



# The Fifth Carbon Budget – Executive Summary



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The Climate Change Act sets the framework for the UK to transition to a low-carbon economy. The Act requires that UK emissions of greenhouse gases in 2050 are reduced to at least 80% below 1990 levels. The Act describes a range of factors – including affordability, competitiveness, the public finances, energy policy, technological progress, international and EU circumstances, scientific knowledge about climate change and the differences between the devolved administrations – that must be balanced to determine how best to reduce emissions to the level required by 2050.

To date, in line with advice from the Committee, four carbon budgets have been legislated. They set the required reduction in emissions, commensurate with balancing those factors, to 2027. The first carbon budget (2008-2012) was met and by 2014 emissions were 520 MtCO<sub>2</sub>e, 36% below 1990 levels. Emissions over the five years of the fourth carbon budget (2023-2027) are capped at 1,950 MtCO<sub>2</sub>e, equivalent to an average 52% below 1990 levels.<sup>1</sup>

We recommend that the fifth carbon budget is set at 1,765 MtCO<sub>2</sub>e, including emissions from international shipping, over the period 2028-2032. That would limit annual emissions to an average 57% below 1990 levels. This balances the range of factors the Committee must consider, keeps the UK on its cost-effective path to 2050 and continues the UK's historical rate of emissions reduction (Figure 1). Our full set of recommendations is set out in Box 1. This statutory report presents our advice. It is accompanied by a technical report, published on our website that sets out the full analysis that supports this advice: *Sectoral scenarios for the fifth carbon budget*.

Our proposed budget requires a continuation of the increase in take-up of ultra-low emission vehicles (e.g. electric and plug-in hybrid cars and vans) and low-carbon heat (e.g. heat networks and heat pumps) required by the fourth carbon budget. These changes will require bigger behavioural adjustments than emissions reductions to date, but are needed to prepare for the 2050 target. To involve genuine emissions reductions they should be accompanied by deep reductions in emissions from electricity generation.

It is important to signal this direction in advance given the time required to develop new policies, to grow currently nascent markets, for consumer behaviours to adapt and to invest in supporting infrastructure and innovation. A looser budget would fail to send that signal and would involve stop-start investment, storing up higher costs for the future. A tighter budget would go beyond what is required to prepare for the 2050 target and beyond existing international commitments by comparable countries.

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<sup>1</sup> The fourth carbon budget was legislated to require a 50% reduction in emissions from 1990 levels. Revisions to the estimate for 1990 emissions mean the budget now requires a 52% reduction on 1990.

## Box 1: Recommendations on the fifth carbon budget

**1. The budget.** The fifth carbon budget should be set at 1,765 MtCO<sub>2</sub>e for 2028-2032, including emissions from international shipping. On the current accounting basis (i.e. excluding emissions from international aviation and shipping), the budget would be 1,725 MtCO<sub>2</sub>e.

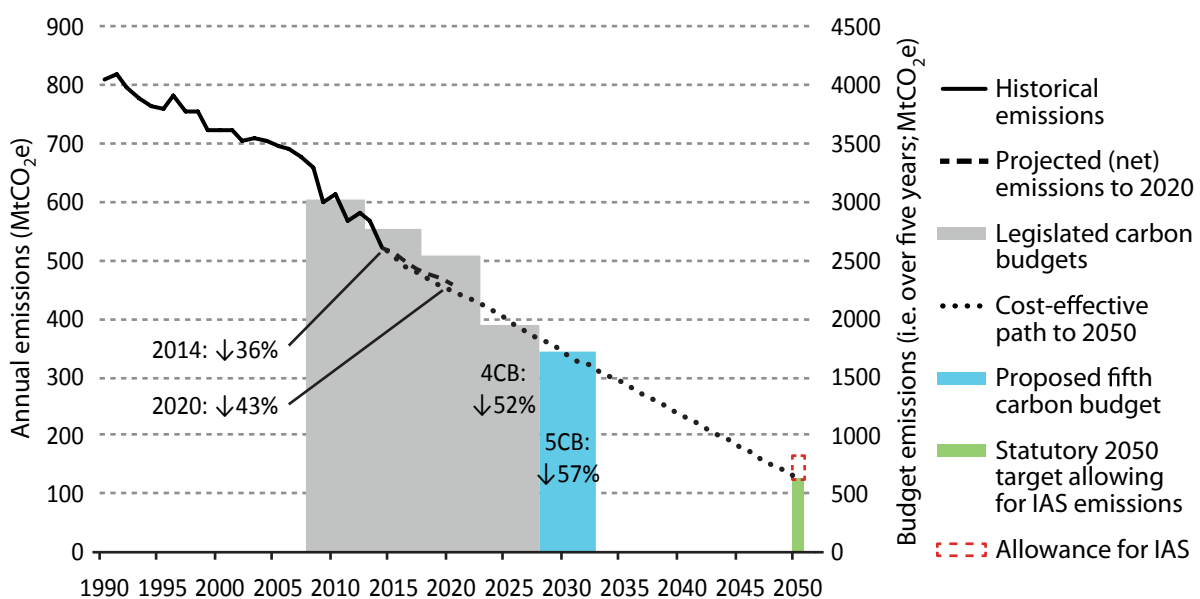
**2. International aviation.** Emissions from international aviation should continue to be allowed for by setting the budget on the path to meeting the 2050 target with international aviation emissions included. However, the accounting for these emissions remains uncertain, so they should not be formally included in the fifth carbon budget.

**3. Credits.** The budget should be met without the use of international carbon units (i.e. credits) outside the EU Emissions Trading System. If unexpected circumstances mean the budget cannot be met cost-effectively without recourse to purchase of credits, the Committee would revisit this advice, including an assessment of the strength and validity of the credit market at that time. Credits could also be used to go beyond the proposed budget to support international action to reduce emissions.

**4. Policy: low-carbon power.** The Government should develop policy approaches consistent with reducing carbon intensity of the power sector to below 100 gCO<sub>2</sub>/kWh in 2030 (compared to 450 gCO<sub>2</sub>/kWh in 2014 and 200-250 gCO<sub>2</sub>/kWh expected by 2020).

**5. Policy: other sectors.** For sectors outside the EU Emissions Trading System the Government should develop policies to drive an average rate of emissions reduction of 2% (6 MtCO<sub>2</sub>e) per year from 2014 to 2030. The Carbon Accounting Regulations should be set to ensure that emissions from these sectors are limited to 1,175 MtCO<sub>2</sub>e over 2028-2032 (1,135 MtCO<sub>2</sub>e excluding emissions from international shipping), which is the Committee's best estimate of the cost-effective path to the statutory 2050 target.

**Figure 1:** The recommended fifth carbon budget would continue emissions reduction on the path to the UK's 2050 target



**Source:** DECC (2015) *Final UK greenhouse gas emissions national statistics: 1990-2013*; DECC (2015) *Provisional UK greenhouse gas emissions national statistics*; DECC Energy Model; CCC analysis.

**Notes:** Data labels show reductions in annual emissions relative to 1990. Historical emissions are on a 'gross' basis (i.e. actual emissions). Projections and carbon budgets are on the current budget accounting basis: net carbon account excluding international aviation and shipping (IAS), but allowing for IAS to be included in the 2050 target.

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## Our fifth carbon budget recommendation follows the requirements of the Climate Change Act

Our advice reflects the full range of criteria set out in the Climate Change Act (section 10):

- The recommended budget is on the cost-effective path to the 2050 target in the Act, allowing for emissions from international aviation and shipping and recognising the differences in circumstances between England, Wales, Scotland and Northern Ireland.
- Potential impacts of the recommended budget for energy security, UK competitiveness, fuel poverty and the fiscal balance have been analysed and can be managed. In the case of competitiveness, suitable measures are currently being put into place. Between now and the start of the fifth budget period, in 2028, there is time to introduce further measures if required.
- The recommended budget is consistent with international and European commitments. It is on the path to the 2050 target which remains an appropriate contribution to the global effort that the latest climate science suggests is required to keep a likely chance of limiting global temperature increase to 2°C.

As required in the Climate Change Act (section 34), we identify the respective contributions towards meeting the carbon budget that should be made by 'traded' and 'non-traded' sources of emissions:

- **The 'traded' sector** refers to those sectors of the economy covered by the EU Emissions Trading System (EU ETS), primarily electricity generation and energy-intensive industry. Emissions from these sectors have reduced by 44% since 1990, and are projected to be 60% below 1990 levels by 2020. Under the accounting rules of the Climate Change Act (Box 2), the contribution of those sectors to the carbon budget will be determined by the emissions allowances allocated to the UK in the EU ETS, which is currently uncertain. Our proposed budget is based on our current best estimate of 590 MtCO<sub>2</sub>e for the fifth budget period, an average of 66% below 1990.<sup>2</sup>
- **The 'non-traded' sector** covers all emissions outside the EU ETS, including transport, heating in buildings, agriculture, waste and some industry. Emissions from these sectors have reduced by 29% since 1990, and are projected to be 35% below 1990 by 2020. For these sectors, performance against the budget is judged on actual emissions. Our proposed budget is based on our best estimate of the cost-effective path for emissions from today to the 2050 target in the Act. This implies emissions of 1,175 MtCO<sub>2</sub>e for the non-traded sector over the fifth budget period (1,135 MtCO<sub>2</sub>e excluding emissions from international shipping), an average of 51% below 1990.

The Committee has been told repeatedly by businesses that the value of the budget is in setting a clear, medium-term vision for the UK. Once legislated, carbon budgets provide a common guide for policymakers and signal to businesses and consumers.

To ensure that carbon budgets fulfil that role effectively they must be met through genuine actions. There is a specific risk that the accounting rules for the EU ETS, which are not yet finalised for the fifth carbon budget period, could undermine the integrity of the budget. If the UK ends up with a smaller share of the EU ETS cap than assumed in our analysis, then the budget could be met with less effort from the rest of the economy, and vice versa. The intention of the proposed budget is that emissions in the non-traded sector should fall an average of 2% (6 MtCO<sub>2</sub>e) annually to 2030, whatever the UK share of the EU ETS cap. To ensure this is clear, **we recommend** that the Government uses the Carbon Accounting Regulations to fix the net carbon account for the traded sector at the assumed level (i.e. 590 MtCO<sub>2</sub>e over 2028-2032).

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<sup>2</sup> This estimate for the traded sector is an update from the estimate the Committee published in its October report on the scientific and international context for the fifth carbon budget. The change reflects the latest information about uncertain inputs, including the eligibility of UK installations for free emissions allowances allocated under the EU ETS. As when previous budgets have been set, the Committee will continue to work with Government officials in the coming months to ensure that when the budget is legislated it reflects any further significant developments in the evidence.

**We also recommend** (in line with our duty in section 35 of the Act) that the scope of the budget be broadened to include international shipping. To preserve the effort required in the budget, the inclusion of international shipping requires a higher limit for the fifth carbon budget at 1,765 MtCO<sub>2</sub>e, rather than 1,725 MtCO<sub>2</sub>e were the budget to be set without including emissions from international shipping.

Carbon budgets are set to ensure the UK is on track to meet its 2050 obligation including emissions from international aviation as well as international shipping. However, continuing uncertainties over aviation's accounting within the EU ETS mean inclusion would be impractical at this time. We therefore recommend a fifth carbon budget that continues the approach to date: carbon budgets are set on the path to meeting the 2050 target including emissions from international aviation and shipping, but international aviation emissions are not formally included in the budget figures.

#### **Box 2: Accounting rules in the Climate Change Act**

Under the Climate Change Act, performance against carbon budgets is measured by the net UK carbon account. In practice, this means that the part of the budget for the power sector and energy-intensive industry, which is covered by the EU Emissions Trading System (EU ETS), is based on the UK's share of the ETS cap rather than the actual emissions in those sectors.

It is clear that in order to stay on track to the 2050 target in the Act, actual emissions must be reduced. The accounting rules should not be used to mask the real progress to the UK's legal commitment.

Our proposed budget implies a 57% reduction in emissions from 1990 to 2030 on the accounting basis in the Act. We also identify the cost-effective path for actual emissions across the UK economy (ignoring the allocation of emissions allowances in the EU ETS). For actual emissions the recommended budget requires a 61% reduction from 1990 to 2030. The larger reduction in actual emissions reflects our scenarios for the power sector. Under the cost-effective path the power sector should reach a carbon intensity of below 100 gCO<sub>2</sub>/kWh in 2030. This would result in emissions in the traded sector of around 450 MtCO<sub>2</sub>e across the fifth carbon budget period, lower than the Committee's current best estimate of the allocation of emissions allowances to the UK.

To stay on track to the 2050 target and to support emissions reductions elsewhere in the economy, the power sector will need to reduce emissions at around the rate in our estimate of the cost-effective path. In line with our approach to date, the Committee will continue to assess progress towards carbon budgets and the 2050 target on the basis of both the net carbon account and actual emissions across the economy.

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## Meeting the fifth carbon budget will require progress in increasingly difficult areas to continue reducing emissions

To date, emissions reductions (beyond those resulting from general economic trends) have come from several sources. Energy efficiency has been improved in buildings and transport, while there has been a shift to lower-carbon fuels in electricity generation – namely natural gas and more recently renewables. There have also been reductions in non-CO<sub>2</sub> gases, in particular because less waste has been sent to landfill.

These trends will continue to be important in future, but will not be enough to reach the 2050 target alone. They must also be supplemented by more challenging measures, including switching to low-carbon energy sources in sectors beyond electricity generation.

Our proposed budget requires those measures to be implemented (Box 3). For example, the budget requires important contributions from electric vehicles (making up the majority of new car and van purchases in 2030), low-carbon heat (providing heat supply for around one in seven homes and over half of business demand), solid wall insulation (in around a quarter of suitable homes) and around a 15% reduction in agriculture emissions, alongside more conventional energy efficiency improvements. These changes will require bigger behavioural adjustments than required for emissions reductions to date.

It is important to commit to these changes in advance given the time required for consumer behaviours to adapt as well as time needed to develop new policies, to grow currently nascent markets and to invest in supporting infrastructure and innovation. A looser carbon budget would therefore not be appropriate. For example, a budget set solely to meet the UK's obligations under the EU's 2030 climate package would fail to prepare sufficiently for the 2050 target as it could be met without roll-out of low-carbon vehicles or heating in the 2020s.

A tighter budget could reflect a greater UK contribution to the international 2°C target<sup>3</sup>, but would go beyond existing commitments in other comparable countries and beyond what is required to prepare for the UK's 2050 target. A tighter budget could still be achieved in future if required through increased UK effort and/or the purchase of emissions credits – potentially as part of a ratcheting up process for global effort.

Notwithstanding the accounting rules of the Climate Change Act, the power sector has a vital role in meeting carbon budgets. In 2030, almost a third of the reduction in emissions in other sectors in our scenarios is dependent on availability of low-carbon power. By 2050, over half of emissions abatement is reliant on low-carbon power. Furthermore, direct emissions from the power sector must be almost eliminated to achieve the final 2050 objective. Investments in generating capacity in the 2020s will still be on the system in 2050 and should be largely low-carbon. Investments in the 2020s should therefore be consistent with reducing carbon intensity of the UK power sector to below 100 gCO<sub>2</sub>/kWh by 2030 and reducing actual UK emissions in 2030 from sectors covered by the EU ETS by around 75% on 1990 levels.

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<sup>3</sup> For a detailed discussion of different shares for the UK and EU in meeting an international 2°C target, see our recent report on The scientific and international context for the fifth carbon budget, available at <https://www.theccc.org.uk/publication/the-scientific-and-international-context-for-the-fifth-carbon-budget>

### Box 3: Central scenario for meeting the fifth carbon budget

In developing its advice the Committee has built various scenarios for reducing emissions on the path to 2050. These scenarios are not prescriptive paths that must be followed. The scenarios allow the Committee to satisfy itself that its overall budget recommendation meets all the requirements under the Act. Our central scenario would meet the recommended budget and is our best estimate of the cost-effective path for the UK to reach the 2050 target in the Climate Change Act. It includes:

- In **Power**, the carbon intensity of generation decreases from around 450 gCO<sub>2</sub>/kWh in 2014 to 200-250 g/kWh in 2020, and to below 100 g/kWh in 2030. This reduction could be delivered by a range of different mixes of low-carbon generation (i.e. renewables, nuclear and plants fitted with carbon capture and storage – CCS) to reach a total share of around 75% of generation by 2030. It is important that the low-carbon portfolio includes roll-out in the 2020s of offshore wind and CCS given their long-term importance and the role of UK deployment in driving down costs. Improvements to energy efficiency (e.g. increased use of LED lighting and more efficient appliances) will support progress in the power sector. The demand side also has an important role in increasing the flexibility of the power system, alongside interconnection, storage and flexible back-up capacity.
- In **Industry**, there is improved energy management and process control, use of more energy efficient plant and equipment, waste heat recovery, use of bioenergy in space and process heat and development of a CCS cluster allowing the use of CCS in the iron and steel and chemicals sectors. Hydrogen could provide an alternative to CCS depending how technologies develop.
- In **Buildings**, deployment of low-carbon heat increases so that heat pumps and heat networks from low-carbon sources provide heat for around 13% of homes and over half of business demand. Insulation increases (including around a further 1.5 million solid walls and 2 million cavity walls in the 2020s) and there is more use of heating controls and efficient lights and appliances. Alternatively, low-carbon heat could be provided via hydrogen added to the gas grid or using hybrid heat pumps, which include a gas boiler to top-up heat supply on the coldest days. The success of any of these measures will depend on public acceptance and wider behavioural factors that, along with skills and technological issues, currently limits their roll-out.
- In **Transport**, efficiency of conventional vehicles continues to improve in the 2020s (e.g. conventional car emissions fall from 125 gCO<sub>2</sub>/km in 2014 to 102g/km in 2020 then 86g/km in 2030 on a test-cycle basis; we allow for ‘real world’ emissions in our scenarios), alongside deployment of electric vehicles across cars, vans and smaller HGVs (e.g. the combination of plug-in hybrids and battery electric vehicles reach 9% of new car and van sales in 2020 and around 60% in 2030). We include hydrogen buses (reaching 25% of sales in 2030), with the possibility of a bigger contribution from hydrogen for other vehicles types. On the demand side we assume some behavioural change results in modest reductions in total distance travelled and more fuel-efficient travel.
- In **Agriculture**, there is increased take-up of: crops and soils measures that mainly target the reduction of N<sub>2</sub>O through improved efficiency of fertiliser use (e.g. use of cover crops and improved manure management practices); livestock measures targeting animal diets, health, and breeding that reduce methane; waste and manure management, including anaerobic digestion; and improvements in the fuel efficiency of stationary machinery.
- In **Waste**, the main biodegradable waste streams, including paper and food waste, are fully diverted away from landfill across the UK by 2025.
- **F-gases** are replaced by low-carbon alternatives in refrigeration, air conditioning and other uses by 2030.

Source: CCC analysis.

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## The recommended budget continues on the lowest cost path to the UK's 2050 target

The proposed budget continues on the lowest cost path to the UK's 2050 target. Meeting it will ensure costs are kept as low as possible in the long term. However, there is a financial cost to climate action since low-carbon technologies currently have higher costs than high-carbon alternatives, which do not face the full cost of their emissions:

- We estimate that meeting the proposed fifth carbon budget will involve an annual cost in 2030 that is up to £3 billion (around 0.1% of expected GDP) more than the cost of meeting the fourth carbon budget that has already been legislated. Costs would be lower to the extent that reduced carbon emissions mean UK firms can purchase fewer emissions allowances in the EU ETS.
- The total annual cost of meeting the fifth carbon budget in 2030 is therefore similar to our estimate of the cost of meeting the fourth carbon budget in 2025: less than 1% of GDP.
- Offsetting some of these costs, there are wider benefits to climate action through reduced air pollution and other health and environmental benefits. Using government valuation methods, we have previously estimated the monetary value of these to be around 0.1-0.6% of GDP in 2030. Our scenarios also involve a 40% reduction in imports of oil and gas compared to a scenario with no climate action, reducing the UK's exposure to volatile international fuel prices.

The Committee recommends setting the budget at this level because it is on the lowest cost path to the legislated 2050 target, and meets the other considerations required under the Act. Even in the absence of this target, not acting to tackle climate change is not an option given the much higher costs of unmitigated climate change and the international commitments in place. If the world is to stay credibly on track to the internationally-agreed objective to limit global temperature increase to 2°C, then the UK's share of the necessary global emissions reduction is likely to be at least as large as that required by our proposed budget.

The budget is therefore a low-regret course to follow.



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## Competitiveness and fuel poverty

Differences in the level and timing of effort and policy around the world could result in UK firms facing costs that differ from their international competitors. Where this could pose a competitive concern, compensations and exemptions are planned or in place, consistent with earlier advice from the Committee. Industries, including steel and cement plants, that are judged to be exposed to a loss of international competitiveness are allocated free allowances through the EU ETS and will be compensated or exempted from costs of supporting low-carbon investment in electricity generation. These plans are in place to 2020 and may need to be extended, depending on the ambition and policy approaches adopted internationally. The Committee will continue to monitor the need for compensation to be awarded to affected industries.

The additional impact on fuel poverty of the fifth carbon budget is small.

- The causes of fuel poverty are complex, dependent on heating needs (themselves dependent on factors including family composition, type and size of home, energy efficiency of home), type of fuel, as well as income. There is also a policy choice about how the costs of low-carbon measures – some of which currently flow through to electricity prices – should be funded.
- Support for low-carbon investment in the power sector, including the carbon price, added around £45 to the annual electricity bill for a typical household in 2014 (out of an average electricity bill of £470, and a typical energy bill of around £1,200). Government policies will increase this cost to around £105 in 2020. Assuming the current funding approach continues, our scenarios imply that this cost, including the carbon price impact, would increase to around £120 in 2030, before falling.<sup>4</sup> The increase in bills in the 2020s as a result of the fifth carbon budget would therefore be about £15 on a typical household bill.
- On top of this, households paid around £35 per year in 2014 to support energy efficiency improvements, which have contributed historically to a reduction in energy use without which bills would be higher. Continuing these or similar policies a little above this level, around £50 per year per household, should be enough to support the additional 1.5-2 million solid walls and around 3 million cavity walls insulated between now and 2030 in our scenarios. This would result in further energy saving and lower bills to the households that install them.

As we have shown in previous work, if energy efficiency measures can be effectively targeted at the fuel poor then overall numbers in fuel poverty would fall even as costs from supporting low-carbon investment increase.<sup>5</sup>

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<sup>4</sup> Exemptions proposed for industrial consumers at risk of competitiveness impacts would increase the costs to household consumers. We estimate they would add around an extra £5 to the annual bill for a typical household.

<sup>5</sup> Letter from Lord Deben to the Parliamentary Under Secretary of State (October 2014), available at <https://www.theccc.org.uk/publication/letter-fuel-poverty-strategy-consultation-response/>

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## Meeting the fifth carbon budget will require new and extended climate policies

Under the Climate Change Act, the Government is required to legislate the fifth carbon budget by the end of June 2016, and must then develop its proposals and policies to meet the budget as soon as is reasonably practicable.

Policies are in place to continue reducing emissions to 2020. New policies will be needed to meet both the fourth and the fifth carbon budgets. The Government has recognised the need for policy development. In their response to the Committee's June 2015 Progress Report, the Government states: *"After we set the fifth carbon budget (by the end of June 2016), we will be able to set out more detail about our expectation for how we intend to meet the targets. Our new emissions reduction plan towards the end of 2016 will set out our proposals in full."*

Particular priorities are:

- Developing effective, low-cost approaches to energy efficiency in buildings and to drive a shift to low-carbon forms of heating (e.g. heat pumps and heat networks).
- Continuing efficiency improvement in vehicles, especially by shifting towards ultra-low emission (e.g. electric and plug-in hybrid) vehicles.
- Ensuring that low-cost, low-carbon power is rolled out in the 2020s.
- Supporting development of key emerging options such as carbon capture and storage.

The Climate Change Act sets statutory deadlines that mean the Committee is giving its advice before the 21<sup>st</sup> Conference of the Parties (COP21) to the UNFCCC takes place in Paris in December 2015. The COP21 negotiations are due to end on 11 December 2015 and could produce significant new developments. The Committee will write to the Secretary of State for Energy and Climate Change in early 2016 to set out if and how the outcomes of Paris, or other significant changes, affect our published advice.