September 2012

Briefing

DECC Pathways analysis and climate change

Friends of the Earth inputs to DECC's pathways model.

Introduction

The Department for Energy and Climate Change (DECC) have produced a powerful web-tool, which allows users to assess different pathways for how the UK might meet its requirement under the Climate Change Act to cut greenhouse gas emissions by 80 per cent by 2050.

This tool is available at http://www.decc.gov.uk/en/content/cms/tackling/2050/2050.aspx

There is a version for schools, a web tool, and an exceptionally detailed Excel calculator and accompanying wiki. DECC's 2050 Pathways project is a seriously impressive piece of work; Friends of the Earth also warmly welcomes DECC's commitment to transparency in this project.

The DECC pathways web tool sets out a variety of pathways suggested by different organisations and individuals, including Friends of the Earth. This briefing sets out the values Friends of the Earth has inputted into the DECC 2050 pathways model, and the reasons why. It sets out the results from this, and compares the results on cost and climate change of our inputs with some other possible pathways. It also sets out some suggestions for how this excellent model might be improved even further.

Friends of the Earth's vision for energy and climate change

Friends of the Earth believes that there should be three underpinning principles for developing a sustainable energy system for the UK:

- **Environmental** – the UK plays its part in preventing dangerous climate change, and minimises other environmental impacts
- **Social** – gives all people access to the services they need: eg available electricity at the right times and right places; warm homes, access to safe, reliable transport; does so without negative impacts on people in other countries.
- **Economic** – does this at affordable cost for all people and businesses.

These principles underpin the choices we've made to input into DECC's model.

On climate change, we believe the Government's current UK targets and carbon budgets are based on an unacceptably high level of risk of dangerous climate change. They're based on a 56-62% chance of exceeding a global 2 degree temperature rise. We believe this is far too high a risk for a temperature rise with major chances of leading to irreversible "tipping points" as well as more catastrophic events like flooding, storms and droughts. We believe that the UK's carbon budget should be no more than 9 GtCO2e between now and 2050 ' keeping the risk of exceeding two degrees at "unlikely" (less than 33%)– as set out in more detail in our report Reckless Gamblers[i]. Our choices in the DECC model are aimed at getting cumulative emissions down as close as practicable to this level: which is far lower than most pathways to the 80% 2050 target. This 9 GtCO2e budget is extremely difficult to stay within – it requires monumental effort across all sectors.

Many of the technologies which could bring emissions down come with potential downsides – such as other environmental problems, high costs, perceived inability to "keep-the-lights-on" or major uncertainties as to feasibility or impacts. The major ones, and our attitude to them, is set out in the Appendix. In short, we believe:

- The UK can decarbonise electricity without new nuclear power stations, so the risks of nuclear proliferation and waste management are risks not worth taking
- The UK cannot play its part in tackling climate change without negative-emissions technologies. We need them, so long as they can be made to work effectively and their risks can be managed.
- The UK should not import unsustainably sourced bioenergy, on environmental and social grounds. There is some sustainable bioenergy resource in the UK, and we should use it.
- Wind power and some other renewable sources of electricity are variable; even with high levels of these renewables sources, variability can be managed at acceptable cost using electricity storage, smart-grids, some back-up capacity and interconnectors.

Friends of the Earth's energy pathway choice

The detail of our inputs to DECC's pathway model are set out in the Appendix.

For each subject area you can see what each level means by clicking on its name on http://2050-calculator-tool.decc.gov.uk/

In essence our approach is to decarbonise the UK as fast as possible using the following approach:

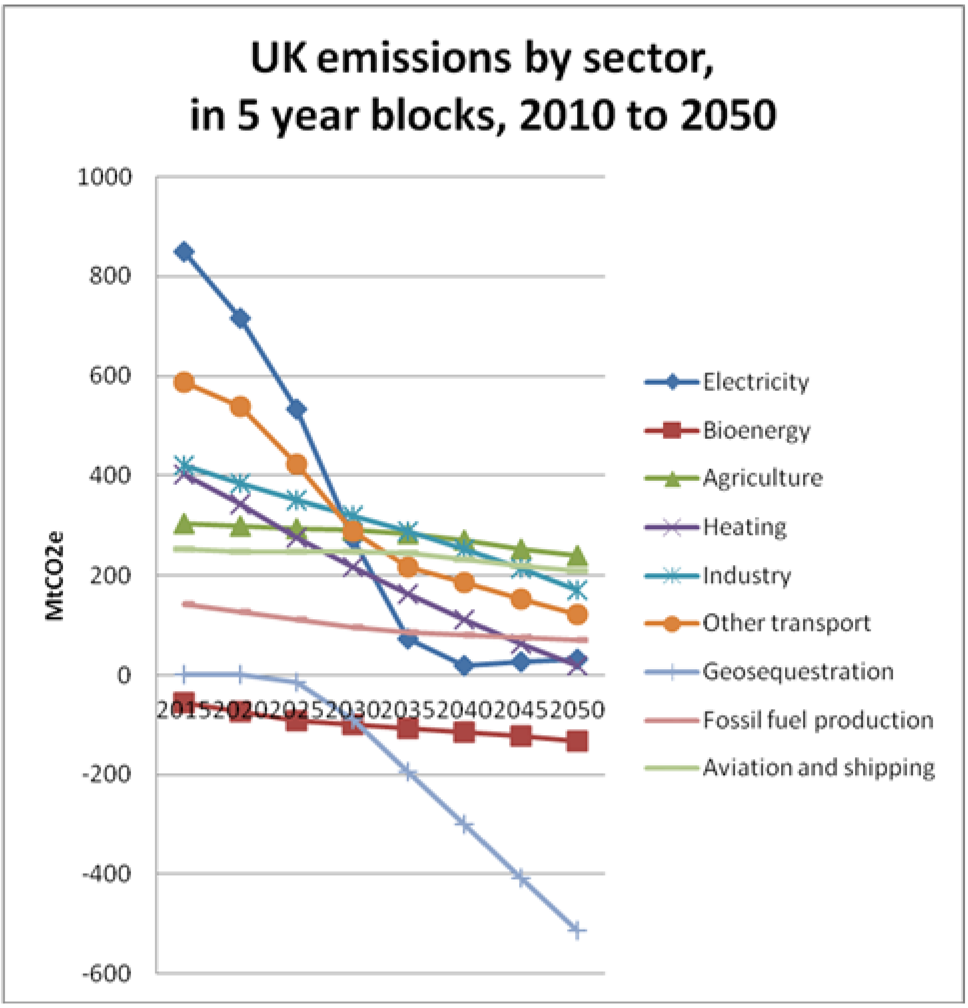
- Reduce energy demand and maximise energy efficiency as much as possible
- Electrify demand where possible as fast as possible
- Use sustainable, renewable energy where possible, for energy demand you can't electrify
- Decarbonise electricity (without use of nuclear or imported biomass)
- Carbon Capture and Storage where possible for remaining energy demand, so long as the technology's risks are well managed.
- Negative emissions technologies (NETs) as needed after that, so long as the technologies' risks are well managed.

Results[ii]

Pathway	Gt CO2e emitted (2010-2049)	Cost £/person/yr
Doesn't tackle climate change	23.7	4700
"Markal" ('Least cost' pathway to meeting 80% target)	13.5	4700
Friends of the Earth	12.6	5500

[NB – DECC are clear that these costs do not include the costs of climate change. They estimate that doing so would add "up to £6500 per person per year" to the 'Doesn't tackle climate change' pathway above]

The breakdown of emissions by sector for Friends of the Earth's pathway is:



Friends of the Earth's carbon budget is lower than other pathways, but is still more than 3 Gt over what is in our view a minimum safe carbon budget. There are some areas where carbon could come down further – these are:

International aviation – the DECC model's highest value still assumes major growth in aviation passenger numbers. This is reflected in the above graph – one of only two sectors to have very slow emissions reductions. Bringing international aviation emissions down to 50% of 2007 levels would save an additional 0.7 Gt. This could mean fewer flights than in 2007, if aviation fuel efficiency gains are not sufficient.

Land-use/Agriculture is the other main sector with slow emissions reductions to 2050. A shift from livestock production to land for biomass, if desirable, could save an additional 0.6 Gt[iii]. However, there are many competing demands for land, and the UK also has a heavy "land footprint" overseas. This issue requires more research. Agriculture is a difficult sector to reduce emissions from – analysis such as from the Tyndall Centre[iv]suggests there is likely to be a large amount of "rump" emissions associated with food production.

Negative Emissions Technologies. DECC level 4 assumes a rapid take up of NETs, Our Negatonnes report[v] implies that a further 1-2 Gt might be possible[vi].

Other measures appear to only have a low effect on carbon budgets – summed, less than 0.5 Gt. "Other transport" has a rapid decrease in emissions to 2030, but slower after that – due to the difficulty in decarbonising the road freight sector.

In total, with extra potential from NETs, aviation and agriculture and a few smaller contributions from other sectors, a further 3-4 Gt saving looks possible, just, bringing the total UK carbon budget to around 9 GtCO2e

Costs

The DECC model allows comparisons of costs between different pathways. This is useful, but as DECC point out, there are major caveats and uncertainties for these figures, which they set out at http://2050-calculator-tool-wiki.decc.gov.uk/pages/82 . We add three further caveats:

- The headline figures **don't have error bars** – it's quite possible that there's no statistically significant difference between any of the figures.
- Costs are highly variable – in particular on energy/fossil fuel costs and on finance cost, but also on choices such as the ratio of battery/hydrogen powered cars (moving it from 80:20 to 100:0 decreases FOE's cost by £200).
- **Carbon budgets** are not the same in all pathways. The pathway tool is geared towards showing the different ways to meet the 80% 2050 target – the UK's legal requirement. However, what is most important is not the end-point, but the total amount of carbon emitted to 2050 – the "carbon budget". The Friends of the Earth pathway is more expensive than the Markal pathway, but it also emits 1 Gigatonne less.

Bearing in the mind these caveats we make the following comments on the above figures:

Tackling climate change is the cheapest option. DECC estimate the cost of not tackling climate change to be up to an additional £6,500/person/yr – so including the costs of climate change makes all of the "tackle climate change" options on the DECC website far cheaper than not tackling climate change.

Finance costs are critical. The sensitivity analysis for costs is clear that the overwhelming issue for costs, whether our the UK's new energy infrastructure is high or low carbon, is finance costs. The cost of capital – whether it's 5% or 7% or 10%, or some other figure, has a huge impact on the costs of all pathways. This has to be a major policy priority for Government. Another large cost of lower carbon pathways is the decarbonisation of transport – a focus on driving down the costs of mass deployment of fuel cells, electricifation of vehicles and other technological advances in transport appears to be another policy priority.

Fossil fuel costs – which way will they go? Fossil fuel costs are another major determinant of costs. Our view is that the default estimates in the DECC model are likely to be underestimates[vii]. We could be wrong. But our view is that it would be prudent to make policy under the assumption that they will be higher – better to plan for worse cases and guard against them.

The type of renewables affects the overall cost. Our pathway has comparatively high levels of relatively more expensive renewables technologies like wave, tidal and geothermal. A different mix of renewables technologies – for example lowering wave, tidal and geothermal and replacing it with the same quantity of extra onshore wind – would lower the above cost by £200. Our mix here aims for a more diverse portfolio of renewable technologies.

Nuclear costs – what is counted? The future cost of all technologies is very uncertain, but what is known is that current figures for nuclear omit certain costs – for example taxpayers picking-up the tab for limits to liability for accidents.

"Default" estimates – when not to use them? Rates of deployment are linked to both cost and to policy. Strong policy can bring costs down. It is likely, for example, a high solar deployment (or a high nuclear deployment) will be linked with lower than default solar prices (and similarly for nuclear). So, it's likely that a high renewables pathway will have lower overall costs than default, as renewables costs will be lower than default renewables costs. And similarly a high nuclear pathway will have lower overall costs than default, as nuclear costs will be lower than default nuclear costs.

Energy security is important too. A major cause of Markal's lower cost is its high dependence on imported biomass for power stations. We don't choose this option because of our concerns over biodiversity impacts, uncertainties over how genuine carbon savings will be, and likely need for this land for other purposes (eg feeding people). However, even ignoring all of these, a remaining problem is that this pathway has the UK's dependence on energy imports at over 60% - way higher than the FOE pathway's 30%

Conclusions on cost

All main pathways to an 80% cut by 2050 are much cheaper than doing nothing – when you take into account the cost of climate change.

There are many different possible pathways to the UK's 80% 2050 target – we believe the focus should be on the total carbon emitted, not the end-point. Our pathway is more expensive than the "least cost" approach – but then the least-cost approach emits more carbon, and also has very high dependence on energy imports. All paths have costs attached - a policy priority has to be to drive those costs down, particularly finance costs which appear to have a pivotal impact on the cost of all pathways, high carbon or not.

Recommendations for changes to DECC model

The DECC excel model does have the ability to calculate cumulative carbon emissions – but it's buried in row 177 of the "intermediate output" tab. Total carbon emitted is more important than the end goal – **carbon budgets should be visible on the front of the web tool**

It's currently difficult to see what figures correspond to "cheap" and "expensive" in the cost sensitivities section of the web tool – this could be made clearer. **It would be useful to be able to vary costs in-between the three options"cheap", default and "expensive"** – using a slider? For example, particularly on "financing costs" it would be good to be able to have values other than 0%, 7% and 10%.

Ability to go beyond Level 4 for international aviation (ie not assuming large increases in aviation numbers), and ability to reduce the total number of passenger and freight miles for transport.

Potential to go beyond Level 4 for cutting electricity demand. Recent draft research by McKinsey for DECC[viii] implies that this might be possible.

Appendix Friends of the Earth inputs and assumptions

Screen-shot of Friends of the Earth inputs to DECC model:

Notes on some inputs:

Electricity generation

For electricity generation our inputs assume higher electricity demand by 2030. Although we put in high values for energy efficiency, because we assuming high electrification of domestic heating and transport sectors, as well as needing electricity for geosequestration, overall electricity demand is higher than today. We meet this electricity demand mostly via a wide range of renewable technologies, with some residual fossil fuel generation, and an increase in CCS. Increased use of storage, demand shifting and interconnection helps deal with variability, alongside 14 GW of peaking plant.

We are not assuming high DECC levels for wind – for example we use level 2.3 for offshore wind: 284 TWh by 2050, whereas Level 4 has 929 TWh by 2050. Similarly, we use level 2.3 for onshore wind.

Nuclear Power

Nuclear power has the major downside of its other environmental impacts – such as its legacy of nuclear waste, safety concerns and risks of nuclear proliferation. We believe it is possible to have an affordable electricity mix which meets our climate change goals without nuclear power, so we do not include it

Carbon Capture and Storage (CCS) for power plants

CCS has drawbacks – in that the technology might not work at scale at reasonable cost, that storage might not be 100% secure, and that it perpetuates fossil fuel extraction and refining – which have major negative environmental impacts in their own right.

However, it is clear that the world is going to keep on using fossil fuels, in at least the short-to-medium term. CCS is likely an essential bridging technology globally to reduce emissions from fossil-fuel power stations. In the UK we believe it is possible to meet most electricity demand from renewables, but we have included some CCS in the mix. It is also likely that CCS will be needed in the industrial sector to keep emissions down there[ix], as some processes cannot be easily electrified: a flourishing industrial CCS sector may require some electricity sector CCS to ensure sufficient scale to bring costs down.

Negative Emissions Technologies (NETs)

Most NETs have significant potential environmental downsides, and are likely to be expensive. These are outlined in our report Negatonnes[x]. However, our view is that even as-fast-as-possible emissions cuts will not now be enough to keep risks of dangerous climate change acceptably low. Decades of inaction from Governments now mean that some forms of geoengineering now appears necessary alongside cutting emissions. The longer we leave cutting emissions, the more likely we would be to need even more risky and expensive geoengineering options like Solar Radiation Management to tackle climate change. This is truly a choice the world would not want to have to make. We conclude here that NETs have to be part of the UK's plan to tackle climate change.

Biomass

Some pathways cut carbon by the heavy use of biomass for electricity. We do not advocate this route. It requires major use of biomass imports – which is likely to likely to use up land that people in other countries need for growing food or keeping livestock, likely to have major negative biodiversity impacts; will increase the UK's energy insecurity, and even the purported carbon benefits are uncertain.

There is a sustainable bioenergy resource within the UK, but in our view this is better used in the domestic, industry and transport sectors, where there are fewer low-carbon alternatives, than in the electricity sector, where there are more alternatives

Marine/Tidal

Marine and Tidal are very low carbon, but come with concerns about cost (they are currently the most expensive low-carbon options) and other environmental impacts. We advocate rapid uptake of these technologies – but not to the highest levels in the DECC model - for example we advocate tidal lagoons instead of tidal barrages in the Severn Estuary: lower electricity generation, but lower environmental impact also. On cost, these technologies will come down in price, but our choice of less-than-maximum deployment reflects the need for an overall mix with reasonable cost

Wind power

In the UK the renewable technology with the greatest potential is wind, particularly offshore. Wind has had a bad press in some quarters over concerns about what happens when the "wind doesn't below" – eg a long low-pressure episode in January; concerns might grow if wind takes up a greater proportion of the UK electricity mix. These concerns can be addressed by the use of a range of electricity sources, greater use of interconnectors, electricity storage and demand-side responses, and the use of stand-by capacity (stand-by capacity exists now – how else is the Coronation Street spike dealt with? This is not a new issue for the UK). "Keeping the lights on" is also dealt with extensively within the DECC model, and its costs incorporated.

Keeping the lights on.

We assume major use of energy storage and interconnectors. In addition to this our inputs require 14 GW of peaking plant (in 2030) – we note that although this is more than in the Markal pathway (7 GW) this is considerably less peaking plant than in other scenarios on the DECC pathways website, for example from the National Grid (26 GW) and Atkins (29 GW).

Transport

Here the DECC pathways project does not allow for lower demand – for example even Level 4 on international aviation still has a 90% increase in passenger numbers over 2005 levels, Level 4 for domestic freight assumes that freight mileage in total will increase.and Level 4 for domestic transport still has the distance each of us travels unchanged in 2050. Friends of the Earth believes that, for example, better planning of city centres could help reduce the need to travel, and that airport expansion is not a sustainable part of aviation policy. We would have wanted to input different values to the DECC calculator, with lower mileage for transport, and in addition to be able to increase the modal shift possible to include higher levels of cycling, as is aimed for in many parts of Europe.

Industry

We assume level 2 for industry. This assumes Industry grows by 30% to 2050 rather than Level 3 or 4 which see industry contract by 30-40% . We think instead industry should grow and be green – the UK also currently "imports" emissions as it is a net importer of products – the UK's "real" carbon emissions (on a "consumption" basis) are higher than the official data suggests.

References

[i] Friends of the Earth, 2010. Reckless Gamblers. http://www.foe.co.uk/resource/reports/reckless_gamblers.pdf

[ii] Throughout we used Version 3.1.0 of the DECC pathways model, published May 2012.

[iii] Friends of the Earth, 2011. Just Transition. http://www.foe.co.uk/resource/reports/just_transition.pdf

[iv] Anderson, K and Bows, A, 2008. Reframing the climate change challenge in light of post-2000 emission trends. Phil. Trans. R. Soc. A 13 November 2008 vol. 366 no. 1882 3863-3882.

[v] Friends of the Earth, 2011. Negatonnes. http://www.foe.co.uk/resource/reports/negatonnes.pdf

[vi] See Negatonnes, 2011, page 31, table 2; assumes linear increase in deployment from 2030 to 2050, total potential = 2-3 Gt; DECC pathway 4 assumes saving at around 1 Gt given other values inputted to the model

[vii] Friends of the Earth, 2012. Gas Prices: is the only way up? http://www.foe.co.uk/resource/briefings/gas_price_briefing.pdf

[viii] McKinsey for DECC, 2012. Draft report. Capturing the full electricity efficiency potential of the UK. http://www.decc.gov.uk/assets/decc/11/cutting-emissions/5776-capturing-the-full-electricity-efficiency-potentia.pdf. July 2012.

[ix] Industrial CCS potential is considered in Element Energy, 2010. Potential for the application of CCS to UK industry and natural gas power generation. Final Report for the Committee on Climate Change. http://downloads.theccc.org.uk.s3.amazonaws.com/pdfs/CCC_final_report_issue2.pdf. May

[x] Op.Cit.