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Dear Liam

Committee on Climate Change: Response to request for additional information relating to advice to Scottish Ministers

I am writing in response to your letter of July 13th, in which you requested assessment of carbon target impacts against criteria listed in the Scottish Climate Change Act, together with more details of the analysis underpinning our advice.

Our assessment against the criteria in the Act suggests that the costs, and fiscal and competitiveness impacts associated with the recommended targets are manageable. The same is true of impacts for rural communities and wider environmental impacts, while fuel poverty is an important issue which should be addressed through a combination of energy efficiency improvement and targeted support to low income households. We provide more details in Annex A.

Our response to your request for more details on the analysis underpinning our advice (e.g. our approach to developing emission projections) is set out in Annex B.

On the question of how we would update our recommendations to reflect updated LULUCF projections that may be available shortly, this would be straightforward and something that we would be happy to do at your request.

You have also asked us about updated advice on the use of a multiplier to allow for non-CO₂ effects of aviation. However, there is still a high degree of scientific uncertainty here. Therefore we recommend that the current approach (i.e. using a multiplier of 1) remains appropriate until scientific uncertainties are resolved. This is an area where we will closely monitor scientific developments, and will report back to the Scottish Government as appropriate.

Yours ever,



David Kennedy
Chief Executive, Committee on Climate Change

Annex A: Response to annual target setting criteria in the Climate Change (Scotland) Act 2009

The Scottish Ministers must, when setting annual targets, also have regard to the following matters (the “target-setting criteria”)—

(a) the objective of not exceeding the fair and safe Scottish emissions budget;

In our advice to Scottish Ministers in February 2011, we defined a fair and safe cumulative emissions budget as an appropriate contribution to required global emission reductions that are consistent with limiting risks of dangerous climate change.

A minimum Scottish contribution to the required global pathway is broadly characterised by equal annual percentage emissions reductions between 2020 and 2050. Combining this with emissions reductions required from now to 2020 gives a cumulative emissions budget of around 1,250 MtCO₂e between 2010 and 2050.

The bottom-up approach recommended to set targets for 2023-2027, which when combined with the legislated targets from 2010-2022 and a path of equal annual percentage reductions after 2027 towards the 2050 target (80% reduction relative to 1990), results in cumulative emissions that are commensurate with the level of the recommended cumulative budget for 2010 – 2050.

(b) scientific knowledge about climate change;

In our 2008 report *Building a Low Carbon Economy* we undertook a review of climate science. This led us to define a climate objective, to identify global pathways to meet that objective, and to recommend an appropriate contribution for the UK towards global emission cuts.

The Committee’s Fourth Budget Report in 2010 updated that analysis, reviewing again the basic science of climate change and developments in climate research since the original report.

The updated review concluded:

- There is a robust scientific case for human-induced climate change, supported by a vast body of theory and observation developed over many

years. Although gaps and uncertainties in understanding exist, the case for action remains strong.

- There has been no major change in the picture of likely future damage from climate change since 2008, although some risks have increased slightly (e.g. the effect of climate change on food production).
- Our climate objective and required global pathways to achieve that objective remain appropriate.

This assessment of the science underpinned our advice on the Scottish cumulative emissions budget, and targets for 2023-27.

(c) technology relevant to climate change;

The bottom-up approach to recommending targets considers technologies that are available or likely to be available over the next two decades. Key technologies include low carbon sources of power generation, renewable heat, and electric vehicles. These are likely either to be cost-effective at projected carbon prices, or required in the context of the 2050 target.

(d) economic circumstances, in particular the likely impact of the target on—

(i) the Scottish economy;

At the UK level, we estimated a cost of achieving the fourth carbon budget (2023-27) of under 1% of GDP in both 2025 and 2030¹.

We would expect a broadly similar cost from meeting Scottish emission targets as a proportion of GDP, given similar opportunities for reducing emissions:

- The largest component of the total estimated abatement cost is the power sector, where costs stem from the increase in electricity bills that provide part of the investment in low carbon plant.

¹These costs are presented in the Committee's report 'The Fourth Carbon Budget', and are derived by multiplying abatement costs (the direct additional costs, over the reference case, of implementing measures to reduce emissions, annualised over measure lifetimes) (£/tCO₂) for each measure abating in the given year, as a proportion of GDP. See Table 3.7, page 143, Committee on Climate Change (2010) 'The Fourth Carbon Budget', available from <http://www.theccc.org.uk/reports/fourth-carbon-budget>

Scotland has a significant proportion of the UK on and offshore renewable resource and a stretching ambition for renewable deployment. It may therefore attract a disproportionately higher share of investment, but the actual cost of this will be borne across the UK as a whole. There is no reason to suggest that costs in the sector would be notably higher/different in Scotland than in the UK as a whole and there may in fact be positive impacts on the Scottish economy through the increased investment.

- In most other sectors, envisaged abatement in Scotland relative to the UK is broadly in line with Scottish shares of UK population/GVA/energy demand. The sector where this is most notably not the case is agriculture, where emissions and abatement are higher in Scotland than in the UK relative to overall emissions. However, many of the abatement options here are available at negative cost (i.e. save farmers money).

Historically there has been a growth differential between Scotland and the UK, and this is reflected in the assumptions for future growth from Oxford Economics, used in the development of this advice. It makes a negligible difference to estimated costs as a percentage of GDP.

Cost estimates are however particularly sensitive to assumptions on capital costs and fossil fuel prices.

- Capital costs: 2025 cost estimates range from 0.3% to 0.8% of GDP depending on whether capital costs are lower or higher than expected in the Medium Scenario
- Fossil fuel prices: 2025 cost estimates range from 0-0.7% of GDP depending on whether fossil fuel prices are higher or lower than in the central fossil fuel forecast² for the Medium Scenario.

(ii) the competitiveness of particular sectors of the Scottish economy;

There is a potential risk to the competitiveness of energy-intensive companies/sectors in Scotland where these firms are subject to a carbon price and compete in global markets with firms who are not subject to a carbon price. As a

² For fossil fuel assumptions see DECC (2010) *Energy and Emissions Projections Annex F: Fossil fuel and retail assumptions*. The range for oil prices in 2025 is from \$61/bbl to \$153/bbl around a central projection of \$87/bbl. For gas prices, the range is 35 to 121 p/therm around a central projection of 72 p/therm.

consequence, firms may suffer loss of profits and/or may chose to move to locations not subject to a carbon price.

Our 2008 report assessed the extent to which the Scottish economy was subject to such a risk in the period to 2022, finding that the sectors most at risk in Scotland accounted for 0.07% of GVA (2005) and less than 0.5% of employment. This outlook is unlikely to be materially different for 2023-2027.

Nevertheless, it remains important to ensure that the carbon constraint for energy-intensive industries in Scotland does not result in leakage. It is unlikely that this is the case for the recommended targets, which include abatement measures that are cost-effective at a relatively low carbon price.

(iii) small and medium-sized enterprises;

The evidence base on impacts and appropriate policies specifically on SMEs is less well developed, however key impacts of meeting emission targets for SMEs could include:

- Higher energy prices, reflecting costs of decarbonising power and heat sectors.
- Offsetting energy bill reductions through energy efficiency improvement.
- Opportunities associated with development of new markets for low carbon goods and services.

(iv) jobs and employment opportunities;

Negative impacts on jobs should be limited, particularly given limited risks of production leakage. Positive impacts may ensue given opportunities for Scotland to sell into new markets for low carbon goods and services.

(d) fiscal circumstances, in particular the likely impact of the target on taxation, public spending and public borrowing;

Given reserved / devolved powers, the main direct fiscal impacts of decarbonising through the 2020s are likely to occur at the UK rather than Scottish level (e.g. as regards EU ETS revenues, fuel duty revenues).

At the Scottish level, the primary fiscal implication relates to possible public expenditure to support emissions reduction programmes, for example:

- In the residential sector, loft and cavity wall insulation should be largely complete; solid wall insulation will need to continue at previous rates and may need a subsidy which could be either financed through energy bills or taxes.
- For transport, the improved efficiency of new cars and vans, driven by regulation at EU level, should be the source of substantial abatement. Some continued investment in charging infrastructure for electric vehicles may be required, but our scenarios envisage the great majority of charging occurring at home.

The roll out of smarter choices programmes will require some continued funding.

- For energy intensive industry the key policy will be likely that the EU ETS will continue to be the main driver of emission reductions, rather than public subsidy

However it will be a matter for the UK and Scottish Governments to decide the appropriate balance between taxation, regulation, carbon trading schemes, and public subsidy to drive emission reductions. To the extent that there is some public expenditure required in the 2020s this is likely to reflect a continuation of the level of expenditure envisaged to meet targets to 2022.

The targets that have been recommended for 2023-2027 should be met through domestic action; therefore no additional expenditure on credit purchase is envisaged.

(e) social circumstances, in particular the likely impact of the target on those living in poorer or deprived communities;

Fuel poverty is currently a major issue in Scotland (e.g. in 2009 around 33% of the population were estimated to live in fuel poverty). Fuel poverty rates have been rising due to sharp increases in energy prices over recent years.

Over the next decade, we would expect fuel prices to increase further, reflecting projected increases in gas and carbon prices, and support for investment in renewable generation.

There is scope for offsetting price increases through energy efficiency measures, most notably loft, cavity and solid wall insulation. Residual fuel poverty after energy

efficiency improvement should be addressed through social tariffs or income transfers. As these are reserved matters, the Scottish Government will need to work closely with the UK Government to ensure effective measures are in place.

In the 2020s, additional electricity price impacts should be limited under new electricity market arrangements, which are aimed at reducing the cost of capital for electricity sector decarbonisation.

(f) the likely impact of the target on those living in remote rural communities and island communities;

There are several main areas where the targets may impact those living in remote rural and island communities:

- There is a particular opportunity for cost-effective investment in renewable heat generation for off-gas grid homes, in conjunction with energy efficiency measures. This could help to reduce the high incidence of fuel poverty in rural areas (e.g. in Scotland 45% of rural households are fuel poor compared to 30% in urban areas³).
- Remote and island communities are often located in areas that are particularly suitable for renewable power generation (i.e. wind and marine power). Investment in renewable generation could therefore provide local benefit in terms of employment and profit sharing.
- Plug-in hybrids are likely to be more suitable than pure battery electric vehicles in some rural areas, and opportunities for rationalising private car use may be limited relative to urban areas.

(g) energy policy, in particular the likely impact of the target on energy supplies, the renewable energy sector and the carbon and energy intensity of the Scottish economy;

Envisaged power sector decarbonisation to meet emissions targets in the 2020s would reduce Scottish reliance on imported fossil fuels.

Although intermittency of renewable power generation raises technical challenges, this is manageable through demand flexibility, increased storage, increased interconnection and gas-fired balancing generation.

³ Scottish House Conditions Survey – results for 2009:
<http://www.scotland.gov.uk/Publications/2010/11/23125350/0>

Through electrification of heat and transport there is an opportunity, from extension of a decarbonised power sector, to lower the carbon intensity of other sectors of the Scottish economy.

(h) environmental considerations and, in particular, the likely impact of the targets on biodiversity;

We do not expect that meeting the recommended targets will incur negative biodiversity impacts, provided that renewable development is undertaken sensitively. There is a need to ensure, for example, that there is no negative impact of offshore renewables on the marine environment.

Improved forestry management for biomass could have a positive effect, though any air quality issues arising from biomass use need to be addressed.

Electric vehicles are positive in terms of urban air quality.

(i) European and international law and policy relating to climate change.

The bottom-up pathway that we have recommended is set out on a gross basis (i.e. it does not currently account for emissions trading, as there is currently no arrangement for the EU ETS post-2020). In our original advice, we highlighted that the targets may have to be adjusted at some point in the future, following any agreement on the EU ETS cap and emissions targets for the non-traded sector post 2020.

Currently at the global level, the Copenhagen Accord pledges that global temperature rises should be constrained to 2°C. This is consistent with the target underpinning the Scottish Climate Change Act and our recommended fair and safe cumulative budget.

Annex B: Response to analytical questions for clarification

1. Clarity regarding the baseline being used whenever the advice talks about abatement by 2030 – can CCC confirm that this is the 1990/1995 baseline?

Where the advice refers to percentage emissions reductions, these are relative to 1990 unless otherwise specified.

Where the advice refers to absolute (i.e. MtCO₂) emissions reductions in 2030, these are relative to a reference projection.

2. On what basis have CCC assumed central, rather than low growth in the STEPS model?

There were two main reasons for this:

1. The first set of annual targets (2010-22) and the Scottish Government's Report on Proposals and Policies (RPP) used the STEPS model v1 to produce a reference emission projection for non-traded sector CO₂.

Subsequent to this model being produced, but before targets were due to be set, there was a substantial downgrading in economic growth forecasts that were not therefore reflected in the emission projection.

To proxy the effect of the lower growth projected over the target period, the CCC and the Scottish Government opted to use the 'low' economic growth scenario in the STEPS model, in the absence of a wholesale update to the STEPS model at that time.

In developing the advice on the current set of targets, the CCC commissioned Cambridge Econometrics to carry out a wholesale update of the STEPS model that incorporated the latest available input data on economic growth, household income forecasts and fossil fuel prices, among others.

Therefore the 'Central' scenario in the new STEPS model takes account of the lower growth forecasts that we previously had to use a proxy measure for.

2. The abatement options in the Medium Scenario for the 2023-2027 target period are consistent with a central run of the DECC energy model, which is the basis for the central run for Scotland's reference projection.

3. Does the STEPS refresh include the 2009 UK emissions outturn?

In addition to using the lower growth forecast (see question 1) the CCC and Scottish Government previously used 2009 UK outturn emissions to estimate the effect on Scottish emissions if the same trends applied in Scotland (in the absence of 2009 outturn data for Scotland⁴).

The STEPS refresh does not include this direct adjustment as the latest DECC model projection, which is used as the basis for the disaggregation to Scottish level non-traded sector emissions, already builds in the 2009 UK emissions outturn.

4. What was the thinking behind shifting from the RPP assumptions which use low growth?

The thinking behind this the same as outlined in response to questions 2 and 3.

5. Why are international shipping emissions forecasts fixed from 2012 onwards?

This reflects the bunker fuels methodology used to account for shipping emissions in Scotland, together with an assumption that refining capacity remains fixed.

6. Are the latest non-traded projections from CCC unadjusted for the 2009 outturn from the UK NAEI (published 15 April 2011)?

Yes. These figures are unadjusted for the same reason as outlined above (response to question 3), that the STEPS update was intended to take account of the factors

⁴ 2009 outturn data for Scotland should be available in September 2011.

that are driving the lower emissions in 2009 and the DECC model projection takes account of the 2009 outturn data.

7. We would like to better understand why there is little difference between CCC and RPP in overall emissions in the business and public sector, but a significant difference appears to arise in classification of the analysis between the CO₂ and non-CO₂ figures of the respective analyses.

The level of emissions overall, before disaggregation into different emission categories and traded/non-traded sectors the same in both analyses (10.4 MtCO₂ in 2008 respectively).

Using 2008 emission figures for illustration, the differences in the emissions totals are down to:

- Scottish Government estimated emissions for the business and public sector are higher than the CCC's by around 2 MtCO₂e due to the inclusion of:
 - - o 528 ktCO₂ Industrial process CO₂ emissions (less agrochemicals).
 - o 1,509 ktCO₂e emissions comprised of non-CO₂ from power, refineries, offshore oil and gas, and industrial process.
 - o These emissions are presented separately in their respective sectors (industrial processes, power sector etc) in the CCC's advice.
- However, the CCC's CO₂ estimate for the non-traded sector is 400 ktCO₂ lower due to including cement sector emissions within the traded sector, as discussed with the Scottish Government during development of the advice.
- In net terms this results in the 1,535 ktCO₂e difference between the two sectors in 2008.

8. Can CCC provide a commentary on the relative increase in CO₂ emissions estimated from the road transport sector compared with the RPP analysis?

The RPP analysis is based on a run of the Department for Transport's National Transport Model (NTM) in 2009, whereas the projection in the CCC's target advice for 2023-2027 is based on a run of the NTM from 2010. It is not possible to make direct comparisons between the two results, as there were significant changes made to the assumptions (e.g. to implied gCO₂/km) and methodology in the NTM between each run of the model.

The CCC and Scottish Government are however in ongoing discussion to assess the differences in projections.

9. Can CCC indicate which source the forecast for International Aviation and Shipping CO₂ originates from?

International aviation reflects the estimated share of the EU cap on aviation as calculated in the first set of targets advice as 97% of 2004-06 average emissions in 2012 and 95% of the same average from 2013 onwards.

International shipping emissions are projected as outlined in response to question 5.

10. Can the CCC confirm the original source of the forecast for refinery CO₂?

Emissions are held flat at 2005 levels (2.5 MtCO₂) which is consistent with the assumptions made for international shipping emissions.

This is broadly consistent with forecasts from the DECC model (e.g. 2.6 MtCO₂ in 2030).

11. We would like to understand the use of LULUCF methodology and sources from which CCC have drawn their conclusions, as category definitions do not appear to match with the CEH2009 data.

We have used currently unpublished LULUCF projections which were provided to us by the Centre for Ecology and Hydrology (CEH) and are based on the 2009 inventory, rather than the CEH 2009 published projections based on the 2007 inventory.

The 2009 inventory publication outlines a number of changes, both in methodology and in data sources. As a result, historic emissions and the projection going forward are now notably different in places. The 2009 projections also include a new category (wetlands) which was not previously reported.

The CEH projections for Scotland are currently only available to 2020, though there will possibly be an update available in the next few months that extend the projection to 2030 (and possibly 2050).

The long run trend (1990 – 2020) was applied to extend the projection to 2030 for each category and emission type in the projection.

12. Can the origin of the projected reduction in waste emissions attributed to UK-wide effort be explained further?

We assume that abatement from the Zero Waste Plan in the RPP is delivered by 2022 and sustained at the 2022 level (0.7 MtCO₂e) through the 2020s.

While the Zero Waste Plan potentially brings forward abatement that would otherwise not be achieved until later in the 2020s, there is the possibility that some further emission reductions that may be achieved beyond 2022 – particularly since a number of the key targets refer to 2025. To put a figure on that we took the mid-point of the abatement estimated to be achievable at the UK level through the 2020s and applied the share of waste currently sent to landfill in Scotland as a proportion of the UK total (12%).

This provides an additional 0.3 MtCO₂e in 2030, which gives the total of 1 MtCO₂e when added to the Zero Waste Plan abatement

13. Can a step-by-step guide be made available to outline how the abatement potentials of the four transport measures in Table 2 were arrived at?

The four transport measures and their abatement in 2030 in the Medium Scenario for Scotland (as set out in Table 2 of the original advice) are:

- Electric and plug-in hybrid electric vehicles (-1.6) (cars and vans)

- Hydrogen vehicles (buses only: -0.02)
- Conventional vehicle efficiency (-1.7) (all vehicle types: cars, vans, buses, heavy goods vehicles (HGVs))
- Biofuels (-0.6) (all vehicle types)

Scottish abatement is calculated by taking a share of the UK abatement for each measure set out in the Committee's Fourth Budget Report⁵ according to the share each year of Scottish emissions for each mode (car, van, HGV, buses) in the National Transport Model 2030 forecast⁶.

In 2030 the forecast shares of Scottish emissions by mode are:

- Car 8.0%
- Van 8.7%
- Rigid HGV 9.4%
- Articulated HGV 7.4%
- Buses 10.9%

Further details of the assumptions associated with each of these measures can be found the Committee's Fourth Budget Report.

14. It would be helpful to understand why measures relating to vehicle fuel efficiency (car and bus) were only presented for the period 2020 – 2030.

The transport abatement here refers to the full period from 2008 to 2030.

15. It appears that the AEA DA report from 2007 was used for non CO₂ calculations. Would it be possible to explain the exact methodology and can the 2008 outturn be used here?

2008 outturn emission data was used in the original advice provided to the Scottish Government to replace the projected 2008 figures from the AEA DA report. The projected trend following that was then applied out to 2025. As AEA's data is only available to 2025, we assumed flat emissions from 2025-2030.

⁵ Committee on Climate Change (2010) 'The Fourth Carbon Budget', available from <http://www.theccc.org.uk/reports/fourth-carbon-budget>.

⁶ Detailed working has been provided to the Scottish Government

16. Can the CCC explain why the data for 2008 (rather than 2009 or 2010) was used to reconcile the verified EU ETS data with the STEPS model?

The purpose of the adjustment is to investigate and reconcile the extent of the difference between the estimate of the size of the traded sector from STEPS and the actual verified emissions as outlined by EU ETS – notwithstanding the acknowledged differences between EU ETS and the inventory emissions.

The adjustment is made based on outturn data.

We use outturn data from STEPS and EU ETS in 2008 to make the adjustment – while we have verified EU ETS for 2009 and 2010, these years are only projections in STEPS.

The size of the adjustment as a proportion of the estimate is applied going forward.

The adjustment is a lot smaller than previous iterations given that the energy supply in STEPS (around 2 MtCO₂) is now considered 100% traded, as are some process emissions relating to the cement sector.

17. Is the baseline used in calculating abatement from the Scottish Heat Model consistent with the baseline in the CCC analysis?

To clarify, we do not have a separate heat model for Scotland, although the UK heat model commissioned by the CCC for the 4th budget work does provide Scottish results.

The baseline for NERA/AEA heat model is consistent with the baseline used in the CCC analysis for UK and Scotland (DECC model).

For example in the residential sector, energy demand is derived by taking each household type and multiplying that up by the average energy use per household type by the number of households of that type. This aggregate is then calibrated to the DECC model central run which is the basis for the residential sector projection used to produce the Scottish reference projection/baseline in the CCC analysis.

18. It appears that the bottom-up analysis for 2023 needed to be adjusted to meet the requirement from the 2009 Act that a reduction of at least 3% is

to be achieved in each year. Does this mean further effort will be required in this year, beyond the CCC cost-effectiveness assessment?

Yes. As outlined in the advice, abatement from later years would need to be brought forward to 2023 to meet the requirements of the Act. Given the limited scope for credit purchase in the Scottish Act, the difference between the current projected path and the required level of the target for 2023 could not be met from credit purchase.

There is potentially a small impact on the cost of meeting the recommended targets given that we expect technology costs to be lower (through learning) later in the 2020s. However on average, the cost of meeting targets would still be less than 1% GDP.