China: The Next CIMS Frontier

By Kevin (Jian Jun) Tu

Historically, CIMS has been used to evaluate the effects of different policy options on the Canadian economy. However, CIMS’ flexible design has always presented the opportunity to adapt it to other countries, and I could not resist the challenge. In 1990, China was the world’s second largest emitter of CO₂, accounting for 596 megatonnes or about one tenth of the total global emissions. As a result, China has always been a country of interest when considering global warming, and coupled with my background, it was the logical launching pad for a new application of CIMS.

The Chinese government has made environmental protection a national priority, but the possibility of global warming remains a secondary concern to the problem of local air pollution caused by increasing use of automobiles and dependence on coal fired electricity plants. At the same time, however, China is expected be one of the regions hardest hit by global warming, so greenhouse gas emissions cannot be ignored. With both concerns on the Chinese government’s agenda, my research will focus on China’s sustainable energy policy planning, specifically looking at policies that aim to simultaneously reduce greenhouse gas emissions and improve local air quality. In short, my research objectives are to understand the dynamics of different technology choices in China’s energy market and be able to predict the resulting GHG and local air pollutant emissions under different energy policies over the next 30 years in China.

Before any of this could happen, the first step was to build CIMS-China.

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Obviously the data requirements to apply CIMS to China are huge, and the collection process alone would go beyond the scope of this project. Fortunately, the MARKAL-China model developed for the China Council for International Cooperation on Environment and Development (CCICED) was made available. EMRG has already had experience working with modellers using the Canadian version of MARKAL. The lessons learned during the National Climate Change Implementation Process, and subsequent collaborations helped prepare me to utilize the information in MARKAL-China.

Access to the existing database saved a lot of time and allowed me to focus on refining the database for China’s energy sectors. At present, thanks to the tremendous help from Dr. Pat DeLaquil at Clean Energy Commercialization LLC and Dr. Eric Larson at Princeton University, I have finalized a representative technological database for the CIMS-China model. Because I have already tested CIMS-China in the electricity sector, I anticipate completing the remainder of the modeling work by the end of 2003. Specific challenges include data calibration, model simulation, interpreting the output, and sensitivity analysis.

CIMS-China’s focus on detailed energy flows through technologies makes it ideal for modelling GHG emissions and local air quality policy. When my research is finished, the results will help inform Chinese policy makers about the likely responses of firms and households to policies that influence their technology acquisition and technology use decisions. The product of this research will be an assessment of the prospects for China to develop an integrated national energy strategy to simultaneously resolve the challenges of GHG emissions abatement and local air pollution control. The research will help Chinese policy makers to understand where the major sources of emissions in China are, which sectors show flexibility in emissions reduction, and the degree to which the various sectors can respond to a call for emissions reduction.

This research represents a significant first step in the application of CIMS to understand the challenges of both GHG emissions abatement and local air pollution control in China. It is only a first step however and, after my research, further efforts could possibly investigate policy impacts on a more refined scale. For example, future research could apply CIMS-China to the municipal level (e.g., Beijing or Shanghai), or a specific economic sector (e.g., electricity sector). Exciting possibilities for CIMS and EMRG in what is soon to be the world’s largest energy market.

Other Research Updates

Although Kevin’s research has taken centre stage in this edition, all of the other Masters students are busy at various stages in their research.

Margo Dennis, Matt Horne, and Nic Rivers have completed the data collection phases of their projects and are currently wading through the piles of surveys they have received, and getting ready to begin estimating their discrete choice models.

The projects of both Maggie Tisdale, and Averil La- mont are nearing completion. Maggie is scheduled to defend her research on March 24, with Averil working on a similar timeline.

Jimena Eyzaguirre and Paulus Mau are finishing up two busy terms of class work, and just now beginning to decide on the research directions they want to explore. Expect details in the summer edition.

Getting the Word Out

This summer, Nic Rivers will be presenting the new approach to improving behavioural realism in CIMS based on discrete choice models at two conferences. This approach was described in the fall 2002 edition of the EMRG newsletter. In June, he will present at the Government of Canada’s annual Pollution Prevention (P2) conference in Calgary, while in July he will present a paper at the American Council for an Energy Efficient Economy (ACEEE) summer seminar on Energy Efficiency in Industry.
With the release of *Energy for our Future: A Plan for BC* this past November, Mark Jaccard and I were pleased to find the new BC energy policy to be consistent with some of the research we have done in the past year, as well as with many of the recommendations made in 1997 in Mark’s *Task Force on Electricity Market Reform*.

The summer 2002 issue of EMRG News presented the results of our study comparing BC Hydro’s natural gas based electricity supply strategy with a low emission alternative portfolio for British Columbia. BC Hydro’s Integrated Electricity Plan for 2000 is dominated by a combined cycle gas turbine (CCGT) plant on Vancouver Island, fed by a new natural gas pipeline called the Georgia Strait Crossing (GSX). We therefore refer to the overall strategy as GSX-CCGT.

We developed an alternative to GSX-CCGT that we call the Low Emission Independent Power Producer (LOW-EM-IPP) portfolio. LOW-EM-IPP involves replacing and increasing undersea electricity transmission capacity to Vancouver Island, and encouraging IPPs to develop low emission resources such as retrofit cogeneration, wood waste and small-medium hydro throughout the province.

As a result of our analysis (mostly using BC Hydro’s own data), we found electricity costs to be slightly lower under GSX-CCGT in the base case. However, when we incorporated uncertainty around key assumptions, we found that there was a substantial possibility that LOW-EM-IPP would be as cheap or cheaper. With respect to air emissions – our indicators of environmental performance – LOW-EM-IPP performs substantially better. It causes virtually no increases in provincial GHG emissions or in NOx emissions in the Georgia Basin. Our findings led us to be concerned about BC Hydro proceeding down the GSX-CCGT path before giving thorough consideration to the uncertainties involved and the other options available. We stressed the value of decision-making that takes into account financial, environmental and social attributes.

The recently launched energy policy calls for the proposed CCGT (referred to as the Vancouver Island Generation Project, VIGP) to go to the BC Utilities Commission for review. This was good news for opponents of the GSX-CCGT strategy, who believed that given due consideration of the other opportunities for providing electricity to customers on Vancouver Island the project would not be justified. Furthermore, the case for the GSX pipeline is weakened without the VIGP.

BC’s new energy policy also matches many of the recommendations made by Mark in 1997 as part of the *Task Force on Electricity Market Reform*, commissioned by the BC cabinet. These recommendations included separating BC Hydro transmission and creating an independent board of directors, creating entitlement contracts that guarantee low cost hydropower to BC consumers, placing BC Hydro under the regulation of the BC Utilities Commission – especially with respect to transmission and distribution, putting more effort into Power Smart and establishing a renewable portfolio standard to encourage the development of environmentally desirable energy sources.

BC Hydro is currently pursuing alternative energy development throughout the province, and they say this is affecting the timing and need for GSX and the VIGP. Again, this is consistent with the work of Mark and myself. A further step in the right direction would be for BC Hydro to conduct a multi-attribute public involvement exercise that would determine if renewing the undersea cables to Vancouver Island, while developing renewables and cogeneration resources throughout the province, is the best option for BC.

Two recent pieces by Jaccard and Murphy on this issue, as well as the final report of the *Task Force on Electricity Market Reform*, may be found on the EMRG website. For more information on BC’s new energy policy, go to www.gov.bc.ca/em.
Cogeneration Potential in Canada: Phase 2

By: John Nyboer

Cogeneration, also referred to as combined heat and power (CHP), is the simultaneous production of electrical and thermal energy from a single fuel. By making use of the heat rejected from one process in the production of the other, substantial gains in energy efficiency are realized compared to the independent production of both products. Cogeneration represents just over 6% of national electricity production in Canada. This relatively low penetration (compared to Europe) is attributed to Canada’s historically low energy prices and electric utility policies guiding the provision of back-up power and the sale of surplus electricity. Despite these conditions, cogeneration has been adopted in some industrial applications, notably the pulp and paper and chemical products sectors where there is a large on site demand for both heat and electricity.

EMRG researchers, Catherine Strickland and John Nyboer, generated a report with the support and input of Natural Resources Canada and Environment Canada personnel, that assesses the potential for cogeneration in Canada. It looks at types and conditions of cogeneration, and the installed cogeneration capacity in Canada. The report also includes estimates of the total technical potential and total achievable potential for cogeneration, as well as the cogeneration potential generated by the Canadian Integrated Modelling System (CIMS) under five scenarios, including a business-as-usual scenario.

If we assume that all heat loads in industrial, commercial / institutional and residential sectors can be met with cogeneration technologies that have low heat to power ratios (2:1 in industry and 0.9:1 in the other sectors), one could generate enough electricity to supply about 80% of Canada’s demand. Taking a more realistic approach, cogeneration could provide 30% of Canada’s current electricity needs.

The results generated by CIMS show the estimated cogeneration potential under five scenarios. The business-as-usual (BAU) scenario predicts the lowest penetration of cogeneration, 2.1 GW$_e$ in 2015. Removing the constraints to cogeneration imposed when CIMS was calibrated to reflect Canada’s Emissions Outlook Update increases the potential for cogeneration to 3.0 GW$_e$ in 2015. Changes in discount rates have a dramatic impact on cogeneration potential, increasing it to 21 GW$_e$ in 2015. When the price of electricity increases by 50%, the results indicate that the potential for cogeneration increases to 7.1 GW$_e$ in 2015. Finally, an increase of 50% in commercial fossil fuel prices would decrease the demand for cogeneration (when compared to the unconstrained scenario) to 2.5 GW$_e$.

CIMS does not include cogeneration as an option in the supply sector, and at present, there is no simple way to “distribute” heat, one of the products of a cogeneration process. In this regard, the modeling process may require some review and reassessment. Having no “merchant” cogeneration as an option means that total cogeneration under the 5 CIMS-based runs likely underestimates the total cogeneration potential. While this has historically not been a chosen alternative, recent events have caused this sort of generation to take hold. Inclusion of this alternative into CIMS is currently being investigated. Copies of the report are available on line from EMRG’s CIEEDAC web site (www.cieedac.sfu.ca).

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