

**Agenda**  
**Technical Advisory Group meeting with**  
**ICF and SSI**  
**November 8, 2007, 9:30 to 12:30**  
**Rooms B1B&A, Lowell Inn and Conference Center,**  
**610 Langdon St., Madison.**

Assumptions and Data Needs

- Resolve any outstanding issues or data needs

Reference Case

- Discuss high and low fuel price reference case approach
- Review examples of reference case outputs
- Determine process for TAG/ICF/SS/Winrock/WRI interaction

Policy Analysis

- Discuss process for policy template review process
- Discuss modeling strategy options and ideas
- Discuss what outcome variables we will be seeing/want to see
- Determine process for TAG/ICF/SSI/Winrock/WRI interaction

Review Timeline

Determine Next Steps

**This meeting is open to the public.**  
**If you have any questions or need special accommodations, please contact**  
**Caroline Garber at the Department of Natural Resources**  
**at 608-264-9218 or**  
**Caroline.Garber@wisconsin.gov**

**Agenda**  
**Work Group Co-Chairs of the**  
**Governor's Global Warming Task Force**  
**meeting with ICF and SSI**  
**November 8, 2007, 1:30 to 3:30**  
**Rooms B1B&A, Lowell Inn and Conference Center,**  
**610 Langdon St., Madison.**

1. Overview and Discussion of Energy 2020/REMI models  
Glen Wood, ICF and Jeff Amlin, SSI
2. Overview and Discussion of policy template review process by ICF/WRI  
Glen Wood, ICF and John Larsen, WRI
3. Review Timeline

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# An Introduction to ENERGY 2020

*November 8, 2007*



**ICF**  
INTERNATIONAL

# An introduction to ENERGY 2020

- Model Overview
- Model Structure
- Behavioral Modeling
- Modeling Principals
- Demand Overview
- Supply Overview

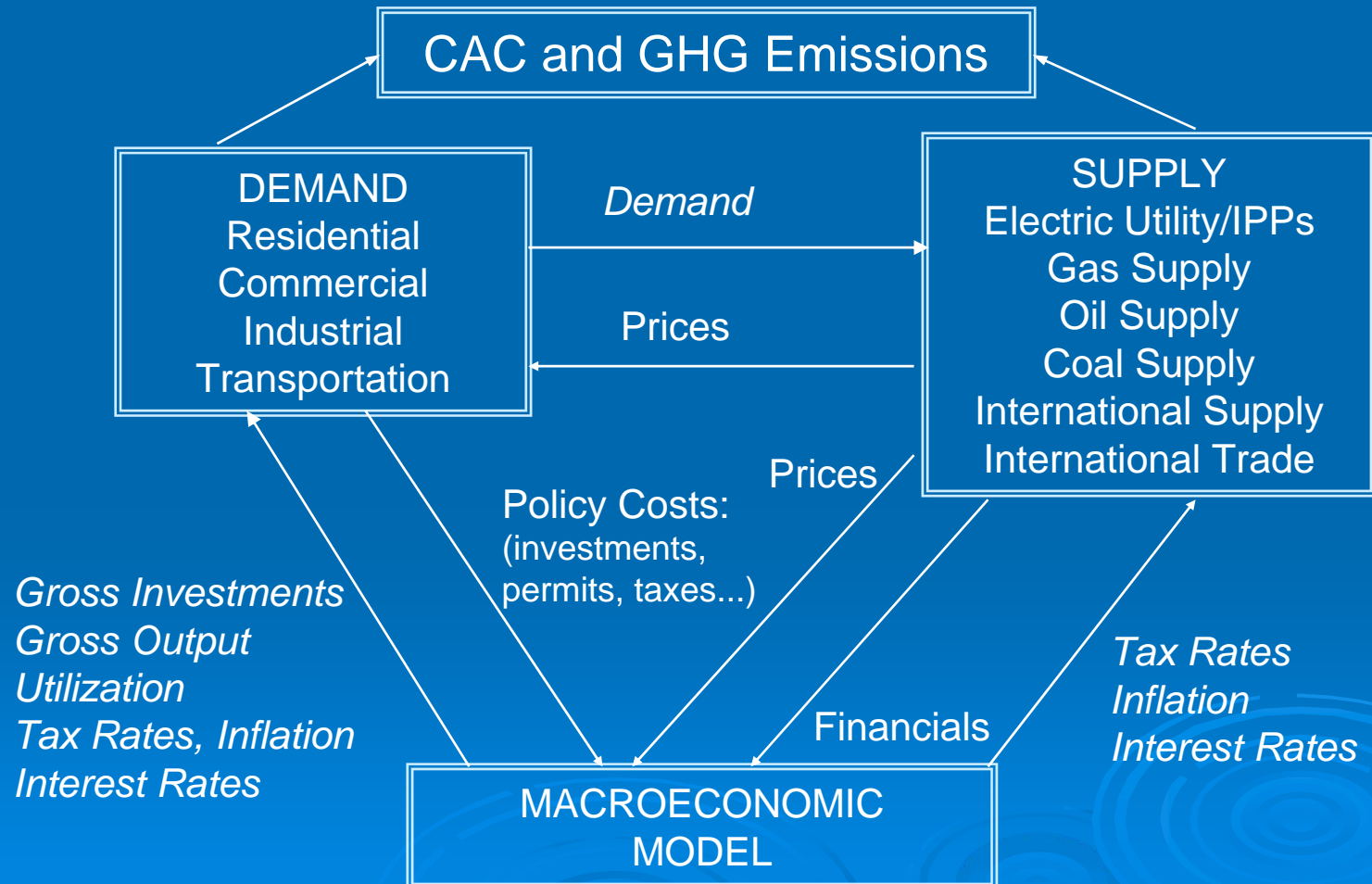
# Overview of ENERGY 2020

# Overview of ENERGY 2020

- Owned by Systematic Solutions Inc. (SSI)
- Integrated North American economy, energy and emissions model
- Multiple U.S. and Canadian regions
- Energy end-use sector disaggregation
- Electricity, oil, gas supply details
- GHG and CAC emissions

# Model Structure

## Sector Relationships



# INPUTS

## Macroeconomic:

GDP at factor cost

Inflation

## Prices:

Wellhead price of Oil

Wellhead price of Gas

Mine-mouth price of Coal

## Energy:

Expected change in energy efficiency

Electricity generation capacities

Programs/policies to be incorporated in the model

ENERGY 2020

# OUTPUTS

## Production/Exports/ Imports:

Electricity Generation/  
Exports/ Imports

Oil production/  
Exports/ Imports

Gas production/  
Exports/ Imports

## Demands:

Energy demands

Gas demands

Oil demands

Coal demands

## Prices:

Electricity Prices

Wellhead price of Oil

Wellhead price of Gas

Mine-mouth price of Coal

## Energy:

Energy intensities

Capital outlays on Energy devices

Energy processes

Operating and Maintenance expenditures

Fuel expenses

## Emissions:

GHG emissions

Emissions Permit purchases

Emissions Permit sales

# Major Model Inputs

- Economic Activity
  - GDP, Gross Output, Personal Income
- World Oil Prices
- US Natural Gas Prices
- Technological Change
  - Process Improvements
  - Device Improvements
- Historical Energy Demands, Prices, 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
- Outputs for all end uses, sectors, and provinces

# Behavioral Model

- Dynamically describes the behavior of both energy suppliers and consumers for all fuels and for all end-uses
- Decisions are endogenous to the model
- Flexible policy scenario analysis capability

# Modeling Principles

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

# Analysis Distinction

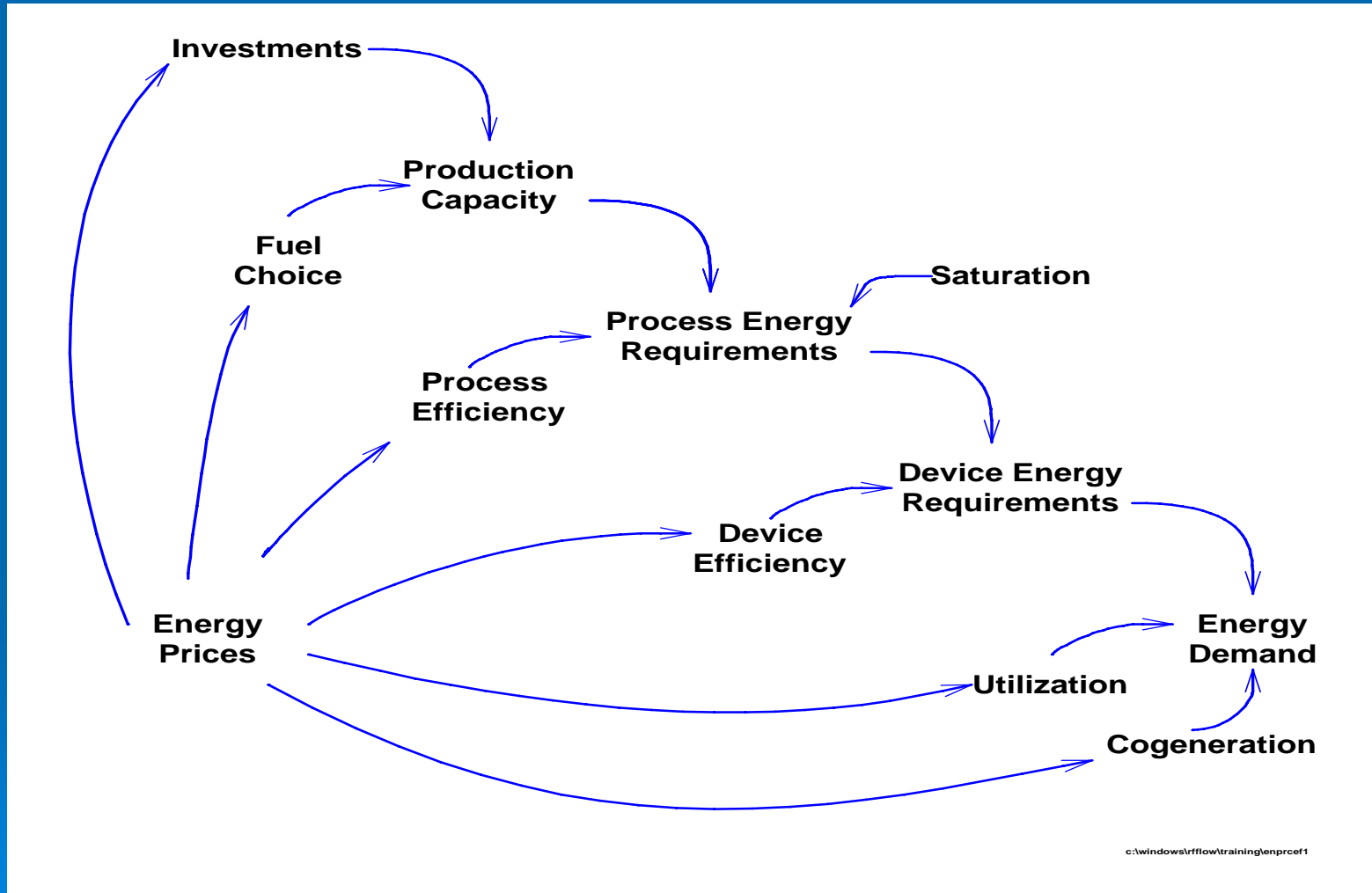
- Not Optimization
  - Want to know risk not hopes; dynamics not static solution
- Not Classical Econometrics
  - Need to robustly focus on unprecedented actions and events
- Causal Dynamics
  - Time Delays and Feedback Dynamics
  - Psychology, Statistics, Engineering, Economics
  - Simulates actual as opposed to assumed responses

# Demand Overview

# Demand Determination:

- Capital Formation
  - Energy is a derived demand
- Fuel and Technology Market Shares
  - Must select fuel and efficiency level
- Stock and Flow Accounting
  - Capital and Energy Stock by Vintage
- Converting energy requirements into actual energy demand
  - Utilization of Capital and Energy Stock

# Demand Determination



# Economic Sectors

Residential	Commercial	Industrial	Transportation	Other
<ul style="list-style-type: none"> <li>1. Single Family</li> <li>2. Multi Family</li> <li>3. Other Residential</li> </ul>	<ul 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> </ul>	<ul 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. Aluminum</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>32. Oil Sands In-Situ</li> <li>33. Oil Sands Mining</li> <li>34. Oil Sands Upgraders</li> <li>35. Gas Mining</li> <li>36. Coal Mining</li> <li>37. Construction</li> <li>38. Forestry</li> <li>39. Agriculture</li> </ul>	<ul style="list-style-type: none"> <li>1. Passenger</li> <li>2. Freight</li> <li>3. Off Road</li> </ul>	<ul 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> </ul>

# 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*

# Supply Overview

# Electricity Supply

- Functional Divisions
  - Distribution
  - Transmission
  - Marketing
  - Generation
- Capacity Expansion (developed endogenously)
- Generation and Fuel Use
- Electricity Prices
- Emissions

# Other Supplies

- Oil Mining
- Gas Mining
- Coal Mining
- CHP – Steam Production
- Ethanol Production
- Renewables

# Policies considered

## SAMPLE POLICIES ANALYZED IN ENERGY 2020

### **RESIDENTIAL**

- Retrofit Programs
- Tax Incentives and Grant Programs
- Building and Appliance Efficiency Standards

### **Commercial**

- Retrofit Programs
- Tax Incentives and Grant Programs
- Building and Appliance Efficiency Standards

### **Transportation**

- Vehicle Efficiency Standards
- Road Fuel Taxes
- National Feebate Program
- Transportation Technology Development Program
- Fuel Substitution
- Potential Use of Alternative Fuels (e.g., Ethanol, bio-diesel; buses, trucks, dual fuel vehicles)
- Potential for hybrid and fuel cell vehicles
- Feasibility and level of Producing Bio-fuels
- Infrastructure Development
- Transport Energy Efficiency Investments
- Inspections & Maintenance

### **Electric Supply**

- Accelerated Retirement of Coal Plants with Replacement with Gas or Renewables
- Green Power Incentive – Medium Hydro, Wind and Biomass
- Replacement of Coal Plants with Natural Gas
- Maintain Nuclear Capacity
- Expand Inter-Provincial Hydro Transmission
- Cogeneration for Grid
- Accelerated Deployment of Advances Technologies – Fuel Cells, FDC, IGCC
- Emissions Standards
- Generation Capacity Retrofits
- Emissions Allowance Trading
- Carbon Capture and Storage

### **Industrial**

- Tax Incentives and Grant Programs
- Equipment Efficiency Standards for Industry
- Renewable Energy
- Process Recapitalization
- Auxiliaries Replacement
- Materials Recycling
- Cogeneration and Boiler Replacement
- Non-Energy Intensive Manufacturing: Audits and Incentives
- R&D Assistance Program

### **Oil, Gas, and Coal**

- Tax Incentives and Grant Programs
- Enhances Production Efficiency and Use of Environmentally Friendly Technologies
- Sequestration of Carbon Dioxide

# ENERGY 2020 in US

- Midwest Utility – Electricity Forecast
- Bonneville Power Administration – RTO Analysis
  - Detailed Transmission Model
  - Western Interconnect
- Michigan – GHG Reduction
  - Bio-Fuels for Transportation
  - Renewable Electric Generation
  - Economic Impacts
- Hawaii – GHG and Oil Dependency
  - Energy Efficiency
  - Demand Response (AC Peak Shaving)
  - Bio-fuels Produced and Used Locally
  - Economic Impacts

# Overview of ENERGY 2020

Questions?