Chapter 30

Future Petroleum Geopolitics: Consequences of Climate Policy and Unconventional Oil and Gas

Indra Overland
Norwegian Institute of International Affairs (NUPI), Oslo, Norway

1 INTRODUCTION

The importance of oil and gas for the finances and international relations of states is unquestionable. The total value of the oil produced in 2013 was around US$3 trillion (estimate based on data from EIA, 2014a). Natural gas comes on top of that. Six of the world's ten largest publically listed companies in terms of revenue are in the petroleum sector—and that does not include the world's largest oil company by output, Saudi Aramco, as it is not traded on any stock exchange (Fortune, 2014). Oil and gas are the backbone of the economies of many petroleum-exporting countries, underpinning the foreign policies of countries such as Russia, Saudi Arabia, and Venezuela (Orttung and Overland, 2011). Conversely, they represent a considerable burden on the trade and fiscal balances of many importing countries, leaving them weaker than they would otherwise have been. Petroleum resources also bring together 12 mostly anti-American countries in OPEC; they are one of the motivations for US political and military involvement in the Middle East, and a factor in territorial disputes between countries in several parts of the world.

This chapter examines how two major ongoing developments in the petroleum sector—advances in production methods for unconventional oil and gas and negotiations over a global climate policy—may transform petroleum-related geopolitics. Rapid growth in the production of shale oil and gas is already a reality in the United States, which is set to overtake Russia and Saudi Arabia as the world's largest oil producer (Jones, Steven, and O'Brien, 2014: 2). Global climate policy has largely been a failure, and energy consumption as well as greenhouse gas emissions have continued to soar (Hoffert, 2010: 1292; Vielle and Viguier, 2007: 844)—but this could change in the future.

It is a paradox that two of the main energy trends today are simultaneously toward a boom in unconventional oil and gas production, and toward a stricter global climate policy. The former contributes to prolonging the era of fossil fuels, perhaps for a lengthy period, while the other aims at cutting greenhouse emissions from fossil fuels, as quickly as possible. The current global energy system is therefore fraught with tensions, making the evolution of the sector dynamic and unpredictable. This chapter can only offer an overview of *possible* developments: exhaustive or conclusive analysis is not possible.

For the purpose of this chapter, "geopolitics" is defined as great power competition over access to strategic locations and natural resources. (For more on how "geopolitics" can be understood, see Section 2.) The geopolitics of the petroleum sector can be understood as growing out of the supply–demand balance, which affects power relations between exporters and importers, energy security, and the military clout of major powers—among other things. Unconventional oil and gas impact on the supply side of these relationships. Climate policy impacts on the demand side and to some extent on the supply side as well, because not only the consumption of oil and gas but also its production involves greenhouse gas emissions.

There is a qualitative difference between the development of unconventionals and climate policy: the former is driven by smaller units (companies, land-owners, and countries) pursuing their own short-term interests, whereas the latter requires international consensus and compromise in order to have an effect at the international level. This is one reason why unconventionals have moved fast, while the formulation of global climate policy is slow (Hoffert, 2010: 1292; Vielle

Handbook of Clean Energy Systems. Edited by Jinyue Yan.

and Viguier, 2007: 844). Looking to the future of unconventionals is a question of how much and how fast, whereas climate policy is a more fundamental "if." Nonetheless, both developments are possible—and those possibilities serve as the starting point for this chapter.

This chapter is divided into two parts, the first dedicated to unconventional oil and gas, and the second to climate policy. But before delving into the possible political consequences of these developments, some basic questions need to be addressed: How does the interpretation of the concept of geopolitics affect the assessment of geopolitical change, what is unconventional oil and gas and what is the market context that these developments would interact with? The main parts of the chapter are then dedicated to teasing out various geopolitical aspects of these developments, before a section toward the end discusses how dramatic these changes are in a historical perspective.

2 THE CONCEPTUALIZATION OF PETROLEUM GEOPOLITICS

In order to understand how the geopolitics of oil and gas may change, we need to understand how the same geopolitics has worked and been understood in the past. In this section, two opposing views of the geopolitics of oil and gas are briefly outlined. Which of them one gravitates toward has implications for how one analyzes the consequences of changes in the energy sector.

The first and more commonplace view is that there is constant geopolitical competition for petroleum resources (Allison, 2004: 277; Jaffe and Sullivan, 2012: 24; Klare, 2008: 7). US military and political involvement in the Middle East is seen as one expression of this, including support for the government of President Hosni Mubarak in Egypt until the late 2010s, two wars in Iraq, continuing tensions with Iran and the cooperation with Saudi Arabia (Pelletiere, 2004; Bronson, 2006; Hurst, 2009; Murray, 2009; Sharp, 2011; Shareef, 2014). Other examples are tensions between the EU and Russia over Russian gas exports and competition between Chinese, Indian, and Western oil companies in Africa and Latin America (Carmody, 2011; Molchanov, 2012; Woehrel, 2012; Fernández Jilberto and Hogenboom, 2012; Sharples, 2013).

This mainstream geopolitical view is easily combined with a peak-oil view of petroleum resources. According to this Malthusian perspective, the high pace of extraction and consumption of oil and gas, driven by population growth and accelerated by economic growth in emerging economies, is leading to the depletion of the world's reserves. The reduced availability of resources, together with rapidly growing demand, leads to a supply crunch that explains the high oil prices of the 2000s, in turn interpreted as an indication of inevitable geopolitical tensions (Fournier and Westervelt, 2005).

Among its mainstream scholarly and dedicated followers, geopolitics is considered an academic discipline pertaining to the relationships between geography, power, and international relations. Such authors see themselves as working in the vein of the classic geopolitical thinkers, such as Rudolf Kjellen, Halford Mackinder, or Friedrich Ratzel, and assume, just they did, that geography and natural resources play a constraining and enabling role in international affairs that can determine the outcome of those affairs (Edwards, 2003: 83; Özkan, 2008: 575; Kelly, 2006: 27). In this perspective, the linkage between geography and interstate relations is a constant and basic aspect of international affairs.

An opposing view on geopolitics could be that, since the birth of the petroleum industry in the nineteenth century, the geopolitics of oil and gas has undergone several phases. One phase was characterized by a genuine geopolitical competition over energy resources. Since then, this competition has become largely imaginary.

During the first decades of the existence of the petroleum industry, there were dramatic ups and downs in the relationship between supply and demand—but these took place within a national context. From around 1900, oil became a highly strategic military commodity, and the globalization of oil production accelerated. This was the golden era of petroleum geopolitics, the age of mature colonialism, and the world wars—global wars of attrition in which industrialized countries sought to exhaust each other militarily. The capacity to produce and deploy vehicles, aircraft, weaponry, and ammunition around the world were decisive—and this capacity depended on access to oil. Many main events in those two wars, such as the Battle of Stalingrad or the oil embargo of Japan with the ensuing bombing of Pearl Harbor, were thus directly or indirectly related to gaining access to petroleum resources, or to cutting off enemy access to such resources.

The invention and first and so far only use of nuclear weapons in an actual war, against Hiroshima and Nagasaki in August 1945, marked the beginning of the end of classical petroleum geopolitics. As all the major powers acquired nuclear weapons, the threat of mutually assured destruction was established—the balance of terror. In addition, there were no longer white spots on the map over which the great powers could compete. Although the two major Cold War blocs continued to occasionally invade or subsume other countries under their influence, it was no longer seen as acceptable to occupy a different country indefinitely.

During this period, the international relations of the petroleum sector, although often envisaged along the same lines as the era of classical petroleum geopolitics from 1900 to 1945, were in fact of a different nature. Prices fluctuated according to the balance between supply and demand. Supply was in turn affected by technological changes such as the accelerating dispersion of offshore drilling in the 1960s and political events like the founding of OPEC in 1960, the 1973 Yom Kippur War, and fluctuating resource nationalism. Demand was in turn affected by various factors: economic growth, growing mobility (car ownership, civil and military aviation), increased use of plastics and artificial fertilizers, larger homes, and increased indoor temperature control in cold and hot countries. Oil and gas continued to be highly valuable assets over which companies and countries competed, but their influence on the military capacity of great powers waned. In the US war in Vietnam (1959–1975), the Soviet invasion of Afghanistan (1979), the US invasions of Iraq (1991 and 2003) and the US-led campaign in Afghanistan (2001–2014), access to oil was an issue and a major expense—but it did not determine the military outcome of those conflicts.

This view of geopolitics has much in common with the critical geopolitics school of thought, according to which geopolitics is a social construction that can best be understood as a series of discourses (Dalby and Thuatail, 1996; Hyndman, 2010; Power and Campbell, 2010). However, it differs insofar as the connection between geography and the international politics of oil and gas is not posited as something fundamentally discursive. Rather, the connection is seen as something that really existed during a specific period until the end of the World War II, and lost relevance thereafter. Because much mainstream geopolitical thinking has failed to realize this, there has been a lag in the conceptualization of geopolitics.

As noted above, which of these two perspectives on geopolitics one subscribes to has implications for how the consequences of unconventional oil and gas and climate policy are understood. If one sees the world as having been involved in a genuine geopolitical competition over petroleum resources until the 2010s, then the changes brought on by these developments may be dramatic at the level of international affairs. If, however, one does not see the world as having been involved in such a completion over petroleum resources, or perhaps only in an imagined competition, then the implications of these new developments may be smaller as well as different.

3 UNCONVENTIONAL OIL AND GAS DEVELOPMENTS

3.1 What is unconventional oil and gas?

The term *unconventional* hydrocarbons refers to oil and gas that are extracted in other ways than through conventional oil and gas wells. Colloquially, as well as in parts of the academic literature, unconventional oil and gas are called *shale gas* and *shale oil*. However, that is a misnomer, as much of the unconventional resources being extracted are not from shale but other geological formations.

Exactly what is defined as "unconventional" is constantly changing. The annual *World Energy Outlook* reports of the International Energy Agency (IEA) serve as an example. In the 2001 issue, unconventional oil included oil shales, oil-sands-based synthetic crudes and derivative products, coal-based liquid supplies, biomass-based liquid supplies, and gas to liquids (IEA, 2001: 44). Ten years later, in the 2011 issue, unconventional oil was defined as including extra-heavy oil, oil sands, kerogen oil, gas to liquids, and coal to liquids (IEA, 2011: 120). When technologies and energy sources are new, they are more likely to be considered unconventional; as they become more widespread, they are more likely to become conventional. Many of the technologies that are widespread and considered standard industrial procedure today were once radically new and considered unconventional.

However, an exact definition of unconventional oil and gas is not decisive for the purposes of this chapter. They can be defined simply as hydrocarbons extracted by use of new technologies that expand the total amount of oil and gas available and are usually more technically complex and expensive to extract than conventional resources.

Important questions in the debate over unconventional petroleum resources include the extent to which they (i) exist, (ii) are technically and economically extractable, and (iii) will be legally administratively feasible to extract outside North America.

Figure 1, showing estimated natural gas reserves of the United Kingdom, demonstrates how variable estimates of shale gas resources can be. In the case of the United Kingdom, resource estimates differ dramatically depending on whether offshore resources are taken into account.

3.2 The global market context for unconventional oil and gas

Until the mid-2010s, conceptualizations of the new role of unconventional oil and gas in the global energy sector were based largely on developments in the United States, where the production of first unconventional natural gas and then unconventional oil surged (for oil, see Figure 2). These surges led to a fall in the price of natural gas (see Figure 3), reduced oil imports (see Figure 4) and a fall in the price of West Texas Intermediate (WTI) crude oil relative to Brent crude oil (see Figure 5).

The effect of unconventional oil and gas developments on the global petroleum sector depends on the degree to

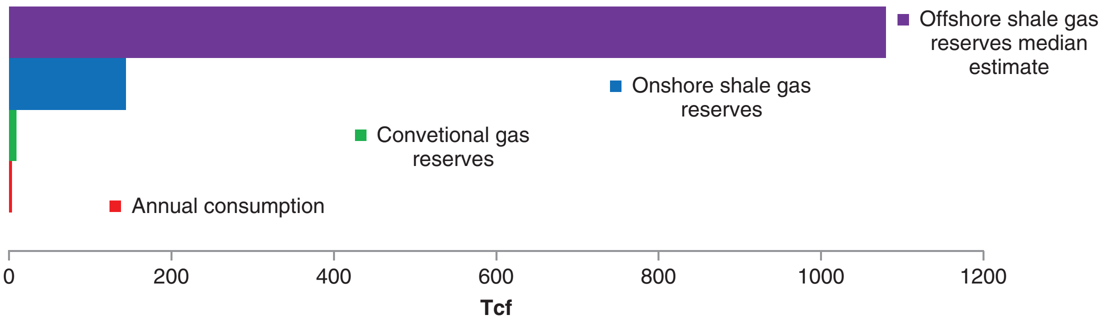

Figure 1. British conventional and shale gas reserves. *Source*: Created by author using data from EIA, 2013a; EIA, 2013b; British Geological Survey, cited in Carbon Brief, 2012; British Geological Survey, cited in Reuters, 2012.

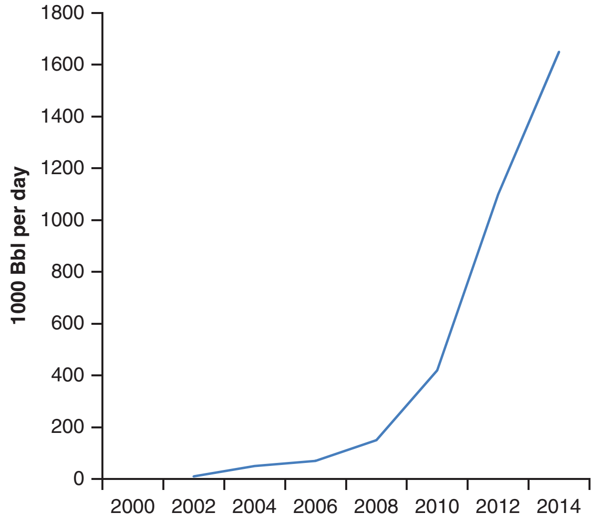

Figure 2. US production of shale oil. *Source*: Created by author using data from Rappaport, 2011.

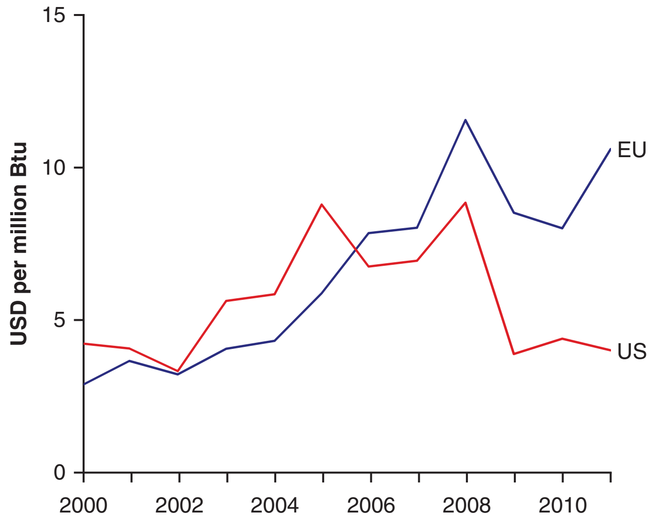

Figure 3. EU and US natural gas prices. *Source*: Created by author using data from BP, 2012a.

which the world oil and gas markets are integrated—not with each other, but each of the two markets in their own right. The received wisdom is that oil markets are globally integrated, but gas markets are not. This entails differing impacts of growing production of unconventional oil and of unconventional gas. The effect of unconventional oil should reach further around the world, but be less pronounced within the countries and regions where it is developed; the effect of unconventional natural gas should be greater in the countries and regions where it is produced, but less at the global level because of the disconnectedness of gas markets. This is illustrated by the limited impact of the increase in US production of unconventional natural gas on European gas prices, shown in Figure 3.

These assumptions need qualification. Oil prices in different parts of the world converge in the long term, but there are short- and middle-term bottlenecks between markets. The divergence between the prices of Brent and WTI crude oil blends in the early 2010s is one example of this (see Figure 5). Brent, the world's most important benchmark crude, is based on oil extracted in the North Sea and is traded in the Atlantic Basin. WTI is traded at Cushing, Oklahoma, and is mainly used in central parts of the United States.

The divergence in the pricing of these two benchmark crudes was caused by the accumulation of oil in the US Midwest, due, *inter alia*, to a surplus generated by the unconventional oil and gas developments in combination with a lack of transport infrastructure to take oil out of the region. Thus, during this period, the impact of shale developments on other parts of the world market was limited, although the resultant decline in US oil imports reduced the country's

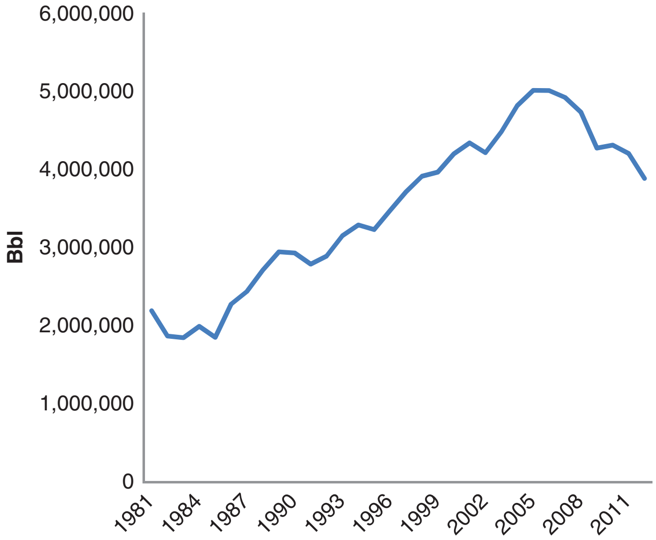

Figure 4. US imports of oil and oil products. *Source*: Created by author using data from EIA, 2014b.

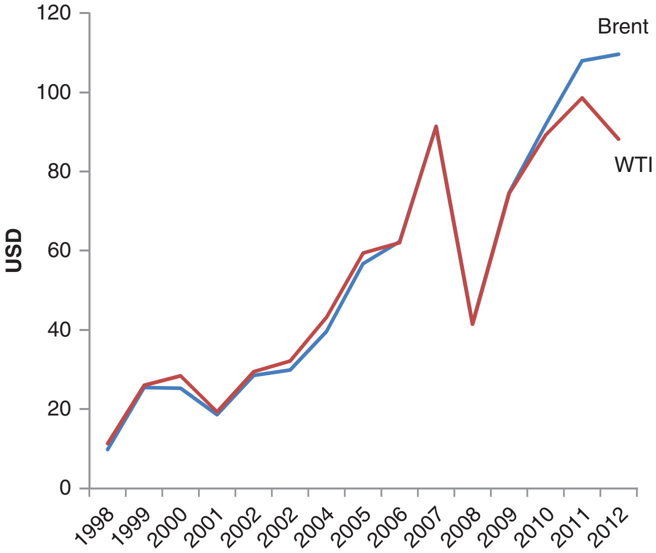

Figure 5. Price of Brent versus WTI crude oil 1998–2012. *Source*: Created by author using data from World Bank, 2012, in Index Mundi, 2013a,b.

energy dependency and might affect its approach to international affairs.

While oil markets may not be as connected as is sometimes thought, gas markets may prove to be more connected than assumed. Two concurrent developments to bear in mind are the steady geographical extension of gas pipelines and grids, and the growth in the global trade in liquefied natural gas (LNG). The building of the Turkmenistan-China gas pipeline is one example. By connecting with China's domestic trunk pipelines, this pipeline makes it possible to transport gas some 7000 km from Turkmenistan to Shanghai. Turkmenistan is already connected via Russia to the European pipeline grid, which extends from southern Spain to the United Kingdom and Finland (Anker *et al.,* 2010). At the same time, there are attempts at liberalizing the European gas market, interconnectors are being built between the various national grids, and European countries are steadily expanding the number of regasification terminals that can receive LNG by ship. Such developments contribute to the integration of markets for natural gas in various parts of the world, gradually making them less disconnected than in the past.

Having dealt with the basic aspects of unconventional oil and gas developments and the context within which they occur, the next sections turn to some possible consequences.

3.3 US shale gas and EU energy dependency on Russia

One of the main consequences attributed to the North American shale gas revolution was the lowering of natural gas prices in Europe in the early 2010s, by causing LNG cargoes destined for the United States to be rerouted to European ports (Szalai, 2012; Cunningham, 2013: 5; Bradshaw, 2014: 67–68). This in turn is often held to have made it possible to reduce the European Union's (EU's) energy dependency on Russia. However, that is at best a simplification. As Figure 6 shows, apart from growth in imports of LNG from Qatar, there was little increase in LNG cargoes to the EU during this period. Prices were probably affected more by the concurrent financial crisis that brought demand down, than by changes on the supply side.

In the longer term, however, as the US natural gas market is expectedly opened for export, North American shale gas could still have a more significant and direct impact on the EU's energy dependency on Russia. The cyclical spats between the EU, Russia, and the Ukraine— in 2006, 2009, and 2014—certainly encourage actors who are worried about EU energy dependency to seek diversification, and have been a driver for the rapid growth in the number of LNG regasification facilities in Europe. This is occurring in spite of the fact that Russian gas stands for only 5-6% of the EU's total energy supply (see Figure 7).

The role of North American LNG in Europe will also depend on developments in the Asia-Pacific LNG market. At present, prices are higher in Asia than in Europe, so North American exporters will logically prioritize that market. However, should the Asia-Pacific market be deluged by natural gas from Australia, Russia, and (perhaps, in the future) East Africa, a North American–European natural gas trade connection might become more salient.

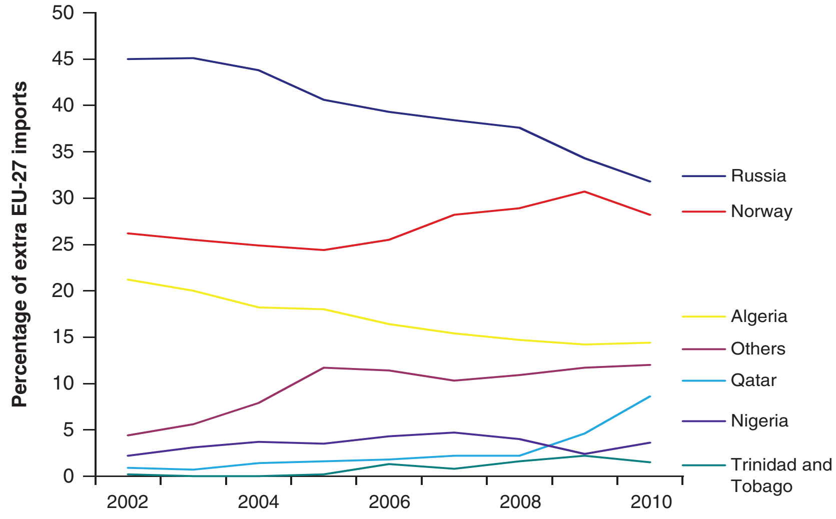

Figure 6. Origin of EU natural gas imports. *Source*: Created by author using data from BP, 2012a, 2012b; Eurostat, 2012.

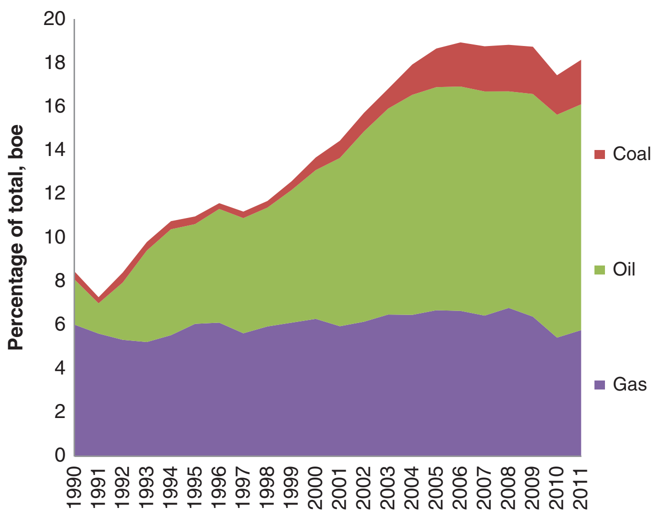

Figure 7. Russian energy, share of EU consumption by energy type. *Source*: Created by author using data from Eurostat, 2014.

3.4 Effects on relationships between different countries and regions

This and the following section examine how increasing extraction of unconventional oil and gas may affect exporting and importing countries and the interdependency between them. It starts by looking at oil exporters and importers at the general level, then turns to export–import interdependencies between specific regions, and finally surveys the main bilateral trade relationships.

Figure 8 shows how the vast majority of world oil exports come from the countries of the Middle East, with the countries of the Former Soviet Union (FSU) rising to become the second-most important exporting region. This means that most of the oil exporters sensitive to falling demand and/or prices are now likely to be found in these two regions.

From Figure 9 we see that the main importing regions are the United States, Europe, and Japan, but with imports to the rest of the world growing steadily from around 1992 onwards. In 1980, the OECD countries stood for around 75% of world oil imports, whereas by 2020 they will probably stand for less than half. Although the BP data underlying these figures do not—oddly enough—disaggregate China from the rest of the world, it is clear that Chinese imports play a large part in this sea change. Indeed, the very fact that BP chose not to disaggregate China from the rest of the world is perhaps indicative of how much more important China is nowadays than a few decades ago when BP started collecting these data.

This is evident in Figure 10, which shows that China overtook the United States as the world's largest oil importer in the fall of 2013. This figure also brings out the striking symmetry between the decline in US and rise in Chinese oil imports. China is now even more dependent than the United States on energy imports—not only because its volume of imports is greater but also because domestic production is smaller. As regards the continuing functioning of the economy and society, China is thus more vulnerable to supply disruptions than the United States. This makes the international military and political involvement in the Middle

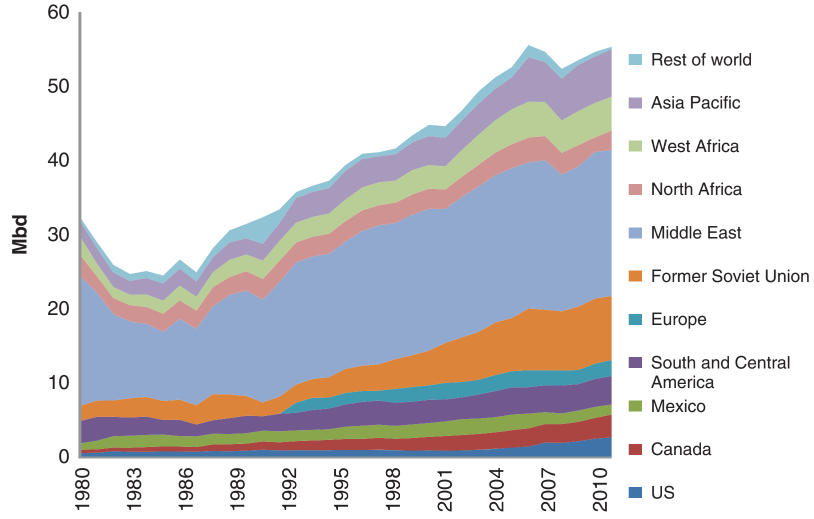

Figure 8. World exports of oil by country. *Source*: Created by author using data from BP, 2013.

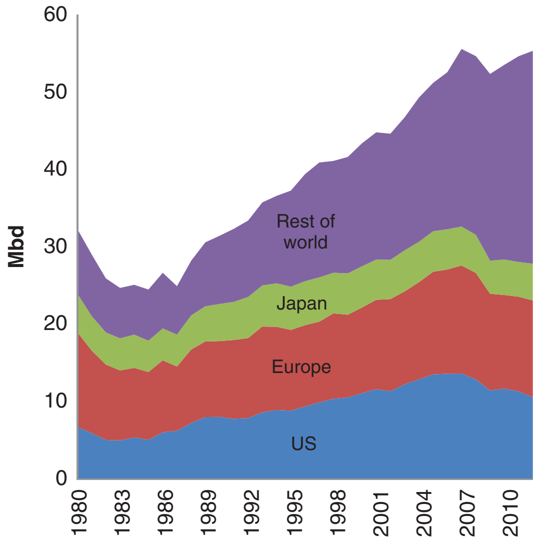

Figure 9. World imports of oil by country or region. *Source*: Created by author using data from BP, 2013.

East, where the United States is heavily represented with forces and allies, whereas China has scant foothold, even more skewed.

Further, it means that China has an even greater interest in the promotion of unconventional oil and gas—anywhere in the world—than the United States, as it reduces the dependency of the entire world oil market on the Middle East. The best thing for China would, of course, be for unconventional resource to be developed within China itself, as that would be of direct benefit to its economy—but also developments elsewhere that contribute to diversifying and thus stabilizing the world supply of oil and gas are a boon to China. For this reason, the US shale boom should be recognized as a development highly positive for China. Without it, both countries would be paying more for their oil than they currently do.

The case of China's increasing import dependency and fragile energy security illustrates a key aspect of the triangular relationship between import dependency, energy security, and conflict. Rising imports are driven by industrialization and economic growth. Thus, national energy supplies tend to become more vulnerable at the same time as those countries become stronger, economically, and militarily—a potentially dangerous combination.

The flipside of this growing energy dependency of China and other emerging economies on supplies from the Gulf countries and other major oil and gas exporters is that the importance of the new importers increases. The exporters once focused almost exclusively on their markets in the United States and other OECD countries, whereas now they increasingly have an interest in the Chinese economy and politics. It may sound paradoxical, but in this regard they might be considered "rising importers."

Figures 11 and 12 provide graphic illustrations of the main regionally specific oil-trading relations in the world. We see that the most intense trade relationship is that between oil exporters in the FSU (Azerbaijan, Kazakhstan and Russia), and oil importers in the EU. Other major oil-trade routes go between North Africa and the United States, and

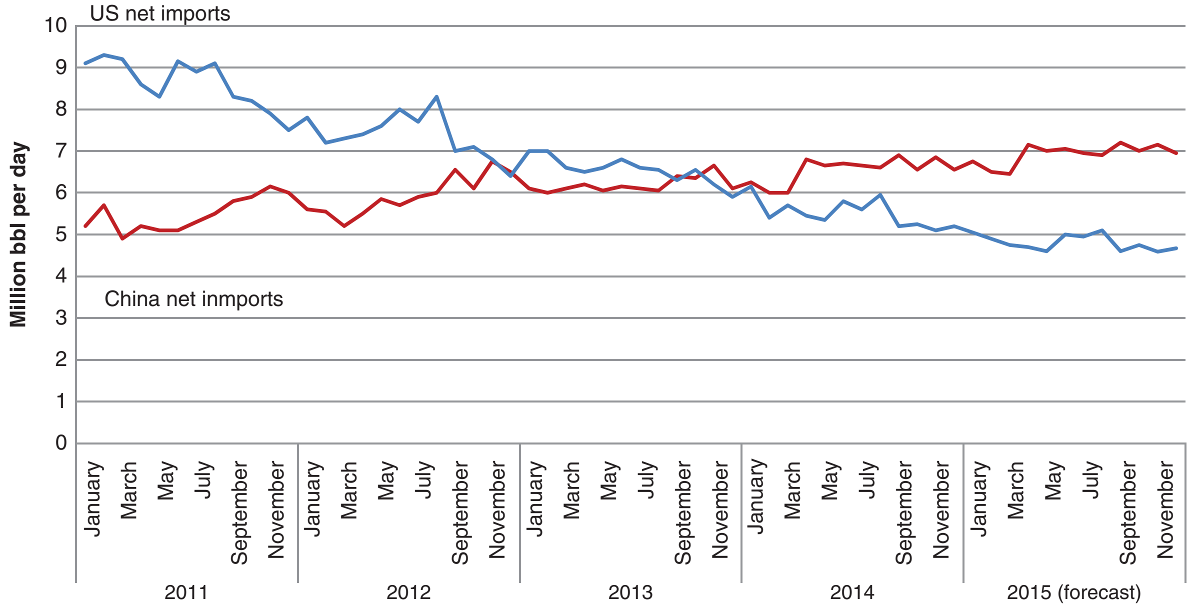

Figure 10. Comparison of net petroleum and liquids imports for China and the United States. *Source*: Created by author using data from Dunn, 2014.

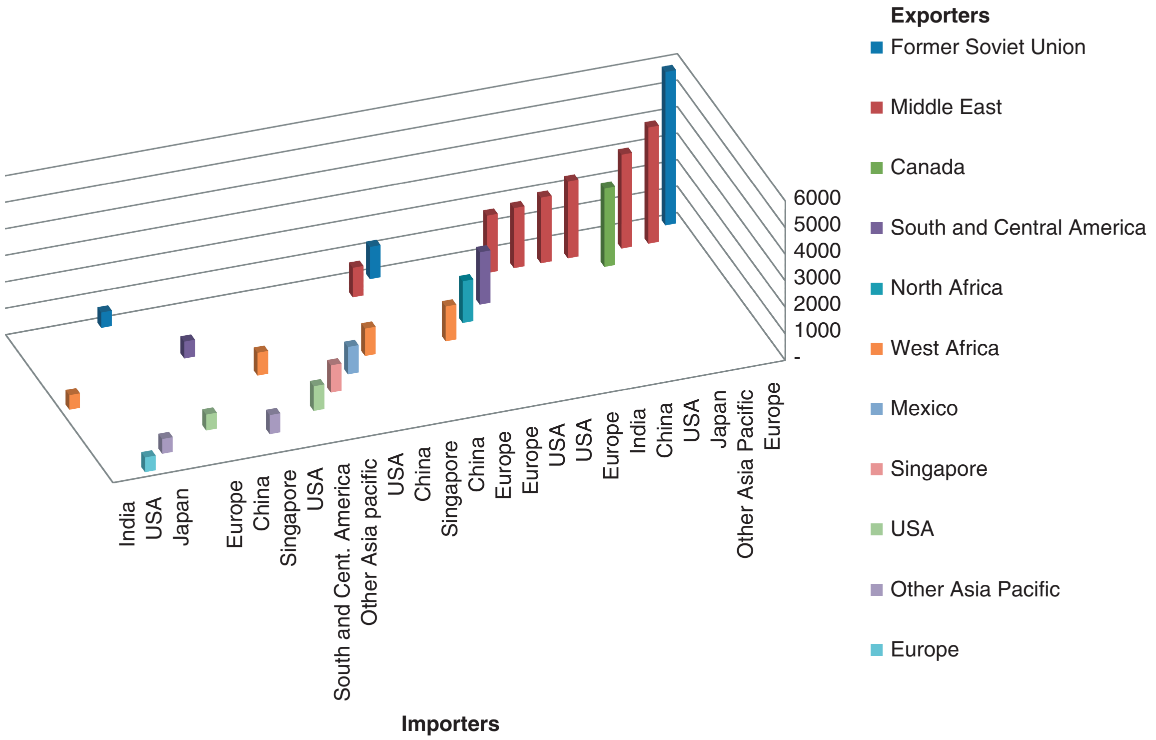

Figure 11. Top 25 intensive bilateral oil trade relationships in 3D. *Source*: Created by author using data from BP, 2013.

between China, Japan, and India and the Middle East. If unconventional oil and gas are developed mainly in North America, then the relative importance of the other interregional relationships is likely to increase. Should, however, the extraction of unconventionals spread to the rest of the world, we might see a general decline in the importance of the Middle East and other conventional oil-exporting regions.

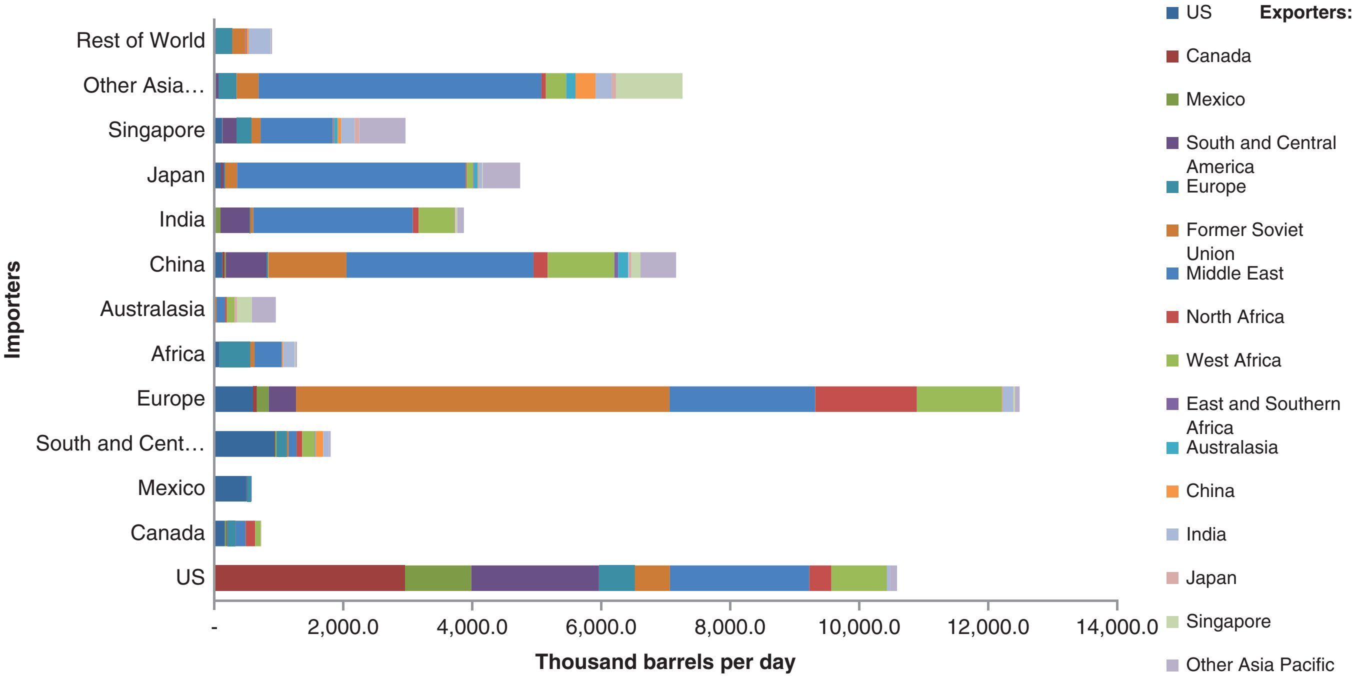

Figure 12. Top 25 bilateral oil trade relationships in 2D. *Source*: Created by author using data from BP, 2013.

In any case, any changes are likely to affect US military engagement in the Middle East, the status of Israel in international affairs, relationships with Russia, and interests in North Africa. It is impossible to predict what the exact effects will be, except that there are likely to be changes in foreign policy, levels of engagement, and the willingness to make sacrifices such as loss of lives in military conflict.

It is not only the relationships and power balance between exporters and importers that may change: also, the power balance between various importers may be impacted. If major unconventional oil and gas developments are largely limited to the United States, this may affect the China–US balance of power. There has already been a partial development away from a situation in which the United States was dependent on oil supplies from unstable Middle Eastern countries and spent considerable amounts of money in seeking to secure these supplies, while China was neither affected nor involved to the same extent; to a situation in which the United States becomes far less vulnerable to supply disruptions in the Middle East, China is far more vulnerable, and the United States still controls the strategic sea lanes of communication. Even just, the prospect of such a development could trigger a rapid expansion in Chinese naval capacity and heightened naval competition between China and the United States. To some extent, these developments have already started; and although they may make some sense in terms of which country has the greater stake in the Gulf, they also have implications for how the increasingly hot conflicts in the East and South China Seas will unfold.

3.5 Consequences of unconventional oil for OPEC

A major political factor in the global petroleum sector is the Organization of Petroleum-Exporting Countries (OPEC), the cartel of major oil exporters, many of which also have some degree of overlap in their ideological and political outlook. For example, OPEC member countries Algeria, Ecuador, Iran, Iraq, Libya, and Venezuela are all run by governments that espouse *anti*-American stances while also being subjected to various degrees of Western criticism over their own record on human rights and democracy. However, Saudi Arabia is the most important oil producer in OPEC and an important US partner, although there are obviously important ideological and cultural differences between the two countries that might play out differently under other circumstances. Most of these countries are highly dependent on continued high oil prices for their socioeconomic welfare and for the long-term political survival of their governments.

OPEC had its heyday in the 1970s, when it stood for over half of world crude oil production and over 80% of world exports (see Figure 13). After a trough in the mid-1980s, the organization's share of output and exports grew again. Although OPEC today does not wield the kind of power that

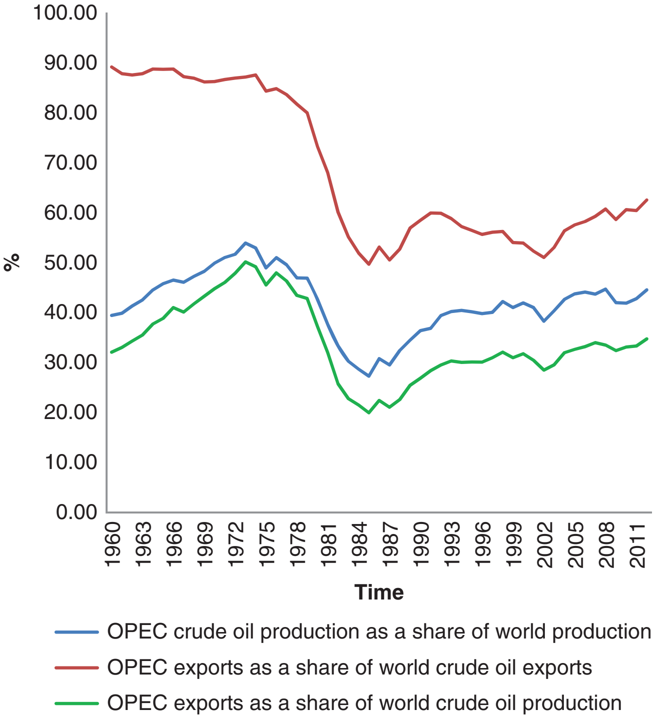

Figure 13. OPEC share of world crude oil production and exports. *Source*: Created by author using data from OPEC, 2013: 30.

it did during the oil crises of 1973 and 1976, it controls a large enough share of world oil production and especially exports to contribute to keeping prices high. If OPEC's reserves were not controlled by the governments of the OPEC countries through their national oil companies but by Western-based international oil companies such as BP and ExxonMobil pursing a maximalist commercial logic, it is likely that oil prices would be significantly lower.

And it is on this background that one must try to understand the impact of unconventional oil and gas. For OPEC, the growth in conventional oil and gas resources until the mid-2010s was not an issue, as oil prices remained stable at historical highs. However, should the most optimistic expectations for the expansion of unconventional oil and gas in the United States and the rest of world come true, that could contribute to driving oil prices downwards, reducing OPEC's income. Alternatively, OPEC could reduce its production, but would lose income all the same. And if such a development were combined with reduced consumption due to prolonged global financial troubles, a crash in China and/or a more effective successor regime to the Kyoto Protocol, then that would pose a serious challenge to the power of OPEC.

Because most OPEC oil—especially in the Gulf countries—is cheap to produce, OPEC would continue to play a central role in world oil supply under a lower price scenario, whereas it would be the most expensive unconventional oil and gas developments that would be canceled. But OPEC would lose its pricing power above the cost levels for producing unconventional oil and could be selling at lower prices than during the first two decades of this century. On the other hand, although the downward price pressure exerted by unconventional oil is limited by the high cost of producing unconventional resources, that cost could change as technologies evolve. If the cost of producing unconventional oil falls, it will drag OPEC's clout down with it.

An additional concern for the OPEC countries is that most of them are heavy energy subsidizers with rapidly growing populations. As Figure 14 shows, almost all of the OPEC countries are among the world's 25 largest subsidizers of fossil fuels, and Iran and Saudi Arabia are the two largest subsidizers in the world. As a consequence, as reflected in Figure 15, the capacity of some OPEC countries for export is dwindling. As the red lines creep up toward the blue lines, the OPEC countries will be rendered increasingly vulnerable to revenue losses from reduced export prices (Cheon, Urpelainen, and Lackner, 2012; Krane, 2013, 2014). In Egypt, these lines crossed only a few years before the Arab Spring that overthrew President Hosni Mubarak; also in Indonesia the lines have crossed, causing the country to leave OPEC and coinciding with a strengthening of democracy.

Energy subsidies are a simple way for otherwise weak states to give something to the population, so they are particularly common in countries with high levels of corruption and low levels of governance (Overland, 2010a, 2013; Overland and Kutschera, 2011). Such subsidies do not make sense for the governments of advanced states, but they can be a means for the governments of weaker states to stay in power. If unconventional oil and gas and/or climate policy put downward pressure on the price of oil, exporters will have less disposable income to maintain subsidies. Subsequent subsidy cuts could lead to political upheaval and potentially regime change in many OPEC countries and other major oil exporters. On the other hand, lower prices for oil and gas would reduce the price difference between exports and domestic subsidized sales—but probably not enough to solve the problem for the subsidizing states.

If unconventional oil and gas extraction were to rise sufficiently for the United States and perhaps China to become major exporters, they could start competing with OPEC, lowering oil prices and further weakening the cartel. On the other hand, then they would also start sharing OPEC's interest in high oil prices, but that would probably not be sufficient for them to limit their exports or otherwise coordinate with OPEC. The case of Russia is illustrative. Russia has strong historical and political ties with important OPEC countries such as Iran and Venezuela, but has still not shown any interest in joining OPEC and has rapidly pushed up its

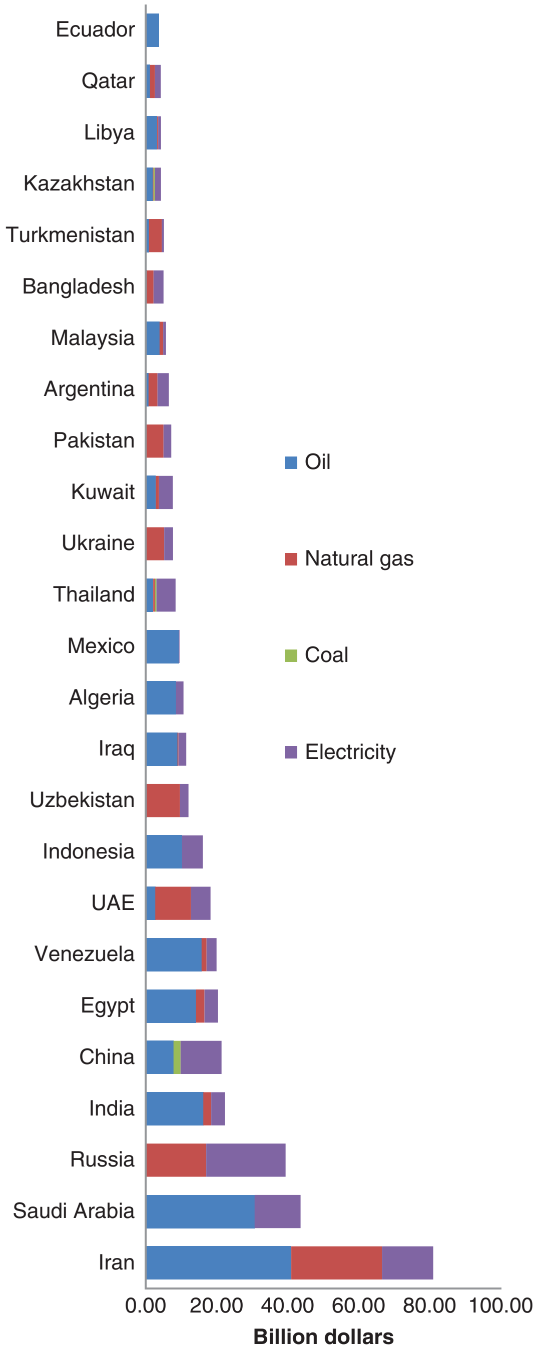

Figure 14. Economic cost of fossil-fuel subsidies for top 25 economics. *Source*: Created by author using data from IEA, 2011.

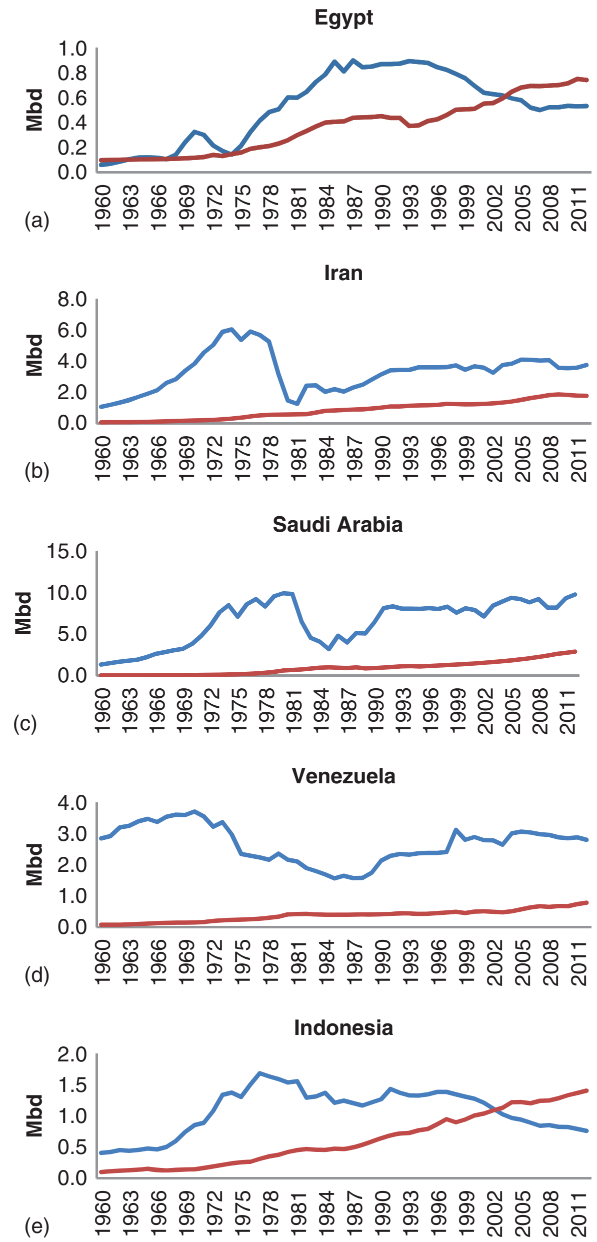

Figure 15. Oil production and consumption for Egypt, Indonesia, Iran, Saudi Arabia, and Venezuela. *Source*: Created by author using data from OPEC, 2013.

oil exports to become the world's second-largest exporter after Saudi Arabia—thus limiting OPEC's market share. The United States, which does not have the same relationships with most OPEC member countries, is even less likely to actively support OPEC's interests.

If China or the United States were to become a major oil exporter, it could be an important factor in the emerging superpower competition between the two countries, by improving their trade balance and making them less dependent on the outside world and therefore freer to interact with other countries as they please. If the United States, but not China, were to become a major oil exporter on the back of growing unconventional oil production, it might help the United States withstand the competition from rapidly rising China and remain the only superpower and vice versa. But at least in the first decade and half of the 2000s, the United

States was reducing its imports on the back of growing production of unconventional oil and gas, whereas China had made little progress on unconventionals and its imports were rising. This may also be indicative of another aspect of the rivalry between the two countries: the United States has always had the technological and innovative upper hand, with China and other countries trying to catch up. In the case of unconventionals that is still very much the case.

3.6 The resource curse and democracy

Windfall revenue from oil and gas is closely associated with the resource curse—the paradoxical notion that resource revenue may have a negative net impact on the development of countries. The resource curse literature includes three main branches, one on economic mismanagement, one on conflict over resources, and one on authoritarianism. Although the literature on authoritarianism has recently been criticized (Haber and Menaldo, 2011), this criticism is weakened by the datasets used and resource revenue remains associated with authoritarian rule, especially in the Arab world.

For the governments of countries such as Saudi Arabia and Qatar (both non-democratic monarchies highly dependent on oil and gas revenue), a scenario in which unconventional oil and gas production reaches sufficiently high levels to lower oil prices involves a double risk. Firstly, oil prices may fall, reducing the cash flow of the governments and thus their ability to keep the population satisfied and themselves in power. Secondly, as the energy dependence of the West on these countries is reduced, Western governments may become more critical and confrontational about human rights issues. The pressure of these two simultaneous developments may cause governments to fall.

As non-democratic countries rarely if ever fight each other, a reduction in resource-supported authoritarianism could also lead to a reduction in the number of interstate conflicts in the world. Non-democratic, oil-fueled states that have been involved in violent interstate conflicts in recent decades include Iran, Iraq, Libya, and Russia. Had not the rulers of these states had access to large revenue flows from oil and gas, it is possible that not all of these conflicts would have occurred.

The simultaneous effect of reduced dependency in oil-importing countries could further reinforce a trend away from authoritarian rule in oil-exporting countries. It is widely assumed that petroleum-importing countries are reluctant to criticize or otherwise put pressure on the countries that they import oil and gas from (Hancock, 2007; Human Rights Watch, 2010). This applies in particular to relations between the United States and Saudi Arabia (Human Rights Watch, 1992: 49; Hancock, 2007: 57–59), but also more broadly to relations between industrialized, democratic importers and authoritarian exporters. It is therefore possible that reduced energy dependency in such bilateral and multilateral relationships might lead to increased criticism and pressure on non-democratic regimes, to more international friction—and ultimately to a more democratic world.

3.7 Where are the unconventional resources located?

Apart from the energy dependencies between countries linked to the trade relationships already discussed, the change of status from importer to exporter—or vice versa—is a big change for any country. The difference is that between making money and losing money—potentially on a large scale. If the extraction of unconventional oil and gas keeps spreading, it is important to be aware of just where the resources are located.

Figures 16 and 17 show the 10 countries that have the largest shale reserves in the world. The first interesting thing to note is that eight of the countries are already among the world's major oil or gas exporters: Algeria, Australia, Brazil, Canada, Libya, Mexico, Russia, and Venezuela. As long as their conventional reserves last, these countries are not likely to put a lot of effort into developing unconventional resources—it is more profitable for them to focus on their conventional onshore reserves. But as these reserves are depleted, unconventional oil and gas may become more attractive, perhaps more so than offshore oil and gas, especially in the Arctic, where costs have skyrocketed (Lunden *et al.,* 2013; Overland *et al.,* 2013; Overland, 2011).

The major oil and gas *importers* that have significant reserves of unconventional oil and gas include China, Pakistan, South Africa, and the United States. Thus, until new resources are identified elsewhere, it is to these countries that we should look for any potentially major changes of fortune as a consequence of unconventional oil and gas.

There are no European countries except Russia on this list. However, both Ukraine and Poland have unconventional natural gas reserves; if these should prove even moderate in a global context, this might have major political implications as regards their energy dependence on Russia.

The global trade in oil is asymmetric, with many importer countries and a few exporter countries. Consequently, the impact of unconventional oil and gas may be asymmetric as well. The largest bars in Figures 16 and 17 represent the category "Others." This indicates that, although other countries have smaller reserves, there exist many such countries—which in turn means that, although there may not be so many new big exporters, there may be many more self-sufficient or partially self-sufficient countries. For each

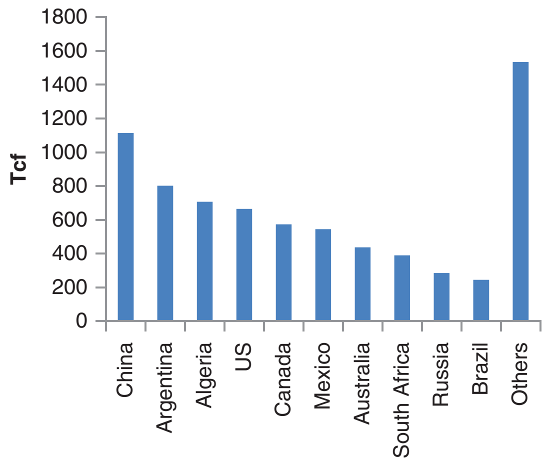

Figure 16. Technically recoverable shale gas reserves, top 10 countries. *Source*: Created by author using data from EIA, 2013c.

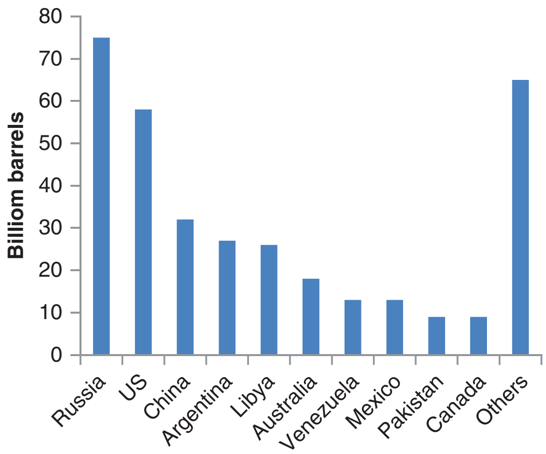

Figure 17. Technically recoverable shale oil reserves, top 10 countries. *Source*: Created by author using data from EIA, 2013c: 10.

such country, that development would be positive, but it probably will not change the world as a whole dramatically. A more significant aspect of such a development would be the weakening position of the major exporters. It is logical to expect that changes would be most felt in exporting countries, due to the asymmetry of the global trade in oil. Throughout the oil era, the majority of the world's countries have been siphoning off a bit of their economy and handing it over to a smaller number of major petroleum exporters, and the sum of all those payments has represented windfall incomes for the exporters. If the old importers reduce their energy dependency, the security and economy of each of them will improve a bit, whereas the situation of the exporters may deteriorate much more.

It should be noted that the data in Figures 16 and 17 concern *technically* recoverable reserves, that is, relatively certain reserves that it is technically possible to extract with current technology. This does not necessarily mean that it is *economically* viable to extract them. On the other hand, these data do not include any new reserves that may be found in the future—which may or may not be large.

It may also be that unconventional resources have been mapped better in countries that have developed petroleum industries, and where more geological exploration has been carried out and thousands of wells have been drilled over decades. On the other hand, it may also be that unconventional resources are more likely to be found in areas where there are also conventional reserves. Oil and gas are the result of the sedimentation of organic material, which has tended to occur more in some locations on the earth's surface than in others.

The size of individual unconventional oil and gas fields in a country may be as important as the overall size of the country's unconventional reserves. Economies of scale for infrastructure, staffing, and legal work are easier to achieve in connection with one large reservoir than with a multitude of small fields in many different locations. That also means that large fields are more likely to be developed than small ones.

Figures 18 and 19 cover the largest known shale oil and shale gas formations in the world, respectively. Natural gas is more cumbersome and expensive to transport intercontinentally than oil and therefore more likely to be developed where there exists a large energy market that is integrated in legal, financial, and infrastructure terms. The importance of upstream factors for the shale revolution in the United States is often emphasized: the prior presence of a large number of drilling rigs and private land ownership including subsoil rights. But the importance of the downstream pull of the large and integrated US market is largely overlooked. The gas markets of most other countries are not even close to the

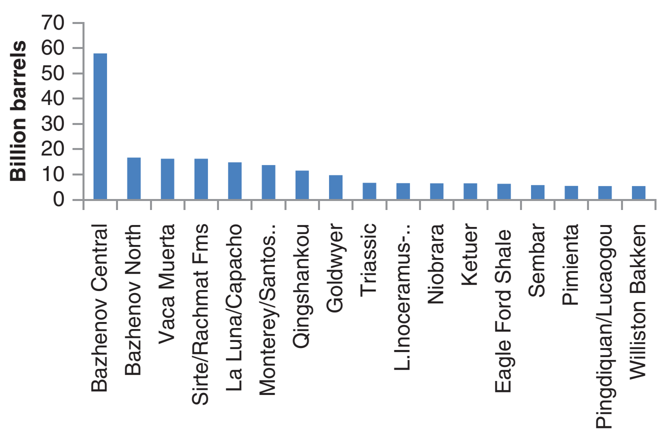

Figure 18. World's largest known shale oil formations. *Source*: Created by author using data from EIA, 2012: 58; EIA, 2013c: Attachment A-1.

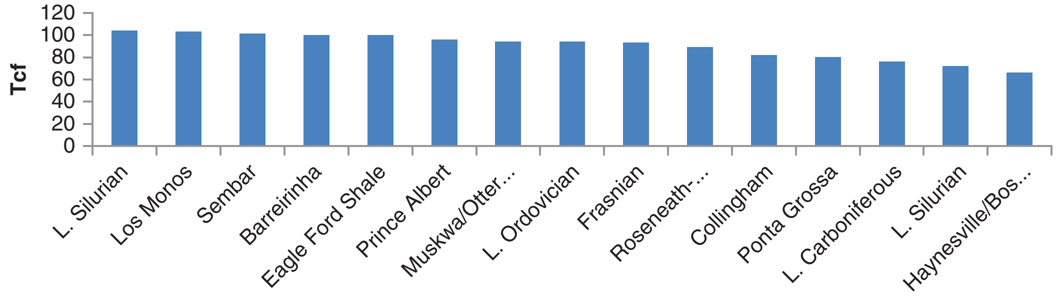

Figure 19. World's largest known shale gas formations. *Source*: Created by author using data from EIA, 2012: 58; EIA, 2013c: Attachment A-1.

size of the US market, and this may slow down or limit the spread of shale gas extraction.

As oil is easier to transport and thus export to the world market, unconventional shale oil may be more important that natural gas, especially in countries and regions with smaller integrated markets. As Figure 18 shows, the largest fields are Bazhenov (Russia), Vaca Muerta (Argentina), Sirte (Libya), La Luna/Capacho (Colombia/Venezuela), and Qingshankou (China). Russia's Bazhenov formation, if counted as a single area, outclasses the rest. The Russian authorities and state companies aim to develop the Bazhenov formation during the coming years, but their ability to achieve rapid development there is not certain. Even if they should succeed, that would not dramatically alter Russia's already well-established status as the world's largest energy exporter. Argentina, whose Vaca Muerta shale oil formation is roughly the size of Belgium, is one of the countries that could be most affected by shale oil. China, which has several major unconventional oil fields, may also be able to extract substantial amounts. That could help break its growing dependency on imports (much of which come from the Gulf countries); however, that dependency is already so great and has been growing at such a rate that domestic shale resource developments are unlikely to result in a fundamental change of trajectory.

High oil and gas prices encourage producing countries to increase their output. Russia is a particularly relevant case, as it has been living the past 20 years on oil and gas fields that were developed during the Soviet period and are now declining. It is therefore now finally making an effort to develop new fields. However, it would also be possible for Russia to instead develop renewable sources of energy—which are also abundant in Russia—for the domestic market, thus freeing up more oil and gas for export. So far however Russia has made little progress on renewable energy (Kjaernet and Overland, 2009; Overland, 2010b). It would take a highly effective global climate agreement to get Russia to make this switch in priorities.

3.8 Environmental aspects of fracking

Shale oil and gas are extracted by means of hydraulic fracturing (fracking). Fracking involves cracking of the rock by using pressurized water mixed with sand and chemicals to keep the cracks open. The environmental consequences of hydraulic fracturing are hotly debated. This debate first centered on the United States, and then spread to other countries with shale gas resources—especially France, Poland, and the United Kingdom. The debate concerns the following potentially environmentally detrimental aspects of shale gas extraction: overconsumption of water, groundwater pollution by gas and/or fracking chemicals, noise and dust from increased traffic to well sites, release of methane into the atmosphere, and increased seismic activity. Here, a brief summary is provided of the main environmental issues at stake and the opposing views. No attempt is made to draw conclusions, as many of these issues are technically complex and remain unresolved.

As water is the main ingredient in fracking, significant amounts of water are inevitably used. This has been raised as a major concern by many commentators (Rahm and Riha, 2012: 16). However, the fracking industry argues that most energy production consumes water; that fracking does not consume more water than most other energy sources and is therefore not a particular problem except in locations where there is already a severe water shortage (see Scott *et al.,* 2011 cited in Uliasz-Misiak, Przybycin, and Winid, 2013: 3; Maugeri, 2012: 59–60; International Association of Oil and Gas Producers, 2012).

A second issue related to water is the claim that groundwater supplies may become contaminated (see Stark *et al.,* 2012: 5). While industry representatives argue that the use of chemicals, below 1% of fracking liquid, is insignificant, Maugeri (2012: 60) points out that, given the large amounts of liquid involved, that may still correspond to 100,000 kg of chemicals per well. However, the Interstate Oil and Gas Compact Commission (IOGCC), which has 30 member states in the United States, reported in 2009 that there was not a single case where it had been confirmed that fracking had contaminated groundwater (Stark *et al.,* 2012: 6). According to the International Association of Oil and Gas Producers (2012), the chemicals used in fracking are used in many domestic cleaners, cosmetics, and food, and therefore pose little environmental risk. Uliasz-Misiak, Przybycin and Winid (2013: 5) note that freshwater aquifers are usually found at depths of up to 300 m, while shale oil and gas is extracted from rock that may be located several kilometers below ground level. However, Maugeri (2012: 59) mentions a water well in Dimock, Pennsylvania, that exploded in 2009, apparently because of the high concentration of methane.

Another criticism of fracking concerns the increased traffic to well sites. Because production from fracked wells declines faster than from conventional oil and gas wells, many more wells need to be drilled, entailing more movement of equipment, drilling crews, and water (Stevens, 2010a: 39; Kolb, 2014: 121). This can lead to a surge in trucks passing through previously quiet rural areas.

Another criticism of fracking concerns the release of methane, a potent climate gas. According to some sources, however, fracking does not entail the release of more methane than does conventional gas production (or oil production, because much oil comes with associated natural gas) (Kolb, 2014: 119).

The final worry related to fracking is the possibility that it might trigger earthquakes. According to Fischetti (cited in Maugeri, 2012: 61), 10 small earthquakes possibly caused by fracking struck Ohio, a state that is not normally earthquake-prone, in 2011. There has also been concern over possible linkages between fracking and earthquakes in the United Kingdom.

A systematic comparison by Louwen (2011: 54) concludes that shale gas extraction leads to emissions of 5.41 gCO_2-eq/MJ compared to 2.81 gCO_2-eq/MJ from conventional gas. However, if the conventional gas is produced in Russia, it leads to 4.9 gCO_2-eq/MJ, not all that much less than shale gas. Emissions from coal are significantly greater, so when competing against coal, shale gas has a distinct advantage under a strict policy on greenhouse gas emissions.

Another comparison by Jenner and Lamadrid (2013: 446) finds that shale gas consumes 606–2016 liters of water per megawatt hour (l/MWh), whereas conventional gas consumes 576–1986 l/MWh and coal 1981–1402 l/MWh. The broad ranges of possible water consumption reflect the great variation in geology, extraction methods, and regulations. Such variations are so great, and change over time so rapid, that it is difficult to make good comparisons of the environmental aspects of these different energy types.

At this stage it is too early to draw conclusions on the environmental aspects of shale gas and oil extraction. Any broad conclusions are going to have to take into account experience from a large number of wells over time and in different locations—as well as new developments in technology and new practices (cf. Rahm and Riha, 2012: 22). What is clear is, firstly, that shale developments will lead to political (as well as scientific and expert) debate over the environmental consequences; and, secondly, that how those debates play out in various countries will affect the evolution of unconventional oil and gas extraction. Politics is as likely to affect unconventionals as unconventionals are likely to affect politics.

4 CLIMATE POLICY

As the references in the first half of this chapter show, unconventional oil and gas developments have led to a flurry of analysis of the possible changes they could cause in oil and gas markets, and the political and geopolitical consequences of such changes. It is striking how much less analysis there has thus been of the consequences of the possible emergence of an effective global climate policy for the petroleum sector. This lack of research is indeed odd, considering that around 36% of global greenhouse gas emissions come from the combustion of oil and 20% from natural gas (IEA, 2012: 8). This discrepancy is all the more paradoxical considering that climate change has been on both the public and social science agendas significantly longer and on a larger scale than unconventional oil and gas and there has thus been more time to conduct and publish research on it.

What little analysis exists of the consequences of climate change for the petroleum sector is mostly from the early 2000s, with a peak around 2002 (Kolk and Levy, 2001; Springer, 2002; Van den Hove, Le Menestrel, and de Bettignies, 2002; Le Menestrel, van den Hove, and de Bettignies, 2002; Skjaerseth and Skodvin, 2003; Barnett, Dessai and Webber, 2004). Given the fast pace of change in the petroleum sector, in climate science and in climate politics, much of this literature is now outdated.

An exception is the literature on stranded carbon assets, which blossomed in 2013 (see Ansar, Caldecott, and Tilbury, 2013; Generation Foundation, 2013; Leaton *et al.,* 2013; Spedding, Mehta, and Robins, 2013). This literature (discussed below) remains small and largely confined to online reports produced by nongovernmental organizations (NGOs), with little in terms of academic scholarship. Considering the media coverage of the International Panel on Climate Change, the international effort put into negotiating a follow-up treaty to the Kyoto Protocol and the discourse on climate change from politicians and even some oil companies, it is surprising that there has been so little attention to the consequences of a stricter climate policy for the petroleum sector.

That is not to say that there is no research on the geopolitics of climate change—but it largely ignores the whole topic of the geopolitics of the petroleum sector. For example, a special issue of the journal *Climate Policy* from 2013 on the changing geopolitics of climate change pays scant attention to the question of how climate policy will affect petroleum exporters and importers or oil companies (Streck and Terhalle, 2013). The topic has also been ignored in other analyses of geopolitics and climate change that might have been expected to cover it (e.g. Falkner, 2010).

One possible reason for this lacuna is that many people in the petroleum industry are either climate skeptics or simply repress any thoughts about climate change (Farrow, 2000: 195; Skjaerseth and Skodvin, 2003: 178; Sim, 2009: 3). They see the climate agenda as something that has been imposed from the outside. By contrast, unconventional oil and gas is very much in line with the internal logic of the petroleum industry, and is being driving by the industry itself.

4.1 Energy diversification versus vulnerability: China, the EU, the United States

Bridge *et al.* (2013: 339) argue that a transition to a low-carbon energy system can be both a "creative and destructive process that significantly changes how different places are related to each other, economically, politically, and even culturally, and at a range of different scales."

The EU is often seen as particularly energy-dependent and vulnerable, becuase of its dependency on Russian natural gas. However, as mentioned above and shown in Figure 7, Russian natural gas in fact makes up only 5–6% of EU energy consumption, although some Central and East European countries are highly dependent on it. As Figure 20 indicates, the EU is no less diversified in its energy sources than China or the United States, and its overall energy consumption is far lower than that of the United States, especially if one takes into account the fact that the EU has a much larger population. And as Figure 21 shows, particularly in terms of electricity supplies, the EU has a far more diversified supply than China (which relies heavily on coal) or the United States (which relies heavily on coal and natural gas).

China's entry into the photovoltaic solar market in the early 2010s lowered prices around the world, and the 2014 deals between Chinese companies and the Russian companies Gazprom (for pipeline gas) and Novatek (for LNG) strengthened China's future access to natural gas supplies. But overall, China remains heavily, and increasingly, dependent on coal—and that could be a problem for China under a stricter global climate policy. In contrast, the EU has made rapid progress on the expansion of renewable energy and is reducing its dependency on other energy sources, especially crude oil (see Figure 22). Thus, of the three big industrial blocs, the EU is best positioned for a stricter global climate policy, and is—unsurprisingly—one of its main champions.

4.2 OPEC and other oil exporters

The OPEC countries have feared attempts to establish a stricter and more global climate policy, seeing them as a threat to their oil export revenues, and possibly even their statehood (Bradshaw, 2010: 285). Also Russia, the world's largest oil exporter outside OPEC, has been skeptical to wards climate change and climate policy. Unlike China and the United States, it is a signatory to the Kyoto Protocol—but this has cost Russia little, as the Protocol takes 1990 as its basis year and Russian emissions fell after that, due to the collapse of the Soviet Union. A future and more effective global climate agreement would be more difficult for Russia to digest and might be resisted more actively.

To mitigate the risk of a more effective global climate policy, some Middle Eastern countries have been investing in renewable energy to diversify away from oil. One example is Abu Dhabi's Mazdar City. But these investments remain small compared to the revenue flows from oil and gas, and it is not clear how they might be turned into new sources of income.

Loulou *et al.* (2008) examine scenarios of introducing strict climate-change targets and their impact on the OPEC countries. They find that while OPEC's export volumes would remain relatively stable under such scenarios, profits would be reduced. It is thus likely that OPEC will continue to resist a strict global climate-change regime with high emission reduction targets (Lolou *et al.*, 2008: 21–22). One development that might change this situation is if the world's oil exporters, dominated by the arid OPEC countries of the Middle East, come to see climate change as such a serious threat to their own ecology and water supply that they start taking it seriously (Brown and Crawford, 2009). However, the threat would have to be seen as very great indeed, as the governments of these countries are heavily dependent on petroleum revenues for maintaining socioeconomic stability and their own popularity.

An effective climate policy would affect not only the fortunes of oil exporters but also other countries that are dependent on intensive trade patterns. For example, a stricter climate-change policy could take the form of a toll on carbon-based imports and be applied to all internationally traded goods (Matoo *et al.,* 2009: 20). Such a policy would increase trade costs in the developed countries, while posing an obstacle to the trade expansion of developing countries. Matoo *et al.* (2009: 20) estimate that a 20% tariff on Chinese and Indian imports would result in 16–21% reduction in

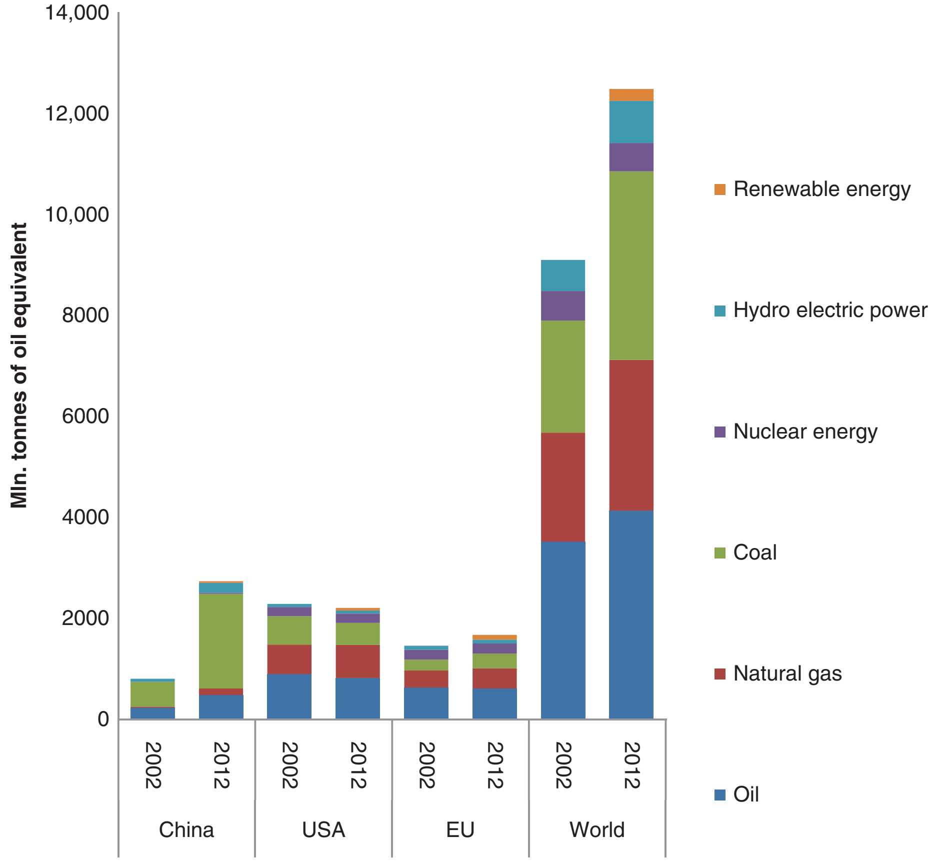

Figure 20. World energy consumption by major bloc and energy source, 2012 compared to 2002. *Source*: Created by author using data from BP, 2002; BP, 2013.

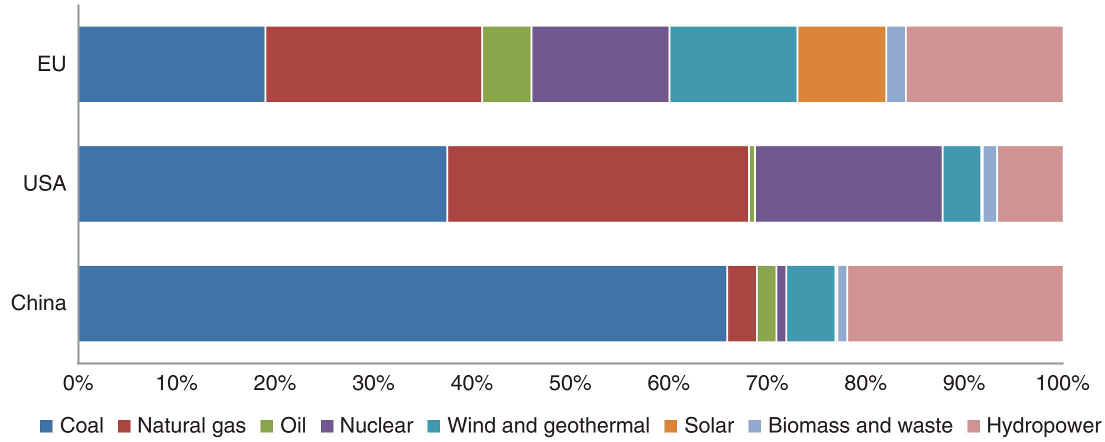

Figure 21. Installed electricity generation capacity by energy source; China, EU, and the United States. *Source*: Created by author using data from EIA, 2013d; EIA, 2014c; European Wind Energy Association, 2014.

their manufacturing exports. Similarly, Paavola and Adger (2006: 603–604) found that introducing a global carbon tax ranging from US$20 to US$50 per carbon equivalent ton would increase the overall per capita tax levels in many countries. If the tax were set at US$20, then the per capita tax would increase by US$100 in the United States and by US$40–70 in Europe (Paavola and Adger, 2006: 604).

The potentially negative effect of climate policy on oil exporters could be thought of either as a side effect or as a necessary component of an effective policy. As oil exporters

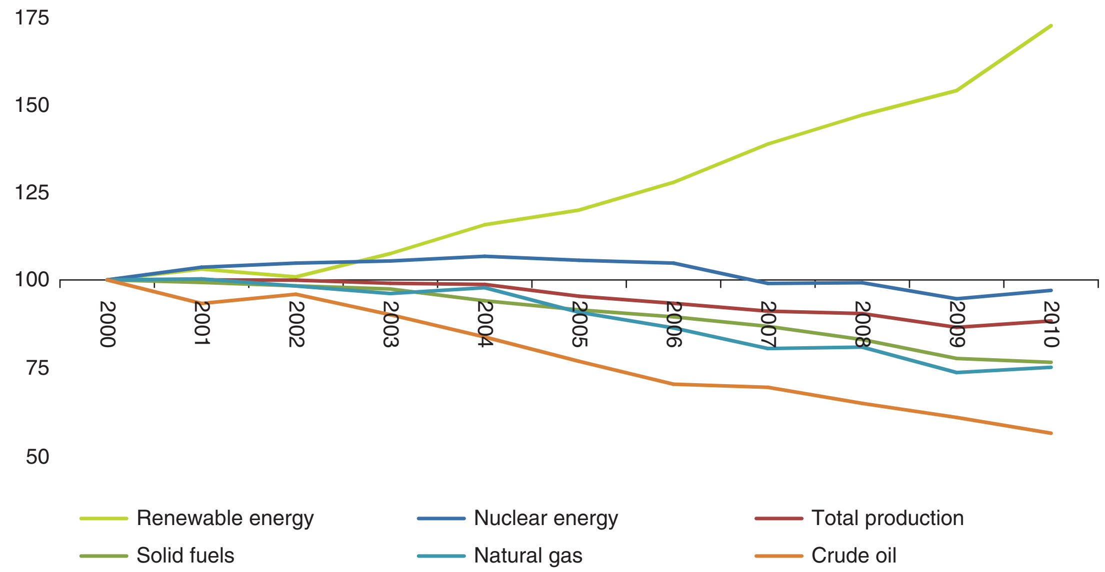

Figure 22. Changes in EU energy production 2000–2010 by energy source. *Source*: Created by author using data from Eurostat, 2013.

sitting on large reserves of oil, the OPEC countries tend to reinvest significant portions of their large revenue flows from the sale of oil back into the petroleum sector, helping to lock in the system and creating obstacles to an energy transition (Verbruggen and Al Marchoni, 2010: 5580). In this regard, the interests of oil exporters and importers are opposed: the oil exporters would prefer to keep their large revenue flows to themselves and avoid an energy transition, whereas the oil importers and countries with a proactive stance on climate issues would need those revenue flows to finance an energy transition (Loulou *et al.,* 2008: 22).

4.3 The Sino-Russian axis

The post-Soviet period saw first a rapprochement and later increasing strategic convergence between China and Russia (Braekhus and Overland, 2008). This convergence was driven partly by ideological compatibility and the nonacceptance of authoritarian regimes by Western countries, but also in large part by the complementarity in natural resources (Overland, Kjærnet, and Kendall-Taylor, 2010). China needed oil and gas, and a country such as Russia has it. Cooperation makes even more sense because the two countries share a long border and transportation is thus relatively easy and safe. However, should a future climate agreement affect demand for oil and gas, such an interstate relationship might also be affected. Especially in the case of coal-dependent China and gas-rich Russia, a stricter climate regime could just as well lead to a further strengthening of complementarity as its weakening.

4.4 Fuel substitution

Fuel substitution—the replacement of one type of fuel with another when it is more advantageous—complicates the effects of any climate policy, and thus also the geopolitical effects of such a policy. If a policy is targeted specifically at the petroleum sector, it might accidentally lead to a shift to coal (Verbruggen and Al Marchoni, 2010: 5579; Vielle and Viguier, 2007: 844). Consumers and politicians tend to be more conscious of emissions from gasoline than coal because they personally tank their cars with gasoline, whereas coal is mostly used for industrial purposes and for electricity generation at centralized plants. In order to be effective, a climate policy cannot focus solely on the petroleum sector, but must deal with coal as well.

4.5 Unburnable carbon and stranded assets

There has been some discussion of stranded assets in the petroleum sector as a possible result of climate policy (Ansar, Caldecott, and Tilbury, 2013; Generation Foundation, 2013; Leaton *et al.,* 2013; Spedding, Mehta, and Robins, 2013; Caldecott, Tilbury, and Carey, 2014). This discussion has focused on the financial and corporate risks related to the possible future devaluation of oil company stocks. Little attention has been paid to the fate of the states that live off the export of oil and gas, and the fact that the biggest oil companies are state-controlled: Saudi Aramco is the world's largest oil company, and Rosneft is the world's largest listed oil company (both in terms of output of barrels per day) (Rapoza, 2013). In one review of stranded assets, Carbon

Tracker (2011: 3) goes into the details of the company, stock exchange and global levels—the entire scale of the financial system—without touching on the wealth of nations.

Stranding of assets might be one of the most important consequences of a stricter climate policy, because it can have a reinforcing effect on the policy. Financial markets consist of large numbers of actors attempting to anticipate the market's—that is, each other's—future moves. Markets therefore tend to move in flock as market participants interpret each other as moving in one direction or another. Should the notion of stranded carbon assets thus catch on among a large enough minority of market actors, it might spread to others trying to anticipate market movements, leading to accelerating divestment in greenhouse gas-emitting industries. Even just fears related to possible risks of holding such assets could in theory start the process.

This process is exactly what the organizations and literature highlighting stranded assets is actively trying to trigger. So far they have not succeeded, as the market value of stock ultimately depends on company profits, which lie outside the interpretative psychological sphere of stock market actors. People already own cars and depend on them for transport, depend on natural gas for heating and coal for electricity, and so on. The infrastructure that underpins these energy consumption patterns took many decades to build and would take many decades to change. Consumers therefore continue to buy oil, gas, and coal, and the companies that sell them continue to profit. Financial market psychology cannot overrule this, at least not quickly.

In the longer term, however, the stranded assets discourse may become more important. Should sufficient effort be made to add alternative infrastructure, as the Germans have done through their large-scale support for solar power, consumers may come to have greater choice, reducing the earnings of fossil fuel companies and allowing the psychological spirals of market anticipation to kick in.

Another limitation of the stranded assets literature is that it fails to recognize the importance of the mix of oil and gas assets in company (and country) reserves. Coal, oil, and gas are all fossil fuels that lead to greenhouse gas emissions, but the combustion of oil results in smaller emissions per energy unit than that of coal, and the combustion of natural gas in yet smaller emissions than oil. Whether assets become stranded or not in a given scenario thus depends on what role oil and especially natural gas play in that scenario. The next section turns to this question.

4.6 Natural gas as a transition fuel

Perhaps the most important question concerning the effect of global climate policy on the geopolitics of the petroleum sector is the role of natural gas. Would a stricter climate regime lead to more or less use of natural gas? What would be the consequences for relations between countries?

According to a much-cited report from the IEA, the world could be entering a "golden age of gas" (IEA, 2011: 1). The report envisaged a role for gas in lowering greenhouse gas emissions by replacing other fossil fuels, and thus predicted the rapid expansion of gas consumption, supplied by, *inter alia,* shale gas.

Should such a development come to pass, countries with large natural gas reserves would benefit. The rise of Qatar as an LNG producer and an increasingly wealthy country could be a sign of things to come. Qatar has used its wealth to become a major international research funder, host the soccer World Cup in 2022, and fend off the Arab Spring when it wracked other countries in the region. But as Figure 23 shows, most of the countries with major gas reserves are already large oil producers. An increase in the relative importance of gas over oil might therefore not lead to dramatic changes in the power balance between oil exporting and importing countries. However, it might lead to some changes in relative income and power among oil and gas producers—in particular, a strengthening of Iran, Qatar, Russia, and Turkmenistan relative to countries such as Iraq, Nigeria, Saudi Arabia, the United Arab Emirates, and Venezuela. Particularly important competitive bilateral relationships that might be rebalanced as a consequence could be Iran–Saudi Arabia and Iran–Iraq.

Some authors have joined the IEA in its enthusiasm for natural gas, pointing to its abundance and (assumed) relatively low cost of development and its utility (Moniz, Jacoby, and Meggs, 2011: 2). The utility argument boils down to the fact that natural gas is easier to transport than electricity, and can be used for electricity generation, transport, and heating. Above all, natural gas advocates cite the lower greenhouse gas emissions from natural gas than from oil and especially coal (Uliasz-Misiak, Przybycin, and Winid, 2013: 8). Others are more skeptical, arguing that renewable energy will be cheaper in the long term because it has no fuel cost and risk (Weiss *et al.,* 2013: 3, 6), and that natural gas, akin to other fossil fuels, is subject to implicit subsidies that will ultimately be removed (REN21, 2013: 11).

Whether natural gas is to enjoy a golden age as a climate policy transition fuel will depend in part on developments in unconventional gas. Stevens (2010b: 39) argues that, in most countries except the United States, there are fewer incentives for extracting it, because landowners generally do not hold subsoil rights. Most significantly, Hughes (2011: 27–28) and Howarth *et al.* (2011: 688) argue that full lifecycle emissions of greenhouse gases from shale gas are far greater than the emissions from the final combustion of the gas itself. As noted earlier, however, other analyses result in other conclusions and the large variation and rapid pace of

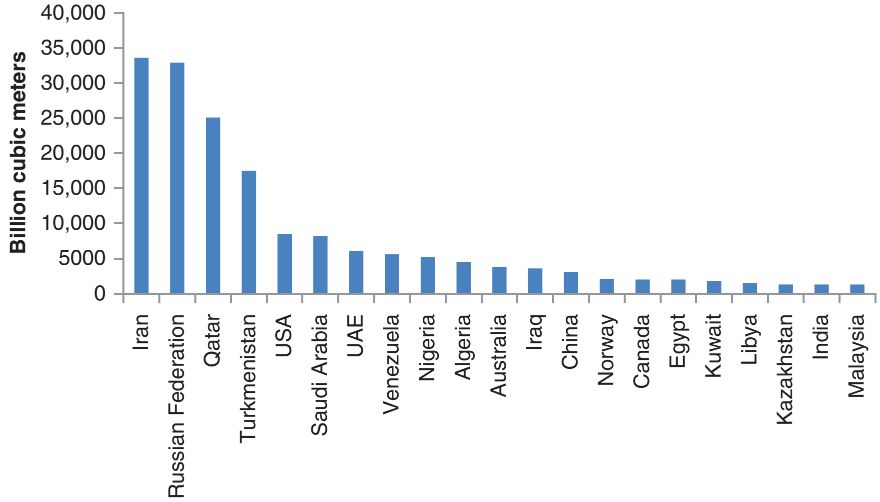

Figure 23. Natural gas reserves by country. *Source*: Created by author using data from BP, 2013: 20.

change in this area makes it difficult to provide accurate numbers. Improving lifecycle analysis for all kinds of energy, industrial products, and modes of transportation will have to feature heavily in working out a future climate policy. There might be surprises in many areas—not only related to shale gas but, for example, with regard to photovoltaic electricity or biofuels as well.

In any case, any major increase in the use of natural gas at the global level will depend in part on expanded use of LNG to move it around. A key factor in how these arguments for and against a bright future for gas play out will be the status of LNG under a stricter climate regime. The next section turns to this question.

4.7 The role of LNG under a strict climate policy

LNG has become one of the most important areas of development in the global energy landscape because it helps connect different markets (see Figure 24). The Fukushima nuclear accident brought a surge in demand for LNG from Japan and higher prices for the whole Asia-Pacific region (International Gas Union, 2011: 3; Mazza, Blumenthal, and Schmitt, 2013: 11–12; IEA, 2013: 29). The cycles of political tension between Russia and Ukraine contributed to the rapid expansion in LNG regasification facilities in Europe (Natural Gas Europe, 2014).

If unconventional oil and gas are to become a global energy revolution, LNG is likely to play a central role. This is especially true of unconventional *gas*, as LNG makes it possible to transport the gas beyond the pipeline grids of the national and regional markets to which most trade in natural gas has historically been confined. But LNG may, perhaps surprisingly, also play some role in the evolution and dispersion of unconventional *oil* extraction. For example, if LNG helps bring down natural gas prices outside North America, it may encourage consumers to shift from oil to natural gas in some usage areas, undermining the high oil prices needed to support unconventional oil developments.

But the cooling of natural gas involved in creating LNG is an energy-intensive process. Normally, a significant part of the natural gas is burned off to create the energy for this process, generating further greenhouse gas emissions. Thus, the future of natural gas as a climate-friendly fuel depends in part on the CO_2 footprint of LNG. Preliminary analysis indicates that the cost of greenhouse gas emissions would have to be very high to have any impact on the viability of LNG as opposed to pipelines (Ulvestad and Overland, 2012). But more research is needed, and this remains a major uncertainty related to the organization of the global petroleum sector under a stricter climate policy.

4.8 The possibility of a nuclear power renaissance

Japan's Fukushima accident led to increased skepticism toward nuclear power in many countries. Public opinion in Japan was naturally particularly affected, but also in a country such as Germany the political climate for nuclear power was strongly influenced. The resulting shutdown of nuclear power production has led to significant greenhouse gas emissions as electricity has instead had to be produced from coal and natural gas.

What is however less noticed by the global public is that many countries—importantly, including China and India—are continuing to build nuclear power plants. This

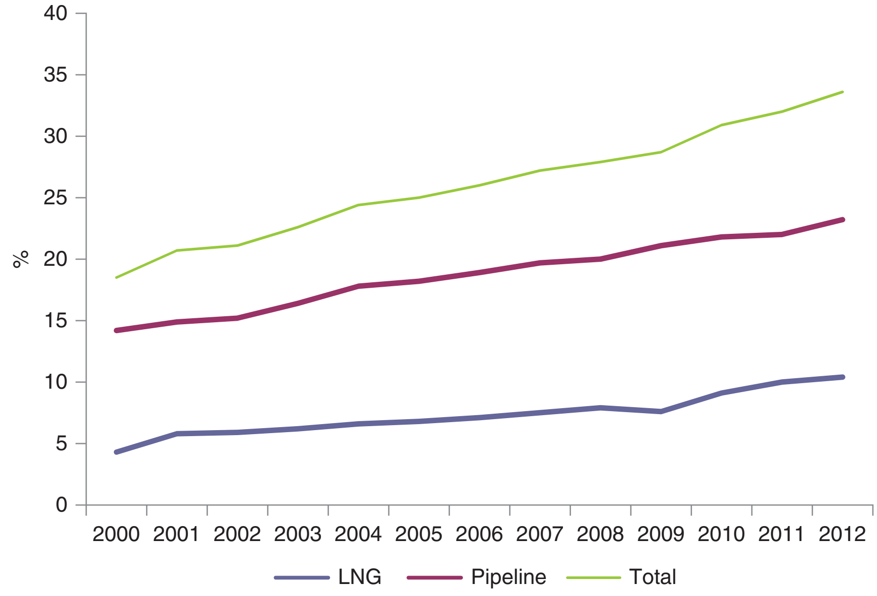

Figure 24. International trade in natural gas by pipeline and LNG as percentage of global natural gas output. *Source*: Created by author using data from BG Group, 2013; BP, 2012b; Jacobs, 2011; Total, 2013.

includes not only developing countries but also industrialized countries such as Finland, France, and Russia. According to the IAEA (2014), there are 71 civilian nuclear power reactors under construction. Several countries are trying to develop safer and more powerful nuclear reactors and parallel research is being carried out on the use of reactors that run on thorium rather than uranium.

If there are new developments in nuclear technology, and/or if other ways of reducing greenhouse emissions fall short of what is seen as necessary, one possibility is therefore that there may be a nuclear renaissance. Nuclear power is used to produce electricity, and already the technologies for the electrification of the transport sector are being rapidly improved. A nuclear renaissance would change many of the premises and points made in this part of the chapter, although some might still be valid. It might lead to some of the same flattening effects on the previously asymmetric relationships between oil exporters and importers and decentralization of power in the international state system. At the same time, countries with large reserves of uranium (and possibly thorium) and those countries and companies that have the best nuclear technology could be strengthened.

5 A GLOBAL ENERGY TURNING POINT?

Both unconventional hydrocarbons and climate policy are often thought of as leading to dramatic changes in the global energy sector. The increase in shale gas production brought US natural gas prices down dramatically at a time when they had been expected to rise, and it is speculated that shale oil may follow a similar trajectory—making the United States first independent of energy imports and then a net exporter in its own right, changing power relations in the world (Michaud, Buccino, and Chenelle, 2014; Maugeri, 2013: 25). According to the vast majority of climate scientists, limiting climate change to a temperature rise of 2°C, or even 3°C, will require dramatic changes in the global energy sector, which would affect different countries in different ways (IPCC, 2014). Major oil and gas importers such as Germany and Japan might stand to benefit, whereas some of the states that have enjoyed the easiest sources of revenue might even find themselves bankrupt and vulnerable to encroachment. However things work out, the global energy sector appears to be on the verge of major upheaval.

Germany is one of the countries that have been most proactive in transforming its energy sector. In German this is referred to as *Die Energiewende*, "the energy transition." Central targets include the achievement of the following by 2050: greenhouse gas reductions of 80–95%; a 60% share of renewable energy; and an increase in electricity efficiency by 50%. These changes in turn call for a major research and development drive, comprehensive restructuring of energy infrastructure, and a restructuring of the economy.

Although the term *Energiewende* was first used in 1980 and reappeared intermittently thereafter, it did not become official government policy until in 2010 (Bundesregierung Deutschland, 2010). Many actors anticipate that the rest

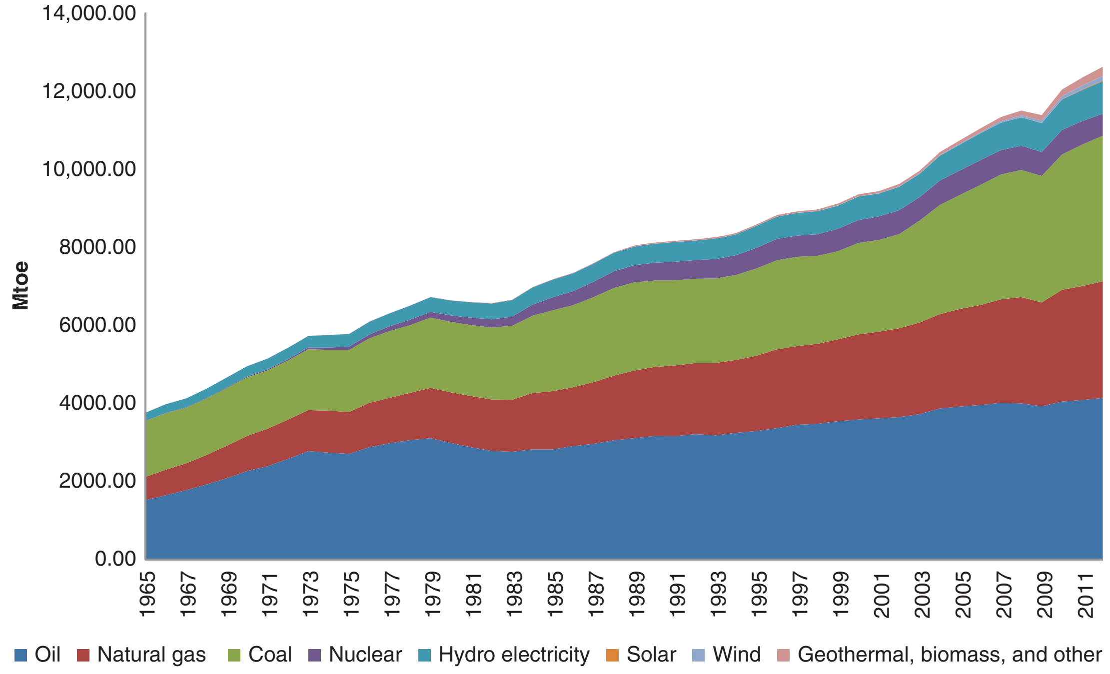

Figure 25. Primary energy sources for the world. *Source*: Created by author using data from BP, 2013.

of the world will also go through an *Energiewende*. As Figure 25 shows, the ratio of various energy sources in global supplies has been stable since the 1960s, with all energy sources growing gradually. If there is a global *Energiewende*, this graph will look different in the future.

Looking further back in history, we note that this is not the first time a comprehensive transformation of the energy sector has taken place. The introduction of the steam engine in the eighteenth century, of the internal combustion engine in the nineteenth century and of nuclear power in the twentieth century all led to major changes in the types of energy used.

Each of these tectonic shifts in the global energy landscape has been associated with transformations of international politics. The steam engine put the colonial race on a new level. Winston Churchill's decision to shift the British Navy from coal to oil in 1911 was an important factor in the outcome of World War I (Dahl, 2001: 55). And it necessitated British control over oil supplies from (among other places) Persia, where the British government in 1914 acquired a controlling stake in the Anglo-Persian Oil Company, later to become BP (Jack, 1968: 139). The rapid growth in private car ownership in industrialized countries after World War II led to a further increase in the importance of oil, triggering the formation of OPEC in 1960 and playing an important role in US military and political involvement in the Middle East.

After a half a century of continuity in the energy sector, we may indeed be facing a global *Energiewende*, but it is far from the first such turning point in the world's energy history. That said, several factors may make the current possible turning point different: the far greater size and wealth of the world population than in the past; the larger number of scientifically advanced countries; and the presence of technologies such as computers, lasers, and various forms of automation. These enable the accelerated development of other new technologies and their rapid mass production and dispersion. Thus, the world should be technologically and industrially capable of carrying out a major transformation of its energy system more swiftly than in the past.

6 CONCLUSIONS

Unconventional oil and gas and climate policy are both indeterminate, unpredictable processes with many complex subcomponents. It is therefore impossible to scientifically predict their outcomes. What this chapter has instead attempted to do is to provide an overview of some of the key questions that these developments raise, and indicate some *possible* consequences.

Firstly, because the relationship between exporting and importing countries is asymmetric, any changes will affect exporting countries more than importing ones. Secondly, the geopolitical changes wrought at the global level by continued rapid growth in unconventional oil and gas production may be limited by the fact that many of the biggest reserves are located in countries that are already major oil and gas exporters. However, in cases where there are tense relationships between exporters and importers, as between Russia and some of its customer countries, even smaller amounts of unconventional oil and gas may change interstate power relationships significantly. Thirdly, it is striking how little research has been published on the possible consequences of a stricter climate policy for the petroleum sector—this is a blank spot in the literature, so surprises could be in store. Fourthly, the trajectory of the petroleum sector under a stricter climate policy will depend greatly on the status of natural gas and LNG under such a policy. The petroleum sector may be dramatically downsized, or it may simply shift emphasis from oil to gas. Even oil may not be so heavily affected, if climate policy comes to focus more on coal, deforestation, and so on.

The changes ensuing from the growth of unconventional oil and gas production, however potentially dramatic, are a continuation of past technologically driven changes in the petroleum sector. By contrast, the changes brought on by climate policy are of a qualitatively different nature. In some ways, they belong to the same class of events as the foundation of OPEC in that they involve the deliberative and coordinated international political action carried out by multiple states in cooperation and affecting world markets. However, they are fundamentally different from OPEC because the case of climate policy is not one of an oligopolistic group of countries pitted against the consumers: what is at stake is an (attempted) global or semiglobal regime.

Ironically, while climate advocates are trying to talk down the stock value of oil and gas companies, the oil price is historically high, and oil companies rank among the world's largest corporations. Although company bottom lines are not always as impressive as their shareholders might have liked, a large chunk of the profits is taken by the supply industry. In sum, the petroleum sector is still profitable. This means that either all the talk about an impending effective global climate regime and stranded assets will come to naught; or that climate mitigation is going to be about reducing coal consumption but not oil and gas; or that there are going to be some abrupt changes in the valuation of companies in the near future.

A central tenet of the oil industry's *anti*-peak oil argumentation has always been that both the technologies and the cost of technologies may change in the future (and in fact do change all the time), and that this in turn affects how much can be found and extracted of a given geological resource. Many of those who espouse *anti*-peak oil stances are also skeptical about the prospects of an effective global climate policy, believing that a shift from fossil-fuel dependency to renewable energy is too costly to ever be realistic. But their own arguments about technological change may apply to renewable energy as well. Improvements in the efficiency of renewable energy technologies, the cost of mass producing and deploying those technologies may or may be drammatic. In addition, there is the possibility that entirely new renewable energy technologies will be invented.

A key aspect of the energy sector is that neither its economics nor its politics are constants: they are subject to changing technology. We can offer guesses about which technologies may be developed in the future, but it is impossible to know with any certainty. Technologies that seem to be near fruition may disappoint, while entirely new technologies may appear unexpectedly.

The coexisting expectations of expanding supply of unconventional oil and gas and of a more effective global climate regime are contradictory. Both unconventional hydrocarbons and renewable energy are expensive, but if one becomes cheaper than the other, it could cancel the other out. This could happen, for example, if climate policy makes renewables cheaper than hydrocarbons through taxes or quota systems. Or it could be through new technologies, whether for renewable energy or for unconventional oil and gas. For example, it is possible to envisage how new and more economical ways of extracting gas hydrates could dramatically change access to natural gas. Sooner or later there may be direct interaction between unconventional hydrocarbons and climate policy. This adds another layer of uncertainty to the world's energy future.

Readers are welcome to use the graphs from this chapter in original or updated form, as long as they give full credit and reference to the chapter. To get hold of the original graphs in Excel format, contact the author.

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