Canadian Renewable Energy Database: New and Improved

By Katherine Muncaster

How do you get 753 renewable energy facility operators to fill out a lengthy survey you’ve sent them? You phone each and every one, and keep phoning until they get them in! The result is a database containing the vital statistics (and some obscure facts) for the majority of Canada’s renewable energy facilities, including each facility’s renewable resource, technology, capacity, generation, history, eco-certification status, finances, and markets. Although the database has been in existence since 2002, the 2004 update included several major improvements: facilities were surveyed directly; producers of non-electric energy—thermal and liquid—were included in our database and report; and producers’ opinions were solicited about renewable energy policy in Canada.

Our report was very well received when it was published this November, and our online searchable database continues to be well-frequented. Surprisingly, no other such compilation of renewable energy facilities in Canada exists. We are now ramping up to send out the new and improved 2005 survey, which will be placed online, allowing respondents to quickly edit their past responses, and allowing us to spend more time on analysis (and okay, maybe on some phoning too) and less on data entry. Following the success of last year’s policy questionnaire, we are also adding a whole new set of questions that we hope will provide both feedback and constructive suggestions. Keep your eyes open for our report this spring!

Facts on Renewable Energy in Canada

- Hydroelectricity accounts for 91% of Canada’s renewable energy capacity, while biomass accounts for 8.5%. Wind, tidal, municipal solid waste, solar, geothermal, biodiesel, and ethanol make up only 0.5% combined.
- Although 70% of renewable energy facilities built in the 1990s were not conventional hydro, 80% of added capacity was. In other words, many low-impact facilities are being built, but they are very small.
- 13% of all hydro facilities are eco-certified while only 11% of run-of-river hydro facilities are eco-certified.
- The vast majority of respondents from hydro and biomass facilities indicated that if they were to build a similar facility today, costs would be higher, while wind, solar PV, and ethanol / biodiesel facilities said costs would be lower.
- Environmental regulations were the most commonly cited regulatory barrier.
EMRG’s in house model, CIMS, has been used to assess appropriate climate change policies for Canada, the potential adoption rates of less GHG-emitting technologies and the costs of these policies to society in the long run. To provide realistic answers to these questions, CIMS must have the capacity to represent how financial costs for new technologies can evolve and how preferences for new technologies may change.

Recently, EMRG research has focused on improving consumer preference dynamics in CIMS under changing market conditions. For their Master’s research projects, recent graduates Jimena Eyzaguirre and Paulus Mau characterized these dynamics for hydrogen fuel cell vehicles (HFCV) and hybrid electric vehicles (HEV).

The two studies were conducted using nationwide surveys in which respondents made repeated discrete choices between the new vehicle technology (HEV or HFCV) and a similar normal gasoline vehicle based on a list of changing vehicle attributes and hypothetical market conditions. The data were used to build decision models describing consumer preferences for each vehicle technology. Parameters from these models were then incorporated into CIMS improving its capacity to better simulate such dynamics—a valuable aid to policy makers.

Both Eyzaguirre’s and Mau’s studies found that the vehicle’s capital cost was the major deciding factor for consumers choosing between the new vehicle technologies and the conventional gasoline vehicle. Furthermore, consumers valued government subsidies on HFCVs and HEVs 1.5 to 3 times as much as a decrease in capital cost, another valuable insight for policy makers and program design.

Aside from these two similarities, consumers’ responses to HFCVs and HEVs were very different. HEVs are representative of “evolutionary” technologies that don’t require significant changes in current infrastructure or learning by producers and consumers. Conversely, HFCVs are “disruptive” technologies that are unique from conventional technologies and may require new supporting infrastructure.

The results indicated that the factors important to consumers’ choices between gasoline fueled vehicles (financial costs, cruising range, warranty, and fuel availability) are also important to consumers who are deciding between HEVs and normal gasoline vehicles. Cruising range and warranty consistently account for between 20% to 30% of the consumer’s purchasing decision. In fact, they were perceived to be more important for HEVs than for conventional gasoline vehicles, increasing in importance with increasing HEVs market share. Extrapolation of these trends indicates that, as the purchase price of the HEVs falls to that of a normal gasoline vehicle, these non-monetary characteristics would become the major deciding factors for consumers. However, the decision models developed from Eyzaguirre’s research into HFCVs showed that these characteristics were not important to consumers’ choices between HFCVs and gasoline vehicles. Additionally, consumer responses to HFCVs did not change as the number of people owning them increased, perhaps because HFVCs are an unfamiliar technology.

To test how consumer preference parameters would change the outcomes of simulations in CIMS, Eyzaguirre and Mau compared the results of a business-as-usual simulation with and without the new parameters.

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Energy policy analysts spend a lot of time wondering about how fast energy efficiency is changing, how it is changing and why. The results of almost any energy policy question will be affected by analysts’ assumptions about the natural rate of turnover of energy using equipment and about how likely people will be to invest in more energy-efficient technologies if energy prices increase.

AEEI, or “autonomous energy efficiency index”, is a value energy modellers use in their models to represent the natural, non-price induced change in energy efficiency over time. Despite being only remotely understood, this process is extremely significant for the results of energy policies, and a better defined value for this “flow” is critical for improved energy policy analysis. Traditionally, analysts have relied on estimates of AEEI calculated from historical data, but in many cases, the past evolution of technology can tell us little about the future. Researchers have therefore tended to use “guesstimated” values, increasing the uncertainty in their analysis.

ESUB, or “capital for energy elasticity of substitution”, is a value that represents how people will switch between more and less efficient equipment as the relative costs of energy and extra efficiency (through more expensive equipment, usually) change relative to one another. As AEEI can be thought of as the ongoing introduction of new technologies, ESUB can be thought of as the substitution of existing ones to meet changes in the relative price of fuels, inputs, final goods and emissions. ESUB, while very important, is also very hard to estimate as its value will be different depending on the period over which you measure it (e.g. 1, 5, 10 or 20 years). Our capital stock, or stock of cars, machinery and houses, is relatively fixed in the short term, but flexible in the long term. ESUB values have also historically been “guesstimated”.

But what if you could calculate AEEI and ESUB for the future (or at least the next 30 years?) Wouldn’t this improve energy policy analysis? That is what we have tried to do at EMRG over the last 5 years, culminating as part of Chris Bataille’s PhD thesis. Chris presented long-run values for AEEI (0.41% / yr with transportation and 0.63% / yr without) and ESUB (0.13 with transportation and 0.27 without). The results were presented with and without transportation because the transportation sector has a much lower AEEI and ESUB than the rest of the economy, given people’s strong preference for driving alone versus carpooling or taking public transportation.

Chris and others at EMRG are now working on AEEI and ESUB estimates that include dynamics such declining real and perceived costs for new technologies as they become more popular. Stay tuned!

By Chris Bataille

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The results indicated no significant difference between the two simulations on HFCVs but the parameters derived from the HEV analysis showed higher initial market penetration rates (14% versus 3%), with market share continuing to rise over time due to declining capital costs and market dynamics. We note that the simulation with the new parameters assumes equal availability of HEVs and gasoline vehicles, which is why initial forecasts of HEV penetration are higher than what is currently observed in Canada.

In the upcoming year, EMRG will further explore the relationships between technology types and market dynamics. You can access the detailed results from Eyzaguirre’s and Mau’s research, including uncertainty analysis on their models, at www.emrg.sfu.ca.

Canada’s Clean Vehicle Future...

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Farewell Alison!

Beginning in March, Alison Laurin will be leaving EMRG for a new career with the city of Vancouver. Alison has been with EMRG since 1998. She has been involved as both a researcher and project manager for several of the group’s greenhouse gas abatement analyses. This includes managing projects for the federal and provincial governments to identify and analyze the potential for greenhouse gas reductions and their costs. She was also responsible for the mining, metal smelting and electricity components of the CIMS model. We are pleased to announce that Nic Rivers will be taking over her responsibilities. We at EMRG wish you all the best as you pursue your new career!

New Students’ Research Projects

Bill Tubbs will be building an integrated energy-economy model of the US and Canada using CIMS. This will allow Canadian policy makers to evaluate the impacts of implementing Canadian energy-environment policies under different US policy scenarios.

Krista Phillips will convert CIMS’ energy supply model to an optimization-based methodology. This will enable CIMS to solve for supply simultaneously, and will facilitate the integration of new energy supply technologies.

Katherine Muncaster will use a decision analysis framework to evaluate long-term policy options to facilitate carbon dioxide capture and storage in Canada and estimate the value of information gained through policy-induced R&D and learning-by-doing.

Jillian Mallory will use the results of the California Vehicle Emission Standard to quantify the value of information provided by this policy, and the effects of artificial niche market regulation in addressing uncertainty about technological change.

John Axsen will use discrete choice modelling to investigate the consumer surplus effects of policies that induce technological change to meet climate objectives, focusing on Vehicle Emission Standards.

Congratulations Graduates!

Jimena Eyzaguirre and Paulus Mau have both successfully defended their masters theses since the last newsletter. Jimena has joined Natural Resources Canada in Ottawa, while Paulus will join EMRG full-time as a research associate.

Dr. Chris Bataille successfully defended his PhD thesis in December. The doctor is in! Chris will remain with EMRG as a research associate.

Welcome Karen!

EMRG welcomes Karen Gorecki to the research team! She has become involved with EMRG in a unique way as a student in SFU’s new Masters of Public Policy Program. Karen’s research will explore the social costs and benefits of congestion pricing on the Burrard Inlet. Through modelling various transportation scenarios, Karen will examine whether transportation demand management, including road tolls, may alleviate traffic congestion and eliminate the need for provincial road expansion plans. Before coming to EMRG, Karen was a Research Associate at the POLIS Project on Ecological Governance, was National Director of the Sierra Youth Coalition, and worked at the Environmental Substances Division and the Office of Sustainable Development in Health Canada. Karen has a B.Sc. (biology/environmental studies) from the University of Victoria.

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