STRANDED ASSETS

PROGRAMME

Smith School of Enterprise and the Environment

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Stranded generation assets: Implications for European capacity mechanisms, energy markets and climate policy

Working Paper

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About the Stranded Assets Programme

'Stranded assets' are assets that have suffered from unanticipated or premature write-downs, devaluations or conversion to liabilities. They can be caused by a range of environment-related risks and these risks are poorly understood and regularly mispriced, which has resulted in a significant over-exposure to environmentally unsustainable assets throughout our financial and economic systems. Current and emerging risks related to the environment represent a major discontinuity, able to profoundly alter asset values across a wide range of sectors. Some of these risk factors include:

- Environmental challenges (e.g. climate change, water constraints)
- Changing resource landscapes (e.g. shale gas, phosphate)
- New government regulations (e.g. carbon pricing, air pollution regulation)
- Falling clean technology costs (e.g. solar PV, onshore wind)
- Evolving social norms (e.g. fossil fuel divestment campaign) and consumer behaviour (e.g. certification schemes)
- Litigation and changing statutory interpretations (e.g. changes in the application of existing laws and legislation)

The Stranded Assets Programme at the University of Oxford's Smith School of Enterprise and the Environment was established in 2012 to understand these risks in different sectors and systemically. We test and analyse the materiality of stranded asset risks over different time horizons and research the potential impacts of stranded assets on investors, businesses, regulators and policymakers. We also work with partners to develop strategies to manage the consequences of stranded assets.

The Programme is currently being supported through donations from the Ashden Trust, Aviva Investors, Bunge Ltd, Craigmore Sustainables, the Generation Foundation, the Growald Family Fund, HSBC Holdings plc, the Rothschild Foundation and WWF-UK. Our non-funding partners currently include Standard & Poor's, the Carbon Disclosure Project, Trucost, Ceres, the Carbon Tracker Initiative, Asset Owners Disclosure Project, 2° Investing Initiativeand RISKERGY.

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This Working Paper is intended to stimulate discussion within the research community and among users of research. The views expressed in this paper represent those of the author(s) and do not necessarily represent those of the host institutions or funders.

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Abstract

An increasing number of recently built, high-efficiency combined-cycle gas turbine (CCGT) power plants, are being mothballed or prematurely closed across the European Union as profits from gas are eroded by decreased electricity demand, changing fuel prices and depressed carbon prices. This paper examines how major EU utilities are reacting to the impacts of market and policy factors upon the profitability and value of CCGT assets, how these stranded assets are affecting firm value and strategy, and what implications may exist for energy market design, low-carbon energy and climate policy. Market research and financial information is used to quantify the scale and scope of competitiveness impacts on gas-fired power assets and financial impacts of stranded CCGT assets in terms of asset impairment charges, firm valuation, credit ratings and debt quality. A meta-analysis of developments occurring in 2013 illustrates that stranded CCGT assets are playing an important role in the development and implementation of capacity remuneration mechanisms in different EU member states. We find that governance and policy gaps exist at national and EU levels regarding the appropriate treatment of stranded assets. Careful thinking is required on how the economic costs of stranded assets should be valued in the design and implementation of different capacity policies. Examining the potential competitiveness impacts of different capacity mechanisms and their relationships to stranded assets stands is an important research priority.

Keywords: Stranded assets, gas-fired power, energy policy, CCGT, capacity mechanism, capacity markets, renewable energy

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Executive Summary

EU gas-fired power is in trouble. Over the last 18 months an increasing number of major EU utilities have decided to mothball or prematurely close recently built, high-efficiency combined-cycle gas turbine (CCGT) power plants, motivated by the combined effects of decreased electricity demand, changing fuel prices and depressed carbon prices. As write-downs on gas generation assets have been reported across the continent, EU energy markets have seen high-performing CCGT plants rendered stranded assets, while coal generation has gained market share. These stranded assets have affected company balance sheets and disincentivised capacity investment. Beyond financial impacts on firms and investors, decisions to mothball CCGTs have led to increasing carbon emissions in some countries and compromised system security in others. Recent utility actions may have important implications for energy policy reform, from national to EU levels, specifically through the rapid implementation of capacity remuneration mechanisms (CRMs) in different EU member states.

This working paper provides a snapshot of the impacts and implications of stranded CCGT assets for utility business models and government policy. We assess how ten major EU utilities (E.ON, RWE, Statkraft, Vattenfall, EnBW, GDF Suez, Centrica, SSE, Verbund and CEZ) are reacting to impacts of market contractions, fuel prices, climate and energy policies upon the profitability and value of CCGT assets. We also assess how these stranded assets are affecting firm value and strategy, and what implications may exist for energy market design, low-carbon energy, and climate policy.

Why care about stranded generation assets?

If incumbent firms cannot recoup the necessary return on current thermal assets, and new entrants cannot establish market capitalisation at the level necessary to finance new investments, system security may be compromised. In response to utility (un)willingness to make investments in new base-load thermal capacity, CRMs and other policies for power-plant reserves may provide economic support for stranded assets as a way to achieve supply security objectives. However, not all governments moving towards CRMs are facing national capacity scarcity issues – some may be considering CRMs in order to support low-carbon energy objectives. In this context, stranded assets are playing an increasing role as focal points for debate around the impacts of decarbonisation policies on the profitability of thermal power generation and utility business models, and raise questions about the best way forward for a smooth transition to clean energy.

Examining asset stranding in EU gas-fired power

Over the course of 2012-13 ten major EU utilities implemented and announced planned mothballing and closure actions of over 20GW of CCGT capacity in response to persistently low or negative clean spark spreads. 8.8GW of this capacity was either built or acquired within the last ten years. These decisions have been motivated by different market and policy factors affecting electricity, coal, gas and carbon prices.

The global financial crisis resulted in significant reductions in EU electricity demand compared with levels projected in 2008-09, which depressed wholesale electricity prices in some EU economies. The financial crisis has also affected carbon prices, with prices of EU Emissions Trading Scheme (EU ETS) allowances falling from nearly €30 in July 2008 to near €4.50 in January 2014. These impacts have been exacerbated by changes to merit order brought on by increasing renewable energy capacity, which has curtailed expected running hours and depressed wholesale prices. This situation has been compounded by changes in coal-gas fuel prices spreads. A 32% drop in EU coal import prices since January 2011 (attributed to reduced domestic demand for US thermal coal driven by the boom in US shale gas extraction) has shifted the balance of profit towards coal plants at the expense of CCGTs. As gas prices remain high, it is unlikely that EU gas-fired power plants will regain competitiveness against coal power on the basis of fuel price changes alone.

EU utilities have experienced substantial financial impacts from the adverse market situation for gas-fired power. As the market conditions for gas-fired generation deteriorated further in 2013, major EU utilities reported increasing impairment charges on thermal assets. Of the ten EU utilities examined here, six reported write-downs on EU CCGTs. Although exact values are unclear, we estimate that nearly €6bn is attributed to write-downs on gas-fired power investments over the course of 2013.

Table ES1: EU utility impairments during 2013 – thermal and gas assets (€m)

Utility	Date	Total Impairment	Thermal impairment	Gas-power impairment	Assets noted
Statkraft	14-Feb-13	375.95	274.12	274.12	German gas-power assets
GDF Suez	28-Feb-13	2,000.00	2,000.00	2,000.00	EU gas-power assets
SSE	22-May-13	692.87	362.00	> 327.80	UK CCGTs, coal assets
Verbund	12-Jun-13	1,130.00	1,030.00	659.00	Austrian and French CCGTs
Vattenfall	23-Jul-13	3,462.18	2,168.20	> 1,690.00	Dutch gas-power and coal assets
GDF Suez	31-Jul-13	200.00	200.00	200.00	Dutch, French and German CCGTs
RWE	14-Aug-13	800.00	800.00	> 800.00	Dutch thermal generation assets
Total		8,661.00	6,834.32	> 5,950.92	

Beyond the devaluation or write-down of specific assets, the value of major EU utilities has been impacted by the changing profitability of base-load thermal power generation in EU countries: stock prices of RWE and E.ON fell 33% and 15% respectively from January to September 2013, before recovering slightly. While profits have been somewhat protected by forward hedging over the last three years, the expiration of forward hedging in EU markets suggests a bleak outlook for EU power prices in negatively impacted firms whose asset base is not widely geographically or technologically diversified. Impacts upon firm equity and market capitalisation have carried through to investors, with a number of utilities (including RWE) aiming to stem capital outflows by reducing dividends.

The credit quality of the utilities has also suffered. Those utilities that have been able to preserve credit ratings or limit further downgrades have benefited from geographical and sector diversification, along with the programmes undertaken to limit spending and increase liquidity. However, as there is a limit to the potential for cash savings within utilities, these effects are likely to serve as a short-term bolster to equity that may not stand up under the weight of long-term low electricity prices and curtailed running hours.

In response, utilities have significantly reoriented their investment strategies, cutting back on planned EU base-load capacity investments and relocating new investments to developing markets.

How are governments responding?

Governments across the EU are undertaking different measures to respond to capacity adequacy concerns brought on by the current market situation for thermal generation. In this paper we have compared the responses taken by both the UK and Germany.

United Kingdom

The UK is projected to face decreasing capacity margins over the coming decade. Currently there are a number of policy tools that have been designed to address these capacity issues: a technology-neutral capacity market, beginning in 2014 for delivery of capacity during 2018-19, and a proposed supplemental balancing reserve would compensate operators for keeping plants available that would otherwise be mothballed or closed in advance of 2018. Utilities have been largely supportive of the implementation of a capacity market, but note that current implementation timelines are not likely to address short-term capacity constraints. Utilities are sceptical about the potential benefits of the supplemental balancing reserve as a short-term mechanism, noting risk of further damage to price signals as incentives for capacity investment.

Germany

While as a whole Germany is not projected to face short-term capacity margin constraints, certain areas in southern Germany already face capacity adequacy issues. Recent discussions have brought forward proposals for a capacity market to be developed in the medium term. The implementation of a 12-month moratorium on the closure of plants deemed "system relevant" has lead to certain stranded CCGTs being compensated for fixed costs while still being allowed to compete in the wholesale market, resulting in competitiveness concerns. On the whole, German utilities largely agree with the need for policy options to improve the market for gas-fired generation and address impacts of renewable energy support policies. However, firms hold divergent attitudes towards the pros and cons of different policy designs.

Key Lessons and Potential Implications

Recent developments regarding stranded CCGTs are influencing political debates about the development of CRM policy in different EU countries, and provide some useful lessons for national and EU-level policymaking.

National-level implications: policy design and interactions

Appropriate consideration of stranded assets within capacity mechanism design is a priority for national governments. Recent developments suggest that firms lobbying for support for stranded assets are likely to weigh the benefits of compensation with market-wide competition priorities. The introduction of discretionary policy mechanisms may increase the ability of firms to manipulate decisions around stranded assets for private benefit, increasing the social cost of supply security. Governments needing to manage short-term supply security issues should take precautions to ensure that plants targeted for short-term service through discretionary mechanisms do not receive undue subsidies.

Important questions remain regarding the potential for CRM policies to deliver on flexibility and decarbonisation goals, and how such groups of policies might interact within energy markets. Capacity mechanisms that only reward long-term adequacy may not incentivise the flexibility characteristics of generation (storage, etc.) which will be valued in the future, both in terms of ramp-up speed and maintenance costs. Beyond flexibility issues, unintentional interactions between CRMs, stranded assets and decarbonisation objectives – including policies to incentivise low-carbon investment – could have conflicting effects on policy effectiveness.

EU-level implications: market integration and governance

Recent developments regarding stranded CCGT assets and CRM policies may prove to have wide-ranging effects on market integration, competition, trade and investment in EU energy markets, resulting in both short-term effects on prices and long-term effects on investment. These interactions may provide opportunities for utilities to recoup stranding losses, but may also lead to more plants being rendered stranded. CRM implementation could lead to further stranded assets if interconnection levels facilitate increased access of lower marginal cost energy (or more competitive capacity) in foreign markets. Over the long term, utilities may reorganise investment plans to move to where different capacity policies provide the most attractive revenue streams. The design features of different CRMs may result in significantly divergent effects for investment environments, affecting national system security as well as the profitability of domestic assets pushed up merit order curves by new investments in foreign countries.

The management interactions between stranded assets and CRMs are a priority for the European Commission. Draft Energy and Environment State Aid guidelines were released in November 2013. These guidelines appear to support strategic reserves and tendering processes over the implementation of capacity markets on the grounds of transaction costs, market distortions and the introduction of long-term state aid payments. These choices may have implications for states currently implementing capacity markets and for firms holding stranding assets. Beyond capacity, current debates about the 2030 energy package – including the integration of renewable energy sources (RES) support mechanisms and policies to optimise RES investment across states – may be significantly affected by further asset stranding. Company lobbying for state support and the revision of renewables subsidies may delay change, which could increase both system costs and retail energy prices.

Further Issues and Remaining Questions

As CRM policies may involve high transaction costs and could be hard to reverse if they deliver unexpected results, potential alternative solutions should be carefully examined before rushed implementation. Increasing spending on transmission improvements, demand-side management technologies and energy efficiency technologies could address capacity margin issues by simply reducing energy demand. More research is required to fully understand and evaluate the costs and benefits of different hard and soft options across EU member states.

There are many remaining questions and knowledge gaps pertaining to asset stranding and energy market reform in the EU that deserve serious consideration. Current issues facing gas-fired power generation in the EU are calling attention to complex interactions between climate and energy policy in different countries, and the difficulties of coordinating these related yet divergent policy imperatives. Issues resulting from CCGT stranding illustrate that the national governments may not fully be prepared to deal with the market impacts of a strong decarbonisation agenda. Developing a clear plan for smoothing this transition is a critical policy priority. Ensuring that gas generation plays an appropriate role within the transition to decarbonisation (while avoiding lock-in effects) stands as a pressing challenge for EU energy policy.

Recommendations

The recent need to mothball and decommission CCGTs in Europe has had significant and rapid consequences for company value, utility strategy and public policy. This acute example of asset stranding is rightly influencing the development of energy market reforms across the EU. As part of the process policymakers should consider the appropriate treatment of stranded assets. Careful thinking is required on how the economic costs of stranded assets should be valued in the design and implementation of different capacity policies. Failing to do this will result in overly expensive CRMs, which could increase retail prices.

Different stakeholders in the electricity sector – including governments, firms and investors – should consider how stranded assets will interact with investment behaviour, capacity margins and energy market regulations.

Firms: Major EU utilities should seek to increase transparency by stress testing existing assets and planned investments. This could provide a clearer view of their attitudes towards the potential for asset stranding across their generation portfolios. Firms should also aim to increase transparency regarding the potential contingency plans available to recoup sunk costs in different assets. At a higher level, firms should continue efforts to diversify the range of cash-generating activities that an individual asset may be able to provide, potentially through entry into ancillary services.

Investors: Investors should apply pressure to utilities to fully disclose material pertaining to marginally profitable generation assets, regardless of technology, in order to assess risks posed across generation portfolios. What is clear from recent developments is that the dynamics of asset stranding in the EU power sector are changing, and stranded assets may appear in unpredictable sections of a generation fleet.

National governments: If deemed entirely necessary, governments seeking to address capacity adequacy concerns should implement competitive, market-based policies that are comprehensive and well-integrated with existing market design. Governments should consider potential interactions with other climate and energy policy priorities, including system flexibility. In addition, governments should examine the potential for alternative actions with lower transaction costs that could increase investor confidence in base-load investments.

EU-level governance: At the EU level, more work should be undertaken to evaluate the implications of different energy market integration actions for stranded gas assets. Examining further questions regarding potential competitiveness impacts of different capacity mechanisms and their relationships to stranded assets stands as an important research priority.

1.0 Introduction

1.1 Overview

Reducing emissions from electricity generation is crucial to addressing risks of anthropogenic climate change. Over the last decade many EU countries have allocated significant effort to deploying renewable energy sources (RES) capacity, which requires base-load support during periods of intermittency[1]. In the absence of significant contributions from nuclear energy or carbon-capture and storage technology, combined-cycle gas turbine (CCGT) power plants are the cleanest and most flexible thermal base-load technology. In this context, natural gas is meant to be the fossil fuel that will support significant EU electricity emissions mitigation into the future,[2] given that the combined effect of renewable energy implementation, emissions control policies like the Large Combustion Plants Directive (LCPD), and increasing carbon prices will make more polluting power plants uneconomic.

However, things are not turning out as intended. The combined effects of market and policy factors have increased the competitiveness of coal-fired generation relative to gas, leading to increasing electricity emissions and decreasing profitability of CCGT investments.[3] This situation has led to many new, high-efficiency CCGTs being mothballed shortly after they have entered operation or even upon commissioning. Recent estimates suggest that 51GW of the EU's generation capacity is currently mothballed,[4] and that 110GW of installed CCGT capacity – 60% of the total gas-fired capacity in the EU – is not recovering fixed costs and may face closure within the next three years.[5] The prospect of a EU gas plant bust has been met with consternation from major EU utilities with a significant proportion of gas in their generation portfolios.

Mothballed CCGT assets may represent considerable losses on investments to utilities if plants are not able to recover capital costs. Beyond balance sheet impacts, these stranded assets may affect the ability and willingness of firms to invest in new plants. In the context of shrinking capacity margins in some EU countries, ageing electricity infrastructure and the need for low-carbon assets to meet climate change objectives, stranded CCGT assets will have significant implications for policies to incentivise investment, capacity remuneration policy, and EU clean energy and market integration goals.

While there exists some recent literature regarding the potential for stranded electricity generation assets resulting from physical and regulatory implications of climate change,[6] there has not yet been a significant amount of analysis of the impacts of stranded CCGT assets upon utilities and the potential implications for policy. This working paper attempts to address the gap by examining the impacts of stranded CCGT assets on firms, as well as preferences for different capacity policies, in order to examine the changing role of stranded assets in the decarbonisation of EU energy markets.

[1] Méray, 2011; Vos, 2012.
[2] IEA, 2012b.
[3] Hromadko, 2013a; Patel, 2013a; Platts, 2013.
[4] CEZ, 2013.
[5] IHS CERA, 2013
[6] IEA, 2013a.

1.2 Objectives

This report examines ten major EU utilities[7] that have had mothballed CCGT assets during 2012-13, assessing: a) impacts upon firm value, equity, debt and investment strategy; b) responses to manage these assets; c) government actions in these countries towards capacity mechanisms; and d) the preferences of firms for different policies. This report aims to answer four key questions regarding stranded electricity assets and their implications (Table 1).

Table 1: Key questions

Q1		**Why should we care about stranded generation assets?**
	a)	What is a stranded generation asset?
	b)	Why might stranded assets have system-level implications?
	c)	How might governments respond to incentivise capacity investment?
	d)	How might stranded assets interact with new policies?
Q2		**What are the impacts of EU gas-power crisis?**
	a)	What are the key drivers?
	b)	What have the impacts been?
	c)	How have firms responded?
Q3		**How are national governments responding?**
	a)	What is the state of play in the UK?
	b)	What is the state of play in Germany?
Q4		**What are the key lessons and potential implications?**

This report aims to provide a clear picture of how major EU utilities are reacting to impacts of market contractions, fuel prices, and climate and energy policies upon the profitability and value of CCGT assets; how these stranded assets are affecting firm value and strategy; and what implications may exist for energy market design, low-carbon energy and climate policy.

1.3 Methods

This report employs case studies of stranded CCGT assets to examine implications of asset stranding for capacity remuneration mechanisms, focusing on recent developments in the UK and Germany. A detailed literature review and news media search was undertaken to identify potential cases of mothballing decisions that could serve as case studies. A heuristic test was employed to assess whether mothballed plants could be considered stranded assets. Market research was undertaken to quantify the scale and scope of competitiveness impacts on gas-fired power assets, as well as the impacts of CCGT mothballing decisions on firm behaviour. Analysis of financial statements and third-party information was undertaken to quantify the scale of financial impacts of stranded CCGT assets to utilities in terms of asset impairment charges, firm valuation, credit ratings and debt quality.

Policy documents, proposals, consultation responses and third-party analysis of capacity remuneration policy developments in the UK and Germany were assessed through an extensive literature review. Following this, position papers and news media sources were reviewed to assess the attitudes of different utilities towards capacity mechanism policy options, and the role of mothballed CCGTs in debates. A number of semi-structured interviews and collaborative discussions were undertaken with representatives of utilities, prominent analytics

[7] E.ON, RWE, Statkraft, Vattenfall, EnBW, GDF Suez, Centrica, SSE, Verbund, and CEZ.

firms and international organisations, the results of which are alluded to here under Chatham House rule. We draw upon the insights of these data sources to substantiate publicly available information regarding utility behaviour and policy preferences.

1.4 Scope and limitations

Many of the mothballing cases examined here are developing at the time of writing and remain dynamic management challenges for utilities. Similarly, policies for capacity mechanisms in the UK and Germany have developed rapidly over the course of the last six months and are likely to remain under discussion in coming months. As such, this study represents an initial assessment and synthesis of information available at the time of writing (December 2013). While this study examines emerging policy developments in the UK and Germany, it is important to note that these countries are not the only EU member states that are undertaking the process of devising and implementing capacity mechanisms (see Section 2.3.2). Similarly, there are many EU member states that have had functional capacity mechanisms in place for a number of years.[8] This study focuses on the UK and Germany as these countries encapsulate a significant concentration of the mothballed CCGT assets examined as case studies. A broader analysis, including France, the Netherlands and central European countries, stands as an important area for further research.

1.5 Structure

Following this introductory section, Section 2.0 addresses key concepts comprising the foundation of this research, including stranded costs, investment risk and capacity mechanism policy, in order to assess why stranded electricity assets may have significant implications in a climate change context. Section 3.0 outlines the key internal and external drivers influencing stranded assets, their impacts upon utilities in terms of asset valuation, and the actions firms have undertaken to respond. Section 4.0 examines new policies for capacity mechanism implementation in the UK and Germany and the preferences of utilities for various policy options, examining the role that stranded CCGTs have played in this debate. Section 5.0 assesses implications of the current market for gas-fired power for national policy-making and EU-level market integration, trade, and governance. Finally, section 6.0 outlines key recommendations and conclusions.

[8] Batlle and Pérez-Arriaga, 2008; Joskow, 2008; Batlle and Rodilla, 2010.

2.0 Why care about stranded generation assets?

As energy decarbonisation in the EU is to be significantly predicated upon further renewable energy implementation, unexpected and unintended interactions between policies and market dynamics may lead to further issues for the base-load component of energy supply. This section provides a brief overview of how and why stranded electricity assets may matter in a decarbonisation context.

2.1 What is a stranded generation asset?

Generation assets become uneconomic to operate when their marginal cost of generation exceeds the price for electricity over an extended period of time, meaning that they cannot generate profits through the sale of electricity.[9] The profitability of a generation asset at a given time can be interpreted by examining the spark spread[10] for a given generation technology. For base-load plants built with the expectation of high running hours, extended periods of low or even negative spark spreads may mean that the plant is a continuously loss-creating investment, and that operations and maintenance costs do not warrant keeping the plant in operation. In such situations, plants may be either temporarily idled or shut down (mothballed), or permanently retired ahead of their planned decommissioning date. If a plant is either mothballed or decommissioned before its capital costs have significantly depreciated, its owners may be left with sunk costs that are rendered unrecoverable (and reductions in expected future cash flows). We view such plants as stranded assets, acknowledging that cases may differ according to permanence, reversibility, and typology (see section 3.4). Mothballing, as opposed to full decommissioning, may allow firms to retain option value on uneconomic generation assets. With flexible generation assets such as CCGTs, owners may have a range of options they are able to pursue in order to recoup sunk costs (Table 2).[11]

[9] It should be noted that peaking plants (such as pumped storage hydro power) have been built with the intention of very short running hours and extended periods of non-use (See Frayer and Uludere, 2001).
[10] Day-ahead spark spreads illustrate the daily margin between spot costs of input fuels and emissions and the price of electricity output fetched within the spot market. The “clean spark spread” indicates the margin of profitability a CCGT power plant will receive by selling power in the spot market, and is calculated by finding the marginal the cost CCGT generation (not including O&M) and subtracting it from the spot electricity price.
[11] De Joode and Boots, 2005.

Table 2. Management options for under-performing generation assets

Option	Action
Mothball	Postpone operations until changes in input or output prices improve profitability
Convert	Modify the asset to provide new services
Improve	Invest in technology to improve competitiveness
Switch	Switch inputs (fuel) or outputs (power) via contract renegotiations
Divest	Partial (valuable equipment) or complete unit sale

Perspectives on stranded electricity assets – in terms of their importance for firms, regulators and market function – have changed over time. The introduction of competition into previously regulated US and EU public electricity utilities in the 1990s presented significant challenges to regulatory economic theory,[12] and the issue of sunk costs rendered unrecoverable through competition has been a point of contention in academic debates.[13] Whether or not sunk costs should be considered legitimately "stranded" proved especially important in evaluating whether or not it was economically or socially desirable to compensate firms for unrecoverable investments. Debate regarding the optimal design of cost recovery and compensation policies has produced divergent outcomes on the appropriate role of government in compensating firms for stranded costs, with compensation methodologies, legal precedent, contracting considerations and market distortions arising as key issues[14]. Ex-post analysis of stranded cost compensation in utility sectors suggests that most compensation decisions have been politically rather than economically motivated.[15] Similarly, longer-term assessments have concluded that policies allowing for full recovery of a firm's stranded costs are not likely to be socially optimal.[16] Developments following the introduction of competition policy – including renewable energy deployment and climate policy– have taken the issue of stranded assets beyond direct regulatory action. As climate change and other environment-related factors affect the economics of generation assets through market, policy, and physical risk factors – which interact in complex ways – utilities may target specific aspects of energy and climate regulation as a basis to lobby for compensatory policies. As recent developments illustrate, this process is proving to be important in terms of both system security and the environmental objectives of energy policy.

2.2 Why might stranded generation assets have system-level implications?

Considering the transition towards clean energy in EU countries is largely being implemented through emissions reductions targets and polices to promote renewable energy, government actions may result in major impacts on the competitiveness of different generation technologies. As utilities operating under liberalised and integrated markets are more exposed to competitiveness impacts from environmental compliance costs (due to their need to pass compliance costs on to ratepayers rather than distribute them among taxpayers),[17] firms have devoted considerable effort to lobbying against policies perceived to have negative impacts on the profitability of different assets.[18] In response to the impacts of climate and renewable energy policies on the profit margins of thermal generation units, incumbent EU utilities have undertaken strategic actions to influence policy to reduce losses and improve competitiveness.[19] In the context of energy decarbonisation, the strategic actions utilities use

[12] Cearley and McKinzie, 1994; Michaels, 1994; Baumol and Sidak, 1995; Kolbe and Tye, 1996.
[13] Brennan and Boyd, 1997; Maloney et al., 1997; Boyd, 1998; Crew and Kleindorfer, 1999; Beard et al., 2003.
[14] Brennan and Boyd, 1996; Boyd, 1998, Garcia-Martin, 2000; Woo et al., 2003.
[15] Beard et al., 2003
[16] Woo et al., 2003.
[17] Guivarch and Hood, 2011.
[18] Hahn and Hester, 1989, Stenzel and Frenzel, 2008.
[19] Stenzel and Frenzel, 2008; Pahle, Fan and Schill 2010.

to recoup costs from stranded assets may prove significant in the design of policies for decarbonisation and system security.

As renewable energy systems require a base-load component to manage intermittency, it is clear that a certain volume of thermal capacity in EU markets will be required to stay within the market under expectations of increasingly marginal running hours.[20] But if incumbent firms cannot recoup the necessary return on current thermal investments, and new entrants cannot establish market capitalisation at the level necessary to finance new base-load assets, system security could be compromised. This issue stems from both *risk asymmetry between producers and consumers* and the issue of *missing money* that can arise in wholesale markets (Box 1). Many EU countries are experiencing what can be understood as *missing money* issues stemming from renewable energy and electricity price caps, reflected by utility unwillingness to make base-load capacity investment. As shown in Figure 1, an increasing number of planned base-load thermal generation plants have been cancelled or postponed in the EU over the last decade. This situation is inspiring a debate regarding the suitability of wholesale markets as a platform for supporting decarbonised electricity systems.[21]

Box 1: Risk Asymmetry and Missing Money in electricity investment

Risk asymmetry between producers and consumers in electricity investments can be captured by the notion of a socially optimal level of capacity investment. As the negative impacts of underinvestment to the public can be extremely costly (in terms of blackouts), governments and regulators place a significant risk premium of ensuring supply security through adequate capacity margins[22]. Attempts to quantify these negative impacts have tried to estimate the value of lost load (VOLL) price, which has been estimated at many orders of magnitude above retail electricity prices to consumers[23]. In this context, electricity can be characterized by a strongly asymmetric loss-of-welfare curve for consumers[24] - the social costs of overinvestment are likely to make marginal increases in final electricity bills, which are far below the value of lost load. For firms, the risk structure of capacity investment is opposite to that of consumers: firms have an incentive to under-invest in capacity as it may have a positive effect on wholesale and retail prices, and overinvestment in capacity may lead to stranded assets[25]. In other words, at the margin, the societal value of incremental capacity is greater than the private market value to the producing firm. This asymmetry brings into question whether a liberalised energy market model alone will bring about the necessary conditions to facilitate a socially optimal amount of capacity investment.

In energy-only markets, price signals in the power market play the decisive role in incentivizing generation investment: negative price signals may indicate that flexibility improvements are required, while price spikes should incentivise new investment[26]. However, competitive wholesale markets may not be able to deliver prices high enough to cover marginal and fixed costs of electricity generation, including a risk-adjusted cost of capital[27]. Low wholesale prices, reflected in forward prices depressed by inter-temporal arbitrage, may therefore fail to attract new investment necessary to facilitate adequate capacity[28]. This "missing money" problem may be compounded by the price-inelastic demand profile of electricity and low demand flexibility of end users, which results in many consumers being unable to respond to volatile real-time prices[29]. In this context, market failures may arise if the optimal investment for any firm in additional capacity does not align with the socially optimal level of capacity investment.

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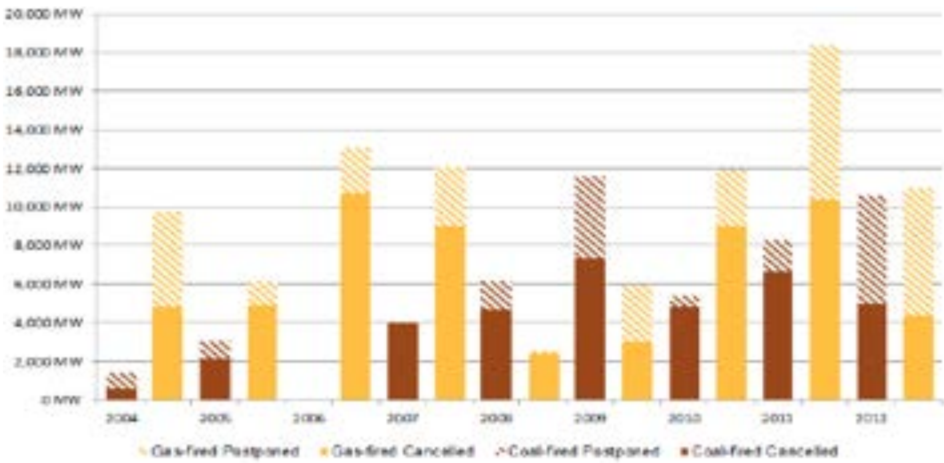
[20] Vos, 2012.
[21] Finon, 2013.
[22] Nicolosi, 2010; Cramton et al., 2013.
[23] Estimates of VOLL range upwards of $10,000/MWh (Nicolosi, 2012).
[24] De Vries and Hakvoort, 2004.
[25] Milstein and Tishler, 2012.
[26] See Nicolosi, 2010, Stoft, 2002.
[27] See Cramton and Stoft, 2006.
[28] Joskow, 2006, 2008.
[29] Cramton and Stoft, 2006; Cramton et al., 2013.

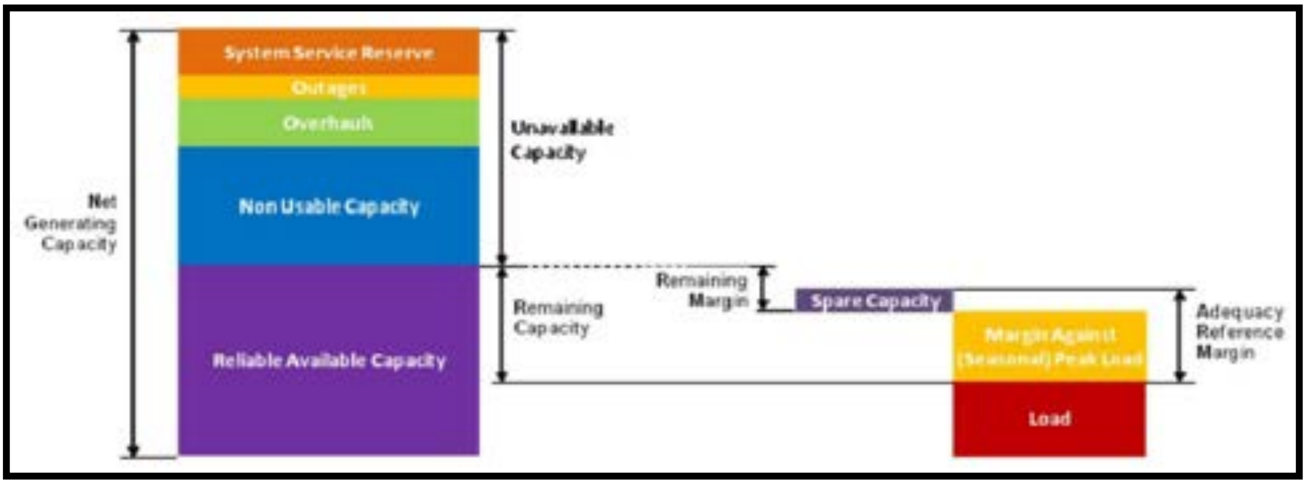
Figure 1. Cancelled and postponed EU coal and gas-fired generation projects[30]



2.3 What are capacity remuneration mechanisms?

In response to system adequacy concerns, governments have developed a number of solutions to ensure generation system adequacy.[31] System adequacy refers to the ability of an electricity system to meet demand in the context of fluctuating supply and demand, the temporal aspects of electricity generation and transmission, and the long timeframes associated with the development of new generation capacity[32] (Figure 2). Some governments have undertaken actions to remunerate firms for the provision of generation capacity alongside energy sold in a wholesale market. We refer to these types of policies as capacity remuneration mechanisms (CRMs).

Figure 2: Visualisation of generation system adequacy[33]

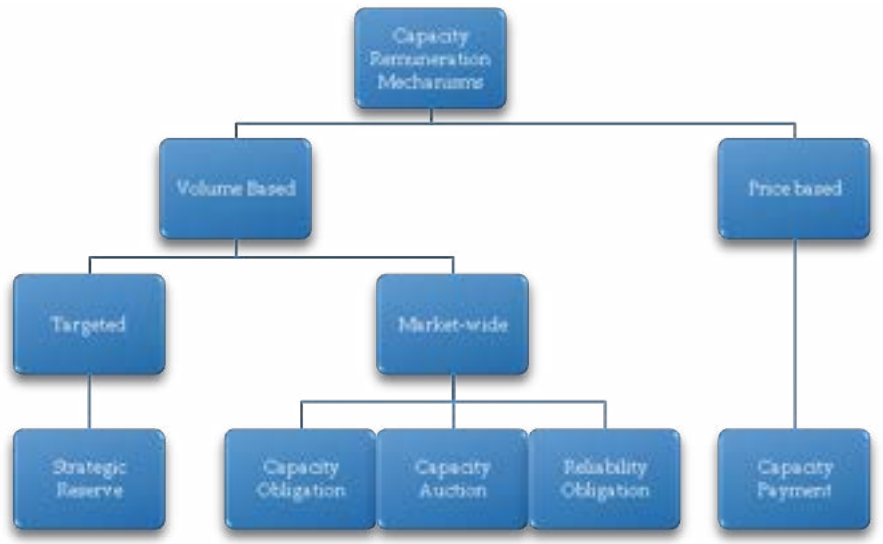


[30] European Commission, 2013a.
[31] Oren, 2005; de Vries and Heijen, 2008; Joskow, 2008; Batlle and Perez-Arriaga, 2008.
[32] Oren, 2000.
[33] ACER, 2013.

2.3.1 CRM Designs

In very simple terms, CRMs aim to solve the missing money problem by correcting for market failures that may arise in providing the socially optimal amount of system adequacy.[34] The effectiveness of a CRM is dependent upon political context, market organisation, rate recovery structures and international integration, and different designs have been shown to have significantly different effects on investment.[35] CRMs may involve an array of different policy structures, including *capacity markets, strategic reserves, capacity obligations, capacity payments, reliability contracts* and *capacity subscriptions*.[36] Policies can be differentiated upon two levels: the degree to which capacity is made explicit and the reliance upon financial incentives to influence investment, as visualised in Figure 3.

Figure 3. Taxonomy of capacity remuneration mechanisms[37]



While a comprehensive discussion of the merits and risks of different CRMs is beyond the scope of this paper,[38] a brief outline of capacity auctions and strategic reserves is useful to understand current developments in the UK and Germany.

- **Capacity auction** schemes are market-wide mechanisms where firms bid to supply a predetermined volume of generation capacity at a future date, allowing for competitive price discovery between firms. Assessments of the volume of capacity required are decided by an independent regulator that is charged with deciding accurate system adequacy margins. The costs of capacity are charged to electricity suppliers, who pass these costs to consumers.

- Under a **strategic reserve** scheme, generation capacity is “set aside” to ensure supply security in the event of exceptional circumstances, which may be dispatched upon reaching price signal thresholds in day-ahead, intra-day or balancing markets. Similar to a capacity market system, the amount of reserve capacity required is determined by an independent regulatory body or transmission service operators

[34] Cramton and Stoft, 2006.
[35] DeVries and Hakvoort, 2004; De Vries, 2007; Batlle and Perez-Arriaga, 2008; Meulman and Méray, 2012.
[36] ACER, 2013.
[37] Adapted from ACER, 2013.
[38] For a detailed overview, please refer to Meulman and Méray, 2012; and ACER, 2013.

(TSOs). In this regard, strategic reserves are a targeted, volume-based capacity mechanism that does not rely upon competitive price discovery.

Beyond these general design features, capacity auctions and strategic reserves may have design features that differentiate them within a wide range of different criteria (Table 4).

Table 4. Design criteria for capacity mechanisms[39]

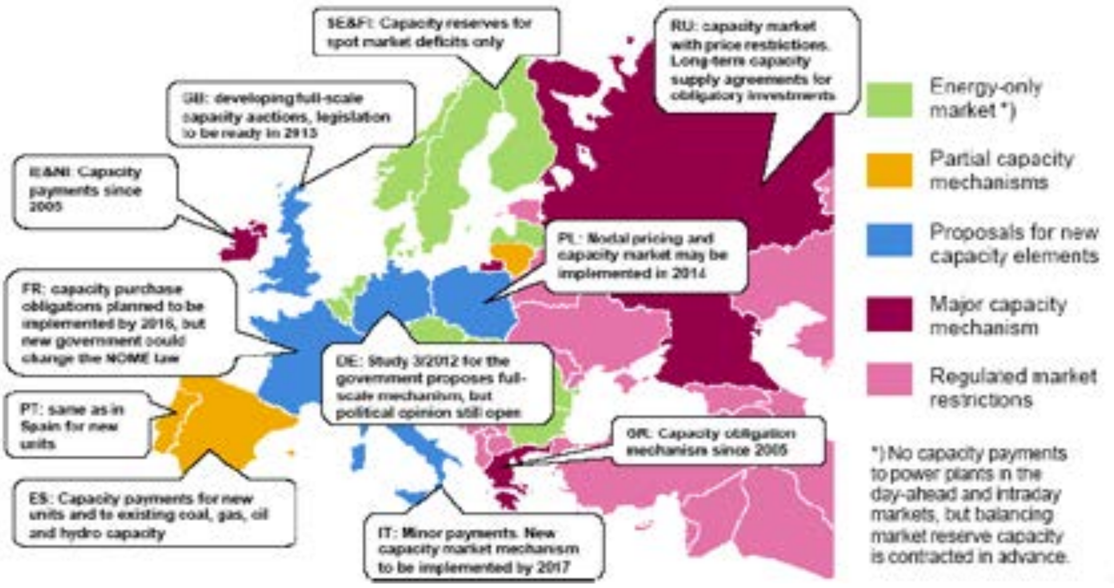
	Delineation of capacity, balancing, and reserve services
Eligibility	Criteria upon which capacity may be contracted
Timing	Lead times between contracting and provision of capacity
Adequacy	Determination of levels of capacity required
Costs	Allocation of costs between service providers and consumers
Regulation	Rules for participation within wholesale energy markets

2.3.2 CRM Policy in the EU

Over the last several decades, a range of different CRMs have been developed in liberalised markets around the world, including regional markets in the US,[40] South America,[41] and a number of EU countries, most notably Spain.[42] Experiences with the implementation of different mechanisms have been mixed, with some designs (principally direct capacity payments) leading to perverse incentives for investment in overcapacity.[43] Views on CRM implementation in the context of increasing RES are mixed. A number of analysts have suggested market-wide capacity auctions as the most appropriate method to ensure capacity adequacy and targeted support for decarbonisation.[44] Others have found that the increasing government intervention through CRMs can have significant adverse effects for long-term system adequacy.[45] Nevertheless, the number of EU countries that have implemented or are proposing CRMs (Figure 4) illustrates the appeal of these policies in the context of system security and decarbonisation objectives.

[39] ACER, 2013.
[40] Joskow, 2008.
[41] Larsen et al., 2004.
[42] Battle et al, 2007.
[43] Oren, 2005; Battle and Rodilla, 2010.
[44] Boot and van Bree, 2010; Gottstein & Schwartz, 2010; Helm, 2010.
[45] Briggs and Kliet, 2013.

Figure 4. Existing and planned capacity mechanisms in Europe[46]



2.3.3 Interactions between stranded assets and capacity policies

In liberalised energy markets, financial losses from stranded assets may further disincentivise base-load capacity investment. Government actions to ameliorate this issue through the implementation of capacity mechanisms may provide economic support for stranded assets in order to achieve supply security objectives. In this regard, the introduction of CRMs into markets where utilities are experiencing significant financial pressure from stranded assets may create opportunities for strategic actions by firms. CRMs may affect operations strategy by allowing for stranded assets to generate profits through alternative revenue streams, and may affect investment strategy by alleviating capital constraints imposed by stranded assets. Although CRMs are not designed to provide compensation for stranded assets, capacity policies and short-term actions to ensure capacity adequacy may result in this outcome. While CRMs can indeed be competitive instruments if designed properly, there is a risk that policies which provide new rents for stranded assets may simply increase consumer costs without facilitating improved supply security.[47] Concerns about system adequacy can lead to the implementation of policy options that may achieve short-term goals by allowing mothballed assets to re-enter the market, but may not achieve the policy security necessary to incentivise investment. These issues and related questions are examined in section 4.

[46] CREG, 2012.
[47] Carr and Morison, 2012.

3.0 Examining asset stranding in EU gas-fired power

In this report we examine ten EU utilities[48] that implemented decisions and announced plans to mothball or close CCGT assets in response to persistently low or negative clean spark spreads (Table 5). Collectively, current and potential mothballing actions announced in 2012-2013 amount to 20.08GW of gas-fired capacity, of which 8.87GW were either built or acquired within the last ten years. Although not comprehensive on a pan-EU scale, this selection of firms aims to provide a snapshot of the situation facing multinational utilities based in northwestern Europe with significant generation operations across the EU (including the UK, France, Germany, Italy, Netherlands, Austria and the Czech Republic). More information on the different responses undertaken by utilities – in terms of partial, seasonal, shallow, and deep mothballing, as well as conversion and decommissioning – can be found in section 3.3.1.

Table 5. Current and planned gas-power mothballing and closures announced by major EU utilities, March 1st 2012 – December 31st 2013

Utility	Ownership (sub/partner)	Plant	Country	Capacity (Mw)	Commissioning (ownership)	Response
E.ON	100%	Irsching 4	DE	545	2011	Deal struck to avert closure
E.ON	100%	Irsching 5	DE	425	2010	Deal struck to avert closure
E.ON	100%	Malzenice	SK	417	2011	Mothballed
E.ON	100% (E.ON IT)	Tazavanno 8	IT	300	2005	Mothballed
E.ON	100% (E.ON IT)	Ostiglia 4	IT	280	1974, CCGT 2008	Closed
E.ON	66% (Stadwerke Biefeld)	Veltheim 4	DE	390	1975	Decommissioned
E.ON	100%	Staudinger 4	DE	622	1977	Converted to standby plant
RWE	100% (Essent)	Moerdijk 2	NL	430	2012	Mothballed
RWE	100%	Weisweiler G	DE	272	2007	Mothballed
RWE	100%	Weisweiler H	DE	272	2007	Mothballed
RWE	100%	Emsland B	DE	360	1974	To be summer mothballed
RWE	100%	Emsland C	DE	360	1975	To be summer mothballed
RWE	100%	Gersteinwerk F	DE	355	1973	Mothballed
RWE	100%	Gersteinwerk G	DE	355	1973	To be mothballed
Statkraft	100%	Knapsack 2	DE	430	2013	Shallow mothballed
Statkraft	100%	Knapsack 1	DE	800	2007	Shallow mothballed
Statkraft	50% (Mark E)	Herdecke	DE	417	2007	Shallow mothballed
Statkraft	100%	Emden	DE	450	1972 (2009)	Deep mothballed
Statkraft	100%	Robert Franck	DE	510	1962	Deep mothballed

48 E.ON, RWE, Statkraft, Vattenfall, EnBW, GDF Suez, Centrica, SSE, Verbund, CEZ

Vattenfall	100% (Nuon)	Magnum	NL	1300	2013 (planned)	Shallow mothballed
EnBW	100%	RDK 4	DE	365	2008	Mothballing TBD
GDF Suez	100%	Cycofos	FR	490	2009	Summer Mothballed
GDF Suez	100%	Combigolfe	FR	435	2010	Summer mothballed
GDF Suez	100%	SPEM	FR	435	2011	Summer mothballed
GDF Suez	100%	Teeside	UK	1,875	1993 (2008)	To be decommissioned
GDF Suez	100%	Shotton	UK	210	2001 (2003)	Closed
GDF Suez	33% (SSE, Acordis)	Derwent	UK	210	1995 (2000)	Closed
GDF Suez	100% (Electrabel)	Bergum BG	NL	504	1975	Closed
GDF Suez	100% (Electrabel)	Harculo	NL	263	1982	Closed
GDF Suez	100% (Electrabel)	Eems	NL	530	1987	Closed
GDF Suez	100% (Electrabel)	Awirs 5	BE	294	1973	Closed
GDF Suez	100% (Electrabel)	Herdersbrug	BE	480	1998	Conversion to peaking unit
SSE	100%	Keadby	UK	760	1996	Deep mothballed
SSE	100%	Peterhead	UK	1,840	1980	Partially mothballed
Centrica	100%	King's Lynn	UK	325	1997 (2001)	Deep mothballed
Centrica	100%	Roosecote	UK	229	1991 (2003)	Decommissioned
Verbund	100% (Poweo)	Pt.-sur-sambre	FR	420	2009 (2011)	Final decision TBD
Verbund	100% (Poweo)	Toul	FR	422	2012	Final decision TBD
Verbund	100%	Mellach	AU	832	2011	Final decision TBD
CEZ	100%	Pocerady	CZ	840	2013 (planned)	To be shallow mothballed
Total	All plants			20079		
Total	10 years old + newer			8877		

3.1 What are the key drivers?

The profitability of European CCGT power stations has been negatively impacted by a number of different drivers including electricity prices, fuel costs and the cost of emissions. These factors all affect clean spark spread prices, which have been decreasing to persistently low and even negative levels since winter 2008-09 (as illustrated for the UK and Germany in Figures 5 and 6).

Figure 5. UK clean and dark spark spreads 2008-13[49]

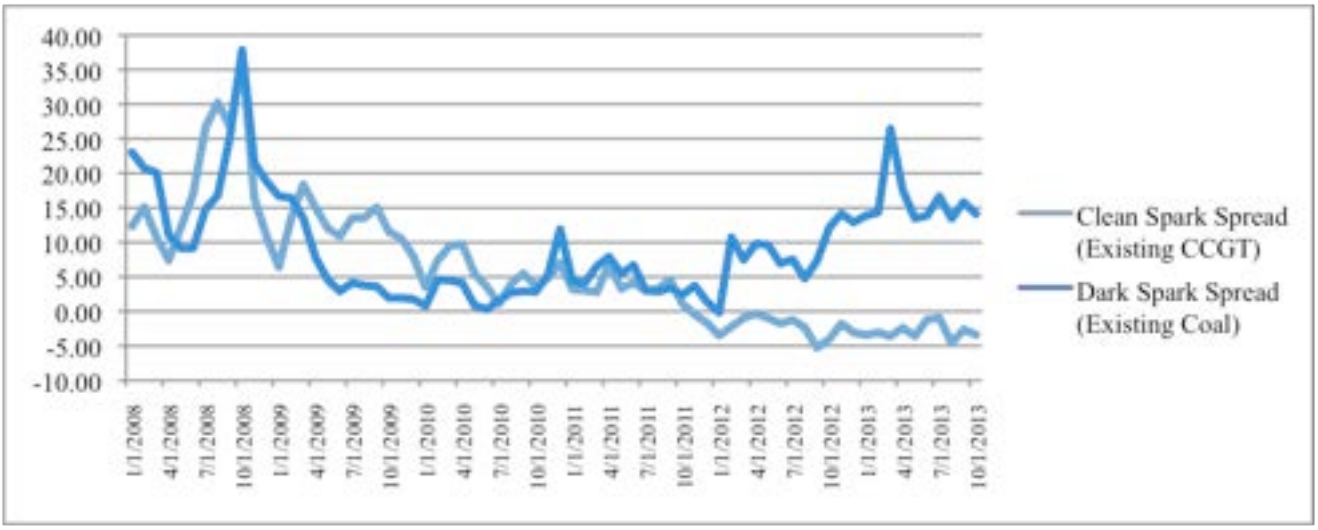
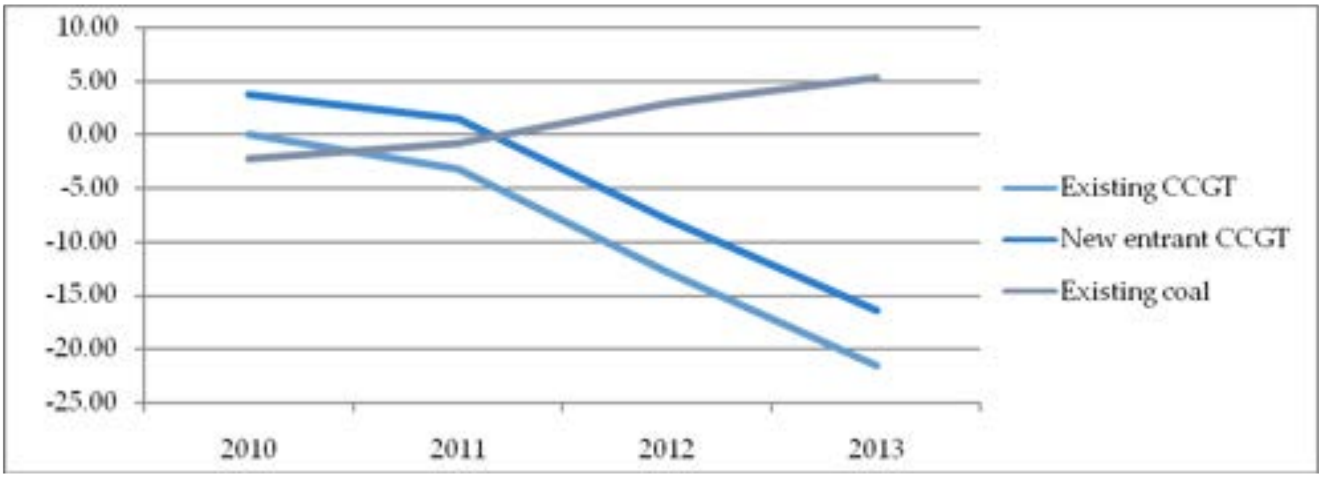


Figure 6. Germany clean and dark spark spreads, 2010-13[50]

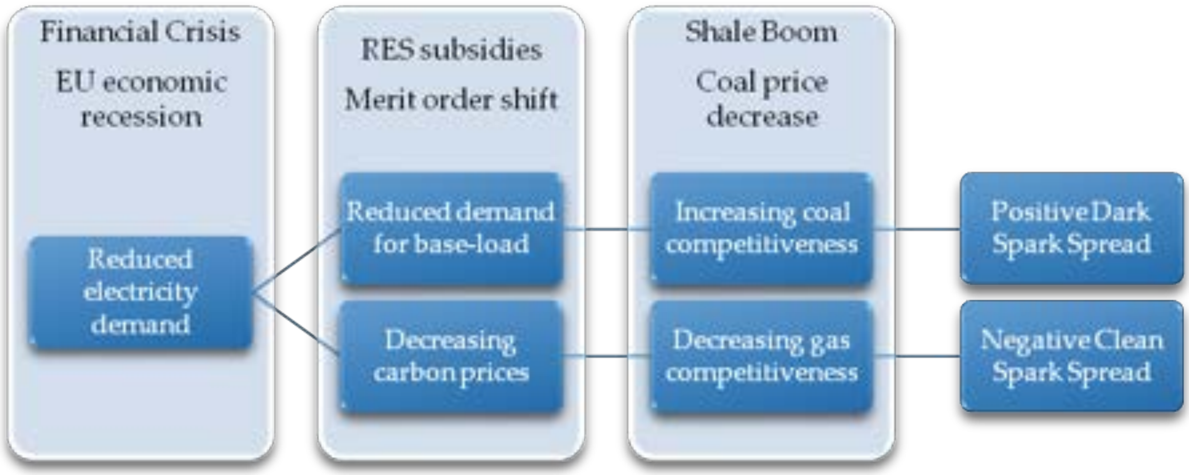


Different drivers affecting electricity, coal, gas and carbon prices have resulted in diverging competitiveness of coal and gas-fired power as base-load generation, as expressed by clean spark spreads for gas and dark spark spreads for coal. In Figure 7, macro-level drivers (grey polygons) correspond to one or more proximate factors (blue polygons).

[49] BNEF, 2013a

[50] BNEF, 2013b

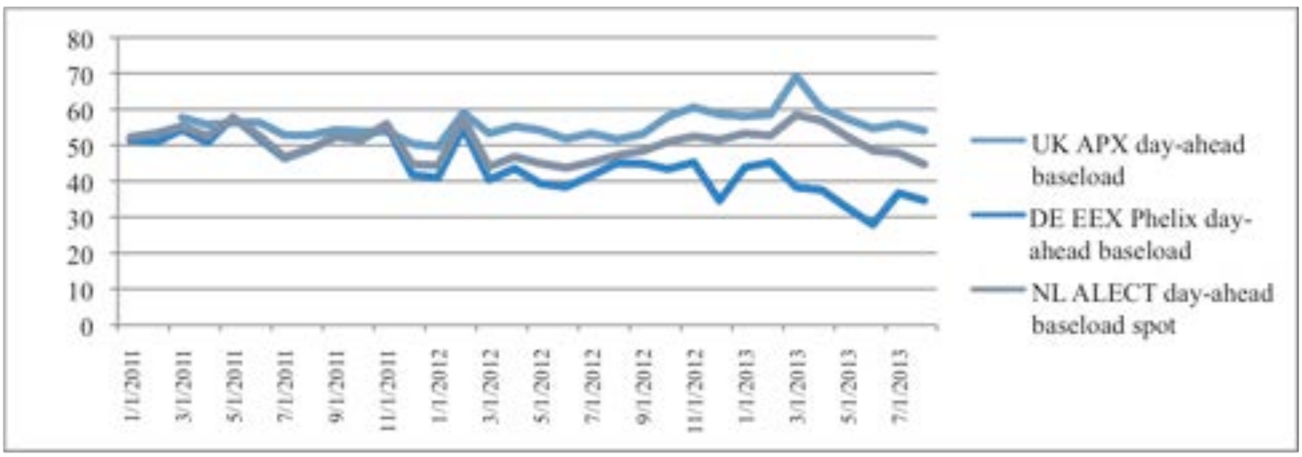
Figure 7: Drivers of factors affecting clean (CSS) and dark (DSS) spark spreads



3.1.1 Electricity demand

Since 2008, the impacts of the global financial crisis have resulted in a significant reduction of EU electricity demand compared with projected levels before the recession. Although the EU has recently come out of recession,[51] the combined effects of slow economic growth with demand-side management and energy efficiency technologies are projected to result in a 2% decline in total EU energy demand between 2010 and 2015.[52] Electricity demand reductions are also mandated through the EU 20:20:20 targets, which specify a 20% reduction in primary energy use compared to projected growth levels.[53] Reduced electricity demand has influenced changes in electricity prices in some EU economies. As shown in Figure 8, day-ahead base-load spot averages within national markets have diverged, with prices within the German EEX decreasing significantly since 2011.

Figure 8: UK, Germany, and Netherlands day-ahead base load electricity prices (€/MWh)[54]



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[51] EUROSTAT, 2013.
[52] IEA, 2012.
[53] European Commission, 2009.
[54] BNEF, 2013c.

Changes in spot and forward electricity prices (as well as increases in price volatility) are related to several factors, including changes in the generation mix brought on by increasing amounts of electricity from intermittent renewable energy sources (see section 3.1.3). However, the macro-level impacts of reduced electricity demand serve as an important primary driver of the gas-power crisis, as rapid changes following the financial crisis served to set the stage for a series of other changes.

3.1.2 Carbon Markets

The financial crisis has also had impacts on other drivers affecting clean and dark spark spreads, including carbon prices. As shown in Figure 9, the price of emissions within the EU ETS (€/tCO2) has decreased significantly since 2008, with prices dropping to record lows in January 2013.[55] Although EU carbon prices have been affected by a number of different factors, including permit allocation and offset restrictions, decreased economic growth has allowed for member states to meet emissions reduction goals without the price of emissions serving as an incentive for decarbonisation. The financial crisis and resultant impacts on electricity prices have also affected CO2 cost pass through in electricity markets. Electricity prices post-2008 during Phase II of the ETS have been driven more by decreasing capacity scarcity rather than CO2 price changes.[56]

Figure 9: EU ETS (EUA) carbon prices (€/tonne), 2008-13[57]

The price of emissions within the ETS has important impacts on the competitiveness of different base-load generation technologies. Even though other EU-level environmental policies (such as the LCPD) have mandated high-polluting coal plants to either improve emissions performance or close, carbon-intensive plants that meet new emissions standards or face a delayed LCPD opt-out have been able to retain competitiveness against CCGTs due to the price crash of the ETS.

3.1.3 Renewable Energy and Merit Order

Merit order is an approach to ranking generation technologies by their short-run marginal production costs, so that lowest-cost sources of energy are brought into the market first. Generally, the merit order of conventional base-load thermal power in northwestern Europe is nuclear, lignite, hard coal, and lastly CCGTs, which makes gas-fired power the most vulnerable technology to merit order impacts from increasing low-marginal cost renewable energy.[58] Merit order impacts of increased renewable energy capacity have had a significant effect on the profitability of base-load power plants, both in terms of marginal electricity pricing and curtailment of

[55] Carrington, 2013.
[56] Jouvet and Solier, 2013.
[57] BNEF, 2013b.
[58] Meulman and Méray, 2012.

expected running hours.[59] The introduction of support programmes and subsidy mechanisms for renewable energy deployment in EU countries has had a significant effect on the merit order of thermal generation technologies within national markets and energy exchanges.[60] These impacts have been compounded by reductions in the cost of renewable technologies, with solar PV installation costs in Germany falling over 60% between 2006 and 2013.[61]

Significant merit order effects have been identified in different studies analysing the impacts of renewable energy on spot and futures prices, and the functioning of energy markets.[62] The recent explosion in installed RES capacity in Germany – 7.6GW of solar and 2.4GW of wind were installed in 2012 alone, bringing total installed capacity to approximately 32GW respectively[63] – has had enormous effects on both spot and forward energy prices. Although only a portion of energy traded in most European markets is through spot pricing (with 25% of German electricity being traded by spot in 2009),[64] spot prices in national energy exchanges may form the basis of other types of electricity contracts, and merit order impacts within exchanges can be understood as representative of national energy prices.[65].Recent studies have suggested that for every GW of RES fed into the German national grid, day-ahead electricity prices may be reduced by 1.10 to 2.40€/MWh.[66] Total merit order effects from wind and solar PV have increased from 5€/MWh in 2010 to more than 11€/MWh in 2012.[67] In the UK, merit order impacts have changed contracting and market access rules for renewable energy sources;[68] however, these effects have been less dramatic than in the German context.

As some EU countries mandate priority access for RES into the grid, merit order impacts and increasing price volatility have negatively affected the profitability of base-load capacity investment. Renewable energy support policies have had indirect but significant impacts on base-load technologies as a whole. While the flexibility and rapid ramp-up ability of CCGTs has allowed them to retain a competitive edge against other base-load technologies, allowing them to mitigate some aspects of negative merit order impacts, recent changes in fuel prices have had unmanageable impacts on spark spreads, forcing closures.

3.1.4 Changing Fuel Prices: coal vs. gas

The final nail in the coffin for EU CCGTs has been a significant drop in coal prices while gas has remained comparatively expensive (Figure 10). Global coal prices have decreased significantly over the last 18 months, driven by increasing supply from exporters such as Australia and Indonesia amid contracting demand in major import markets such as China.[69] Significant decreases in EU coal import prices have been attributed to reduced demand for thermal coal in the US,[70] which has been driven by coal-to-gas fuel electricity switching facilitated by emissions regulations and impacts of the shale boom on domestic gas prices.[71]

[59] Jonsson et al., 2009; Bach, 2009; Nicolsi and Fursch, 2009; Tveten et al., 2013.
[60] He et al., 2013.
[61] Economist, 2013a.
[62] Sensfuss, Ragwitz and Genoese, 2007; Bach, 2009; Nicolsi and Fursch, 2009; Jonsson, Pinson and Madsen, 2010; Tveten et al., 2013
[63] Overton, 2013.
[64] Peitz, 2009.
[65] Most et al, 2009.
[66] Von rook and Huck, 2010; Cludius, Hermann and Matthes, 2013.
[67] Cludius, Hermann and Matthes, 2013.
[68] Green and Vasilakos, 2010; Green et al., 2011; Eager et al., 2012.
[69] Sharples, 2013.
[70] Economist, 2013a; Chazan and Wiseman, 2013.
[71] Lu et al.; 2012; Praston et al., 2013.

Figure 10: UK spot gas prices and ARA coal front month prices (GBP/MWh), 2011-13[72]

Although the long-term prospects for durable coal-gas switching and conversions in the US are debatable, due to close price margins of coal and gas[73] as well as infrastructure constraints such as pipeline capacity and gas storage in major gas-power regions,[74] impacts on EU coal import prices are expected to continue in the near future as record US stockpiles depreciate.[75] Other grades of coal, including lignite mined domestically, are insulated from global price dynamics and continue to benefit from state support in some EU countries. In the context of low EU ETS prices, the competitiveness of lignite-fired power in Germany (often supplied by local coalmines) is largely independent of international coal price dynamics, and many plants are likely to remain profitable in the absence of further environmental regulations.[76]

In contrast to the deterioration of spot and futures prices in global coal markets, EU gas prices have been relatively high over the last few years. In the last 12 months there have been slight changes due to a move away from oil indexing, but prices at major EU hubs have not experienced significant declines. The impacts of other potential developments, such as the exploitation of European shale gas resources, are unclear in the context of electricity generation.[77] As progress towards domestic shale gas extraction in EU member states remains slow due to regulatory uncertainty,[78] prospects for a European shale boom and accompanying gas price reductions remain distant.

Coal/gas price differentials have been, and are likely to remain, too great for CCGTs to regain competitiveness in the EU based upon on fuel and carbon prices alone. Estimates suggest that coal prices would need to increase by 80% in order for gas to be a competitive option for major European utilities,[79] which is clearly driving more major firms to burn coal. Estimates by GDF Suez suggest that the load factor of the entire EU gas-fired fleet dropped from 45-34% from 2011 to 2012, while the load factor of coal stations increased from 53-59%.[80] However, while the shale boom and global coal markets have had an influence on EU coal/gas competitiveness, it is unlikely that further coal price declines resulting from US shale will generate a significant resurgence of EU

[72] BNEF, 2013a.
[73] EIA, 2013a.
[74] Navigant Research, 2013.
[75] EIA, 2013b.
[76] Reuters, 2013a.
[77] European Commission, 2012; De Joode et al., 2013.
[78] Nicola and Andersen, 2013; Aglionby, 2013.
[79] Gloystein, 2013.
[80] GTPJ, 2013a.

coal investment, as has been suggested by some analysts.[81]

3.1.5 Internal attitudes and risk premiums

Decisions to build CCGTs that have now been rendered stranded assets were likely based on a range of different internal biases. Until 2010, many utilities reasoned that building gas was the safest mistake one could make, as demand for flexible assets to support variable renewable energy capacity was expected to increase. Projections of increasing energy demand and assumptions regarding capacity margin tightening from both EU-level and national-level policy actions may have incentivised the construction of a significant amount of CCGT capacity since rendered superfluous. This was especially relevant in the German context, where the nuclear exit looked set to curtail capacity margins. However, while peaking capacity in certain areas of Germany is still required, falling electricity demand and increasing RES capacity have meant that the German market is now characterised by significant oversupply.[82]

First-mover incentives to capture market share in high-efficiency gas-fired power may have inspired the enthusiasm for CCGT investment exhibited by EU utilities from 2000-10. Investments in gas in the early 2000s boosted fossil-fuel capacity across the EU by 16%.[83] These decisions were supported by strong upward trends in electricity, carbon and fuel prices across EU countries, with oil prices reaching record peaks in 2008. Assumptions regarding the stability of global oil, coal and gas prices may also have contributed to a false sense of security about future CCGT competitiveness. Government support for renewable energy deployment may also have contributed to lowering perceived risk premiums for gas-fired power, due to assumptions of higher carbon prices increasing generation costs of coal plants. In the German case, immense growth of RES (including domestic solar) exceeded expected diffusion levels, despite policies being clearly laid out by 2008. Following the nuclear exit, hard coal and lignite-fired plants were able to retain market share against gas as wholesale prices fell, due to both lower marginal generation costs as well as low carbon prices.[84]

[81] Chazan and Wiseman, 2013; Economist, 2013b.
[82] Standard & Poor's, 2012.
[83] Economist, 2013a.
[84] Pahle, Fan and Schill, 2010.

3.2 What have the impacts been?

Many utilities have experienced significant financial impacts from the adverse market situation for gas-fired power in different EU markets. This section outlines how stranded CCGTs are affecting balance sheets and firm value, focusing on asset impairment, equity, credit and debt, and investment strategy.

3.2.1 Asset impairment

Many utilities across Europe have been faced with significant write-downs in recent years; according to Ernst and Young, 16 major EU power and utility companies reported total asset and goodwill impairments of €17.7bn during 2010-11 and €12.8bn in 2012. Many write-downs during 2010-12 were related to generation assets (Table 6).

Table 6: Asset impairment losses of major EU utilities, 2010-12 (€bn)[85]

	2010	2011	2012	Total
Generation assets	€3.3b	€5.4b	€6.0b	€14.6b
Other assets	€2.9b	€2.1b	€2.9b	€7.9b
Total impairment	€6.2b	€7.5b	€8.9b	€22.5b

As the market conditions for gas-fired generation deteriorated further in 2013, major EU utilities reported increasing write-downs on thermal assets, especially CCGTs. Although write-downs may also be related to organisational issues (including the impact of mergers undertaken before the financial crisis), recent developments imply significant problems for utility business models with a heavy reliance on gas-power generation.[86] Of the ten EU utilities examined here, six have had impairment charges pertaining to EU thermal generation assets reported in 2013. Although exact values are unclear, we estimate that nearly €6bn is attributed to write-downs on gas-fired power investments over the course of 2013.[87] These impairments losses are presented in Table 7. Assessments of impairment charges are presented in million Euros (€m). Charges reported in other currencies were converted in accordance with exchange rates at the date of announcement using the OANDA currency converter.[88]

[85] Ernst and Young, 2013a.
[86] Pfeifer, 2013a.
[87] While we focus on announcements in 2013, some losses pertain to Q4 2012. As some firms are more specific than others in identifying impairment losses on individual assets, some of the values presented are estimates based upon values of impairment charges booked upon various generation units (i.e. thermal generation or national business units).
[88] http://www.oanda.com/currency/converter/

Table 7: EU utility impairments charges in 2013 – thermal and gas assets (€m)

Utility	Date	Total Impairment	Thermal impairment	Gas-power impairment	Assets noted
Statkraft	14-Feb-13	375.95	274.12	274.12	German gas-power assets
GDF Suez	28-Feb-13	2,000.00	2,000.00	2,000.00	EU gas-power assets
SSE	22-May-13	692.87	362.00	> 327.80	UK CCGTs, coal assets
Verbund	12-Jun-13	1,130.00	1,030.00	659.00	Austrian and French CCGTs
Vattenfall	23-Jul-13	3,462.18	2,168.20	> 1,690.00	Dutch gas-power and coal assets
GDF Suez	31-Jul-13	200.00	200.00	200.00	Dutch, French and German CCGTs
RWE	14-Aug-13	800.00	800.00	> 800.00	Dutch thermal generation assets
Total		8,661.00	6,834.32	> 5,950.92	

Statkraft: In February 2013 Statkraft reported a €375m impairment charge on its German thermal power assets for Q4 2012, and wrote down a similar amount on financial assets, including shareholdings in E.ON.[89] These impairment charges reflect mothballing and closure decisions for German CCGT assets reported over the course of 2012. While a number Statkraft's mothballed plants (Landsbergen and Emden) were nearing retirement age, mothballing of new high-efficiency plants (such as Knapsack I, II and Herdecke) suggests that failure to recover stranded costs may have been a factor in impairment losses.

GDF Suez: In February 2013 GDF SUEZ reported impairments of €2bn[90] in its 2012 annual results, of which most was attributed to gas-fired assets in the EU.[91] Impairments were booked on assets in the UK and western continental Europe, as reflected by the mothballing and closure of several CCGTs which are part of an 8GW reduction of EU generation capacity between 2009 and 2013.[92] Impairment charges have also been booked in parallel with the conversion of assets, such the Belgian Herdersbrug plant, which will be converted to operate as a peaking unit.[93] In August 2013 GDF booked €204m in H1 2013 impairment charges on Dutch (€134m), French (€28m) and German (€25m) CCGTs, all due to reductions in profit margins on existing assets and the indefinite mothballing of other plants.[94]

SSE: Scottish and Southern Energy booked a £587.4m (€692.87m) impairment loss in May 2013, with £306.9m (€362m) of these charges being related to thermal generation.[95] SSE's gas-fired output has decreased by 60% from the previous year, and a total of 2.2GW of gas-fired capacity will be mothballed over the course of the coming year.[96]

Verbund: In June 2013 Austrian utility Verbund reported that it would record impairment charges of €1.13bn on generation units.[97] Verbund reported write-downs on CCGTs in Austria and France of €659m. Earlier write-

[89] Statkraft, 2013a.
[90] GDF Suez, 2013a.
[91] De Clercq, 2013.
[92] Patel and Kennedy, 2013.
[93] Patel and Kennedy, 2013.
[94] GDF Suez, 2013b.
[95] SSE, 2013a.
[96] SSE, 2013b.
[97] Verbund, 2013a.

downs included a €52m impairment loss on the Austrian Mellach CCGT in July 2012 related to a gas supply contract indexed to oil.[98]

Vattenfall: In July 2013 Vattenfall posted a 29.7bn SEK (€3.46bn) write-down on its assets, with approximately 18.6bn SEK (€2.1bn) related to coal and gas thermal assets in the Netherlands and coal assets Germany.[99] This impairment represented 6% of Vattenfall's total asset value in 2013.[100] Of the 14.5bn SEK (€1.69bn) impairment charge on Dutch thermal assets (held by subsidiary N.V. Nuon) it is unclear how much is specifically related to gas-fired vs. coal fired power plants. However, five of Nuon's seven main units, and other unit clusters, are gas-fired,[101] and all recent investments (2005 onwards) have been in CCGTs. The mothballing of new plants, such as the Magnum unit mothballed upon commissioning,[102] suggests that stranded CCGT assets have had significant implications for impairment losses.

RWE: In August 2013 RWE incurred an €800m impairment charge on thermal generation assets, largely due to losses on a Dutch generation portfolio controlled by subsidiary Essent.[103] In its H1 2013 filing, RWE noted that these charges were largely due to Dutch thermal assets, which are predominately gas. Plants such as the new Moerdijk 2 unit (commissioned 2012) were mothballed,[104] in conjunction with a planned reduction of 3.1GW of generation capacity during 2013-14 announced in the filing, suggesting that a significant portion of the impairment is due to gas-fired units.[105] However, impairment charges were also likely incurred on the Eemshaven coal plant, currently under construction in advance of a 2014 commissioning date.

Other developments: Czech utility **CEZ** has also had issues with gas-fired capacity, with the planned commissioning of the new 841MW Pocerady CCGT being delayed from June 2013 until the end of the year.[106] It was expected that the plant would be mothballed upon commissioning, however, it remains to be seen what final actions will be taken. Although some analysts have noted that a write-down on the CCGT unit is likely, CEZ has not reported impairment charges on the plant and do not expect to during 2013.[107]

3.2.2 Equity, hedging, and dividends

Beyond the devaluation of specific assets, the equity of major EU utilities has been impacted by the changing profitability of base-load thermal power generation in EU countries. This is especially true for firms holding a substantial amount of gas-fired generation assets within their generation portfolios. Although many utilities have seen stock prices fall since the financial crisis, some firms have experienced significant decreases in market value over the last 12 months (Figure 11). Impacts on equity have been matched by a trend of shrinking market capitalisation exhibited by major EU utilities. Since its peak before the financial crisis in 2008, the MSCI EU Utilities index has lost more than half its value (over €500bn)[108], while the market capitalisation of the top 26 EU utilities has fallen over €230bn.[109] While this decline has been motivated by many macro-scale processes, the stranding of thermal generation assets, including newly built CCGTs unable to depreciate capital costs, has likely been a contributor to recent decreases in firms' market capitalisation.

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98 Edwards-Evans, 2012.
99 Vattenfall, 2013a.
100 Crouch, 2013.
101 Nuon, 2013.
102 Crouch, 2013.
103RWE, 2013a.
104 Essent, 2013.
105 RWE, 2013b.
106 Strzelecki, 2013.
107 Korselt, 2013.
108 Economist, 2013a.
109 Pfifer, 2013b.

Figure 11: Normalised stock value of RWE and E.ON, January-October 2013 (100.0 = January 1, 2013)[110]

Impacts on profits from the generation business units of key EU utilities may have been somewhat protected from electricity price decreases due to forward hedging. Utilities have been hedging power in forward markets at increasing rates over the last few years, with hedging rates reaching record levels in August 2013.[111] Several major utilities, such as Vattenfall, have increased price hedge ratios over the course of 2013.[112] Increasing hedging rates have likely contributed to depressed year-ahead, and further, forward prices; contracts for power delivery for Germany in 2014 have dropped for eight consecutive quarters since June 2010.[113] Considering the bleak outlook for 2014-15 and beyond, it is likely that large amounts of hedging have only delayed what appears to be an inevitable decline in profits for conventional generation. The rolling off of forward hedging in EU markets may prove to have especially significant impacts for firms that are not widely geographically diversified within generation, such as RWE.[114] Impacts on market capitalisation have also affected dividends, as utilities aim to stem capital outflows. In September 2013 RWE proposed to halve dividends and lower future payouts to investors, citing the impacts of renewable energy support on the profitability of its conventional generation units.[115]

3.2.3 Credit quality

Over the last five years many major EU utilities have suffered downgrades in credit ratings applied by international agencies, such as Standard & Poor's, Moody's and Fitch. A series of downgrades, including recent actions in relation to market conditions and asset impairments, may further compound negative impacts on investor confidence in firms expected to shoulder the updating of EU electricity infrastructure. Some earlier ratings downgrades have been related to high-level management and organisational changes which have taken a while to manifest themselves negatively on company balance sheets: many EU utilities remain saddled with high debt burdens from significant debt-financed mergers, acquisitions and investments pre-2008 that expanded operations geographically and by sector.[116] More recently, the credit quality of major EU utilities has been

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[110] Yahoo Finance, 2013.
[111] Mengewein and Morison, 2013.
[112] Vattenfall, 2013b.
[113] Mengewein and Morison, 2013.
[114] Fitch, 2013.
[115] RWE, 2013c.
[116] Standard & Poor's, 2012.

affected by the impact of low clean spark spreads on profitability and asset value.[117] Since 2010 Standard & Poor's has taken a number of significant ratings actions against some of the top 25 EU Utilities, including RWE, Vattenfall, Gas Natural, Enel, EDP, Edison and Public Power Corp, often citing issues of profitability and debt servicing ability in the context of changing electricity markets.[118] Credit rating histories[119] of major EU utilities holding stranded CCGT assets (based upon data provided by Standard & Poor's) are presented in Table 8. Only five of the top ten EU utilities by market share have been able to retain combined ratings of A level or higher that they held in 2008.[120] As profits continue to drop, and a recovery of gas-fired generation seems increasingly unlikely, more issues facing utility credit quality are likely on the horizon.

Table 8: Credit ratings of major utilities undertaking mothballing actions (current and planned)

		2013	2013	2012	2012	2011	2011	2010	2010	2009	2009	2008	2008	2007	2006	2005	2004	2003
RWE AG	Date Out. S/T	Jul-13 Stable A-2			Jul-12 Stable A-2	Jan-11 Negative A-2	Apr-11 Watch Neg A-1				Jan-09 Negative A-1							
E.ON SE	Date Out. S/T	Jul-13 Stable A-2			Jul-12 Stable A-2	Jul-11 Negative A-1								Jan-07 Stable A-1				
Vattenfall AB	Date Out. S/T		Apr-13 Stable A-2			Dec-11 Stable A-2				Dec-09 Negative A-1	Jan-09 Stable A-1							
Statkraft AS	Date Out. S/T			Dec-12 Stable A-2				Nov-10 Stable A-2		Oct-09 Negative A-2	Jan-09 Watch Pos A-2							
EnBW AG	Date Out. S/T			Nov-12 Stable A-2		Nov-11 Stable A-2				Dec-09 Negative A-2	May-09 Watch Neg A-2							
GDF Suez SA	Date Out. S/T	May-13 Negative A-1	Jan-13 Watch Neg A-1				Feb-11 Stable A-1	Jul-10 Watch Neg A-1	Jul-10 Stable A-1			Jul-08 Positive A-1						
Centrica PLC	Date Out. S/T		May-13 Stable A-2								Jan-09 Watch Neg A-1				Jul-06 Negative A-1			
SSE PLC	Date Out. S/T			Aug-12 Negative A-2	Jul-12 Negative A-2					Aug-09 Stable A-2		Jan-08 Negative A-1	Jan-08 Watch Neg A-1					
Verbund	Date Out. S/T		May-13 Stable -					Sep-10 Stable -		Sep-09 Negative -			Jan-08 Watch Neg -					
CEZ	Date Out. S/T		Jan-13 Stable -												Oct-06 Stable -	May-05 Positive -		Nov-03 Stable -

S/T: Short term rating L/T: Long term rating Out.: Rating outlook

L/T: BBB+ A- A A+

LONG TERM	AAA AA+ AA AA-	A+ A	A- BBB+	BBB BBB-
SHORT TERM	A1+	A1	A2	A3

Equity, credit and debt quality impacts upon major EU utilities appear to have been somewhat muted by aggressive consolidation, optimisation and asset disposal programmes undertaken by firms to improve cash flow. Asset disposal has been a key strategy; GDF Suez managed average asset disposals of ~€5bn per year over 2010-12, and is planning to sell €11bn worth of assets during 2013-14.[121] Those utilities that have been able to preserve credit ratings or limit further downgrades have benefited from geographical and sector diversification, along with the programmes undertaken to limit spending and increase liquidity, as mentioned in the previous section. However, there is a limit to the potential for cash savings within utilities, and as such, these effects are likely to serve as a short-term bolster to equity which may not stand up under the weight of long-term low electricity prices and curtailed running hours. In response, utilities have reoriented their investment strategies.

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[117] Ibid.

[118] Ibid.

[119] Long-term ratings are offered with an outlook (credit watch) as to whether the rating may be upgraded, downgraded, or remain neutral. Please refer to Standard and Poor's for more information regarding ratings: http://www.standardandpoors.com/MicrositeHome/en/us/Microsites

[120] Economist, 2013a.

[121] GDF Suez, 2013a.

3.2.4 Investment strategy and capex

The current market environment for gas-fired power generation in the EU is acting as a strong disincentive for investment in new generation capacity that is required to replace old units that have either come to the end of their economic life or are being decommissioned under the LCPD. This is due to expected returns on thermal investments, but can also be traced to the financial constraints on balance sheets mentioned previously. Utilities have had to cut planned capex in order to retain liquidity, reduce debt and offset losses from generation businesses. Beyond capex cuts, many firms have reorganised planned capex in order to invest in growing markets outside the EU. These changes bring up important questions regarding the impacts of stranded CCGT assets on firm strategy, and whether or not incumbent firms can still be relied upon to deliver and finance the EU's power sector transformation.

Many utilities have adopted a "wait and see" approach to planned CCGT investments and upgrades that were expected to have broken ground over the course of 2012-13. Perceived risk-adjusted discount rates on CCGT investments have changed significantly in recent years, influenced by market conditions and policy uncertainty at national and EU levels regarding emissions regulation, renewable energy support and transmission infrastructure development. Over the course of 2012-13 some utilities noted changes in risk premiums applied in asset impairment testing due to uncertain policy contexts,[122] which may be inspiring changes in discount rates applied to new investments.

UK utilities have postponed and cancelled planned capacity expansions, citing the effects of market factors upon cash flow as well as the impact of policy uncertainty. Increasing risk premiums have compounded capital availability issues for UK utilities, leading to disjunction between rising capital costs and expected investment returns.[123] SSE is maintaining a number of projects as "shovel-ready" investment options, but is not likely to take action until price signals change or government policy for capacity revenue is solidified.[124] Despite cancellations and decisions to postpone investments, many UK utilities have expressed confidence in the long-term need for new gas generation capacity. Increasing clarity on policies for capacity mechanisms and renewable energy deployment is likely to have a positive impact on investor confidence. However, recent political debate and controversy over increasing domestic energy bills may serve as a further barrier to investment in the absence of new policies to bolster investor confidence.

Continental utilities have also cancelled or delayed proposed capacity expansions. Some of these decisions have been attributed to burgeoning over-capacity issues in the German market stemming from increasing renewables deployment, while others have been attributed to gas/coal price differentials.[125] For example, Statkraft has delayed plans to construct a new CCGT at its Emden site to replace the current unit that was recently mothballed,[126] and expressed that its outlook for gas generation in the German market was predominately negative.[127]. Tight capital constraints are influencing German utilities towards investment choices favoured by lower risk premiums; in the future, it may be likely that the only viable option for continental gas-power investments will be combined heat and power (CHP) units rather than energy-only CCGTs.[128] Indeed, many new CCGT investments, such as EnBW's 600-Mw CCGT under construction in Dusseldorf,[129] are likely to generate a significant portion of revenues from CHP components.

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[122] Ernst and Young, 2013a.
[123] GTPJ, 2013c.
[124] SSE, 2013a.
[125] Vattenfall, 2013b.
[126] Statkraft, 2012.
[127] Statkraft, 2013b.
[128] May, 2013.
[129] EnBW, 2013.

Cancellations, delays and hesitation towards new CCGT investment reflect the volume of reductions in planned capex announced by several utilities during 2013:

- **Vattenfall** announced plans to reduce investment targets by 18bn SEK to a total of 10.5bn SEK (€1.2bn) over the course of 2014-18 alongside significant write-downs in Q2 2013. Cost-reduction targets were increased by 67% to savings of 2.5b SEK (€291m) during 2014.[130]

- **E.ON** is planning to reduce discretionary capex (including legacy and growth segments) by approximately €2.5bn from 2013 levels by 2015, with almost all this being allocated to priority growth areas and developing markets.[131] Beyond capex cuts, cost reductions targets of €0.5bn have been set for 2015.

- **RWE** has plans for a €12-13bncapex plan during 2013-15 with the majority committed up to 2015; however, further reductions in capex levels from 2015 onwards have been alluded to.[132] Moderate investments in German and central European markets are set to include expansion into energy services markets, while investments in conventional power are expected to end by 2014 at the latest. On top of spending, a €200m efficiency enhancement is planned from the conventional power generation division.

- **GDF Suez** announced a €900m capex optimisation under its Perform 2015 plan, with 46% of H1 2013 growth capex being allocated to growing markets and no new greenfield thermal development planned in the EU.[133] Beyond the mothballing of 1.4GW of CCGT capacity announced in 2013, a further review of 2GW of capacity is expected.

- **Verbund** announced plans to cut investment capex by €1.2bn from 2013-17 as electricity market conditions showed no sign of improvement alongside cost saving targets of €130m during 2013-15.[134]

- Although not reporting significant reductions in planned spending, **CEZ** has also moved to a "wait and see" approach to new investments and hinted that future reductions in capex, operating expenditures, and dividends may be likely as large-scale investments in the Temelin nuclear project tighten capital constraints in coming years.[135]

Firms' responses to current market conditions suggest that stranded CCGT assets may be being cited to justify constraints on capacity for generation investment in the absence of new policies to secure revenue and reduce risk.

3.3 How have firms responded?

EU utilities are responding to recent negative CSS trends in a number of different ways, all with the objectives of reducing costs, improving efficiency and spreading risk. Utilities implement strategies from the asset level to the organisational level. These can be grouped into three main categories: a) *asset management*, b) *contracting*, and c) *operational and organisational optimisation.* This range of responses stems from the size and flexibility of CCGT generation investments: due the modular nature of CCGT technology, utilities are able to undertake a range of actions that would be prohibitively expensive for large coal plants.

[130] Vattenfall, 2013b.
[131] E.ON, 2013c.
[132] RWE, 2013d.
[133] GDF Suez, 2013c.
[134] Verbund, 2013a.
[135] Khan and Hovet, 2013.

3.3.1 Asset management

Utilities employ a range of strategies to optimise the performance of their CCGTs in response to challenging market conditions, including *mothballing*, *conversion*, *relocation* and *divestment*.

The primary strategy utilities use to manage uneconomic CCGT assets is to mothball plants via a temporary cessation of operations or longer-term closure without full decommissioning actions. However, as such decisions are dynamic and context dependent, mothballing decisions may have very different characteristics. *Partial mothballing* is the temporary closure of some of a plant's generating units to reduce its output capacity, while still allowing the plant to operate and participate in energy sales. Vattenfall's Dutch subsidiary will likely be operating the new Magnum CCGT unit on a rolling closure system between three generation blocks in order reduce operations and maintenance costs.[136] *Shallow mothballing* is the short-term shutdown of a plant without long-term preservation actions, under the expectation of generating within six to 12 months. This strategy was implemented at Statkraft's new Knapsack 2 unit upon commissioning in July 2013,[137] as the plant is expected to enter into commercial production within a timeframe short enough to render long-term mothballing actions less economic. More recently, decisions have been announced to put both Knapsack 1 and the 400MW Herdecke CCGT (commissioned in 2007) in "wet storage" until market conditions improve.[138] *Deep mothballing* is long-term closure of a plant without full decommissioning, including maintenance actions to preserve turbines and internal transmission infrastructure for extended periods of non-use. Most deep mothballing decisions are motivated by an expected return to market profitability in three to five years, allowing a firm long-term hedge option on the improvement of market conditions.

If technological constraints allow, utilities may *convert* CCGT assets from combined-cycle to an open-cycle (OCGT) mode by decommissioning steam turbines and running the plant at a reduced load factor. Investing in conversion actions may facilitate improved flexibility and reduce maintenance costs, but also increase marginal costs of generation. A number of EU generators have undertaken actions to convert CCGT assets to OCGT modes during the last two years.[139] Decisions to convert CCGTs are made under expectations of significantly curtailed running hours and high peak prices, and are contingent upon conversion costs and capital cost depreciation.

Recently some utilities have considered *dismantling and relocating* CCGTs to more profitable markets as a strategy to recoup losses. E.ON has undertaken discussions to assess the feasibility of relocating the mothballed Malzenice 1 unit from Slovakia to Turkey, where E.ON is expanding operations.[140] Utilities may also benefit from the sale of specific valuable plant infrastructure such as gas and steam turbines, as evinced by the sale of turbines from the Enecogen plant to a CCGT near Tel Aviv earlier this year.[141] As the economic viability of any relocation decisions depends on the scale of the plant, its efficiency, and its age,[142] it is unlikely that relocation will become an increasingly profitable option for plants. Beyond valuation issues, a number of regulatory considerations in EU markets (see section 4.4) may prevent this strategy from being implemented for more than a few plants.

A final strategy for utilities is to *divest* from the asset through sale of the plant. Sales of recently built, high efficiency CCGTs (remaining in situ) to new buyers has increased in European markets in recent years.[143] In order to alleviate debts many EU utilities have sold gas-power assets to trading houses and investment funds

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[136] Crouch, 2013; Vattenfall Q2 2013.
[137] Statkraft, 2013a.
[138] Statkraft 2013c.
[139] ICIS, 2012; Airlie, 2012.
[140] E.ON, 2013a; Varnholt and Hromadko, 2013.
[141] Morison, 2013.
[142] GTPJ, 2013a.
[143] Ernst and Young, 2013b.

both inside and outside the EU;[144] significant sales have included Vitol's purchase of the Immingham CHP plant from Philips 66,[145] and Macquarie's purchase of EDF's Sutton Bridge station.[146] Institutional investors have also made inroads in the EU power sector. However many major groups (including large pension funds) remain cautious about increasing direct investment in power assets and infrastructure.[147]

3.3.2 Contracting

Some EU utilities have been active in renegotiating contracts governing transactions for fuel inputs and electricity off-take for CCGT assets. Taking advantage of a changing EU gas market and international arbitrage opportunities, many utilities have renegotiated gas contracts away from long-term oil-linked take-or-pay contracts to spot volumes.[148] Recently, E.ON has undertaken contract risk reduction actions with fuel suppliers,[149] while RWE has settled a protracted legal dispute over gas contracts with Gazprom.[150] Other suppliers such as Norway's Statoil have gained market share by offering pipeline gas contracts benchmarked to spot prices at major EU hubs.[151] In the future, shifts away from oil-linked pricing contracts may have a downward influence on input costs for gas-fired power generation, but these impacts are not likely to be significant over the short term. Actions to renegotiate power purchase contracts reduce costs for utilities, but the context-specific nature of contracting and potential for diversified service provision may render negotiations and implementation complex and time consuming. In the UK, modifications of transmission access contracts have been related to mothballing actions by serving as a proxy to reduce plant output: SSE noted that the partial mothballing the Peterhead CCGT was motivated by high transmission charges due to the plant's location.[152]

3.3.3 Organisational optimisation

Finally, utilities implement strategies at the organisation level to reduce costs and improve efficiency. Utilities with international ownership structures have been reorganising business units across countries, increasing coordination and dispatch of generation fleets across borders to optimise the use and maintenance of specific assets.[153] While such change has been prevalent in trading businesses over the last five years as a way to optimise hedging capabilities across markets, it has recently been reflected in generation units. Other specific optimisation strategies depend on technology; for example, demand for combined heat and power CCGT units could be managed by investing in heat storage technology, allowing them to stop production in times of negative spark spreads. Utilities also may offer the use of plants on ancillary services markets, beginning with high marginal cost plants where the opportunity cost of generation is low.

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144 Schaps, 2013.
145 Vitol, 2013.
146 Podkul, 2013.
147 Lewis, 2013.
148 Pirani, 2013.
149 ICIS, 2013a.
150 Hromadko, 2013b.
151 Gloystein and Adomaitis, 2013.
152 SSE, 2013a.
153 E.ON, 2012; Vattenfall, 2013b.

4.0 How are governments responding?

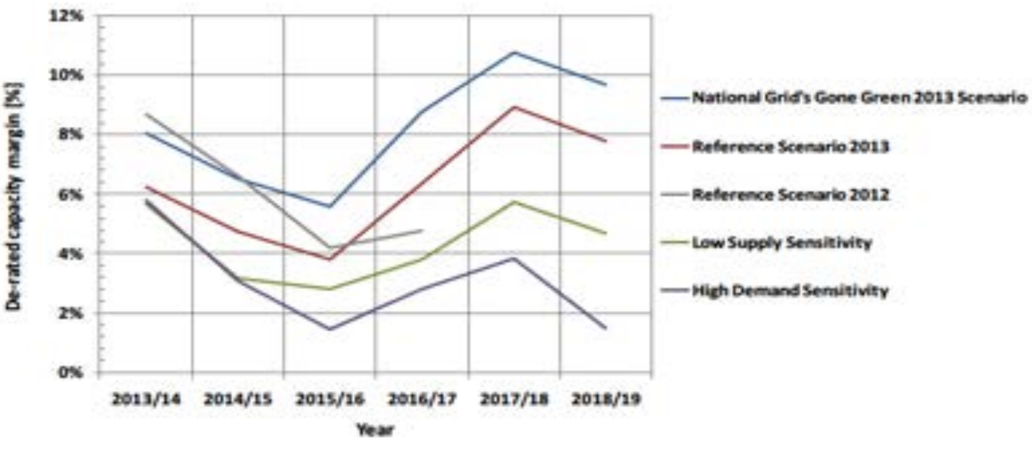
Governments across the EU have undertaken different measures to respond to the current market situation for thermal generation and its potential implications for future system adequacy. Several EU countries have made significant steps towards the implementation of CRMs as a way to assuage system stability and investment profitability concerns of incumbent utilities. Two countries of particular interest in the CRM debate are the UK and Germany, as new policies in these countries illustrate alternative pathways for capacity remuneration in the context of asset stranding, capacity adequacy concerns and decarbonisation. This section examines recent policy developments and the strategic preferences of utilities towards different potential policy mechanisms.

4.1 United Kingdom

4.1.1 Current capacity outlook and policy context

Due to a number of different factors – including plant retirement cycles, emissions control regulations and constrained financial capacities of incumbent utilities – the UK may face decreasing capacity margins over the coming decade. Between 8 and 9GW of coal and oil plants are forecast to close by 2015 due to the impact of the LCPD.[154] In its 2013 electricity capacity assessment report, the Office of Gas and Electricity Markets (Ofgem) forecast a decline in UK capacity margins until 2015-16, with a de-rated reference scenario margin of 4%.[155] A visualisation of capacity projections is presented in Figure 12. However, debate on the potential for a serious "capacity crunch" continues, with key issues being the potential role of interconnectors[156] and the impact of various demand-response policy tools.

Figure 12. De-rated UK capacity margin scenario projections[157]



Currently there are a number of policy tools at an advanced stage of development that have been designed to address capacity issues in the UK. The Department of Energy and Climate Change (DECC), Ofgem and

154 ENTSO-E, 2013.
155 OFGEM, 2013.
156 Analysts have noted that interconnector flows into UK markets have not been driven solely by domestic system parameters, and may improve or constrain UK capacity margins under current market conditions (See Poyry, June 2013).
157 OFGEM, 2013.

transmission network operator National Grid have put forward several policy products that are designed to ensure appropriate levels of system adequacy, including the capacity market, the short-term operating reserve, the demand-side balancing reserve and the supplemental balancing reserve. Two proposals under development pertaining to capacity – the capacity market and the supplemental balancing reserve – are discussed here.

In June 2013 DECC decided to implement a capacity market system in order to ensure system adequacy towards the end of the decade.[158] A capacity price (£/MWh) will be discovered through an annual competitive auction, beginning in 2014 for delivery of capacity during 2018-19.[159] Through the implementation of the capacity market, mothballed CCGTs may be able to secure additional revenues. CCGTs will need to be pre-qualified, participate in the auction, and then derive capacity revenue based upon where the plant would sit within the supply curve.[160] Revenues will depend on a variety of factors, including how the clearing price of the auction is affected by the competitiveness of other generation capacity and what impact the capacity market may have on wholesale electricity prices. If it depresses power prices over the long term, capacity market implementation may negatively affect the economics of mothballed CCGT assets.

Alongside capacity market legislation, National Grid is undertaking consultations on a proposed Supplemental Balancing Reserve (SBR), which would operate until the capacity market delivery starts in 2018-19. The SBR would compensate operators to keep plants that would otherwise be mothballed or closed available to generate electricity during the winter months of 2014-15 and 2015-16.[161] This proposal would directly target plants recently rendered uneconomic, but is specifically noted to be a "last resort" option.[162] Details regarding the design of the SBR are currently scarce, but can be understood as a tender for plants to stay online if they can "demonstrate to (National Grid's) reasonable satisfaction" that they would "otherwise be mothballed or decommissioned".[163]

4.1.2 Firm responses

a) Capacity market

UK utilities have been largely supportive of the implementation of a capacity market, given the insensitivity of energy prices to capacity scarcity and market conditions. However, some have expressed reservations that current implementation timelines are not likely to address the short-term capacity crunch projected for 2014-15. Some utilities have been vocal in noting that the four-year timeframe between auction and capacity delivery – appropriate for generation construction lead-times – would not provide an efficient incentive for mothballed plants to re-enter the market. For example, along with seeing the initial auction run earlier than anticipated, SSE has expressed the importance of early payment availability "in order to keep existing plants on the system",[164] and that an additional near-term auction system could be implemented to manage short-term capacity issues. E.ON UK suggested that capacity mechanisms should be brought into the UK market "as soon as possible" in order to correct for poor market conditions,[165] and Scottish Power noted that in the absence of a rise of clean spark spreads to 12-14 £/MWh, a new capacity mechanism framework should be delivered by 2014 in order to avoid capacity shortages.[166]

b) Supplemental Balancing Reserve

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[158] DECC, 2013a
[159] DECC, 2013b
[160] DECC, 2013a
[161] National Grid, 2013.
[162] Kemp, 2013.
[163] National Grid, 2013: 2.
[164] GTPJ, 2013c.
[165] GTPJ, 2013d.
[166] GTPJ, 2013e

UK utilities have expressed somewhat sceptical views about the potential benefits of the SBR as a short-term mechanism, noting risk of further damage to price signals as incentives for capacity investment by bringing old plants into operation. Both Centrica and SSE have expressed reservations about the SBR as a short-term fix,[167] noting that potential for balancing service provision will do little to improve overall market conditions for generation investment.[168] International firms, such as GDF Suez, have also criticised the SBR as it is likely to bring inefficient plants back into the market at public expense, distorting incentives for new investment.[169] Beyond this, a key remaining issue stemming from the discretionary nature of the SBR acknowledged by various utility representatives is the potential for perverse incentives to strategically mothball plants in order to secure revenue streams.

4.2 Germany

4.2.1 Current capacity outlook and policy context

Unlike the UK, Germany is not projected to face short-term capacity margin constraints. Current installed power capacity in Germany amounts to 174GW, of which 80GW is fossil-fuel base load.[170] The security of Germany's large and diversified energy system has benefited from high levels of interconnection with other countries, which smoothed security issues during the closure of nuclear capacity.[171] However, the medium and long-term outlook for German capacity adequacy is hotly debated.[172] Currently the German market is defined by over-capacity in both thermal and renewable generation, but this capacity is not evenly distributed throughout the country. Certain areas of southern Germany (specifically the state of Bavaria) may face serious capacity adequacy issues in coming years.[173]

There have been several legislative actions undertaken as short-term solutions for localised supply security affecting the mothballing of German thermal assets. The most important of these has been the implementation of a 12-month moratorium on the closure of plants deemed "system relevant" by transmission service operators and *Bundesnetzaugenteur* (BNetzA), the federal regulatory agency.[174] The decree, valid until 2017, specifies that gas-fired assets considered system relevant shall be compensated for fixed costs if they are required for more than 10% of total MWh capacity by system operators.[175] In June 2013 the German government legislated the *Reservekraftwerksverordnung* (Order on Reserve Power Plants), specifying the role of BNetzA to evaluate the need for thermal capacity expansion and the ability of responsible transmission system operators (TSOs) to tender for new reserve capacity.[176]

Capacity policy in Germany has not progressed to a point of proposed legislation, and no developments are likely until later this year. During discussions for a coalition contract between the main CDU/CSU and SPD parties in late November 2013, it emerged that a capacity market is likely to be developed in the medium term in response to base-load capacity concerns towards 2020.[177] The capacity forecast is to be technology neutral and integrated with a planned expansion of the grid reserve system. There exists the option to develop a tender

[167] Utility Week, 2013a.
[168] SSE, 2013c.
[169] Utility Week, 2013b.
[170] BNEF, 2013b.
[171] IEA, 2013b.
[172] Bracke and Schroder, 2012, ACER, 2013.
[173] IEA, 2013b.
[174] Deustcher Bundestag, 2012; Lang, 2012.
[175] ICIS, 2013b; Lang, 2013.
[176] Lang, 2013.
[177] ICIS, 2013c.

model for grid operators' required capacity as a way to increase transparency in the current system-relevance legislation.[178]

4.2.2 Firm responses

a) System relevance legislation

The system relevance legislation was first applied to determine compensation in response to E.ON's decision to mothball the Irsching 4 and 5 CCGT units, located in Bavaria. E.ON announced its intention to mothball units in March 2013, citing operational performance of less than 25% of expected running hours.[179] Following negotiations with TSO TenneT it was decided that E.ON would receive compensation to cover fixed costs of the new units,[180] which would allow them to stay within the system.[181] E.ON's settlement for the Irsching plants has provoked controversy among Germany utilities. Competitors have expressed reservations that Irsching is still participating in the wholesale market, albeit with a subsidy introducing competitiveness asymmetries. As the system-relevance legislation would regularly have specified that compensated plants be prohibited from participating in the spot market, it is unclear how future applications of the law may be applied. A lack of transparency in the decision appears to have undermined investor confidence, and utilities have raised concerns that market efficiency over the next few years may be compromised if compensation decisions go forward in a similarly ad hoc manner. However, many utilities have welcomed government acknowledgement that the closure of new flexible, high-efficiency base-load thermal generation is not an efficient outcome for energy decarbonisation policy.

b) Capacity Mechanism Proposals

While German utilities largely agree on the need for policy options to improve the market for gas-fired generation and address impacts of RES support policies, firms hold divergent attitudes towards the pros and cons of different mechanisms. Statkraft has expressed support for a non-discriminatory market-based system – either via auctions or capacity obligations – as a cost-effective solution, comparable with 10% of total RES subsidies.[182] Statkraft has highlighted the need for competition to avoid subsidies for specific CCGT assets, suggesting that equal opportunity for government support is crucial for a competitive market,[183] and that the implementation of strategic reserves could affect investment incentives. Other utilities such as Vattenfall have opposed capacity markets,[184] supporting strategic reserves as a preferable complement to energy-only markets; proponents cite base-load capacity adequacy in Germany and the potential for capacity markets to incentivise old, inefficient plants to be reintroduced into the market and refinanced by consumers. Some utilities have highlighted the low transaction costs associated with transforming existing winter reserve regulations into a strategic reserve scheme, and the potential capacity congestion benefits that could be gained by expanding the mechanism to include plants in neighbouring countries. Other issues remain under debate, such as implications of different CRM structures for technological innovations (including energy storage, micro CHP, and smart grids), which will require increasing price volatility in order to become commercially viable.

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[178] ICIS, 2013c.
[179] Andersen and Patel, 2013.
[180] While the compensation amount was undisclosed, E.ON reported annual operating costs of 100m euro (Reuters, 2013b).
[181] TenneT, 2013; Lang, 2013.
[182] Statkraft, 2013e.
[183] Statkraft, 2013e.
[184] Morison, 2012.

5.0 Key lessons and potential implications

CCGT mothballing and closure decisions are influencing political debate regarding the development of CRM policy in EU member states and within the European Commission. Recent developments illustrate how stranded generation assets may hold important implications for energy decarbonisation, and provide some useful lessons for policymaking and governance.

5.1 National Policy-making

5.1.1 Lessons learned

In the UK concern regarding the influence of stranded assets in political debate has been taken up by politicians, with MPs remarking that utilities may be incentivised to mothball "all the capacity (they) could before 2014" in order to "encourage… more funds in the pot".[185] However, while utilities may be pushing for the acceleration of CRM implementation, concern regarding the exploitation of capacity adequacy could be nullified by the design of the market mechanism. This suggests that market designs allowing for competitive price discovery may prevent utilities from mobilising stranded assets for private benefit. In the German context, stranded CCGT assets are motivating a capacity mechanism debate that appears to be oriented towards keeping new, high efficiency investments in the system and addressing localised capacity adequacy issues. While some firms that have mothballed recently constructed CCGTs are very supportive of capacity market implementation, competitors with diversified assets in Germany and neighbouring markets have opposed these proposals, instead preferring a strategic reserve. These positions suggest that firms may develop political strategies around stranded assets to limit benefits to competitors.

The situations in the UK and Germany suggests that utilities are mobilising arguments to either protect their assets (by lobbying for compensation opportunities), ensure equal footing within the market place (by lobbying against policies that would reward their competitors), or both. It also suggests that utilities are likely to weigh the benefits of stranded cost compensation with market-wide competition priorities, as incumbent firms work towards similar policy objectives (securing policy certainty and improving investment risk). This is exemplified in the debate regarding transparency in the German system-relevance regulation and the UK supplemental balancing reserve, where competitiveness impacts may be brought on by compensation for individual stranded assets. Beyond competitiveness asymmetries, the introduction of discretionary non-market policy mechanisms could potentially increase the ability of firms to manipulate decisions around stranded assets for strategic benefit. In this context, governments needing to manage short-term supply security issues should seek to limit discretionary payments to utilities, and take precautions to ensure that plants targeted for short-term service do not receive undue subsidies.

5.1.2 Policy Interactions

CRMs may interact with other climate and energy policies in unpredictable ways. The objective of capacity mechanisms is primarily to ensure system adequacy. However, such policies are likely to have implications for environmental aspects of energy policy. Important questions remain regarding the potential for CRM policies to deliver on flexibility and decarbonisation goals, and how such groups of policies should be integrated within energy markets. Capacity mechanisms that only reward long-term adequacy may not incentivise the flexibility characteristics of generation assets (including ramp-up speed and balancing potential) that will be become more important in the future.[186] Considerations regarding flexibility must be understood in comparison with the

[185] ICIS, 2013d.

[186] Bertsch et al., 2013, Baron, 2013.

broader framework of policies managing an energy market. While the UK is taking steps towards incentivising and monetising flexibility through mechanisms like the short-term operating reserve and the demand-side balancing reserve, this debate is proceeding slowly in other EU countries. In Germany, policy actions to improve demand-side management and short-term system balancing may need to be advanced in addition with capacity mechanism actions in order to facilitate localised system balancing.[187]

Alongside flexibility issues, interactions between CRMs, stranded assets and decarbonisation policy could have conflicting effects. Designing capacity mechanism policy to incentivise low-carbon generation has been undertaken in a number of different markets, and some analysts have promoted the use of capacity mechanisms at the EU level to improve risk premiums for low-carbon investments.[188] However, the pros and cons of designing capacity mechanisms to facilitate environmental objectives must be evaluated within domestic climate policy contexts. Domestic carbon pricing actions are a pertinent issue: as the UK's carbon price floor could provide an adequate incentive for low-carbon generation, picking low-carbon winners through a capacity market could reduce the efficiency of competitive price discovery for capacity. Within the rest of the ETS area, the potential for carbon pricing to motivate low-carbon investment could be affected by policy uncertainty, inadequate forward markets and investment timeframes. Clearly understanding such potential policy interactions is a priority for national governments.

5.2 Implications at the EU level

5.2.1 Market integration: competition, trade, and investment

Independent and uncoordinated implementation of different national CRM policies could have significant implications for EU energy market integration.[189] While the implementation of the third EU energy package and the development of network codes illustrate important progress towards market integration objectives, the implementation of CRMs with differential treatment of national and foreign capacity could have significant impacts on competition between electricity generators and suppliers.[190] The unilateral implementation of CRMs in energy-only markets may have immediate short-term effects on prices and dispatch decision-making by utilities, as well as influencing investment choices with long-term implications.[191] Beyond the presence or absence of CRMs between countries, the implications of CRM policy design differences for prices, competition and investment are unclear. For example, distortion effects from a strategic reserve scheme – where the threshold price may act as a market price cap – may be exported across borders into energy-only markets, reducing revenues of generators across borders. These interactions may provide opportunities for utilities to recoup losses from stranded assets, but may also increase the risk of asset stranding.

Electricity trading may be affected by how domestic and foreign plants are included in a given national capacity mechanism, either by permission to participate freely in the capacity procurement process, or by exclusion from procurement but inclusion via interconnection.[192] CRM implementation could lead to further asset stranding by increasing access of low-marginal cost renewable energy (or more competitive capacity provision) to foreign markets. If plants are put at a competitive disadvantage by a neighbouring country's capacity mechanism, this may affect political incentives to increase interconnector capacity across borders. While the cross-border implications of national energy policies (exemplified by national RES subsidies) have so far been tolerated in EU markets, significant changes in the valuation of capacity, effects on wholesale prices and decreased competitiveness of domestic assets may negatively affect cooperation between EU member states.

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[187] Bertsch et al., 2013.
[188] Gottstein and Schwartz, 2010; Baker and Gottstein, 2013.
[189] Baritaud, 2012; ACER, 2013.
[190] Meulman and Méray, 2012; Baritaud, 2012.
[191] ACER, 2013.
[192] Meulman and Méray, 2012.

Over the long-term, utilities may reorganise planned investments to move to where different capacity policies provide the most attractive revenue streams. Recent studies have suggested that the implementation of capacity markets could displace energy prices as a primary driver of decisions to invest in generation capacity.[193] The design features of different CRMs may result in significantly divergent effects: capacity markets may increase investment in domestic capacity at the expense of international investments, while the impacts of low threshold prices in strategic reserve schemes on market prices could disincentivise investment.[194] Effects on investment climates in different countries could exacerbate national system security, as well as increasing pressure on the profitability of assets pushed up merit order curves by international investment.

5.2.3 State aid and governance

The European Commission is undertaking an update of state aid regulations pertaining to environment and energy,[195] and as part of this process is developing new legislation pertaining to capacity policies. Draft guidelines on the development of CRMs were released in November 2013.[196] They appear to support alternative options to improve capacity adequacy – including market function, transmission infrastructure and demand-side management – instead of the implementation of capacity policies. If deemed entirely necessary following independent assessments of capacity adequacy, CRMs should aim to be "transparent and non-discriminatory", avoiding cross-border impacts on trade.[197] Overall, the guidelines appear to support strategic reserves and tendering processes over the implementation of capacity markets on the grounds of transaction costs, market distortions and the introduction of long-term state aid payments.[198] A recent presentation to the International Energy Agency (IEA) confirms this orientation, highlighting the need to "objectively (analyse) generation adequacy concern" by considering cross-border assessments, interconnectors, demand-side response and the "profitability concerns" of major utilities.[199] Managing lock-in to fossil-fuel base-load capacity built on the back of capacity mechanisms – and the potential for the stranding of these assets – is specifically noted in the guidelines as a rationale for careful national assessment of potential policy interactions.[200]

If, in practice, the European Commission's new state aid regulations favour strategic reserve schemes over capacity markets, then there may be future regulatory implications for states currently implementing the latter. In countries employing a range of policy frameworks to address capacity (such as the UK, where the supplemental balancing reserve will run in conjunction with the capacity market until delivery of capacity by 2018), certain elements might conform to European Commission guidelines while other elements are deemed inappropriate. Sorting out these issues at the commission level may prove to be a challenge if countries continue towards independent and uncoordinated implementation.

Other current debates about the 2030 energy package – including the integration of RES support mechanisms and policies to optimise RES investment across states – may be significantly affected by CRM implementation and stranded base load assets. These issues have been particularly relevant for the political lobbying of utilities at the EU level, which have been increasingly active in pushing for reforms to improve markets for gas-fired generation and the investment environment for new capacity. In October 2013 the heads of ten major EU energy companies[201] lobbied the EC to reduce subsidies for renewable energy and strengthen the carbon market in order to secure a place for gas generation within the EU energy mix.[202] Future lobbying may delay change, which could increase both system costs and spiraling retail energy prices.

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193 Ozdemir et al., 2013;
194 ACER, 2013.
195 European Commission, 2013c.
196 European Commission, 2013d.
197 European Commission, 2013d.
198 Lewis, 2013b.
199 O'Briain, 2013.
200 European Commission, 2013d.
201 E.ON, RWE, Vattenfall, GDF Suez, CEZ, Enel, Gasterra, Iberdrola, Eni and GasNatural
202 De Clercq and Lewis, 2013.

5.3 Remaining questions

As CRM policies may involve high transaction costs and be hard to reverse if implementation delivers unexpected results, potential alternative solutions to achieve capacity objectives should be carefully examined before implementation. There exist a range of EU-level energy market design improvements to address investment market failures that could be implemented quickly at low administrative cost, including the integration of balancing and reserve resources through coordinated mechanisms, addressing price caps, and even exploring locationally-based marginal pricing.[203] Increasing the power of associations (such as the Agency for the Cooperation of Energy Regulators) could facilitate coordination between national regulatory agencies and TSOs.[204] Other barriers to capacity integration could be addressed by increasing harmonisation between national energy regulators regarding security standards. While technically complex, making progress towards uniform system management and transmission standards could improve the potential for trading balancing services across countries as a way to alleviate system congestion issues. Beyond policy and regulatory innovations, increasing spending on transmission improvements, demand-side management technologies, and energy efficiency technologies could address capacity margin issues by simply reducing energy demand.[205] Increasing public support for R&D in new technologies for energy storage and flexible renewable generation could help bring new technological solutions to market.[206] To date there has been limited research on the costs and benefits of these different options across the EU.[207] More detailed benefit-cost analysis of potential alternatives would improve cost effectiveness, coordination and implementation.

The issues facing gas-fired power generation in the EU are calling attention to complex interactions between climate and energy policy across EU member states. A key remaining question is what actions might be necessary to facilitate the exit of unclean generation in the absence of tight carbon constraints. High carbon prices are assumed to drive the generation mix away from coal over the long term in many scenarios for future energy decarbonisation.[208] But as the carbon price necessary to motivate the mothballing and decommissioning of low-marginal cost coal plants (such as German lignite plants) would likely have to rise higher than prices necessary to emissions reduction targets, but it remains unclear whether or not this is a likely outcome.[209]

At a higher level, the cases of stranded CCGT assets examined here illustrate that the EU may already be experiencing the market impacts of a strong decarbonisation agenda, but individual national governments may not fully be prepared to deal with the wide ranging consequences of clean energy support for system stability and investment security. Ensuring that gas generation plays an appropriate role within the transition to decarbonisation (while avoiding lock-in effects) stands as a pressing challenge for EU energy policy. More thinking is required to design competitive, efficient policy options for supply security and low-carbon generation in the context of stranded assets if markets are to be able to deliver decarbonisation.

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[203] Baritaud, 2012.
[204] Hoskyns, 2013.
[205] IEA, 2012b.
[206] Nemet and Baker, 2009; Gallagher et al., 2012; Williams et al., 2012.
[207] ECF, 2011.
[208] For example, various carbon pricing scenarios in as presented in the IEA's WEO 2012.
[209] Finon, 2013.

6.0 Recommendations and Conclusions

The recent need to mothball and decommission CCGTs in Europe has had significant and rapid consequences for company value, utility strategy, and public policy. This acute example of asset stranding is rightly influencing the development of energy market reforms across the EU. As part of the process policymakers should consider the appropriate treatment of stranded assets. Careful thinking is required on how the economic costs of stranded assets should be valued in the design and implementation of different capacity policies. Failing to do this will result in overly expensive CRMs, which could increase retail prices. Different stakeholders in the electricity sector – including, firms, investors and shareholders, regulators, and governments – may want to consider how stranded assets may interact with investment behaviour, capacity policy and energy market regulation.

Firms

Major EU utilities should increase their transparency around stress testing existing assets and planned investments, in order to provide a clearer view of their attitudes towards the potential for asset stranding across their generation portfolios. Beyond this, firms should aim to increase transparency regarding the potential contingency plans available to recoup sunk costs in different assets, and develop a range of options to either improve, diversify, or convert the range of cash-generating activities that an individual asset may be able to provide. Firms should continue to expand upon recent efforts to diversify service provision to better fit the needs of a rapidly decarbonising energy system, including examining potential market opportunities in ancillary and balancing services.

Investors

Investors should apply pressure to utilities to fully disclose material pertaining to marginally profitable generation assets, regardless of technology, in order to assess risks posed across generation portfolios. What is clear from recent developments is that the dynamics of asset stranding in the EU power sector are changing, and stranded assets may appear in unpredictable sections of a generation fleet. As policy uncertainty continues to be an issue, increasing transparency regarding planned investments and risk premiums (both fossil-fuel based and low-carbon) should be a priority for investors holding large stakes in utilities.

National Governments

If implementing capacity mechanisms, governments should seek to address capacity adequacy concerns through competitive, market-based policies. In addition to the objective of generation adequacy assessments undertaken by independent bodies, governments should consider potential interactions regarding flexibility and clean energy objectives in order for policies to be comprehensive, targeted and effective. Governments should think clearly about how different designs for capacity mechanisms may affect the competitiveness of different firms, and assess the potential for strategic behavior by these firms around stranded assets. More broadly, governments should work to consider a range of actions that could increase investor confidence enough to achieve the objectives of a capacity mechanism. Pressing issues, including improving management renewable energy deployment, remain a key issue for governments.

Governments should also seek to examine a wider range of potential "soft" actions (including increasing coordination between network agencies, TSOs, and regulatory bodies) that could support groundwork towards more significant actions on both energy market design (including price caps) and infrastructure investment. Coordinated efforts between countries would be useful to assess how interconnections and energy trading could improve or exacerbate profitability issues that may drive asset stranding across borders.

EU-level governance

At the EU level, more work should be undertaken to evaluate the implications of different energy market integration actions for stranded gas assets. Examining further questions regarding potential competitiveness impacts of different capacity mechanisms and their relationships to stranded assets stands as an important research priority. At a higher level, more research is required to assess whether or not the EU's target energy market model is really tenable under increasing renewable energy deployment. It could be that a wholesale shift in the market paradigm for electricity markets – a shift from energy revenues to the valuation of capacity, and from competition to longer-term strategic planning – is required to support deep decarbonisation across the energy system, from supply and transmission to energy service provision.

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