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# Technical Annex 1 - Economy-wide progress

This Technical Annex supports the Economy-wide chapter of the report *Meeting Carbon Budgets - 2016 Progress Report to Parliament* covering the following sections:

1. Estimating the change in temperature-adjusted emissions
2. The impact of planned infrastructure on meeting carbon budgets

## 1. Estimating the change in temperature-adjusted emissions

Variations in weather can have a substantial effect on energy consumption in some sectors and therefore associated CO<sub>2</sub> emissions. In particular, winter temperatures influence demand for heating fuels while summer temperatures currently play a relatively small role (since energy demand for cooling is significantly lower than demand for heating).

While the winter months of 2015 (i.e. January, February and December) were slightly warmer (by on average 0.4 °C) than those of 2014 the total number of heating degree days<sup>1</sup> was higher than in 2014 resulting in higher energy use and higher emissions, mainly in the residential sector<sup>2</sup>.

We have applied DECC estimates of the 'temperature-adjusted' change in energy consumption from 2014 to 2015 (i.e. how energy consumption would have changed without the increase in the number of heating degree days). We have then used our own estimates of CO<sub>2</sub> emissions intensity in 2015 for relevant fuels to calculate the effect of weather variation on emissions. This approach allows us to review underlying progress, removing the year-to-year variations in temperature, which is also useful in assessing emission trends.

Total greenhouse gas emissions in 2015 fell by 3.4%, but adjusting for temperature variation they would have dropped by 4%, mainly as a result of lower energy use for heating in residential and non-residential buildings. For CO<sub>2</sub> only, emissions fell by 4%, but would have fallen by 5% when adjusting for temperature.

DECC publish their own estimates of temperature-adjusted CO<sub>2</sub> emissions which they also estimate would have fallen 5% in 2015.<sup>3</sup> DECC's methodology adjusts emissions directly, as opposed to energy consumption, and as such it may capture second-order impacts such as fuel switching. Our aim is to identify the impact of fuel switching separately and we thus continue to temperature-adjust energy demand rather than CO<sub>2</sub> emissions.

## 2. The impact of planned infrastructure on meeting carbon budgets

Infrastructure can increase GHG emissions through embodied emissions, increasing demand for fossil fuels, and increasing supply of fossil fuels.

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<sup>1</sup> Heating degree days measure the demand for energy needed to heat a building, given the outside air temperature and specific location.

<sup>2</sup> See DECC's Energy Trends, section 7, at <https://www.gov.uk/government/statistics/energy-trends-section-7-weather>

<sup>3</sup> See Provisional UK greenhouse gas emissions national statistics 2015, Table 4 at <https://www.gov.uk/government/statistics/provisional-uk-greenhouse-gas-emissions-national-statistics-2015>

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## Embodied emissions

Embodied emissions are GHGs emitted at each stage in the infrastructure value chain, from extraction of raw materials, through transport and processing of products and materials, to construction.

Our advice on carbon budgets is underpinned by Government projections of energy demand and emissions. It is difficult to assess whether the investments in those areas covered in the National Infrastructure Delivery Plan are consistent with these projections. There is a small projected increase in spending on infrastructure in the Delivery Plan but the impact on emissions is uncertain and there is scope to moderate any increase through best practice:

- Government projections of energy demand and resulting emissions are based on historical trends across individual economic sectors, constrained by economy-wide assumptions for macro-economic and demographic factors, such as GDP and population. They do not explicitly incorporate the impact of specific infrastructure projects. These projections might not reflect the impact on emissions of an increase in infrastructure spending if the investments:
  - are additional to the rate of investment in the economy accounted for in GDP assumptions
  - do not displace similarly carbon-intensive investments elsewhere in the economy.
- The National Infrastructure Development Plan sets out an expected average annual infrastructure expenditure of £50 billion between 2015/16 and 2018/19. This is similar to historical expenditure on infrastructure of around £46 billion per annum over the last 10 years. Historical estimates are based on a top-down calculation whereas future estimates are based on a bottom-up calculation of spending on projects in the National Infrastructure Pipeline. Due to these different methodologies, historical and future estimates are not directly comparable, so the actual difference may be larger.
- Embodied emissions from infrastructure can be reduced through best practice approaches, such as reducing the amount of material used for a specific project, so-called 'material efficiency', or using less carbon-intensive materials in construction. Such measures are not currently included within CCC scenarios, due to a lack of evidence on the potential scale of their impact on UK emissions.

We will work with DECC to understand the extent to which the impact of additional investment in infrastructure is included within the energy and emissions projections. We will also assess the potential for measures to reduce embodied emissions in construction.

## Demand for fossil fuels

### *Roads*

As well as investing in measures that reduce demand for car travel, such as investment in cycling infrastructure, DfT is carrying out a programme of investments in the road network that are likely to slightly increase overall travel demand.

The National Infrastructure Pipeline includes the Road Investment Strategy, comprising around £15 billion of expenditure to improve the Strategic Road Network between 2015 and 2021. The

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investment is weighted towards improving existing roads, rather than building new roads and is therefore likely to lead to a relatively small increase in traffic and emissions:

- Around £9 billion is allocated to road widening, smart motorways and junction improvements, with the remaining £6 billion being used for resurfacing. DfT estimates that the investment will result in a less than 1% increase in additional lane miles on the network.
- In its impact assessment, DfT estimate the additional traffic and associated CO<sub>2</sub> emissions caused by these projects. These investments are modelled using the National Transport Model as increases in capacity on the network. The estimated impact is a 0.2% increase in vehicle-km and a 0.1-0.2% increase in CO<sub>2</sub> emissions by 2040.
- The National Transport Model is not designed to model these types of investments, so does not fully capture the impact of the Road Investment Strategy and is likely to underestimate the impact on emissions. However, even taking account of this potential bias, the impact appears small.

Whilst the impact of the first Road Investment Strategy is likely to be small and manageable, the Government is currently considering options for a second Road Investment Strategy from 2020 to 2025, which could include a more significant programme of road building. If this results in higher than anticipated traffic, the Government will have to offset any increase in emissions with additional abatement measures in transport or elsewhere in the economy.

### *Airports*

In December 2015 the Government confirmed it has accepted the case for airport expansion in the south-east and the Airports Commission's shortlist of options for expansion. They also committed to a further programme of work over summer 2016 to assess the implications for air quality, noise, carbon emissions, and local communities.

Our assessment of appropriate long-term assumptions for Government planning is for aviation emissions to be around 2005 levels in 2050 (with anticipated efficiency improvements, implying around a possible 60% increase in demand over the same period, or around a 45% increase from 2015). Government should plan future policy and infrastructure investment decisions that affect aviation emissions on this basis.

### **Supply of fossil fuels**

The National Infrastructure Pipeline includes £37 billion expenditure on capital costs relating to oil and gas fields and associated infrastructure on the UK continental shelf for the years 2015/16-2018/19. This level of expenditure is consistent with historical levels. While the National Infrastructure Plan summarises private investment in oil and gas infrastructure, this investment depends in part on Government policy, such as taxation levels.

The question of what level of oil and gas extraction is consistent with carbon budgets and the climate objective is complex. It requires careful consideration of various factors, including:

- The extraction rates consistent with meeting the climate objective at the global level, and the expected fossil fuel prices consistent with these extraction rates.
- Costs of UK extraction relative to global fossil fuel prices.

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- The degree to which domestic production of oil and gas might affect domestic consumption (in the case of carbon budgets) and global consumption (in the case of the climate objective).
  - Geopolitical and energy security considerations.
  - The potential impact of gas extraction in the UK on methane emissions.

This question is particularly important given the objective set out in the Infrastructure Act 2015 of “maximising the economic recovery of UK petroleum”. That Act also gave the CCC a duty to provide advice on the impact of onshore petroleum (e.g. shale gas) on meeting carbon budgets and the 2050 target. Our advice, "Compatibility of Onshore Petroleum with meeting UK carbon budgets" was delivered to the Secretary of State on 30 March 2016. The Act states that the Secretary of State must lay the Committee’s report before Parliament alongside the Department of Energy and Climate Change’s official response ‘as soon as is practicable’ after 1 April 2016.