The Fifth Carbon Budget - Call for Evidence

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Question and Response form

When responding please provide answers that are as specific and evidence-based as possible, providing data and references to the extent possible. Please limit your response to a maximum of 400 words per question.

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Questions for consideration:

A. Climate Science and International Circumstances

Climate science and international circumstances are important criteria in setting carbon budgets.

- The science indicates the impacts associated with different levels of climate change and the limit on emissions globally if these risks are to be contained.
- International circumstances inform the prospects of future action to reduce emissions globally, potential requirements of the UK to contribute to those actions, and prospects for low-carbon technology development and carbon pricing.
- The EU places obligations on Member States to reduce emissions to contribute to reductions in the bloc as a whole. These imply a minimum level of effort for the UK's carbon budgets.

The Committee intends to draw primarily on the work of the IPCC, as published in the Fifth Assessment Report, in assessing the implications of climate science for the budget advice

The Committee's advice is based on a climate objective to limit central estimates of temperature rise to as close to 2°C as possible, with a very low chance of exceeding 4°C by 2100 (henceforth referred to as "the climate objective"). This is broadly similar to the UNFCCC climate objective, and that of the EU.

In order to achieve this objective, global emissions would have to peak around 2020, before decreasing to roughly half of recent levels by 2050 and falling further thereafter.

The UNFCCC is working toward a global deal consistent with such reductions. Individual parties are submitting pledges for effort beyond 2020, with the details of the agreement to be discussed in Paris late in 2015.

The EU has agreed a package that requires a reduction in emissions of at least 40% on 1990 levels by 2030, on the way to an 80-95% reduction by 2050. The UK Government supported this package, while arguing for an increase to 50% in the context of a global deal.

The US and China have jointly made pledges for the period beyond 2020. The US has pledged a reduction of 26-28% by 2025 versus 2005, requiring a doubling of the rate of carbon reduction compared to 2005-2020 and on a trajectory to economy-wide cuts of the order of 80% by 2050. China has pledged to peak CO_2 emissions around 2030, and to make best efforts to do so earlier.

Question 1 *The IPCC's Fifth Assessment Report will form the basis of the Committee's assessment of climate risks and global emissions pathways consistent with climate objectives. What further evidence should the Committee consider in this area?*
ANSWER:

Question 2 *To what extent are the UN talks in Paris likely to have implications for the Committee's advice beyond the pledges and positions announced in advance of the talks?*
ANSWER:

Question 3 *Based on the available evidence, does the EU 2030 package reflect the best path to its stated 2050 ambition? How might this package change, specifically its targeted emissions reduction, either before the end of Paris or after Paris?*
ANSWER:

Question 4 *How does the UK's legislated 2050 target affect its ability to support international efforts to reduce emissions, including its position in negotiations? Does the level of UK carbon budgets have any additional impact (over-and-above the 2050 target) for the UK in international discussions?*
ANSWER: The UK reports Greenhouse Gas Emissions from a territorial basis, including all the emissions that occur within the territory of the UK. However, the UK is one of the largest net importers of emissions embodied in trade in the world. While emissions continue to decline (albeit at a relatively slow rate) within the UK, the emissions associated with the imports of products consumed by the UK are not

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reducing with an increase in the emissions in 2012. These emissions are not included in the UK 2050 carbon target to reduce 1990 level emissions by 80%. The UK's boasts of cutting carbon emissions are illusory because the carbon embedded in imports outweighs the savings at home. UK territorial emissions have reduced by 194 Mt in 2012 compared to 1990. Net emissions embodied in trade added an additional 280 Mt in 2012 (see attached brief 'Climate Change targets must reflect the impacts of our consumption').

The emissions included under the UK's current 2050 target have reduced while aviation, shipping and emissions embodied in net trade, which are excluded from the target, have increased. With increasing global trade, emissions accounting and setting targets from a territorial perspective doesn't counteract the adverse impacts globally driven by a nation's consumption.

Research undertaken by the CCC and the University of Leeds demonstrated that even with deep cuts in global emissions, the UK would remain a net importer of global emissions in line with trends in imports up to 2050. If the UK was to take responsibility for these additional emissions, then the target would have to change. At present, the UK has a legally binding commitment to reduce territorial emissions by 80% by 2050 based on 1990 levels. With the additional emissions included, the UK would need to achieve an 80% cut ten years earlier (80% reduction by 2040). Instead of emission reductions of 2% a year, the UK would need to reduce emissions at a rate of 3.5%. Without the tightening of the target and an increase in the rate of annual reductions, the UK will not achieve the intended climate outcome associated with the existing target.

B. The cost-effective path to the 2050 target

The carbon budgets need to set a path that is achievable from today without being over-optimistic about what is achievable in later periods to prepare for the 2050 target.

The Committee has previously set out scenarios for 2030 that balance effort before 2030 with potential opportunities from 2030 to 2050. The scenarios aim to include ways of reducing emissions that are likely to be relatively low cost and actions that will develop options that may need to be deployed at scale by 2050.

These scenarios, reviewed in detail in the Committee's report *The Fourth Carbon Budget Review – the cost-effective path to the 2050 target*, include substantial investment in low-carbon power generation, roll-out of low-carbon heat (heat pumps

and district heating), development of the markets for ultra-low emissions vehicles and a combination of energy efficiency measures and fuel switching in industrial sectors.

The scenarios also reflect detailed assessments of what is practically deliverable, and the Committee monitors progress towards them as part of its statutory duties. The *2014 Progress Report to Parliament* indicated that current policy would not be enough to meet the fourth carbon budget, but that the 'policy gap' could be closed at affordable cost.

The set of policy options required to close the gap include:

- Strengthening the EU Emissions Trading System.
- Setting a clear objective for Electricity Market Reform (EMR) beyond 2020.
- Focusing on low-cost residential energy efficiency.
- Simplifying policies targeting commercial energy efficiency.
- Tackling financial and non-financial barriers to low-carbon heat.
- Pushing for strong EU targets for new vehicle efficiency in 2030.

The Government has subsequently published various documents, including its formal response, as required under the Climate Change Act, and the National Infrastructure Plan. The Plan includes investments of around £100 billion in low-carbon power generation in the 2020s, in line with the scenarios from the EMR Delivery Plan that reach 100 gCO_2/kWh by 2030. It also has significant investments in offshore oil and gas and in the road network. This includes £15 billion of new spending on roads and around £50 billion on offshore oil and gas.

Question 5 ***In the area(s) of your expertise, what are the opportunities and challenges in reducing emissions to 2032, and at what cost? What may be required by 2032 to prepare for the 2050 target, recognising that this may require that emissions in some areas are reduced close to zero?***

ANSWER:

One of the most significant opportunities to reduce emissions, particularly in the short term is to reduce demand for energy. Energy demand is driven by multiple factors beyond the remit of DECC and requires a government wide response to ensure that all government policy will lead to a reduction in energy use. For example, the National Infrastructure Plan, transport policy and taxation can all have

a significant effect on energy demand.

Evidence shows that the energy demand of the UK economy has barely reduced for the past 20 years, despite widespread energy efficiency policies. From a consumption perspective, in 1990, the primary energy demand of the UK economy was 11.5 EJ and in 2011 it was 11.0 EJ[1]. If less is achieved through reducing demand for energy; energy supply will have to decarbonise further and faster significantly increasing the cost of abatement. Furthermore, demand reduction is an important transition mechanism while effective supply-side technologies are developed[2].

Demand reduction can provide many parallel benefits, including fuel poverty alleviation, energy security, lower public health spending and job creation[3]. Furthermore, it could reduce the need to invest in new supply capacity and grid reinforcement and requires no technological breakthrough. Despite this importance, support for demand reduction is marginalised in comparison to supply technologies[4].

It's important to note that the majority of current policies are based on energy efficiency (using fewer units of energy for each unit of output) not a reduction in energy consumption (reducing absolute demand for energy). Energy efficiency does not necessarily lead to a reduction in energy use. Considerable evidence of rebounds effects demonstrate that efficiency gains drive further economic growth that, in turn, drive growth in energy consumption[5,6].

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[1] Department for Environment, Food and Rural Affairs (2014) Defra Official Statistics Release: UK's Carbon Footprint 1997 – 2011, available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/261692/Consumption_emissions_28_Nov_2013.pdf

[2] Pye, S., Usher, W. & Strachan, N., 2014. The uncertain but critical role of demand reduction in meeting long-term energy decarbonisation targets. *Energy Policy*, 73, pp.575-586.

[3] IEA, 2014. *Capturing the Multiple Benefits of Energy Efficiency*,

[4] Wilson, C. et al., 2012. Marginalization of end-use technologies in energy innovation for climate protection. *Nature Climate Change*, 2(11), pp.780-788.

[5] Saunders H. D. (2013). Historical evidence for energy efficiency rebound in 30 US sectors and a toolkit for rebound analysts. Technological Forecasting and Social Change 80, 1317

[6] Blanco G., R. Gerlagh, S. Suh, J. Barrett, H. C. de Coninck, C. F. Diaz Morejon, R. Mathur, N. Nakicenovic, A. Ofosu Ahenkora, J. Pan, H. Pathak, J. Rice, R. Richels, S. J. Smith, D. I. Stern, F. L. Toth, and P. Zhou, 2014: Drivers, Trends and Mitigation. In: Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

As technological solutions become more expensive as budgets get tighter, DECC would benefit from broadening its remit to consider the role of resource efficiency to reduce energy demand. Considerable evidence exists that demonstrates significant emission reductions and cost savings for companies and households[7,8].

Question 6 ***What, if any, is the role of consumer, individual or household behaviour in delivering emissions reductions between now and 2032? And, separately, after 2032?***

ANSWER:

Question 7 ***Is there evidence to suggest that actions to further reduce emissions after 2032 are likely to be more or less challenging to achieve than actions in the period up to 2032?***

ANSWER:

Question 8 ***Are there alternatives for closing the 'policy gap' to the fourth carbon budget that could be more effective? What evidence supports that?***

ANSWER: Energy efficiency policy in Europe, and in the UK in particular, has evolved to focus on technologies that use energy, such as buildings and energy-using products and on efficiency, not absolute reduction. Furthermore, many countries, like the UK, rely on market forces to deliver energy efficiency programmes. It is important that momentum on building and product efficiency is maintained, however, there must be a parallel debate to address a series of limitations of this approach in achieving energy demand reduction.

[7] Barrett, J. et al 2014 Benefits and savings from better use of material resources and energy

[8] Barrett, J. and Scott, K. (2012) Link between climate change mitigation and resource efficiency: A UK case study, *Global Environmental Change*, **22**, pp.299-307

Wider drivers of energy demand: energy demand is driven by a complex range of factors including; infrastructure, economics, habits and social norms. In this way it is a socio-technical system[9]. Many of the factors that influence energy demand are affected by policy in departments with no responsibility for energy or climate change. For example, decisions on road buildings, public transport and spatial planning will affect the demand for energy from transport; planning policy and building codes will affect demand from residential buildings; economic policies on VAT rates, interest rates, banking reserves all affect energy demand from industry and households. A focus on energy technology and on market forces alone will not deliver change in a complex socio-technical system.

This is a particular challenge for industrial emissions, where the most significant driver of emissions is the total physical output of the sector – the more units of product produced the more emissions are produced. In addition to energy efficiency (producing each unit of product with less energy) one of the most effective ways to reduce emissions is to reduce the physical output of key industrial sectors[10,11]. This would be possible without affecting consumers' wellbeing or companies' profits by extending products lifetimes, using products more intensively (for example using a car club, rather than owning a car) and selling produce service systems, rather than products.

Rebound effect: The effects of energy efficiency on demand reduction can be further diminished by what are termed rebound effects. Rebound effects can be direct; for example if a car is more fuel efficient the owner may choose to drive further, offsetting any energy savings. They can also be indirect; for example the savings from fuel costs of a more efficient car could be spent on other goods, which require energy to produce. And finally, a reduction in fuel demand could reduce fuel prices and increase fuel consumption in other parts of the economy. There is growing evidence to suggest that rebound effects can offset or eliminate savings from energy efficiency. While they are likely to be less than 100% (which would result in no benefit), they are likely to be significant (in the region of 65-80%). These are most significantly due to economy-wide changes such as market price and economic growth effects, adjustments in capital stocks as well indirect emissions associated with new energy infrastructure[12].

[9] Verbong, G.P.J. & Geels, F.W., 2010. Exploring sustainability transitions in the electricity sector with socio-technical pathways. *Technological Forecasting and Social Change*, 77(8), pp.1214-1221.
[10] Allwood, J. And Cullen, J. (2012) Sustainable Materials with Both Eyes Open
[11] Barrett, J. and Scott, K. (2012) Link between climate change mitigation and resource efficiency: A UK case study, *Global Environmental Change*, **22**, pp.299-307
[12] Saunders H. D. (2013). Historical evidence for energy efficiency rebound in 30 US sectors and a toolkit for rebound analysts. Technological Forecasting and Social Change 80, 1317

Low price elasticity: energy price elasticity is low, meaning that broad-brush market-based instruments, like taxes, which aim to drive behaviour change by increasing the cost of energy, have limited success. This is compounded by the presence of a series of market barriers to reducing energy demand. Furthermore, in the face of rising energy prices, politicians are unwilling to tax at the level necessary to drive behaviour change. Therefore, broad economic instruments like taxes and cap and trade, on their own, are unlikely to be the most efficient way to reduce energy demand.

How might we address these limitations?

An economy-wide approach that focuses on demand reduction is needed to overcome the challenges of the rebound effect and to address the wider drivers of energy consumption. Furthermore, energy demand policy needs to move from relying on orthodox economic instruments to those that address the socio-technical system that drives energy consumption.

The current lack of co-ordination across government departments could be addressed, and action on demand accelerated, if a cross-government target for primary energy demand reduction was enforced alongside the current target for emissions reductions. This would increase the focus of policy makers on the rebound effect and result in interventions that better represent the breadth of drivers of energy consumption.

A wider range of interventions, beyond those that rely on orthodox economic assumptions about economic rationality and autonomous decision making must be developed to address the infrastructural and social factors locking us into current patterns of energy demand. This can include providing appropriate information by trusted individuals, benchmarking against others' performance and ensuring that default options are energy efficient[13].

Mechanisms that apply only to the change in demand, not the whole of demand, could overcome some of the market barriers to demand reduction. This would also reduce the political risk of intervention because the ratio of energy reduction to revenue transfer would be high[14]. An example of this would be a Feed in Tariff

[13] Sorrell, S., 2014. Reducing energy demand: A review of issues, challenges and approaches. SPRU Working Paper series SWPS 2014-22.

[14] Eyre, N., 2013. Energy saving in energy market reform — The feed-in tariffs option. *Energy Policy*, 52, pp.190-198.

(FiT) for demand reduction, where a payment is made for monitored reduction in energy usage, similar to the current FiT for generation of renewable energy[15]. A price-based mechanism (like a FiT) has advantages over a quantity-based mechanism (like white certificates) because it is more likely to encourage new entrants[16]. Furthermore, the transparency and bankability of FiTs can lower the risk and cost of finance, which can be a significant barrier to energy demand reduction[14].

A focus on materials and products, as well as energy use in industry could reveal a wider range of policies to reduce industrial energy demand. This might include requiring longer warranties on products to encourage longer lifetimes, tax relief for service-based business models offering real material and produce efficiency, and extending eco-design requirements to include product durability and reparability.

It is well recognised that there is an inherent paradox in the business models of the traditional utilities, based on a volume of energy sold model, and the need to reduce final demand[17]. What are needed are policy instruments to facilitate new business models in the energy sector that are more compatible with the reduction of final demand[18]. Recent work has detailed new business models in the electricity sector that are more suited to delivering final demand reduction, and suggested short, medium and long term policy responses that could enable these business models to proliferate in the energy sector[19]. Electricity market reform should be extended to include a real focus on business models based on demand management.

[15] Bertoldi, P., Rezessy, S. and Oikonomou, V. 2009. Feed-in tariff for energy saving: thinking of the design. Proceedings of the ECEEE summer study 2009.
[16] Mitchell, C., 2010. *The political economy of sustainable energy*, Palgrave Macmillan.
[17] Sousa, J. L., Martins, A. G., & Jorge, H. (2013). Dealing with the paradox of energy efficiency promotion by electric utilities. *Energy*, *57*, 251-258.
[18] Roelich, K., Knoeri, C., Steinberger, J. K., Varga, L., Blythe, P. T., Butler, D., ... & Purnell, P. (2015). Towards resource-efficient and service-oriented integrated infrastructure operation. *Technological Forecasting and Social Change*, *92*, 40-52.
[19] *Hall, S., Roelich, K., (2015) Local Electricity Supply: Opportunities, archetypes and outcomes. Ibuild/RTP Independent Report. March 2015, Available online at: https://research.ncl.ac.uk/ibuild/outputs/local_electricity_supply_report_WEB.pdf*

Question 9 ***Are the investments envisaged in the National Infrastructure Plan consistent with meeting legislated carbon budgets and following the cost-effective path to the 2050 target? Would they have wider implications for global emissions and the UK's position in international climate negotiations?***

ANSWER: Many of the investments in the National Infrastructure Plan (NIP) are not consistent with the scale and speed of emissions reductions needed to meet carbon budgets and could constrain our ability to meet long-term targets. The NIP constitutes one of the 'wider drivers' of energy demand described in the response to question 8. Investment in new road infrastructure for private, fossil fuel powered transport could increase demand for fossil fuel dependent modes[20] Furthermore, there is a great deal of evidence that much of the remaining reserves must stay in the ground if we are to achieve the necessary scale of emissions reductions[21]. Therefore, continued support for the oil and gas industry could damage our potential to achieve targets as well as weakening the UK's negotiation position in international agreements.

C. Budgets and action

The UK's statutory 2050 target requires actions across the economy to reduce emissions. Many of these actions will be driven by (UK and devolved) Government policy and implemented by businesses and consumers. There will be an important role for Local Authorities in successful delivery.

Although the carbon budgets do not require specific actions, they provide an important indication of the overall direction that policy will take in future. Once set, carbon budgets can only be changed if there has been a significant change in the relevant circumstances set out in the Climate Change Act.

Feedback from businesses as part of the Committee's 2013 Call for Evidence for the review of the fourth carbon budget was that stability is an important and valuable characteristic of carbon budgets.

Question 10 ***As a business, as a Local Authority, or as a consumer, how do carbon budgets affect your planning and decision-making?***

[20] Goodwin, P. B. (1996). Empirical evidence on induced traffic. *Transportation*, *23*(1), 35-54.
[21] McGlade, C. E., & Ekins, P. (2014). Un-burnable oil: an examination of oil resource utilisation in a decarbonised energy system. *Energy Policy, 64 (1)*, 102-112.

ANSWER:

Question 11 ***What challenges and opportunities do carbon budgets bring, including in relation to your ability to compete internationally? What evidence do you have for this from your experience of carbon budgets to date?***

ANSWER:

Question 12 ***What would you consider to be important characteristics of an effective carbon budget? What is the evidence for their importance?***

ANSWER: Important characteristics of the budget include:

- Assigning the net emissions embodied in trade to the UK (as discussed in Question 4 above);
- Increasing the probability of limiting temperature rise; and
- Sharing emissions fairly.

The current UK target to reduce emissions by 80% is based on the contraction of global cumulative emissions to have a 50% probability of limiting temperature rise to 2 degrees and less than 1% probability of reaching four degrees, and an assumed UK allowance equivalent to equal global per capita emissions in 2050. However, the target indirectly implies that other countries in the world have a smaller proportion of the remaining carbon budget based on the size of their population in 2015. Figure 3 gives some insights into what the carbon budget could be for the UK under a different set of assumptions on how to distribute the remaining global carbon budget.

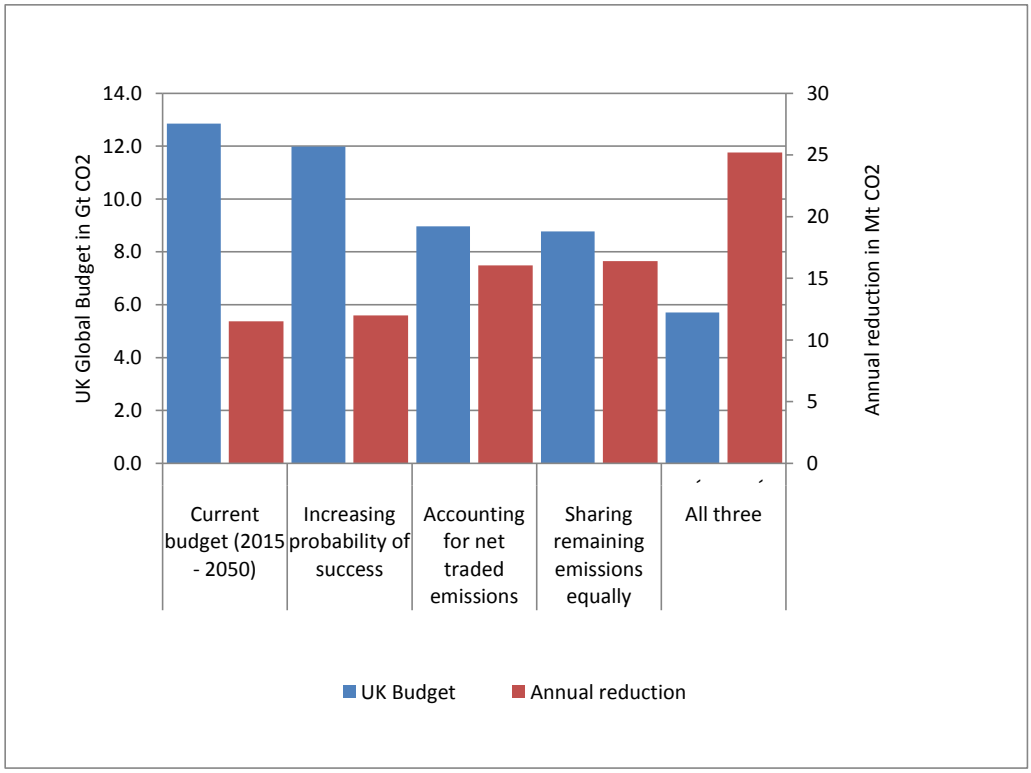

Figure 1: Allocation of the global carbon budget to the UK

The current target of 80% in the UK implies a budget of 13 Gt from 2015 to 2050 based on a linear annual reduction. If the UK were to assume a probability of 60% as opposed to the current 50% for achieving the two degree target, then the overall budget would reduce by 1 Gt, meaning the 80% target would need to be brought forward a year. As previously discussed, accounting for the net traded emissions would bring forward the target to 2040. Finally, if the remaining global carbon budget was shared evenly based on today's population the UK's target would also be brought forward to 2040. If all three assumptions were adopted, then the UK would need to achieve its carbon target by 2031 and double the annual rate of emission reduction. The UK has already set establish carbon budgets up to 2027 and these budgets are not in line with the assumptions shown in figure 1. To achieve the same climate outcome, deeper and faster cuts would need to be made after 2027.

D. Other issues

The Climate Change Act requires that in designing the fifth carbon budget we consider impacts on competitiveness, fiscal circumstances, fuel poverty and security

of energy supply, as well as differences in circumstances between UK nations. High-level conclusions on these from our advice on the fourth carbon budget were:

- **Competitiveness** risks for energy-intensive industries over the period to 2020 can be addressed under policies already announced by the Government. Incremental impacts of the fourth carbon budget are limited and manageable.

- **Fiscal impacts**. The order of magnitude of any fiscal impacts through the 2020s is likely to be small, and with adjusted VED banding and full auctioning of EU ETS allowances could be neutral or broadly positive.

- **Fuel poverty**. Energy policies are likely to have broadly neutral impacts on fuel poverty to 2020, with the impact of increases in electricity prices due to investment in low-carbon generation being offset by energy efficiency improvement delivered under the Energy Company Obligation. Incremental impacts through the 2020s are likely to be limited and manageable through a combination of further energy efficiency improvement, and possible income transfers or social tariffs.

- **Security of supply** risks due to increasing levels of intermittent power generation through the 2020s can be managed through a range of flexibility options including demand-side response, increased interconnection and flexible generation. Decarbonisation of the economy will reduce the reliance on fossil fuels through the 2020s and thus help mitigate any geopolitical risks of fuel supply interruption and price volatility.

- **Devolved administrations**. Significant abatement opportunities exist at the national level across all of the key options (i.e. renewable electricity, energy efficiency, low-carbon heat, more carbon-efficient vehicles, agriculture and land use).

Question 13 ***What evidence should the Committee draw on in assessing the (incremental) impacts of the fifth carbon budget on competitiveness, the fiscal balance, fuel poverty and security of supply?***

ANSWER:

Question 14 ***What new evidence exists on differences in circumstances between England, Wales, Scotland and Northern Ireland that should be reflected in the Committee's advice on the fifth carbon budget?***

ANSWER:

Question 15 ***Is there anything else not covered in your answers to previous questions that you would like to add?***

ANSWER: In relation to our answer to question 9, very little work has been done on induced energy demand through city-regional infrastructure investment. Whilst the Committee has paid attention to the importance of the National Infrastructure Plan, there needs to be much more emphasis on the infrastructure investment decisions being made by the city-regions and LEP areas of the UK, which often fall out of the NIP scope. In the recent round of devolution UK cities received new powers on infrastructure spending. In the past infrastructure projects such as transport investments were subject to a common appraisal method in WEBTAG at DfT which was able to account for GHG impacts. In the current formation, a great deal of infrastructure spending is being prioritised by land use intensification models which select schemes based on Gross Value Added for city-regions. Implicitly these models favour more and faster mobility, which in turn locks in city-regional infrastructure investment decisions to higher carbon trajectories. Much more work needs to be done on the implications of city regional decision support tools on national carbon accounts. Contact s.hall@leeds.ac.uk