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SEVEN MEGATRENDS IN ENERGY POLICY

Friedbert Pflüger

Throughout history, energy has been the driving physical component of change; few other industries can claim to have had a more wide-ranging impact on other industries and society in general. Thus, critical questions revolving around the supply and demand of energy as well as its sustainability will continue to represent one of the greatest and most important challenges of the 21st century. Seven megatrends in particular will in all likelihood determine the global energy landscape and energy policy agenda in the coming decades.

DIMINISHED SALIENCE OF GLOBAL CLIMATE CHANGE POLICY

On 25 April 2012, at the Energy Dialogue of Hannover's municipal utility company Enercity, the head of the renowned Potsdam Institute of Climate Research Hans Joachim Schellnhuber stated that the chances of the international community reaching a globally binding climate agreement stand at only about five per cent. This caused a noticeable stir among the participants. If even one of the world's foremost supporters of climate protection makes such a prediction, the current state of the climate change debate must be dismal indeed!

And it seems that this may actually be the case. Without a globally binding agreement on climate change, the EU stands little chance of meeting its climate targets. In the draft report on its Energy Roadmap 2050, the EU Commission succinctly states that "if coordinated action on climate among the main global players fails to strengthen

in the next few years, the question arises how far the EU should continue with an energy system transition oriented to decarbonisation".[1]

Scepticism about the success of global climate politics can be found in the Energy Roadmap 2050 by the European Commission, developed under supervision of Commissioner for Energy Günther Oettinger (l., on the right Friedbert Pflüger). | Source: European Centre for Energy and Resource Security (EUCERS).

It is apparent that the topic of climate change has lost some of its salience worldwide and has clearly taken a backseat to economic priorities. Issues like the global financial crisis, unemployment and reform of the banking industry continue to dominate the political agenda. Barack Obama said during the U.S. presidential election campaign of 2008 that he would make climate policy a top priority of his presidency; now, he rarely touches on the subject. In his 2012 State of the Union Address, Obama mentioned the words climate change once. In fact, an analysis by Bristol University found that Obama has talked less about climate change during his State of the Union addresses than both Presidents Bill Clinton and George W. Bush!

1 | Cf. "Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the regions 'Energy Roadmap 2050'", European Commision, COM(2011) 885/2, 2011, http://ec.europa.eu/energy/energy2020/roadmap/doc/com_2011_8852_en.pdf (accessed 22 Jul 2012).

This trend is expected to continue. The topic of climate change will clearly lose ground to issues pertaining to economic growth, competitiveness, affordable energy, and energy security. However, this paradigm shift does not mean that climate change will entirely disappear from the global agenda. The fact that millions of people in developing countries continue to face unbearable living conditions in cities across the globe as well as the recurrence of major floods and tropical storms with a certain degree of regularity will prevent the climate issue from being forgotten altogether. During the recent Energy Dialogues at the German Reichstag, Swiss RE calculated the enormous economic costs of climate-induced natural disasters. As a result, the climate change topic will remain on the agenda, but with diminished significance relative to other energy policy objectives.

RISING ENERGY DEMAND

Another megatrend that is sure to be a fundamental driver of global energy policy is rising energy demand. Roland Berger Strategy Consultants estimate that global energy demand is expected to rise by 26 per cent over the next two decades. Particularly energy consumption in developing countries will experience a sharp increase – about 45 per cent – by 2030, compared to an increase of 2.5 per cent in developed countries.[2]

Three primary long-run trends will drive this rise in global energy demand over the short to medium-term: population growth/demographics, economic expansion and urbanisation. By 2030, there will be about 8.3 billion people on the planet, up from about 7 billion today.[3] While low birth rates and a shrinking working-age population (people 15 to 64 years old) in developed countries will result in modest economic growth and energy demand, developing regions like India and Africa, for instance, will see steep growth in their populations and working-age groups. These demographic trends in developing countries will help

India and Africa will see steep growth in their populations and working-age groups, which will help their economies grow more than twice as fast as those in developed countries.

2 | Roland Berger Strategy Consultants, *The Trend Compendium 2030*, 2011, http://rolandberger.com/expertise/trend_compendium_2030/index.html (accessed 22 Jul 2012).

3 | Ibid.

their economies grow more than twice as fast as those in developed countries (2 per cent in developed countries; 4.5 per cent in developing countries).[4] Strong economic growth – and the improved living standards and increased prosperity that it brings with it – will require more energy. By 2030, energy consumption in developing countries will make up 64 per cent of the global share and nearly double that of developed countries with 36 per cent.[5]

Rising urbanisation rates will also continue to play a key role in increasing future energy demand. The share of the world's population living in cities has increased from thirty per cent in 1950 to fifty per cent today and is expected to rise to nearly seventy per cent by 2050.[6] To illustrate: thirty years ago there were only three cities with over ten million inhabitants (Mexico City, New York and Tokyo); today there are twenty such cities – and only four of them are in developed countries (Los Angeles, New York, Osaka-Kobe, and Tokyo).[7] The astronomical rise in urban populations will require additional housing, public transportation, infrastructure and water systems which, in turn, will consequently drive up the demand for energy.

A "GREEN REVOLUTION" IS UNDERWAY – BUT FOSSIL FUELS REMAIN!

During the period from 2005 to 2010, total global capacity of renewable energy technologies grew at average rates ranging from 15 per cent to 50 per cent annually.

An increasing share of energy stemming from renewable sources is expected to meet this rising global demand. The "Green Revolution" that we have experienced over the last decade will continue. During the period from 2005 to 2010, total global capacity of renewable energy technologies grew at average rates ranging from 15 per cent to 50 per cent annually. The IEA estimates that the share of renewables in global electricity generation, excluding large hydropower, will increase from about three per cent today to 15 per cent in 2035, with the EU and China making up nearly half of this increase.

4 | Cf. ExxonMobil, *The Outlook for Energy: A View to 2040*, 2012, 7.
5 | Cf. Roland Berger Strategy Consultants, n. 2.
6 | Cf. Deutsche Bank Research, *Globalisation 2011: Investing in the global megatrends*, 2011, 4.
7 | Cf. ibid., 69.

This rise in renewables is made possible by the provision of enormous amounts of subsidies, whose annual sum is expected to quadruple from around 50 billion euros in 2010 to some 200 billion euros by 2035.[8] Countries with strong political support and subsidy schemes like the United States, Germany and China as well as many in the developed world are leading the pack in renewable power generation. But the promotion of renewable energy is not confined to just these regions – it is spreading to more and more countries around the world. In 2011, about 120 countries had some type of policy target or renewable support policy at the national level, up from 55 countries in 2005.[9] Developing countries in particular, which already represent more than half of all countries with policy targets and renewable support policies, will play an increasingly important role in advancing renewable energy globally in the coming years.[10]

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And yet, despite this expansion in global renewable energy capacity, we will still be far away from a so-called "Age of Renewables" in the next two decades. It is true that the dominance of traditional fossil fuels will wane due to the rise of renewable energy sources, but not by much. Since total energy demand by 2030 will rise by over 25 per cent – due to population growth, economic expansion and urbanisation – the consumption of, and demand for, fossil fuels will also increase. In 2030, coal, oil, and natural gas will still account for nearly 80 per cent of the world's primary energy mix (26-28 per cent each) while major non-fossil fuel groups will have market shares of around 7 per cent each.[11]

Global oil consumption, excluding biofuels, is set to increase from 87 million barrels a day in 2010 to 99 million barrels a day in 2035.[12] Much of the demand will come from the transportation sector (especially the commercial

8 | Cf. IEA, *World Energy Outlook 2011*, 2011, http://www.oecd.org/document/43/0,3746,de_34968570_34968855_39572459_1_1_1_1,00.html (accessed 22 Jul 2012).
9 | Ren21, *Renewables 2011 Global Status Report*, 2011, 7.
10 | Cf. ibid.
11 | Cf. BP, *BP Energy Outlook 2030*, 2011, http://bp.com/sectiongenericarticle800.do?categoryId=9037134&contentId=7068677 (accessed 22 Jul 2012).
12 | Cf. IEA, n. 8, 41.

transport sector), 90 per cent of which will still run on liquid petroleum-based products in 2040, only slightly down from about 95 per cent today.[13]

According to the IEA, coal accounted for nearly half of the increase in global energy use over the past decade and its use will continue to rise through to the early 2020s, before remaining broadly flat if policy measures are undertaken to curb consumption. If no such measures are taken, then coal use is even projected to increase 65 per cent by 2035 under current policy conditions, making it the fastest growing fossil fuel. Moreover, regardless of what policy decisions are taken today to reduce consumption, coal will still continue to be the second-largest primary fuel globally at least until 2035.

Especially countries with indigenous coal reserves and a high share of solids in their energy mix are expected to continue to drive demand. Take, for instance, the Central and Eastern European countries, also dubbed the EU-11. Coal comprises about 36 per cent of their energy mix, triple that of the rest of the EU with 12 per cent.[14] Couple this with a lower share of nuclear power in their gross inland consumption as well as the desire to reduce import dependency and enhance energy security, and it is clear why higher coal use is expected to continue in the region. China, the world's largest coal producer with the third-largest reserves (13 per cent), already consumes nearly half of global demand and will likely maintain its heavy reliance on coal as a relatively cheap alternative to other fuels to power its rapidly growing economy. Thus, while the overall percentage share of coal in the global energy mix is expected to decline as it concedes market shares to other fuel sources, coal use is still expected to increase, at least over the mid-term.

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Alongside coal, natural gas is projected to be one of the fastest growing fossil fuels; its share in the global primary energy mix will nearly reach parity with oil/coal by 2030.[15]

13 | Cf. ExxonMobil, *The Outlook for Energy: A View to 2040*, 2012, 17.
14 | Cf. Ernst & Young, *Executive Summary to the Report: 'Introductory analysis of EU-11 countries energy sectors'*, 2012.
15 | Cf. IEA, n. 8, 79.

Meanwhile, unconventional gas makes up about half of the world's total estimated natural gas resources, largely due to recent advances in technology. The IEA is already talking about entering a "Golden Age of Gas".[16]

The widespread belief prevalent in Germany of swiftly making the transition away from an era of fossil fuels towards an age of renewables is hardly shared by anyone worldwide. Through enhanced recovery techniques, technological improvements, as well as unconventional hydrocarbon sources like tight oil, tight gas, shale gas and so forth, the available supply of fossil fuels has actually increased significantly over the past decade. The world's proved oil reserves rose from 1.1 trillion barrels in 2000 to 1.38 trillion barrels in 2010; this increase is approximately equal to the total oil reserves of South and Central America combined. Similarly, proved global natural gas reserves jumped from some 155 trillion cubic meters in 2000 to 187 trillion cubic meters in 2010.[17] This increase alone is enough to meet the EU's entire annual gas demand for the next 60 years.

Current developments in shale oil production serve to elucidate the rapid expansion of the fossil fuels industry in general. According to the U.S. Energy Information Administration (EIA), the Bakken shale oil formation in North Dakota and Montana, with an estimated 3.6 billion barrels of oil reserves (the same as the total reserves in Gabon), produced an average of 2,000 barrels a day in the year 2000; today, the average production rate stands at around 445,000 barrels a day, nearly the equivalent of the average 2011 oil output of North and South Sudan.[18] This has been facilitated by the increased use of horizontal drilling and hydraulic fracturing, coupled with elevated prices for crude oil and other natural gas liquids.[19] As a result, U.S. domestic oil production has increased by over 1 million barrels per day since 2008; but there is also

The average production rate of the Bakken shale oil formation in North Dakota and Montana stands at around 445,000 barrels a day, nearly the equivalent of the average 2011 oil output of North and South Sudan.

16 | Ibid., 170.
17 | Cf. Petroleum Economist, *World Oil and Gas Map, 2010/2011*, Jun 2010.
18 | Cf. BP, n. 11.
19 | Cf. U.S. Department of Energy (EIA), "Bakken formation oil and gas drilling activity mirrors development in the Barnett", 2 Nov 2011, http://eia.gov/todayinenergy/detail.cfm?id=3750 (accessed 22 Jul 2012).

a notable development on the consumption side. During the latest presentation of the *BP World Statistical Review 2012*, Chief Economist Christof Rühl observed that the United States has demonstrated a remarkable improvement vis-à-vis other economies due to "a reduction in U.S. oil imports – further evidence of the intricate ways in which the technological improvements fostered by open competition in North America are changing the geopolitics of energy".[20] In other words, the U.S. is taking large steps towards becoming energy independent. This development has significant geopolitical implications, as it adds an element of uncertainty regarding the degree and dynamics of continued U.S. involvement in the Middle East. Is the U.S. gradually preparing to reduce its presence in the region? To what extent is it still willing to secure vital energy shipping routes like the Strait of Hormuz, through which roughly 20 per cent of the world's daily oil exports flow? Such questions are sure to gain traction as the momentum of the U.S.' path towards energy independence intensifies.

In light of these developments it is clear that even as the deployment of "green technologies" continues to progress, it will still be the fossil fuels that sate the bulk of rising global energy demand in the foreseeable future. Even today, local populations and governments in most regions throughout the world express their pleasure whenever new hydrocarbon discoveries are made in their respective countries; they are generally far removed from sharing the concerns associated with fossil fuel production and consumption common in some developed countries. In general, the sometimes observable "demonisation" of fossil fuels that seems to be more common in developed countries like Germany is markedly absent in many other societies. Hence, those who hope that the effects of climate change will spur greater international awareness for the environment to the detriment of coal, natural gas, and oil will in all likelihood be disappointed.

The "demonisation" of fossil fuels that seems to be more common in developed countries like Germany is markedly absent in many other societies.

20 | Christof Rühl, "Energy in 2011 – disruptions and continuity", *BP Statistical Review of World Energy 2012*, 1306.2012, http://bp.com/assets/bp_internet/globalbp/globalbp_uk_english/reports_and_publications/statistical_energy_review_2011/STAGING/local_assets/pdf/BP_Stats_2012_FINAL.pdf (accessed 22 Jul 2012).

RISING ENERGY NATIONALISM AND IMPERIALISM

The continued dependence on fossil fuels also bears important political and security implications. We are currently experiencing a precipitous rise in energy nationalism and imperialism where governments with substantial natural resource reserves are securing greater economic benefits from their exploitation or are utilising them for political gain. The recent cases of Argentinean President Cristina Fernandez de Kirchner deciding to nationalise the Spanish-owned oil company Yacimientos Petrolíferos Fiscales or Bolivian President Evo Morales seizing control of the Spanish electric company Red Eléctrica de España underscores this trend. But this phenomenon is by no means confined to South America. Today, nationally-owned oil companies control almost 90 per cent of the globe's total oil reserves and 75 per cent of production. In comparison, the largest of the private supermajor oil companies, ExxonMobil, only ranks 14th in terms of reserve holdings! This is hardly different in the case of natural gas. Some of the largest conventional natural gas reserves in the world are located in countries with nationally-owned energy companies like the Russian Federation, Qatar, and Iran, just to name a few. This implies that the risk of energy being used as a political and foreign policy tool by resource-rich states is very likely to increase due to the diverging objectives of nationally-owned energy companies from purely commercial ones.

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An even more recent, and much-over-looked, development is that energy-related nationalistic tendencies are no longer traditionally limited to resource-rich states, but have actually spilled over into other energy producing sectors such as the renewables industry. A downright "subsidy war" is currently raging between China's and Europe's solar industry – and it looks like the Chinese will emerge as the victors. What is more, Beijing is active on all fronts when it comes to securing the natural resources needed for its rapidly growing economy – in Africa, Latin America and Central Asia. A pipeline which is currently being constructed from Turkmenistan to China does not only have an economic purpose, it is also concurrently a projection of political power. The same certainly goes for the Russian

South Stream pipeline project or the various pipeline projects that are currently vying to transport Shah Deniz gas from Azerbaijan.

Geopolitics always plays a role. It does so when Russia plants its national flag on the seabed at the North Pole during a submarine expedition, when Canada reacts with a military maneuver in the Arctic or when the U.S. drills for oil in West Africa in order to secure their influence in the region with a greater military presence. It is quite likely that the intensified quest to secure the finite natural resources of this world will eventually lead to serious inter-state disputes, imperialism and even outright war.

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HEIGHTENED RISKS TO CRITICAL INFRASTRUCTURES

Even as the specter of intensified state conflicts over natural resources looms in the not-too-distant future, we are already witnessing a rise in the frequency of attacks on critical infrastructures being carried out both by violent non-state actors as well as (covertly) nation-states. Since the Arab uprisings in January 2011, a recurring theme has been the sabotage of energy infrastructures in the oil and gas sectors. Production facilities and pipelines have regularly been targeted by saboteurs throughout the Middle East and North Africa (MENA), causing major supply disruptions to energy-importing states. While the effects of the attacks in Egypt, Syria and Yemen "only" had a regional impact on neighboring importers, the supply disruptions in Libya, a major oil producer, were much more significant.

As a result of the outbreak of the conflict in February 2011 during which a number of energy infrastructures were attacked, Libyan oil production declined from 1.6 million barrels per day to a mere 169,000 barrels per day in just three months – a decrease of 90 per cent. This sharp drop in output caused oil prices to jump from 92 U.S. dollars a barrel in January 2011 to a high of 116 U.S. dollars in April, before going back down to an average of 103 U.S. dollars for the second half of the year after the IEA decided in June to coordinate the release of 60 million barrels of strategic reserves. This was only the third time there had ever been a release of emergency petroleum reserves, after the

First Gulf War in 1991 and for Hurricane Katrina and Rita in 2005.[21]

Clearly, physical attacks on critical energy infrastructures can have broad adverse effects on international energy markets, especially in terms of supply disruptions and higher energy prices. However, the greatest threats to critical infrastructures are likely to come in the form of cyber-espionage and cyber-attacks.[22] Intelligence-gathering malware like the newly discovered Flame virus or the worm Duqu, programmed to obtain intelligence on industrial infrastructure for future attacks, are increasingly on the rise.[23]

Cyber-attacks that actually aim to control critical infrastructures or disrupt vital industrial processes bear even greater risks. The discovery of the Stuxnet computer worm in 2010 – widely thought to have been developed by Western governments – has had serious cyber-security implications. The virus has the ability to infiltrate supervisory control and data acquisition (SCADA) systems; most of the world's industry runs on SCADA. Initially designed to disrupt Iran's Siemens-based uranium enrichment infrastructure, its code has been leaked and is available on the internet. Now, not only states but any capable cyber criminal group could use it to penetrate SCADA security that controls critical infrastructure around the world.[24]

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Ironically, the more technologically advanced and complex modern critical infrastructures become, so too does their vulnerability to cyber attacks increase. The U.S. Department of Energy observes that the "immense complexity of modern energy systems and the increased need to respond rapidly to systems and market fluctuations have

21 | Cf. Devin Glick, *A Look at the IEA 2011 Release of Strategic Oil Reserves*, 2011, 1, http://bakerinstitute.org/files/documents/students/IFRI-pub-GlickStrategicOilReserves-2011.pdf (accessed 22 Jul 2012).

22 | Cf. on this topic in this issue: Frank Umbach, "Critical Energy Infrastructure at Risk of Cyber Attack", 35.

23 | Daniel Fineren, "Energy assets in front line of cyber war", Reuters, 31 May 2012, http://reuters.com/article/2012/05/31/us-cyber-attacks-energy-idUSBRE84U15E20120531 (accessed 22 Jul 2012).

24 | Ibid.

led the energy industry to rely substantially on information technology and the communication infrastructure to operate its physical assets".[25] But even traditional "high-impact" targets like nuclear power plants continue to remain at risk.

NO "RENAISSANCE", BUT NUCLEAR POWER AND ITS LEGACY ARE HERE TO STAY FOR THE FORESEEABLE FUTURE

Despite higher risks to critical infrastructures through sabotage or natural disasters, the global deployment of nuclear power will continue, albeit at a slower pace than perhaps anticipated. This is because the Fukushima Daiichi nuclear disaster of 2011 raised serious doubts about the safety risks associated with nuclear energy and even prompted policy changes in several countries. Just two months after the incident, Germany announced that it would become the first industrialized nation to phase out nuclear energy by 2022; Switzerland and Belgium quickly followed suit and Italy abandoned previous plans to build new nuclear plants. Japan has only recently restarted two of its fifty idle reactors,[26] while many other countries are re-assessing the safety of their nuclear plants.

The global deployment of nuclear power will continue, albeit at a slower pace than perhaps anticipated.

Possible implications arising from the Fukushima catastrophe such as tighter safety regulations, delayed investments, higher risk premiums, as well as increased public resistance could likely decelerate the rate of global nuclear expansion, especially in industrialised countries where the concentration of existing nuclear plants is greatest.[27] Combine these factors with potentially lower global fossil fuel prices in the years ahead (especially natural gas) due to supply expansions as well as relatively high construction costs for new-build reactors, and the nuclear industry is not likely to experience a "Renaissance", particularly not in the debt-plagued OECD region.

25 | U.S. Department of Energy, *Multi Year Plan FY2008-2013*, 2008, 1, http://energy.gov/sites/prod/files/oeprod/DocumentsandMedia/DOE_OE_NSTB_Multi-Year_Plan.pdf (accessed 22 Jul 2012).

26 | Cf. Akiko Fujita, "Japan Restarts Nuclear Reactors", *ABC News*, 16 June 2012, http://abcnews.go.com/International/japan-restarts-nuclear-reactors/story?id=16585084 (accessed 22 Jul 2012).

27 | IEA, n. 8, 448.

This may be considered a setback for proponents who consider it an essential, "clean" source of energy that contributes to the aims of limiting global CO_2 emissions and supply diversification. Nevertheless, backers may rest assured that global nuclear capacity will still trend upwards in the coming years primarily due to developments in emerging economies. According to the IEA, of the 67 reactors currently under construction worldwide, 55 are centered in non-OECD countries; China (28), Russia (11), and India (6) alone account for 67 per cent.[28]

67 reactors are currently under construction worldwide. China, Russia, and India alone account for 67 per cent.

However, cost and safety issues regarding decommissioning and waste management remain important challenges. The German nuclear waste disposal site Asse in Lower Saxony clearly underscores this assertion. Due to radioactive leaks, the government has determined that the site will have to be emptied of all of its 126,000 barrels of nuclear waste, costing several billion Euros and taking 30 to 40 years to retrieve all the waste.[29] Hence, while continued nuclear expansion is a positive development for some and negative for others, depending on one's perspective, one thing remains clear: It does not matter if countries choose to phase out nuclear power now or not at all – the legacy of nuclear energy will remain for a long time to come.

THE HOPE – TECHNOLOGICAL INNOVATION AND A WELL-FUNCTIONING MARKET ECONOMY

No international climate change agreement, increasing energy demand, the persistent dominance of fossil fuels, energy imperialism, higher risks to critical infrastructures and the continued challenges of nuclear power – is there any positive news? Are there no options available to cope with these daunting developments?

The only true hope lies in the strength of technological innovation and a well-functioning market economy. More energy efficiency, the economic and controlled use of carbon capture and storage (CCS), new storage technologies,

28 | Ibid., 451.

29 | Cf. Klaus Dahmann, "Röttgen makes first visit to controversial German nuclear dump", *Deutsche Welle*, 13 Mar 2012, http://dw.de/dw/article/0,,15806890,00.html (accessed 22 Jul 2012).

dramatic efficiency gains in conventional and unconventional energy use, substitution of oil with natural gas or hydrogen in the transport sector, and smart grids coupled with the ability to market these technologies – these could be the solutions, not wishful thinking or the ability of nations to compromise. The only chance that the planet has is the hope of a more efficient and economic utilization of energy in the future.