



Climate change modelling information

Quarterly report – Q4 2020 report

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Climate change modelling information

Quarterly report – Q4 2020 report

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1 High-level executive summary

This report under the “Climate change modelling information” series presents recent developments reported by key international climate modelling institutions. This issue sets a particular emphasis on the Covid-19 public health crisis and its effects, in addition to the regular sections on Nationally Determined Contributions, Mid-century strategies and the Sustainable Development Goals.

The first section of the report features initial results from economic modelling of **the Covid-19 public health crisis**. With the caveat that it is too early for concrete research results, there is already some evidence that modellers are working to integrate the impacts of the crisis in their work. While there are no published studies yet, half of the respondents in the August CCMI survey have indicated that they are working on integrating the impact of Covid-19 in economic recovery plans and current policy scenarios. One of the research streams of the IAMC meeting in December 2020 is dedicated to assessment of the impact of the pandemic and the crisis recovery packages.

Various developments linked to the implementation of the **Nationally Determined Contributions (NDCs)** are reported on in the second section. A research team across institutions in China and the US has published an article on the health and economic benefits of China’s greenhouse gas mitigation by 2050. TNO in the Netherlands has modelled the possibility to use domestic low-carbon energy sources to help Madagascar reach its GHG emissions reduction target. And researchers in Brazil have included carbon revenue recycling schemes in the TEA model.

In the third section, the report features research linked to **mid-century strategies** on shaping long-term baselines with CGE models. Different articles deal with macroeconomic assumptions (including GDP growth projections), long-term consumption trends, key energy and emission trends, and model linking (e.g. CGE models with more detailed energy models). Researchers from the Netherlands and the UK have constructed a metamodel of climate and integrated assessment models that assesses the emissions budget, costs and uncertainty sources of achieving temperature targets

The fourth section of the report is dedicated to developments linked to the **Sustainable Development Goals (SDGs)**. An article from researchers in Italy estimates the impact of climate change on labour supply and nutrition in Uganda in the 21st century. A study from Austria uses element limitation factors methodology to examine the sustainability of energy sources until 2050.

2 Introduction

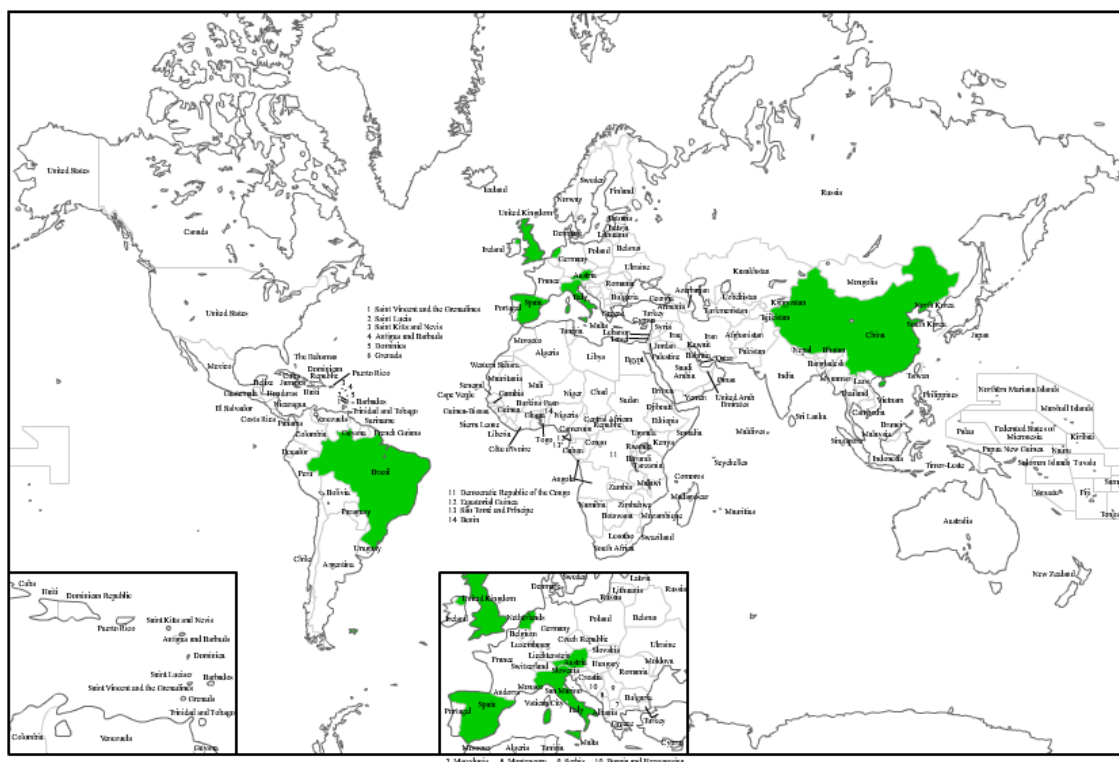
This report is the fourth quarterly report of 2020 under the series “Climate change modelling information” financed by the European Commission. The objective of this series is to inform the European Commission and the wider climate change and energy modelling community about recent and relevant modelling developments. The data presented in this report were collected through an open survey sent to more than 200 modelling teams worldwide and open from 29 July to 14 August 2020.

The survey asked modellers to report relevant developments with a focus on the implementation of Nationally Determined Contributions (NDCs), mid-century strategies and the Sustainable Development Goals. In light of the Covid-19 crisis, an additional set of questions was asked about whether modellers are integrating the impact of Covid-19 in current policy scenarios and in economic recovery plans. Although the objective of this report is to present an extensive list of recent

developments, it cannot be considered as exhaustive. For this quarterly report, responses came from 8 countries (see Figure 2.1), 9 different organisations and covered 8 different modelling developments and projects.

Additional research was undertaken to complement the survey results.

Figure 2.1 Geographical coverage of climate change modelling developments reported through the online survey (n = 9)



Source: ICF, 2020. Climate change modelling information Q4 2020 survey.

The modelling developments discussed in this report are summarised below and further described in the coming chapters.

Modelling developments linked to the integration of the Covid-19 public health crisis:

- [Initial results from economic modelling of the Covid-19 pandemic](#) (UK)

Modelling developments linked to nationally determined contributions (NDCs):

- [Health and economic benefits of China’s GHG mitigation by 2050](#) (China)
- [Pathways to Madagascar’s NDC](#) (Netherlands)
- [Carbon revenue recycling schemes included in TEA Model](#) (Brazil)

Modelling developments linked to mid-century strategies:

- [Special journal issue on shaping long-term baselines with CGE models](#) (USA)
- [Metamodel of climate and integrated assessment models](#) (Netherlands)

Modelling developments linked to Sustainable Development Goals (SDGs):

- [Climate impact on nutrition and labour supply in rural Uganda](#) (Italy)
- [Energy Limitation Factors methodology for assessing energy sources](#) (Austria)

3 Modelling developments linked to the integration of the Covid-19 crisis

- [Cambridge Econometrics](#) has published [initial results](#) from economic modelling of the coronavirus pandemic. Using their E3ME macroeconomic model they estimate that the pandemic will reduce global GDP by 5% below the baseline scenario in 2020 and 2021. The model contains two scenarios, which differ in terms of the level of government response to the pandemic – one in which governments do not intervene fiscally and another in which they do. To build their assumptions, the authors use information from the 2003 SARS virus outbreak and the Chinese government to the Covid-19 reaction so far. The model estimates sectoral effects as well as macroeconomic predictions for the global recovery. More information about the modelling assumptions and the complexities of modelling the Covid-19 pandemic is available [here](#)..

4 Modelling developments linked to Nationally Determined Contributions (NDCs)

- A research team across Beihang University, Peking University, the Gansu Provincial Center for Disease Control, and Duke University has published an article on the health and economic benefits of China's greenhouse gas mitigation by 2050. The study combines the GAINS (Global Air Pollution Information and Simulation model) model from the International Institute for Applied Systems Analysis (IIASA), the CAM-Chem (a global chemistry-climate model), and the IMED/HEL (Integrated Model of Economy, Energy and Environment for Sustainable Development/Health impact assessment) from Peking University to estimate the co-benefits on global health and economy from air quality improvements resulting from different climate policies in China. The results show that China's mitigation has significant impact on both air quality and health improvement in eastern China and eastern Asia, and less impact in the rest of Asia. The improved air quality could avoid 0.37 million premature deaths due to ambient PM2.5 exposure by 2050s globally, with the majority happening in China. The research teams uses a willingness to pay methodology to estimate the economic benefits from the improved air quality, and find that the reduced ambient PM2.5 concentration could avoid \$406 billion and \$1,206 billion economic costs by 2030s and 2050s globally, with China the largest fraction of 98.5% (\$400 billion) and 99.5% (\$1,200 billion) respectively. The reduced ambient PM2.5 exposure can also avoid 11.3 million cases morbidity globally by 2050s, due to asthma attacks and hospital admissions. The study shows that most of the economic benefits from air quality improvement due to China's mitigation accrue in China, followed by eastern Asia (such as South Korea and Japan) and the rest of Asia. Health improvement is the main fraction of the potential benefits, such as saving health expenditure, increasing the work time. The article is available [online](#) in [Environmental Research Letters](#).
- A recent journal article from [TNO](#) in the Netherlands analyses how Madagascar's nationally determined contribution to the Paris Agreement can be implemented in both the energy and non-energy sectors. Madagascar could reach its 14% GHG emission reduction target relative to 2030 business-as-usual levels through the land use sector only. However, given the potential higher mitigation costs in land use and its links with the energy system, overlooking mitigation options in the energy sector could be a missed opportunity to exploit abundant domestic low-carbon energy resources. The authors use the integrated assessment model TIAM-ECN, and they have updated and adjusted relevant

input data and the simulated structure of AFOLU (agriculture, forestry and other land use) to better reflect the reality on the ground in Madagascar, which is the focus of the assessment. The research project has substantially improved the representation and data input of non-energy GHG emissions and abatement options, as well as their respective potentials. The article is available [online](#) in [Climate Policy](#).

- Researchers at [COPPE UFRJ](#) in Brazil have further developed the [TEA model](#). Improvements of the model include more carbon revenue recycling schemes, comprising direct and indirect methods. Carbon revenues can now be recycled through lump-sum transfers to households and/or through rebates on labour taxes or sales taxes. In addition, carbon revenues can be kept under the public budget and without revenue recycling. An increasing number of low and middle-income countries are looking at carbon pricing as part of their overall climate and energy policy mix. Carbon pricing has considerable effects on households, and therefore the topic is particularly relevant for policy makers in addressing their distributional effects on households. The research is currently under review.

5 Modelling developments linked to Mid-century strategies

- The [Journal of Global Economic Analysis](#) has issued a special issue on shaping long-term baselines with Computable General Equilibrium (CGE) models. The project aims to improve the representation of key trends (overall economic activity, energy, consumption) in CGE models. Improved baselines will be helpful to inform mid- and long-term strategies for climate policy. The special issue is based on research conducted in part for the CGE Baseline model comparison [project](#) at Purdue University. The special issue presents an overview of state-of-the-art research, many of the topics are relevant to modellers engaging in long-term scenario analysis with economic models. In particular, papers on macroeconomic assumptions (including GDP growth projections), long-term consumption trends, key energy and emission trends, and model linking (e.g. CGE models with more detailed energy models) might be of relevance to the research community working on climate change economics. The special issue is available [online](#) with open access.
- Researchers from the Netherlands and the UK have constructed a metamodel of climate and integrated assessment models that assesses the emissions budget, costs and uncertainty sources of achieving temperature targets. The study published in [Nature Climate Change](#) earlier this year provides median estimates for the cumulative abatement costs of meeting the 2°C and 1.5°C targets to range between 15 and 30 trillion USD. However, uncertainty related to climate systems dominates when warming levels are high while uncertainty in emissions reductions costs dominates for more stringent targets such as the Paris Agreement targets. This results in estimates that vary over a wide range, e.g. 10–100 trillion USD for the 1.5 °C target. The article is available [online](#).

6 Modelling developments linked to SDGs

- A research team from four universities in Italy has published a study examining the climate impact on nutrition and labour supply in Uganda. The authors have used a nationally-representative, longitudinal micro-level survey combined with high-resolution climate data and have applied an instrumental variable approach to disentangle the direct impact that climate change has on the labour supply and the indirect impact it has on food supply and nutrition. The results show that

increased temperatures initially increase labour supply as people can work longer hours in a week in a milder environment. Another finding is that increased temperatures will increase the need for calories intake and therefore affect food supply and nutrition. However, if temperatures increase past 21.3°C the number of work hours per worker decreases due to heat stress. The overall effect of these impacts is predicted to increase low-skilled labour in Uganda due to the higher demand for agricultural products. This is the first study to provide empirical evidence for the link between climate change, nutrition, and labour supply. The article is available [online](#) in the [*Journal of Environment and Development Economics*](#).

- New research from [GISOC](#) examines the sustainability of energy sources versus raw materials demand until 2050. The authors use the element limitation factors (ELF) methodology to analyse the GHG emissions of different energy sources and their ability to meet a number of SDGs. This methodology allows for the identification of energy sources that are less demanding in terms of resource use rather than only looking at their production capacity. As a consequence, it shows where some approaches to energy production cannot be realistically put in practice because they are too resource-intensive. The research helps identify issues for policy challenges such as determination of the budget to allow to different energy sources according to their energy generation potential and to their resource consumption. A [poster](#) for the research is available online.