



## Modelling Climate Change Mitigation Policies with ENERGY 2020

Global Warming Task Force  
State of Wisconsin



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# Agenda

1. Introduction to ICF International
2. ICF Climate Change & Modeling Experience
3. Overview of ENERGY 2020 Model
4. Modeling Process
5. Reference Case Development
6. Policy Analyses
7. Portfolio Modeling (economic & emission impacts)
8. Delivering Results
9. Discussion/Questions

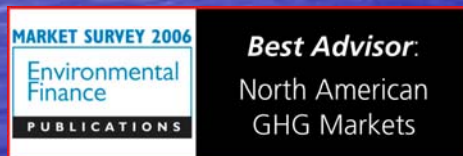
# 1. ICF Overview

- Thirty-eight years of experience – founded in 1969
  - A leading management, technology, and policy consulting firm providing advisory and program implementation services to public and private clients in many sectors:
    - Energy
    - Environment
    - Economic Development
    - Transport
    - Security
    - Social Programs
  - Over 2,000 employees (*1,700 full-time, 300 part-time*)
  - Global presence:
    - Headquarters in Washington, DC area; with offices in:
      - Toronto
      - Moscow
      - New Delhi
      - London
      - Rio de Janeiro
- and fourteen locations across the U.S.

## 2. Summary of Climate Change Experience

### *Highlights of Experience*

- Provide climate policy advice to more than 60 governments
- Provide climate strategy advice to over 55 companies in the FT Global 500
- Over 230 professionals with climate-related expertise



### *Service Offerings*

- Developing climate strategies aligned with key corporate drivers based on our *Value-at-Stake* methodology
- Carbon market pricing analysis using our *InCaP* model
- GHG emission inventories
- Bringing CDM and JI projects through the Kyoto cycle
- Undertaking due diligence of CDM and JI projects using our *K-Prism* model
- Providing market analysis to low-carbon technology companies
- Modeling emissions scenarios
- Assisting governments establish their climate change policy framework and institutions

## 2. Recent Climate Change Modeling:

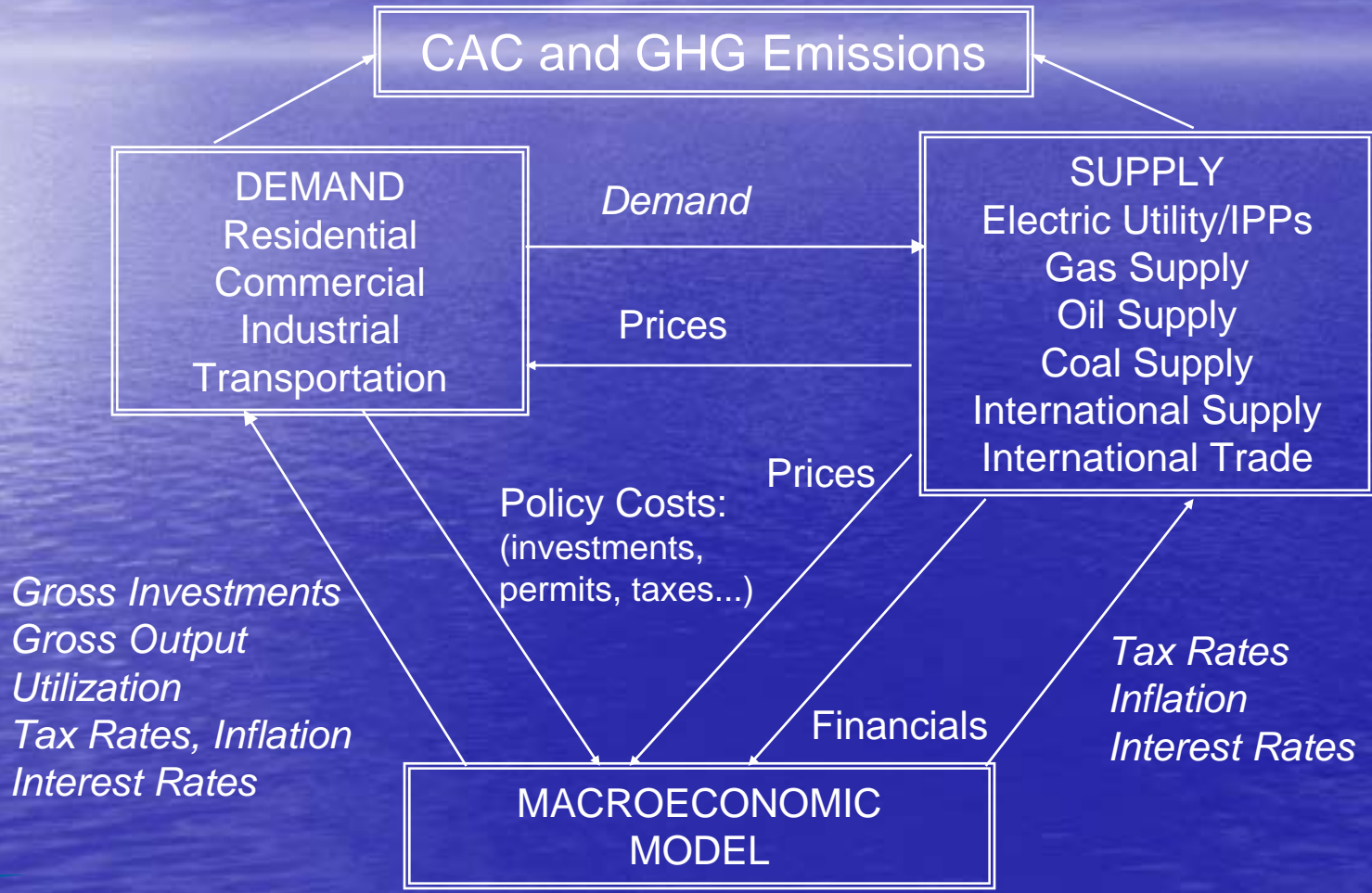
- **NRTEE** (National Round Table on the Environment and the Economy - Canada)
  - Long-Term Energy and Climate Change Strategy to reduce GHG emissions by 60% below 1990 levels by 2050
  - Measures included energy efficiency across all sectors, renewable fuels for transportation and electric generation, restructuring industrial and urban mix, and carbon capture and sequestration.
- **Ontario Climate Change Plan**
  - Provincial climate change strategy – modeling both current and proposed government policies across all sectors.
  - Target – 6% < 1990 by 2014, 15% below by 2020; 80% below by 2050.
- **Illinois – Governor’s Climate Change Advisory Group**
  - Target - Reduce emissions to 1990 level
  - Policies in All Sectors including Cap and Trade
  - Economic Impacts analyzed in conjunction with macro-economic model

### 3. ENERGY 2020 Model Overview

- Integrated North American economy, energy and emissions model
- U.S. States and Canada Provinces
- Energy demand end-use sector disaggregation
- Energy supply for electricity, oil, gas, coal, other
- GHG and CAC emissions

# Model Structure

## *Sector Relationships*



# Major Model Inputs

- Economic Activity from macro-economic model (ie. REMI)
  - GDP, Gross Output, Personal Income
- World Oil Prices
- US Natural Gas Prices
- Technological Change
  - Process Improvements
  - Device Improvements
- Historical Energy Demands, Prices, and Emissions

# Major Model Outputs

- Fuel Usage for All Fuels
- Device and Process Efficiencies
- Fuel Shares
- Electricity Generation, Capacity, Prices
- Oil and Gas Imports and Exports
- Emissions – GHG and CAC (SO<sub>x</sub>, NO<sub>x</sub>, PM, etc.)
- Outputs for all end uses, sectors, and jurisdictions

# Modeling Principles

- Key Decisions are Endogenous
- Marginal Decisions
- Stocks and Flows
- Causality vs. Correlation
- Model Actual vs. Optimal Decisions

# Demand – Sectors & End Uses

## ➤ Detailed model of sectors:

- Residential – 3 structure types
- Commercial/Institutional – 14 sub-sectors
- Industrial – 39 sub-sectors (including construction, agriculture & forestry)
- Transportation – separates passenger, freight & off-road

## ➤ End Uses:

- Specific to each sector
- Separates “substitutable” loads (multiple fuel choices) from “non-substitutable”
- Transportation divided into 7 “modes” as well as by vehicle classes/sizes within passenger and freight categories.

# Economic Sectors

Residential	Commercial	Industrial	Transportation	Other
<ol style="list-style-type: none"> <li>1. Single Family</li> <li>2. Multi Family</li> <li>3. Other Residential</li> </ol>	<ol style="list-style-type: none"> <li>1. Transportation Services</li> <li>2. Pipelines</li> <li>3. Communication</li> <li>4. Electric Utilities</li> <li>5. Gas Utilities</li> <li>6. Water &amp; Other Utilities</li> <li>7. Wholesale</li> <li>8. Retail</li> <li>9. FIRE</li> <li>10. Offices - Business Services</li> <li>11. Education</li> <li>12. Health &amp; Social</li> <li>13. Food, Lodging, Recreation</li> <li>14. Government</li> </ol>	<ol style="list-style-type: none"> <li>1. Food &amp; Tobacco</li> <li>2. Textiles</li> <li>3. Apparel</li> <li>4. Lumber</li> <li>5. Furniture</li> <li>6. Paper</li> <li>7. Printing</li> <li>8. Chemicals</li> <li>9. Petroleum Products</li> <li>10. Rubber</li> <li>11. Leather</li> <li>12. Cement</li> <li>13. Glass</li> <li>14. Lime &amp; Gypsum</li> <li>15. Other Non-Metallic</li> <li>16. Iron &amp; Steel</li> <li>17. Aluminium</li> <li>18. Other Nonferrous</li> <li>19. Fabricated Metals</li> <li>20. Machines</li> <li>21. Computers</li> <li>22. Electric</li> <li>23. Equipment</li> <li>24. Transport Equipment</li> <li>25. Other Manufacturing</li> <li>26. Metal Mining</li> <li>27. Non-metal</li> <li>28. Mining</li> <li>29. Light Oil Mining</li> <li>30. Heavy Oil Mining</li> <li>31. Frontier Oil Mining</li> <li>35. Gas Mining</li> <li>36. Coal Mining</li> <li>37. Construction</li> <li>38. Forestry</li> <li>39. Agriculture</li> </ol>	<ol style="list-style-type: none"> <li>1. Passenger</li> <li>2. Freight</li> <li>3. Off Road</li> </ol>	<ol style="list-style-type: none"> <li>1. Misc. &amp; Street lighting</li> <li>2. Electric Resale</li> <li>3. Utility Electric</li> <li>4. Generation</li> <li>5. Industry Electric</li> <li>6. Generation</li> <li>7. Steam Generation</li> <li>8. Solid Waste</li> <li>9. Waste Water</li> <li>10. Incineration</li> <li>11. Land Use</li> </ol>

# End Uses

Residential	Commercial	Industrial	Transportation
1. Space heating	1. Space heating	1. Process heat	1. Highway (automobile & trucks)
2. Water heating	2. Water heating	2. Electric motors	2. Buses
3. Lighting	3. Lighting	3. Other substitutable <sup>c</sup>	3. Trains
4. Air conditioning	4. Air conditioning	4. Miscellaneous <sup>d</sup>	4. Planes
5. Refrigeration	5. Refrigeration		5. Marine
6. Other substitutable <sup>a</sup>	6. Other substitutable <sup>a</sup>		6. Others (electric vehicles, fuel cells and ethanol)
7. Other non-substitutable <sup>b</sup>	7. Other non-substitutable <sup>b</sup>		

*a an aggregate category to include cooking and drying end-use services*

*b represents miscellaneous electric appliances*

*c hot water or drying that is not part of the primary-process heat*

*d lighting and electrochemical process*

## 4. Modeling Process:

- Development of “Reference Case” (requires majority of project time)
- Calibration (2003 last historic year - calibrate with recent years)
- Analysis of proposed policies provided by GWTF
- Translation of policies into modeling terms
- Testing of individual policies
- Modeling of “portfolio” of policies (Analysis of economic and emission impacts of portfolios).
- Analysis of Modeling Results
- Delivery of Results (iterative).

# 5. Reference Case:

## Development of "Reference Case"

- Represents how emissions are expected to develop (ie. "Business as Usual")
- Forms basis of comparison for Policy cases to estimate reductions resulting from policies.
- Quality of data and assumptions critical to later evaluations
- Tasks include:
  - Collection of economic, energy, emissions and other state-specific data
  - Development of assumptions & decisions of what to include (ie. new generation, ethanol or other significant facilities currently in planning stage, regulatory or legislative requirements, etc.).
  - Use "Assumptions Book" to feedback and verify data and assumptions included.
- Reasonableness review and calibrate with recent history (2004 – 06)

## 6. Policy Analysis:

### Tasks:

- Analysis of proposed policies and translation into modeling terms.
- Assumes that GWTF will calculate “stand alone” emission impacts
- Quality of modeling will reflect specificity of policy descriptions
  - i.e. impacts on end uses and levels of service demand required
  - as of 2010 policy will result in x% of gasoline in Wisconsin containing y% ethanol, or
  - Regulation will require all new gas furnaces to be 90%+ efficient as of 2009.
- Policies will be modeled to verify that the expected stand-alone results are obtained (in terms of changes in service levels, energy use, etc.)
- Policies will then be run as portfolios in following steps.

## 7. Portfolio Analysis:

- “Portfolios” of policies specified by GWTF will be modeled
- Policies are expected to be implemented as a package
- ENERGY 2020 will model interactions between policies (net effect is less than sum of individual stand-alone policy impacts).
- ENERGY 2020 and REMI will be run iteratively to determine economic impacts (ie. Gross State Product, employment, personal income)
- Package/portfolio may include various configurations of Cap & Trade systems (ie. different sector coverage, different target levels, with or without linkages to Regional trading systems)
- Expanding number of portfolios complicates analysis/reporting more than increasing number of policies.

## 8. Delivering Results:

- Delivering results
  - Reference Case – Iterative process of feedback as Reference Case inputs & assumptions are developed.
  - Policy & Portfolio Analysis – Presentation & Final Report
- Present interim results as PowerPoint presentations
- Budgeted for 3 “in-person” meetings as part of project (2 meetings to provide interim feedback and one for final results).
- Additional meetings may be arranged via teleconference.
- Draft and Final Report:
  - Deliver Draft Final report (including “Assumptions Book” as Appendix)
  - Allow one month for review and feedback
  - Deliver Final Report including that feedback.

## 8. Delivering Results:

- Model will calculate the emission change resulting from the policy combinations put forward by the GWTF
- Can model neighbouring states, Region, Rest of U.S. and the rest of N. America
  - Can provide information on impacts on power system, GHG emissions, and economic impacts, etc. outside of Wisconsin.
  - Level of detail available for results dependent on how model is set up, level of calibration of reference case for other states, etc.
  - We have assumed that we will model the state, the Region directly interconnected with the state and the rest of the U.S. as well as Canada.
  - If the GWTF wishes to do more specific (ie. state by state) modeling some adjustment to the proposal would be required.
- Project is designed to analyze impacts of “portfolios” – not contributions of individual policies to that portfolio.

## 9. Questions and Discussion?

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