MAPS

Mitigation Action Plans & Scenarios

ECON LAB – WORKSHOP

November 2012

Brainstorming the future

Any efforts to curb greenhouse gas emissions within countries will have ripple effects through the rest of the economy. The social and economic implications of such mitigation actions, be they in the transport sector, or waste, energy, forestry or agriculture, for example, creates uncertainty which concerns decision makers.

Computer modelling programs are a useful tool to draw up scenarios which illustrate the possible outcomes of different emissions reduction actions, and give a platform to compare those outcomes. The results, if communicated effectively, can assist decision makers and other stakeholders to work together in order to steer their countries and economies towards a lower carbon pathway in the longer term.

Researchers from Peru, Brazil, Colombia, Chile and South Africa came together in Cape Town, South Africa, from 6 to 8 August 2012 to discuss precisely these issues at the Econ Lab Workshop. Participants were drawn from the Mitigation Action Plans and Scenarios (MAPS) research teams, who are also collaborating through a Climate and Development Knowledge Network (CDKN) funded project.

The objective of this thought exercise was for researchers and modellers from these developing countries to consider the wide range of models that are available to them. They discussed how different models can be brought together to produce more complex projections, and how to overcome some of the difficulties arising from linking these models. The aim was to design the most appropriate scenario-building processes for individual country's mitigation responses.

Models are roadmaps – imperfect but useful

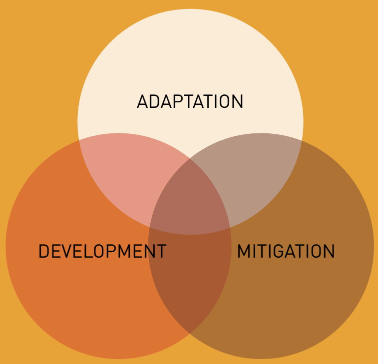
'Models are like maps,' says the South African Human Sciences Research Council's (HSRC) Rob Davies. What he means is that you can't compare a national map of South Africa with a map of the city of Cape Town and say one is better than the other. They are not comparable. Rather, Davies says that the user will choose the map that's most appropriate to the task at hand.

But as roadmaps, these models nevertheless become a representation of how reality might evolve. 'The map of the London underground (rail system) is one of the best maps in the world,' explains Davies, 'but it creates the impression that that's how London is laid out.'And yet the city clearly isn't laid out like this at all.

'Modelling is abstract,' Davies elaborates, 'but it determines our perceptions of reality which is why we need to stand back from time to time, and critique them.' Models are thus tools designed to examine specific questions.

The juggling act: responding to climate change, without forgetting the poor

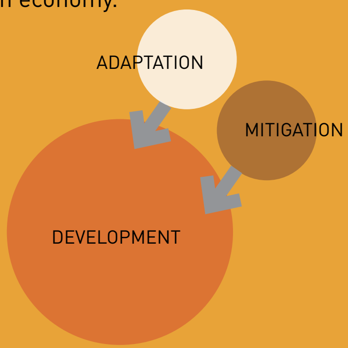
In an ideal world, governments would give adaptation and mitigation responses to climate change equal priority to development needs. But this kind of climate compatible development model is *'idealistic and naïve'*, says MAPS co-leader Stef Raubenheimer, of the non-profit organisation SouthSouthNorth.



In reality, governments are concerned with jobs and poverty. And the focus on mitigation over the past few years, which they see as having the potential to stifle development, is seen as an irritant by governments concerned with pressing issues of development and poverty. If modellers and researchers wish to inform policy making and influence government, they need to show how mitigation actions will address issues of poverty and inequality at the same time as tackling the problem of carbon emissions.

Referring to the more 'realistic' model of climate development (see diagram), professor Harald Winkler of the University of Cape Town's Energy Research Centre (ERC) says the issue for policy makers is more about how the 'small' – adaptation and mitigation – impacts on the 'big', namely development.

In the context of developing countries, development means something different to what it does in Japan or Europe. Tension arises when developing world policy makers push for carbon-intense development, at the cost of addressing climate change, when scientists point to the urgent need for all countries, rich and poor alike, to begin moving towards a low-carbon economy.



Choosing the right tool for the job

'Essentially, all models are wrong, but some are useful.' Statistician George E. P. Box.

There are many different models that can be used for social and economic scenario building. Each model has different qualities, and different functions, and researchers need to select the most appropriate tool for the job at hand. Sometimes, more than one model can be used, although selecting how to use these together comes with its own challenges.

- **Soft-linking versus hard-linking between models**
  Tools to model systems that combine energy, environment and development need to be able to capture information across different time periods and geographical areas, as well as handle varying levels of disaggregation. When you soft-link data between models, you pass results from one model to another manually, i.e. it is not done automatically by the model through its code. An example of soft-linking is using the results from one model (e.g. the gross domestic product of a country) and manually inputting it into a second model, for instance a CGE model. Because the input is not processed directly by the model, the results depend on the modeller ensuring the model uses the input in the best way possible.

When results are hard-linked between models, the model processes the data without needing the modeller to directly input the data. The method of transfer is via code written or developed by the modeller.

Static versus dynamic models
Static models change one variable at a time, keeping all other variables constant, and they usually refer to one time period only, normally a year. Static models are therefore quite rigid in structure and don't reflect changes that take place over time. For example, introducing a carbon tax shock to a static model would probably show an increase in production cost for relevant sectors but would not allow those sectors to show an adjustment or response e.g. introduction of energy efficiency measures. Static models, therefore, are appropriate when simulating the impacts of one or two discrete influences to an economy; dynamic models can describe the effects of various influences to the economy over many time periods. However, dynamic models are more complicated to construct and require a longer time period for model development which could steer modellers away from choosing them.

Top-down versus bottom-up
Top-down models use an economic approach and evaluate systems based on aggregate variables. They do not explicitly represent technologies. On the other hand, bottom-up models are much more disaggregated and allow for detailed description of technologies and other technical aspects. One of the main limitations of bottom-up models is that they have a sector-specific focus and do not represent the system or economy as a whole. When they do, details tend to get stylised.

Exogenous versus endogenous
Endogenous refers to inputs originating from within the model. It is an answer the model has provided, essentially a result from the model that the model then uses again. Exogenous refers to an input generated from outside of the model, i.e. it is not determined by the model. The exchange rate is an example of this.

The modeller's toolbox

There are several different models that can be used for scenario-building in the context of poverty and development in the global south. Some models run on off-the-shelf computer programs as readily available as an Excel spreadsheet; others need custom-made software that requires high levels of skill to use effectively.

Sector-specific models
These deal with mitigation forecasting in specific sectors, such as transportation, waste, land-use change (deforestation, for instance), energy and agriculture. Examples include TIMES or LEAP as energy models, BLUM for land-use, and WEAP for the evaluation and planning of water systems.

Economy-wide models
A computable general equilibrium (CGE) model uses the outputs of a social accounting matrix, or SAM (see below), but includes mathematical equations that allow it to reflect the relationships between different economic sectors. The advantage of this method is that it gives a realistic structure of the economy, providing a 'simulation laboratory' for policy analysis.

Another important tool
The social accounting matrix, or SAM, is a matrix of data, and runs in a spreadsheet. This allows modellers to break the economy down into constituent parts and explore how different factors might be influenced in the process. SAM results are fed into a CGE model. For instance, the SAM can obtain information on household income which could be used to explore the impact of mitigation actions on poverty.

Professor P. R. Shukla, from the Indian Institute of Management, introduced the integrated assessment models, such as MiniCAM, GCAM and AIM System models. These models may take up to twenty years to develop, time which modellers don't have, and a factor which might influence their choice of model.

Because MAPS teams want to compare modelling results between countries, Professor Shukla suggested that protocols are needed that link macroeconomic and sectoral models to provide consistency across scenarios.

Country-specific approaches in linking models, and key challenges:

Brazil

The Brazilian team has selected the macroeconomic model, IMACLIM-S which they will link to their detailed energy model, written in MESSAGE. Feedback between the economy and various sectors, such as energy, land-use and waste will be worked on.

South Africa

The team will link the macroeconomic CGE model, E-SAGE, to their TIMES energy model, SATIM. During the Long Term Mitigation Scenarios (LTMS) process, the macroeconomic model was not linked to the detailed energy model, so no feedback loops existed between the models, for example when the system was shocked by a carbon tax. A demonstration was given on how the model will be linked and what information will be passed on from one model to another.

Chile

The Chilean team will work with the input-output matrix, social accounting matrix, CGE and dynamic stochastic computable general equilibrium model (DSCGE), in spite of some limitations. The DSCGE is preferred as it is possible to take policy changes into account given that it does not rely on past observations. A range of models is needed to solve some of the questions.

Colombia

The team uses a bottom-up sectoral approach to build mitigation abatement cost curves, and they will link a macroeconomic CGE model to an energy model and possibly a land-use model.

Peru

The team has completed a greenhouse gas inventory. They expect to have a combination of bottom-up sectoral models, either simulation or optimisation, and run an economy-wide model across the sectors to assess impacts of mitigation actions on growth, inequality and jobs creation. Research is underway to optimise the linking of an economy-wide model to a sectoral model that covers forestry-related emissions.

Long Term Mitigation Scenarios

The Long Term Mitigation Scenarios was commissioned by the South African Cabinet in 2005 and was completed in 2008. It was a stakeholder-driven process, supported by sound research, to investigate various mitigation action scenarios in South Africa. The results from the LTMS informed South Africa's position for Copenhagen and is the base of much of South Africa's domestic climate change policy. For more information see http://www.erc.uct.ac.za/Research/publications/07-Winkler-LTMS-Technical%20Report.pdf

Creating an authoritative voice

Various factors can undermine the perception that stakeholders have regarding the credibility of modelling results.

- **Data troubles**
  Robust data is often not available for developing countries, forcing modellers to use globally generated data. If data is of poor quality, it opens the model results up to criticism. Sometimes differences between interest groups will result in disagreements about data.

- **Independence**
  If institutions producing forecasts appear to be influenced by any interest groups, be they politicians or activists, it raises questions about the impartiality and credibility of the modelling results.

- **Short term-ism**
  Modellers communicate their long-term forecasting results to politicians who are often planning according to short constitutional terms, often around five years.

- **The modelling**
  There are challenges that exist in long-term modelling, and related complications. This needs a detailed understanding of longer-term variables in the realm of uncertainty.

- **Win-win**
  The controversy around whether there really are any win-win climate measures often clouds the issue.

- **Risk**
  There is political risk associated with moving into the policy landscape.

- **Scope**
  Narrowing the scope of the work too much could result in modellers losing credibility.

- **Time**
  Time constraints can limit the modellers' methodological choices.

- **Communication**
  In communicating modelling results, it is important to consider who communicates and what they say. It is also important not to cross any political lines in this process, because modellers might appear biased towards a specific group.

- **Black box**
  Stakeholders could be suspicious of results obtained from models that are not transparent or easily accessible. Such models are sometimes referred to as black boxes. Modellers must be transparent in their processes, and appear credible if policy makers are to trust and use their results.

Café-style huddles

Emerging themes from the workshop became the focus of cafe-style breakaways.

Hard-linked and soft-linked models

Information is passed manually between models in soft-linked models compared to automated communication between models in the case of hard-linked models. Hard-linked models are considered attractive as model linking happens at the 'click of a button'. Challenges in linking energy and economic models: how to include time in the models, dealing with different base years within the models, and changing technical coefficients in the production function.

Discount rates

Discount rates refer to the time value of money and imply value judgement on intergenerational equity. The choice of discount rate has significant impact on model results and proposed mitigation options. There is no clear answer or consensus on how to select discount rates. MAPS teams should do what is appropriate within the country context, do sensitivity analysis and get different country perspectives.

Carbon tax

This group debated two economic instruments of carbon tax and emissions trading. The Brazilian and Peruvian modelling teams both expressed sentiments that a carbon tax is not a politically feasible instrument within their respective country contexts. The Brazilian modelling team will model effects of a cap-and-trade system. The Peruvian modelling team will explore this as part of their future modelling plan. The South African modelling team will use a SATIM-ESAGE model in the near future to model effects of carbon tax on the economy.

Long-term modelling

It is useful to use different methodologies when modelling over very long time periods, for example up to 2050 or 2100. Qualitative methodologies may be better suited for this purpose but it is critical not to undermine rigorous short-term modelling. Scenarios defined by the scenario building teams (SBTs) may be used to do this long-term modelling.

Back-casting

Professor Shukla explained the rationale of the back-casting approach: the starting point would be the targets, for example global/national socio-economic objectives and climate change targets. The model could provide a path that corresponds to a sustainable low-carbon society. The normal forecasting approach would mean assessing the drivers and interventions needed to move to a low-carbon society, in order to define targets. MAPS country teams discussed available methodological tools to follow a back-casting approach.

Uncertainties

Modelling uncertainties relate to both the short and long term, which is relevant for energy modelling in developing countries. A topic for discussion in future is how to deal with exogenous certainty related to import prices. The discussion did not include modelling methodologies to treat endogenous uncertainties but is considered important and should be communicated when presenting results to policy makers.

Key narratives and emerging messages

- **Discount rates:** The choice of discount rate is critical. There is conflict between choosing a high rate that reflects the opportunity cost of capital, and choosing a low rate that places a more equal value on the welfare of current and future generations. Instead of applying a constant rate over time researchers could consider applying a declining rate over time, or a sector-specific rate that better reflects the internal rates of return applied in those different sectors.

- **Indicators:** Before choosing indicators it is important to assess them in the context of climate change mitigation, i.e. whether it is a development constraint, a goal or part of development. Traditional indicators such as GDP and employment are important in terms of communicating the findings to policy makers. It is important that indicators reflect changes that occur as a result of climate change. Different policies need to be assessed on how they influence indicators.

- **Social conflict:** Economy-wide modelling can identify winners or losers in an emissions reduction context, and where possible conflict could emerge within society.

- **Horizons:** When considering models, the validity of outputs and communicating this to stakeholders, it is important to consider different time horizons, be they short-, medium- or long-term. There is short-term rigidity in the economy, for instance, and therefore there won't be any sudden changes. So how do modellers build flexibility into the medium-term scenarios? Meanwhile, economists are reluctant to consider scenarios that project as far ahead as 2050, which is what South Africa's LTMS does, because there is too much uncertainty about changes in the structure of the economy that far in the future.

Poverty

Brazil has modelled the impact of different carbon tax revenue recycling options on six household groups, disaggregated according to income levels. The Colombians used the co-benefits of mitigation options with input from SBT sectoral experts to rank mitigation actions based on a list of indicators. Understanding co-benefits for poverty and inequality reduction of mitigation options is key to the Colombian modelling process. Chile and Peru are exploring approaches to incorporate co-benefits. Civil society representatives are included in the Chile SBT meetings as a mechanism to capture poverty issues.

Co-benefits

There was consensus that there is little understanding on how to present information to policy makers about the co-benefits of mitigation. It is expected that co-benefits are better understood at project level rather than at national level. The Colombian team used multi-criteria decision analysis based on qualitative expert opinions related to economy-wide, social and environmental co-benefits. Identification and description of co-benefits of mitigation actions both quantitatively and qualitatively remain a challenge.

Implementation

Mitigation options aligned with government priorities are most likely to be implemented. A limitation of using marginal abatement cost analysis is that implementation costs are not included. It is unclear what the difference is between implementation and transaction costs and how to include these in the modelling process. There was debate about whether co-benefits are the strongest motivation for successful implementation.

Integrating climate change impacts

Different models use different scenarios. A range of models is available to evaluate both impacts and mitigation actions. MAPS teams currently facing challenges with linking models should consider integrating impacts at a later phase.

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