One Project Done, Two To Go!

When it comes to energy analysis, especially in the light of CO₂ emissions reduction, a never ending stream of work seems to emerge, falling, at least in part, in the lap of the Energy Research Group here at SFU. In the last issue of ISTNEWS, we introduced a project focused on CO₂ and NOₓ emissions reduction in BC. In essence, the project asks, What will a BC energy plan that meets specific emissions criteria for these two gases look like? We'll reproduce some of the results of that project in this issue. That's one done (it isn't quite down yet!).

As a consequence of a desire to move on the government-initiated Green Plan, the Canadian Industry Program for Energy Conservation (CIPEC) and Natural Resources Canada (NRCan) has sought the input of the ERG in trying to establish appropriate energy efficiency targets for major industries across Canada. CIPEC's primary job is to promote energy efficiency in all industry in Canada, and to measure energy efficiency improvement. In other words, CIPEC wishes to both promote and monitor energy consumption and energy efficiency in the Industrial Sector in Canada. As a consequence of this activity, it is quite possible to also monitor the generation of CO₂ emissions in Canada.

In order to establish a functional, directed energy efficiency program, each task force (a group of industry representatives associated with each one of 20 specific industry groups, in charge of the promotion in and monitoring energy efficiency of these industry groups) sought to establish a feasible efficiency target (or set of targets) as a goal for their particular industry. The task forces will review potential that exists in each industry group using historical and industry-specific expert analysis. As a second or supplementary approach, the ERG, using ISTUM, will help to focus these goals, pointing out the potential levels of efficiency gains and potential conservation levels through a modelling analysis.

The analysis initially involves six of the largest (in terms of energy consumption) industries: pulp and paper, industrial minerals, petroleum refining, mining, chemical production and iron and steel production. The project involves three phases: 1) careful establishment and definitions of the industry, including process and energy flow models, 2) four simulations reflecting a frozen efficiency, a business-as-usual, an economic and a technical potential run, and 3) industry response and requests for simulation. Industry will participate in all phases; in model confirmation, in assessment of model results and in determining criteria for follow-up simulations.

Finally, another project, sponsored by the newly established Canadian Industry End-use Energy Database and Analysis Centre (CIEEDAC) and already under way, will attempt a comprehensive analysis of existing energy-related databases and attempt to answer questions related to energy data gaps, possible energy data collection devices, procedures and costs. Increasing demand for end-use energy data provides incentive for such a project. It's going to be a busy summer!

John Nyboer, Editor

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Preliminary Results of a BC Energy Environment Study

In the past, energy policy in British Columbia focused almost exclusively on ensuring that enough energy supply existed to meet expected energy demand. Today, the situation has become more complex. Increased study in policy generally, and in energy systems specifically, have not only revealed some of the complex connections between energy and economic growth, environmental health, and social well-being but have also shown that many energy system options exist. Increasingly, energy policy must account for economic, environmental, and social impacts while integrating demand and supply components of the system. The objective of this study is to complete an energy plan for BC which shows the implications of a package of energy policies and energy-related policies designed primarily to meet environmental targets, but constrained by economic and social parameters.

The package of energy policies considered in this study are designed to meet three environmental targets:

1. Stabilize carbon dioxide emissions at 1990 levels by 2000
2. Reduce carbon dioxide emissions by 20% of 1990 levels by 2010
3. Reduce summer nitrous oxides in Lower Mainland by 50% of 1990 levels by 2010

The following list of economic and social parameters were used to constrain the selection of policies,

- growth rates maintained (population, services, products)
- employment creation, especially outside metropolitan areas, is desirable
- urban quality of life should be improved (time spent in cars, noise, air pollution, urban fragmentation, lack of greenspace, etc.)
- material standard of living should not change significantly
- non-metropolitan particulate emission levels must be acceptable
- no more land will be alienated to large hydro reservoirs
- policies should not negatively affect land claims by aboriginal peoples
- dramatic price changes and harsh regulatory solutions should be avoided
- policies should be cost-effective.

This study required several steps. The first two steps, developing the analytical framework of models and disaggregating the energy system into sub-models, reflect work previously completed by the Energy Research Group. The final steps, scoping the project, developing scenarios, and running the models, are specific to this study. The model framework consists of ISTUM models for the four energy demand sectors, industrial, transportation, commercial, and residential, connected with an electricity supply model.

Each model consists of many assumptions such as the future levels of services, the behavioural aspects that affect technology purchases, and energy prices. These assumptions reflect the analyst’s perception of the future, usually based on a combination of historic data and expert advice. Since many different perceptions of the future exist and since implementing new policies may change the assumptions, often models are run several times with different sets of assumptions. Each set of assumptions is called a scenario.

This study consists of two scenarios, the business as usual scenario and the energy environment policy scenario. In the business as usual scenario, the model assumptions attempt to reflect current policies and behaviour. In the energy environment policy, the model assumptions reflect a variety of policies that could be implemented by policy makers dedicated to meeting this study’s environmental targets. The policies aim to meet the environmental targets but are constrained by the economic and social parameters. For example, on the demand side, the service level -- the amount of households, commercial buildings, goods produced, and people or freight transported -- remains the same in both scenarios. Thus, the standard of living remains at or near the current level. Similarly, the electricity supply model excludes large dams as an option of new supply so no more land will be alienated to large hydro reservoirs.

Some examples of the policies modelled in the energy environment policy scenario include:

- electricity supply - all new supply technologies emit no carbon dioxide
- transportation - promotion of alternatively fueled vehicles, increased density in the Lower Mainland
- industrial - promotion of wood waste and cogeneration
- residential - information programs to change equipment purchase behaviour, increased density in the Lower Mainland
commercial - information programs to change equipment purchase behaviour, building code standards
In addition to the above policies, all demand sectors face a $20.00 / tonne carbon dioxide tax.

Figure 1 presents the carbon dioxide emissions summed for all four demand sectors, the electricity supply sector, and natural gas distribution. Carbon dioxide emissions are distributed unevenly across the various sectors. In particular, the transportation sector accounted for nearly half of the total carbon dioxide emissions in B.C. in 1990. In the business as usual scenario, carbon dioxide emissions increase by about 41% between 1990 and 2010. The large increase in emissions from the electricity supply sector combines with the significant increase in transportation sector emissions to override the minimal increases in other sectors.

![Aggregate Carbon Dioxide Emissions Graph]

**Figure 1: British Columbia Carbon Dioxide Emissions 1990-2010**

In the energy environment policy scenario, carbon dioxide emissions increase, but the levels are much lower than the business as usual scenario levels. By 2010, emissions are 19% higher than the 1990 levels but 16% lower than the business as usual scenario. The sectors and industries with the largest reductions between the two scenarios are:

- electricity supply  4,452,396 tonnes  55% of total reduction
- residential 1,052,710 tonnes  13% of total reduction
- pulp and paper 635,012 tonnes  8% of total reduction
- commercial 546,725 tonnes  7% of total reduction.

Figure 1 clearly demonstrates that, under the energy environment policy scenario assumptions, the policy package analysed in this study does not meet the environmental targets. However, the graph masks how each sector and industry responds differently to the policy package. For example, the commercial sector meets both carbon dioxide targets in the energy environment policy scenario. The residential and industrial sectors meet the 2000 target but not the 2010 target, although the residential sector almost meets the latter target. However, carbon dioxide levels in both the transportation sector and the electricity supply sector increase between 1990 and 2010, even under the energy environment scenario. Although new electricity supply technologies in the energy environment policy scenario do not emit any net carbon dioxide, both scenarios assume significantly increased use, over 1990 levels, of Burrard thermal generating station. This assumption alone leads to nearly a 300% increase in carbon dioxide levels between 1990 and 2010 from the electricity supply sector. However, as mentioned
above, electricity supply sector also contributes to the majority of the reductions between the two scenarios. Since the transportation sector contributes nearly half of all carbon dioxide emissions and since the electricity supply carbon dioxide increases are so large, the aggregate carbon dioxide emission level increase in the energy environment scenario.

While in-depth analysis will be required to separate the effects of the various policies on the overall carbon dioxide reductions, a few generalizations can be made. The reductions from the electricity supply and industrial sectors mainly stem from policies promoting energy sources with zero net carbon dioxide emissions (biomass, solar, waste fuels). In the commercial and residential sectors, emission reductions result mainly from energy efficiency improvements in building shells and space conditioning equipment. The carbon dioxide tax seems to only lead to minor emission reductions.

Figure 2 shows carbon dioxide levels per capita in both scenarios. Although, overall emission levels rise in both scenarios, the increases are lower than population growth. Therefore, overall carbon dioxide emissions per person decreases in both scenarios.

![Carbon Dioxide / Capita](image)

Figure 2: BC Carbon Dioxide per Capita

The nitrogen oxides emissions are still being analysed. Copies of the completed report will be available from the Energy Research Group.

Alison Bailie, Researcher

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### What's Going On?

The ISTUM-PC user group is open to all, is growing and includes ERG, BC Hydro, Natural Resources Canada (NRCan), the Ontario Ministry of the Environment and Energy, the Saskatchewan Energy Conservation and Development Authority and Willis Energy Services, Ltd.

Most of the ERGers are involved with the completion of their program-required projects, much of which is directly related to the major project discussed in the previous edition of ISTNEWS, John Nyboer's Ph.D. thesis.

The ERGers began another project focused on potential levels of conservation in the Canadian Industrial sector, especially six major industries in that sector: pulp and paper, industrial minerals, petroleum refining, chemical products, mining and iron and steel production.

### Correspondence

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