Centre on Regulation in Europe
Improving network industries regulation

Energy security and sustainability: what role for gas in the Energy Union?

CERRE Policy Paper

Professor Natalia Fabra (Joint Academic Director, CERRE, and Universidad Carlos III de Madrid)

Professor José Luis Moraga (Research Fellow, CERRE, and VU University Amsterdam)

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About the authors

Professor Natalia Fabra joined CERRE as a Joint Academic Director in January 2014. She is Associate Professor in the Economics Department of Universidad Carlos III de Madrid. She is also Research Affiliate at the Centre of Economic Policy Research in London and Associate Editor of the Journal of Industrial Economics. She edits RePEc's New Economic Papers on Regulation. In the past, Natalia has been a visiting scholar at various universities, including the University of California Energy Institute, the *Institut d'Economie Industrielle* (Toulouse), and Nuffield College (Oxford). Natalia works in the field of Industrial Organisation, with emphasis on Regulation and Competition Policy issues. She has worked extensively on the economic analysis of electricity markets. She holds a PhD from the European University Institute.

Professor José Luis Moraga joined CERRE as Research Fellow in December 2014. He is professor of Microeconomics at VU University Amsterdam. He holds a PhD in Economics from the Universidad Carlos III de Madrid. José Luis is an ICREA Research Professor (on leave) and worked at the Department of Economics at IESE in Barcelona from 2009 to 2011. In addition to the study of the market imperfections generated by transaction costs, his research interests include energy economics, two-sided markets, advertising and research and development networks. His work has been published in leading economic journals, including the Journal of Political Economy, the Review of Economic Studies and the Rand Journal of Economics. José Luis' research in energy economics is mainly focused on transparency in forward markets, access pricing for and investment in interconnectors, and the role of open seasons.

Executive Summary

It is beyond dispute that the fight against climate change requires a drastic reduction in greenhouse gas emissions. Given that a lion's share of total emissions comes from the energy sector, and given its great potential to reduce them through the integration of renewables in the energy mix, climate and energy policies are bound to be closely linked to one another. The smart avenue is to design a framework in which security and sustainability can be achieved at least cost.

The public good attributes of energy security and energy sustainability call for regulatory intervention in this area. Indeed, both issues are at the core of the EU's energy and climate policy, as demonstrated by the recently released Energy Union package. The completion of the internal market – through the deployment of new cross-border infrastructure and the harmonization of market rules – is a key driver to achieve both goals, as it makes Europe more resilient to external energy supply shocks and allows for a more effective integration of renewables into the energy mix. As stated in the Energy Union package, Europe's goals of becoming the "most energy efficient economy in the world" as well as "number one in renewables" will strengthen energy security by reducing its dependence from imported fossil fuels.

As an indigenous energy source, renewables are indeed key contributors to security of supply, but their intermittency strengthens the need to resort to gas as a back-up for electricity generation. At least in the short to medium run, gas-fired plants are well positioned to fulfill this role. However, there are some challenges ahead: one refers to the design of electricity markets; the other refers to the deployment of the necessary infrastructure.

Since market integration is far from being complete, and the potential for demand side response and economic storage are yet to be seen, renewables and natural gas plants are bound to coexist. The recent performance of several electricity markets across Europe shows that the current market design is not well suited to allow for a peaceful coexistence between the two. The widespread energy-only, technology-neutral, approach to the regulation of electricity markets fails to internalize the externalities created by the different technologies, notably, those that provide energy security and sustainability. A robust carbon price would certainly make the market's task easier: the urgency to reform the currently defunct ETS is compelling. Still, there are additional market failures that the carbon price alone cannot address – even if set at the right level.

The challenges implied by the public good nature of energy security and sustainability require a more prominent role of the regulator in determining the amount and type of capacity to be procured, not its price. While several member states are implementing capacity markets, it is not clear whether these constitute the most efficient and least expensive way to address security of supply concerns. Instead, the recently introduced renewable capacity auctions in the UK could show a way forward to address not only the sustainability objective, but also the energy security one. In these auctions, competition among investors has the potential to drive prices down to the average costs of the best available technologies, thus allowing consumers to benefit from technological progress through lower prices. Furthermore, the reduced price exposure of investors reduces their risk-*premia*, ultimately benefiting consumers through lower prices. If similar mechanisms are applied to the procurement of new back-up capacity, security of supply would potentially be guaranteed at lower cost than under the existing capacity markets.

For gas to fulfill a relevant role in the future Energy Union, regulators and policy makers should ensure a level playing field. For this purpose, infrastructure development is crucial. A robust gas grid with sufficient interconnection and reverse flow infrastructure makes the system robust to disruptions of particular supply corridors while improving security of supply. A properly functioning carbon market is also key.

There is no consensus as to the regulatory framework that provides the right investment incentives for infrastructure. Remuneration should be fair and predictable, with a combination of long-term contracts with short-term market mechanisms capable of reflecting scarcity conditions while allowing prices to hike when necessary.

On the basis of recent decisions on benefit and cost of cross-border allocation, the European regulator could develop guidelines for the remuneration of capacity in order to reduce regulatory uncertainty. Lengthy administrative procedures should also be kept to a minimum, with the 3.5 years for CPIs being important progress to be extended to all projects. Notwithstanding the need to prioritize projects on the basis of cost-benefit analyses, there is also a case for non-viable commercial projects with large strategic value to be implemented, with costs socialized via usage-tariffs.

In sum, natural gas has a role to play in the Energy Union as a key provider of security of supply. However, the achievement of climate change goals together with the need to reduce Europe's dependence from imported fossil fuels, imply an arguably reduced role for gas in the 2030-2050 horizon. The industry will probably need to tap opportunities elsewhere, including road and maritime transportation, CCS, combined heat and power boilers, power-to-gas, and biogas, among others.

1. Introduction

The recently released Energy Union Package advocates for "a resilient Energy Union with an ambitious energy policy at its core", with the ultimate goal of providing EU consumers "secure, sustainable, competitive and affordable energy". Maintaining the balance between these objectives is certainly challenging, but the challenge is worth now more than ever before.

Despite the increased weight of renewables in primary energy consumption, the EU remains heavily dependent on imported fossil fuels.[1] This dependence makes Europe particularly vulnerable to external supply shocks. Indeed, the conflict in Ukraine has once again raised concerns about the EU's dependence on Russian gas imports[2], putting the security of supply objective at the forefront of the policy debate. In a context in which it is increasingly difficult for countries to push for energy and climate objectives on their own, the volatility in global energy markets - with oil and coal prices dipping to record lows, and shale gas booming in the US - has added further challenges for the EU. Internally, the lack of economic growth has delayed the need for new energy investments, but has added pressure on customer bills, making it harder to attract investments. Last but not least, delays in the completion of the internal energy market have also made it harder to fulfil the EU's energy and climate objectives.

Reliance on indigenous energy resources, such as renewables, and improvements in energy efficiency would mitigate Europe's dependence on imported fossil fuels, thus reducing its vulnerability to external supply shocks. This has been well understood by the EU, which has put the climate agenda at the core of its Energy Union proposal as a way to strengthening energy security in Europe.

Europe has made significant steps towards its climate policy targets, but effort remains to be done. In 2012, greenhouse gas emissions had decreased by 19.2% relative to 1990 levels and the weight of renewables in total energy consumption had increased from 8.7% in 2005 to 14.1% in 2012. Projections show that some member states are not on

[1] The most recent data released by Eurostat reveal that the EU was dependent on energy imports for 53% of its consumption in 2013. Renewable energy accounted for 24.3% of EU primary energy consumption in 2013, while oil, gas and solid fuels summed up to 45,5%. In 2011, 56% of all fossil fuels consumed in the EU were imported, as compared to 45% in 1990 (European Environmental Agency, 2015).

[2] In 2013, energy supplies from Russia accounted for 42% of EU natural gas.

track to meet their 2020 renewables target, leaving the overall EU27 figure at 17.9%, short of the 20% objective.[3]

In spite of this, the climate policy agenda remains ambitious. The 2030 climate and energy package recently released commits Europe to reducing greenhouse gas emissions by 40% as compared to 1990 levels, to increasing the EU-wide weight of renewables on final energy consumption to 27%, and to improving energy efficiency up to 27% by 2030. Further, the Roadmap for moving to a competitive low carbon economy states that the EU should be prepared to reduce its domestic emissions by 80% in 2050, as compared to 1990. The achievement of this goal requires almost full decarbonisation of the power sector, given its greater potential to reduce emissions through renewable generation, as compared to other polluting sectors in the economy – notably, transport and heating.

Member State projections indicate that current policies would only reduce emissions to 22% below 1990 levels by 2030. The additional measures currently planned would enhance emissions reductions, but only up to 28%. Even if more optimistic, estimates by the European Commission and the International Energy Agency also indicate that current policies are insufficient for the EU to comply with its 2030 emissions target.[4] Thus, there seems to be a unanimous view for the need of further efforts to achieve decarbonisation. As recently stated by the European Environmental Agency "in order to meet its 2050 objectives and contribute fully to meeting the global 2°C target, the EU will need to accelerate its implementation of new policies, while restructuring the ways that Europe meets its demand for energy, food, transport and housing."

As a consequence, progress to date does not allow pushing energy security objectives at the expense of climate policy objectives. How to tackle these two sets of objectives simultaneously represents one of the major challenges for stakeholders, policy makers and the society as a whole.

This CERRE Policy Paper elaborates on what this challenge implies for the natural gas industry and discusses the role of gas in the road towards decarbonisation. Specifically, in Section 2, we focus on the contribution of gas to security of supply and sustainability in the power sector, while in Section 3 we focus on issues related to the deployment of gas infrastructure.

[3] See Resch et al. (2014).

[4] As compared to 1990 levels, the EU and the IEA estimates indicate that carbon emissions will be reduced by 32%, significantly below the 40% objective.

2. Sustainability and security: an impossible marriage?

Energy security and sustainability as public goods

Economists define “public goods” as those goods or services that are “non-excludable” and “non-rivalrous”, i.e. once available, no one can be excluded from their use, but use by an additional agent does not reduce the availability for others. Since private agents cannot fully reap the benefits created by public goods, the market under-provides them. Hence, public goods provide a paramount example of market failure that justifies regulatory intervention.

This issue is particularly relevant when it comes to dealing with energy security and energy sustainability, as they both share public good attributes. Energy consumers value not just the energy consumed, but also the *certainty* of being able to purchase it when needed. However, if one consumer refused to pay for such certainty, it would be difficult to prevent him from enjoying it. For instance, in power markets, additional generating capacity reduces the probability of system blackouts, thus benefitting all users connected to the grid, regardless of whether they actually use it for their own consumption. Similarly, improvements in energy sustainability create global benefits by reducing the risk and incidence of climate change. Since all individuals benefit from a cleaner environment, including those that do not contribute to financing the necessary investments, incentives to free-ride on the others’ efforts are strong. The public good nature of energy security and sustainability thus calls for regulatory intervention in this area. Not surprisingly, both issues are at the core of the EU’s energy policy, as we elaborate below.

Energy security, sustainability and the Energy Union

The EU has decided to boost its energy and climate agenda through the recently released Energy Union package, in which energy security and sustainability take a prominent role. In turn, the completion of the internal market – through the deployment of new cross-border infrastructure and the harmonization of market rules – is conceived as the key driver to achieve both goals.

There is indeed a clear case for dealing with energy security and sustainability in a coordinated fashion given the trade-offs and interactions among the instruments used to tackle both. Rather than viewing security and sustainability as an impossible marriage, the search for joint solutions has the potential of facilitating the achievement of both goals.

The Energy Union strategy implements this idea through a series of policies. The strengthening of the internal energy market through increased interconnection alleviates both security of supply and environmental concerns. On the electricity front, a more closely-linked network facilitates the integration of renewables into the electricity system by reducing the amount of back-up capacity necessary to compensate for their intermittency. It also enables a better use of renewables by reducing the likelihood of overproduction, which occurs when renewable energy production peaks at times of low demand. On the gas front, completing links in the gas network will curb our dependence on Russia as Europe's dominant gas supplier. Increased infrastructure will also improve the functioning of the gas market, contributing to Europe's resilience to unforeseen supply disruptions. There is no doubt that a substantial amount of additional infrastructure has to come online to reach those objectives, as discussed in Section 3 below.

In the Energy Union package, Europe aims at becoming the "most energy efficient economy in the world" as well as "number one in renewables". While traditionally falling within the climate agenda, the strengthening of energy efficiency and renewables targets can also alleviate concerns over security of supply. Since gas consumption in buildings represents 40% of total gas consumption in Europe, there is ample scope to decrease import dependency by reducing gas consumption in heating through improved efficiency or through the use of renewables for district heating. Indeed, as estimated by the European Commission (EC)[5], a 1% increase in energy savings could diminish gas imports by 2.6%.

Finally, the revival of coal at the expense of gas[6] raises not only environmental concerns, but it also puts security of supply at risk as gas-fired plants are being mothballed – particularly so in central Europe. While there are several factors behind that trend[7], it is beyond dispute that the failure of an oversupplied carbon market to deliver sufficiently high and stable permit prices – which have plunged almost 70% since 2008 – has not

[5] See the EC's Communication on Energy Efficiency and its contribution to energy security and the 2030 Framework for climate and energy policy, July 2014.

[6] For instance, the UK Department of Energy and Climate Change's latest energy trends statistics, reveal that after being briefly displaced by gas, coal returned to its place as the UK's most used fuel for electricity generation towards the end of 2014.

[7] Notably, the movement of relative prices: while import prices for natural gas have doubled from 2005-2012, coal import prices have dropped by a half from 2011 to 2013.

deterred power companies from switching from more expensive gas to more polluting coal, particularly so in the UK, Germany, Spain and the Netherlands[8]. Indeed, carbon prices of €40/Ton would be needed for power companies to be willing to switch back to gas. However, with current prices at around €6/Ton, it is unlikely that future prices will increase enough unless reforms are put in place to absorb the current surplus of allowances. To the extent that the survival of natural gas plants is facilitated by higher carbon prices, a deep reform of the EU Emissions Trading Scheme is necessary first and foremost to address the environmental externality, but also, as a tool to reinforce security of supply in Europe.

What role for gas in the power sector? The medium run versus the short run

In the next few years, the energy sector will go through a profound transformation as Europe seeks to achieve its 2030 and 2050 climate targets while keeping the lights on. The electricity sector plays a key role in the decarbonisation agenda because of its potential for reducing emissions in other sectors of the economy, notably through the integration of renewables in the energy mix. As an indigenous energy source, renewables are also key contributors to security of supply as they are available regardless of political turmoil. However, the intermittency of renewable resources strengthens the need to resort to gas as a back-up, as gas plants are available when the wind does not blow or when the sun does not shine.

The power sector has to be almost completely carbon-free by 2050[9]. Assuming that the EU takes this climate objective seriously, this implies that by 2050 the role of gas in power generation will be significantly reduced. Unless carbon capture and storage becomes cost-effective,[10] gas-fired plants will only be used to provide spinning reserves for electricity generation. Some European energy companies are already anticipating this. Very recently, E.On has announced its plan to spin off its fossil fuel generation assets into a new company, in order to focus on renewables, distribution networks, and energy efficiency services. Other firms might follow as the Bank of England has recently

[8] For instance, between 2010 and 2012, electricity generation from gas was reduced by 58 TWh in the UK, by 13 TWh in Denmark, by 26 TWh in Spain and by 20Twh in the Netherlands. In the same period, generation from coal rose by 38 TWh in the UK, by 14 TWh in Denmark, by 32 TWh in Spain and by 2 TWh in the Netherlands. See Rüdinger et al. (2014).

[9] European Commission, March (2011), A Roadmap for moving to a competitive low carbon economy in 2050.

[10] As recently argued by the Intergovernmental Panel on Climate Change, avoiding dangerous warming will cost twice as much without carbon capture and storage.

warned of the financial risks involved in fossil fuel investments, which can become stranded by climate change policy. As argued by the current Governor of the Bank of England and Chairman of the G20's Financial Stability Board, for the threshold to "dangerous" climate change to be avoided, the "vast majority of [fossil fuel] reserves are unburnable" [11]. In the case of gas, this amounts to half the reserves, as documented by the 2013 report of Professor Nicholas Stern on the "carbon bubble" [12].

However, in the short run, Europe is not ready to strand its fossil fuel assets completely – not to mention other parts of the world. Thus, renewables and gas are bound to coexist as a necessary condition to address the sustainability and security of supply agenda. Adequate regulatory approaches have to be devised in order to facilitate the coexistence of the two.

Gas and renewables in the electricity sector: complements or substitutes?

Experience tells us that the coexistence between gas and renewables has not been a peaceful one so far. One reason is that, under the current market design, the interaction between renewables and gas in the power sector is faced with a fundamental trade-off: in a renewables-based system, electricity prices can slide below the average costs of gas plants, with their load factors being low and uncertain.

However, it is important not to disregard other factors that might also be behind the low profitability of natural gas plants. In addition to the increased penetration of renewables, there are other confounding factors such as the drastic reduction in electricity demand during the economic crisis, the revival of coal triggered by expensive gas and low carbon prices, the auctioning of emissions permits, and the overinvestment in CCGTs, among others.[13] It is paramount to disentangle these factors in explaining the poor performance of gas-fired plants, as otherwise, policies can be misguided.

[11] Similar views have been expressed by the President of the World Bank as well as by the former US Treasury Secretary. By the end of 2015, the Bank of England is expected to submit a report to the British Government on the implications of the so-called "carbon bubble". See The Guardian, "Bank of England warns of huge financial risk from fossil fuel investments", 4 March 2015.

[12] Stern, N. And Carbon Tracker (2013), "Unburnable Carbon 2013: Wasted capital and stranded assets" Available at http://carbontracker.live.kiln.it/Unburnable-Carbon-2-Web-Version.pdf.

[13] For example, in Spain, in 2005 the regulator expected that CCGT capacity would add up to 14.800MW by 2010. In 2014, actual investment was 25.353 MW, i.e., 80% above the forecast. In 2014, the production of CCGTs was 21.979 GWh (8.5% of total demand), implying that CCGTs produced at slightly less than 10% load factor. If only 14.800 MW had been invested, the load factor of CCGTs – all else equal – would have been approximately 17%.

Given the focus of this section, let us elaborate further on the impact that renewables have on the profitability of CCGTs. Renewable energy depresses electricity market prices because of the interplay of various effects. First, there is the so-called merit order effect. Since renewables have essentially zero marginal costs, an increase in renewables shifts the aggregate supply function outwards, thus resulting in a reduced market price. This effect arises even under perfect competition. However, if there is market power, there are other indirect effects at play. In the short run, the increase in renewable energy implies that the residual demand faced by the thermal generators is both reduced and becomes more uncertain. These two effects mitigate market power, thus reducing market prices beyond the reduction caused by the pure merit order effect[14].

The merit order effect also has a quantity side to it: as the aggregate supply function shifts out, renewables displace conventional energy resources. Under the current green-dark spread, coal precedes gas in the merit order, thus implying that an increase in renewable production comes at the expense of the production of natural gas plants. However, if the relative prices of coal and gas were more favourable to gas, e.g. if carbon prices were higher, the merit order effect would displace coal and not gas-fired plants.

This poses a problem given that natural gas plants are still needed to smooth the integration of renewables into the power market. As already argued, natural gas plants have an important role to play as they can provide back-up capacity to cover demand when the wind does not blow or the sun does not shine, and can ramp up or down to accommodate the variability of renewable resources.

There are other options to ease the penetration of renewables[15]. One has already been mentioned: strengthening market integration through increased interconnection capacity. Since the variance of aggregate renewables output is lower than the variance of renewable output at the individual member states, market integration reduces the amount of spare capacity that needs to be used as a back-up.

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[14] Several studies have measured the relationship between market prices and renewable production. For instance, the German Federal Environment Ministry, in their first monitoring report of the Renewable Energy Sources Act, reports that the merit order effect in Germany has depressed prices by 2-13 €/MWh. See Cludius et al. (2014) for a survey of this evidence. These studies do not address whether this has been driven by a pure merit order effect, or also by the impact of renewables on market power.

[15] Mills and Wiser (2014) compare alternative policies to allow for the penetration of renewables into the power sector. Among these, the study considers increased geographic diversity, technological diversity, more-flexible new conventional generation, increased storage, and demand side response through the implementation of Real Time Pricing.

An additional option is to promote demand side response and to increase storage, as they might both bring in the flexibility needed to cope with intermittent resources. However, demand side response requires the mass deployment of smart meters as well as the change in pricing rules towards Real Time Pricing. An even then, it is still unknown whether consumer's demand will be sufficiently elastic to provide all the needed flexibility. Similarly, the high cost of storage rules it out as a viable alternative in the short run.

In sum, since market integration is far from being complete, and the potential for demand side response and economic storage are yet to be seen, renewables and natural gas plants are bound to coexist, at least in the short term. This does not mean that we should abandon the other options. To the contrary, the smart avenue would probably be to follow all options to design a framework in which security and sustainability can be achieved at least cost.

This conclusion poses a natural question: how can the coexistence between renewables and natural gas be more peaceful? Arguably, a rethinking of electricity markets is necessary.

Rethinking electricity markets

Concerns regarding the co-existence between renewables and gas are not intrinsic to these technologies per se. Such concerns are rather created by the current market rules in the power sector. Indeed, the recent performance of several electricity markets across Europe shows that the current market design is not well suited to delivering secure, sustainable and affordable electricity[16].

The suitability of the current market design is being challenged by changes in the energy mix. While it was once conceived for a mix dominated by fossil-fuel plants, with high operating costs and relatively lower capital costs, it now has to accommodate an increasing share of intermittent resources with high capital costs and low operating costs. In this context, what is the correlation (if any) between market prices, which reflect the marginal costs of burning coal or natural gas, and the average costs of low-carbon resources? What is the value of the risk-*premia* demanded by investors in order to provide back-up capacity that will have to recover its fixed costs during an uncertain and reduced number of peak hours? The increasing disparity in the cost structures of the existing technologies exacerbates the flaws of the current market design.

[16] See Newbery (2011) in the context of the UK electricity market.

With the focus moving from short-term issues, e.g. dispatch optimisation, to long-term issues, e.g. investment, the need to rethink the design of electricity markets is now compelling. The widespread energy-only, technology-neutral, approach to the regulation of electricity markets fails to internalise the externalities created by the different technologies. For instance, the increased flexibility and reliability – with public good attributes, as argued before – provided by natural gas plants, remains unpriced under an energy-only market arrangement. Similarly, the learning economies triggered by the deployment of renewables cannot be captured by investors through market prices alone under a technology-neutral approach. The contribution of renewables to the reduction of greenhouse gas emissions is not reflected in market prices either, not least because carbon prices at record lows do not capture properly the negative externalities associated to carbon emissions.

The Energy Transition

Several Member States – notably, Germany, the UK and France – have already implemented reforms to their electricity systems with the ultimate aim of facilitating decarbonisation without putting security of supply at risk.[17] Among the various elements of the reforms, these countries have created capacity markets, implemented mechanisms to boost carbon prices, or fostered the use of capacity tenders for low carbon resources. Arguably, the absence of a common regulatory approach to the low carbon transition has resulted in a patchwork of diverse policies across member states that weaken the internal energy market.

To be clear, there is no unanimity on how to implement the energy transition while keeping the lights on. First, there is the debate as to whether natural gas power plants can serve as a bridge in this transition, or whether any kind of investment in fossil fuels locks us into a high-carbon future, undermining or at least delaying the switch to greener forms of power. Second, under the premise that in the short- to medium- run natural gas plants remain indispensable as a back-up, as argued in the previous section, there is no consensus as to the right regulatory framework to provide the right investment incentives.

The most widely adopted option in Europe has been the creation of capacity markets. The UK is among the countries that have implemented a capacity market. Through the

[17] This will be the topic of a forthcoming CERRE study as well as of a CERRE Executive Seminar both entitled: "Energy Reforms in Germany, the UK and France: Initial Lessons for the Energy Transition in Europe?"

first capacity market auction, at least 48.6 GWs of fossil fuel capacity are guaranteed to be available in 2018. Gas was the auction's biggest winner, as it secured capacity payments for approximately 25 GWs of new and existing plants, for a market clearing price of £19.40/KW. The issue is that this price was also paid to polluting coal power plants, an outcome which is at odds with the sustainability objective.

While some argue that capacity markets are needed to avoid the mothballing of natural gas plants, others criticise those support schemes on various grounds. First and foremost, critics emphasise the increased costs faced by consumers. Second, capacity markets help coal-fired power stations stay open longer, exacerbating the mini "dash for coal" trend that contradicts the climate goals. And third, capacity payments could disguise public aid aimed at facilitating the survival of natural gas plants. Notwithstanding other factors, the low profitability of some gas-fired stations has partly been driven by the overinvestment in this type of plants, as argued in the previous section. If this is so, why should consumers pay for the mistakes committed by private investors who took those decisions freely? Whereas there are compelling arguments to price security of supply given its public good attributes, it is not clear whether the existing capacity markets are the least expensive way to do so.

A way forward?

The renewable capacity auctions recently implemented in the UK open up a promising way forward- not just for renewables but, more broadly, for other types of investments as well.

In these auctions, bidders compete for the right to deliver renewable energy under a Contract for Differences (CfD), with a strike price which is set competitively through the auction. The winning investors sell their electricity at wholesale market prices, but any difference (positive or negative) with respect to the strike price is settled by differences, i.e., if the wholesale price is below the strike price, the investor receives the difference, and it pays it back otherwise. The CfD guarantees that the production of the new plants will effectively be sold at (roughly[18]) the strike price.

The first round of auctions held in the UK has awarded contracts worth £315 million to 27 renewable energy projects (including solar, onshore and offshore wind and energy from waste, among others) with a combined capacity of 2.1 GW. Total payments to the

[18] There might be disparities if the reference wholesale price is not exactly the same price at which the producer sells its electricity.

new investments will add up to around £4 billion over the 15 years lifetime of the contracts. This first auction has been very successful in pushing procurement costs down: the "less established" technologies were awarded at an average £117 MWh, while energy from waste, onshore wind and solar received an average of £82 MWh[19]. Notably, these prices are well below the £140-£150 expected by the Government, and well below the prices that were agreed last year between the regulator and five new offshore wind farms.

As illustrated by these results, this mechanism has several appealing features. First, payments for the new investments are set competitively. Thus, if there are enough bidders (and no significant cost disparities among the various technologies competing in the auction)[20], the strike price should reflect the average cost of the new investment. It is then inconsequential whether the wholesale price has no bearing with the cost of the plant – a problem that arises under the current market arrangements -, because the plant will effectively receive the strike price. Setting the strike price through the auction also allows the regulator to overcome her information asymmetries, which are particularly relevant in the case of renewables as their costs are declining fast. Thus, even if the regulator does not know the current state of the technology, the auction allows her to elicit investors' information, and thus set the price at the right level. In this way, the cost reductions achieved through leaning-by-doing are passed on to consumers. Furthermore, since the strike price remains constant for the 15 years lifetime of the contracts, investors face much less uncertainty than if they were to sell the electricity at wholesale prices plus (possibly) a premium.[21] This reduced risk exposure translates into reduced risk-*premia*, thus leading to lower prices for consumers.

The UK approach entails regulatory intervention given that the auctioneer determines the amount of capacity to be auctioned. However, this should not be seen as a drawback. To the extent that the renewable objectives have already been set, the regulator is simply resorting to a new instrument that allows her to implement the objectives more efficiently than through other means.

Previously, we argued that the market fails in promoting investments in back up capacity given that the public good nature of security of supply. In turn, the use of

[19]Https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/407059/Contracts_for_Difference_-_Auction_Results_-_Official_Statistics.pdf

[20] Indeed, a technology-neutral approach can result in large rents for the low-coat technologies.

[21] This is in contrast to what the new Environmental and Energy State Aid Guidelines advocate.

capacity auctions for renewables is also grounded in their public good attributes, even if these are related to other externalities, the environmental ones. Hence, why not apply the same arguments to also support investments in back-up capacity through auctions? Importantly, these auctions are not to be confounded with existing capacity markets, for these auctions would only apply for the new investments. The auctions for new back-up capacity would eliminate the need of running capacity markets in parallel, and thus the criticisms that come with them.

In sum, the move towards renewables-based energy systems with gas as a back-up, calls for a redesign of electricity markets. The challenges implied by the public good nature of investments that allow for greater energy security and sustainability require a more prominent role of the regulator in determining the amount of capacity to be procured, not its price. Indeed, competition among potential investors would drive prices down to the average costs of the best available technologies, thus allowing consumers to benefit from technological progress through lower prices.

3. Gas infrastructures: threatened or fostered by climate change policy?

As already put forward in the previous section, a key element to accomplish the envisioned internal market for natural gas is the deployment of proper infrastructure, proper in terms of location, size and timing. Gas infrastructure is essential for ensuring that the commodity can reach the consumption centres where it is most valued (or needed), for making sure demand meets supply, and for eliminating (or weakening) market power.

The Third Energy Package (TEP), in particular Directive 2009/73/EC[22], was a cornerstone in EU regulation towards the creation of the internal market for natural gas. One of the central elements of the TEP is the unbundling of transmission system operators (TSOs) from generation, production and supply stakeholders, thereby promoting competition in the energy sector. But more importantly, the TEP is also instrumental in fostering the much needed investment in gas interconnecting infrastructure. The creation of the Agency for the Cooperation of Energy Regulators (ACER) and of the European Network for Transmission System Operators-Gas (ENTSOG) are noteworthy steps towards the necessary coordination between individual Member State regulators and TSOs to facilitate investment in cross-border facilities.

[22] Directive 2009/73/EC of the European Parliament and of the Council concerning common rules for the internal market in natural gas and repealing Directive 2003/55/EC, , 13 July 2009, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:211:0094:0136:en:PDF

In spite of the enactment of the TEP, in 2011 the EC estimated that around Euro 70 billion worth of investments were still needed in gas pipelines, storage, liquefied natural gas (LNG) terminals and reverse flow infrastructure. The EC also concluded that a great deal of the necessary investment would not be made at all, or not on time to ease meeting the environmental and renewable energy targets embedded in the 2020 commitments. Of particular concern was the development of trans-European energy networks[23].

In response, the EC launched the Energy Infrastructure Package (EIP), mainly aiming at ensuring that sufficient cross-border connections and storage facilities are active by 2020. Three main investment barriers were identified. First, administrative barriers are regarded as very significant. Obtaining the necessary licenses to deploy new infrastructure involves lengthy and costly bureaucratic procedures; sometimes projects can take up to 10 years before they are finished. Second, financial barriers are also substantial, rendering some projects commercially non-viable. In particular, projects with a significant European-wide strategic value do seem to fail to raise investors' interest because of their low rate of return. Finally, some projects, related for example to reverse flow infrastructure, often involve parties under separate regulatory jurisdiction, which requires cooperation among TSOs in order to avoid potential conflicts of interests, and among the corresponding national regulators.

The EIP addresses these shortcomings by incorporating a number of projects into the so-called Projects of Common Interest (PCIs) category. Eligible projects must involve at least two Member States, must be viable and their contribution to the development of the internal energy market must be proven. With the energy infrastructure package, PCIs benefit from simplified and quicker –within 3.5 years– licensing procedures. Moreover, PCIs benefit from enhanced regulatory treatment. In particular, ACER can take binding decisions when the concerned NRAs fail to reach an agreement on the allocation of benefits and costs of an infrastructure project.[24] Finally, PCIs are eligible for EU support from the so-called Connecting Europe Facility (CEF). Such support includes the co-payment of the costs of studies and in the exceptional cases of commercially non-viable projects of especially high common interest, also the co-payment of the costs

[23] Seen from the perspective of the most recent Ten-Year Network Development Plan (TYNDP) produced by ENTSOG, the 2011 estimate seems overly optimistic. In its TYNDP, ENTSOG presents an account of the investments necessary for a reasonable completion of the internal market for natural gas. ENTSOG reports a total of 281 projects and 35% of these projects exhaust already the Euro 70 billion.

[24] ACER released its first binding decision on August 2014, on the Cross-Border Cost-Allocation of the Gas interconnection Poland Lithuania (GIPL).

of the works. The available funds, initially around Euro 9 billion but later reduced to around Euro 5.5 billion, seem however rather limited.

The EIP has been less successful than expected due to the recent economic and financial crisis. As a matter of fact, the level of investment in the EU has approximately dropped by 15% since 2007. The fall has been even more marked for the southern European countries and Ireland. In response, the EC announced last November an ambitious Investment Plan for Europe[25]. The plan aims at mobilising Euro 315 billion in additional public and private investments for EU projects, with energy infrastructures, energy efficiency and renewable energy being priorities for the plan. The investment plan shall employ public money to provide greater risk-bearing capacity to the private sector. It is hoped that the plan will stimulate investment in projects that, though viable, would not occur due to risk considerations. The new and upcoming European Fund for Strategic Investments (EFSI), drawing from EU and European Investment Bank (EIB) funds, will provide risk support for long-term investments to attract private money for otherwise non-viable projects.

Infrastructure challenges

The implementation of the Third Energy Package and the completion of the internal energy market still remain high priorities on the European agenda. According to the EU, and to most industry observers and stakeholders, infrastructure development lags behind. In particular, there exist regions in Europe where cross-border interconnections are scarce, reverse-flow infrastructure is scant, gas storages are limited and more LNG terminals would be welcome.

The lack of proper infrastructure results in a fragmented market. As we can see in the recent report of the European Commission26, gas wholesale prices differ significantly across regions, with some EU countries (like Greece or Bulgaria) paying for gas in excess of 50% more than what is paid in other countries like the UK, The Netherlands or Belgium.

More worrying is the fact that the current gas infrastructure is not sufficiently robust to undergo stress situations and possible transit disruptions. According to ENTSOG, the European gas system still needs a substantial amount of investment to be fully satisfactory. In ENTSOG's 2013-2022 Ten-Year Network Development Plan (TYNDP), the

[25] See EC's Communication on An Investment Plan for Europe, November 2014.
[26] See EC's Quarterly Report on European Gas Markets, Fourth Quarter 2014.

association of TSOs identifies a number of investment gaps. There is first the resilience assessment of the infrastructure. Under very high daily demand, the gas systems of Bosnia-Herzegovina, Denmark, Sweden and Luxembourg would fall under unacceptable levels of flexibility. Storage facilities would also have to be used at perhaps too high levels. When it comes to network sensitivity to disruptions in supplies, ENTSOG concludes that the most stressful situation would be the one caused by a disruption of transit through Ukraine. A disruption of supply transit via Ukraine would stress the system of additionally Serbia, Croatia, Macedonia, Bulgaria, Greece, Hungary, Romania and Slovenia. Disruptions of supplies from Norway, Algeria, Libya and Azerbaijan would have little effect even under high demand conditions. A disruption of transit through Belarus would have a limited effect on Lithuania and Poland. In order to solve these problems, ENTSOG has a catalogue of investment gaps but the problem is that the majority of these investments are just plans and not yet final investment decisions.

A second important aspect is the dependency on a few sources of supply. According to ENTSOG, the European market as a whole continues to be highly dependent on Russian gas. The ongoing projects are not sufficient to lower this dependency to acceptable levels. The Iberian Peninsula, France and Greece are also quite dependent on LNG supplies. Because LNG is provided by 9 suppliers, the problem is less of an issue though. Again, both for Russian and LNG gas, only if the planned but not yet final investment decisions were undertaken would the dependency come to bearable levels.

ENTSOG highlights that the necessary investment to make the gas system resilient, to lower the dependency of some areas on a few supply sources, to enable the system to adapt to different flow patterns and to enhance supply diversification, is likely to be well in excess of Euro 100 billion. However, the association of TSOs' report notes that those investments are unlikely to be completed given the current investment barriers.

Barriers to investment

First, there is the perception that the return on investment is perhaps too low. Access to the financial markets has been costly in the last few years, though the situation has improved recently. Regulation, in an attempt to keep consumer bills at bay, tends to keep rates of return relatively low. For many projects this means that amortisation periods are very long, up to 50 years or more. By contrast, commitments by infrastructure users have traditionally had a shorter duration, usually 15 to 20 years. But because the whole market is becoming more and more short-term oriented, investors are finding it increasingly difficult to secure even this type of commitments in open seasons. This misalignment ought to be corrected if the market is expected to undertake the necessary investments.

Second, the return on investment may be perceived as too uncertain. One problem is that the returns from a given project are not independent from other projects. These externalities define situations known as strategic games, which are difficult to understand and thereby stakeholders may find it difficult to predict their outcomes. The project catalogue compiled by ENTSOG represents good progress in this regard as it limits information asymmetries. Moreover, if regulatory frameworks fail to guarantee a sufficiently stable and predictable long-term return, investment is discouraged. In this sense, it seems as if the recent efforts to harmonise regulation are not yet resulting in a clear, predictable, stable and coherent regulatory framework. Perhaps uncertainty is even higher when it relates to investments where various NRAs are required to cooperate, since in case of failure to cooperate ACER must release a binding decision on how to allocate benefits and costs across countries.

Third, licensing procedures have been identified as generating high barriers to investment, and some projects have not reached the implementation phase due to this. The regulation of the PCIs within the EIP represents a clear response to this issue. Nevertheless, the shorter the administrative procedures, the better.

Fourth, it is inevitable that some projects of great strategic value will have low economic return and therefore will attract little private support. It is desirable that those projects are implemented for security of supply reasons. One example is the case of projects that help diversify supply and thereby eliminate energy islands. Another example is reverse flow infrastructure that is intended for emergency situations. A fair remuneration of these projects is essential. Perhaps more financial support from the public sector is needed if these types of projects are expected to be online. The choice under the Investment Plan for Europe is to implement those projects by means of private-public partnerships. Such partnerships have their own management challenges and public support should facilitate the resolution of those difficulties. Moreover, financial tools such as the CEF and the EFSI should be better endowed and targeted to these projects.

Last but not least, the latest gas market developments along with the European climate change goals are putting additional pressure on the gas sector, perhaps undermining its future prospects by reducing investors' profitability expectations. Current demand and price developments are not encouraging. European natural gas demand has decreased in the last few years, the economic crisis being part of the reason but not the only one, as discussed in the previous section. Though several scenarios are contemplated, it is expected that demand will continue to fall slightly. This is so for various reasons. First, if the price differential with the US is maintained, and there are no clear reasons to believe otherwise, energy intensive industries may delocalise to other parts of the world (e.g. the recent Alcoa case in Spain) or otherwise they will cease to be competitive in their respective markets. Second, the low coal and CO2 prices are making coal-fired electricity units more attractive than gas-fired plants. As we write, some gas-fired power plants are running below cost and others are being mothballed. Third, and most importantly, European environmental regulation is affecting the sector prominently. The environmental agenda is enhancing energy efficiency. For example, the residential sector is responsible for a significant amount of emissions of greenhouse gases (GHG). Energy efficiency measures, such as the European Performance of Buildings Directive27, will likely result in lower residential sector demand for energy for heating and cooling purposes. As mentioned above, the environmental targets in the electricity sector are also rather ambitious. The share of low carbon technologies in the electricity mix is expected to increase to 60% in 2020, and to 75-80% in 2030. Some countries like the UK or Denmark have set a 100% renewable electricity generation target by 2050. These developments inevitably displace gas gradually away from the energy mix.

On the other hand, because of the intrinsic intermittent nature of energy supply based on renewables, a backup technology for generating electricity is needed. While gas may have a prominent position in the race for such a role, these developments may also be increasing the perception in the market that many investments may end up stranded. Relegating gas to a mere backup fuel, in the absence of proper remuneration, may imply that much of the existing infrastructure may be underutilised, and thus much of the necessary infrastructure to complete the internal market for natural gas may not come online.

This tension may be viewed as a chicken-egg problem. With the infrastructure in place, gas may easily be the alternative fuel of choice, but without guarantees that the future of gas is safeguarded, investors may fade away as time elapses. According to various stakeholders, one of the most important challenges they are facing is the forecasting of EU attractiveness for gas, and the role of gas in the future energy mix.

Regulation should ensure a level playing field for natural gas to compete with other technologies for offering sustainability and energy security. Proper remuneration of strategic projects is thus essential to stimulate investors to deploy the rest of the

[27] Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings (recast), http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32010L0031&from=EN

infrastructure needed. Priority should be given to strategic projects, and clear long-term signals should be given to ensure those projects are undertaken on a commercial basis. The best remuneration scheme should then perhaps contain long- and short-term elements. Socialization of the investment costs via tariffs should then be accompanied by short-term pricing of the added flexibility and supply security. It is clear that the market should be ready to pay for the flexibility brought about by the infrastructure investments.

Given the current developments, the gas sector might need to reinvent itself in order to secure a major role in the future Energy Union in Europe. Decentralised power generation via small-scale gas-fired combined heat and power micro plants is now more feasible than ever before. Bio-gas has an important potential to produce green gas and account for a large share of the supply. Carbon-capture-and-storage technologies could play a significant role in the market, but further I+D has to be devoted to this area for them to become cost effective. The transportation sector including automobiles, vessels and trains might also offer wonderful opportunities. Tapping these opportunities might be fundamental for the future of the sector.

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