Institution: University of Manchester

Unit of Assessment: UOA14 Civil and Construction Engineering

Title of case study: *Reframing climate change: from long-term targets to stringent and inclusive carbon budgets*

1.Summary of the impact

The UK's Climate Change Bill (2008) proposed a reduction in carbon dioxide emissions of 60% by 2050. Tyndall-Manchester's research concluded this target was inconsistent with the government's repeated commitment to a temperature rise of no more than 2°C above pre-industrial levels. It demonstrated a minimum 80% reduction was necessary; scientifically-robust policies must be based on 'cumulative emissions' (carbon budgets); and that targets should include emissions from aviation and shipping. All three recommendations are now explicitly enshrined in primary legislation, with the responsible Secretary of State acknowledging the *"signal contribution"* of Tyndall-Manchester's research to the 2008 Climate Change Act.

2. Underpinning research

Key researchers: Kevin Anderson (Tyndall-Manchester director '02 - present, Tyndall director '08 – 10); Alice Bows (research associate '03 -'08, lecturer '08, senior lecturer '11, reader '13); Sarah Mander (research associate '03 –'08, research fellow '08 - '10 on this topic); Carly McLachlan (PhD researcher '05 –'09, lecturer '10); Clair Gough (Tyndall research fellow '00 - present); Simon Shackley (lecturer, '01 - '06).

Tyndall Manchester's *Decarbonising the UK* research programme (2001-2006) developed energy scenarios for meeting the government's carbon reduction target. The scenarios integrated perspectives from engineering and economics along with those from the social and environmental sciences to provide the UK's first assessment of greenhouse gas emissions from all energy-related sources [4]. This was an international first; the method developed by Tyndall-Manchester subsequently being used to assess China's national emissions and develop scenarios of their potential emission futures. The research also made a seminal contribution to understanding the role and importance of emissions from international transport (aviation and shipping) and how their exclusion from the reporting requirements of the Kyoto protocol undermined the validity of national emissions inventories and reduction targets [5].

This early body of research [4] subsequently underpinned a wealth of rigorous, interdisciplinary, whole-system analysis of energy and emissions at both UK and global levels (2006-2011). Focussing specifically on the transition from long-term reductions targets to scientifically robust cumulative emissions and carbon budgets, this was the first detailed analysis derived for the 2°C characterisation of dangerous climate change. The work was developed to provide clear global-scale analysis, with important papers published in Royal Society journals [1, 2], *Nature* [6] and *Energy Policy* [3].

3. References to the research

Three Key References

1. Anderson, K., and Bows, A., (2011). "Beyond dangerous climate change: emission pathways for a new world". Philosophical Transactions of the Royal Society A, 369, pp. 20-44, doi: 10.1098/rsta.2010.0290.

   This pivotal paper was the first to disaggregate comprehensive global carbon budgets to the level of Annex 1 and non-Annex 1 nations, and provided the basis for the *4°C and beyond* Oxford-Tyndall conference in Autumn 2009 (www.eci.ox.ac.uk/4degrees/programme.php). Currently 131 citations in Google Scholar.

2. Anderson, K. and A. Bows (2008). "Reframing the climate change challenge in light of post-2000 emission trends." Philosophical Transactions of the Royal Society A, 366: pp.3863-3882, doi: 10.1098/rsta.2008.0138.

This has become a seminal paper, receiving over 274 citations to date (Google Scholar) and significantly reframing much of academic and, increasingly, policy debate on the scale of the mitigation challenge.

3. Anderson, K., Bows, A., and Mander, S., (2008), "From long-term targets to cumulative emission pathways; reframing the climate policy debate", Energy Policy 36, pp. 3714-3722. doi: 10.1016/j.enpol.2008.07.003.

Based on comprehensive analysis of emissions accounting and the importance of including aviation in national inventories, this influential paper became central to the development of the UK's Climate Change Act 2008, and in particular the inclusion of cumulative emissions and carbon budgets. The highly topical journal, Energy Policy (the international journal of the political, economic, planning, environmental and social aspects of energy). The article has been cited 49 times in Google Scholar.

Three supplementary references

4. Anderson, K. Shackley, S. Bows, A. and Mander, S. (2005). "Decarbonising the UK: Energy for a climate conscious future". Tyndall Centre. www.tyndall.ac.uk/content/decarbonising-uk-energy-climate-conscious-future.

The report was the first academic research to quantify comprehensive UK energy and emission scenarios (including international aviation and shipping), launched at a high-level event at Westminster with a keynote by David King (then government chief scientist). Cited 41 times in Google Scholar, copies still frequently requested at events where Tyndall researchers speak.

5. Anderson, A. and Bows, B. (2012). "Executing a Scharnow turn: reconciling shipping emissions with international commitments on climate change". Carbon Management 3(6), pp. 615–628, doi: 10.4155/cmt.12.63.

This agenda-setting paper was the first to apply the carbon budget framing of climate change to a single sector; in this case international shipping. The paper provided and academic grounding for a special issue on shipping by this relatively new journal, which is rapidly gaining status.

6. New, M., Liverman, D. & Anderson, K. (2009), "Mind the gap". Nature, 912, 143–144. doi:10.1038/climate.2009.126.

Important and timely contribution in this highly prestigious and widely read journal, highlighting the scale of the emission gap between rhetoric and reality on mitigation. 11 citations to date in Google Scholar.

4. Details of the impact - bracketed letters refer to sources to corroborate impacts in section 5.

Climate change predictions of global temperature rise rely on accurate forecasts of CO_2 concentration in the atmosphere. Tyndall-Manchester's research is at the forefront of analysis on emissions targets and carbon budgets, delivering challenging insights to policy makers. The conclusions from this research have countered orthodox views of the responses necessary for tackling climate change.

Four headline areas where it has had a tangible impact on policy development:

1) Cumulative emissions (carbon budgets) as a scientifically robust basis for policy.

The insights gained from Tyndall-Manchester's comprehensive emission scenarios attracted considerable political attention, leading to a major conference in Westminster opened by the then government chief scientist, Professor David King. As a result, the research was highly influential in bringing the singular importance of carbon budgets, as opposed to long-term targets, to the forefront of political debate [A, B].

NATIONAL IMPACT: In 2008 the Climate Change Act established the UK Committee on

Climate Change (CCC), which ultimately advised the government to introduce carbon budgets for the UK. The Secretary of State (David Miliband) acknowledged the *"signal contribution"* of Tyndall-Manchester's research to the 2008 Climate Change Act [A]; and the CCC subsequently adjusted their recommendation in line with our research findings, suggesting an 80% reduction in emissions by 2050 would be necessary to meet UK's international commitments to 2°C (as enshrined in the Copenhagen Accord). Tyndall-Manchester research also had influence in the Scottish parliament's formulating its own Climate Change Act.

REGIONAL IMPACT: At the regional level, Tyndall-Manchester was commissioned by Manchester City Council (MCC) to develop carbon budgets for the city region, subsequently adopted in the City Council's climate change action plan, *A Certain Future* (2008 and 2010).

COMMERCIAL IMPACT: Research was also taken up by a leading British retail and banking group for use in their discussions with government on the need both for a UK climate change act and any forthcoming legislation being premised on scientifically-informed cumulative emission budgets and not simple 2050 targets [C].

2) The need to increase the UK carbon reduction target.

Initially through interactions with the Welsh Assembly Government (Anderson appointed as commissioner and scientific advisor to Welsh Government's climate change commission, 2007–date) and subsequently the UK Committee on Climate Change, Tyndall-Manchester's work was, as noted by the Secretary of State [A], to be pivotal in the UK basing it targets on a cumulative approach. Ultimately this led to a shift from an advisory 60% reduction target to an 80% target enshrined in primary legislation

Tyndall Manchester influenced this decision through:

i. A report commissioned by Welsh Assembly Government (*Towards 2°C: emissions reduction scenarios for Wales*) – Tyndall-Manchester developed emission scenarios for Wales based on the cumulative budget analysis undertaken by Anderson and Bows and provided formal written and oral reports back to the Welsh Climate Change Commission and the Welsh Cabinet.
ii. Evidence presented to Northern Ireland devolved administration (2008) [D]
iii. Contributing to Prime Minister's Office report on carbon trading (2009) [E]

3) Inclusion of shipping emissions in UK carbon budgets.

Transport contributes significantly to carbon emissions but was initially excluded from targets in the UK Climate Change act. Input from Tyndall-Manchester academics was influential in the UK Committee on Climate Change's (CCC) advice to government to include international shipping emissions in the UK carbon budgets [F]. This advice is not legally-binding, but the 2008 Act does require Government to respond directly to the advice of the CCC and typically Government develops policy on the basis of the advice (as it is with aviation and shipping)

4) Emission pathways align more with a 4°C than 2°C level of warming.

Tyndall Manchester research is continuing to have significant impact on the UK, EU and Global debates on the carbon budgets and emission pathways commensurate with 2°C. This is ongoing with the impact being on framing and informing high-level debates; including invited submissions to give evidence to various parliamentary committees reviewing the UK's carbon budgets and 2°C commitments. Other examples include:

- Numerous presentations (government, parliamentary, public, business) (2008-11) [G]
- Broad media coverage (e.g. Guardian – climate scientists warn of 4°C … Nov. 2010) 2008-2011
- Article in Parliamentary Brief (2010)
- Considerable foreign media coverage (e.g. Sydney Morning Herald – July 2011)
- Anderson speaking as advisor to the Department for International Development (DfID) on

the prospects of potential emissions and impacts on DfID's development programme. Most recently, a 'morning update' on climate change at the behest of the director general for policy and global issues (Michael Anderson) and video linked DfID's Asian offices [H]

- Environmental Audit Committee report on Carbon Budgets, 2010-12 session [I].

In addition to the above policy areas, Tyndall-Manchester work on comprehensive emissions budgets has been used by the research councils to inform the context of their future funding programme and calls. This impact was influenced through an invited keynote address to RCUK workshop to frame the research councils' forthcoming ~£50M investment in energy demand research, in which Tyndall-Manchester researchers were asked to provide the UK and international climate change context and outline criteria for guiding the future programme and calls.

Whilst all the research included in the submission was academically and proactively pursued, it often benefitted from close liaison and some financial support from the Cooperative Group, several NGOs and scientists at the UK's Committee on Climate Change and the UK's leading climate modelling group (the Met Office-based Hadley Centre). Furthermore, Tyndall-Manchester work was influential in guiding the campaigning objectives of major NGOs – for example through a commissioned review of the first report of the Committee on Climate Change (2009) [J].

5. Sources to corroborate the impact

A. Statement of corroboration from former Secretary of State for Environment, Food and Rural Affairs.

B. Statement of corroboration from former special advisor to Secretary of State for Environment, Food and Rural Affairs.

C. Statement of corroboration from senior manager at large British retail and banking group.

D. "MacLochlainn welcomes Environment Committee enquiry into Climate Change" http://www.derrysinnfein.ie/news/10132

E. Lazarowicz, M (2009) 'Global Carbon Trading, A Framework for Reducing Emissions'. http://www.marklazarowicz.org.uk/uploads/2765fed3-1eaf-a954-3903-978d6047231b.pdf

F. Statement of corroboration from senior member of Committee on Climate Change (CCC).

G. Anderson, K., and Bows, A., oral evidence on the UK Climate Change Act and Committee Report, Environmental Audit Committee, March 2009.

H. http://www.slideshare.net/DFID/professor-kevin-anderson-climate-change-going-beyond-dangerous. Viewed 32,214 times.

I. House of Commons Environmental Audit Committee, Carbon Budgets – Seventh Report of Session 2010–12 Volume II. www.publications.parliament.uk/pa/cm201012/cmselect/cmenvaud/1080/1080.pdf

J. Statement of corroboration from head of policy, research and science at leading environmental NGO