Coal Generation in Great Britain: The pathway to a low-carbon future

Introduction

This document is a response to the BEIS consultation "Coal Generation in Great Britain: The pathway to a low-carbon future" from researchers across SPRU, University of Sussex, Centre on Innovation and Energy Demand (CIED) and the Sussex Energy Group. This response also includes comments from the Institute of Structural Research (IBS) in Poland.

The response is formed around selected aspects of the four questions put forward in the consultation. A summary of our main views is as follows:

- A constraint on coal generation in the years ahead of 2025 is necessary
- Greater emphasis and further studies needed on demand-side management in decarbonising the electricity sector
- Carbon capture and storage (CCS) has many uncertainties that require further exploration
- Renewable energy sources supported by the appropriate policy mix can contribute significantly to decarbonising the electricity sector as well as other energy sectors
- Energy sector system wide approach should be adopted in policy making to ensure targets are met in a coherent, timely and cost effective manner.
- Studies should be carried out to explore the impacts of a coal phase out on the labour market

The researchers that have contributed to this response are:

Prof Benjamin K. Sovacool
Dr Lucy Baker
Dr Noam Bergman
Dr Jenny Lieu
Dr Karoline Rogge
Dr Paula Kivimaa
Claire Copeland
Bryony Parrish
Ed Dearnley
Dr Jan Witajewski-Baltvilks (IBS)
Marek Antosiewicz (IBS)

About SPRU

SPRU is rated the top science and technology think tank in the UK and 7th in the world by the Global Go To Think Tank Index. Interdisciplinary research addresses pressing global policy agendas across a diverse range of sectors and issues including; industrial policy, inclusive economic growth, innovation, energy policy, security issues, entrepreneurship, and pathways to a more sustainable future. SPRU is at the forefront of new ideas, problem-orientated research, inspiring teaching, and creative, high impact engagement with decision makers across government, business and civil society.

About Centre on Innovation and Energy Demand (CIED)

CIED is a collaboration between researchers from the Sussex Energy Group, Transport Studies Unit at the University of Oxford and the Sustainable Consumption Institute at the University of Manchester. It is one of six Research Centres on End Use Energy Demand funded by the Research Councils UK Energy Programme. Our primary focus is on the processes of innovation – both technological and social – that will contribute to energy demand reduction for a more sustainable energy future.

About Sussex Energy Group (SEG)

SEG is a group of 24 interdisciplinary researchers focusing on sustainable energy systems. Interests are in a very wide range of energy policy challenges. Our research is problem-driven, informed by social science, and grounded in empirical understanding and data. The Sussex Energy Group is based at SPRU, University of Sussex and directed by Prof Benjamin K. Sovacool and Dr Florian Kern.

About IBS

The Institute for Structural Research (IBS) is an independent and non-profit research foundation exploring the fields of labour and environmental economics, mathematics, and quantitative methods. The Institute's activity is directed to promoting the implementation of scientific results in practical social-economic policy on the central, regional and local level.

1 Policy Proposals

1.1 Do you have any views and evidence on the options outlined above, including on relative benefits and risks? Are the principles above a sound basis for designing a regulatory approach?

Views and Evidence

In order for the UK to achieve targets legislated under the Climate Act 2008 it is clear that unabated coal fired power must be discontinued. This electricity supply technology contributes twice the level of greenhouse gas emissions than the next highest emitter; gas-fired power. Closing unabated coal-fired power plants therefore makes an important contribution to achieving UK's emissions reductions targets in line with the Climate Change Act 2008.

Climate Change policies should however involve a much wider approach than simply replacing one technology with another. There is little mention of renewable technologies in the consultation documents. The UK is considered to have the best wind power potential in Europe and in 2016 wind generated more power than coal over an entire year for the first time in the UK [1]. Yet this source of power is not specifically mentioned in the documents.

There is also little consideration of demand side policies in the consultation documents. In our view this is a substantial oversight. Demand side management can provide a significant contribution in reducing energy demand overall (and therefore emissions reduction), smooth out peak demand and improve security of supply.

Benefits and Risks

While coal-fired power generation fell by more than 25% in 2015, coal still provides 22% UK's electricity needs [2]. To close unabated coal within 8 years therefore needs careful consideration as to how the gap left can be filled. The documents provided for this consultation suggest that gas-fired power would be expected to fill the majority of this gap. While there would clearly be emissions reductions as a result in the short term, there is the risk of being locked into emissions levels that are incompatible with longer term legislated targets [3], [4].

A "whole-system" outlook to the energy sector is required. This would help ensure policies are coherent across the different energy sectors; power, heating, and transport, and also with industry. Policies that work across the different sectors will also help achieve targets in the most cost effective and timely manner. It is crucial that the necessary infrastructure is in place for the transition to a lower carbon economy. Such infrastructure may need to be shared across energy sectors and industry e.g. carbon capture and storage. The cross sector policy approach would need to consider apportioning appropriate costs of any new infrastructure. This is to avoid inadvertently making a sector or technology carry the cost burden unfairly and therefore risk being economically unviable.

The cross sector approach was put forward by the House of Commons Energy and Climate Change Committee report on 2020 renewable energy targets for the heat and transport sectors [5]. In their report the UK Hydrogen Fuel Cell Association is quoted as stating [5, p. 30]:

"at present, the Government's heat, power and transport teams appear to be working entirely independently"

There is an opportunity for BEIS, by bringing together energy, industry and business, is well placed for cross sector policy making. The consultation here however does not appear to demonstrate the application of such thinking in the documents provided.

The consultation document mentions that it would be feasible for coal to still be operating in 2030 (paragraph 33 on p.17). If this is the case and without carbon capture and storage (CCS) technology further emissions reductions would be required elsewhere e.g. in heating and transport, in order to meet the legislative targets. The UK is heavily reliant on gas for its heating – meeting 70% of heating needs [4]. By switching to gas-fired power would also reinforce the need for the gas grid thereby making an even greater hurdle to decarbonise heat. It is generally acknowledged that heat and transport are the hardest energy sectors to decarbonise. Progress on reducing emissions in these sectors is far from being on course for 2020 EU targets [5].

Basis for Regulatory Approach: Carbon Capture & Storage (CCS)

Carbon Capture and Storage (CCS) would become extremely important if the gap left by coal is filled with gas. It will be a requirement of any coal plants that continue to operate. However CCS accrues significant energy penalties [6]. The International Energy Agency has noted that CCS requires a substantial amount of heat and complex processes, reducing the operating efficiency of a coal power plant by 8-10% [7]. According to the IPCC widespread adoption of CCS could erase the energy efficiency gains made in the last fifty years and increase coal consumption by one-third [8]. Even then, actual capture rates are not perfect, with 15% of carbon dioxide escaping into the environment [7, p. 13].

Substantial discrepancies have been found between simulated energy efficiency penalties for CCS plants reported by vendors and the plants' actual operating performance [9]. The reported efficiencies were 8-15.4%, but resulted mostly from process simulations. The researchers warned that such information contrasts sharply with data from a "real world scenario": Energy losses would be required to capture, compress, transport, and store CO_2. Their calculations suggest energy penalties of between 43.5-48.6% (depending on whether CO_2 was liquefied or compressed) [9]. This is almost twice as large as projections from the industry. The conclusion [9, p. 9]:

"CCS is not presently a near-term measure for mitigating greenhouse gas emissions … In light of the tension between the current status of CCS and the need for rapid and deep emissions contractions … the value of further investment in CCS must be seriously questioned"

1.2 Under option 1, do you have any views on the proportion of generation capacity on which CCS demonstration should be mandated?

If switching from coal to gas is an option, then it is going to be very important to be able to roll out CCS in a relatively timely manner in order to decarbonise gas. Not only does CCS need to be economically viable for the plant – the necessary infrastructure needs to be publicly accepted and in place to transport and store the carbon dioxide. Currently this looks to be a long way off and note the comments on CCS in the previous section.

1.3 Might there be any unintended consequences for other forms of generation? Are there better alternatives, and if so, why? If so, do you have any evidence to support your suggestions?

Unintended Consequences

Policies that are "pro gas-fired power" could restrict investment in other low carbon technologies. There are also associated activities with gas-fired power that are unpopular with the local communities it affects: It could lead to increased shale gas exploration, and there will be a need to roll out infrastructure in order to transport captured carbon dioxide to storage.

Alternatives

The first, most cost-effective alternate would be continued investments in energy efficiency and demand side management. After that, policies for decarbonisation of power generation need to be coherent with decarbonisation of other energy sectors, in particular heating. In other words policies for power generation should not lead to co-dependencies on infrastructure, e.g. gas grid, creating barriers to decarbonising heating. Combined heat and power (CHP) plant, even using fossil fuels, can reduce overall emissions due to greater efficiency in resource use. However, CHP need heat distribution networks, that may need to replace gas pipework, and will be costly to install.

2 Constraint in years ahead of 2025 closure

2.1 Do you agree with the principle of establishing a constraint on coal generation in the years ahead of 2025?

Yes – this is sending appropriate signals to industry. The constraint on coal generation is very much in line with research findings on how to speed up decarbonisation of the electricity sector, and also how phase out policies are important in complementing energy innovation policy to send the right signal to companies [10], [11]. This should have positive implications for both renewable energy and also energy demand innovation. As is acknowledged coal plant closure can happen with little notice (but note this also applies to gas plants too). Therefore a strong policy direction will provide greater investor certainty to avoid risks in security of supply.

2.2 Have you any views on the extent to which a constraint might affect coal plants' ability to participate in the Capacity Market?

The Capacity Market on its own has been found to be ineffective in discouraging coal-fired power. In particular it has been found to be [12], [13]:

- Too focused on large power stations (such as coal)
- Providing finance to old coal-fired power stations (£1,7 billion in 2014 and £1.1 billion in 2015 auctions) plus subsidies for diesel fired power

We believe the Capacity Market should be radically reformed to include allowance for:

- Demand-side solutions including energy efficiency measures
- Integration of new technologies such as electricity storage

Ways to achieve this include [12]:

- Emissions performance standard (EPS) that prevents carbon intensive generation accessing the capacity market
- Dividing the auction into 2; one for old and one for new generation capacity with an EPS prohibiting the most polluting from participating
- Large gas plants i.e. >300MW to be built with CCS technology
- New capacity should be allowed to bid for contracts of up to 15 year to facilitate investor certainty
- Allowing demand side response providers to participate

2.3 Are there alternative ways of delivering the objective of phasing out coal generation by 2025 without negative impacts on the security of supply?

The consultation only seems to suggest that gas will fill the gap left by switching off coal. We believe that a whole system approach is needed with consideration of feasibility of decarbonisation across all energy sectors. Other technologies, e.g. electricity storage and demand side responses need to be looked into to determine the most cost effective pathway to decarbonisation of the power, heat and transport sectors.

There is significant potential in demand side management. There are a range of measures that could be applied including [14]:

- Improving efficiency of appliances; this can be most effective at least in the short term
- Improving thermal efficiency in buildings especially where electric heating is used
- Demand shifting through static time of use tariffs, which could provide a useful (but much smaller) contribution
- Direct load controls could be applied, though this maybe politically unpalatable

Demand side management measures reduce bills for consumers and improve security of supply, therefore making a valuable contribution economically, environmentally and politically.

Further research is needed in the UK as to whether these different approaches will be effective, particularly with the introduction of new loads such as electric vehicles.

3 Ensuring Security of Supply

3.1 With reference to the analysis set out in the Impact Assessment, what additional factors and evidence might we need to take account of to measure the impact on investment in replacement capacity?

The discussion in the consultation document relating to this question (Part 3) is largely about ensuring security of supply. The modelling "suggests that in both scenarios, the Capacity Market will ensure that there is sufficient capacity in place and that there will be no impact on the security of electricity supply" (#56). However what is missing from the discussion is energy *demand*.

Assumptions made about demand are crucial in determining sufficient capacity. Capacity needed to meet peak demand is highly dependent on policies to address energy efficiency, demand-side response and load shifting. Demand side management policies need to be included therefore in assessing the security of electricity supply. We suggest drawing on the Electricity Demand Reduction Pilot for an evidence-based policy proposal. In research at Imperial [14]:

"In the UK, the Electricity Demand Reduction Pilot is testing whether peak demand reduction could compete with generation, storage and demand response in the capacity market, although this pilot does not cover residential consumers at present."

This work [14] suggests that from the demand side, (electrical) efficiency might have a bigger impact on peak demand than demand shifting for residential users (e.g., through smart meters and time of use tariffs). This is at least in the near term, as demand response is still emerging in the UK.

Considering efficiency as a cost-effective competitor to generation is an idea that has already been successfully implemented elsewhere. For example, least cost requirements have succeeded in the US, where many states require supply-side investments to be tested against demand-side options before permits (e.g., for power plants or transmission lines) are issued [15].

In a European context it has been suggested "demand reduction should be seen as a policy option and infrastructure investment that can be actively deployed to address energy security problems" [16]. For example, Germany considers energy as one of two key pillars of its 'Energiewende' which aims at decarbonising its economy by increasing the share of renewable energies and reducing its energy demand [17].

In sum, we suggest:

- That additional factors and evidence should be considered when considering investment in replacement capacity, such as how energy demand, and specifically peak demand, are modelled, and assumptions applied

- That peak demand reduction, through electrical efficiency or other means, could potentially compete with increased or replacement generation in the capacity market.

4 Wider Impacts of Coal Closure

4.1 We would welcome views and supporting evidence on the wider impacts of regulating the closure of unabated coal by 2025, particularly where these are additional to what might be expected without this measure.

Implementing a coal phase-out strategy provides guidance on the direction of the future electricity system. It therefore sends a clear signal to investors that the government is committed to the UK's GHG emission targets. Such a signal can boost and speed up investments in low-carbon and energy efficient alternatives, both in terms of building new supply capacities and conducting R&D and pilots to develop low-carbon and energy efficient solutions [10].

A case in point is the German phase out policy for nuclear energy. This is seen by German manufactures of renewable power generation technologies as a main driver for the future expansion of renewable energy in the German electricity system, and as important driver for their corporate innovation expenditures. However, the same evidence suggests that it is key that such phase-out policies are embedded in a consistent policy mix. This should draw on a combination of instruments promoting demand for low-carbon alternatives (such as through predictable feed-in tariffs which support small to large scale renewable energy systems), stimulating innovation (such as through R&D grants) and broader system functioning (such as through skills training programs) [11].

To fully harness the positive innovation impact of a coal phase out policy, it calls for a design that provides investment certainty. The coal phase-out policy should also be coupled with the wider instrument mix implemented to achieve the UK's climate targets in a cost-effective manner, creating low-carbon business opportunities for innovative companies. Such a policy mix also creates potential to combine energy supply and energy demand considerations under one umbrella.

Impact of coal-fired power plant closure on the labour market [18]

The closure of coal-fired power plants will have a significant impact for several local communities. The job loss problem will be particularly severe for plants located far away from other industrial zones. The document states that:

"the losses of activity in the coal supply chain will to some extent be compensated by increased activity in supply chains for lower-carbon forms of generation."

However, it must be recognised that the positive effects will likely materialise in different geographical regions than those were the coal plants are located, and possibly for workers with different skills than those employed in the coal plants. In this situation, the government may consider playing an active role as a coordinator. This can, on the one hand, involve preparing job-centres and providing dedicated resources for the retraining of workers. On the other hand, the Government can inform representatives of business about the expected closures and encouraging them to channel investment to activities, which would create job opportunities for the workforce in the affected regions. The type of a pro-investment policy (tax holidays or workforce retraining) should depend on the expected size of job-loss.

In order to prepare communities for the forthcoming job losses, and to support business in preparation of appropriate job opportunities, we advise the Government to study in detail the skill and demographic structure of the workforce that will be affected by the closure.

Although the negative demand shock induced by the shift away from coal will have negligible effects for the aggregate UK economy, it might have noticeable consequences for several regions. Detailed economic projections for these regions can be performed using a macroeconomic model.

We suggest using a model that utilises input-output tables to account for the interlinkages between sectors, because such model would allow quantifying of the effect on GDP and employment not only in the coal power generation sector but also in the entire supply chain. We also advise the use of a model with high time frequency: 1 quarter, instead of 1 or 5 years commonly used in energy-related models.

High time frequency makes it possible to study in detail different paths of shutting down coal power plants and to assess welfare differences between various scenarios e.g. a rapid closure due vs. a gradual coal phase-out. Examples of the use of a high-frequency model to study the effect of resource policy on the labour market [19]. Since most of the existing coal power plants in the UK are located in two regions, it could also be beneficial to construct a regional model at the NUTS2 level (data permitting) instead of modelling the entire UK.

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