Net Zero
The UK's contribution to stopping global warming

Committee on Climate Change
May 2019

The UK should set and vigorously pursue an ambitious target to reduce greenhouse gas emissions (GHGs) to 'net-zero' by 2050, ending the UK's contribution to global warming within 30 years.

Reflecting their respective circumstances, Scotland should set a net-zero GHG target for 2045 and Wales should target a 95% reduction by 2050 relative to 1990.

A net-zero GHG target for 2050 will deliver on the commitment that the UK made by signing the Paris Agreement. It is achievable with known technologies, alongside improvements in people's lives, and within the expected economic cost that Parliament accepted when it legislated the existing 2050 target for an 80% reduction from 1990.

However, this is only possible if clear, stable and well-designed policies to reduce emissions further are introduced across the economy without delay. Current policy is insufficient for even the existing targets.

A net-zero GHG target for 2050 would respond to the latest climate science and fully meet the UK's obligations under the Paris Agreement:

- It would constitute the UK's '**highest possible ambition**', as called for by Article 4 of the Paris Agreement. The Committee do not currently consider it credible to aim to reach net-zero emissions earlier than 2050.
- It goes beyond the reduction needed globally to hold the expected rise in global average temperature to **well below 2°C** and beyond the Paris Agreement's goal to achieve a balance between global sources and sinks of greenhouse gas emissions in the second half of the century.
- If replicated across the world, and coupled with ambitious near-term reductions in emissions, it would deliver a greater than 50% chance of limiting the temperature increase to **1.5°C**.

Now is a crucial time in the global effort to tackle climate change, with revised pledges of effort currently being considered ahead of the UN climate summit in late-2020. An ambitious new UK target would encourage increases in ambition elsewhere, including the adoption of other net-zero GHG targets, such as the 2050 target currently under consideration by the European Union.

In committing to a net-zero GHG target, Parliament must understand that, while many of the policy foundations are in place, a major ramp-up in policy effort is now required:

- **The foundations are in place.** Policy development has begun for many of the components needed to reach net-zero GHG emissions: low-carbon electricity (which must quadruple its supply by 2050), efficient buildings and low-carbon heating (needed throughout the building stock), electric vehicles, carbon capture and storage (CCS), diversion of biodegradable waste from landfill, phase-out of fluorinated gases, increased afforestation and measures to reduce emissions on farms. These policies must be strengthened and they must deliver action.
- **A net-zero GHG target is not credible unless policy is ramped up significantly.** Most sectors will need to reduce emissions close to zero without offsetting; the target cannot be met by simply adding mass removal of CO_2 onto existing plans for the 80% target.
  - **Delivery must progress with far greater urgency.** Many current plans are insufficiently ambitious; others are proceeding too slowly, even for the current 80% target:
    - 2040 is too late for the phase-out of petrol and diesel cars and vans, and current plans for delivering this are too vague.

        - Over ten years after the Climate Change Act was passed, there is still no serious plan for decarbonising UK heating systems and no large-scale trials have begun for either heat pumps or hydrogen.
        - Carbon capture (usage) and storage, which is crucial to the delivery of zero GHG emissions and strategically important to the UK economy, is yet to get started. While global progress has also been slow, there are now 43 large-scale projects operating or under development around the world, but none in the UK.
        - Afforestation targets for 20,000 hectares/year across the UK nations (due to increase to 27,000 by 2025), are not being delivered, with less than 10,000 hectares planted on average over the last five years. The voluntary approach that has been pursued so far for agriculture is not delivering reductions in emissions.
    - **Challenges that have not yet been confronted must now be addressed** by government. Industry must be largely decarbonised, heavy goods vehicles must also switch to low-carbon fuel sources, emissions from international aviation and shipping cannot be ignored, and a fifth of our agricultural land must shift to alternative uses that support emissions reduction: afforestation, biomass production and peatland restoration. Where there are remaining emissions these must be fully offset by removing CO_2 from the atmosphere and permanently sequestering it, for example by using sustainable bioenergy in combination with CCS.
    - **Clear leadership is needed, right across Government, with delivery in partnership with businesses and communities.** Emissions reduction cannot be left to the energy and environment departments or to the Treasury.[1] It must be vital to the whole of government and to every level of government in the UK. Policies must be fully funded and implemented coherently across all sectors of the economy to drive the necessary innovation, market development and consumer take-up of low-carbon technologies, and to positively influence societal change.
- **Overall costs are manageable but must be fairly distributed.**
    - There have been rapid cost reductions during mass deployment for key technologies (e.g. offshore wind and batteries for electric vehicles). As a result, we now expect that a net-zero GHG target can be met at an annual resource cost of up to **1-2% of GDP** to 2050, the same cost as the previous expectation for an 80% reduction from 1990.
    - The transition, including for workers and energy bill payers, must be fair, and perceived to be fair. Government should develop the necessary frameworks to ensure this. An early priority must be to review the plan for funding and the distribution of costs for businesses, households and the Exchequer.

The background for this report is one of increased awareness of climate risks and falling low-carbon technology costs, but where global emissions continue to rise:

- Global average temperature has already risen 1°C from pre-industrial levels and climate risks are increasingly apparent. The Special Report of the Intergovernmental Panel on Climate Change (IPCC) in October 2018 emphasised the critical importance of limiting further

[1] i.e. the Department for Business, Energy and Industrial Strategy (BEIS); the Department for Environment, Food and Rural Affairs (Defra); and HM Treasury (HMT).

Maximising the international influence of the net-zero target

The Government should consider when and how to announce the new target to maximise its influence internationally. Others are actively considering increasing their targets and the UK has an opportunity to support increased ambition.

The UK could also submit a strengthened Nationally Determined Contribution (NDC) for 2030 and revised long-term strategy.

- Currently the UK's official contribution to the Paris Agreement is set through the EU's collective pledge to reduce emissions by at least 40% by 2030 relative to 1990.
- Outside the EU, the UK would need to submit its own NDC to the UN.
- For now, this could be based on the higher ambition in the UK's fifth carbon budget (which was set to require a 57% reduction in UK emissions from 1990 to 2030) but ultimately it should be based on the more ambitious pathway that the Committee will advise on next year, on the path to net-zero GHG emissions in 2050.
- The Paris Agreement asks countries 'to formulate and communicate long-term low greenhouse gas emission development strategies'. The UK has previously submitted the Government's *Clean Growth Strategy*. Setting a net-zero GHG target and introducing long-term plans to meet it would provide a basis for a strengthened strategy.

The UK should continue to collaborate internationally, including through provision of climate finance, and support increased ambition elsewhere. A key part of the UK's leadership has been as a positive example: setting and meeting ambitious targets within a robust legal framework while growing the economy and developing key emerging technologies. This track record allows the UK to have an influence diplomatically and politically, in negotiations and in new initiatives such as sustainable finance. This should continue, including contributing to strengthening governance for bioenergy and removals, which play a key role in our scenarios.

Although the aim should be to meet the net-zero GHG target without international carbon units, the UK should take steps to develop markets for carbon units as a potentially useful mechanism to mobilise finance and to support increased effort internationally, and as a contingency mechanism for meeting UK targets. The Paris Agreement allows this and the UK is well placed to help develop effective rules and governance as well as to build capacity in countries that could be sellers.

UK emissions, in line with our population, are only 1% of global emissions. It is therefore vital for the UK to maximise the impact of any new target on actions beyond the UK in order to tackle climate change and avoid some of the largest risks that would involve. This will also make the UK's task easier by stimulating the innovation and cost reduction for low-carbon technologies that global roll-out can bring.

Building on the existing foundations to prepare for a net-zero target in the UK

Our conclusion that the UK can achieve a net-zero GHG target by 2050 and at acceptable cost is entirely contingent on the introduction of clear, stable and well-designed policies. Government must set the direction and provide the urgency. Our analysis points to a number of obstacles that Government will need to overcome if it is to succeed (Box 6).

Box 6. Overcoming obstacles to reaching net-zero emissions

- **Strengthening policy-making.** The net-zero challenge must be embedded and integrated across all departments, at all levels of Government and in all major decisions that impact on emissions. It must also be integrated with businesses and society at large. Since many of the solutions cut across systems (e.g. hydrogen has a role in electricity generation, transportation, industry and heating), fully integrated policy, regulatory design and implementation is crucial. That may require new frameworks, for example to ensure that departments, other than BEIS alone, sufficiently prioritise net-zero GHG emissions. Policy teams across departments must be sufficiently resourced to develop and implement the changes required.
- **Ensuring businesses respond.** Some previous policies have delivered the desired business response in full (e.g. the banning of inefficient gas boilers in the 2005/06 Building Regulations, the offering of long-term contracts to offshore wind farms). Others, like the Green Deal and vehicle emissions standards, have not. For a net-zero GHG target, standards will need strict enforcement and incentive schemes must be designed with businesses and investors in mind. The ends (i.e. stopping GHG emissions) should be clear, but there should be flexibility to meet them in the most effective way. Crucially, there should be a stable and long-term approach.
- **Engaging the public to act.** Much of the success so far in reducing emissions (e.g. power sector decarbonisation and even the phase-out of inefficient gas boilers) has happened with minimal change or awareness needed from the public. However, this cannot continue if the UK is to reach net-zero emissions. Public engagement and support will be particularly vital for the switch to low-carbon heating - people will need to make changes inside their homes and co-ordinated central decisions must be taken on the balance between electrification and hydrogen. People should understand why and what changes are needed, to see a benefit from making low-carbon choices and to access the information and resources required to make the change happen.
- **Determining who pays.** If policies are not sufficiently funded or their costs are seen as unfair, then they will fail. HM Treasury should undertake a review of how the transition will be funded and where the costs will fall. The review should cover the use of fiscal levers and Exchequer revenue, costs from carbon trading schemes, the impact on energy bill-payers and motorists, and the costs to industries especially where they are carbon-intensive and trade-exposed. It should cover costs from now through to 2050.
- **Providing the skills.** The Government has recognised the importance of developing skills in its Industrial Strategy and sector deals. These should be used to tackle any skills gaps that would otherwise hinder progress. For example, new skills support for designers, builders and installers is urgently needed for low-carbon heating (especially heat pumps), energy and water efficiency, ventilation and thermal comfort, and property-level flood resilience.
- **Ensuring a just transition.** Building on the reviews of who pays and of skills, the Government should assess more broadly how to ensure that the overall transition is perceived as fair and that vulnerable workers and consumers are protected. That must include analysis at the regional level and for specific industrial sectors. We note that Scotland has already appointed an independent Just Transition Commission to advise on 'a carbon-neutral economy that is fair for all'.
- **Developing the infrastructure.** Reaching net-zero emissions will require development or enhancement of shared infrastructure such as electricity networks, hydrogen production and distribution and CO_2 transport and storage. Government, in partnership with the National Infrastructure Commission, should give urgent consideration to how such infrastructure might best be identified, financed and delivered. Regional coordination will be required, including for transport where powers are devolved.

Specific policies are now required to address the key areas of emissions across the economy. This is a pre-condition of achieving a net-zero GHG target by 2050. Many of our recommendations here are not new: the Committee has already recommended strengthened approaches to heat decarbonisation, CCS and hydrogen, electric vehicles, agriculture, waste, and low-carbon power. The interdependencies between these sectors must be taken adequately into account, emphasising the importance of a coherent overall strategy.

- **Heating buildings.** An overhaul of the approach to low-carbon heating and energy efficiency is needed. The Government's planned 2020 Heat Roadmap must establish a new approach that will lead to full decarbonisation of buildings by 2050. This must be fully-funded, following the Spending Review, and it is essential that the Treasury commits now to working with BEIS on this. Recent announcements on new build must be delivered.
- **CCS.** Carbon capture and storage (CCS) is essential. We previously recommended that the first CCS cluster should be operational by 2026, with two clusters, capturing at least 10 $MtCO_2$, operating by 2030. For a net-zero target it is very likely that more will be needed. At least one of the clusters should involve substantial production of low-carbon hydrogen. The Government will need to take a lead on infrastructure development, with long-term contracts to reward carbon capture plants and encourage investment.
- **Electric vehicles.** By 2035 at the latest all new cars and vans should be electric (or use a low-carbon alternative such as hydrogen). If possible, an earlier switchover (e.g. 2030) would be desirable, reducing costs for motorists and improving air quality. This could help position the UK to take advantage of shifts in global markets. The Government must continue to support strengthening of the charging infrastructure, including for drivers without access to off-street parking.
- **Agriculture.** Agriculture is already facing a period of considerable change. Future success will require diversification of incomes and taking the opportunities that come with transformational land use change. Policy to encourage farming practices that reduce emissions must move beyond the existing voluntary approach. Financial payments in the UK Agriculture Bill should be linked to actions to reduce and sequester emissions, to take effect from 2022.
- **Waste.** Bio-degradable waste streams should not be sent to landfill after 2025. This will require regulation and enforcement, with supporting actions through the waste chain, including for example mandatory separation of remaining waste.
- **Low-carbon power.** The supply of low-carbon power must continue to expand rapidly, and increasingly, from around 2030, some may need to run for only part of the year. While many options no longer need subsidies, Government intervention may still be needed, for example by backing long-term contracts aligned to expected wholesale prices. Policy and regulatory frameworks should also encourage flexibility (e.g. demand response, storage and interconnection).

In setting a net-zero target, these actions must be supplemented by stronger approaches to policy for industry, land use, HGVs, aviation and shipping, and GHG removals.

- **Industry.** Government must implement an approach to incentivise industries to reduce their emissions through energy and resource efficiency, electrification, hydrogen and CCS in ways that do not adversely affect their competitiveness. In the short-term, this is likely to imply a role for Exchequer funding. Longer term, it could involve international sectoral agreements (e.g. for industries like steel where there are relatively few global companies), procurement

(c) Technology and economics

One of the most positive and important developments since 2008 has been the very rapid cost reduction that has accompanied the global expansion of renewable electricity generation (especially for wind and solar power) and an accompanying fall in the cost of batteries. These technologies have benefited from major scale-ups in global deployment, open global markets that have supported lower cost manufacturing and well-designed policy environments such as auctions of long-term contracts for renewable power.

These changes are crucial given the importance of power generation and surface transport in global emissions (in combination making up around 40% of the global total in 2017) and their projected growth, particularly in middle-income and developing countries.

There have also been technologies that played significant roles in the Committee's UK scenarios in 2008 that have under-performed, either as projects have been delayed and costs have overrun (e.g. nuclear) or as policy has failed to drive take-up effectively (e.g. heat pumps and carbon capture and storage, CCS). Alongside these, new options have emerged (e.g. information technology and artificial intelligence could help make energy demand lower or more flexible than the Committee assumed in 2008, while technologies to remove carbon dioxide from the atmosphere have gained prominence in scenarios for both global and UK emissions reduction).

The economics of low-carbon technologies have been further bolstered by an increasing prevalence and strength of carbon pricing and regulations to drive efficiency improvements:

- Carbon pricing is now in place in 46 national jurisdictions, covering over 20% of global emissions, while vehicle efficiency standards are even more widespread, with nearly 80% of new light duty vehicles sold globally subject to GHG emission or fuel economy standards as of 2017.[18]
- UK carbon prices have risen since the introduction of the Carbon Price Floor in 2013 and more recently as reforms to the EU Emissions Trading System (EU ETS) have restricted the number of permits and increased the price of carbon allowances in the EU ETS.

Globally, these changes make low-carbon development paths far more likely (see Chapter 3), as low-carbon options like wind and solar power are now generally of comparable or lower cost than power from fossil fuels, while bringing significant co-benefits such as reduced air pollution. The requirement for policy is therefore increasingly to enable low-carbon energy paths rather than to subsidise them.

4. UK progress since 2008

Emissions can be cut while growing the economy

Since the Climate Change Act was passed in 2008, the UK has continued to demonstrate that it is possible to decouple emissions growth and economic growth – leading the G7 group of advanced economies in this decoupling. Greenhouse gas emissions have fallen by 30% while the economy has grown by 13% over 2008-2018, continuing trends of falling emissions and rising GDP since the 1990 base year (Figure 1.3 and see Chapter 7). Per capita emissions are now close to the global average at 7-8 tCO_2e/person, having been over 50% above in 2008.

[18] ICCT (2017) *2017 Global update: Light-duty vehicle greenhouse gas and fuel economy standards.*