# MULTI DIMENSION IMPACT ACCOUNTING (MDIA)

# The Global Calculator
# A UK Initiative to Model the Future

*January 2015*

## History of the Calculator

The Global Calculator is really a spin-off of the successful 2050 Calculator energy modelling methodology that started in the UK and has spread around the world.

The Calculator story began in the UK in 2009, when the UK government's Department of Energy and Climate Change (DECC) was tasked with coming up with a plan to meet the world's first legally binding emissions target (an 80% reduction by 2050 based on a 1990 baseline). Because there was so much uncertainty about what technologies would be available in the future, the team decided to build a new tool to explore all the options available, rather than using existing models that determine an optimum pathway. This was called the 2050 Pathways Calculator.

A number of 'key messages' from the Calculator were published - lessons learnt from all pathways that meet the 2050 target. These were then used to develop the Carbon Plan, the government's overall emission reduction strategy, in 2011. A simplified version of the Calculator called My2050 was developed aimed at the general public. Over 17,000 people have submitted pathways using this site, giving a unique insight into public opinion on the energy transition.

Since then, around 20 countries, regions and territories have adopted a similar approach and have built or are building their own calculators to help inform policy and increase public understanding of energy issues. This began with the Belgian region of Wallonia, and was quickly followed by China. In 2012 DECC received funding from the International Climate Fund to support 10 developing countries to build calculators using locally based teams, as well as to build the Global Calculator. You can see a full list of countries on the DECC Calculator website.

### What makes the Calculator special?

Each Calculator project has been unique, reflecting the individual circumstances and requirements of a country or territory. But the common features of these Calculators - and the Global Calculator - are:

Completely open source - the underlying model (built in Excel) and documentation are published.

Relatively simple, engineering-based models designed for scenario testing.

User friendly web-based interface means that non-experts can use them.

Shows the full range of potential ambition across sectors using a level 1-4 approach.

Involves external experts in the build of the tool.

Models are published as public 'calls for evidence' on their data and approach.

## Our consultation process

The Global Calculator team is committed to openness and transparency. For example, we have published the online tool under a Creative Commons Licence and have also published the full Excel model under an Open Government Licence. The Excel spreadsheet is fully referenced so that everyone can see where our assumptions come from and how the model works.

As part of this commitment, we have consulted hundreds of experts in the development of the model. This is to ensure that we are use the best data, include the most accurate assumptions, and take into account the full range of opinion when we look into what is possible in the future.

A series of nine workshops and various meetings were held during the development phase in Washington DC, London, New Delhi, Beijing and Brussels. These allowed experts in the different sectors included in the model to discuss issues in detail. The tool was then launched in draft form with a call for evidence in July 2014 so that we could receive more feedback on a working prototype. On this page you can see information on our workshops.

### Workshops and meetings

Electricity and fossil fuels workshop in New Delhi, 23-24 April 2014:

- Electricity and fossil fuels slides day 1.pdf
- Electricity and fossil fuels slides day 2.pdf
- Electricity and fossil fuels attendance list.pdf

Land, bioenergy and food workshop held on 22 to 23 April 2014, London:

- Land bio food workshop notes.pdf

Transport workshop in Washington DC, 15th January 2014:

- Transport workshop notes and discussion.pdf

Greenhouse gas removal (GGR) workshop on 10th February 2014, London:

- GGR workshop notes.pdf

Manufacturing sector workshops held in April and May 2014, Brussels

- Cross sector workshop preread.pdf
- Steel Workshop Preread.pdf
- Cement Workshop Preread.pdf
- Chemicals Workshop Preread.pdf

Buildings sector:

- Building sector - feedback from stakeholders.pdf

Climate-KIC climate science committee:

- Climate committee minutes 24 October 2013.pdf
- Climate committee minutes 4 February 2014.pdf
- Climate committee minutes 1 May 2014.pdf
- Climate committee minutes 25 June 2014.pdf

## Excel version and code

As part of the commitment to be the most open, collaborative and accessible world energy model, the Global Calculator team has published the full model behind the online tool. This is built in Excel so that it can be accessed by people easily without downloading special software, and so it can be relatively easy to understand. You are welcome to examine the methodology and assumptions we have used. If you do not agree with them, you can change them and see the impact of the change.

We have also published the source code behind the online tool so that you can create and modify your own version.

## The team behind the Calculator

The Global Calculator has been built by a team based in a number of organisations around the world. Each partner organisation was in charge of one sector of the model (e.g. transport or buildings), with the UK's Department of Energy and Climate Change overseeing the project.

A short profile of each of the team members in alphabetical order follows:

## Laura Aylett

Laura works on the communications and outreach sides of the Global Calculator project. Prior to joining DECC in 2013, she worked in communications and policy at the Royal College of Nursing of the UK. Here she led on research for the Frontline First campaign against cuts in the National Health Service, and worked on the College's response to health care reforms. She started her career at Phaidon Press, where she was Assistant Editor of the Phaidon Archive of Graphic Design. Laura studied Human Sciences at Oxford University and received a Postgraduate Diploma in Journalism from the London School of Journalism. She maintains her interest in science communication by volunteering at the Natural History Museum.

## Tom Bain

Tom is an Economic Advisor at DECC, and the lead modeller for the Global Calculator. He coordinates modelling across the team, and oversees the methodology for all sectors and their implementation into the Excel spreadsheet. Tom worked with Sophie to scope the project, set up the team and to determine the key messages, and designed and developed the overarching structure and methodology of the tool.

Tom has worked in DECC since early 2012. He previously worked on the UK's 2050 Calculator, developing the cost analysis and applying the tool to strategy and policy issues within the department and promoting the messages to external organisations. He then worked on international outreach, promoting the modelling approach and providing direct technical support to a number of developing countries. Prior to DECC, Tom worked as an economist at the UK Ministry of Justice for three years, advising on offender management, competition and procurement policy and strategy. Prior to the MoJ, Tom worked as an economist at the UK Law Commission. Tom has a masters degree and an undergraduate degree in Economics from the University of East Anglia.

## Anindya Bhattacharya

Anindya is a Senior Manager at E&Y in India, and leads on the electricity and fossil fuels sector in the Global Calculator. He is experienced in developing and using energy systems model like TIMES-MARKAL and MESSAGE and their related databases for global energy assessment. For example, he developed a strategy for the Japanese government using TIMES. He has assisted developing countries like Indonesia, Vietnam and Thailand to build national energy planning tools. Anindya is also specialised in long-term energy technology development pathway assessment, including electricity from fossil fuels and renewables. He is also experienced in conducting integrated assessment modelling for the water, energy, climate and land use nexus. This is Anindya’s second calculator project, as he was part of the team that built the Japanese 2050 Calculator.

## Ephraim Broschkowski

Media scholar Ephraim Broschkowski completed postgraduate training in creative producing and has worked as an author, producer, lecturer and director for different organizations and companies focusing on topics of sustainable development.  He won several prizes for his work. Today he is creative producer of the Climate Media Factory, working e.g., for the European Research Project 'RAMSES - science for cities in transition' and on various short movies, web applications and animations.

## Erin Cooper

Erin is part of the team developing the transport sector of the Global Calculator. She is a Research Analyst with EMBARQ‘s Research and Practice team where she supports programmes across the world, as well as leadingh research projects. Her work focuses on vehicle emissions and technologies, GHG accounting of transport projects, and tracking the impact of EMBARQ transport and urban development projects. She also focuses on expanding this research into information and tools that agencies can use to guide decision making. Prior to this, Erin worked for three years as a Research and Teaching Assistant at California Polytechnic State University, San Luis Obispo in the areas of transportation and land use. This included a user preference study for the provision of cycling and pedestrian infrastructure, and using new data, resources

and software to promote efficient transportation planning. At Cal Poly, Erin received a dual Master's degree in City and Regional Planning and Engineering, with a specialization in Transportation Planning. She was able to work with cities, transit agencies and non-profits on planning and sustainability projects. She also holds a BSc in Human Geography from the University of Surrey, UK.

## Michel Cornet

Michel leads on manufacturing in the Global Calculator. He is the Energy & Climate Change Manager at Climact, where he supports companies, NGOs and governments with projects related to these issues. Michel is no stranger calculators, having worked on the Wallonian 2050 Calculator and a number of others in collaboration with DECC. Earlier, while at A.T. Kearney, he focused on strategy (corporate and functional) and in operations (complexity management). Prior to that, he worked in microfinance both in the field and serving the United Nations. Michel is a computer science engineer by training. He also lectures on energy and climate change at various universities.

## Dr Tom Counsell

Dr Thomas Counsell is the Deputy Director in charge of the DECC's 2050 team, which is behind the Global Calculator and other initiatives. He is an engineer by training, with a PhD in paper recycling. Within DECC he has led one of the strategy teams, the engineering team, and been an assistant to David MacKay, the department's Chief Scientific Advisor. His main practical contribution to the Global Calculator has been his open source toolkit that converts spreadsheets to run in the C programming language.

## Ruth Curran

Ruth is the lead analyst for quality assurance on the Global Calculator. During the later stages of development she coordinated the identification and fixing of issues in the spreadsheet calculations and documentation. As well as supporting the Global Calculator development, Ruth is one of the 2050 team's technical analysts, working with countries like India, Colombia and Mexico to help them adapt the 2050 calculator approach to their own energy systems.

Ruth joined DECC's Strategy team in August 2012, having previously worked at Forum for the Future, a sustainability charity. Her role there involved helping Forum's food and finance sector partners to understand and measure the risks and opportunities of sustainability. Prior to this, Ruth began her career at Tesco as an analyst in marketing and site research, helping to use customer, store and geographic data to build models and inform business decisions. In 2009 she also worked for the Environment Agency, researching the barriers to more sustainable behaviour. Ruth has an undergraduate degree in Computer Science, a Masters in Operational Research and a Masters in Leadership for Sustainable Development.

## Davide D'Ambrosio

Davide D'Ambrosio is coordinating IEA efforts for the Global Calculator project. Davide works for the International Energy Agency (IEA) in the Directorate of Sustainable Energy Policy and Technologies where he provides modelling and data analysis for the Energy Technology Perspectives publication series. He coordinated and co-authored the 2013 and 2014 Tracking Clean Energy Progress publications. He contributed to a number of other publications on energy policy and statistics including the 2012 and 2014 Energy Technology Perspectives and Towards a More Energy Efficient Future. Davide conceived and designed the data visualisations for Energy Technology Perspectives and Tracking Clean Energy Progress for which he received the 2012 IEA excellence award. Before joining the IEA, Davide worked as a project manager on mobile solutions and services for communications operators. His clients included companies such as Vodafone, H3G and RDS broadcasting. Davide holds a Masters in Computer Science Engineering from the University of Roma Tre.

## Dr Bernd Hezel

Bernd turned from a theoretical quantum mechanic at Heidelberg University to a climate communication scientist at the Potsdam-Institute for Climate Impact Research (PIK). For the Climate Media Factory he decodes climate science results and designs suitable media formats.

## Nicole Kalas

Nicole is a doctoral researcher at the Centre for Environmental Policy (CEP) and the Imperial Centre for Energy Policy and Technology (ICEPT) at Imperial College London with experience in land use modelling, life cycle assessment (LCA) and carbon footprinting, techno-economic and sustainability assessments of bioenergy supply chains and the bioeconomy. Her PhD research is focused on system dynamic modelling of potential pathways for the sustainable intensification of agriculture and the integrated production of food, feed, fibres, energy and feedstocks for the bioeconomy. In this context, she is particularly interested in the management of carbon stocks and interactions with other ecosystem services and food security. Nicole has worked on international climate change mitigation projects as researcher in academia and the private sector in the UK, Switzerland, USA, and Latin America for over ten years and is a member of the Climate-KIC Bioeconomy Platform.

## Sophie Hartfield

Sophie is leading the Global Calculator project, focusing on project objectives and strategy, partner collaboration, stakeholder engagement, planning, governance and finance. Prior to the Global Calculator, she worked on including costs in the UK Calculator. Previously, Sophie worked in DECC's Strategy Directorate on the department's first White Paper to knit together

climate and energy objectives: the Low Carbon Transition Plan (2009). Before that, she spent three years in the Office of Climate Change, a small independent unit in Whitehall, working on various consultancy-style projects including the development of the Global Carbon Finance Flows (Glocaf) model. In 2005/6, Sophie worked in the Stern Review team, focusing on emission projections, mitigation costs and transport. She has also worked in the Department for Transport, Office of the Deputy Prime Minister, Department for Environment, Food and Rural Affairs and the Scottish Executive. She has a masters in environmental and resource economics from University College London and an undergraduate degree in economics from Edinburgh University.

## Dr Benoit Lefevre

Benoit is part of the team developing the transport sector of the Global Calculator. He is the Director of Transport and Climate at EMBARQ, part of the World Resources Institute, where he is in charge of developing a new cross-programmatic initiative on transport, climate change and finance. Previously, Benoit worked as the Director of the Urban Fabric Program (UFP) at the Institute of Sustainable Development and International Relations (IDDRI), a think tank based in Paris and Brussels. He has done research and consultancy on a variety of topics related to climate change including urban energy modeling, urban GHG inventory, integrated land-use, housing markets, and climate finance. Prior to joining IDDRI, Benoit was visiting scholar at the Global Metropolitan Studies and the Institute of Urban and Regional Development at the University of California at Berkeley. Benoit holds a PhD in Economics and Finance from MINES ParisTech and a Master's Degree in Environmental and Natural Resources Economics. He did his post-doctorate work at the Center for Energy in Columbia University. Benoit leads the Transport Working Group of the Low Emissions Development Strategies Global Partnership. He serves as an external member of the ADB's Transport Community of Practice – Economic Analysis Advisory Team. Benoit is also lead author for chapter 16 of the Intergovernmental Panel on Climate Change (IPCC) Working Group III's 5th Assessment Report (AR5) titled "Cross-cutting Investment and Finance Issues".

## Brijesh Manan

Brijesh Manan is a consultant with Ernst & Young (EY), India, having more than seven years of experience in the energy sector. He is involved in policy formulation, designing and implementing projects in the domain of power, fossil fuel and renewable energy. Prior to joining EY, Brijesh worked with the Government of India in the Bureau of Energy Efficiency, Ministry of Power on Energy Conservation Building Codes, National Mission on Enhanced Energy Efficiency (launched by the Prime Minister of India) and low-carbon policy matters. He has also worked in the field of power generation and distribution with Wartsila India and was posted at coal and oil based power plants, spanning across India. Brijesh received his Bachelor's degree in Electrical Engineering from the Uttar Pradesh Technical University, India. He is a member of Solar Energy Tribe and has also undertaken a professional course on Industrial Energy Efficiency by National Productivity Council.

## Kerenza McFaul

Kerenza provides business support to the DECC's 2050 team. This ranges from a role in finance to helping team members with outreach work. After joining DECC in 2013 on an apprenticeship scheme, she gave assistance to DECC's International Climate Change team and its director. Kerenza helped on the logistics of various international conferences, including the 'Cartagena

Dialogues', COP19 in Warsaw, and the Bonn Climate Change Conference. She also coordinated the 'International Conference on the 2050 Calculator', in Taiwan, presenting on the public engagement and opinion poll research of the UK's My2050.

## Julien Pestiaux

Julien is the part of the team working on the transport sector of the Global Calculator. He is Partner & Director of Prospective Analysis at Climact.  Julien is trained as an electromechanical engineer, which he complemented with a Master in Engineering Management and Sustainable Development at Cornell University. He then worked for five years at McKinsey & Company, where he managed various large climate and energy-related projects, in particular the global GHG abatement cost curve as well as the 2050 roadmap for the European Climate Foundation (ECF). He then supported the DG Energy team at the EU Commission with their 2050 roadmap. His expertise was also used as reviewer to some international reports such as UNEP's Bridging the Emissions Gap report or the recent Green Growth Best Practice. At Climact since 2010, he is managing their projects on pathways towards a low-carbon society, including several country calculators in collaboration with DECC.

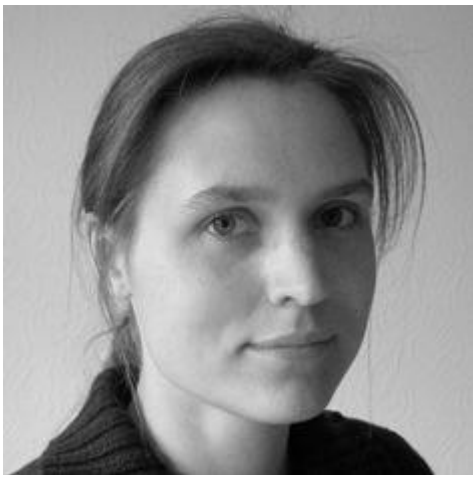
## Dr Anna Stephenson

Anna is an engineer at DECC, who helped in the modeling of the land use section of Global Calculator, along with general quality assurance of the calculator. Prior to joining DECC, Anna worked as an engineer at an energy-from-waste company, and as a Research Associate at the University of Cambridge, researching the use of algae to make biofuels.

## Dr Alexandre Strapasson

Alexandre leads on land, food, bioenergy and GGR in the Global Calculator. He is a Research Associate at  Imperial College London, working on global system dynamics models. He is also a Visiting Lecturer at IFP School in Paris. Alexandre worked for several years at the Brazilian Government, as Director of the Department of Sugarcane and Agro-energy at the Ministry of Agriculture, Livestock and Food Supply (MAPA), and as UNDP Consultant for energy and climate change affairs at the Ministry of the Environment (MMA). He led a pioneering agro-ecological zoning programme in biofuels, participated in UNFCCC negotiations, and promoted several international collaborations, including capacity-development programmes for more than 70 developing countries. He is an Agricultural Engineer, with a Masters in Energy from the University of Sao Paulo (USP) and a Ph.D. degree in Energy and Environmental Sciences from Imperial College.

## Dr Erica Thompson



Erica leads on climate science in the Global Calculator. She is a Research Officer at the LSE's Centre for the Analysis of Time Series (CATS), where she works on understanding and quantifying uncertainty in climate model projections. Her research interests also include the design of climate model experiments and fair evaluation of probabilistic projections, with a focus on the relevance of the model output for informing real-world decisions. Prior to joining CATS, Erica gained her PhD from Imperial College London with a thesis entitled 'Modelling North Atlantic Storms in a Changing Climate'.

## Dr Jeremy Woods

Jeremy is part of the team working on the land, food and bioenergy sector of the Global Calculator. He is a Lecturer in Bioenergy at the Centre for Environmental Policy and Co-Director of the Centre for Energy Policy and Technology (ICEPT) at Imperial College London. His research focuses on the interplay between development, land-use and the sustainable use of natural resources. He is a member of Climate-KIC's Bioeconomy platform, and has an extensive track record on biofuels policy, carbon stock management, climate change impacts on development and land use.

## Dr Markus Wrobel

Markus is the lead developer of the Global Calculator web tool. He has a background both in computer science and in information science and holds a PhD from Freie Universität Berlin. Markus's focus is on developing appropriate and usable information systems in the context of climate change, with a special interest in human-computer interaction, user interface design and usability. He has been responsible for the design and development of various interactive web- or desktop-based applications in the context of climate change communication, including the ADAM Digital Compendium, the PIK Vegetation Visualizer, the MEDIATION Adaptation Platform, a diagram generator for measured and projected climate data on German protected areas, and the new version of the Climate Impacts: Global and Regional Adaptation Support Platform (ci:grasp).

## Dr Zhang Bo

Zhang is the team lead for buildings in the Global Calculator, and works for the Energy Research Institute of the National Development and Reform Commission of China (ERI). He is skilled in data analysis and energy modelling, having built several models in his career. His current projects include the China 2050 Energy and Economic Pathway Analysis tool, Beijing's City Pathway Calculator, the China Energy Outlook series (both monthly and annual) and China Energy Security Analysis.

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