Canada's Integrated Energy & Macro Economic Modeling of Energy Efficiency Gains

Presentation to the IEA Workshop on Capturing The Multiple Benefits of Energy Efficiency

Session 5:

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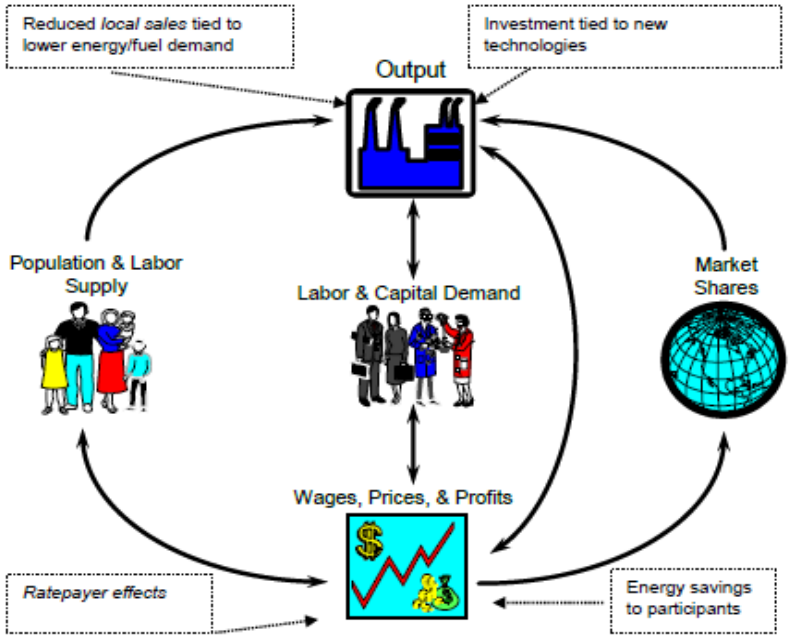
Session 5: Utilising macroeconomic models to evaluate energy efficency policies and programs

- Using integrated energy & macroeconomic models to estimate macro benefits from Canadian energy efficiency gains
  - Illustrate approach from 2 modeling approaches
    - Environment North East using the REMI Model
    - Integrated Energy 2020/Informetrica Model
  - Results
  - Challenges and Considerations

Two Approaches - Partial-equilibrium Models

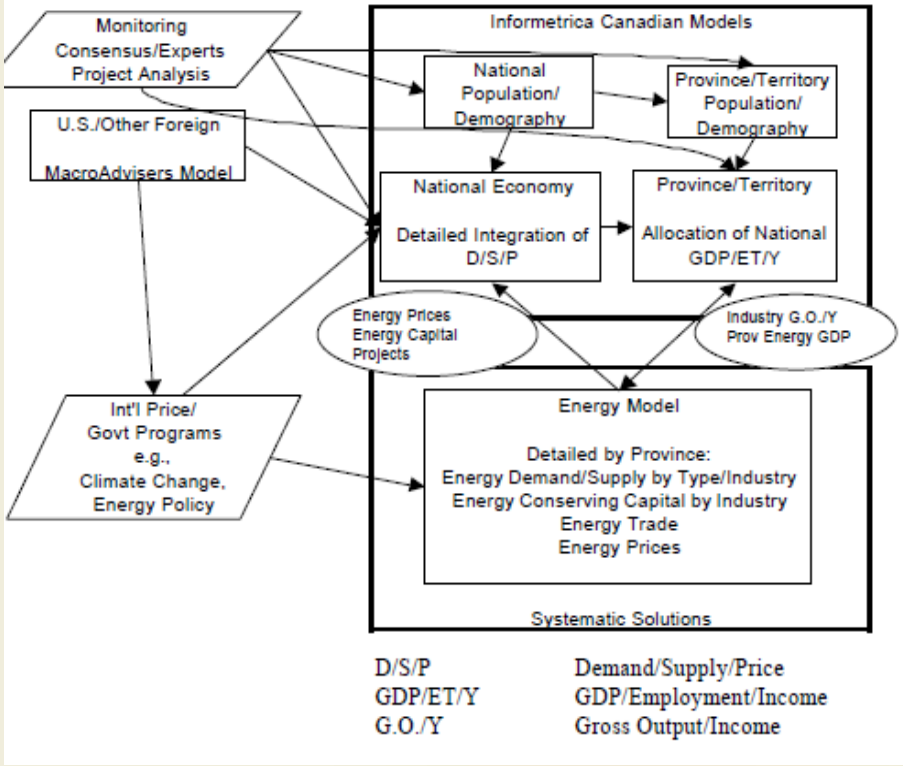
Environment North East (ENE) REMI Model

Figure 7: REMI Economic Forecasting Model – Basic Structure and Linkages



Source: EDR Group, Inc.

Integrated Energy/Macro Model



- Integrated with energy savings developed outside model

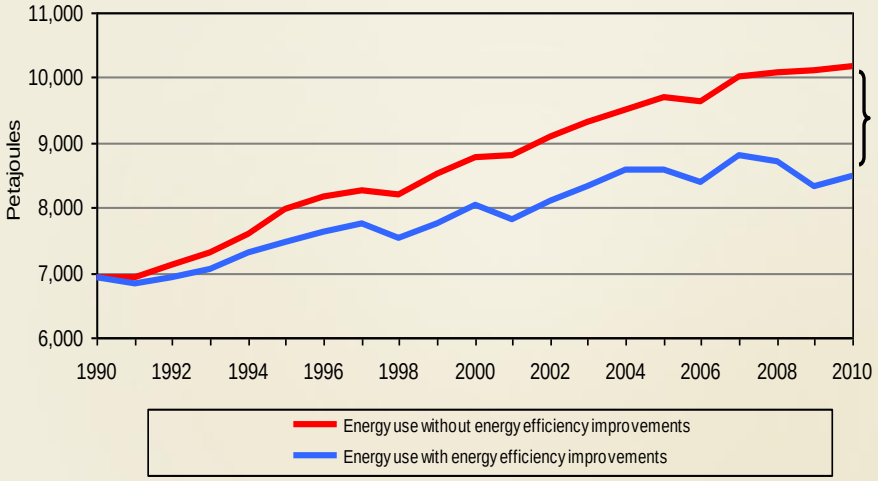
Policy and Scenario Development

ENE

	Illustration of Strategic Direction of Scenarios	
	BAU+ Scenario	**Mid Scenario**
Summary	Moderately intensify current effort	Put provinces among EE leaders
Degree to which low cost measures are pursued (e.g. CFLs, Education, etc.)	Aggressive	Very Aggressive
Degree to which high cost measures are pursued (e.g. building envelope, ground source heat pumps)	Moderate	Aggressive
Financial support	30-40% of costs	50-60% of costs + Financing
Government policies	BAU (w/consideration for funding mandates)	BAU & Innovative financing (w/consideration for funding mandates)

Energy2020/Informetrica

Figure 2.8 Secondary energy use, with and without energy efficiency improvements, 1990–2010



Source: NRCan, Energy Efficency Trends In Canada 1990-2010, Forthcoming http://oee.nrcan.gc.ca/statistics

- Energy savings developed at NRCan using historical sectoral energy database models developed to track energy efficency trends

Both Approaches Need Energy Savings Policy Estimation to Start Simulations

ENE

Avoided costs

- Electricity avoided spending at the margin based on utility plans
- Natural gas based on Gaz Metro Forecasts
- Heating oil, propane and kerosene from the National Energy Board

Net annual energy costs savings (avoided costs less efficiency costs)

- 5% for electricity, 4 % for natural gas and 10% for liquid fuels

Energy2020/Informetrica

Energy Savings

- To approach the goals set by the input data (efficiency gains by sector less adjusted for regulatory impact)
- Changes to efficiency of new devices are increased over a five year period and held constant causing energy efficiency to gradually reach goals.

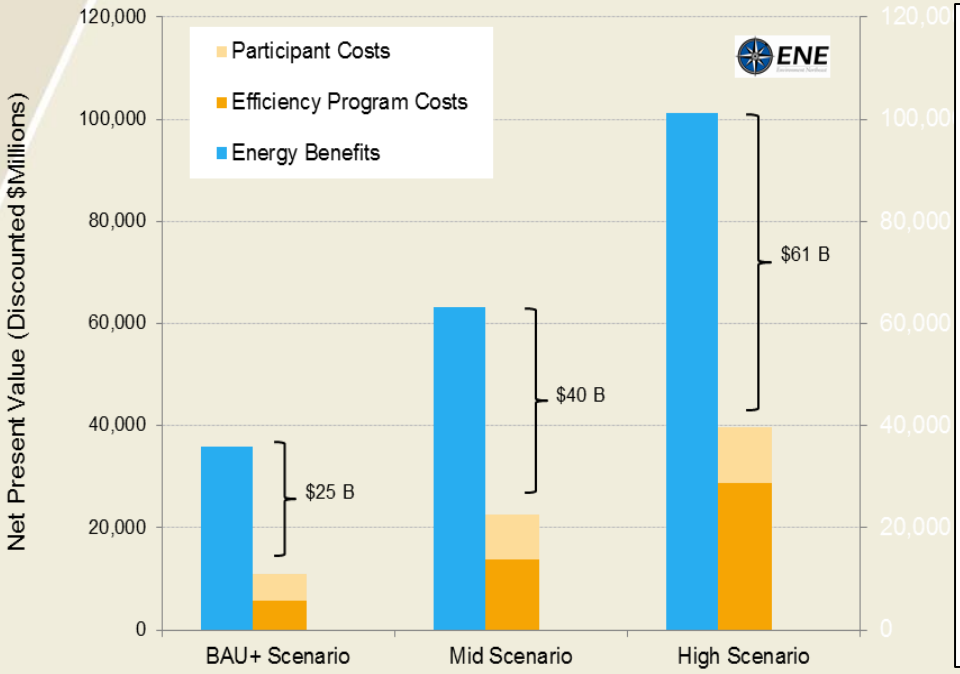
Results are provided by sector by fuel type

- Then weighted to estimate GDP savings (at 1997$ prices) as input to Macro model

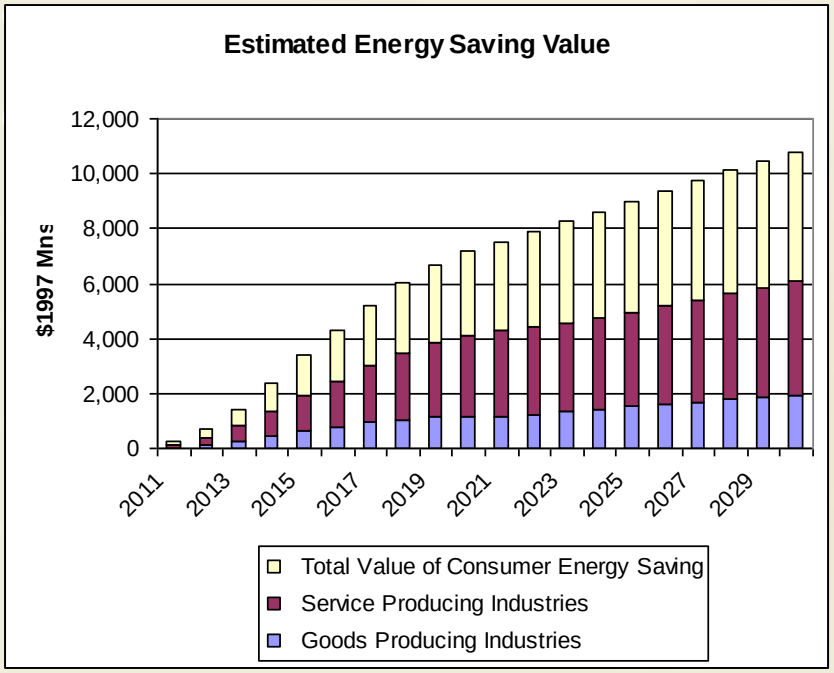
Savings Inputs to Modeling Frameworks

ENE

Regional energy savings (avoided costs) versus 15 years of program and participant investment



Energy E2020/Informetrica



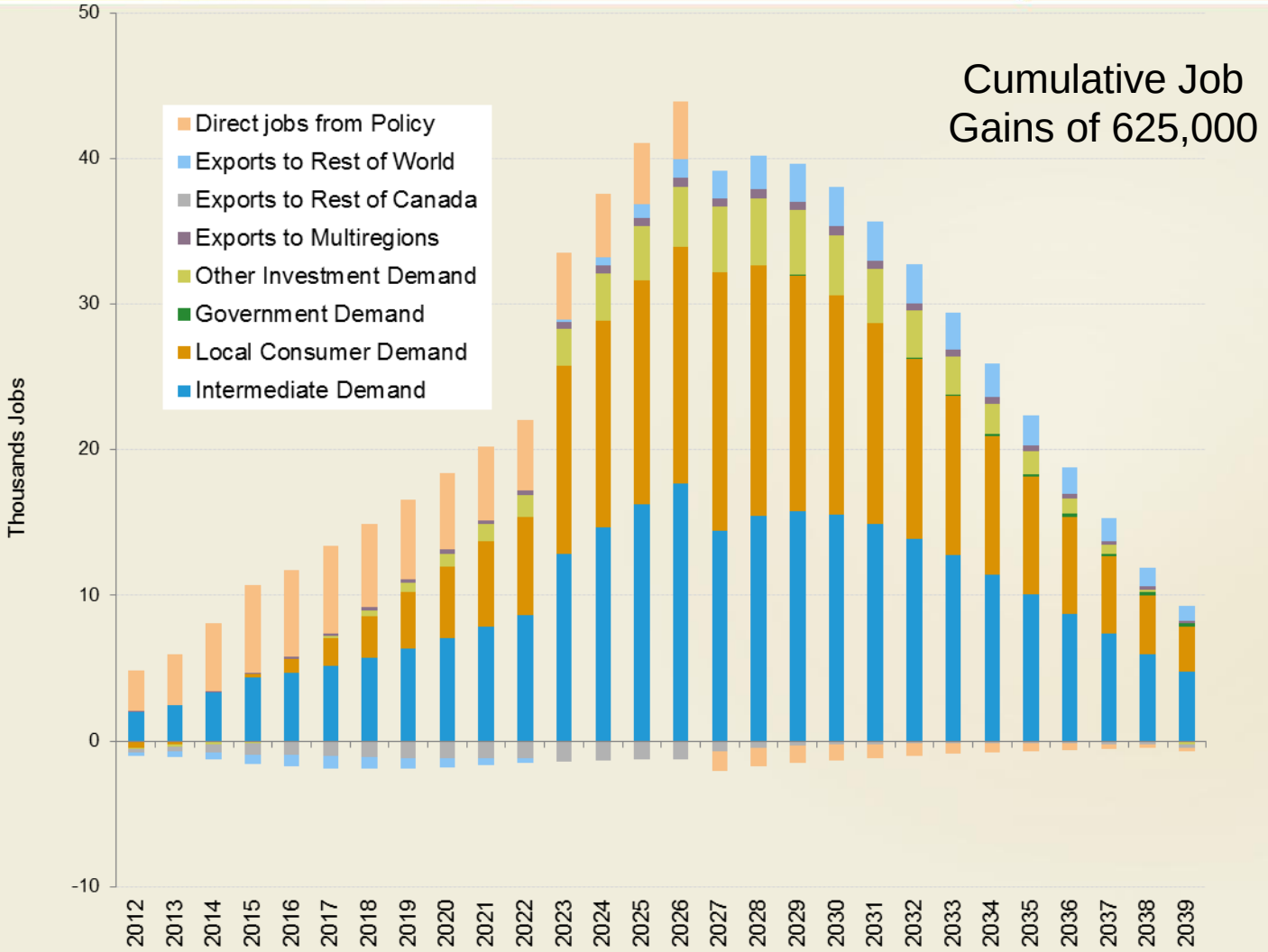
Summary Results

ENE – Cumulative regional impacts (2012-2040)

All Fuels – QC,NB,NS,PEI	BAU+	Mid	High
Total Efficiency Program Costs ($2011 Millions)	**5,768**	**14,460**	**28,600**
Net Increase in GDP ($2011 Millions)	**45,238**	**83,955**	**113,250**
Increased GDP per $1 of Program Spending	7.8	**5.8**	4.0
Increase in Employment (Job years)	**330,110**	**625,110**	**867,650**
Maximum Annual Employment Increase (Jobs)	23,880	**42,670**	52,327
Job-Years per $Million of Program Spending	57	**43**	30
Job-Years per $Million of Program & Participant Spending	29	**27**	22

ENE - Employment Impact by Source

"Sum of Regions" annual job impacts (thousands) by demand source under the All Fuels, Mid Scenarios (2012-2040)



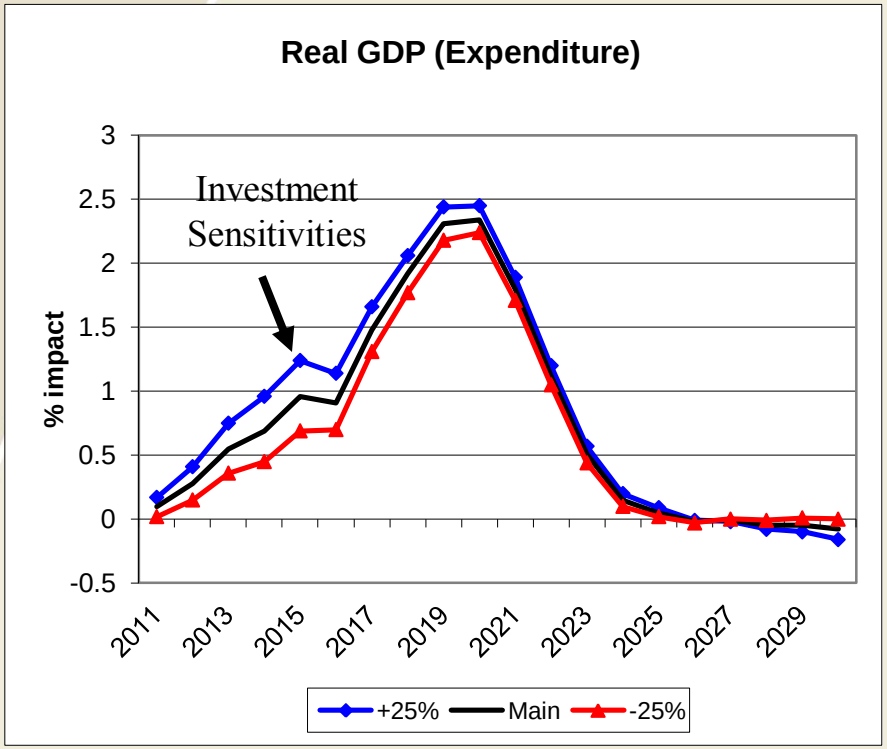
ENE - Tax Revenue Impact Assessment

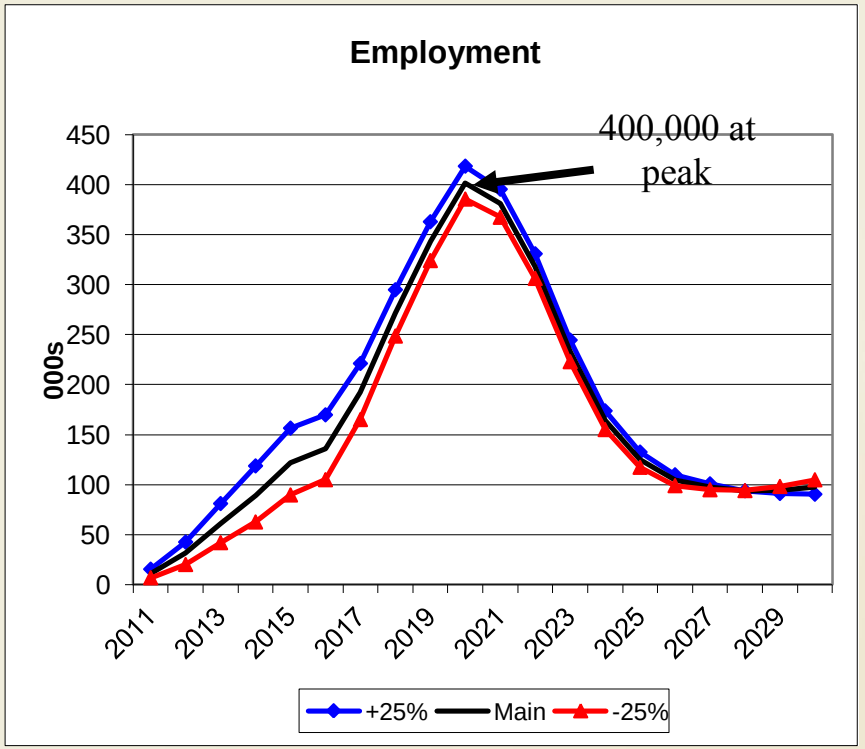
- The significant increase in economic output would generate a net increase in collections of personal income tax, corporate income tax, and sales tax even with a reduction in revenue from fuel sales tax.

	New Revenues, Average Annual[1] (Million 2011$)			
	Sales Tax	**Personal Income**	**Corporate Income**	**Sum**
New Brunswick	$4	$4	$1	$9
Nova Scotia	$11	$12	$4	$27
Prince Edward Island	$1	$1	$0	$2
Quebec	$91	$116	$36	$243
Federal[2]	$51	$250	$56	$312

1 These values should be interpreted as more indicative of revenue changes near 2012, rather than 2040, since the fuel tax rates are current. No projection of tax policy has been attempted.
2 The federal values are collections of the federal tax across the four provinces and do not include potential effects in provinces outside the region of study.

Energy 2020/Informetrica - price and income effects are important





- Electric power prices provide competitive advantage combined with direct and induced impact of energy savings and investment stimulus

- Employment in the directly impacted construction and manufacturing industries from investment contribute 15% of total gains, indirect and induced effects in services account for 84% of employment.

Lessons Learned and Commonalities from Modeling Results

Two approaches but similar conclusions

- Investment shock is overshadowed by gains from avoided costs by energy consumers through the indirect and induced effects.
- More work needs to be done on the income and price effects from energy price changes in this context.
- Trade is an important component, in these models, through changes to competitive advantage.
- Energy efficiency gains can be an engine of growth.

Modeling Challenges and Considerations

- Time and effort to develop front-end estimation of assumptions on energy efficiency investment, avoided costs

- Energy market in play (is it competitive)
  - Energy price implications from reduced energy demand – can have a larger impact than investment (both modelers were surprised by this)
  - Energy trade and capacity –
    - Do producers anticipate demand reductions?
    - Is surplus energy available for export?

- How will Government treat increased revenues?

- Rebound effect – implicitly included – neither study developed specific assumptions on rebound but embedded in their models

Office of Energy Efficiency: Databases and Analysis

http://oee.nrcan.gc.ca/statistics