The Global Calculator will enable the user to explore choices for the global energy system in 2050 and view the impact these choices could have on the climate system by 2100. This work will help to bring the climate science to life by presenting it to users in an accessible and engaging way.

Prof. David MacKay, CSA to DECC

The Department of Energy and Climate Change (DECC) is tasked with ensuring affordable, reliable energy supply to the UK within binding carbon targets. Its UK Calculator is a user-friendly online tool that allows public exploration of possible mitigation actions, with a visualisation of energy use and carbon impacts.

The proposed Global Calculator extends the idea to the world, and to the fullest extent possible will include climate impacts. This project will prototype a tool to visualise the output and uncertainties in possible climate trajectories, while admitting the ambiguity in the detailed outcomes. It is hoped that the visualiser will raise awareness with the general public, promote engagement with the challenges we face, and feed into evidence-based policy.

The 2050 Global Calculator will be launched in July 2014 as an open source web tool, aimed at international decision-makers in businesses and governments. Users will be able to select technically feasible pathways for deployment of energy technologies and changes in behaviour, and then view global energy supply and demand, and net carbon emissions.

The role of the work funded by PURE was to provide a visual representation of regional climate change and in particular to show the uncertainty in climate model projections in a suitable, understandable format, fitting within the constraints of the Global Calculator principles (simple, transparent, quick to run, based on an Excel spreadsheet).

After exploration and discussion of the merits of possible alternatives, we have provided a series of colourful animations showing state-of-the-art model output, taking into account uncertainty. These will be a key part of the Global Calculator, which aims to energise the debate on climate change and build momentum for action in the run-up to the UN-FCCC COP in Paris in 2015.

This project is part of a larger project funded by DECC and Climate-KIC.

“The Global Calculator will enable the user to explore choices for the global energy system in 2050 and view the impact these choices could have on the climate system by 2100. This work will help to bring the climate science to life by presenting it to users in an accessible and engaging way.”

Prof. David MacKay, CSA to DECC
How we did it

We explored a number of possible solutions and concluded that the most appropriate implementation was to provide maps based on gridded data from the state-of-the-art CMIP5 climate modelling project, and to represent uncertainty in those maps using an animation showing different possible modelled futures consistent with the projected change in global mean temperature.

Real-time calculation is clearly ruled out by the observation that with 40 user-defined levers and 4 choices of each, there are \(4^{40} = 2^{80}\) possible combinations of user trajectories. We are not able to run even a very simple climate model in real time as users click buttons, nor could we pre-calculate and store \(2^{80}\) distinct runs (and that is before consideration of uncertainty). Therefore we have taken a simple approach which relies on the IPCC’s judgement that global mean temperature is approximately linearly related to cumulative carbon dioxide emissions under certain conditions. This allows pre-calculation of all the animation frames using CMIP5 data, which are then selected using a simple look-up table based on the high-low range.

A number of warning messages are also provided which make clear to the user when their technological choices (for instance, very high emissions pathways are possible) move outside the realm of the IPCC assessment.

Meet the team

From left to right
Dr Erica Thompson, LSE
Prof. David MacKay, DECC
Prof. Leonard Smith, LSE

“It’s been really interesting to get involved with a project taking such a broad viewpoint, and to see how climate change fits in with other factors governments need to consider. I hope my contribution will help to make the Global Calculator a great success with a strong scientific basis.”

Dr Erica Thompson, LSE

This project is part of the Probability Uncertainty and Risk in the Environment (PURE) Associate programme, funded by the Natural Environment Research Council (NERC) and managed by the Smith Institute for Industrial Mathematics and System Engineering.

NERC is the UK’s main agency for funding and managing research, training and knowledge exchange in the environmental sciences. Its research contributes to a strong UK economy and improves people’s lives.

PURE is a Knowledge Exchange Network and Research Programme funded by NERC to increase the impact of Natural Hazard research and to take a national leadership role in changing the way in which uncertainty and risk are assessed and managed across the Natural Hazard community.

Project Details

Partners
DECC
LSE
Climate-KIC

Project dates
December 2013 – May 2014

Other contact info:
Professor David MacKay
DECC
csa@decc.gsi.gov.uk

For information on the NERC PURE Associates programme or the PURE Network, contact:
Dr Vera Hazelwood
PURE Network Director
vera.hazelwood@pure-associates.org
+44 (0) 1483 579108

http://www.nerc.ac.uk/research/programmes/pure

PA13-036 / May 2014