for natural gas.²⁷³ Although the difference is small, Algeria is thus relatively more exposed to changes in the price of oil than natural gas. GDP per capita stood at just over US\$ 4533 in 2010.²⁷⁴ Youth unemployment levels reached 18.7% in the same year.²⁷⁵ Resource rents comprised 45% of Algeria's GDP in 2010.²⁷⁶ With a Polity IV score of 2.0 Algeria can be qualified as an anocracy.²⁷⁷

AZERBAIJAN

Azerbaijan was home to 7 TMB of oil reserves and 46.35 Tcf of natural gas at the end of 2010. The share of oil out of total fuel resources is far greater in Azerbaijan, at 78%, compared to a mere 22% for natural gas.²⁷⁸ This is reflected in the fuel extraction capacity, where the share of oil extraction capacity stood at 80% in 2010 compared to 20% for natural gas.²⁷⁹ As such Azerbaijan is more exposed to changes in the price of oil than in the price of natural gas. GDP per capita stood at just over US\$ 5709 in 2010.²⁸⁰ Youth unemployment levels reached 17.3% in 2010.²⁸¹ Resource rents comprised 63% of Azerbaijan's GDP in 2010.²⁸² With a Polity IV score of -7.0 Azerbaijan can be qualified as an autocracy.²⁸³

EGYPT

Egypt possessed 77.3 Tcf of natural gas and 4.4 TMB of oil reserves at the end of 2010. The ratio of natural gas reserves to oil reserves out of total fuel

273 Ibid., 8 and 24.

274 The International Monetary Fund, 'World Economic Outlook Database April 2012,' April 2012, <http://www.imf.org/external/pubs/ft/weo/2012/01/weodata/index.aspx>.

275 'Unemployment, Youth Male (% of Male Labor Force Ages 15-24),' *The World Bank*, 2012, <http://data.worldbank.org/indicator/SL.UEM.1524.MA.ZS>.

276 Author's own calculations.

277 'Polity IV Regime Trends: Algeria, 1962-2010,' *Center for Systemic Peace*, 2011, <http://www.systemicpeace.org/polity/alg2.htm>; Bekkers et al., *De Toekomst in Alle Staten - HCSS Strategische Monitor 2013*, 23.

278 *BP Statistical Review of World Energy 2010*, 6 and 22.

279 Ibid., 8 and 24.

280 The International Monetary Fund, 'World Economic Outlook Database April 2012.'

281 'Unemployment, Youth Male (% of Male Labor Force Ages 15-24).'

282 Author's own calculations.

283 'Polity IV Regime Trends: Azerbaijan, 1991-2010,' *Center for Systemic Peace*, 2011, <http://www.systemicpeace.org/polity/aze2.htm>.

resources stood at 3:1.²⁸⁴ Initial natural gas extraction capacity took up 58% of total fuel extraction capacity in 2010, compared to 42% for oil.²⁸⁵ As such, Egypt is much more exposed to fluctuations in the price of natural gas than it is to oil price swings. Having said that, it should be pointed out that the oil price per energy content is much higher than the natural gas price, meaning that even though the share of oil extraction is lower than that of natural gas, the revenues generated through oil sales still matter a great deal to the country's GDP. GDP per capita stood at just over US\$ 2808 in 2010.²⁸⁶ Youth unemployment levels reached 14.7% in the same year.²⁸⁷ Resource rents comprised 16% of Egypt's GDP in 2010.²⁸⁸ With a Polity IV score of -4.0 Egypt can be qualified as an anocracy.²⁸⁹

KAZAKHSTAN

Kazakhstan held 39.8 TMB of oil and 64.4 Tcf of natural gas reserves at the end of 2010. The share of oil reserves out of total fuel resources stood at 78% in 2010, compared to 22% for natural gas.²⁹⁰ This is reflected in the initial fuel extraction capacity in 2010 which measured 75% for oil, against 25% for natural gas.²⁹¹ Exposure to oil price swings represents thus a greater risk to Kazakhstan than do changes in the price of natural gas. GDP per capita reached just over US\$ 9069 in 2010.²⁹² Youth unemployment stood at 4.8% in the same year.²⁹³ Resource rents comprised 37% of Kazakhstan's GDP in 2010.²⁹⁴ With a Polity IV score of -6.0 Kazakhstan can be qualified as an autocracy.²⁹⁵

284 *BP Statistical Review of World Energy 2010*, 6 and 22.

285 *Ibid.*, 8 and 24.

286 The International Monetary Fund, 'World Economic Outlook Database April 2012.'

287 'Unemployment, Youth Male (% of Male Labor Force Ages 15-24).'

288 Author's own calculations.

289 'Polity IV Regime Trends: Egypt, 1946-2010,' *Center for Systemic Peace*, 2011, <http://www.systemicpeace.org/polity/egy2.htm>; Bekkers et al., *De Toekomst in Alle Staten - HCSS Strategische Monitor 2013*, 23.

290 *BP Statistical Review of World Energy 2010*, 6 and 22.

291 *Ibid.*, 8 and 24.

292 The International Monetary Fund, 'World Economic Outlook Database April 2012.'

293 'Unemployment, Youth Male (% of Male Labor Force Ages 15-24).'

294 Author's own calculations.

295 'Polity IV Regime Trends: Kazakhstan, 1991-2010,' *Center for Systemic Peace*, 2011, <http://www.systemicpeace.org/polity/kzk2.htm>.

NORTHWESTERN EUROPE

Northwestern Europe (the Netherlands, Norway, Denmark and the United Kingdom) was home to 120.9 Tcf worth of natural gas reserves in 2010. Combined oil reserves for the region were 1.3 TMB in the same year. The share of natural gas reserves out of total fuel resources measured 66%, compared to 34% for oil.²⁹⁶ The ratio of oil to natural gas extraction capacity lay much closer together in 2010, at 51% for natural gas and 49% for oil.²⁹⁷ Northwestern Europe's exposure to natural gas or oil price shocks is thus roughly equal. However, given that the relative price of oil is higher than the relative price of natural gas, Northwestern Europe is likely to be more affected by a change in the price of oil. GDP per capita was just over US\$ 42391 in 2010.²⁹⁸ Youth unemployment stood at 18.53% in the same year.²⁹⁹ Resource rents comprised 0.83% of the combined GDP of Northwestern Europe in 2010.³⁰⁰ With all countries having a Polity IV score of 10.0, The Netherlands, Norway, Denmark and the United Kingdom can all be qualified as democracies.³⁰¹

QATAR

Qatar is a country rich in natural gas reserves, which measured 895.8 Tcf in 2010. It is the largest LNG exporting country in the world. Oil reserves comprised 26.8 TMB in the same year. The bulk of energy resources in Qatar are made up of natural gas reserves, comprising 88% of total fuel resources, compared to a 12% share for oil.³⁰² Initial natural gas extraction capacity stood at 59% in 2010, compared to 41% for oil.³⁰³ Despite having a

296 *BP Statistical Review of World Energy 2010*, 6 and 22.

297 *Ibid.*, 8 and 24.

298 The International Monetary Fund, 'World Economic Outlook Database April 2012.'

299 'Unemployment, Youth Male (% of Male Labor Force Ages 15-24).'

300 Author's own calculations.

301 'Polity IV Regime Trends: Netherlands, 1946-2010,' *Center for Systemic Peace*, 2011, <http://www.systemicpeace.org/polity/nth2.htm>; 'Polity IV Regime Trends: Norway, 1946-2010,' *Center for Systemic Peace*, 2011, <http://www.systemicpeace.org/polity/nor2.htm>; 'Polity IV Regime Trends: Denmark, 1946-2010,' *Center for Systemic Peace*, 2011, <http://www.systemicpeace.org/polity/den2.htm>; 'Polity IV Regime Trends: United Kingdom, 1946-2010,' *Center for Systemic Peace*, 2011, <http://www.systemicpeace.org/polity/ukg2.htm>.

302 *BP Statistical Review of World Energy 2010*, 6 and 22.

303 *Ibid.*, 8 and 24.

relatively larger natural gas extraction capacity, the relative price of oil compared to natural gas is much higher, meaning that – similar to the situation in Egypt – the revenues generated through oil sales still matter a great deal to the country’s GDP. GDP per capita was just over US\$ 72397 in 2010.³⁰⁴ Youth unemployment measured 11% in the same year.³⁰⁵ Resource rents comprised 40% of Qatar’s GDP in 2010.³⁰⁶ With a Polity IV score of -10.0 Qatar can be qualified as an autocracy.³⁰⁷

RUSSIA

Russia holds the largest natural gas reserves in the world, measured at 1567.1 Tcf in 2010. Oil reserves stood at 74.2 TMB in the same year. The ratio of natural gas to oil reserves stood at almost 4:1 in 2010.³⁰⁸ Oil extraction capacity measured 53% of total fuel capacity in 2010, against 47% for natural gas.³⁰⁹ Oil exports thus matter a great deal to the Russian GDP and fluctuations in the price of oil will affect the Russian economy, amplified by the greater relative price of oil compared to natural gas. GDP per capita was just under US\$ 11490 in 2010 and youth unemployment stood at 16.9% in the same year.³¹⁰ Resource rents comprised 29% of Russia’s GDP in 2010.³¹¹ With a Polity IV score of 4.0 Russia can be qualified as an anocracy.³¹²

SAUDI ARABIA

Saudi Arabia is the world’s premier oil producer, with reserves measured at 264.6 TMB in 2010. Natural gas reserves comprised 279.9 Tcf in the same

304 The International Monetary Fund, ‘World Economic Outlook Database April 2012.’

305 ‘A Growing Gulf: Public and Private Sector Initiatives and the Realities of Youth Employment Outcomes,’ *The Gulf Research Meeting Cambridge 2013: Workshop Details*, July 12, 2012, <http://grm.grc.net/index.php?pgid=Njk=&wid=Mjg=#Qatar>.

306 Author’s own calculations.

307 ‘Polity IV Regime Trends: Qatar, 1971-2010,’ *Center for Systemic Peace*, 2011, <http://www.systemicpeace.org/polity/qat2.htm>.

308 *BP Statistical Review of World Energy 2010*, 6 and 22.

309 *Ibid.*, 8 and 24.

310 The International Monetary Fund, ‘World Economic Outlook Database April 2012; ‘Unemployment, Youth Male (% of Male Labor Force Ages 15-24).’

311 Author’s own calculations.

312 ‘Polity IV Regime Trends: Russia, 1946-2010,’ *Center for Systemic Peace*, 2011, <http://www.systemicpeace.org/polity/rus2.htm>; Bekkers et al., *De Toekomst in Alle Staten - HCSS Strategische Monitor 2013*, 23.

year. The share of oil reserves out of total fuel resources comprised 85% in 2010, versus 15% for natural gas.³¹³ Initial oil extraction capacity stood at 88% in 2010, compared to 12% for natural gas.³¹⁴ Saudi Arabia is as such at more at risk of oil price fluctuations than it is with respect to changes in the price of natural gas. GDP per capita was just over US\$ 16445 in 2010. Youth unemployment measured 23.6% in the same year.³¹⁵ Resource rents comprised 67% of Saudi Arabia's GDP in 2010.³¹⁶ With a Polity IV score of -10.0 Saudi Arabia can be qualified as an autocracy.³¹⁷

SCENARIO DYNAMICS

This section analyzes the dynamics of intra-state instability we encountered after feeding the price scenarios into the country stability model. It is important to stress that only the European natural gas price and the international oil price of each scenario were used as price input variables. As a consequence, the effects of price fluctuations in the natural gas price in the Far East and North America are not reflected in the outcomes of the country stability model. This could mean that largely desirable scenarios (from the viewpoint of oil- and gas-exporting countries) given a rise in the natural gas price in Europe and a steady or increasing oil price, may not necessarily prove positive for countries that have invested heavily in Asian natural gas exports, if that particular scenario shows a decline in the price of natural gas in the Far East. By the same token, a largely undesirable scenario in light of a decreasing gas price in Europe and a declining oil price could potentially be (partially) compensated for by an increase in the price of natural gas in the Far East.

313 *BP Statistical Review of World Energy 2010*, 6 and 22.

314 *Ibid.*, 8 and 24.

315 The International Monetary Fund, 'World Economic Outlook Database April 2012'; 'Unemployment, Youth Male (% of Male Labor Force Ages 15-24).'

316 Author's own calculations.

317 'Polity IV Regime Trends: Saudi Arabia, 1946-2010,' *Center for Systemic Peace*, 2011, <http://www.systemicpeace.org/polity/sau2.htm>.

SCENARIO 1

The first scenario (see p. 188) shows a significant decrease in the price of natural gas in Europe. The oil price also shows an overall downward trend, accompanied by significant price shocks that occur roughly every five years. This scenario can be judged as ‘mostly undesirable’ (see Figure 104 and Figure 105 for examples of how this scenario affects Russia and Qatar).

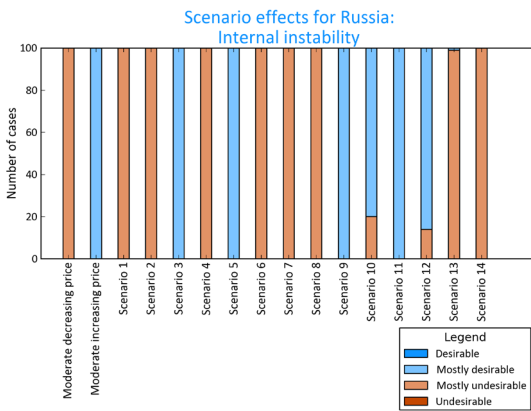


FIGURE 104. SCENARIO EFFECTS FOR RUSSIA

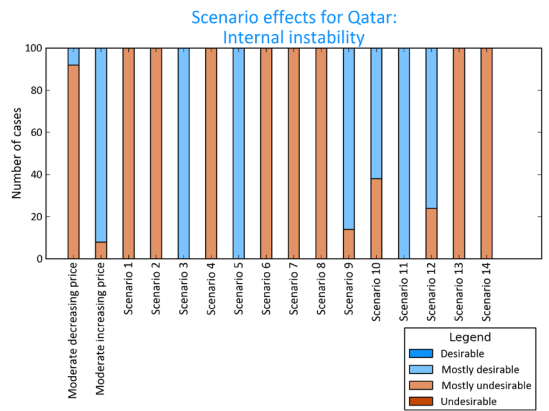


FIGURE 105. SCENARIO EFFECTS FOR QATAR

The positive effect (in terms of an increase in internal stability) compared against the reference scenario is extremely minute. The negative effect (an increase in instability) takes the upper hand as time passes and the prices of natural gas and oil decline, whereby the gap between the internal tension score of the reference scenario and scenario 1 reaches almost double the score of the reference scenario. The extent of this negative effect differs per country however. In countries more prone to instability, for example Russia and Algeria, the effect is much larger than in Qatar or Azerbaijan given that the latter two countries have a slightly more diversified economy. Resource rents come under pressure and decline over time, compared to the reference scenario. Moreover, unemployment increases, youth unemployment in particular. The increase in unemployment creates pressure on wages and leads to an increase in the food dependency ratio. Although the lower natural gas and oil prices cause fuel dependency to decrease slightly in this scenario, the rise in unemployment and resultant

stress on wages causes purchasing power to decline nevertheless. For countries whose budgets are not well diversified this scenario means that fuel and food subsidies will have to be halted, which in turn leads to an even higher level of social unrest. Furthermore, oil extraction capacity may decrease due to incurred losses in light of slowly increasing costs, set against declining prices. This amplifies the loss in income due to the lower prices. Consequently, resource rents strongly decline. This last point is problematic for all countries heavily dependent on oil exports (e.g., Saudi Arabia, Azerbaijan, Kazakhstan, and to a lesser extent Algeria and Russia).

SCENARIO 2

In this scenario (see p. 190), the price of natural gas in Europe experience a steady decline until 2050 (see Figure 40). The oil price shows an overall downward trend, coupled with significant price swings throughout the entire period (see Figure 43). Initially, the price of oil loses almost half its value, only to skyrocket immediately thereafter. Over time, these price swings become less pronounced with the oil price gradually going down.

The scenario can be labeled as generally undesirable for all countries. In its impact, it is largely similar to scenario 1, with the difference that the drop in prices is less pronounced. Unemployment and youth unemployment increase slightly compared to the reference scenario. Internal tension rises and is almost always higher than in the reference scenario, though the increase is not as strong as in scenario 1. Fuel and food subsidies are less likely to be halted in this scenario, thus dampening the onset of instability. Ultimately however, fuel extraction capacity will be negatively affected in the long term due to the declining prices. By comparison, in scenario 1 the fuel extraction capacity is already affected in the medium term.

SCENARIO 3

In this scenario (see p. 192), natural gas dominates Europe's energy mix. As a result, the natural gas price in Europe remains consistently high throughout the entire period (see Figure 45). The same cannot be said for the natural gas price in the Far East however, which collapses and drops to roughly half the value of natural gas sold in Europe. The oil price rises steeply in the short term, after which a period of sustained high oil prices persists (see Figure 48).

This scenario is largely desirable for all countries. Internal tension is always lower than in the reference scenario. Indeed, the scenario has a mostly desirable effect, however the negative effect is so minute that in fact one could speak of a purely desirable scenario. The consistently high natural gas price in Europe, coupled with a sustained high oil price, ensures high resource rents and renders the effects on instability largely desirable. The exact impact on the fuel and food dependency differs per country, however overall dependency levels will increase slightly owing to the higher energy prices and the resultant loss in purchasing power. In countries which have a higher degree of labor scarcity, the increase in wages – due to the increase in government income – may compensate for this loss in purchasing power. It should be stressed that the collapse in natural gas prices in the Far East observed in this scenario will adversely impact resource rents in countries which export heavily to Asian markets, notably Qatar which exported close to 50% of its natural gas to Asia in 2011.³¹⁸ Depending on the extent to which Qatar is able to reroute its LNG supplies to Europe, the actual impact of scenario 3 in Qatar is likely to be less positive than shown in this analysis.

SCENARIO 4

In this scenario (see p. 194), both the natural gas price in Europe and the international oil price show a gradual decline (see Figure 50 and Figure 53). The decline in the price of oil sets is delayed due to short-medium term volatility whereby the oil price fluctuates around the reference scenario. The decline in the price of oil does not set in until the long term. Overall, this scenario can be judged as ‘mostly undesirable’, with partial exceptions for Azerbaijan and Saudi Arabia (see Figure 106 and Figure 107).

318 ‘Qatar Country Profile,’ *US Energy Information Administration*, January 30, 2013, <http://www.eia.gov/countries/cab.cfm?fips=QA>.

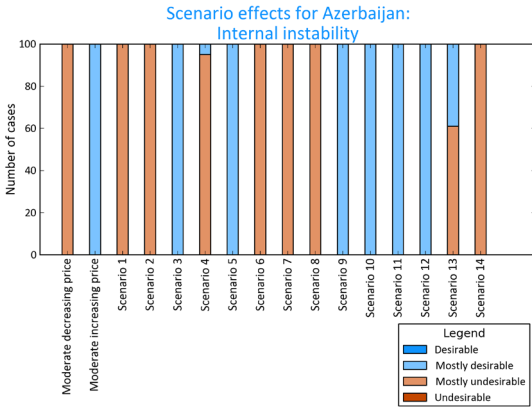


FIGURE 106. SCENARIO EFFECTS FOR AZERBAIJAN

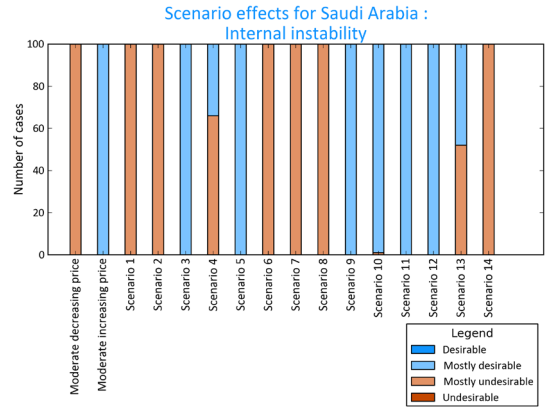


FIGURE 107. SCENARIO EFFECTS FOR SAUDI ARABIA

As the above figures demonstrate, instances exist in Azerbaijan and Saudi Arabia where the impact of this scenario compared to the reference scenario is mostly desirable. The reason is that countries which produce more oil relative to natural gas (i.e., Saudi Arabia and Azerbaijan) profit from the initial upward volatility of the oil price. This is most clearly visible in Saudi Arabia which, due to its vast oil production, experiences many more instances of ‘mostly desirable’ impact compared to Azerbaijan, as well as the other countries in this study. Whereas the initial upswing causes an increase in resource rents and a downward effect on instability, the long-term decline does the opposite, thus explaining the ‘undesirable’ cases.

Two observations should be made with respect to the volatility of the oil price observed in this scenario. First, the volatility may also cause a number of recessions in the short to medium term. Second, due to the rapid volatility in the medium term, the difference with the reference scenario in terms of the onset of instability for this period is negligible. The observed instability (i.e. the ‘undesirable’ cases) is mostly caused by the oil price decrease in the second half of the observed period.

Unemployment fluctuates in the short to medium term. In the long term, we witnessed an increase in the levels of unemployment caused by declining export revenues. Although scenario 4 shows a decrease in the

prices of natural gas and oil, this decrease is much less pronounced than in scenario 1. This means that – depending on local circumstances – subsidy levels are less likely to be adjusted.

SCENARIO 5

Natural gas prices in Europe show a slight increase in this scenario (see p. 196). In the Far East, the natural gas price drops considerably until 2030, after which it begins to stabilize (see Figure 55). Similar to in scenario 3, the oil price rises steeply in the short term, after which a period of sustained high oil prices persists (see Figure 58).

Overall this scenario can be judged as mostly desirable for all countries. The cases in which the scenario is undesirable (instability) are negligible due to the sustained high prices for oil and natural gas. Similar to in scenario 3, fuel and food dependency levels will increase slightly owing to the higher energy prices and the resultant loss in purchasing power. Labor scarcity can mitigate for this loss in purchasing power through higher wages. Only countries which export heavily to the Far East, notably Qatar, are likely to be negatively affected by this scenario. However, as in scenario 3, the extent to which instability occurs is dependent on whether Qatar manages to reroute some of its LNG to other markets. Overall, many similarities exist between scenario 5 and 3, whereby the impact of scenario 5 is more positive given the higher energy prices.

SCENARIO 6

In this scenario, the natural gas price in Europe shows an overall downward trend (see p. 198). However, this trend is interrupted by a rise in the price of natural gas in the period 2020-2030 to almost its initial level (see Figure 60). In the long term however, a sharp decline sets in. The oil price (see Figure 63) shows a general downward trend with some degree of volatility. Initially the price shows a sharp decrease, followed by a steep rise and subsequently remaining at a plateau (of high prices) between 2020 and 2026. After this period the price of oil shows a sharp decrease. The scenario is largely 'undesirable' for all countries in the study due to the overall decrease in the price of natural gas, the initial lull in the oil price and its long-term decline. A minor exception exists in Northwestern Europe (see Figure 108 and Figure 109 for a comparison between Algeria and Northwestern Europe).

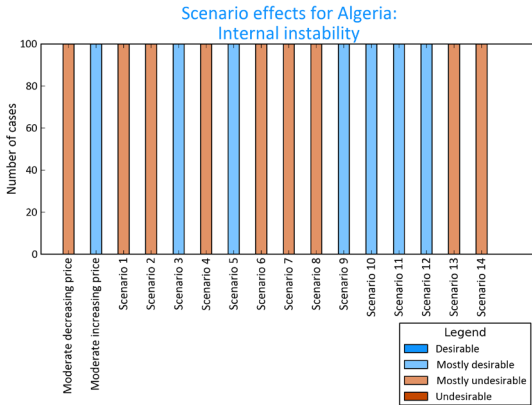


FIGURE 108. SCENARIO EFFECTS FOR ALGERIA

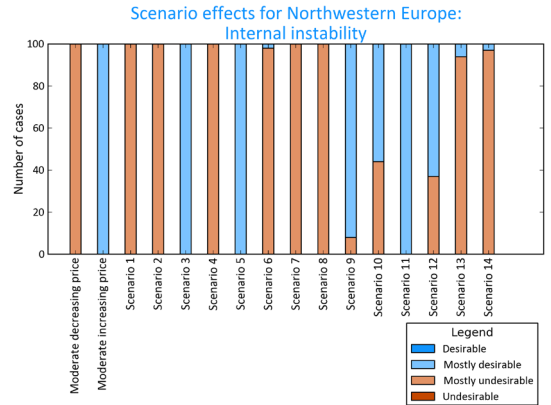


FIGURE 109. SCENARIO EFFECTS FOR NORTHWESTERN EUROPE

The few cases in Northwestern Europe which prove 'desirable' are caused by a positive effect on purchasing power due to lower natural gas and oil prices. In most cases however, the gradual drop in natural gas and oil prices will still have a negative effect on GDP (lower resource rents) and result in an increase in unemployment, thus explaining the rise in instability. Having said that, the decline in resource rents in Northwestern Europe is largely cushioned by the fact that the economies in this region are highly diversified. In Algeria, by comparison, the scenario falls completely within the 'mostly undesirable' category due to the declining oil and natural gas prices and the fact that the relatively undiversified economy has comparatively few other sectors that can act as a 'buffer'.

Resource rents follow a pattern similar to the oil and gas prices in this scenario, declining in the short term, increasing thereafter and ending up much lower in the long term. Although undesirable from the viewpoint of traditional oil- and gas-exporting countries, this scenario is much less extreme than scenario 1 due to the period of sustained high oil prices in the medium term. Observable is that instability 'follows' price developments with a certain delay due to the high fluctuations. This lagged effect causes instability to be the highest in the medium term when oil prices have increased significantly, rather than at the point where they have dropped considerably.

SCENARIO 7

Scenario 7 sees the share of oil in Europe's energy mix grow at the expense of natural gas (see p. 200). Consequently the price of natural gas declines gradually throughout the observed period (see Figure 65). The oil price shows a general declining trend, interrupted by two large price fluctuations. A sharp decline can be observed in the short to medium term, after which the oil price skyrockets. In the long term the price subsequently collapses and stays at a low level, only experiencing a slight further decrease (see Figure 68).

Compared to the reference scenario, this scenario (with the exception of the short term) always generates more instability for all countries observed. Despite a temporarily higher level of employment during the oil price peak and a subsequent lowered degree of 'youth frustration', this price increase cannot compensate for the overall negative trend (in terms of heightened instability caused by the long term decline in oil and gas prices).

Resource rents are continuously lower than in the reference scenario as the oil price peak is offset by the reduction in extraction capacity caused by the lower prices in the preceding period. Consequently, GDP is also continuously lower than in the reference scenario. Purchasing power can increase as a result of sustained lower oil and gas prices. However, in economies with a large share of resource rents in their GDP, this effect can be reduced by the lower wages which result from the worsened economic circumstances.

SCENARIO 8

The price of natural gas in Europe is in decline throughout this entire scenario (see p. 202), with the most severe drop experienced in the short term (see Figure 70). The oil price declines sharply in the short term, after which it shows a steep increase toward the medium term to just below half its initial value. After 2020, the oil price again experiences a gradual decline, with some degree of volatility (see Figure 73).

Similar to scenario 1, this scenario can be judged as 'mostly undesirable' in all countries. The impact will differ per country, depending on the share of resource rents within the GDP, the extent to which the economy is diversified, a country holds significant financial reserves, and so on. Having

said that, what is clear is that the negative effects (in terms of instability) in this scenario are even more pronounced than in scenario 1. Resource rents come under serious strain over time compared to the reference scenario. Unemployment increases, which causes stress on wages, fuels youth frustration, and leads to an increase in the food dependency ratio. In countries with a high share of resource rents in their GDP, the improvement of the fuel dependency ratio is offset by the rise in unemployment and downward pressure on wages, leading to a net loss in purchasing power.

Under this scenario it is even more likely that fuel and food subsidies will have to be halted, causing even greater social unrest. In this scenario oil extraction capacity is also likely to suffer from increasing costs, set against declining prices. Again, this functions as a stress multiplier in countries heavily reliant on oil exports, as resource rents decrease even further as a result.

SCENARIO 9

In this scenario (see p. 204), the price of natural gas in Europe declines only minimally (see Figure 75). The price of natural gas in the Far East also shows a downward trend, though at a much faster rate than in Europe, ending up far below the European price. After an initial dip, the price of oil reaches a level slightly higher than the present value and from there it increases continuously at a slow pace (see Figure 78). This scenario is 'mostly desirable' in practically all countries. Exceptions occur in Qatar and Northwestern Europe (see Figure 105 and Figure 109).

Due to the higher oil price and the minimal reduction in the European natural gas price, this scenario will generally result in less internal instability compared to the reference scenario. It should however be noted that this difference is minimal. In countries which have a comparable share of oil and natural gas production, the gradual increase of the oil price acts as a buffer against the instability caused by the drop in the price of natural gas.

The extent to which resource rents are affected depends on the relation between oil and natural gas production. Only countries which have a minimal share of oil production compared to natural gas production (out of total fuel production) will see a relative reduction in resource rents given the slightly lower price for natural gas in Europe. The exceptions in

Northwestern Europe and Qatar can be explained by a loss in purchasing power caused by the higher oil prices, causing fuel dependency to increase – in so far that this is not compensated by higher wages. This causes a limited number of cases to be ‘mostly undesirable’, leading to a small increase in instability.

SCENARIO 10

The natural gas price in Europe fluctuates around a slightly lower price than its current level in this scenario (see p. 206). The price in the Far East by contrast, experiences a gradual decline. The oil price fluctuates around a slightly higher level than its current, with considerable volatility. A significant price drop can be recorded in the short term. In general, there are more instances in which this scenario can be considered ‘mostly desirable’, although numerous partial exceptions exist.

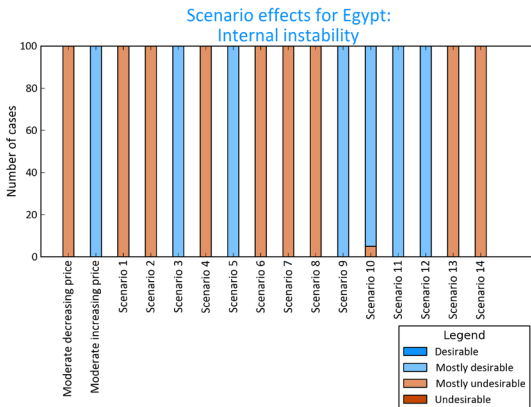


FIGURE 110. SCENARIO EFFECTS FOR EGYPT

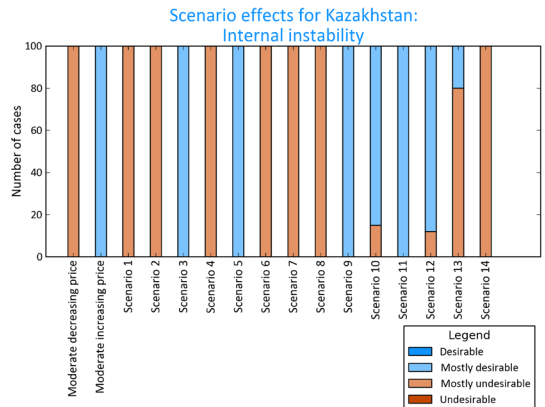


FIGURE 111. SCENARIO EFFECTS FOR KAZAKHSTAN

The extent to which instances of internal instability are higher than in the reference scenario differs per country. What can be observed is that the number of instances in which this scenario is ‘mostly undesirable’ is much smaller in Egypt and Kazakhstan (see Figure 110 and Figure 111) than it is in Russia (see Figure 104), Qatar (see Figure 105) and Northwestern Europe (see Figure 109).

Resource rents in Egypt decrease slightly owing to the minor drop in the natural gas price in Europe and the steep initial drop in the price of oil. This causes a rise in unemployment, particularly youth unemployment, and leads to an increase in instability compared to the reference scenario. In Kazakhstan, the number of 'undesirable' cases can be explained by the initial decline in the price of oil, causing its resource rents and GDP to go down and (youth) unemployment to rise. Over time, the increase in the price of oil however ensures that resource rents and GDP increase again, thus dampening instability. In the long run the scenario therefore proves largely desirable in the case of Kazakhstan.

In Northwestern Europe, despite profiting from the initial drop in the price of oil in the form of a reduction in fuel dependency, purchasing power is negatively affected in the long term when the price of oil begins to increase. Moreover, the steep rise in the price of oil occurs right at a moment in time when Europe is going through a profound economic crisis, thus further compounding the effect on purchasing power. Instability thus increases compared to the reference scenario.

In Qatar, the decline in the price of natural gas in Europe causes resource rents to decrease slightly more than in the reference scenario. The initial sharp drop in the price of oil further compounds this effect. The overall level of instability is likely to be amplified by the drop in the price of natural gas in the Far East. This means that the number of instances in which this scenario can be labeled 'mostly undesirable' in Qatar is likely to be even higher when taking the worsening of Asian market conditions into account. The overall effect in Russia is largely desirable given the long-term increase in the price of oil. The number of 'undesirable' cases is lower than for example in Qatar. This is due to the fact that Russia, compared to Qatar, is a much larger oil producer (over 10 million barrels per day in Russia in 2010 compared to around 1.5 million in Qatar) and thus profits more from higher prices than Qatar.³¹⁹ However, the lower natural gas price in Europe does put pressure on resource rents. Moreover, Russia too feels the initial drop in the price of oil, thus causing a rise in (youth) unemployment and an increase in instability compared to the reference scenario. In the long run,

319 *BP Statistical Review of World Energy 2010*, 8.

the increase in the price of oil compensates the increase in instability to some extent, causing resource rents to increase.

SCENARIO 11

In this scenario (see p. 208), the price of natural gas in Europe fluctuates slightly. In the short term, it does so around the current price. In the medium to long term, it does so just below the current price. The oil price shows considerable volatility throughout the entire period. Periods where it fluctuates above the current price are longer than episodes where it drops below the current price.

Overall, this scenario leads to 'mostly desirable' situations in all countries. The level of instability is almost always lower than in the reference scenario. This is especially due to lower unemployment figures. Resource rents, and with GDP, are most of the time higher than in the reference scenario. The effect this has on purchasing power depends on the effect the additional economic growth has on the wages. As such, the effects can be both positive, as well as negative.

Exceptions to the rise in resource rents are those moments when the oil price dips. Logically, given the natural gas/oil production balance, such an oil price dip hits countries which rely to a greater extent on oil production such as Azerbaijan, Kazakhstan, Russia, and Saudi Arabia harder than it does Egypt and Qatar. However, when these countries have enough financial redundancy and/or a significant migrant worker population to be able to cope with these price fluctuations, this scenario will not be problematic. In a situation with fragile economic growth on the other hand, this may mean that a country experiences short periods of economic recession with consequentially higher levels of instability. On average however, this price scenario has a positive impact. This is because the long term effect of the slightly lower gas price is largely compensated by the longer periods whereby the price of oil floats above the current price level.

SCENARIO 12

The natural gas price in Europe exerts a gradual upward trend with limited volatility in this scenario (see p. 210). The natural gas price in the Far East by contrast shows a decline throughout the entire period, losing almost a third of its value along the way (see Figure 90). The oil price shows

considerable volatility (see Figure 93). Price shocks occur regularly throughout the entire period. In the long term, the price of oil shows an increase, though coupled with some heavy downward volatility.

In half the countries analyzed in this study, this scenario can be viewed as 'mostly desirable'. This is largely due to the rise in the price of natural gas, the long-term increase in the price of oil and the observation that periods of high oil prices are longer in duration than periods in which the price is low. Partial exceptions exist in Russia (see Figure 104), Qatar (see Figure 105), Northwestern Europe (see Figure 109) and Kazakhstan (see Figure 111).

As the oil price falls sharply in the short term, especially countries (or cases in countries) where the internal instability is highest in the short term, may experience undesirable effects in this scenario. In countries with their highest levels of instability (with the reference scenario) in the medium or long term, the effect of this scenarios is mostly positive. In other words, especially when a country is vulnerable for instability in the short term, this scenario will have most severe negative consequences. In Kazakhstan for example, the heavy downward volatility in the price of oil causes resource rents – and with it GDP – to decline, thus causing the level of instability during these downward swings to be higher than in the reference scenario. In the long term, the higher price causes resource rents to increase. The same reasoning applies to Russia.

In Northwestern Europe, the long-term rise in the price of oil causes purchasing power to be negatively affected. The limited number of 'desirable' cases is explained by the periods during which the price of oil experiences a decline, causing purchasing power to increase.

Qatar sees its level of instability increase in the short term compared to the reference scenario due to the steep decline of the price of oil. This is caused by an increase in youth unemployment, which, together with the relatively highly educated young population and a very autocratic government, fuels higher levels of instability in the short term. In the long term, resource rents as a share of GDP may decline in Qatar as the country develops and diversifies its economy, thus dampening instability.

SCENARIO 13

In this scenario, the price of natural gas in Europe declines during the first decades, under some volatility (see p. 212). During the last decades, the price increases again to a level still under the present price (see Figure 95). The oil price shows similar dynamics, yet at much greater volatility. In the last decades the oil price seems to stabilize at a higher price level compared to present prices. Overall, this scenario can be described as 'mostly undesirable', although partial exceptions exist in Azerbaijan (see Figure 106), Saudi Arabia (see Figure 107), Northwestern Europe (see Figure 109) and Kazakhstan (see Figure 111).

In the first half of the observed period, both the natural gas and oil price drop. This causes greater instability compared the reference scenario. Although the price of natural gas increases in the second period, it remains slightly below the current level. What can be seen is that countries which sell a significant amount of natural gas to Europe such as Russia (see Figure 104), Qatar (see Figure 105), Algeria (see Figure 108) and Egypt (see Figure 110) all experience more instability than in the reference scenario. Instability in Qatar is likely to be even greater than shown, given the reduction in the price of natural gas in the Far East. The reduction in the price of natural gas in Europe causes resource rents to decline initially, leading to an increase in unemployment. Wages come under pressure as a result, causing a worsening of the food dependency ratio. This is to some extent compensated in the second half of the observed period when the price of natural gas increases again. The long-term increase in the price of oil can go some way in compensating for lost revenue on natural gas, yet this is undermined by the strong bouts of downward volatility. Of the above states, only Russia (the largest oil producer of the above four mentioned countries) demonstrates a minute number of cases which can be considered 'mostly desirable'.

Oil states such as Azerbaijan (see Figure 106), Saudi Arabia (see Figure 107) and Kazakhstan (see Figure 111) – in differing degrees – all experience a greater number of cases which can be considered 'mostly desirable'. This is due to the possibility that the higher oil prices in the second half of the observed period can lead to higher oil production, causing additional resource rents, thus reducing the level of instability relative to the reference scenario. The number of instances in which instability is lower than in the

reference scenario is arguably greatest in Saudi Arabia given the country's large oil production. However, notably Kazakhstan and Azerbaijan also experience cases which can be considered 'mostly undesirable' in which internal instability is higher than in the reference scenario. This is because during periods where the oil price drops considerably (in the short term and between 2020 and 2025), (youth) unemployment increases, giving rise to youth frustration. In Northwestern Europe the scenario is largely undesirable with only a small number of cases in which instability is lower than in the reference scenario. This is due to the negative impact that the rising oil prices in the second half of the observed period have on overall purchasing power.

SCENARIO 14

In this scenario (see p. 214), the price of natural gas in Europe shows an overall downward trend and drops to a considerably lower level in the medium term (see Figure 100). The oil price shows a number of fluctuations throughout the observed period (see Figure 103). Of interest is the relatively long 'intermezzo' of low prices between 2025 and 2035 which is both preceded and followed by a price shock.

In almost all cases, internal instability is higher than the reference scenario throughout the entire period. The only exception is posed by Northwestern Europe (see Figure 109), which experiences a relatively small number of cases where the level of instability is lower than in the reference case. In this scenario resource rents will come under pressure, notably during the period where oil prices are very low. Oil states are likely to be hit harder than natural gas states, although the latter also experience a decline in resource rents due to the lower natural gas price. The period of low prices has a negative influence on the profitability of the available extraction capacity. The oil extraction capacity in particular is negatively affected by the low prices, coupled with slowly increasing costs. It is possible however that it partially recovers after the oil price rises again in the second half of the observed period. The limited number of instances in Northwestern Europe which are 'mostly desirable' are caused by an increase in purchasing power caused by the decline in the price of oil.

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