By Mark Jaccard and Mallika Nanduri

Or is it? Is it really possible that ISTUM – revered, trusted and loved by ERG researchers for so long – is truly dead and buried? Or could it be that the Energy Research Group is moving on to bigger and better things?

Actually, both are true. In the next several months, ISTUM as we know and love it will cease to exist. It will be replaced by, or rather merged with, the Canadian Integrated Modelling System, affectionately known as CIMS.

CIMS includes the major component currently lacking in ISTUM, namely macro-economic feedbacks. This first (default) version of CIMS simulates not just energy demand and technology acquisition, as ISTUM did, but the interactions of energy demand, energy supply and overall macro-economic impacts both within the Canadian economy and in interaction with other economies, as well.

Why did ERG choose an integrated modelling system?

The short answer is to meet the needs of energy and climate change decision-makers in the next two decades. Canadian decision-makers are especially interested in the technology choices of firms and households over the coming years, since these will play a major role in controlling greenhouse gas (GHG) emissions. Although information on short run actions affecting technology choices can be helpful, governments are not focused on this dimension, nor are they focused on how firms and households acquired and used technologies in the past. Decision-makers are also not focused on how firms and households might behave in an unrealistic world where they have complete information.

What decision-makers are focused on, and ultimately, what they really need, is information on how government policies can affect technology choices, both today and in the future, and how these technology choices will impact on both GHG emissions and the macro-economy. In other words, Canadian decision-makers need to know the direct and indirect net costs of actions to reduce or capture GHG emissions. This requires an evaluation of such actions, as well as an evaluation of how various types of policies (regulations, moral suasion, financial incentives, etc.), and their differing implementation costs and success potentials, might change the assessment of both direct and indirect (macro-
economic) costs. The Energy Research Group’s Canadian Integrated Modelling System meets these exact needs. Indeed, the complete CIMS serves as an important analytical tool for climate change policy analysis in Canada.

**CIMS in a nutshell…**

The Canadian Integrated Modelling System provides decision-makers with the information they need by enabling:

- the simulation of government policies such as regulations, taxes, tradable permit systems, and tax credits among others;

- the examination of the entire energy supply system and its key interactions, instead of just focusing on a particular energy market like electricity;

- the estimation of indirect effects from energy/GHG policies. These include other environmental effects, but also socio-economic effects such as overall macro-economic performance, structural change throughout the economy and regional impacts; and

- the assessment of effects on Canada's economic and political relationship with other countries.

From a modelling perspective, this is a concern for understanding the costs and benefits to Canada of any particular implementation strategy.

**And the highlights are…**

Most of CIMS’ key components have been applied and tested continuously for the past decade. CIMS already contains the most detailed and accurate data in Canada on both technology stocks and Canadian-specific behavioural parameters relating to equipment acquisition decisions by firms and households. More recent developments with the model have enhanced its capabilities to probe the macro-economic implications of actions and policies to reduce GHG emissions. The model system can also be easily linked to the most sophisticated energy supply models available.

CIMS is based on the same approach to modelling that dominates the ISTUM set of energy demand models. Like ISTUM, CIMS is technologically explicit and behaviourally realistic. As always, considerable technological detail is included in order to better probe the range of future policy.

However, behavioural realism is also a priority. Without information on the factors consumers consider when making technology purchases, the model will be incapable of helping decision-makers assess the true costs and other impacts of GHG.
emission reduction alternatives.
The diagram describes the Canadian Integrated Modelling System. It is a system of modules, each of which contains one or several specific models. The system has various options allowing users to select the degree of disaggregation, or the type of representation, they wish to explore.

An old friend: Energy demand in CIMS
The four models in the energy demand module comprise the industrial, residential, commercial and transportation sectors. In the default version of CIMS these models closely resemble the modules in ISTUM, and allow the user to endogenously simulate technology acquisition decisions as a function of observable financial costs, as well as intangible costs and cost risks.

Re-worked: Energy supply in CIMS
On the left side of the diagram is the energy supply module. This includes both energy supply markets and major energy conversion processes. In the default version of CIMS, the energy supply markets (coal, oil, natural gas, renewables) are modelled based on estimates of Canadian resources and global markets. Linkages to U.S. markets are options. Also, both electricity generation and the production of refined petroleum products are modelled using a version of ISTUM.

The new kid on the block: Macro-economic links in CIMS
At the top of the diagram is the macro-economic module. In the past, model simulations were driven by one or several macro-economic scenarios about structural change, economic growth and other key assumptions (regulations, technologies, international prices, trade, etc.). This approach did not allow for feedbacks, since changes in the costs of industrial inputs and consumer products can lead to structural shifts (one major sector or industrial branch grows relative to another) and changes in overall economic activity (the key indirect effects of GHG reduction policies). In the default version of CIMS, ERG is using estimated energy service price elasticities and a few key macro-economic linkages to simulate the structural and total output feedbacks from changes in the costs of energy services (resulting from policies that affect energy prices and/or the choice of technologies by firms and households).

The other rookie module: Community energy management
The link between the macro-economic module and the energy demand module is mediated by key assumptions about land use planning and urban infrastructure development; this occurs within the Community Energy Management (CEM) module. This module links broad assumptions about the effort made by different levels of government to influence the long term evolution of urban form and urban infrastructure. Efforts in this domain have implications for the level of energy services to be met by the energy demand module. Currently, the module links policy assumptions about land use planning and zoning, transportation, energy and other infrastructure development, and site design requirements, to forecasted levels of energy service demand that then feed into the demand module.

Last but not least, a different direction for the future...
The current problem of how best to decarbonize the economy is only one important part of a much larger issue: sustainability. Although different definitions of sustainability abound, decoupling energy and material flows from industrial production processes is likely to be an important part of operationalizing this definition, as will identifying material substitution and waste recycling possibilities.

To this end, subsequent versions of CIMS will include materials flows, eventually allowing for the estimation of GHG reductions from actions
affecting the interaction between key material and energy flows, as well as the assessment of government policies aimed at reducing the broader environmental impacts associated with material consumption and waste production in the Canadian economy.

**Next steps…**

In all, the CIMS approach is similar to the National Energy Modelling System (NEMS) developed by the U.S. government, especially in its structure, approach to modelling technology acquisition decision-making and in its convergence procedure.

However, the CIMS default version has less detail on energy supply markets because Canadian market developments have a negligible effect on global energy markets. There is also currently less macro-economic detail, though full development of this module is scheduled for completion by next fall. CIMS also has the community energy management module, which is not currently included in NEMS.

A last, but equally important, goal of the Energy Research Group is to make the user interface for CIMS as user friendly as the latest developments in software can allow.

The effect of GHG emission reduction policies on the Canadian economy is perhaps one of the most important concerns of the federal government, and indeed of all Canadians. CIMS will eventually have the most detailed and calibrated data for different sectors of the Canadian economy. Most importantly, the CIMS approach allows for a full appraisal of the direct and indirect impacts of government policies amid alternative scenarios of the policies followed by Canada's major trading partners and competitors.

**Endnotes**

Mallika Nanduri and Bryn Sadownik, two members of the ERG team, recently completed their Master’s degrees in Resource and Environmental Management. Bryn is now a full time researcher at ERG, and is in the thick of things regarding CIMS. Mallika, in the meantime, has elected to accumulate an even larger student debt, and entered the REM PhD program this January.

Amy Taylor, another long-time ERG member and graduate researcher, is also set to finish her degree this spring. Amy, whose work on ecological taxonomy was profiled in previous issues of ERG News, has yet to formalize her post-graduation plans, although she maintains they are sure to involve an extended vacation!

The Energy Research Group is also happy to welcome its newest member, Alison Balzer. Alison, who is a first year REM Masters student is a recent convert to ERG. Stay tune for a profile of this newcomer in the next ERG News.