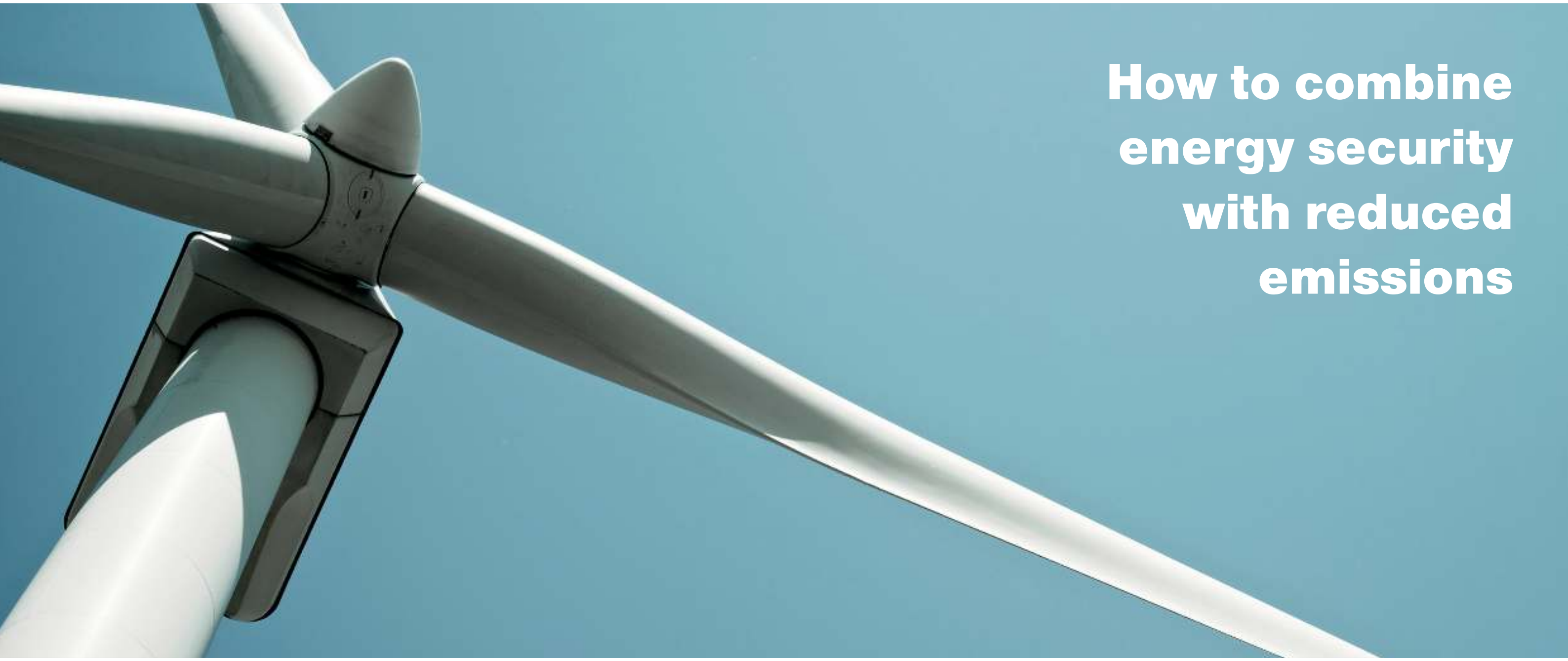
EUROPE'S ENERGY FUTURE



EDITED BY **DANIEL ENGSTRÖM STENSON**

European Liberal Forum

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EUROPE'S ENERGY FUTURE

How to combine energy security with reduced emissions

elf

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INTRODUCTION – EUROPE’S ENERGY FUTURE

Daniel Engström Stenson

This project was initiated in the summer of 2014. It was motivated by the observation that many of Europe's long-term challenges are connected to the supply of energy. Events in Ukraine, the European Union's (EU) long-term climate targets, and the findings and use of shale-gas in the US all highlight the need for a thoroughly considered energy policy for Europe. In 2015, the European Commission launched its communication on an Energy Union, highlighting five priorities, of which many are addressed in this project:

- Supply security
- Integrated energy market
- Energy efficiency
- Emissions reductions
- Research, innovation and competitiveness

Europe is to a large extent dependent on imports to meet its energy needs (the EU imports 53 per cent of the energy it consumes). In 2012, Europe spent more than €400 billion, the equivalent of around 3.1 per cent of its GDP, on fossil fuel imports. Given the increased demand for energy around the globe, competition over energy is likely to increase. The political turmoil unfolding next to the EU's borders, Ukraine to the east and the MENA region on the other side of the Mediterranean , have also shed light on the risks of being dependent on unreliable regimes for energy supplies. In particular the dependence on Russian gas has been much debated. With many countries being dependent on a single supplier for gas, diversification of energy sources and suppliers is crucial for improving energy security for individual countries as well as for the EU. Exploring supply regions for fuels, exploring new technologies, further developing indigenous resources and improving infrastructure to access new sources of supply are all contributing elements for increasing the diversity and security of Europe's energy sector.

Furthermore, if Europe is serious about reducing its emissions by 40 per cent by 2030, and by 80-95 per cent by 2050, Europe's energy mix is in need of transition. This requires a reduced use of fossil fuels, while the growth of renewable energy and energy efficiency will be crucial for moving towards a low carbon society.

During 2015, the European Liberal Forum and its members Fores (Sweden), Neos-lab (Austria) and Friedrich Naumann Foundation Sofia (Bulgaria) organized three workshops and are now delivering this publication with four chapters written by highly qualified experts on energy policy.

Energy security and carbon emissions reduction discussions vary per individual European state, as countries have different preconditions and perspectives. For this project, the three project partners shed light onto the different debates and policies in Austria, Bulgaria and Sweden—countries that resemble one other in terms of population, but differ in most other areas. In Austria, discussions on energy security due to dependency on Russian gas are combined with climate policies being relatively high on the agenda, although emissions reductions results are somewhat modest to date. In Bulgaria, the energy security risk is not only debated but a reality: Russia created a "cold winter" in 2009 by interrupting the gas supply, an action which caused energy poverty, bringing people to the streets and ousting governments. In Sweden, the topic of energy security is almost absent, and the debate on climate and energy is focused on the future of nuclear power and reducing carbon emissions. These three cases give a sense of how energy realities look like around Europe.

In each country, the debate benefits from learning about discussions in fellow European countries. This report aims to be a helpful contribution by presenting three country cases. The report begins, however, with a more general discussion on energy security risks in Europe.

In chapter one, Chloe le Coq and Elena Paltseva, both from SITE (Stockholm Institute of Transition Economics) at the Stockholm School of Economics, offer an index approach to characterising risks in energy supply. They show how this approach can be used to compare the energy security risks among EU countries, and to access the viability of political decisions. The authors focus primarily on the external dimension of energy security, that is, the risks associated with energy supplied by producers outside the EU. They discuss different factors contributing to the energy security – such as energy dependency, concentration of suppliers, transportation and political risks – and show how these factors can be combined into a single quantitative index, and why this approach is more precise than the traditional energy dependency approach. Applying the methodology to the EU Member States, they demonstrate that natural gas is the most risky fuel for EU external energy security. For example, a few EU Member States, in particular in the eastern and central parts of Europe, such as Hungary, Czech Republic and Bulgaria, score high on the gas supply risk index, because of highly concentrated gas imports from Russia. Le Coq and Paltseva also discuss the contribution of Member States to the overall EU energy supply risks, and argue that these are affected both by the individual risk exposure of the Member States and their relative size. In the above example of natural gas, Czech Republic would be one of the largest contributors to the EU-wide risk due to its high risk exposure. In contrast, Italy and Germany are less vulnerable to gas supply risks but are still large contributors to the EU-wide risk due to their size. The authors also discuss other challenges of the energy security, in particular, the interrelation between the environmental targets and energy security. They point to the fact that while natural gas is the most risky fuel for the EU, it emits less carbon compared to the more secure oil and coal. Thereby, EU energy policies need to carefully assess the trade-offs between environmental goals and energy security.

In chapter two, Ronald Pohoryles of the ICCR Foundation provides insights into Austria's energy policy, and begins by explaining Austria's longstanding opposition to nuclear energy. Due to its gas imports and dependency on Russian gas, Austria is exposed to energy security risks, and like many other countries also depends on imported oil and remains a net importer of energy. On the other hand, Pohoryles also shows that Austria is among the top European countries for its share of renewable energy, which could be attributed more to its geography than political decisions. Transports, industry and households together make up for more than 87 per cent of the energy use in the country. The energy consumption is increasing but is outpaced by GDP, which means energy intensity is improved. Austria has been able to meet its carbon emission reductions target for 2012 by using a flexible mechanism to compensate for the fact that its domestic emissions in 2012 were 2,5 per cent above 1990 levels, rather than the -13 per cent stipulated in the Kyoto Protocol. To reach the 2020 emissions reduction targets of -16 per cent compared to 2005, Austria has implemented a Climate Change Act with fixed ceilings for GHG emissions from 2013-2020. Identifying key future challenges in the area of energy policy, Pohoryles highlights the import dependency on Russian gas, and investments in energy infrastructure.

In chapter three on Bulgarian energy policy, Rumiana Decheva notes that the energy market is only formally a liberalised market. In reality, it remains a regulated market with regional monopolies and regulated electricity pricing in large sectors of the economy. The regulated prices are aimed at keeping energy prices down to prevent energy poverty, but this has also meant little to no investments in the necessary infrastructure. However, the plan is to liberalise the electricity market for households in the beginning of 2016. During the "cold winter" in 2009, Bulgaria experienced the realities of energy security risks when its gas supply from Russia was interrupted. Policy makers have yet to implement measures to build gas storage facilities and interconnectors to neighbouring countries that could help limit the dependency on Russian gas. In Bulgaria, a large share of households is unable to afford utilities, and using the World Bank's methodology, energy poverty is above 60 per cent. Bulgaria is on track to meet its climate targets. For the future, Decheva identifies the discussion on whether to focus on nuclear power or renewable energy as a key issue, and highlights regional integration as a way to reduce the dependency of Russian energy.

In chapter four, Lovisa Källmark and Chloe le Coq outline the case of the Swedish energy market. As an economy heavily dependent on fossil fuels, especially oil, Sweden has managed to change its energy profile. In particular, it has invested greatly in nuclear energy and has increased the share of renewables by implementing the carbon tax in 1991. Sweden is now, to a large extent, fossil free in electricity and heating. The transport sector, however, remains heavily dependent on imported oil. The energy demand has remained stable over the last decade, with industry and housing being the two main consuming sectors. The reduction of carbon emissions since 1990 by around 25 per cent is also worth noting. In particular, the reduction of 80 per cent in private homes and commercial buildings is remarkable. Le Coq and Källmark claim that Sweden is not facing energy security problems, and that the Swedish energy market is well connected to Nordic countries, and the Nordic electricity system is in turn connected to Estonia, Russia, the Netherlands and Poland. Looking towards the future, the authors see challenges in the possible phase out of Swedish nuclear power in terms of back up capacity and transmission, and the competitiveness of the Swedish industry if the price of electricity increases.

In chapter five, Daniel Engström Stenson concludes the preceding four chapters and the three workshops held during the project. He identifies a number of key issues that need to be elevated in the debate around European energy and climate policies. He stresses that the conditions and capabilities differ among countries. He therefore argues that the pan-European approach of the Energy Union needs to be complemented by a focus on regional integration of energy markets and grids. Regarding energy security, he notes that the fact that energy security risks differ among countries complicates how the solidarity clause should be implemented.

Taking on such a complex task, one needs to stay humble. Providing clear and concise recommendations has proven difficult. Over the course of the project, members of the project team and workshop participants have received inputs from different angles, making them better equipped to discuss these issues. Our hope is that this publication will trigger important discussions in your networks. Together, we can create a Europe that combines improved energy security and competitiveness with reduced carbon emissions.

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MEASURING EUROPEAN SECURITY OF ENERGY SUPPLY[1]

Chloé Le Coq and Elena Paltseva
(Stockholm School of Economics-SITE)

[1] This chapter is based on an ongoing research project on the security of energy supply. A few of the references used in the chapter, such as Le Coq and Paltseva (2009) and (2012), are among the project outcomes. We are grateful for the valuable comments and suggestions from Daniel Engström Stenson and one anonymous referee. All remaining mistakes are our own.

Introduction

Energy security has been on the European political agenda at least since the creation of the European Coal and Steel Community (ECSC) in July 1951. Concern over energy security has been recurrently raised during many past energy crises, and remains highly topical now. The European Union has just recently reassessed its willingness to form an Energy Union. In a document released on February 25, 2015, the European Commission stressed that energy security is one of the five dimensions of the common energy policy (see European Commission, 2015).

The energy security concern arises from the three main energy challenges faced by any country or region – the "quantity", the "quality" and the "source" challenges. The "quantity" challenge concerns the decision on the amount of energy necessary for a nation's well-being and sustained development. The "quality" challenge concerns the choice of the preferable composition of the energy mix. The "source" challenge concerns the decision on the proportion of its energy bundle to be produced domestically, the proportion to be imported, and the best way to organize energy trade with foreign energy suppliers. The challenges are deeply intertwined among themselves and with other policy decisions and constraints. The way they are met determines many political and economic outcomes, and, most importantly for the current chapter, a country's (or a region's) energy security.

Energy security is a multifaceted phenomenon, so it is not surprising that the definitions of energy security vary. Nearly all of them, naturally, address the above-mentioned challenges – that is, the energy demand and the ways to optimally meet this demand with a preferable mix and source of energy. However, the emphasis on different dimensions and aspects of these challenges, as well as on certain additional concerns, can vary noticeably across the definitions. Some of them prioritize security of supply and affordability of energy, others highlight availability, energy efficiency, trade, environmental quality, and/or social and political aspects (see, e.g., Sovacool and Mukherjee (2011) for an overview).

In this article, we focus on the one, most universally stressed aspect of energy security – *continuous availability of energy*. Given this focus, it is also common to distinguish between *external* energy security and *internal* energy security. *External* energy security is associated with imported energy – energy delivered by suppliers outside the country. *Internal* energy security is related to the stability of the energy supply within the country. In this chapter, we discuss mostly the external dimension of energy security, looking at the risks associated with energy supplied by producers outside the country.

The chapter is divided into three sections. The first section discusses how a country/region's energy security can be measured, given its energy profile. It presents some estimates of the European Union's energy security. The second section addresses possible extensions of the above approach, using the EU-Russia gas relationship as a running example. The last section summarizes our findings and discusses future challenges faced by the European Union regarding energy security.

Energy portfolio and energy security in EU

Energy security is typically addressed in a comparative perspective, either over time, or across different countries/regions, or both. For example, one may assess the evolution of energy security in response to certain policy measures, or address the trade-off between energy security at a country level and international cooperation. This comparative perspective calls for the development of quantifiable indicators of energy security. In this section we illustrate how this task can be approached. We outline various aspects of external energy security, explain how they can be quantitatively measured, and provide estimates of the security of external energy supply for the EU member states.

What matters for the external energy security?

The above "quantity-quality-source" triad combined with our focus on external energy security suggest a number of key dimensions that need to be considered when assessing energy security.

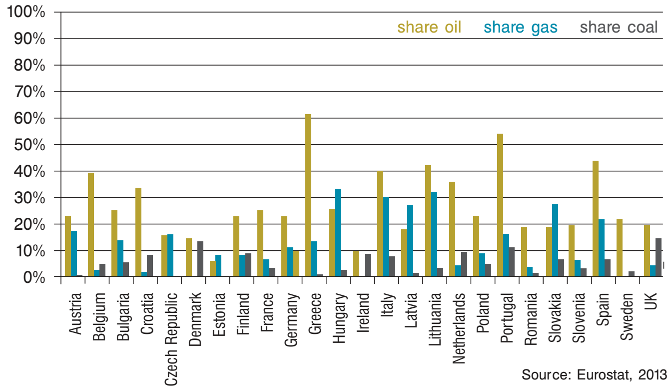
(i) The first is the *dependency* dimension that characterizes the importance of imported fuels/external energy systems for the economy in question. This is, perhaps, the most commonly used energy security indicator, frequently appearing both in political and in media debate.

There are different ways of measuring the dependency. The most straightforward one is simply to evaluate the "total" energy import dependence, i.e. the share of energy imports in a country's primary fuel consumption. However, this measure may often not be informative enough, and, in particular, not well suited to reflecting the country's approach to the "quality" challenge of choosing an appropriate energy mix. A common solution is to narrow down the dependency by considering a specific fuel and analysing the country's energy portfolio to get a better overview of the exposure to external energy security risks. Specifically, dependency in this case would be measured on a by-fuel basis, e.g. by the share of imports of each fuel in a country's consumption of the considered fuel and/or contribution of this fuel to the total primary fuel consumption of this country.

Figure 1 presents an example of this latter dependency measure for the EU member states. It depicts a share of non-EU import of a fuel in the total country's energy consumption for three fuels (oil, gas, coal). For example, in the case of Spain, the red bar indicates that 44% of Spain's total energy consumption corresponds to oil imported from non-EU suppliers, the blue bar shows that 24% of total energy consumption corresponds to non-EU gas imports, and the green one that 7% of consumption comes from non-EU coal.

There are a few observations to infer from this figure. First, for most EU member states the import ratio varies greatly across fuels. This illustrates the above point that the "total" energy import dependency measures, such as an aggregate share of imported fuels in energy consumption, are likely to be too imprecise in reflecting energy security concerns. Second, there is also a substantial variation of the indicators across countries, which may impose certain constraints on the formation of the EU Energy Union (we return to this point later). Third, the variation of import dependency both between fuels and across EU member states also highlights the environmental aspects of choosing an energy im-

Figure 1:
Share of non-EU imports in total energy consumption, by fuel.[2]



Source: Eurostat, 2013

port bundle. Indeed, different fuels have different emission content and overall environmental impact. Thus, the supply security concerns should be carefully weighed against the green objectives of the energy policy of the country (again, we return to this discussion later in section 2).

This figure also suggests that oil seems to be the most critical fuel for EU energy security, substantially more so than gas and coal. The last point does not seem to be in line with the public, political and academic discussion of the current EU energy security issues, where gas is perceived to be at least as problematic as oil, if not more so. This might reflect the limitations of the (total or by fuel) import dependency indicators, which do not take into account supply vulnerabilities arising from the composition of the import portfolio or from uncertainty associated with external energy supply.

This brings us to the next key energy security aspect:

[2] For a few EU member states the net imports from non-EU sources exceed their domestic consumption for a given fuel due to re-exports (such as, e.g., in case of oil in Lithuania or the Netherlands). Ideally, to measure the security of the energy supply we would need to account for the geographic origins of the fuel for domestic consumption vs. re-exports. However, Eurostat data do not allow for this distinction. So in Figure 1 we assume that whenever the net non-EU imports of a country exceed its domestic consumption of a fuel, the entire domestic consumption comes from non-EU sources.

(ii) The *availability* dimension. The energy security of a country is crucially dependent on the existence of alternatives to compensate for a sudden energy supply disruption. For example, if all imports of a country originate from the same supplier, and there is not much of a supply alternative available in the market, a supply disruption may be far more costly than if the import portfolio is well diversified across the suppliers, or when the market for respective fuel is readily available.

(iii) Relatedly, the *uncertainty* dimension is characterized by different external (strategic or random) factors that increase the risk of energy/fuel supply disruption, such as political risks related to the supplier, risks of tensions in the supplier-consumer relations and political or technical risks regarding transit. These factors may be general or supplier- or fuel-specific, and measuring them may often represent a considerable challenge.

A measure of energy security

This subsection provides an example of an external energy security indicator incorporating the above components to measure energy security in the EU. We follow the index approach developed by Le Coq and Paltseva (2009). The index, named Risky External Energy Supply (REES), is constructed to measure the short-term impact of external energy supply disruption.

In line with the discussion above, the REES index combines the three main aspects of energy security (the exact formulae can be found in Le Coq and Paltseva (2009, p. 4476)). First, it includes the import dependency ratio. Second, it accounts for the diversification of the fuel supply for a specific country by measuring the concentration of suppliers in the imports of each fuel. This element captures the options available to a country in the case when one of the energy suppliers fails to deliver. The index also accounts for the fuel's fungibility (which measures how easy it is to switch between suppliers of this fuel – for example, the fungibility of a pipeline gas would be lower than that of liquefied natural gas). Finally, it quantifies the uncertainty aspect of an energy transaction, by including indicators of the political risks associated with a supplying country and the distance between consuming and supplying country as a proxy for the transit-associated risks. The REES index is calculated for a specific fuel and a specific country/region.[3]

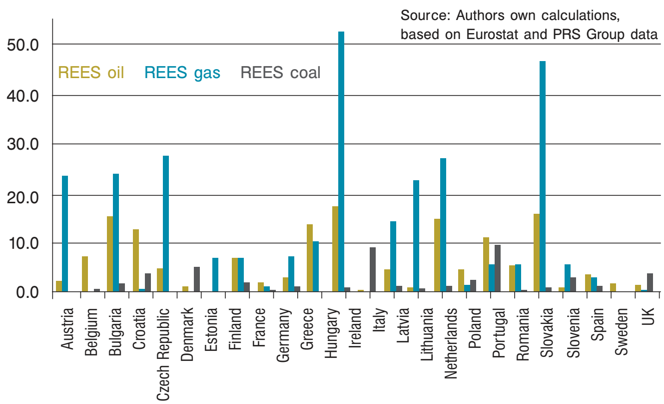
The above REES index components are combined in such a way that higher values of REES correspond to higher risks of a supply disruption for a country. For example, an increase in the fuel imports or political risks of the supplying country will increase REES. On the other hand, an increase in energy import diversification will lower REES.

Figure 2 illustrates the REES index estimates for 2013 for each EU member state, for three types of fuels – oil, gas and coal – based on Eurostat data on these fuels' imports, exports and consumption, a political risk rating produced by the PRS group, and our own proxies for energy transportation risks, etc. (see Le Coq and Paltseva (2009) for the details).

Similarly to Figure 1, it clearly shows that the exposure to energy risks is not the same for different member states and is also different across energy types. However, unlike the dependency ratio in Figure 1, the REES index singles out natural gas as the riskiest fuel for the EU's external energy security, with oil being somewhat less risky (and coal being significantly less risky). The reason for this difference is at least twofold: first, the majority of natural gas consumed in the EU is supplied via pipeline, making gas not very easy to substitute in the case of a supply disruption. Liquefied natural gas (LNG), which can be more easily substituted in the market, is consumed very little, or not at all, by some member states. No less importantly, many EU member states have highly concentrated gas imports (e.g. in central and eastern Europe, as well as in some of the western European countries, such as Austria, most natural gas originates from Russia). This again contributes to the risks associated with the security of gas supplies. Both these components raise

[3] In this chapter we choose to limit our analysis to fossil fuels, such as oil, gas and coal. In fact, the fuel with the highest import dependency in the EU is uranium – an EC Memo (2014) states that in 2012 the EU imported 88% of its consumption of crude oil, 66% of natural gas, 42% of solid fuels and 95% of uranium. However, EU uranium import is, as of today, well diversified and a significant share of it comes from "safe" producers such as Australia and Canada, making the risks of uranium supply relatively limited.

Figure 2:
REES index by fuel, 2013.



the REES for gas, as compared to, e.g., oil, where neither of the above is true to the same extent.

Notice that the absolute value of the REES index would not necessarily have a direct interpretation. Naturally, any energy security index combining different variables would be sensitive to the weights of each variable. However, the benefit of REES (and other similar indexes) is that it gives a quantitative assessment to energy security problems, and provides a reference point for international and over-time comparisons.

So far we have focused on the EU member state level. However, it is interesting to assess the contribution of the individual member states to the energy security at the EU level. One rough measure would be an average of the estimated REES for the member states. However, such a measure would not account for the relative size of the member states' energy consumption.

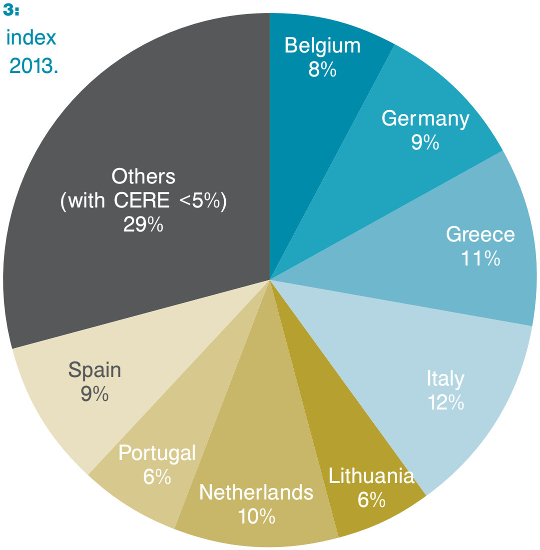
We thus use the Contribution to EU Risk Exposure (CERE) index approach developed by Le Coq and Paltseva (2009). The CERE index is calculated as the sum of REES indexes across the member states weighted by member states' shares in total EU energy imports. Figures 3, 4 and 5 give the CERE index estimates for oil, gas and coal, calculated with Eurostat data from 2013 and the PRS group.[4]

Naturally, member states with high country-level energy supply risks (such as Greece for oil, Hungary for gas or Portugal for coal) are found to contribute significantly to the EU-wide external energy risk exposure. However, country size is no less important for EU energy risks. Indeed, another group of large contributors to CERE are large member states with high aggregate energy consumption but intermediate country-level risks (like Spain or Germany for oil, Italy for gas and oil, and the UK for coal).

Beyond energy portfolio/ consumption and energy security

So far we have discussed the measures of the EU's external energy security based on the energy portfolio of the member states. However, there are many other aspects that mat-

Figure 3:
CERE index for oil, 2013.



Source: Authors own calculations, based on Eurostat and PRS Group data

[4] Due to inconsistencies in Eurostat energy import data for Poland before and after 2010 we chose not to include Poland in Figures 2–6. However, the 2006 CERE and REES indexes (see Le Coq and Paltseva (2009), Tables 2 and 3) suggested that Poland has above-EU-average external oil supply risks, but below-average risks for natural gas and coal, as measured by REES. Poland's contribution to 2006 EU energy risks measured by the CERE index did not exceed 6% (and was, again, the highest for oil).

Figure 4:
CERE index for gas, 2013.

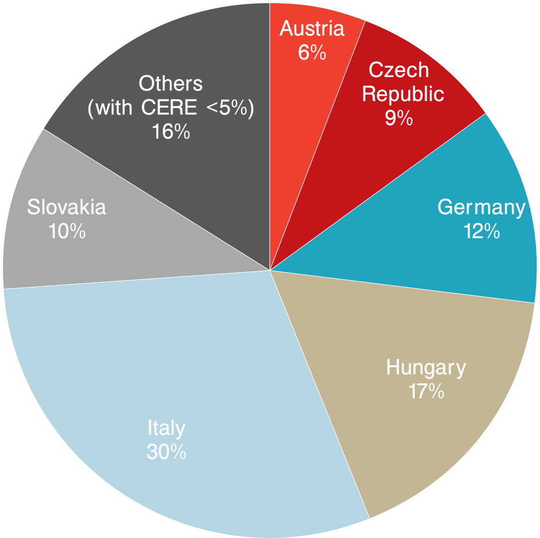
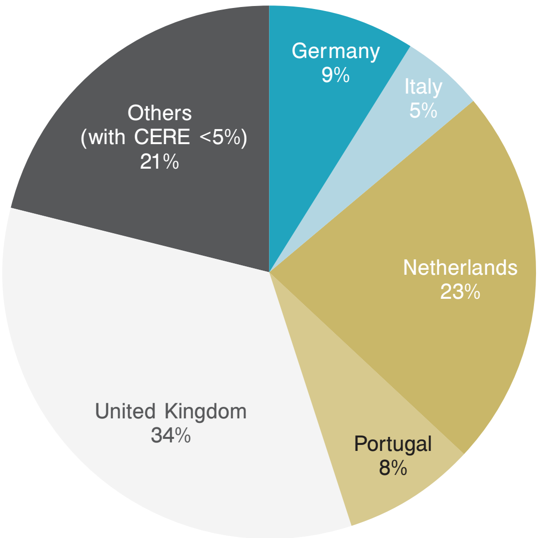


Figure 5:
CERE index for coal, 2013.



Source: Authors own calculations, based on Eurostat and PRS Group data

ter for energy security, such as the energy routes used by the member states, the bargaining power possessed by the energy consumers vs. suppliers, and the characteristics of domestic energy markets. While quantification of these aspects to include them in energy security measure(s) is often difficult (and, at times, prohibitively so) due to non-availability of systematic data, certain progress can also be made in this direction. In this section we outline several other important contributors to external energy security and (selectively) discuss how they can be incorporated into energy security measures.

The above indexes, as well as most other indexes, only marginally account for the risks of energy transportation. Further, they do not take into account the interdependency between the economic and political relations between the importing and exporting states. This is for a reason, as information of this kind would require access to a lot of data, most of which is not directly available, at least to our knowledge. However, the EU case represents an important example that allows us to demonstrate the benefits of such an extension to the energy security approach.

Energy security and energy routes

Transportation of energy (from the extraction point to the final consumer) may be associated with both technical and political risks. This implies that the security of supply from a given producer also depends on the characteristics of the energy routes – such as the availability of alternative routes to redirect the energy in the case of physical or political disturbances along the regular route.

One interesting case to look at in this respect is the case of gas trade between the EU and Russia. As discussed above, according to the REES index (see Figure 2), gas is one of the more risky imported fuels in the EU. Many member states strongly rely on Russia as the main (and in some cases the only) supplier of natural gas, which is transported via pipeline, and thus cannot easily be substituted by gas from other producers.

In Le Coq and Paltseva (2012), we aim to incorporate physical and political aspects of pipeline gas transit into the more conventional measure of gas import risks. We give a quantitative assessment of the risk associated with external gas pipeline supply by constructing a *Transit Risk Index* (TRI). The TRI accounts for (i) diversification of transit routes from a given supplier; (ii) the risk of a physical rupture of a pipeline; (iii) political instability in the countries on the transit path, and (iv) the bargaining power for each transit route, i.e. the political influence that the countries served by the same pipeline may exert on the gas supplier to prevent or minimize the supply disruption for political purposes.

This methodology is then applied to evaluate the EU member states' exposure to risks associated with Russian gas supply. It shows a clear asymmetry in current transit risk exposure among the EU member states purchasing Russian gas. This unsurprising finding reflects the variation across the member states in terms of gas dependency, the number of available gas transit routes, the political influence associated with each route, etc.

Such an index can be used to analyse the change in energy security associated with potential access to a new energy route. For example, in Le Coq and Paltseva (2012) we have studied the effect of Nord Stream on the energy security of EU member states using the TRI index. We show that for the member states immediately served by Nord Stream ("NS countries"), Nord Stream allows a better gas route diversification and therefore lowers transit risk exposure. However, the transit risk exposure is increased for the member states that are not themselves connected to Nord Stream but share another, "older" energy route with the NS countries. The reason is that NS countries are now less willing to exercise their bargaining power along the "older" gas routes, thereby reducing the political influence that countries served by the same pipeline may exert on the gas supplier.

Energy security on both sides of the market

Another important aspect overlooked in the typical approaches to measuring energy security is the interrelation between a buyer and a seller. Energy security is typically evaluated from the buyer's perspective, thereby stressing the size of import dependency on toward a specific energy supplier. However, energy security may be no less of a concern for the energy supplier, for example due to a lack of demand diversification and economic dependency on energy export profits.

Once again, the EU-Russia gas relationship offers a good illustration of this point. European energy security is often discussed by stressing the extent of the EU dependency on Russian gas and the risks associated with this dependency. This is, of course, a valid point, because 27% of the EU's gas import export comes from Russia (Eurogas, 2014), and for several EU member states this share has exceeded 90% (Eurostat, 2014). However, Russia is no less dependent on the EU. First, the EU accounts for 60% of Gazprom's revenue from gas sales (FT, March 2015), which in turn impacts on the Russian budget revenue. Moreover, Gazprom is currently under antitrust investigation regarding its selling practices within the EU (see FT, April 2015), which creates some additional uncertainty for this supplier.

In other words, security of gas trade is a concern for both parties. The EU is concerned with its *security of gas supply* and in particular would like to avoid Russian gas supply disruption. Russia is concerned about the *security of gas demand* and would like to secure a stable gas market share in the EU despite the geopolitical tensions. Clearly, these two objectives are closely interrelated and represent the core of the mutual gas dependency between Russia and the EU.

Le Coq and Paltseva (2013) have proposed a unified framework to characterize and quantify mutual gas dependency between the EU and Russia. We have constructed an index for each gas trading party, the *Supply Dependency Index* (SDI) for the EU and the *Demand Dependency Index* (DDI) for Russia. These indexes can be used to evaluate future gas market developments (such as a new pipeline or improved access to LNG) from the dependency angle.

Developing the internal market

So far we have not mentioned the role that the internal market is (and could be) playing in the improvement of the EU's energy security. A well-functioning internal energy market could affect the external energy supply security of the EU through a number of economic and technological mechanisms. For example, increased competitiveness in the internal market would enable reaction to energy shortages via the market mechanisms rather than governmental/intergovernmental "from-the-top" decisions, which require significant effort in terms of design and implementation. The availability of reverse flow technology for natural gas can enable the delivery of gas from other regions, or other EU member states, in the case of sudden halts of supply or technical failures. The development of internal storage combined with market interconnection between the EU member states may also facilitate coping with sudden energy crises.

While incorporating the storage capacities into the energy security index may be relatively straightforward, the other above-mentioned components are more difficult to quantify. A sophisticated computational model of pipeline networks and/or local market structure would be needed to account for market interconnections between different EU member states. While this approach is feasible, it is computationally very involved and is typically not used in indexes measuring energy security risks.

Additionally, the EU's internal energy markets have improved in recent years, but more work and more investment are still needed for the internal market to be a buffer against external energy risks.

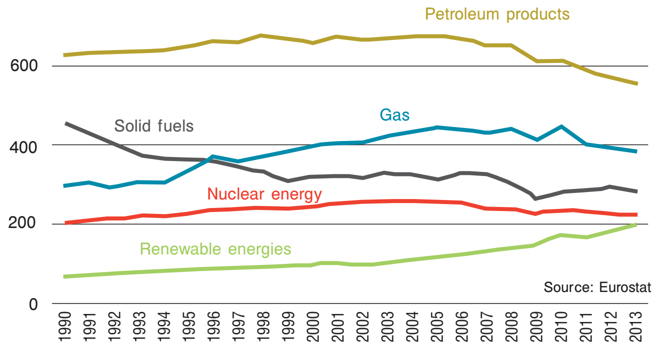
Environmental aspects of energy security

Growing concern about climate change has put pressure on the EU to move to low-carbon sources. The above discussion has highlighted that there is a trade-off between environmental concerns and energy security. Remember that our index has identified natural gas as the most risky among the three fuels that we have considered above as concerns for the security of energy supply. At the same time, out of these three fossil fuels, natural gas is associated with the lowest carbon emissions: the Energy Information Administration estimated the CO_2 emissions of coal to be 95 kg/MlnBTU, the CO_2 emissions of gasoline and other transportation fuels to be around 70 kg/MlnBTU, and that of natural gas to be 53 kg/MlnBTU, almost twice as little as for coal.[5]

Figure 6 summarizes the evolution of the EU energy consumption over the last couple of decades. As can be seen from Figure 6, the use of natural gas has been increasing (and then stabilizing), while the use of petroleum products, and especially coal, has been declining. The increased con-

Figure 6:

EU energy consumption 1990–2013, by fuel, MlnTOE.



sumption of gas replacing coal and oil has thus had positive environmental effects within the EU, while at the same time exacerbating the energy security concerns.

One potential way to control for this trade-off in an energy security measure would be to account for the pollution resulting from imported and domestically produced energy. This, however, would require a substantial amount of data on energy flows and their CO_2 and other pollution content, energy transformation, efficiency of energy use, quality of abatement technologies available in the country in question, etc. Just as above, due to computational difficulties, this approach has limited use in indexes measuring energy security risks. One example of such an index is the Energy Trilemma Index of the World Energy Council, which incorporates both energy security and environmental sustainability components. However, its construction is complicated and not entirely transparent, and the approach it takes to the security of energy supply falls short of accounting for the above-mentioned important aspects of energy security, such as portfolio diversification and different energy types. Böhringer and Keller (2011) combine a supply security index approach with a sophisticated CGE-based model to assess the impact of climate policies on the security of energy supply (see their paper for a discussion of associated conceptual and data difficulties, and approach limitations).

[5] See http://www.eia.gov/environment/emissions/co2_vol_mass.cfm.

Domestic energy security

Finally, we would like to mention a topic we have overlooked so far – domestic energy security. Indeed, the energy dependency argument above clearly suggests that reliance on domestic sources of energy increases a country's self-sufficiency and lowers external energy supply risks. However, this does not imply that domestic energy supply bears no risks. Indeed, domestic transportation of energy may equally be prone to technological failures, leading to power outages, oil spills and other kinds of energy delivery interruptions. Another energy security issue that is typically dealt with domestically is the ability to effectively cope with demand peaks. The balance between the industrial, transport and residential energy use, the adequacy of energy conversion and distribution and the availability of fuel storage also contribute to domestic energy security.

Many of these factors can be approximated by measurable observables – for example, the reserve margin of generation capacity can be used as a proxy for demand peak management ability, and the ratio of domestic energy production to consumption is used as a proxy for energy self-sufficiency. Some of these measures are indeed incorporated into the energy security indicators offered by the literature (see, e.g., the Supply-Demand Index of De Jong et al. (2007)). Nevertheless, the main focus in the energy security literature has been on external security – perhaps because domestic governments would normally have better control over domestic energy security factors than over external supply risk determinants.

Conclusion

What did we learn with the index exercise?

In this chapter, we have discussed an approach measuring the risk of energy supply disruption in the EU. We have focused on the "external" dimension of energy security, quantifying the risks associated with energy supplied by producers from outside the EU. Our first measure, the Risky External Energy Supply (REES) index, allows us to put a number on the risks of, and damage from, a potential supply disruption for a specific member state. Our second measure, Contribution to EU Risk Exposure (CERE), evaluates the relative contribution of the member states to the EU-wide risks.

There are at least two lessons to learn from these indexes. The first group of lessons concerns methodological aspects of measuring the security of energy supply. We have discussed and illustrated in our exercise the fact that energy security is a complex phenomenon, and simplistic indicators addressing only single aspects of energy security are likely to be a poor measure of it. Indicators combining different variables may be more preferable. At the same time, more involved indicators may require access to large amounts of specific data, which is often not available. Another point is that composite indexes are sensitive to the component aggregation procedure. This makes them more relevant as a policy/research tool for cross-country and over-time comparisons, and perhaps less relevant for one-point-in-time risk assessment. Further, both REES and CERE for the EU member states vary greatly across fuels. Thus, an aggregate index that estimates a risk of all kinds of energy supply disruption would be inadequate for capturing short-term external energy risks, when substitutability between fuels is highly limited. While better justified in the longer run, such aggregations across fuels should still be taken with caution.

The other group of lessons has more political relevance, especially in view of the recently proposed and actively debated European Energy Union. Figures 1–5 demonstrate that external energy risks for the EU member states are very different between states. This suggests that member states are likely to have different foci and widely varying "hot spots" when it comes to external energy security issues. This may be one of the explanations for the delays in implementation of long-discussed common energy policy in the EU, which has been on the active political agenda for at least 15 years. Indeed, the diversity of energy risks across the EU suggests that "one size fits all" solutions are not likely to have sufficient support across the member states, while country-specific energy policies may be difficult to justify as an EU-wide energy policy. However, recent developments in the EU's internal energy markets (such as more competition or interconnection between the individual markets) allow for more flexible, market-based compensation mechanisms across different EU member states, thereby facilitating the development and implementation of common energy policy rules. These considerations are likely to be relevant for the design of the mechanisms behind the European Energy Union.

EU's next challenges in terms of energy security

The total net imports of natural gas, solid fuels and oil represent more than half (53% in 2013, Eurostat) of the share of primary energy consumption in the EU. Moreover, the EU's demand for energy is predicted to increase substantially. As a result, Europe will increase its energy imports from non-European suppliers, implying that energy security concern is not likely to fade in the coming decade.

At the same time, evolution of the internal and external energy markets may radically shift the main focus of the energy security concern. We have already addressed the internal markets perspective earlier in the chapter. Another good example here is ongoing change in the *liquidity of the energy markets*, associated first with LNG, and currently with the shale gas revolution. Indeed, before the LNG technology became commercially available, natural gas markets were very geographically segmented, and were often characterized by the significant market power of the producers and resulting low fungibility of natural gas. LNG transportation was the first step toward interconnecting different international markets. However, the gas market dynamics have completely changed with the new extraction techniques (mostly hydraulic fracturing, or fracking) on top of the possibilities of transporting liquefied gas. First, countries who are used to being net gas importers have the potential to become gas exporters (see BP statistical book, 2014). Combined with the LNG transportation possibilities, this change is likely to transform the regional gas markets into more globalized markets. This means that the gas market will become more liquid, the number of available gas suppliers for Europe will increase, and large gas producers like Russia are likely to lose bargaining power. In this sense, the shale gas revolution may increase EU's energy security in the long run.

However, if the gas market becomes more liquid, it is also likely that the EU will face some competition on the demand side. Indeed, the current prices of LNG in South-East Asia exceed the European prices, so there are no guarantees that US shale gas, if available for exports, will flow into the EU. At the same time, Russia, foreseeing the future market developments, is likely to be searching for new consumers already now. Indeed, China has already started to compete with the EU for Russian gas with the decision to build a new pipeline between Russia and China. In other words, there are no guarantees that the shale gas revolution will improve the external energy security in the EU in the short-to-medium run, and this needs to be accounted for in political decisions.

Another important challenge the EU is about to face is the interrelation between the environmental targets and energy security. The concerns about climate change and environmental damage have been growing substantially over recent decades, and the EU has been determined to move to lower-carbon traditional fuels, such as gas, as well as green energy sources, such as wind and solar. The increased use of gas, primarily replacing coal, has indeed had a positive environmental benefit within the EU (for example via reduced greenhouse and air pollutant emissions). However, it has also increased the risks associated with the security of energy supply. Similarly, the use of wind energy in the absence of a backup technology may result in power outages (and energy security risks) due to the instability of wind energy production. In turn, backup technologies are often coal- and gas-based, with the former being carbon-intense, and the latter potentially prone to security risks. No less important is the composition of the renewable energy portfolio. Indeed, while renewables have very low external supply risks, simply because they have very low import share, domestic supply disruption risks are likely to vary across different renewable energy types, and different operation networks. For example, wind and solar energy are more intermittent than, say, geothermal energy; large-scale grids are more vulnerable to disruption than the networked microgrids. All of the above suggests that the EU needs to carefully assess the interconnection between environmental goals and energy security risks and put more effort into developing environmentally friendly energy technologies that are not at the same time associated with higher energy security risks.

3

THE AUSTRIAN ENERGY POLICY FROM A EUROPEAN PERSPECTIVE

Ronald Pohoryles

Introduction

From a European perspective, the opposition against nuclear energy is one of the defining issues of Austrian energy policy.

Austria was the first European country to reject the production of nuclear power, in the 1978 referendum, and has historically favoured renewables. This is, at least in part, due to the availability of hydrodynamic power, and recently wind energy. The major arguments against the production of nuclear power were safety, but security as well: the nuclear fuel rods have to be imported, and the final storage was unclear. This was followed by a legislative action in the Austrian Parliament that led to a constitutional law in 1979 that bans the production of nuclear energy in Austria. In 1990, the Austrian government announced a plan to create a "nuclear-free zone" in central and eastern Europe. In turn, it offered support to its neighbouring countries to support the increase of energy efficiency and the production of renewables (Lofsted, 2008).

Since Austria's accession to the EU in 1995 it has used its EU membership to underline its opposition to the construction and modernization of nuclear power stations in neighbouring countries. For example, Austria threatened to block the Accession process of the Eastern European candidate countries because of their energy policy. Austria was, at least in part, successful: the plan to enlarge the Czech nuclear plant Temelín was stopped in 2006. Furthermore, Austria blocked a credit from the EBRD to finance the modernization and/or building of nuclear power stations. And indeed, Austria has sued the European Commission at the European Court of Justice for its decision to support financially the construction of the British nuclear power station on the site of Hinkley Point C (Wiener Zeitung, 2015). If successful, EDF, which intends to construct and run the nuclear power station, would most likely withdraw from the plan.

[1] It should be noted here that the energy policy is a contested issue. For instance, in Austria there is a strong influence from the Chamber of Economy, the public interest organization of Austrian entrepreneurs (Bärenthaler, Guhsl, and Kaiser, 2012). With respect to the Energy Efficiency Act, some of the opposition, including the Austrian liberals, opposed the Act for several reasons (Pock, 2014a).

Austria's energy profile

The policy framework

The energy strategy of Austria presented in 2010 rests on three pillars (Federal Ministry of Economy, Family and Youth, 2010a):

- security of supply;
- energy efficiency; and
- renewable energy resources.

It states that the goal of Austria's energy policy is to ensure security of supply, environmental compatibility, cost-effectiveness, social compatibility and competitiveness within the framework of the European targets (Federal Ministry of Economy, Family and Youth, 2010a). If implemented, the share of renewable energy consumption of the total final energy consumption is thought to increase from 24.4% (2005) to 35.5%.

In addition, the most important laws for Austrian energy policy are the Energy Efficiency Act (Energieeffizienzgesetz 2014 (Energy Efficiency Act), 2014), provisions for the implementation (Energieeffizienzpaket 2014 (Energy Efficiency Package 2014), 2015) and the Green Electricity Act (Ökostromgesetz 2012, 2012).[1]

- The Energy Efficiency Act: The Act is the transposition of the Energy Efficiency Directive 2012/27/EU of the European Commission (European Commission, 2012). The consumption reduction requirements particularly apply to energy providers, large companies and government agencies. One of the requirements of the directive is the delivery of an Annual Progress Report on Energy Efficiency (Federal Ministry for Economic Affairs, the Family and Youth, 2013).
- The Green Electricity Act is the transposition of three European directives on the promotion of the use of energy from renewable sources and on the internal market (European Commission, 2009). It includes regulations for certifying the origin of, and the production from, renewable sources, preconditions for, and the regime of, support for electricity generation from renewable energy, and the financing mechanism for the expenses incurred.

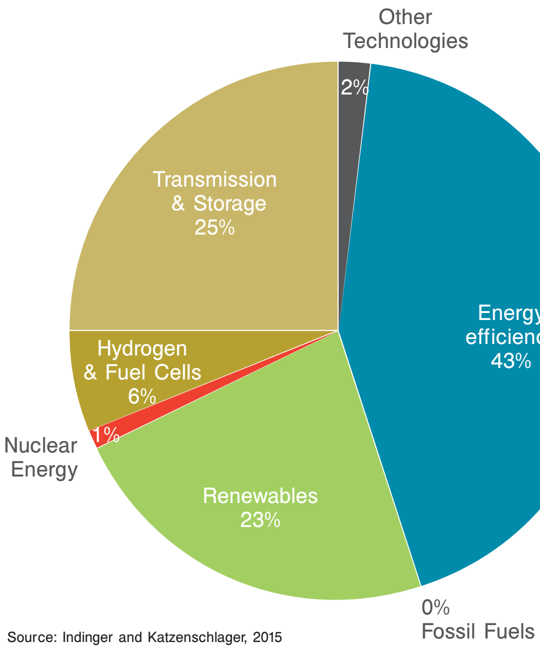
Obviously, Austria's energy policy is not independent from the European energy policy (Katzian, 2011). The policy papers make direct reference to the European Climate and Energy Policy 20-20-20 targets, e.g. the reduction of GHG emissions by 20% as compared to 1990, 20% energy consumption from renewable sources and an increase in energy efficiency of 20% as compared to a business-as-usual scenario.

An important element, also underlined by the IEA, of the Austrian energy policy is the financial support for R&D-related research. The IEA notes that Austria has more than tripled public funding for energy research, development and demonstration (RD&D) since 2007 (OECD/IEA, 2014).

In 2010, nearly half of the public expenses for energy-related research were devoted to energy efficiency research, and about half to research on renewables, with the remaining budget being devoted to other energy-related issues (Indinger, 2011). Compared to 2010, the structure of expenditures has changed: whilst the share of expenditures for energy efficiency has remained by and large stable, the share of research expenditures for electricity transmission, distribution, energy storage etc., overtaking the sector of renewables as the second largest. In 2014, Austria's public expenditures for energy-related research and development amounted to

43,100,718 euros, increasing the expenditure of 2013 by 15% and reaching an all-time high (Indinger and Katzenschlager, 2015).[2]

Figure 1:
The structure of public funding for R&D in 2014.



Source: Indinger and Katzenschlager, 2015

Energy supply and domestic production

Renewables account for nearly 75% of the Austrian primary production. This is, however, not – or at least not only – the result of the Austrian energy policy. Austria has, for geographical reasons, a high potential for energy production from hydropower. Among the EU countries, only Sweden has a higher share of hydropower in its energy production. Overall, the domestic production of energy is steadily increasing: whereas the total domestic energy production in Austria in 1990 was 94.7 TWH, in 2005 it was 116.75 TWH and in 2013 142.6 TWH.

Renewables play an important role in primary energy production. About 4/5 of the production comes from renewables, and less than 1/5 from other sources. As we will see later on, this is quite different from the energy use, which leads to the import dependency of Austria.

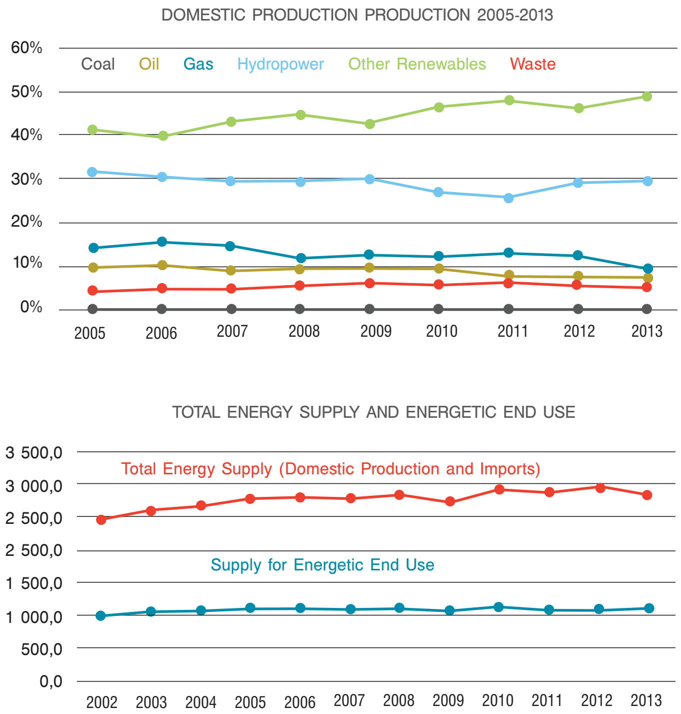
Hydropower has an important share in the renewables in the production of primary energy. The highest share, however, belongs to biogenic energy resources.[3] The rapid growth in the production of photovoltaics, which increased in 2013 compared to 2012 by 72.5%, is remarkable.

The example of the production of electricity shows that in this sector, hydropower accounts for two-thirds of the pro-

[2] It should be noted here that in Austria it is very interesting to have a transparent overview of public expenditure. In accordance with the federal constitution of Austria, the nine provinces of Austria ("Bundesländer") have their own budgets and different systems to account for them. Furthermore, public agencies have their own budgets as well. The data that are used by the Austrian Energy Agency derive from a survey study on around 1,100 projects.

[3] Biogenic resources are, inter alia, wood-based energy sources, biogenetic fuels, wastes and biogas.

Figure 2:
Total energy supply and supply for energetic end use



Source: Federal Ministry for Science and Research, 2015

duction of the sources. Of course, this is not so much due to policy, but to the geographic position of Austria. However, the comparatively high share of innovative sustainable energy is based on the financial support from the state.

As mentioned above Austria is still a net importer of energy. Although there is a slight decline in energy imports as compared to the previous years the import as compared to 2002 are about.

Energy demand and consumer groups

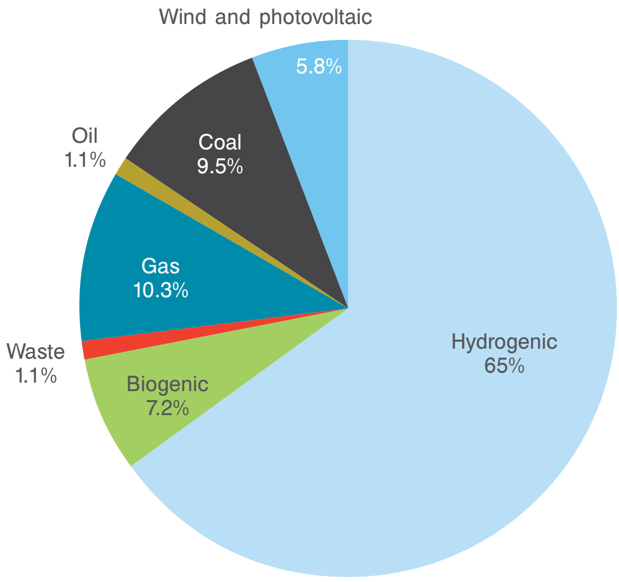
Industry, transport and private households account for about 88% of the total demand. There are various policy instruments to encourage these groups to increase energy efficiency, which are mostly specific to the different groups.

Obviously, the different user groups use different energy sources. Based on the data of Statistik Austria on energetic energy use (Gollner, 2014), the following should be noted:

- The biggest energy user group is transport. The overwhelming energy source for transport is oil with a share of 88.4%. Renewables, electricity and gas play a minor role. However, renewables have a high potential to increase in the near future, especially wind energy and photovoltaics.
- The industry has a more differentiated energy profile. Gas and electricity account for around one-third each, and renewables for about one-sixth.
- The energy profile of private households is characterized by the use of renewable energy sources (29.6%) and electricity (21.9%).

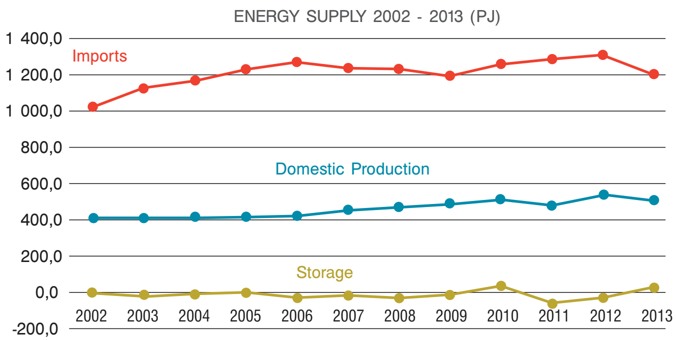
Due largely to the transport sector, oil remains the most important source for energy consumption. The share of oil in

Figure 3:
Share of energy sources for the production of electricity.



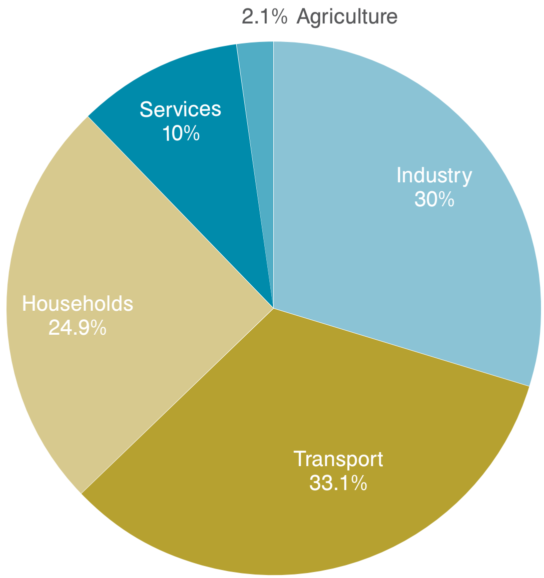
Source: Statistik Austria, 2013

Figure 4:
Domestic production, imports and storage in PJ



Source: Federal Ministry for Science and Research, 2015

Figure 5:
Energy use by user group.



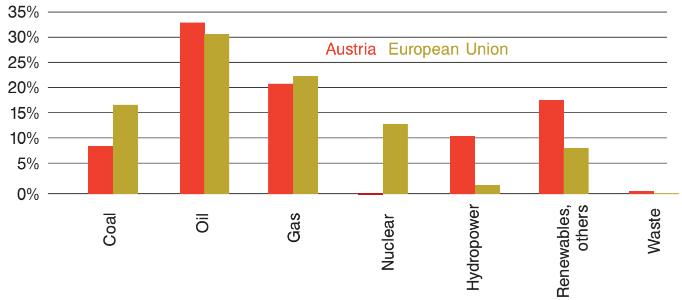
Source: Gollner, 2014

the total use of energy consumption is slightly higher than in the European Union. In Austria, one-third of the energy consumption derives from renewables, whilst in the EU it is only one-tenth.

Energy efficiency

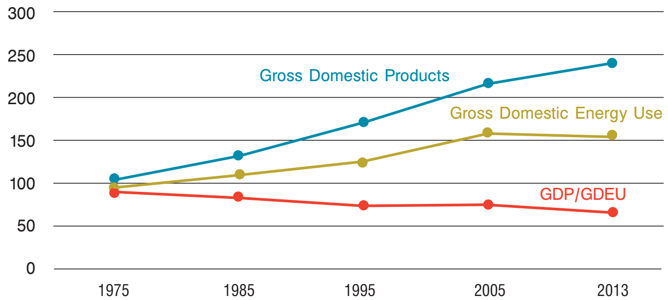
Among the pillars of the energy policy is the increase of energy efficiency. Austria has a good record in decoupling the growth of the gross domestic product (GDP) and the gross domestic energy use (GDEU).

Figure 6:
Sources of energy consumption.



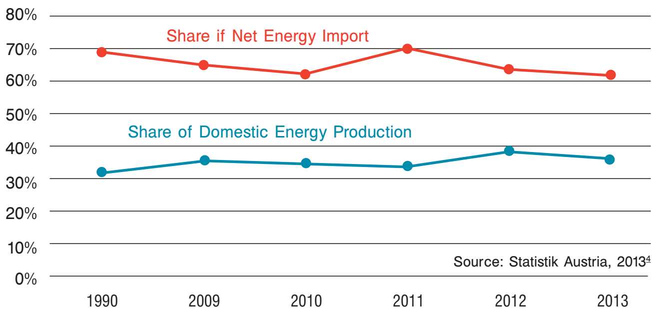
Source: Federal Ministry for Science and Research, 2015; based on IEA data

Figure 7:
The relation between GDP and energy use (100=1973).



Source: Federal Ministry for Science and Research, 2015

Figure 8:
Figure 8: Dependency on energy import.



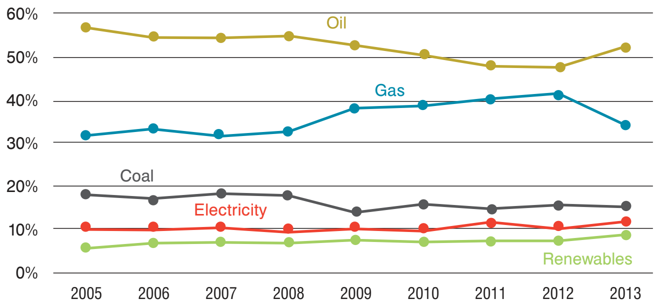
Import dependency and energy trade (import vs. export)

Despite the increase of the energy efficiency, Austria is still a net importer of energy and hence depends on imports.

Energy security is not only dependent on the ratio between domestic production and imports, but also on the energy carrier. As the statistics show, by far the most important energy carriers are oil products and gas, whereas the shares of coal, electricity and renewables are less than 10% each. The supply of oil and gas is hence not only an economic issue, but political as well. The political stability of the exporting countries is quite relevant too, and this in turn leads to the energy carrier that Austria imports.

More than 90% of the Austrian oil demand is met through imports, while the remaining 10% stems from domestic oil production. With respect to the oil exporting countries, Austria's import structure features a certain fragility. There are various things that might endanger the supply of oil: political stability and international policy issues influence the world trade to an important degree. Examples include Libya, Iran and Russia. But the other major suppliers are also far from being stable democracies. However, this is not a problem facing Austria only. As is to be expected, the Austrian trade balance in energy is negative. Although there is a slight shift in the share of Austrian exports (11.2% against 12.3% share of domestic production), there is no room for a significant increase in exports. Obviously, decreasing energy imports is the only way to reduce the dependency.

Figure 9:
Austria's energy imports 2005–2013.



GHG emissions

Austria's share of GHG emissions in Mt CO_2 equivalent in the EU is 1.85% (as compared to a 2.1% share of the EU GDP). In 2013, GHG emissions totalled 64.73 Mt. Against the peak in 2005, this means a reduction of nearly 20% (Federal Ministry for Science and Research, 2015). The most important type of emissions are CO_2 emissions.

Most of the GHG emissions are caused by the energy sector. However, against the peak in 2005, the energy sector was able to reduce its emissions by around 20%. The emissions of the other sectors remained constant.

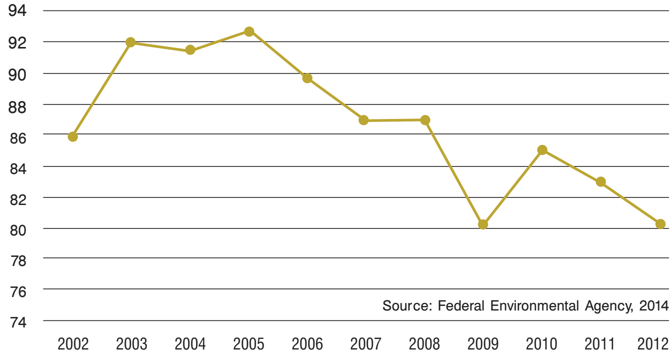
Current energy issues for Austria

According to the IEA policy review on Austria, there are three major issues for the future of Austrian energy policy (OECD/IEA, 2014):

- the integration of security of supply, energy efficiency, sustainability and internal market dimensions;
- the further reduction of greenhouse gas emissions; and
- the integration of these two elements into an energy and climate strategy 2030.

[4] The share of domestic energy production is primary production/gross domestic consumption, the share of net energy import is import-export/gross domestic consumption.

Figure 10:
Total GHG emissions in Mt CO_2 equivalent.



Source: Federal Environmental Agency, 2014

Energy security

In its annual country review, the International Energy Agency assumes that the energy security of Austria is at this point robust. However, the IEA is calling for an increase of the domestic gas production[5] and a further integration into the European internal energy market (OECD/IEA Review of Austria's Energy Policies, 2014).

There are good reasons for this assessment: the Austrian energy policy opts for the increase of energy efficiency and the promotion of renewables. The aim for the future is to increase the amount of renewables in the country's energy mix further, based on specific targets and subsidies (Ökostromgesetz 2012, 2012). Also, Austria invests a satisfactory amount in research, development and demonstration projects to reach the policy goals, and the governance by independent research funding agencies is a standard that follows the international ones. OECD/IEA (2014) data show that up until now the policy has been quite successful.

However, there are two problems that might occur: Austria still depends on energy imports, especially for transport, industry and agriculture. And although the share of imported energy has decreased and the decoupling of GDP and energy use seems to progress, the absolute amount of energy import is growing and for the foreseeable future Austria will remain a net importer of energy.

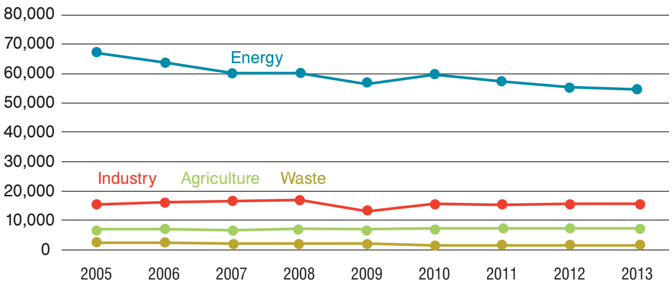
Although some experts are calling for a change to the no-nuclear policy of Austria (Promper and Böck, 2007), the overwhelming majority of experts, the public at large and the Austrian government are clearly against such an option. It is not inconceivable that in the years to come a new debate might arise on this issue. The same holds for shale gas, of which only the IEA seems to be a herald (OECD/IEA, 2014).

Energy efficiency and increase of the production from renewable sources

As shown before, the Austrian energy policy relies on energy efficiency and the production of renewables. Recent research by the leading Austrian economic research institute WIFO (Österreichisches Institut für Wirtschaftsforschung – Austrian Institute of Economic Research) acknowledges some structural adjustment. The report, however, criticizes the fact that from an international perspective the efficiency gains are below the average improvement (Kletzan-Slamanig et al., 2015).

With respect to the increase of energy efficiency, the aforementioned IEA report points to the high potential of the transport sector. This necessitates an increased effort in R&D to stimulate innovation. The European Framework Programme supports transport R&D to a significant extent: the overall budget for transport research in FP7 was 4.16 billion euro. About 80% of the project coordinators claim that their research contributes to the increase of energy efficiency

Figure 11:
GHG source and sink categories in kt CO_2 equivalent.



Source: Pazdernik et al., 2015[6]

[5] The IEA mentions explicitly the production of shale gas, which in Austria is rejected both by the government and the public at large.
[6] Without Land Use, Land-Use Change and Forestry (LULUCF).

(Pohoryles, 2014a). The Austrian comparative value is, however, 10% lower (Pohoryles, 2014b).

Austria seems to be quite advanced with its share of renewables in the energy production in relation to 2020 targets. Austria had nearly met its 2020 targets already by 2013; only Sweden has already exceeded its target for renewable energy.

A recent Austrian study explores the market potential of renewables in Austria (Biermayr et al., 2014). The study covers all sources of renewables, i.e. biomass, photovoltaics, solar thermal collectors, heat pumps and wind power. The findings are quite ambiguous: whereas there is a steady increase of photovoltaics, wind power and heating pumps, biomass seems to be decreasing. As a result, the study suggests a careful combination of incentives and disincentives using subsidies, but eco-taxes as well, but at the same time warns against both a go-and-stop policy and a policy that creates bandwagon effects.

The IEA underlines the importance of increasing the energy efficiency in the transport sector, and e-mobility seems to be the only viable solution to achieve this. Biomass and biofuels are quite unlikely to become a future-oriented solution: the domestic production of biofuels will not suffice, and whilst its production reduces the CO_2 emissions, it still produces about half of the emissions as compared to fossil fuels (OECD/IEA, 2014). Potential exporters of biofuels are developing countries that do not fulfil the European sustainability criteria (Vadrot and Pohoryles, 2010).[7]

Connection to the regional markets and the European market

In its recommendations to the Austrian government, the IEA suggested the strengthening of the cross-border integration of both electricity and natural gas markets (OECD/IEA, 2014). There are, however, major obstacles in this respect. In a recent article in the widely distributed Austrian newspaper Kurier, the journalist disclosed the main obstacle to this cooperation: Germany intends to erect technological barriers of electricity networks against Austria's networks. The reason for this is not a political one, but merely a technological one: on the one hand, the electricity networks in Poland are outdated and do not have enough capacity to absorb the increased electricity production of Germany, which is partly due to the fact that Germany supports the erection of wind energy plants in the north of Germany to prepare for the German energy transformation that inter alia foresees its departure from the production of nuclear power. Furthermore, Germany has a growing problem with the capacity of its own distribution networks for electricity. The aim of this policy is that Austria would have to buy additional capacity via the Leipzig stock exchange. The Austrian government expects additional costs of about 100 M€ as a result this policy (Kischko, 2015).

The same article points to another issue, namely the standard of the Austrian energy networks: they are somewhat outdated and, furthermore, do not provide enough capacity in the light of the growing demand, production and import of electricity.

National climate goals

The Kyoto targets and the legislative European Climate and Energy Package from 2009 define the national climate goals of Austria. The Austrian GHG reduction target in the non-trading sectors for 2020, in accordance with the EU Effort Sharing Decision, is -16% compared to 2005.

The Austrian government published a comprehensive action plan for all sectors (Federal Ministry for Agriculture, Forestry and the Environment, 2007). Furthermore, most of the nine federal provinces (Bundesländer) have formulated their own regional climate change programmes, taking into account specific regional circumstances and needs. Based on the analysis of the current state, and acknowledging the progress in the reduction of GHG emissions, the plan already casts doubts over whether Austria can meet its 2020 targets. The action plan calls for:

- the development and use of technologies in the fields of energy efficiency and renewables, where possible the use of local resources, and
- the use of cost-efficient flexible instruments like the

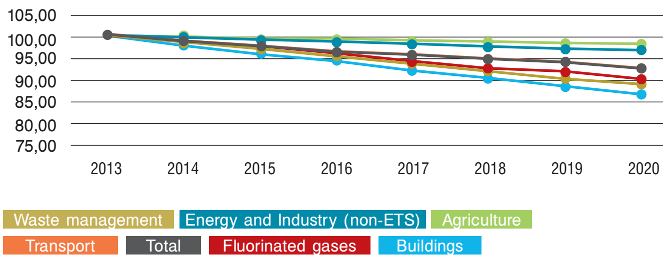
[7] There is an ongoing debate about second-, third- and even fourth-generation biofuels. However, up until now the results of R&D have not been convincing.

Austrian activities in the Joint Implementation and Clean Development Mechanism (JI/CDM)[8] and the Green Investment Scheme (GIS) as well as the Emission Trade Scheme (ETS).

Furthermore, it refers to the need to take national cross-sectional policies (like economy policy and social policy) into account. The most recent report on climate protection was published in 2014 (Zechmeister et al., 2014). It shows that Austria failed to meet its Kyoto targets for 2008–2012. The emissions were 2.5% above the levels of 1990 and 11.3 million tonnes above the annual mean value of the Kyoto target stipulated for 2008–2012 (minus 13% below 1990 levels, i.e. 68.8 Mt CO_2 equivalent). The resulting overall gap, as compared to the JI/CDM measures planned under the Austrian climate strategy amounting to 45 Mt CO_2 equivalent, corresponds to an extra need for flexible instruments amounting to 24 Mt CO_2 equivalent (Zechmeister et al., 2014).

In 2011, Austria introduced the Austrian Climate Change Act (Klimaschutzgesetz (KSG)), which was amended in 2013. Following the logic of the Climate Strategy 2007 the law fixes the ceilings for GHG emissions for 2013–2020 and specifies the targets for each sector (excluding ETS-related sectors). In parallel, working groups defined measures in order to meet the goals. The overall reduction in 2013–2020 should reach about 7%, and the highest reduction is expected from the building sector. The overall reduction should be 3.7 Mt CO_2 equivalent.

Figure 12
Reduction of GHG emissions, total and by sector.



Source: Annex to the Austrian Climate Change Act

The Austrian Energy Strategy 2010 defines the targets necessary to reach this goal (Federal Ministry of Economy, Family and Youth, 2010a; Federal Ministry of Economy, Family and Youth, 2010b):

- increase of the energy efficiency of 20% as compared to 2005;
- increase of renewables of 34% as compared to 2005;
- decrease of the GHG emissions caused by ETS of 21% as compared to 2005; and
- decrease of the GHG emissions through effort-sharing activities as compared to 2005. The energy strategy was developed in a participatory process that brought together public and private stakeholders, research communities and NGOs.

Energy taxation and support measures for energy efficiency and renewable energy resources

In Austria, there is an ongoing debate about the structure of the taxation system as a whole, i.e. the potential role of eco-taxes, which would include energy-related taxes as well. In a recent report, the OECD, whilst praising the environmental situation in Austria in general, criticizes the lack of a comprehensive socio-ecological tax reform. Furthermore, the OECD criticizes indirect subsidies that discourage energy saving. This is caused by tax rates that do not consistently reflect the environmental impacts of energy use. Examples are the tax rates on fossil fuels that are below the EU average as well as the favourable tax treatment of company cars. Furthermore, there are still tax breaks and rebates for energy use for energy-intensive industries (OECD, 2013).

With respect to subsidies and investment, the OECD acknowledges a major shift between 1993 and 2011. Whilst expressing a *caveat* with respect to the data provided,[9] the report mentions explicitly:

[8] JI allows a country, firm or individual to implement an emission reduction project and earn emission reduction units that can be sold. The main difference between the CDM and JI lies in their application, as JI projects can only be hosted by countries with emission reduction commitments.

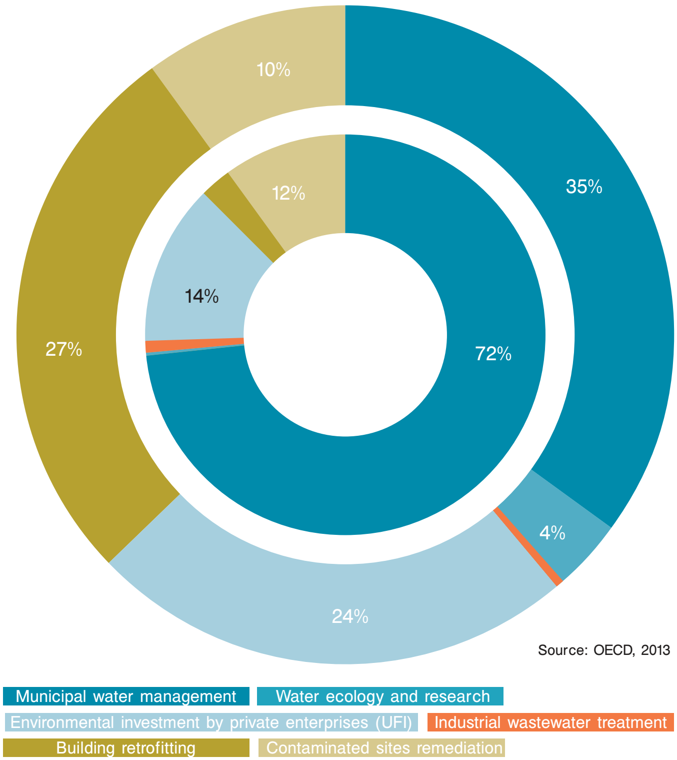
[9] "it is not always clear how these impacts are calculated, how potential job losses are taken into account, and to what extent the various estimates are comparable(OECD, 2013).

- the 2002 Green Electricity Act that provides a stable feed-in tariff system;
- the *klima:aktiv mobil* that started in 2007 to finance local and provincial authorities and providers of cycling facilities to promote more sustainable transport; and
- the *thermal building retrofitting initiative* of the Austrian government.

In 2011, environmentally motivated subsidies accounted for more than 40% of general government expenditure on the environment. The OECD criticizes the fact that this is more than four times the average for the countries in the euro area and warns against a free-rider effect. The OECD's assessment is that Austria's subsidy policy is not efficient, and this is because of the federalist system and the lack of multilevel governance coordination, which leads to multiple funding from the national and subnational levels. Hence, the OECD recommends reviewing the subsidy policy.

Figure 13
The changing focus of environment subsidies and investment.

2011 (OUTER CIRCLE) AND AVERAGE 1993-2010 (INNER CIRCLE)



The next energy challenges

A note on the European Energy Union

The debate on energy security, renewables, energy efficiency, backup capacity and transmission in Austria is directly related to the Commission's communications on the Energy Union Package (2015a, 2014b), which highlight roughly the same issues. The motivation of the Commission is to ensure sustainable energy security at affordable prices by fostering the coordination of the member states, based upon innovative and competitive companies that deliver energy for a low-carbon industry and at the same time offer qualified jobs. In the view of the Commission, this necessitates a shift from a fragmented system characterized by uncoordinated national policies, market barriers and energy-isolated areas.

Although the Commission's communications have no legislative character, the Austrian energy policy regarding the development of the European Energy Union will impact on the current Austrian debate. The Commission's communications point to weaknesses, of which some are particularly true for Austria. Although Austria has liberalized its internal energy market, conflicts may arise in other matters relating to the concept of the Energy Union.

Security, renewables, energy efficiency and transmission

Over the coming years, Austria is facing a number of challenges in relation to its energy policies. Below is a short summary of the key challenges.

Energy security

In the foreseeable future, Austria will remain a net importer of energy. Even if Austria was to meet its targets for increasing energy efficiency and the share in renewables, the increase in demand will bring about an increase of energy imports. As for the imports of oil products, the main suppliers are countries that are characterized by political instability and/or do not respect human rights. The medium-term and long-term security of the production capacity and the ability to delivery, sometimes even in the short term, is quite risky. Furthermore, the transport of fusil fuels by pipelines constitutes another risk as was experienced during the conflict between Russia and Ukraine. Recently discovered or explored oil deposits might increase the choice of supplier countries, however the size of the deposits is as unclear as the environmental impact of the marine oil extraction.

Renewables

Increasing the share of renewables is a stated target of the Austrian government, and an increase is expected in the 2010 Energy Strategy. Technology-driven innovation has an important role to play in further stimulating the increase, as transport is one of the major originators of the import dependency of Austria (oil products) and emissions. However, this is not true for all sources of renewables:

- The expectations in biofuels, both biodiesel and bioethanol, that were raised in the recent past were not met and it is rather unlikely that biofuels will play a more important role in the near future. The earlier hype of biofuels was caused by the agro-industrial sector. The Common Agricultural Policy (CAP) of the European Union aimed to cut the overproduction of agricultural products. Hence the production of biofuels was supposed to avoid the closure of agriculturally used area. The European Commission originally defined targets without commissioning research of the feasibility and effectiveness of the production and use of biofuels and later on, after receiving the first results of the studies, changed its policy. The same holds for Austria (Vadrot and Pohoryles, 2010).
- The potential of other sources of renewable energy is, however, quite promising: the development of photovoltaics, the use of solar energy and the use of wind power are increasing and the technology is rapidly developing. Given the rapid progress in transport-related research and development towards e-mobility, expectations of a significant change towards the share of renewables in the transport sector seem to be justified (Pohoryles, 2013). A later Austrian study confirms the result on the national level (Pohoryles, 2014).
- As for wind energy, a recent study forecasts an increase in the share of wind energy in the electricity supply to end-users from 5.9% in 2012 to 13.5% in 2020 and 24.0% in 2030 (Winkelmeier, Krenn, and Zimmer, 2014).

Energy efficiency

In light of the European directive (European Commission, 2012), and with the aim of fulfilling its targets for energy efficiency, Austria has revised its energy efficiency legislation as a transposition of the directive (Energieeffizienzgesetz 2014 (Energy Efficiency Act), 2014).

The Austrian Energieeffizienzgesetz 2014 (Energy Efficiency Act) addresses mostly the energy suppliers delivering more than 25 GWh of energy to end consumers, who are obliged to annually initiate energy efficiency measures and to report the results of their activities. Overall, these entities must achieve a reduction of 0.6% of the total supply to the end consumers. In general, the target is that at least 40% of the decrease should derive from households, however suppliers who are delivering energy to the transport and mobility sectors can substitute the effect of the required efficiency gains to the other sectors. If the supplier cannot reach the target substitution payments, administrative fines apply (Starlinger, 2015).

The challenge to the implementation of the law is that the energy-monitoring unit is a newly established institution without former experience. At the moment the ministry acts on behalf of this spin-off agency.

Transmission

An official communication of the European Commission states that Europe's infrastructures are outdated and that an upgrade is an important element for further development of the European Energy Union (European Commission, 2015a). Minimum standards have to be upgraded. The communication mentions explicitly transmission systems and the ICT infrastructure. This is a clear signal for Austria. Martin Graf, the CEO of "e-control",[10] calls for an investment of around 5.65 B€. The current situation is unsustainable and puts Austria at risk of blackouts in the supply of electricity (Kischko, 2015). The Austrian government recently announced a new package for growth in the next year. According to this declaration, the package will include investments in energy infrastructure.

Conclusions

Despite the fact that an efficient and effective European Energy Union has a long way to go, the development over the last 20 years suggests that the European policymaking has a reasonable impact on the national energy and environment policies of the member states. Austria is an excellent example of both the success and the shortcomings of the current situation.

From a purely technological and economic perspective, Austria does not seem to have problems ensuring energy security in the short and medium term. Although dependent on imports, Austria has the potential to increase energy efficiency and the production of renewables, which, however, necessitates a policy shift, stakeholder involvement, public awareness and public participation. With respect to imports, it is fair to say that the planet can offer a sufficient supply if the technological advances enable the production, transmission and use of solar energy, photovoltaics and wind energy.

Having said that, energy security not only depends on physical indicators but has to be understood in a more complex policy environment. Rather, the issue at hand must be understood in the wider context of the shift towards sustainable economies and sustainable societies.

[10] E-control is the central authority for regulating the energy provision in Austria. It has been operating since 2001 and since then has had the status of a public-law company.

4

ENERGY SECURITY AND CLIMATE CHANGE IN BULGARIA: THE BULGARIAN ENERGY MARKET

Rumiana Decheva

Introduction

In Bulgaria, until its accession to the EU, the energy policies had been focused on the generation, transmission and export of cheap nuclear and coal electricity, on safe imports of oil and gas and export of their derivatives, regardless of the security of the imports, with Russia in this case being the single country of origin. Industry, agriculture, transport and social well-being derive from oil, gas and electricity availability and affordability.

Transparency and accountability in the national energy sector are very high on the public agenda. Anecdotal evidence of bad administrative practices and mismanagement has fuelled protests, leading in 2013 to the extension of the lack of trust in the energy sector and trust in governance in general. EU energy regulations and efficiency standards are yet to be fully implemented, and although the share of the liberalized market has increased, the market is regulated to a large extent by ad hoc decisions.

Interruption of the gas supply from Russia, popularly known as the "cold winter of 2009", a real-life stress test for the economy and entire society, suggested focused research and innovations for remodelling the system. Most of the timely decisions made at that time – to expand the existing gas storage facility and construct a new one and to build interconnectors with the neighbouring countries – are yet to be implemented.

The energy market in Bulgaria lacks transparency and bears pockets of secretive clauses and undue privileges for some of the players. At present, the Parliament is carrying out an investigation into contracts for the production, transmission and sale of energy. Irregularities have been identified in the administration, regulation, production and supply, with final results expected in November 2015. This will coincide with the liberalization of the electricity market for households and small and medium companies, as of 1 January 2016.

The EU energy market is of common interest. For Bulgaria, however, a country relying now for its strategic needs on imports from Russia, the single country of origin, becoming a regional hub of interconnections and reliable suppliers is of critical importance.

Bulgaria's energy profile

Today, the energy profile of Bulgaria is a result of its past industrial plans as a part of the Eastern Block, mixed with the country's commitments as an EU member state since 2007; in some aspects the former still prevails. The state of the energy market, undergoing at present major liberalization, is yet to lay down conditions for a truly reformed economy, one marked with prospects of sustainability.

The reduction of GHG emissions has triggered major changes across Europe but not in Bulgaria. The reshaped economy of the country and the lowering population account for over a 40% reduction from its 1990 levels. In that sense, the large increase in power generation from renewables is largely due to economic incentives.

Energy intensity remains by far the highest within the EU, a factor that is only partially due to purchase parity power, which is also the lowest amongst the EU-28. This key sector of the economy has also led to the accumulation of national public investments and EU co-funding. Decreasing energy intensity has been declared as the primary goal for the next five years. Legislation has changed far too often and the 2015 Energy Law is already amended. EU supranational regulations, however, are adopted rather slowly and a transparent and accountable national energy market is yet to materialize.

Energy supply and domestic production

The majority of the electricity production and transmission facilities in Bulgaria remain state owned, as along with all import and export of electricity and gas. There is only one functioning refinery, owned by Lukoil and operating on *Urals*-type oil imported from Russia. Coal mining is also predominantly state owned.

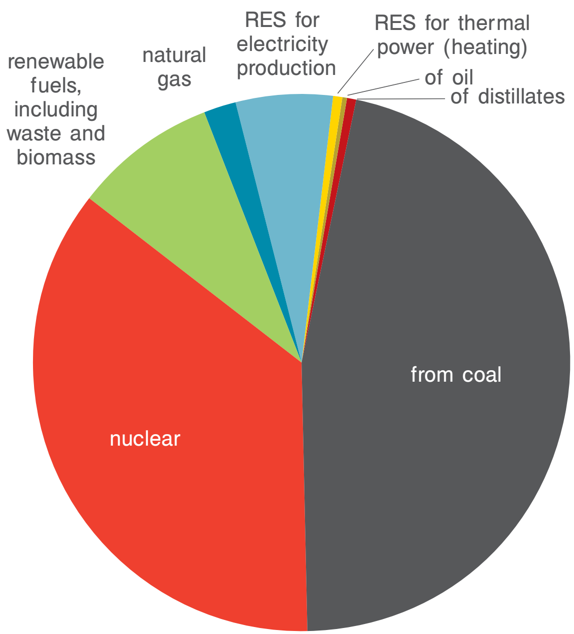
Bulgarian Energy Holding EAD (BEH), a 100% state-owned company, was created in 2008 to acquire, manage, assess and dispose of businesses in the area of production, extraction, supply, transit, storage, management, distribution, sales and/or acquisition of natural gas, coal, electricity and thermal power, as well as any other types of energy and raw material. Through its subsidiaries the holding also controls the nuclear power, most of the hydro energy plants, the gas supply, storage and transmission, the high- and medium-voltage distribution network, coal extraction and thermal power generation, and most of the controlled water.

The energy sector, being a cornerstone of both industry and the budget, has undergone diversification in electricity generation and is expanding its supply in terms of both quality and quantity in a shrinking-market environment.

Energy supply

Around 60% of the gross national energy consumption is covered by domestic energy generation. In that classification, the nuclear energy is accounted as domestic. The amounts produced are based on the demand, and have the

Graph 1:
Primary Energy Generation, generated from data from NSI[1]



[1] NSI, http://nsi.bg, accessed 4 September 2015

capacity to cover and balance in times of peak consumption.

The domestic primary energy production mix has the following structure: 46.8% from coal, 35.9% nuclear, 8.5% renewable fuels, including waste and biomass, 2.2% natural gas, 5.7% RES for electricity production, 0.5% RES for thermal power (heating), 0.5% and 0.3% oil and distillates (Ministry of Energy 2015).

Around one-third of that energy is used by refineries for oil processing, while another third is used by other heavy industries. Out of the invested 2/3 of the primary energy in the process of energy transformation, the equivalent of some 60% is generated.

Coal mining

Bulgaria holds deposits of over 1.2 billion tons of anthracite coal that is too deep for commercial extraction. The brown coal – around 800 million tons in deposits in western Bulgaria – provides one of the rare employment opportunities at the primary and secondary production levels. Social tensions when opening and closing mining fields are not rare, escalating to a forced corporative vote at election time. Equally socially charged is lignite production, with close to 94% being used for thermo power generation – electricity and heating. Two per cent of the coal production is for direct household use. The lignite deposits, if used at the current rates, will suffice for another 80 years.

Oil and natural gas

The oil market and its products is totally deregulated. Lukoil Neftochim Burgas, the largest refinery in the Balkans, has its majoritarian owner Lukoil. A subsidiary of the Russian company, it is leading in the sale of petrol products in Bulgaria and the SEE, with 200 petrol stations and a large number of franchises in the country. Prista Oil is a producer and distributor of lubricants, with a market share in 20 countries in Europe, Asia, the Middle East and North Africa of between 5 and 55%. Petrol AD is a private company, a distributor of fuels, with its own petrol terminal, and extensive storage facilities and 500 petrol stations across the country.

An insignificant volume of oil and gas has been explored offshore in the Black Sea basin over the last few decades.

More recently, Petroceltic, ex Melrose Resources Sarl, and the local company Проучване и експлоатация на нефт и газ АД (Research and Exploration of Oil and Gaz AD)have extracted varying volumes of natural gas over the years, with some 35% less in 2014 than in the previous year.

A concession deemed to produce up to 84 billion cubic meters of gas was signed with Shell just recently. Oil is also expected from those drillings. A contract has been delayed due to low international prices in the past year. In parallel, based on tax revenue bills, an American subsidiary in Bulgaria has opened a credit line to an unnamed local contractor for purchase of land in the area of anthracite deposits, for coal bed methane.

An extraction process commonly known as fracking, under strong public pressure, has been banned in Bulgaria since 2012.

When gas storage facilities are expanded, in the next year or so, the security of the gas supply will significantly improve.

Renewable energy

There have been steady increases in the use of wood by-products and other biomass for household heating, energy production and powering industry. A large number of the plants involved in wood processing and other small enterprises produce and sell such biofuels.

Electricity generation

The electricity production mix of 47.4 TWh in 2014 marked an increase of 8.4% compared to 2013. This came from nuclear, thermal and RES (hydro, oleic, solar and biomass) production plants. According to official reports, the electricity market is fully liberated. However, there is a significant share of the regulated market, allegedly for securing low electricity prices for households and small and medium enterprises connected to the low-voltage (LW) network.

Nuclear

The cheapest in the energy mix is the nuclear power of Kozloduy's two VVER-1000 generators. It is permanently connected to the grid. Many of the political divides deepen around the subject of expansion of nuclear power production. Earlier than initially planned, accession to the EU was conditional on the decommissioning of four older VVER-400 generators, which immediately resulted in a rise in the price for the end-users and political confrontation. One of the two recent referenda in the modern history of Bulgaria was also on the construction of a nuclear plant at Belene, an island on the Danube River. Today, the website of the Kozloduy Nuclear Power Plant instead suggests the construction of a new VVER-1000 generator within their plant. Billions of dollars spent on preparing the Belene site, then restructuring and eventually abandoning it altogether, are hidden in the electricity prices and account for the losses of the energy holding. An upgrade of the existing generators is in progress and extension of their production is expected.

Thermal power generation

The second line of the electricity production in Bulgaria is generated by coal – some locally produced, some imported due to having higher calories and lower pollution.

Most of the installations run on lignite coal and are in the Maritsa Iztok Complex, whose combined capacity is close to 4 MWh. The Maritsa Iztok-2 Thermal Power Plant currently tops by far the European Union list of the most polluting industrial facilities, causing the highest damage costs to health and the environment (EEA 2015). As recently as last July, the population of Radnevo was instructed to remain indoors while the operator was ordered to reduce electricity production, in order to decrease the sulphur emissions in the air. Those plants are generating electricity most of the time but remain off the grid, balancing the supply when solar and wind generators fail to produce power. That makes the energy particularly expensive, as in the price is calculated: incentives for renewables, renewable energy generation and thermal power generation.

The EC has started a procedure for incorrect contracts with two American investors. As operators of two power plants, they have acquired contracts for double benefits: for their investments and for preferential conditions in the purchase of all produced by them energy. There is a significant potential for increasing those production facilities if and when conditions for a real market appear.

Some of those thermal power plants generate power for heating while also producing electricity. Typically, they should only work during the cold season. At present, there is a parliamentary investigation into the production and sale of electricity and heating power during the summer. The heating produced has been wasted while it has also been calculated in the bills of the end-users – for services they never used. Only recently, applying the latest legal requirements, the thermal plants have had to install meters at the output of their facilities so that energy supplied can be measured in real time, as opposed to the three-monthly invoice from the producers practised now.

The current level of independence and efficiency of the judiciary, however, does not support effective measures for claimants to pursue their rights and thus to secure compliance with environmental and other regulations.

Renewable energy resources (RES)

In 2012, the country fulfilled the commitment that 16% of the energy mix would come from renewable energy resources (RES). In 2013 alone, the number of green production facilities increased by 20%. In 2014, the end-use share of the electricity mix generated by RES reached 19%. Those facilities enjoy priority connection to the grid and other preferences and, due to the lack of control from the regulator, have also generated corruptive practices. At present, green energy is sold at prices up to 10 times higher than the production at the nuclear or the coal plants. In order to prevent large increases in end-user prices on the regulated market, a law put new green facilities on hold, except for production from biomass.

Waste

Waste management is a permanent issue in Bulgaria, with a series of EC sanctions for mismanagement. Since late August, the first power generation from waste in Sofia has been operational. Further investment across the country will contribute to the solution of both problems – waste management and energy production.

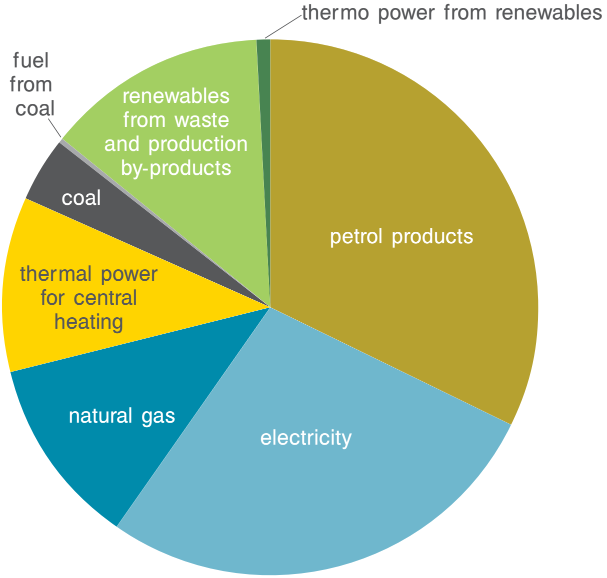
Energy demand and large consumers

In line with Directive 2009/72/EC and under the Energy Act (EA), the electricity market has been reported to be fully liberalized since 1 July 2007. In 2013, the free electricity market opened to customers connected to the high- (HV) and medium-voltage (MV) system. In January 2016, it is said to provide similar conditions to consumers connected to the low-voltage (LV) system – both household consumers and small companies.

In 2013, the last assessed year, 30% of the energy was

Graph 2:

End-User Energy Consumption, generated from data from NSI[2]

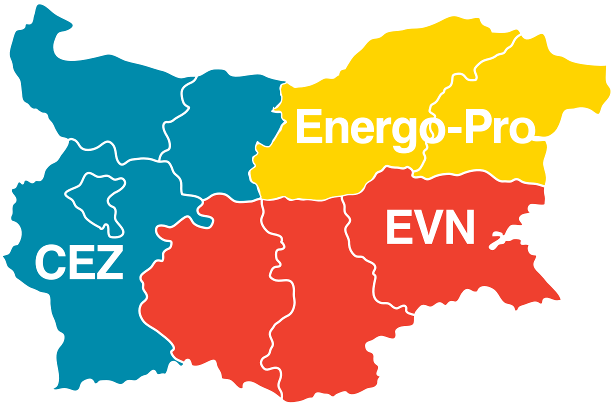


used by industry, 30.1% by transport and 39.9% by households and small businesses.

In terms of its share in the market, the end-user energy consumption has the following pattern: 32.3% petrol products, 27.5% electricity, 11.4% natural gas, 10.5% thermal power for central heating, 3.9% coal, 0.5% fuels from coal, 13.3% renewables from waste and production by-products and 0.6% thermo power from renewables.

[2] NSI, http://nsi.bg, accessed 6 September 2015

Map 1.
Territorial partition of the distribution grid between the network operators.



Source BWEA 2015[3]

The largest share of the primary energy production, around 2/3, goes on processing and production of end-user energy products and heavy industry. The largest share of the end-user energy consumption is by households and small businesses, followed by transport, and finally industry.

A last-minute decision by the regulator, DKER, on "surcharges" ("green energy" surcharge, "high-efficiency co-generation" surcharge and "stranded costs" surcharge) paid for the energy consumed in the domestic market and for exports resulted in lower exports in 2013. "Social responsibility" surcharges in July 2015 resulted in social tensions. Attempts to secure economically affordable and socially acceptable prices have so far stayed clear of a fundamental audit of the system – from import and production until delivery to distribution companies.

At present, the LV consumers are split between three network operators. The operators plan for maintenance and other expenses and calculate cost and price. Their prices, however, are subject to approval by the regulator. Investments are consequently very low and the lack of a proper business environment has hampered the supply – both in terms of quantity and quality. Some aspects of that situation are expected to change on 1 January 2016. The regulator has limited investments in network development, in an attempt to keep end-user prices lower.

At present levels of demand, the production, transmission and delivery of energy is properly secured.

Energy trade (import vs. export)

Energy production of 38% depends on imports, whereas nuclear energy generation is considered a domestic asset. At present, for oil and gas, the economy depends entirely on imports.

Bulgaria imports coal for electricity and thermal power generation in most of its small thermal stations across the country. The imported coal is higher in calories and lower in pollution and can hardly be replaced with locally produced coal.

High-octane gasoline and some of the diesel are also imported.

Table 1.
Bulgaria's energy import and export, Source: NSI. Measured in thousand tons of oil equivalent

	Total	Coal	Fuel from coal	Gas	Oil, oil distillates, gas condensates	Oil derivatives	RES, incl. waste
Import	12 015	959	48	2 225	6 526	1 872	97
Export	5 423	37	-	-	-	4 464	103

[3] BWEA, http://bgwea.eu [accessed on 1 October 2015]

Among the fossil fuels, the largest is the exported share of gasoline, diesel and lubricants, with an insignificant amount of export of coal and renewable energy resources.

More significant is the share of the exported electricity. There is significant fluctuation in flows, with the produced power falling to 20% in January 2015 and reaching its peak of 30% in June 2014.

With the revival of some sectors of the economy, large Bulgaria-based businesses have pushed for a decrease in exports. The international market is most interested in cheap production from the NPP Kozloduy, which makes the locally available energy mix more expensive, loaded with green energy taxes.

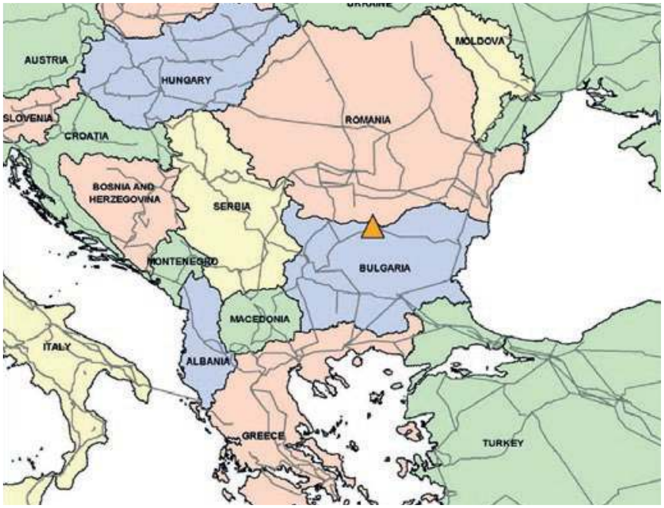
There are considerations (or rather unrealistic political promises) of a gradual decrease in electricity exports until 2018 because the exported electricity is the cheapest produced, from the nuclear power plants. There are calculations suggesting that the same quantity of cheap electricity may instead generate more competitive economic products and so to enhance in-country development. Selling end-user goods rather than raw material enhances the effectiveness of the economy.

GHG emissions

Based on the provisions of the Kyoto Protocol and the community commitment, known as 20/20/20, the strategy for energy efficiency and reduction of GHG emissions (Mt CO_2-eq.), many countries achieved significant progress in clean energy production. That objective has already been achieved in Bulgaria with the green energy connected to the grid since 2012 and the decrease of GHG emissions as a result of decommissioning heavy-industry installations – metallurgical, chemical, refineries – before 2000 (EEA 2015)

According to a recent EEA publication, Bulgaria scores amongst the top 13 countries, better than countries who have made serious efforts, in terms of energy efficiency (EEA 2015). A more recent EU objective for a 10% reduction compared to 2005 of emissions from plants not included in the European scheme for greenhouse gas emission allowance trading (buildings, light industry, transport, agriculture and waste) and a 21% reduction compared to 2005 of emissions from plants participating in the scheme for emission trading (all large industrial and energy sources of emissions, as well as the aviation sector) binds Bulgaria. *The polluter pays* is a market principle and has great potential in the country. However, as the main share of the emissions comes from structurally important energy-producing plants, Bulgaria, along with a group of 10 other countries, has requested derogation from the EC.

Map 2.
HV transmission lines, by NERA, using Platts Powervision



Fossil energy production, even when accompanied by harmful-for-health pollutants, is not seriously opposed by the public as it is the only livelihood for the areas of coal mining and thermal power generation.

Current energy issues for Bulgaria

Access to information is important for assessing the diverse and complex energy situation. Civil society, experts and academics experience difficulties in receiving information. In the past, all information relevant to the energy sector was easily classified. Even now, primary data from the sector are difficult to acquire and access to public contracts, paid with taxpayers' money, remains beyond reach. In that category fall all associated with the construction of the nuclear power plant at Belene, the new reactor at Kosloduy, the agreements on South Stream, and all other agreements on interconnectors and deals. That information remains closed to ministers and members of parliament.

The lack of effectiveness of the energy sector expressed in an abrupt rise in utility prices in 2013 provoked mass protests and resignation of the cabinet, which could not at the time deal with the imminent sectoral reform and the associated social and economic consequences. The interim government asked for World Bank and EC analysis. It was assessed that on an annual basis the country will generate a deficit of up to 500m euro in order to maintain the regulated prices. There is also a procedure by the EC that in its title mentions corruption in the sector. In recent months, the EC has requested retrieval of funds for the Rural Development Programme because of misuse of public European funding.

The energy sector is dominated by the state. Full compliance with the EU energy regulations, in theory and practice, is important for the enhancement of trust in the energy sector, especially in the area of administration and transparent, based on cost and pricing.

Energy efficiency is another area for national concern. Bypassed so far by the GHG emissions reduction actions, energy efficiency is a way to decrease costs of economic production.

Energy efficiency in Bulgaria – economy and households

Full transposition of the EU legislation is important for the transition towards a more energy-efficient economy. The clear possibility of paying less for more efficient energy use is important for motivating households and small businesses, the main end-users of energy.

The Third Energy Package is only now slowly being implemented and not in its full scope. The Energy end-use efficiency and energy services

Directive 2006/32/EC of the European Parliament and of the Council has never been implemented in any shape or form in Bulgaria, nor are there provisions in the foreseeable future to move in that direction.

The energy law in Bulgaria was enforced in 2003 and since then it has been revised and amended 35 times with an average of three modifications per year, the latest in July 2015. It is hard for all interested parties – producers, traders and regulators – to navigate within such uncertainty, not to mention the investors who can hardly find solid ground.

More than 95% of Bulgarian households live in their own owned residences. A significant proportion of both rural housing and urban condominiums needs renovation for more energy-efficient tenure. In 2005, the first such programme started with initial funding from Austria and a basket fund from WB and other development partners. A lack of capacity and competencies to handle such a program resulted in delays and a series of complications for the eventual users. Eventually, a compensation mechanism for the decommissioning of the nuclear generators was also added to boost the funds. There is no data on the number of beneficiaries and the energy consumption impact. Since early 2015, a much more ambitious national programme for renovations of over 30,000 condominiums across the country has been expected to decrease the utility bills while also contributing to more conforming and better living conditions for more than half a million people. Voluntary certification of the energy efficiency of private buildings is performed by a private entity and is not very popular. Compulsory certification of large public buildings has not led to any measures so far.

Energy poverty, assessed using the World Bank methodology, is 61%. Many argue that the conditions in Bulgaria are so different that the methodology is not applicable. Accepting that 61% is far too high a share, there is a significant proportion of households that cannot afford utilities. The price of the heating alone in a two-bedroom apartment is more than the minimum salary. The affordability of utilities has become an issue while a lack of funds – own and bank credits – prevents meaningful renovations enhancing energy efficiency.

Transport is important for improved energy efficiency. Bulgaria does not have public electricity chargers for hybrid and electric cars. While the national strategy for energy efficiency in 2011 included provisions for electric cars, smart grids and other important measures, electric transport has been removed from cities (Plovdiv, for example) and replaced with vehicles run on fossil fuels.

The concerns of experts, notifications from the EC and investigative journalism led to an investigation into the green energy market. According to a media interview with the chair of a special parliamentary commission of inquiry, as official news is not available and all parliamentary sessions are hosted behind closed doors, and based on EC notifications and sanctions, it appears that five companies have invoiced for energy produced before the commissioning of their facilities, four have received payments for facilities without licences, an address or registration of their owners, and 250 oleic and photovoltaic facilities have not declared to DKER co-funding from EU funds for construction, and so have also benefitted from 100% increased preferential prices.

Low income is one of the components, although not the decisive one, of the low energy efficiency of the economy, as it accounts for the purchase parity power. Increased income (345% on the minimum wages since 2000) would ultimately contribute to a more efficient economy. This also accounts for the quality of the vehicles and, moreover, the quality of the maintenance. The majority, 68% of the 3,769,117 vehicles registered in 2014, are older than 15 years, and run on gasoline and diesel. There are 114 electric cars and 799 hybrids.

Energy efficiency is an enormous task that also requires innovations and research. Out of the 206m leva (103m EUR) for R&D in 2014, the energy and environment have a cumulative share of 0.9%, below 900,000 EUR.

Energy security and supply

In January 2009, when typically the energy system was at its peak consumption and load, the gas supply from Russia was interrupted due to a commercial and political stand-off with Ukraine. Lighting, heating and normal economic activities were interrupted. That test of the system demonstrated the weaknesses, and once the crisis was over, a series of decisions were tabled: the construction of gas interconnectors with Turkey, Greece and Romania, investments in the electricity distribution network, etc.

The energy security strategy is yet to account for a truly reformed economy – industry, agriculture, transport, mitigation of the effects of climate change. Now, the energy strategy targets diversification of gas sources (production and imports), production of green energy and a less carbon-intensive economy.

Due to major changes in the plans for gas supply and electricity generation, the national strategy on energy security needs formal revision. In practical terms, the governmental efforts are aimed towards a community energy market.

Liberalization of the energy market

In 2010, 20 countries (Bulgaria included) received warnings from the EC for non-compliance with the requirements for the community gas and electricity market. Five years later, Bulgaria is still badly lagging behind, reporting a fully liberalized market but regulating at the same time investments, quotas and end-user prices for low-voltage electricity consumers (40% of the market). For the gas market, critical impediments are the delayed expansion of the gas storage at Chiren and the construction of a new storage facility at Galata. Once available, they will enable distributors to store gas when it is readily available and at better prices and deliver it at convenient times.

With regard to electricity, restrictions and regulation by the regulator, as well as legal impediments not fully eliminated even in the latest law amendment, are preventing a free market from operating.

It is said that all limitations will be lifted on 1 January 2016 and the following three months will be critical for preparing the system to function freely.

National climate challenges and goals

The National Action Plan for Climate Change sets the roadmap between 2013 and 2020 for a further reduction of over 10% in GHG emissions, for the period after 2008, in addition to the already achieved 50% reduction from 1988, the agreed base year for Bulgaria. The plan lays down a commitment for 5% of all investments to be for greener energy production, and for a more energy-efficient and less carbon-intensive economy.

With a 19% share of the end-used electricity energy produced from RES and many more installations soon to get to the grid, Bulgaria is on track with its EU and UN commitments.

However, extreme weather conditions occur more often than in previous decades and high summer temperatures in 2015 resulted in stress loads on the electricity distribution network, even during the summer holidays. The situation is similar with the winter peaks, events for which the energy holding has developed a special protocol for energy security.

Three measures from different programme documents would produce cumulatively active action. The first in terms of efficacy is gasification of the central heating and households in all 20 cities and beyond. Currently only 1.5% of households use natural gas, while the plan is that, by 2020, 30% will benefit. The second is to increase the efficiency of household heating and cooling, as well as the use of RES at household level for water warming, heating and cooling.

Increasing income is not typically part of the energy efficiency and climate change programmes. Most of the damage to the environment, however, and the most damaging practices result from poverty and extreme poverty.

Future energy challenges

Any serious long-term commitment to a major shift in the paradigm of the most vital sector of the economy requires a national commitment beyond a shift of power and cabinets. Although green energy and a real free market is the only sustainable option in the long run, the environment of political uncertainty and the elections that have happened in Bulgaria every year in the past six years have pushed for non-conflicting and more popular decisions.

Waste management, biomass for domestic use, self-sufficient houses and environmentally friendly transport, including more use of pushbikes, are the prospective ways ahead in a country with so much sun, and with enough water and arable land for well beyond its population. A national strategy for sustainable development, incorporating a strategy for poverty alleviation, elaborated with efforts from the broad professional and civil society circles, could be a roadmap for the nation, not only for the ruling elite.

In the absence of a strong national consensus, what mobilizes the efforts of a still predominantly euro optimistic society are the EU policies and regulations.

Which path to take? Nuclear energy vs. renewables

The notion that circulates in the public domain is that energy from renewable sources comes at tenfold higher prices for the end-users. Because of malpractices, green energy is also associated with political corruption. There is no need to explain to consumers that with higher production levels, the price of the electricity produced from renewable resources will eventually drop, while the prices of that from fossils will rise, due to their depletion.

Another aspect is the investment in nuclear energy. The Belene Nuclear Power Plant was fully designed and the generators were ordered and produced. Commissioned or not, they will be paid for by the taxpayers. While an entirely new nuclear power plant seems less appealing as time goes by, new generators at the existing site of Kozloduy are very possible.

An extract from the otherwise outdated national strategy for energy efficiency of Bulgaria (2011) makes it very clear:
In search of a reasonable balance between the available energy resource in the country and the European clean-energy objectives, Bulgaria shall further support and encourage the development of nuclear energy. We will maintain our points before the European institutions for the preservation and increase of the nuclear energy share in the country by extending the service life of units 5 and 6 of Kozloduy NPP to the maximum as well as the construction of 2000 MW new nuclear capacities.
(Ministry of Energy 2011)

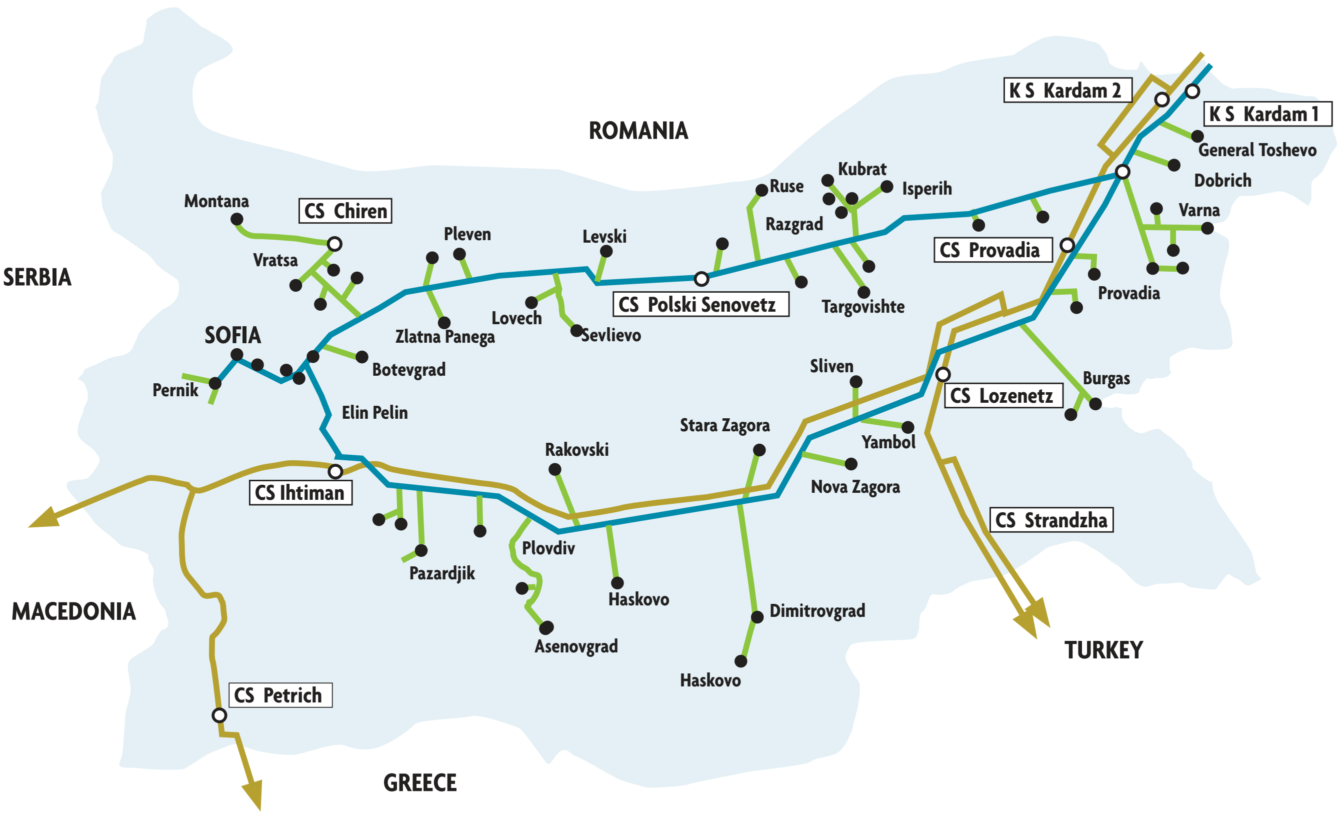
European Energy Union – regional perspective and Bulgaria's contribution

The European Energy Union has its goal of making energy more secure, affordable and sustainable.

The European Energy Market has the potential to enhance and better target all efforts at regional and community level. As discussed in September at the South-East European regional meeting in Sofia on energy security, such a market will provide diversification in the supply, securing gas and electricity deliveries across borders. Moreover, an open regional market will strengthen the national market, export electricity and keep more affordable prices. It can balance regionally available capacities for energy production with energy demands. Interconnection between national supply networks of gas and electricity, thereby eliminating reliance on a single supplier, provides the capacity for deliveries in times of stress in the system (both ways), but not only that. Such integration of the market enhances the efforts for energy efficiency – both for industry and households. Faced with the need fo decarbonization of the economy, an integrated market provides a range of sustainably produced options across the region.

South-eastern Europe is a region with specific political dynamics and potential. Critical infrastructure in countries of the western Balkans was damaged 20 years ago, in the course of the conflict, and interconnection into a regional market, with reconstruction of previously existing and construction of new interconnectors, opens new prospects for

Map 3.
Gas distribution and transition network



all involved economies.

With a strategic location within the region, Bulgaria is very interested in collaboration. With that aim in mind, the international conference "Energy security and energy infrastructure in SEE" explored the potential for sustainable development of the region and supported the creation of an energy union.

With regard to energy efficiency and decarbonization of the economy of Bulgaria, the country is on track to meet its 2020 targets for GHG emission reductions and renewable energy. In terms of energy efficiency, there is much to be done. Despite national reports suggesting much lower EU-28 external dependency, recent EC stress tests proved a particular vulnerability and insufficient energy security. Transparent management of EU-funded energy projects should speed up the critical infrastructure construction and impossibility of abuse in SME projects. A significant increase in R&D funding, with targeted pilot projects, will improve the prospects of energy efficiency in a variety of areas – water and waste treatment, public transport, energy production, etc. are very important for meeting the targets.

Overcoming the dependency on a single gas supplier

For years Bulgaria was part of the planning for alternative or complementary projects: the Nabucco and South Stream pipelines. At this point in time, both have been cancelled. Nabucco was planned to supply Caspian Sea gas to the EU, while South Stream avoided the transition through other countries and entered Bulgaria/the EU through a seabed pipeline. The conflicting issue with South Stream is the exclusive ownership and use of the pipeline by the investor, Gazprom. Nabucco is a more complex project, as it crosses a number of countries with sometimes conflicting interests. Eventually, it developed into Nabucco West, a pipeline connecting the Turkish network with Austria, crossing Bulgaria, Romania and Hungary on its way.

The last public information on both projects is from 2013 but further developments are still possible.

At present, the focus in Bulgaria is on interconnectors with Romania and Greece. Procurement for the works under the Danube is on its way and the construction of the Greece-Bulgaria Interconnector is very much delayed but still in the implementation phase. It will connect Komotini with Stara Zagora.

Gas contracts have never been public in Bulgaria, hiding behind corporate confidentiality. Every winter season, the government and the public find themselves under stress before the possibility of another interruption in the gas supply.

Conclusion

The energy sector is the biggest of the economy. It accounts for most of the state budget and its status is reflected in every single public domain and the well-being of every individual. Any meaningful change openly involving the society in the decision-making will eventually succeed. Transparent and efficient management of all public utility companies is also a must.

A free energy market is a fact for oil and coal production, import, processing and distribution. Major players still play an undue role and the evidence is that prices for gasoline, diesel and gas were the highest in Europe in September, without any reason for that. Gas continues to be the preferred fuel for vehicles and households but the distribution network depends on imports and availability. The price for utilities remains regulated, so a 30% reduction in the international market price of gas for the last season's electricity generation and heating was not reflected in the bills. Now, there is a promise of a conservative 4% reduction, just in case prices skyrocket.

The Energy Strategy of the Republic of Bulgaria until 2020, the Energy Law (last modified in July), the decisions of the regulator, the administrative decisions of the ministry and last, but not least, the legislature are yet to become fully synchronized internally and to fully respect all EU regulations. Even after the widely acclaimed full liberalization of the energy market on 1 January 2016, the 20 thermal power plants that produce power for heating for the majority of the population will preserve their monopoly on production and distribution.

5

THE SWEDISH ENERGY MARKET

Chloe le Coq and Lovisa Källmark

Introduction

Energy, even though crucial for the Swedish economy, is not considered to be a troublesome issue for the country. At the present, Sweden is self-sufficient in terms of electricity and other energy sources needed are mainly imported from EU energy suppliers. However, the energy profile used to look very different before the 1970s. With the economic development of Sweden after the Second World War, the country faced increased energy consumption and had to endure extreme energy/oil dependency. To face these constraints, Sweden adopted a dramatic strategy by investing in nuclear. This strategy paid off as Sweden has changed its energy profile since the 70s. This chapter provides a snapshot of the current Swedish energy market. As we discuss in Section 1, the energy situation in Sweden is relatively secure, with a significant domestic energy production. This energy profile, as discussed in Section 2, results in high energy security, ambitious climate goals and strong energy transmissions. Nevertheless, Sweden is facing challenges ahead that are discussed in Section 3.

Sweden's energy profile

The Swedish energy profile consists of two main parts. The first part is based on domestic renewable resources such as hydropower, wind and biofuels, while the other large part consists of energy that comes from nuclear power and fossil fuels, which are mainly used in the transport sector. Sweden's main energy imports are nuclear fuel for the power plants and fossil fuels for the transport sector; during the last couple of years, Sweden has been self-sufficient in terms of electricity and has been a net electricity exporter since 2012.

The policy framework

The current climate policy, "An integrated climate and energy policy", was adopted by the Swedish Parliament in 2009. The Swedish climate strategy puts great emphasis on general financial instruments such as carbon tax and emissions trading. These have, however, been supplemented by more targeted instruments.

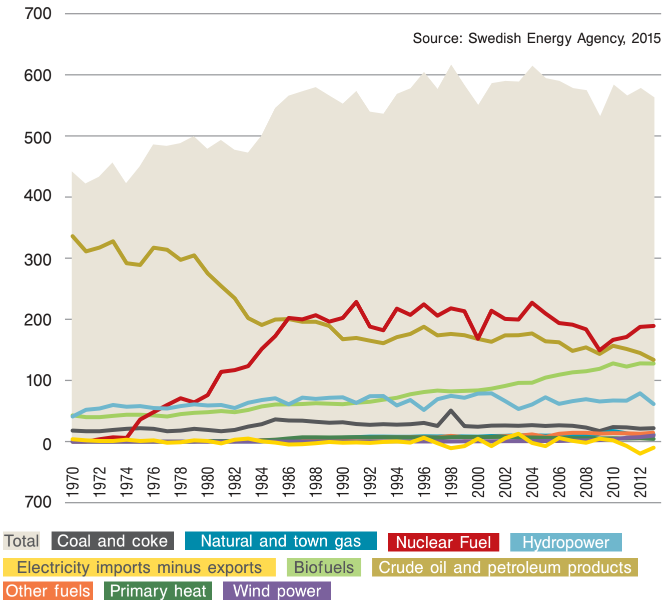
Since 2015, one of the task assigned by the government to the minister of the environment is to develop a framework for long-term climate policies. This is the latest development in the work to provide a basis for a Swedish roadmap to zero net emissions by 2050 (Swedish Environmental Protection Agency, 2015-4).

Energy supply and domestic production

According to the Swedish Energy Agency, the annual total supply of energy in Sweden is nearly 600 TWh. In 2013, the total energy supply was 563 TWh, with 189 coming from nuclear power. Another 128 TWh came from biofuels, peat and waste. Fossil fuels also represent a significant share of the total energy supply. Hydropower produced 61 TWh and wind power 10 TWh.

For almost 50 years, the total energy supply has been increasing from 422 to 617 TWh. The trend slightly increased

Figure 1:
Energy supply, total and by energy source



at the beginning of the period but then became constant after 1985 (see Figure 1). Interestingly, the amount of electricity produced from wind power has increased by 70% since 2010 (Swedish Energy Agency, 2015).

The supply has been rather stable but the relative importance of the different energy sources has changed since the 1970s. We see a sharp decline in the use of fossil fuels, and at the same time we see a rapid increase in energy supply from nuclear power but also from biofuels. This shift away from fossil fuels was mainly due to the oil crises in the 1970s when the price of oil increased dramatically. Due to the high prices of oil, Sweden had to lower its level of oil dependency. Different measures were then decided upon. Through energy savings campaigns and investments we can see a clear change in the energy mix from the 1970s. A large investment in nuclear power and increasing share of biofuels represent the biggest changes in the energy mix.(The Confederation of Swedish Enterprise 2015).

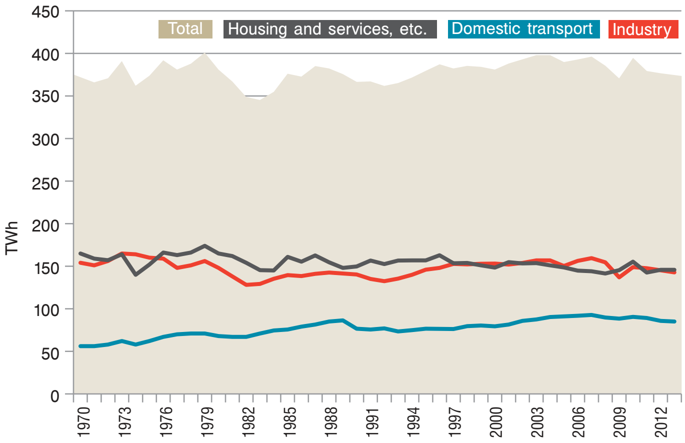
Energy demand and large consumers

For the last few decades the demand for energy in Sweden has been quite stable (around 400 TWh, see Figure 2). The industry and housing sectors have almost the same level of energy consumption, whereas the transport sector is much smaller. Electricity is the dominant energy source in Sweden, and petroleum products are almost only used in the transport sector. The largest consumers of biofuels are the district heating sector and the industry sector; however, a small share is also used in the transport sector.

Note that the difference between the total supply and the total consumption is the energy losses. They consist of foreign transport (shipping and air) and the use of products for non-energy purposes. In 2013, the losses were 184 TWh.

The historical relationship between energy use and economic growth has been such that if GDP increased by 1%, energy use would increase by 0.5%. However, in recent years this link has been broken. Since the 1990s, energy consumption has increased by 3% whereas GDP has grown by approximately 65% according to the Swedish Energy Agency and Statistics Sweden. In addition, the Swedish population has grown by 18%. This shows that Sweden has improved its energy efficiency by a significant amount (Swedish Energy Agency, 2015-5).

Figure 2:
Total final energy consumption by sector

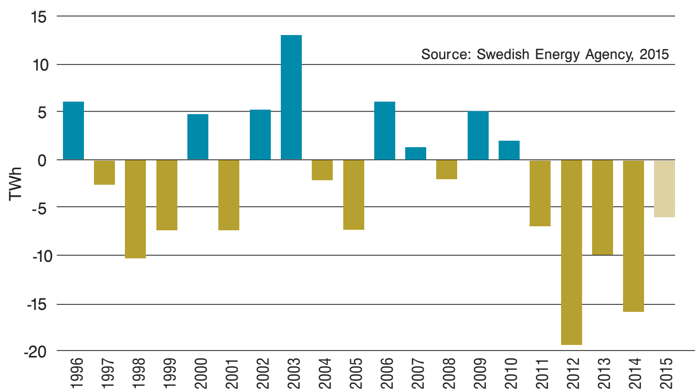


Source: Swedish Energy Agency, 2015

Oil import and electricity export

Since hydropower represents a large share of the energy supply, Sweden's need for electricity imports varies seasonally but also yearly (see Figure 3). Since 2012, Sweden has been a net exporter of electricity and it is likely that it will remain a net exporter until the shutdown of some nuclear

Figure 3:
Annual net trade, Sweden



plants (expected around 2020–2025). The main trade partners in electricity are Norway and Finland.

Sweden is totally dependent on the import of crude oil. In 2014, the oil import represented almost 22 million cubic metres. Sweden's imports mainly come from the North Sea and Russia. Sweden has a refinery industry with a large capacity. It produces more fuel and other refined oil products than the domestic consumption, allowing for export (Swedish Energy Agency, 2015-2).

GHG emissions

In 2014, Sweden released 53.8 million tons of carbon dioxide. One-third of the total GHG emissions in Sweden comes from the domestic transport sector. The emissions from the transport sector have shown a declining trend since 2008. The decreasing trend is partly due to an increased use of biofuels in diesel and more fuel-efficient cars. However, the increase in the sales of four-wheel-drive cars is slowing down the increase in efficiency in newly produced and sold cars.

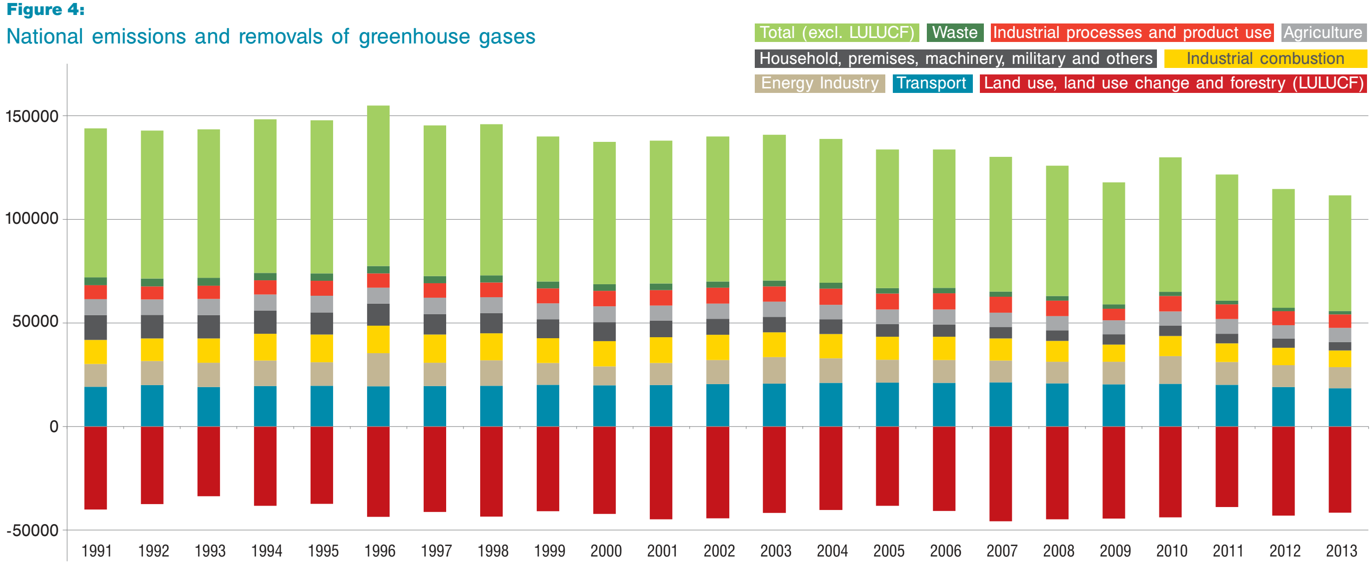
There is strict regulation in Sweden regarding the emissions from the transport sector. The official target is to have a fossil-free transport sector by 2030. And there is strong political support for this target (Swedish Environmental Protection Agency 2015).

Almost a quarter of total GHG emissions comes from Swedish industry. The material used in the industrial processes accounts for about 30–40% of total industrial emissions. Emissions from industries burning fossil fuels make up the rest. Between 2002 and 2014 the emissions declined, mainly due to a shift away from fossil fuels to electricity and biofuels.

Private homes and commercial buildings have decreased their GHG emissions by more than 80% since 1990. This is due partly to the shift from fossil fuels to district heating, electric heating and biofuels. Additionally, the use of heat pumps has increased (Swedish Environmental Protection Agency, 2015-2).

The general trend since 1990 shows decreasing greenhouse gas emissions in Sweden (see Figure 4), and the net uptake of greenhouse gases in land use, land use change and forestry was approximately 42 million tons of carbon dioxide equivalent. The net uptake from land use and forestry has varied between 34 and 46 million tons in the period between 1990 and 2014 (see Figure 4).

Figure 4:
National emissions and removals of greenhouse gases



Current energy issues for Sweden

Energy security

In the current situation, Sweden is not facing energy security problems. There are many reasons for this situation. A significant share of Sweden's energy consumption is provided by domestic production. Hence Sweden imports only 24% of energy consumption provided by non-EU producers. There is good electrification and the connections to the other Nordic countries are sufficient to avoid blackouts. These stylized facts explain why Sweden is generally considered to have good energy security. This is in line with the introductory chapter that provides estimates of the energy security associated with most of the EU member states. There, Sweden belongs clearly to the group of countries with a low-risk exposure index. Indeed, according to Figure 2 (in Chapter 1), Sweden has almost no risk regarding coal and gas. Figure 2 shows that Sweden's risk exposure is also relatively small even though it imports all its oil.

Connections between Nordic and Continental European countries

The Swedish energy market is well connected to the rest of the Nordic countries, and the Nordic electricity system is also connected to Germany, Estonia, Russia, the Netherlands and Poland. A future connection is planned between Norway and the UK, and is to be finished around 2020. When completed it will be the longest subsea energy interconnection in the world (NSN Link, 2015).

In the early 1990s, the Nordic countries deregulated their electricity market to create a common electricity market, Nord Pool. It is a centralized market where companies buy and sell electricity. Nord Pool Spot is located in Oslo and is owned by the Nordic transmission system operators (for Sweden, Svenska kraftnät). The total traded volume was 501 TWh in 2014. Moreover, at the end of 2000 the Baltic region deregulated their markets, and Baltic states are now integrated into the Nordic electricity market. Nord Pool is also a part of the north-western Europe price-coupling project that was launched in early 2014. This market connects central-western Europe, Great Britain, the Nordic countries, the Baltic countries and Poland.

Note that the price for electricity on the Nord Pool market is made up of three different parts: electricity, power grid fees and taxes. The price varies for different consumer categories and in the rural and urban areas. From 2007, the cost of the electricity certificate has also been included in the total price (Svensk Energi, 2015).

National climate goals

The current climate policy, "An integrated climate and energy policy", was adopted by the Swedish Parliament in 2009. The overall target is to reduce the GHG emissions by 40% until 2020, with 1990 as a base year, in the sectors that are not covered by the ETS. The policy also states that at least 50% should be due to renewable energy, 20% to more efficient energy use and at least 10% to renewable energy in the transport sector (Government Offices of Sweden, 2015).

The target is that by 2050, Sweden should have a sustainable and resource-efficient energy supply without any net emissions of greenhouse gases in the atmosphere. The Swedish government has appointed a parliamentary commission to draw up a draft proposal for new policies for long-term energy supply by 2050 (Swedish Environmental Protection Agency, 2015-3).

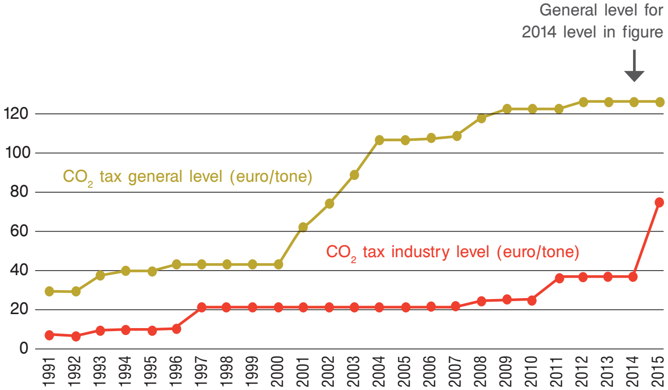
Energy taxation and support measures for conventional and renewable energy resources

Sweden, as part of the Nordic countries group, has a broad set of environmental and energy regulations and policies. The Swedish energy and climate policy also states that it should reconcile ecological sustainability, competitiveness and energy security, i.e. the same three pillars that are the base for the European energy cooperation.

The main instruments for lowering GHG emissions are the carbon tax – among the highest in the world – and participation in the European permit trading system (indeed 760 Swedish plants are regulated by the ETS). Figure 5 presents the development of the Swedish CO_2 tax on a general level and industry level from 2008. (The figure presents industries outside the EU Emissions Trading Scheme.)

Note that policies on carbon taxes and ETS have also been complemented by more specific policies such as technology regulations, information, differentiated vehicle taxes and investment grants. Furthermore, the Swedish government now distributes a range of subsidies to increase environmental investments. In 2012, these accounted for investments amounting to approximately 0.12% of GDP (OECD, 2014). The bulk of the money goes to support the management of environmental resources and the EU's agricultural programme. But a large share of the money also goes to renewable energy and energy efficiency.

Figure 5.
CO_2-tax level Sweden



Until 2012, biofuels were subject to full tax exemption, with the aim of getting both drivers and companies to use environmentally friendly biofuels instead of fossil fuels. After 2012, taxes started increasing and the tax exemption will be completely removed for some biofuels in 2016. This increase was mainly due to the EU's state aid rules that do not allow tax reductions on biofuels, which makes them cheaper than their fossil equivalents, so-called "overcompensation" (Government Offices of Sweden, 2008). The issue of tax exemptions has been a conflict between the Swedish government and the European Commission for several years. If Sweden does not follow the European Commission's demand, they face the risk of being taken to court and companies could become repayable.

To reach the goal of 50% renewable energy, the Renewable Electricity Certificate was introduced in 2012. The certificate system for electricity is a market-based system aimed at increasing the share of renewable electricity, so for every MWh that is produced in an approved facility the producer receives a certificate that can be sold. The buyers of the certificates are required to fill a quota of renewable energy (Swedish Energy Agency, 2015-1). The Renewable Electricity Certificate is a joint system between Sweden and Norway. The purpose of this cooperation is to increase the share of renewable electricity in the region as a whole.

Energikartläggning i stora företag[1] (SFS 2014:266) aims to promote improved energy efficiency in large companies, through a Swedish energy audit (Energy Agency, 2015-4). Other ways of improving energy efficiency are mandatory energy labelling, tax exceptions for biofuel consumption and a car premium to promote more fuel-efficient cars.

The next energy challenges

Sweden uses about as much energy today as in the 1980s, and despite increasing energy efficiency the energy demand remains at approximately the same level (The Confederation of Swedish Enterprise, 2015-2). The industrial sector is likely to increase its electricity share in its total energy consumption. This means that Sweden is still facing some challenges on the energy market that we discuss in this section.

Nuclear investment and uncertainty of the regulatory environment

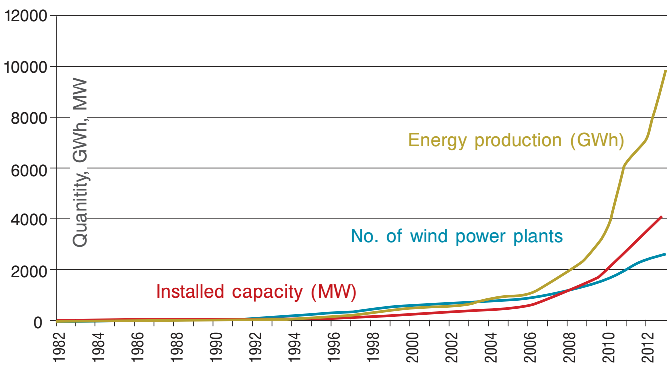
As mentioned before, nuclear represents a significant part of the energy/electricity production. However, Swedish nuclear is at a crossroad. Indeed, the Swedish nuclear industry is currently experiencing uncertainty. For a long time, the nuclear-owning companies have argued that they can operate existing nuclear plants until they are 50–60 years old, which they will be between 2022 and 2045. But future electricity

[1] (audits of large companies)

prices and additional safety requirements might affect the lifespan of nuclear plants (Swedish Energy Agency, 2015-3). Moreover, there is relatively weak political support for nuclear power in Sweden. In 2010, for example, the Parliament decided to repeal the ban on new reactors. Investment in new nuclear power plants is relatively limited since there are entry barriers and any new reactor must replace an older one and be built on the site of the three current nuclear power plants. Furthermore, Sweden has a tax discrimination against nuclear power, which is currently about 0.67 euro cents/kWh. This amount makes up about one-third of the operating cost of nuclear power. At the same time, wind and biomass are subsidized by about three times that amount (World Nuclear Association, 2015).

This instability in the regulatory environment has led to underinvestment in the nuclear industry, which in turn has had some impact on the nuclear production efficiency with low-capacity utilization of the Swedish nuclear power plants. According to the Swedish Energy Agency, it is likely that Sweden will, in the future, have a power system with a smaller proportion of nuclear power and a larger share of renewable electricity generation (Swedish Energy Agency, 2015-3).

Figure 6.
Development of wind power in Sweden 1982–2013



Source: Statistics Sweden

Renewable, backup capacity and transmission

The development of wind power has been strong since 2008. The subsidies for wind power were already in place in the 1990s but only after 2008 did this industry experience exponential growth in terms of both capacity installed and energy produced.

As a result of the increased renewable energy, mainly wind power, the adjustable base power in the system has decreased and has triggered some discussion about the need for a capacity market in Sweden.

Demand response and competitiveness

The Swedish industrial sector constitutes a large share of the energy consumers' group. For most energy-intense industries, electricity costs can represent up to 40% of value added (The Confederation of Swedish Enterprise, 2015-2). The development of the Swedish industry has been, and is still, moving towards a more efficient and automated production. This often means that electricity is used in new ways or as a replacement for other energy sources. One example is the Swedish mining industry, which reduced the use of fossil fuels by using more electricity. Indeed, the Confederation of Swedish Enterprise is currently lobbying for a more secure energy supply and competitive electricity prices.

Electricity prices are mostly dependent on fuel prices, the ETS price and the overall economic situation. Sweden is currently facing an excess of electricity supply, implying a downward pressure on the electricity price. A rise in electricity prices is not expected within the next few years since the Nordic electricity market will continue to expand and an even greater electricity supply is expected. However, if nuclear power plants are taken out of service, electricity prices are likely to increase (Swedish Energy Agency, 2015-3).

In a survey conducted by the Confederation of Swedish Enterprises (Swedish Energy Agency, 2015-3), almost 80% believe that electricity prices will also increase in the case of a fully European electricity market. Two-thirds of respondent companies believe that energy policy until today has created an advantage or a major advantage for Sweden as a developed country.

Furthermore, the electricity markets in several regions are becoming more deregulated and integrated, for example in the north-western Europe price-coupling project there is a risk of higher prices in the Nordic region. Prices have generally been higher in the European countries than in the Nordic countries, and integrated markets have previously shown a harmonization of prices. Therefore, one risk is that prices would rise compared to the Nordic electricity prices. However, a more integrated market is also a business opportunity for Sweden to export more energy to additional countries that are connected. On the other hand, becoming a net exporter of electricity could mean greater uncertainty and increased costs for Swedish consumers and companies (Swedish Energy Agency, 2015-3).

The energy price is not only a competitive issue for Sweden and the Nordic countries but also an EU-wide concern. The EU countries face very different energy price levels. The shale gas revolution in the US has changed the price situation for energy and as a result the US has gained a comparative advantage in relation to energy-intensive production. On average, electricity prices are higher in Sweden than in the US. Note that in the current state, Sweden is a small gas consumer along with the Nordic countries. However, a low price and the possibility of transporting liquefied gas could increase consumption.

Conclusion

This chapter provides an overview of Sweden's current energy profile, focusing on the past and the future (energy) challenges for this country. Sweden, like many European countries, will have to find a way to balance the future energy system with the demand for energy and the environmental targets, and to maintain a competitive energy price that can compete with other big markets. These three pillars can be handled together in several ways. However, Sweden as part of the Nordic region, benefits from the stability of a unique environment and a unique market.

Moreover, new technical developments may also help Sweden to fulfil its energy challenges. For example, it is likely that the use of bioenergy will increase and will play a significant role in a sustainable and environmentally friendly energy mix. Moreover, the expansion of the next generation of microproducers may also change the market structure. Microproducers are the new actors on the energy supply side, and connect small-scale wind or solar plants to the local distribution network. What effect this will have on the market system and how they should be regulated will be a key issue for the future development of this sector (Swedish Energy Agency, 2015-3).

Finally, behavioural changes to increase energy efficiency will also be necessary to balance the future supply and demand. One way to change consumers' behaviour is through price signals. Sensitivity to price variations makes individuals move their consumption away from the most expensive hours. By using feedback from smart electricity meters and “Home Energy Management” technology, users and/or producers can shift or reduce their electricity consumption to avoid load peaks when the prices are high. The growing share of renewable energy with irregular and weather-dependent production will also increase the need for flexibility in the system, namely the so-called “smart grids” (Environmental Objektives, 2015).

6

CONCLUDING THOUGHTS AND WAY FORWARD[1]

Daniel Engström Stenson

[1] This final chapter of the publication raises a number of the key issues for the future of European policy relating to energy security and climate change. These issues were identified in both the previous chapters and during the three workshops held for this project. The chapter is authored by Daniel Engström Stenson, who has benefited greatly from the inputs made by colleagues in the project team and participants at workshops.

Cooperate - on all levels

Europe is a large and differentiated continent. Conditions and policies relating to security and climate policy vary. Energy security risks differ due to geography, as well as historical and current policies. This also applies to greenhouse gas emissions. In both cases, national conditions have an impact at the European level and on other Member States. The EU carbon emissions reduction target is to be shared between members. In addition, the energy security of one country may well depend on decisions taken in another Member State.

In its communication on an Energy Union, the European Commission makes an attempt to highlight a number of issues related to this. In particular, the Commission argues that a better integrated energy market helps reduce energy security risks, increases competiveness, lowers energy prices, increases the share of renewables and helps the EU reach its climate targets at a lower cost (European Commission 2015).

The aim of this project has been to better understand how the conditions around Europe differ, and what issues need to be addressed if the combination of climate targets and energy security is to be fulfilled.

In this concluding chapter, we aim to identify critical issues for improving energy security while reducing GHG emissions.

Country variation

Unsurprisingly, conditions between countries vary in terms of energy security, climate policies and economic development. Comparing the three countries studied in this publication, one can note major differences.

These differences highlight that a common policy must take national circumstances into account.

The EU Emissions trading scheme, EU ETS, provides a basis for the common climate policy, with roughly half of the EU total emissions. For this half, which consists mainly of the power sector and industry, Europe is using the ETS as a common policy tool. For the other half of emissions (i.e., transport, agriculture, etc.), the EU shares a common target divided between Member States, which is left to national governments to fulfil. Here, a number of policies may be implemented, but the Swedish carbon tax perhaps deserves a special mention. With the energy tax being divided into energy and carbon, both the energy and carbon content is taxed in line with the "polluters pay" principle.

Figure 1. Country Comparison

	Austria	Bulgaria	Sweden
Population 2014	8.5 million	7.2 million	9.6 million
GDP/capita2014	€38500	€5800	€44300
CO_2-emissions	60 Mton (2012)	53 Mton (2012)	55 Mton (2012)
Energy Consumption 2013	33.8 Mton Oil equivalent	16.8 Mton Oil equivalent	49.1 Mton Oil equivalent
Share Renewables energy consumption	32.6% (2013)	19% (2013)	52.1% (2013)
Prime domestic energy source	Hydro	Coal	Nuclear
Prime import energy source	Oil	Oil	Oil
GHG emissions targets 2020	-16%	-10%	-40%
REES-index Oil Gas Coal	2.3 23.9 0	15.4 23.9 1.73	1.8 0 0.32
Share Energy consumption non-EU import	42% (2013)	46% (2013)	24% (2103)

Sources: Eurostat 2015, le Coq&Paltseva (2015)

The climate targets are complemented by targets for share of renewable energy, energy efficiency and interconnectivity of electric grids. Fulfilling targets for energy efficiency will definitely have a positive impact on the energy security of the Member States, but it is still uncertain how the renewables targets will affect energy security. On the one hand, most renewable energy is produced domestically and could therefore reduce the need of energy imports. But the increased use of intermittent renewable energy creates a need for back-up capacity. This might create a greater vulnerability if back-up capacity is dependent on EU imports from outside the EU.

Renewable targets also relate to the more sensitive issue of nuclear power in domestic energy policies. Austria stands out as the main objector to nuclear power. Consequently, Austria's renewable target would entail replacing carbon intensive fossil fuels with renewable energy. In Sweden, the role of nuclear power has been essential over the last four decades. At present, however, the future of nuclear energy remains uncertain. In an energy sector with low carbon emissions, a renewables target would have an impact primarily on replacing low carbon nuclear power, not reducing the use of fossil fuels. For Bulgaria, the use of nuclear power seems to be an essential part of the national energy strategy.

Chapter one demonstrates that external energy risks for EU Member States vary, meaning that priorities relating to energy security also vary, making coordinated efforts more difficult.

Therefore, "one size fits all" solutions are unlikely to be effective. On the other hand, country-specific energy policies may be difficult to justify as an EU-wide energy policy. Striking a balance between national and European policies will be crucial for the design of the mechanisms behind the European Energy Union. Recent developments in the EU's internal energy markets, such as interconnection and competition between markets, allow for more flexible market-based compensation mechanisms across member countries, facilitating the development and implementation of common energy policy rules.

Another observation is that the import ratio greatly varies across fuels. Different fuels come with different risks energy security wise, but also in terms of emissions. Thus, the supply security concerns should be carefully weighed against the green objectives of the energy policy of the country.

How to combine energy security and climate objectives when fuel risk differs

In chapter 1, Le Coq and Paltseva state that compared to oil and coal, natural gas is the fuel associated with most risks in relation to energy security. With a majority of natural gas being supplied to the EU via pipelines, and liquefied natural gas being insignificant on European level, gas becomes more difficult to substitute in case of a supply disruption. Adding further to the risk is that many EU Member States, in particular in Central and Eastern Europe, have highly concentrated gas imports (most natural gas coming from Russia).

At the same time, out of these three fossil fuels, natural gas is associated with the lowest carbon emissions. Hence, a country could reduce its carbon emissions drastically by shifting from coal to gas.

This points to a recurring policy challenge – the trade-off between different policy targets.

Policies that contribute to replacing coal with gas are likely to lead to reduced carbon emissions as well as to increased energy security risks. Similarly, policies leading to increased use of intermittent renewable energy might, if not carefully considered, lead to reduced emissions but increases in the risk of power outages, or further dependence on foreign energy to avoid such outages.

All of the above suggests that the EU needs to carefully assess the interconnection between environmental goals and energy security risks, and put more effort into developing environmentally-friendly energy technologies that are not associated with higher energy security risks. It also points to the fact that diversity of supply should be a key priority for all governments as well as Brussels technocrats.

EU solidarity

In a press release, the European Commission states that the Energy Union is to be based upon the solidarity clause, "to help reducing the dependence on single suppliers and fully relying on their neighbours, especially when confronted with energy supply disruptions".

As the REES index in chapter one shows, the energy security risk of individual countries varies. Focusing on the most risky fuel - gas - we see that the most vulnerable countries are located in the eastern parts of Europe, with the top five being Slovakia, Hungary, Czech Republic, Lithuania and Bulgaria. However, when looking at the CERE index on EU risk exposure, for coal we see that the "top three" REES index countries are among the top contributors to the EU risk exposure. But the top risk contributor on a European level is Italy, due to its large share of the total EU gas import, despite its relatively low score in the RESS index. Germany also scores low on the REES index, but greatly contributes to the EU risk exposure. This becomes an interesting crossroad for a common EU energy policy, with solidarity being central: should policies and support be directed towards individual countries experiencing larger risks of external energy supply disruption, or should it be directed towards countries in which supply disruption would have a greater impact on a European level?

The solidarity clause also gives rise to a discussion similar to the "moral hazard" discussion in financial markets. If the risk exposure is a function of dysfunctional national governance, the solidarity clause may provide a perverse incentive. Rather than making the necessary investments, a government could wait for support from other Member States if an emergency situation emerges. However, this behaviour requires a certain amount of trust in European solidarity that currently seems to be lacking.

The solidarity clause is central to a better-coordinated European energy policy, but it should be handled wisely.

National, regional and European solutions

Interconnections, integrated markets, smart grids. The European energy policy has been circling around similar issues for a long time. There are a vast number of reports that put forward these ideas. The idea is fairly simple – by integrating energy markets and grids, vulnerability is reduced due to an increase in suppliers. However, the integration of markets and grids faces several national obstacles. Industries in countries with low electricity prices may be reluctant to level out prices; state-aided nuclear power may cease to be competitive if neighbouring countries are allowed to transfer large portions of renewable energy; and insufficient national infrastructures may make the interconnections useless for long periods of time. In addition, more integrated grids would increase the risk of a country importing electricity from a source it has domestically rejected, as in the case of nuclear power in Austria.

These considerations take us back to the ever-present tension in European cooperation – the balance between national and European power.

During a workshop in Sofia, one participant stated that it is "premature to discuss smart grids – we need functional grids". The Bulgarian case is striking. Due to over-regulated markets, the incentives to invest in infrastructure has been lacking for decades. The result is a dysfunctional grid that provides an obstacle for further interconnection. Similar examples come from interconnections between Denmark and Germany, as well as Germany and Austria. Without having domestic infrastructures in place, the discussion on interconnections becomes premature.

An evaluation from the European Commission shows that 22 EU member states are on track, or have already reached, the 2020 target of 10 per cent electricity interconnection capacity (European Commission 2015a). In order to improve the actual transmission, infrastructure needs to be improved.

The same evaluation demonstrates that most of the electricity markets are at least regionally integrated, with interconnections to at least one neighbouring country. For gas markets, however, the integration is less established, and the Commission requests Member States make further efforts to advance regional market integration.

The necessity of regional cooperation has been a recurring theme throughout the workshops. Much like the European Union has encouraged candidate countries to engage in regional cooperation, this seems a reasonable place to start. In some cases, such as in the Nordic countries, the electricity market is well integrated, more so than other sectors.

The Energy Union is a concept that tries to deal with a wide range of challenges. The vision of a common European energy market is admirable and one which we should strive to achieve. However, in many cases, regional integration is a necessary first step deserving of considerable attention.

But in many cases it is also obvious that national governance, policies and legislation create obstacles for a better integration, reduced energy security risks, and an energy system with less emissions.

Lessons from country case studies

As has been pointed out earlier in this chapter, conditions, policies and capabilities differ. From a Swedish perspective, coal mining seems an odd choice, but from a Bulgarian perspective coalmines provide energy security and jobs in key electorates.

The preceding case studies have shed light on a number of good, and bad, examples of how to deal with energy security and reducing carbon emissions, of which a few are worth mentioning here.

For one, it is obvious that nature matters. Sweden and Austria have been lucky enough to have access to hydro power to cover significant shares of electricity needs. But, using domestic resources is also a matter of making the right policy decisions. The use of waste, a product to which most countries have access, differs significantly between countries. Sweden, for example, has long since used waste for district heating, contrasting Bulgaria, which only recently opened its first waste-to-power generation facility.

The case studies also show the long-term impact of political decisions. In the 1970's, Sweden decided to invest in nuclear energy, and in the 1990's it decided to impose a carbon tax. Both of these decisions are key to understanding Sweden's nearly fossil-free electricity and heating sectors. At the same time, the Austrian decision to exclude nuclear energy in 1978 has shown that this path is possible, and is something that still characterises its energy policy. In Bulgaria, the sudden shifts in energy policy, as well as a continuation of price regulation and state owned utilities have proven to have damaging impacts on its energy policy. The fear of high energy prices in the short term is likely to be damaging in the long-run. The Bulgarian case has also illustrates that energy policy is a sensitive issue that may make people take to the streets. In general, the Bulgarian decision-making process seems to be less inclusive than that of Austria, which has made use of stakeholder processes when making long-term energy decisions.

Final remarks

This project concludes that Europe faces many challenges relating to energy security and climate targets. But this is not just an issue for Brussels: it is an issue that needs to be dealt with by (at least) 28 countries.

National decision makers should focus on implementing carbon and energy taxes that stimulate energy efficiency and encourage a shift away from fossil fuels. Combined, this will lead to lower carbon emissions and improved energy security. National decision makers should also seek to liberalise energy markets and increase the number of energy suppliers, preferably within Europe. This will in many cases not only require investments in interconnections, but also investments in domestic infrastructure. It requires a coordinated effort between countries as well as between countries and Brussels institutions. Some of the less developed Member States will probably need external support in order to make these investments. However, such support will only be effective if domestic policies meet European standards. In particular, Bulgaria's regulation of the energy market is damaging to infrastructure investments.

Regional cooperation crucial is at this stage. The common European energy market is a vision that only can be realised if regional cooperation functions well. Therefore, both domestic policy makers and Brussels should stimulate regional integration of energy markets and grids.

Brussels' decision makers should be active in strengthening the European Emissions Trading schemes. It will also help to achieve emissions reductions in the power sector, which is the sector most vulnerable to energy security risks. Brussels' policy makers should also take into consideration how to apply the solidarity clause when seeking support for investments. They should ask themselves if the most vulnerable countries are eligible for the most support, or should support be directed towards countries with greater contributions to the "European risks"?

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EUROPE'S ENERGY FUTURE

How to combine energy security with reduced emissions

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This project was motivated by the observation that many of Europe's long-term challenges are connected to the supply of energy. Events in Ukraine, the European Union's (EU) long-term climate targets, and the findings and use of shale-gas in the US all highlight the need for a thoroughly considered energy policy for Europe.

During 2015, the European Liberal Forum and its members Fores (Sweden), Neos-lab (Austria) and Friedrich Naumann Foundation Sofia (Bulgaria) organized three workshops to discuss Europe's Energy Future. This publication is summarizing these workshops. It also contain four chapters covering the concept of energy security and providing case studies from Austria, Bulgaria and Sweden.

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