



2015 Spending Review: submission to HM Treasury by the Energy Technologies Institute

Efficiently decarbonising the UK energy system is vital for UK economic competitiveness, productivity and living standards

The efficiency with which the UK delivers reductions in its carbon emissions will have a major impact on its long term economic competitiveness and productivity.

- Energy is a key determinant of the cost of living – affecting real wages and living standards across the economy and all groups in society (particularly those on lower incomes)
- Energy is a key input to the UK's industrial cost base, particularly many manufacturing and process industries which have important broader economic linkages
- Direct spending on energy (solid and liquid fuels, gas & electricity) makes up around 7.5% of GDP. Total spending on meeting energy needs forms an even higher proportion of GDP, since it also includes complementary equipment and services (e.g. vehicles, buildings, appliances, heating systems etc). The future cost to business and consumers of low carbon energy services will be significantly influenced by the UK's broad strategic approach to decarbonisation.

Policy and spending decisions around low carbon energy will shape how efficiently the UK can transition to a low carbon future.

The UK can efficiently decarbonise its economy by developing, deploying and integrating known but currently underdeveloped energy technologies

The ETI is a public private partnership which is able to draw on the business and engineering expertise of key global players engaged in the UK energy sector. The ETI's analysis of the UK's low carbon transition is based on rigorous whole-system analysis informed by our public and private sector members and our portfolio of technology development and knowledge building projects. While modelling such as that carried out by the ETI cannot forecast the future or create 'blueprints' of the future shape of our national energy system, it clearly shows the importance of enabling a strategic and cost-effective approach to decarbonisation¹.

¹ Further details can be found in the ETI report 'Options, Choices, Actions: UK scenarios for a low carbon energy system transition', available via the ETI website www.eti.co.uk

- Our analysis shows that the UK can implement an affordable low carbon transition by 2050, based on developing, commercialising and integrating a basket of low carbon technology options, which are currently largely known but under-developed.
- The incremental (average annual) costs of carbon abatement across the national energy system (i.e. electricity networks, transport, heat, industry and infrastructure) could be contained at around 1% of GDP by 2050 within a coherent economy-wide market and policy framework. Failure to successfully develop and deploy key technologies could easily double this cost to the UK economy.
- Action in the next decade will be critical in preparing for and beginning the large-scale deployment of key technologies. Resources should be focused specifically on bringing a basket of the most promising options to genuine deployment readiness in the UK. A portfolio approach will limit inevitable implementation risks (and cost) in the future and should include: carbon capture and storage (CCS), new nuclear, offshore wind, gaseous systems, bioenergy, efficient vehicles and low carbon heat for buildings.

By the early 2030s we will need to have largely decarbonised electricity production and be initiating large scale deployment of low carbon heat and transport solutions.

It is vital to take a whole economy (or whole energy system) approach to policy for decarbonisation

The ETI's evidence-based analysis of the energy system transition demonstrates the importance of taking an economy (or 'national energy system') wide perspective. This contrasts with typical frames of analysis which often focus on one particular component of the energy economy (e.g. the electricity sector), or which emphasise narrow cost measures such as the 'levelised cost of electricity' of different energy generation options.

National energy system analysis can provide a broad evidence-based overview of the national cost impact of alternative pathways towards meeting carbon targets. Ultimately it is the overall economic cost of low carbon energy which drives the impact on national economic competitiveness. National energy system modelling provides the clearest basis for integrated analysis of the key determinants and choices which impact on the cost of delivering low carbon energy across the economy.

Energy system analysis and scenarios help to identify the broad shape of potential least cost energy systems. But there is clearly a risk that misaligned economic signals or market failures in the real world will drive investment choices that ultimately increase costs for consumers. For example, choices may be influenced by how costs are socialised across users of networks, or be shaped by decisions (e.g. on the allocation of policy support) based on narrow cost measures.

Flexible and versatile energy options offer high value to the UK's decarbonisation strategy which is only revealed by a whole economy perspective

ETI analysis points to the importance of flexible and versatile low carbon energy technologies which can be deployed in a range of applications across the energy system, most notably carbon capture and storage (CCS) and bioenergy. The value of these technologies is only revealed by a whole system analysis, rather than considering one component (e.g. the electricity sector) of the energy system. Versatility also means that the value of these technologies is robust across a range of potential futures.

By contrast less flexible technologies often appear less valuable when viewed as a component of a wider system. By way of example, whole system analysis suggests a limited role for solar generation, even with very optimistic assumptions about future cost reductions, in a least cost low carbon UK energy sector. This reflects the inherent characteristics of solar technology (supply is dependent on weather conditions and is not well matched with typical patterns of UK energy demand) as a component of a wider system.

Unless policy mechanisms and incentives internalise these wider system considerations there is a real risk that choices and resource allocation decisions will drive costs to a level which is higher than necessary. This has important implications for spending priorities and the design of policy frameworks to enable markets to drive an efficient approach to decarbonisation.

The UK needs to invest in developing a basket of the most promising low carbon energy options such that they can be deployed efficiently at largescale

To effectively position itself for an efficient transition to low carbon energy, the UK must develop and prove a basket of the most promising supply and demand technology options, such that they are genuinely 'deployment-ready' at large scale. Developing a basket of options (rather than a single blueprint) will help to limit inevitable implementation risks. Key technology priorities for UK decarbonisation include:

- Carbon capture and storage
- New nuclear (including both large-scale and small modular reactors)
- Offshore wind
- Gaseous systems
- Bioenergy
- Efficiency of vehicles
- Efficiency and low carbon heat for buildings

It is critical to focus resources in the next decade on preparing these options for wide-scale deployment. Preparedness entails not just technology development and first of a kind deployment, but also the development and proving of viable business models, operating and regulatory frameworks to underpin stakeholder and investor confidence. By the mid 2020s crucial decisions on long life infrastructure assets will need to be made, so it will be important to have greater clarity about our ability to deploy key options in practice.

Within this broad context there are important opportunities:

- The effective large-scale deployment of CCS and bioenergy are the two most important system-wide opportunities to contain abatement costs. Each can reduce low carbon UK energy system costs by circa 1% of GDP (compared with the cost of meeting carbon targets without their deployment)². Sensitivity analysis suggests that these findings are robust under a broad range of future scenarios. The ability (or failure) to deploy them has a huge impact on future energy infrastructure requirements, on which key decisions will be needed by the mid 2020s. Other technology options are important, but from an energy system perspective are more easily substituted.
- Delivering negative emissions from the 2030s onwards by combining bioenergy and CCS could unlock headroom for some continued use of fossil fuels where they are most costly to replace with low carbon alternatives. This would enable a much broader portfolio of options for future heat and transport systems, and enable the cost savings described above.

Spending decisions in the current parliament will be vital in determining UK success in low carbon energy

Clearly it is vitally important to contain the costs imposed on UK businesses and energy consumers by energy policies in the near and medium term. Given the importance of the UK meeting its climate change targets, it is equally important to continue investing in developing low carbon energy and options for the challenges ahead. This means that spending decisions in the current parliament are crucial.

In the short term policy mechanisms will need to effectively target resources on the most efficient and promising energy options. Crucially these decisions about priorities should take into account decarbonisation needs across the whole economy and all parts of the national energy system. There is a real risk that excessive focus on immediate cost reduction (using analysis based on partial cost metrics), or on electricity sector decarbonisation, will drive inefficiency into resource allocation and prioritisation.

In particular, ETI's system analysis highlights a need for additional and stronger policy focus on:

- **Carbon capture and storage**

A significantly stronger policy push will be needed to create the momentum and investor confidence required to deliver CCS in the power and industrial sectors at sufficient scale to enable CCS as a genuine option for large-scale deployment. This includes implementing the commercialisation programme projects, early investment in storage appraisal to overcome early

² ETI's latest modelling estimates savings significantly higher than 1% of GDP. However, figures based on modelled scenarios extending over 35 years into the future must always be used with caution and provide an indication of broad orders of magnitude. For these reasons we quote a more conservative order of magnitude estimate 'more than 1% of GDP'. Implicitly this (conservatively) allows for the potential that very steep abatement cost curves in future energy transitions without deploying both or either CCS or bioenergy would induce significant unanticipated innovation and efficiency improvements.

stage market failures, awarding further contracts for strategically valuable phase 2 projects before 2020, developing incentives for industrial CCS applications and creating clearer policy signals to bring forward a robust pipeline of projects. The creation of the Oil and Gas Authority provides a potential mechanism to positively shape the environment for investment and address market failures in developing North Sea carbon storage. ETI's insights report referenced below and supporting material contains further detail³.

- **Bioenergy**

As set out above, bioenergy is a key option to enable a least cost low carbon UK energy system⁴. ETI analysis also indicates that the UK could produce around 6% of its primary energy needs from sustainable domestic production of biomass. This could also enable improved land use productivity and develop new income streams for the farming sector. The cost savings arising from effective deployment of bioenergy are potentially more than 1% of GDP, while UK current agricultural production is lower at around 0.7% of GDP. By aligning energy, agricultural and land use policies intelligently the UK could stimulate the production of sustainable biomass with benefits for energy security, affordability as well as rural incomes. Immediate priorities for this parliament include a renewed focus on stimulating domestic plantings, as well as a comprehensive review of policies to improve incentives for sustainable production of biomass for energy (e.g. in thinking about the post-2020 shape of EU common agricultural policy and the UK's use of 'pillar 2' environment and rural development funds).

- **Heat**

ETI's work on low carbon heat for UK homes points to the need for early action to develop a succession of pilot schemes at increasing scales to test the design approach, build evidence and create confidence and capability to deliver integrated local area system solutions. Early pilots will also be critical in learning lessons about how to create attractive consumer propositions and an enabling policy framework⁵.

In terms of specific decisions around policy support within the levy control framework (or its successor) during this parliament it will be vital to ensure both effective targeting and balance in resource allocation, and the availability of sufficient resource to enable the development of a realistic portfolio of low carbon options.

In the short term, allocation decisions will shape the development of three key low carbon electricity options (offshore wind, new nuclear and CCS). Continuing to invest in developing and deploying offshore wind energy is an important investment for the UK. An effective capability to deploy offshore wind can mitigate the risk of deployment difficulties arising for other forms of low carbon electricity (e.g. new nuclear or CCS). While it is vital to ensure that the UK develops offshore wind capability to deploy this technology, and that cost reduction continues, it is also equally vital to ensure that early deployment does not absorb a disproportionate share of available policy support.

³ ETI insights report: Building the UK carbon capture and storage sector by 2030 – scenarios and actions, available via www.eti.co.uk

⁴ ETI insights report: Insights into the future UK bioenergy sector, gained using the ETI's bioenergy value chain model, available via www.eti.co.uk

⁵ ETI insights report: Decarbonising heat in UK homes, available via www.eti.co.uk

Sufficient policy support resources should be retained to enable substantial progress in the development of both new nuclear and carbon capture and storage during this parliament. ETI is currently developing further analysis around nature of these requirements, the minimum costs in terms of policy support requirements, as well as the consequences of failing to invest sufficiently.

Current approaches to decarbonisation policy (and expenditure decisions) could be reformed to unlock an efficient transition to a low carbon future

Current policy and spending on low carbon energy has the following characteristics:

- It comprises a complex range of policy interventions and mechanisms for allocating policy support, which has the effect of limiting investor confidence in long-term signals.
- The contracts for difference feed in tariffs created under the Coalition government's electricity market reform programme (EMR) is now the dominant mechanism for delivering further policy support for low carbon energy. This means that decisions about policy support for low carbon energy are dominated by electricity sector considerations. Current approaches to allocating CFDs are complex and technology-specific, with bespoke negotiation for two of the most important options: new nuclear and CCS.
- The stated intention under electricity market reform is to move towards competitive auctions to reveal the lowest cost sources of low carbon electricity. ETI's system wide analysis shows that this is crucially different from the lowest cost approach to delivering emissions reductions across the economy. In effect there is no mechanism for valuing the contribution of flexible, versatile technologies which can be applied across the energy system (ie not just within the electricity sector). Outside the electricity sector the rewards for delivering emissions reductions remain much less clear cut (e.g. in heat or industry) inhibiting incentives for investment and innovation.
- The costs of maintaining security of supply in electricity are socialised through the capacity mechanism, although the contribution to system security of supply varies significantly across different forms of generation.
- The approach of financing policy support through energy bills leads to a more regressive impact on consumers than would be the case if costs were recovered through taxation.
- The approach to containing policy costs (through the levy control framework) means that imputed spending is driven to a significant extent by short term movements in energy prices, introducing instability into long term decarbonisation policy.

Given the size and complexity of the challenges around decarbonisation it is easy to see how this has arisen. However, given resource constraints it is vital to build confidence that policy support is being allocated efficiently, to broaden the frame of reference beyond the electricity sector and to consolidate and simplify energy policy. This could significantly lower policy costs, help to improve investor confidence and lower the cost of capital for low carbon investment. Two broad approaches to this appear possible:

- Continued use of **technology-specific approaches to allocating policy support** under a reformed approach to controlling spending on low carbon energy.
 - Giving greater visibility to investors by clarifying the medium term shape of policy support, including removing the dependence between available policy resources and short term movements in energy prices (as is currently the case under the levy control

framework). This will improve the ability of policy to bring forward private sector investment in supply chains and early deployment of key technologies.

- Improving the targeting of limited resources by moving away from a primary emphasis on lowest strike prices to differentiate between projects in contract allocation, while introducing explicit recognition of the wider system contribution of different generation technologies in the operation of the EMR framework. Decisions about the rate of deployment of individual technologies would reflect both their near term cost-effectiveness in delivering emissions reductions, as well as medium term considerations around developing the deployment-readiness of key options (e.g. offshore wind, new nuclear & CCS) and UK capabilities to deliver at scale.
- The frame of reference should be broadened to encompass all elements of the energy system (i.e. including industry, heat and transport) and to focus on preparing and proving the portfolio of most promising technologies.

For example, under this approach decisions about how much of the policy support 'pot' to allocate to CCS, and the choice of projects within that allocation, would explicitly reflect their strategic value to broader UK decarbonisation and development of the CCS sector. Market mechanisms would need to be adapted accordingly.

- Alternatively policy could move over a transitional period towards the creation of **a clearer long-term framework to underpin economy-wide carbon price signals**. Carbon constraints which are binding within markets, and associated carbon price signals, would become the primary means for incentivising investment in low carbon innovation, technology development and deployment. One broad approach to this could be to translate existing legally-binding UK carbon targets and budgets into steadily tightening decarbonisation targets applied across electricity, heat and transport fuels, while allowing for trading of emissions reductions between these sectors and the emergence of a near economy-wide carbon price (covering 85% of emissions).

This approach would place private sector investment and decision making at the heart of decarbonisation investment, and improve long term visibility to investors (e.g. as is currently the case for investment by vehicle manufacturers in response to the emissions standards they face). This would allow for policy support to be focused mainly on addressing innovation market failures rather than deployment, and would mean less involvement by policy-makers in detailed allocation decisions around deployment.

A further area which merits consideration under the spending review is the significant potential to integrate decarbonisation into broader policies and spending decisions on infrastructure, land use, agriculture and transport. Spending decisions in these areas will significantly influence UK ability to deliver economy-wide decarbonisation, so it would be surprising if there were not significant opportunities to realise synergies, thereby delivering better value for consumers and taxpayers.

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