

whatIf?® Energy and Emissions Planning Models

Powerful Simulation Models for Policy and Scenario Analysis

Policy makers are currently challenged to understand a variety of possible energy futures, economic trajectories and their implications over the long term. Critical questions include:

- What future energy supply and use balances are feasible?
- To what degree can we achieve or maintain energy independence?
- Can we quantify possible technological substitutions for both energy supply and use?
- How do we estimate whole-system emissions levels across many energy scenarios?
- How sensitive is the energy equation to economic and demographic change?

whatIf? Energy and Emissions Planning Models enable a holistic, quantitative approach to exploring these and other questions. Users interactively create and analyze scenarios via simulation. The whatIf? approach enables superior group communication and consensus building leading to effective policies and strategies.

At the core of the whatIf? Energy and Emissions Planning Models are customizable modules. Depending on client requirements, models are constructed from modules that may include (but are not limited to):

- Cohort population growth
- Household formation
- Commercial buildings
- Residential building space conditioning
- Residential hot water
- Residential appliances for cooking, refrigeration, laundry etc.
- Passenger and freight transportation
- Motor vehicle stocks and their operation
- Industrial energy end-use
- Co-generation
- Electricity generation
- Bio-fuels
- Oil and gas production, refining and distribution
- Nuclear energy
- Oil sands production and upgrading
- Green house gas emissions
- Criteria air contaminants
- International and interregional trade

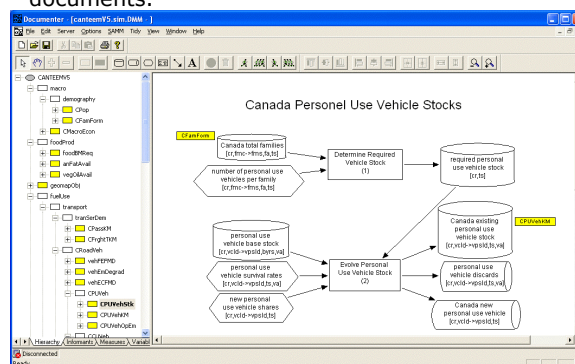
The whatIf? Approach - Benefits

Flexible model development. Each region or country is unique with regard to its energy supply and use system. Hence to represent it a model must also be unique. However, there are many common components in the energy supply and use systems across regions. This commonality may be leveraged for significant efficiency

gains in the implementation of a whatIf? energy and emissions model by drawing upon the large collection of existing modules. These modules may be customized to meet client specific requirements and quickly assembled. Completely new and unique issues can be addressed through development of new modules, as required.

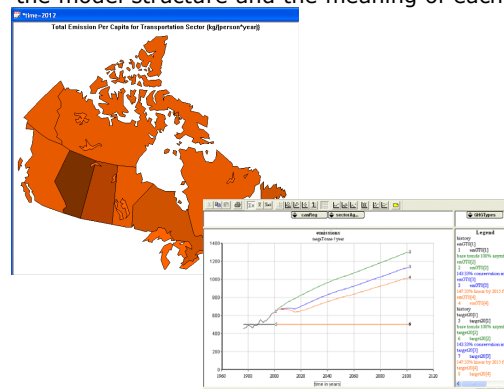
High utility for stakeholder and analyst consultation. Innovative features make our energy and emissions models a highly effective support for group discussion and for consultation with stakeholder or community groups. These include:

- extensible active views - These are active reports that may be added to the model at any time after its customization. They may be used to create new scenarios, debrief existing scenarios and export data to documents.



Diagrams are used to represent and navigate models

- model navigation using diagrams - The diagrams used to represent the model and convey its meaning are also used to facilitate navigation within the model during scenario construction and debriefing.
- white box approach - This allows 'zooming' in or out to any level of model detail to facilitate understanding of the model structure and the meaning of each scenario.



Simulation data can be presented on maps or graphs

- strong interactive data display - This allows easy understanding of the meaning of data assumptions and scenario outcomes. These include interactive tabular, line graphics and thematic map colouring display tools.

Built in scenario management. Users can construct, document, manage and communicate effectively on any number of scenarios. The assumptions upon which each scenario is based are preserved and powerful scenario comparison tools are readily accessible. Scenarios are fully documented and easily retrieved for comparison. This supports effective data and knowledge management – thereby ensuring corporate memory.

Rapid, low cost development. The modular approach to whatIf? energy and emission models draws upon decades of model-building expertise. This approach lends itself to rapid, low cost development cycles – for both initial model customization and subsequent modification and enhancement.

Interface to other major tools. whatIf? energy and emission models interface to spreadsheet packages, geographic information systems (GIS) and relational databases.

High value with long productive life. Because whatIf? energy and emission models are easily maintained and modified, they provide a long productive life and thus have high value for the client. Some clients have had whatIf? models in operation for over ten years thus amortizing model investment over many years. Our models are usually built to explore specific client concerns (e.g. impacts of ethanol based fuels). Due to the integrated and extensible nature of the models, they are often expanded or adapted over time to explore a growing set of issues (e.g. impact of rapidly increasing share of new diesel engined vehicles).

The whatIf? Project – Life Cycle

Customizing a whatIf? energy and emission model includes the following stages:

- 1. Customization workshop.** Here we define the problem set and identify key issues with a team of subject matter experts so that the model modules can be customized to accommodate all scenarios advocated by various stakeholders. Data sets are also identified.
- 2. Model calibration.** Historical data is gathered to calibrate the model – that is, to ensure acceptable tracking in history. This leads to an historical database upon which future scenarios can be built.
- 3. Scenario construction workshop.** Primary planning scenarios are developed in consultation with the client.
- 4. Training.** Depending on client requirements, technology transfer training and user support is provided.
- 5. Integration.** The model is integrated in the client's planning, consultation and communication processes.

A typical whatIf? energy and emission model customization takes six to twelve months, depending on model complexity and data availability. Clients with large-scale models may adopt a multi-phase implementation schedule.

whatIf? Projects – Profiled

Canadian Transportation Energy and Emissions Model (CANTEEM): Natural Resources Canada and National Research Council of Canada

CANTEEM was implemented in partnership with Natural Resources Canada and the National Research Council of Canada. It was designed to complement life cycle modelling in the analysis of the greenhouse gas emissions associated with transportation in Canada.

The model scales energy use in passenger and freight transportation to population, household and the economy. It represents: personal and commercial motor vehicle stocks, rail, intercity bus, urban transit, and air transportation. Energy supply is also represented: refined petroleum fuels, hydrogen, electricity, bio fuels; and feedstocks including oil, gas, coal, uranium and biomass. Inter-provincial and international energy trade is simulated. Emissions of greenhouse gases (CO₂, CH₄, N₂O) and criteria air contaminants (CAC's) are accounted for at point of source by process, sector and province. The model is calibrated with historical data from 1976 to the present and scenarios runs to 2101.

CANPLAN: National Energy Board, Canada

The CANPLAN model, originally implemented in FORTRAN, represents electricity generation on a plant-by-plant basis. It is one of the suite of models used by the NEB to prepare energy supply and demand outlooks.

Electricity demand is allocated to plants and new plants are deployed as needed. In this project, significant legacy FORTRAN code was salvaged by "shrink wrapping" it in the whatIf? environment.

Corporate Profile – whatIf? Technologies

whatIf? Technologies Inc. is an Ottawa based firm serving international clients since 1989. Our mission is to provide the most powerful, effective and affordable simulation modeling software capability for strategic planning and scenario analysis.

We are the developers of the whatIf?® software suite, a complete integrated environment for development and use of simulation models.

We specialize in the interactive design and implementation of simulation tools used for analysis of urban and regional long-term sustainability and strategic planning as well and energy and emissions analysis.

whatIf? Technologies has developed simulation models in a wide range of problem domains including: urban and regional planning, demography, sustainable development, energy analysis (including energy end use, emissions and fuel production systems).

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