Background paper November 2015

The Market Design Initiative and Path Dependency: *Smart retirement of old, high-carbon, inflexible capacity as a prerequisite for a successful market design*

Matthias Buck[1], Michael Hogan[2], Christian Redl[1]

1 The future low-carbon power system must be more flexible

In October 2014, EU leaders set new EU climate and energy targets for 2030.[3] In its Communication launching the consultation on "a new energy market design", the European Commission highlights that the targets imply a share of renewable electricity in the European power system of up to 50% by 2030.[4]

The Commission goes on to argue that the European power system will need to be much more flexible than it is today, on both the supply and the demand side, in order to integrate such share of renewable electricity into the power system. This in turn calls for market arrangements that can drive the investments in supply side and demand side resources with the flexibility the market will need.

This clear and unambiguous statement is highly welcome and is consistent with numerous studies[5] on least cost pathways to a secure, affordable and sustainable power system.

2 Old, high-carbon, inflexible generation capacities are a stumbling block to successful power system transition

While the Commission is to be applauded for clearly elucidating the flexibility challenge, it failed to address the challenges facing the transition as a consequence of the legacy of past investment decisions. At present this has led to a significant oversupply of reliable capacity in most regions of

[1] Agora Energiewende.

[2] The Regulatory Assistance Project (RAP). The authors thank Sarah Keay-Bright and Philip Baker (RAP), Patrick Graichen and Philipp Litz (Agora Energiewende), Simon Skillings (E3G), and Dries Acke (ECF) for valuable comments.

[3] EUCO 169/14: European Council (23 and 24 October) Conclusions.

[4] COM(2015) 340 final, p.3.

[5] E.g.: ECF (2010): Roadmap 2050. RAP (2014): Power Market Operations and System Reliability: A contribution to the market design debate in the Pentalateral Energy Forum. Study on behalf of Agora Energiewende. Fraunhofer IWES (2015): The European Power System in 2030: Flexibility Challenges and Integration Benefits. An Analysis with a Focus on the Pentalateral Energy Forum Region. Analysis on behalf of Agora Energiewende. Connect Energy Economics (2015): Pilot study electricity market 2015 ("*Leitstudie Strommarkt 2015*").

Europe, which is the primary cause of the current financial instability in the sector.[6] Looking forward, it has created a glut of high-carbon, inflexible generation that threatens to crowd out for many years to come a large share of the investments envisioned by the Commission in newer, cleaner and more flexible resources. Together these legacy effects create a path dependency that runs counter to the reliable, affordable energy sector transformation described in the Communication. That path dependency will not be broken simply by re-designing the electricity market.

Figure 1 shows that current market conditions yield high generation costs for gas-fired plants and low costs for coal-fired power plants. Even inefficient old coal plants currently produce at lower costs than the newest and most efficient gas-fired plants. As a result, when there is more capacity than demand it is the newer, more flexible and lower emitting natural gas plants that are pushed out of the market.

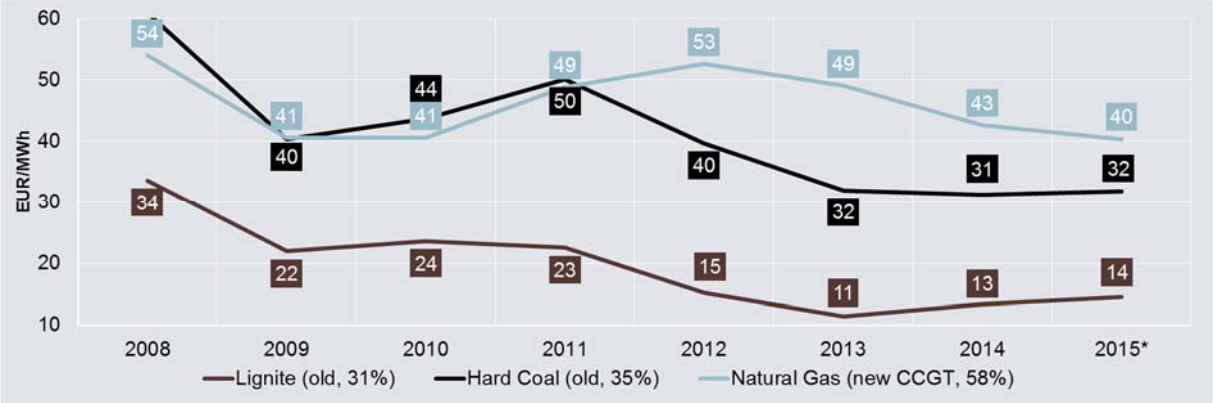

Figure 1. Short-run marginal costs of fossil power plants in Germany; 2008 – 2015. The bracketed numbers denote average plant efficiency. Costs include CO_2 costs. Source: Own calculations based on BAFA, DEHSt, Destatis, EEA, Lazard, UBA

Even as and when the current oversupply of reliable capacity is reduced, this stratum of inflexible, high-carbon legacy generation will remain a problem that will not be addressed simply by tinkering with the market design. Most of this legacy plant not only has low production costs but is mostly or entirely depreciated. It is therefore well positioned to prosper in the market for many years to come, forestalling the critical shift to a more flexible mix of resources (see Box below) and severely limiting any pure market basis for additional investment in renewables and other low-carbon resource options.

The proposed reforms of the EU Emissions Trading System (EU ETS), even if they are enacted, cannot be expected to change this picture. Prices for emission allowances through 2030 are

[6] We derive a margin of reliably available capacities over peak load ("de-rated reserve margin") in the ENTSO-E system of 13% for 2016 from ENTSO-E's most recent adequacy forecast, a figure that reflects overly conservative assumptions in many cases and that, even so, is 2 to 3 times what is necessary to maintain traditional standards of supply reliability. (Source: ENTSO-E (2015): 2015 Scenario Outlook & Adequacy Forecast)

projected to remain well below what is likely to be needed to shift investment and production towards cleaner, more flexible resources such as gas-fired power plants.[7]

Nor can the gradual tightening of air pollution limits be expected to do the job. More stringent legislation introduced by the Large Combustion Plant Directive has contributed to a net decrease of some 6.5 GW of coal-fired power generation capacity within the EU since 2013.[8] From 1st January 2016, the Industrial Emissions Directive (IED) further tightens air emission limits for large combustion plants and will likely contribute to further plant closures. However, at least 70 GW of existing coal-fired generation capacity in various Member States (some 40 GW in Germany alone) is already compliant or planning to be compliant.[9] Compliance with the IED is being facilitated by cost reductions in abatement techniques[10] and by favourable economic and market conditions, as highlighted in this paper. The IED offers a number of flexibilities and derogations, particularly for older plant, such that operators can delay the decision to invest in compliance until nearer 2020[11] or avoid compliance altogether under certain conditions.[12] According to 2014 figures, operators of some 40 additional GW of capacity were undecided on whether to invest in IED compliance.[13] Thus, policy-makers have a critical window of opportunity in the near term to intervene and prevent stranded investment in plant upgrades.

Worse, the current situation is being exacerbated by the introduction of national capacity mechanisms that commit additional, technology neutral financial support for existing investments in generation, in many cases years in advance. This has the perverse consequence of extending the lives of these legacy plants, forestalling the transformation we know will be required for the low-carbon transition.

[7] At the current price differential between lignite and natural gas, the fuel switch from existing (old) lignite to existing (new) gas power plants occurs at approx. 35 EUR/t CO_2. According to the Commission's own projections (draft PRIMES reference scenario for 2015) such prices are not expected before 2034. Note that volatility in gas and coal prices means that is impossible to be sure of fuel switching, much less long-term investment decisions, occurring at a specific CO_2 price.
[8] Eurelectric (2015): A sector in transformation: Electricity industry trends and figures.
[9] Sandbag (2014): Europe's Failure to Tackle Coal.
[10] Ibid.
[11] Ibid.
[12] For example, IED derogations unnecessarily include relaxed emission limits for older plant if operating less than 1500 hours. The latest draft of the LCP BREF, currently being updated by the European Integrated Pollution Prevention and Control Bureau (EIPPCB), would allow this derogation to continue beyond 2020. Such provisions are market distorting. EIPPCB webpage: <http://eippcb.jrc.ec.europa.eu/reference/lcp.html>.
[13] Sandbag (2014): Europe's Failure to Tackle Coal.

Features of a power system suitable to cope with high shares of renewable electricity

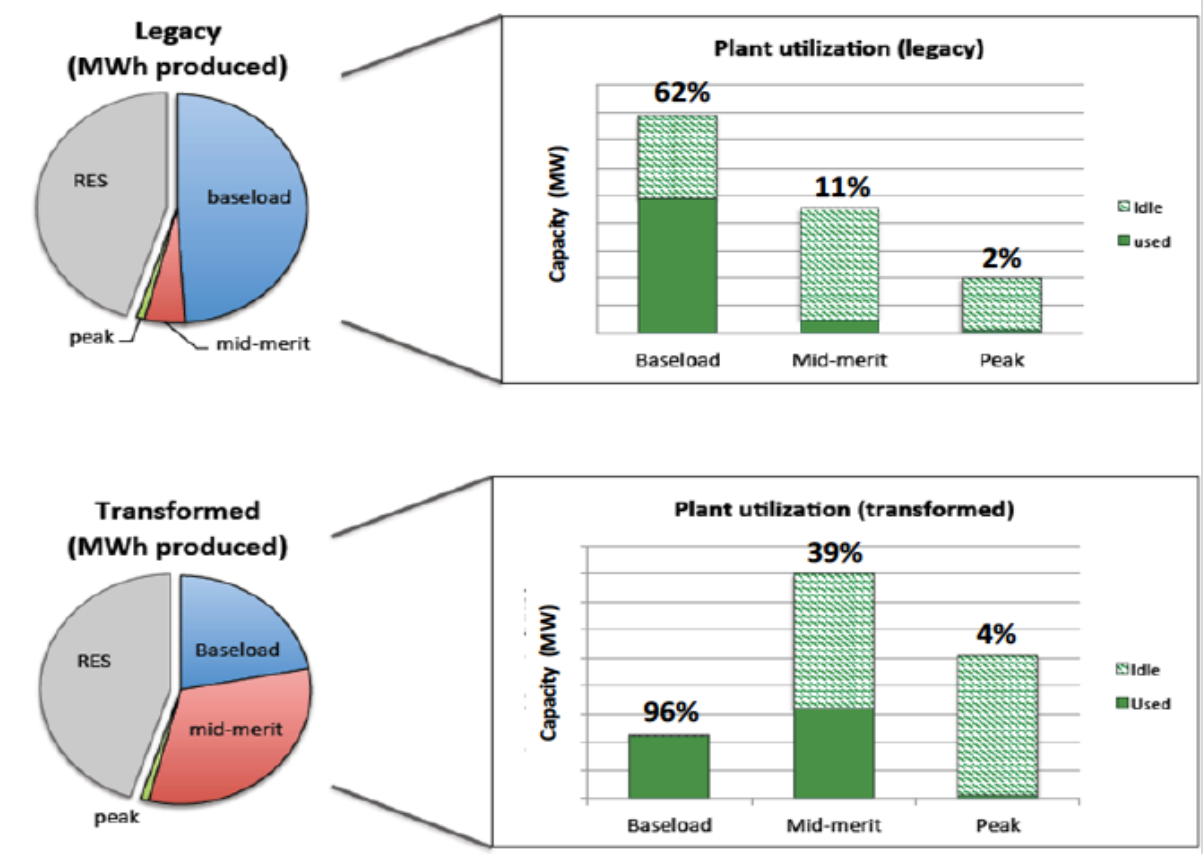

Figure 2. Impact of thermal plant mix on investment and plant utilisation rates. Source: Adapted from IEA in footnote 14

A recent study by the International Energy Agency* highlighted the dramatic benefits of a power system in which the mix of power generation resources shifts in response to the growing role of variable renewables, increasing the share of investment in flexible resources and decreasing the share of inflexible resources. The graphs in Figure 2 depict a system in which the share of variable renewable energy sources has grown to 45%, under two scenarios each of which has the same level of demand and the same reliability standards. In the "Legacy" scenario the incumbent mix of thermal generation capacity (the shares of baseload, mid-merit and peak) has remained essentially unchanged through the transition. Most of the non-renewable energy production comes from inflexible baseload plants. Baseload plants that traditionally saw utilization rates in the 90% range are running only 62% of the time, while mid-merit plants that typically ran about 40-60% of the time are seeing only 11% utilization rates in this "Legacy" scenario.

*IEA (2014): The Power of Transformation: Wind, Sun and the Economics of Flexible Power Systems, in particular pages 162-164.

In the "Transformed" scenario the mix of thermal resource types has been re-balanced in response to the growth in variable resources, with a mix shifting to more flexible plant. Investment has shifted dramatically toward more flexible mid-merit plants. The remaining baseload plants are back at over 90% of capacity while the mid-merit plants are back to about 40% of capacity. In short, a more flexible mix of dispatchable resources, capable of shifting operations up and down in synch with the less controllable shifts in variable renewable production, will have far higher asset utilization rates and require far less redundancy (and therefore far less investment) than a less flexible mix of thermal resources.

3 We are in the midst of a transition period during which market design changes alone will not be sufficient

The above suggests in our view that the period from today until at least 2030 must be regarded as a *transition period* during which the wholesale electricity market must be aligned with, but cannot be relied upon on its own to drive the *nature* of the investments and disinvestments that will be required.

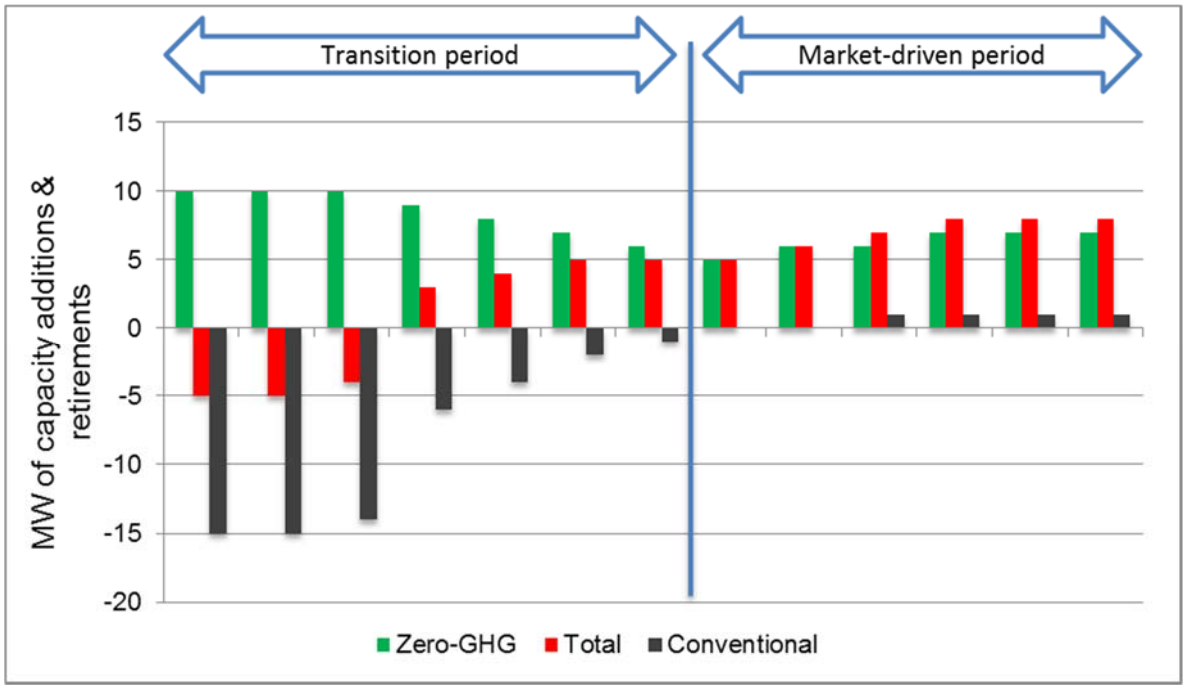

Figure 3. Conceptual outlook for generation investment through 2040. Market-driven period assumes a reliable CO_2 price of at least 60 EUR/t CO_2 (see footnote 15) Source: Own illustration

Figure 3 illustrates conceptually the reality of the investment challenge facing most regions in Europe. While the specific details will vary from region to region, the market overall currently faces the need to reduce the supply of capacity (seen here in red) in order to restore financial stability to the sector, regardless of what market design is ultimately chosen. At the same time, established climate and energy policies require the continued deployment of new low-carbon production

capacity (in green), much of which will be variable renewables (wind power and solar PV), and investment in the flexible resources that will be needed to integrate them. While variable renewables typically cannot replace dispatchable generation on a MW-for-MW basis, nonetheless they do add firm capacity to the system. The net result is a need to retire a considerable amount of existing inflexible, high-carbon capacity (in black), in many cases years before it would otherwise be retired.

Some market design improvements, such as those described by the Commission that would raise the quality of information provided by the energy and balancing services markets, will aid the transition by better aligning market prices with the underlying value of resources. But for all the reasons outlined above, even a well-designed market is unlikely to drive the deep transformation depicted in Figure 3.

4 A strategy is needed for smart and managed retirement of old, high-carbon, inflexible generation capacity

Reflecting on the above, our conclusion is that Europe needs a strategic approach for addressing the persistent glut of old, high-carbon, inflexible generation capacity. That is, **Europe needs a "strategy for smart and managed retirement**."

Such a strategy would:

- Align the evolution of the legacy resource portfolio with the demands embedded in established energy and climate policy objectives;
- Restore financial health to the owners of capacity remaining in the market that is actually required and has the capability to "keep the lights on;"
- Strengthen market demand for the new, clean, more flexible resource investments needed to achieve the desired transition at least cost to consumers and industry; and
- Complement the EU ETS by providing investors with greater clarity as to what kind of future competitive environment they are likely to face.
- Define the role that the EU can play in assisting Member States to manage the economic and social consequences of the clean power transition, particularly for low income member states with national industries or companies reliant on high carbon resources.

We see different potential instruments or measures as part of a European or of national smart retirement strategies, including but not limited to (at EU level) further strengthening of the EU ETS, eliminating derogations from the Industrial Emissions Directive and (at national level) facilitated retirement of stranded assets. The Energy Union governance system, currently in development around integrated national climate and energy plans and a set of progress indicators, could also be used for putting a spotlight on the issues of current overcapacity, resource adequacy and carbon intensity in the power sector.
However, closure decisions do not happen in a vacuum. They come with social challenges. Jobs will be lost, municipalities may see some of their tax base disappear, pensioners could see retirement funds coming under stress. For all these reasons, we firmly believe that the qualitative changes in the capacity mix that are needed must be embedded in a strategy for *smart* and *managed* retirement.

5 Protecting security of supply at least cost must begin with a fundamental overhaul of resource adequacy assessment

Despite clear evidence at EU level of oversupply of firm capacity relative to resource adequacy requirements, individual member states continue to insist that needed investments in new capacity are not being made because of flawed market design, in turn giving rise to the growing patchwork of national market interventions. The Market Design communication touches on the need for improvements in resource adequacy assessment methodologies and processes, including the need for more regional perspectives. But it fails to capture the urgency of reforming what is currently a balkanized, opaque and uneven process of aggregating Member State assessments that in too many cases reflect questionable methods.

This discordance between the macro reality and national perspectives, and the threat it poses to progress toward an integrated EU wholesale electricity market and to the transition towards a low-carbon power system, points to an urgent need for transparent, state-of-the-art resource adequacy assessment methodologies and processes. As importantly, it points to the need for a truly independent institutional framework capable of assessing resource adequacy at a regional level that reflects the physical reality of an integrated wholesale electricity market. A revised Security of Supply and Infrastructure Directive could address a number of needed improvements, for instance by establishing a normative methodology for accounting for the contribution of interconnectors. Such improvements in the assessment of adequacy are fundamental to unlocking the significant cost saving potential of the IEM by reducing the quantity of investment required and expanding the portfolio of options for balancing an increasingly decarbonized power grid. While Member States may retain primary responsibility for security of supply, a much improved and independent framework for assessment of supply and demand is needed to validate Member State applications for State Aid exemptions.

6 Capacity mechanisms must pay for what is really needed and most valuable, not for whatever happens to be in place

There may be a role for administrative measures to ensure that needed investment has an opportunity to earn a fair return. Such measures should, in the first instance, be based on a greatly improved regional process for assessing resource adequacy. They should also be introduced in a way that facilitates rather than impedes the shift in investment toward the resources of highest value to a power system in transformation. Most current member state proposals fail on both counts, but in particular they will fail to drive the transformation in resource investment toward a more flexible system.

Various options are available to address this shortcoming. Improving the effectiveness of short-term energy and balancing market pricing is the first priority in valuing investment in flexibility. If additional measures are needed, they should complement these investment signals rather than distort or contradict them. Some options are meant to capture the residual value of capacity outside of the energy and balancing services markets, and in doing so they should also reflect the difference in value between resources with different operational capabilities. Other options operate within

the energy and balancing services markets, applying real-time price premiums to ensure that prices fully reflect the reliability value of investments in capacity. They inherently drive effective energy market price formation and, in so doing, inherently improve the market's ability to value investment in flexible resources. They are also inherently compatible with the IEM.

7 Domestic (and European) renewable support schemes will be needed to meet the 2030 targets

Market-driven investment in new low-carbon resources at the pace and scale required will not emerge until the barrier of legacy high-carbon investment is addressed, and until there is a reliable and credible expectation of a price for carbon in the EU emissions trading system of at least 60 EUR/t CO_2. Such prices are unlikely to occur before 2040.[14]

This suggests that - throughout the decade from 2020-2030 - targeted measures supporting the further development of renewable energies will be needed to meet the 2030 EU renewable energy target. We expect that the general push by EU state aid rules for the market-based setting of support levels and the integration of renewable electricity into the market, will continue. The upcoming revision of the Renewable Energy Directive will need to reap the full scale of significant cost reductions in renewable energy technologies (in particular on-shore wind and PV) that have occurred over the last decade, for instance by removing national barriers to renewable energy deployment and by de-risking new investments into renewable energy and thereby bringing down costs of capital.

8 Conclusions

To conclude, the market design communication focusses primarily on the question of whether and how to intervene in support of investment in needed capacity. We believe that such interventions should be carefully considered in light of the need for smart and managed retirement of old, high-carbon, inflexible generation capacity. Interventions should also be evaluated in light of the unique characteristics of the integrated European power market.

Continued support for new investment in low-carbon resources such as variable renewables will be required for the foreseeable future and should not be confused with capacity mechanisms – they are fundamentally different decisions driven by fundamentally different considerations.

Finally, a proper regional approach to resource adequacy will almost certainly reveal that the most urgent challenge facing the EU power markets is not a shortage of megawatts of capacity, even on a de-rated basis. The most urgent challenge facing the EU power markets is tackling the implications of the legacy of investments in high-carbon, inflexible generation.

[14] At least 60 EUR/t CO_2 is the estimate found in Deutsch et al. (2014): Let's talk about risk: Why we need more than the EU Emissions Trading System to foster investment in wind and solar PV. The projected evolution of CO_2 prices is taken from the draft PRIMES reference scenario 2015.