Exploring the Energy, Economic & Environmental Benefits of Insulation Investment and Home Weatherization in New England

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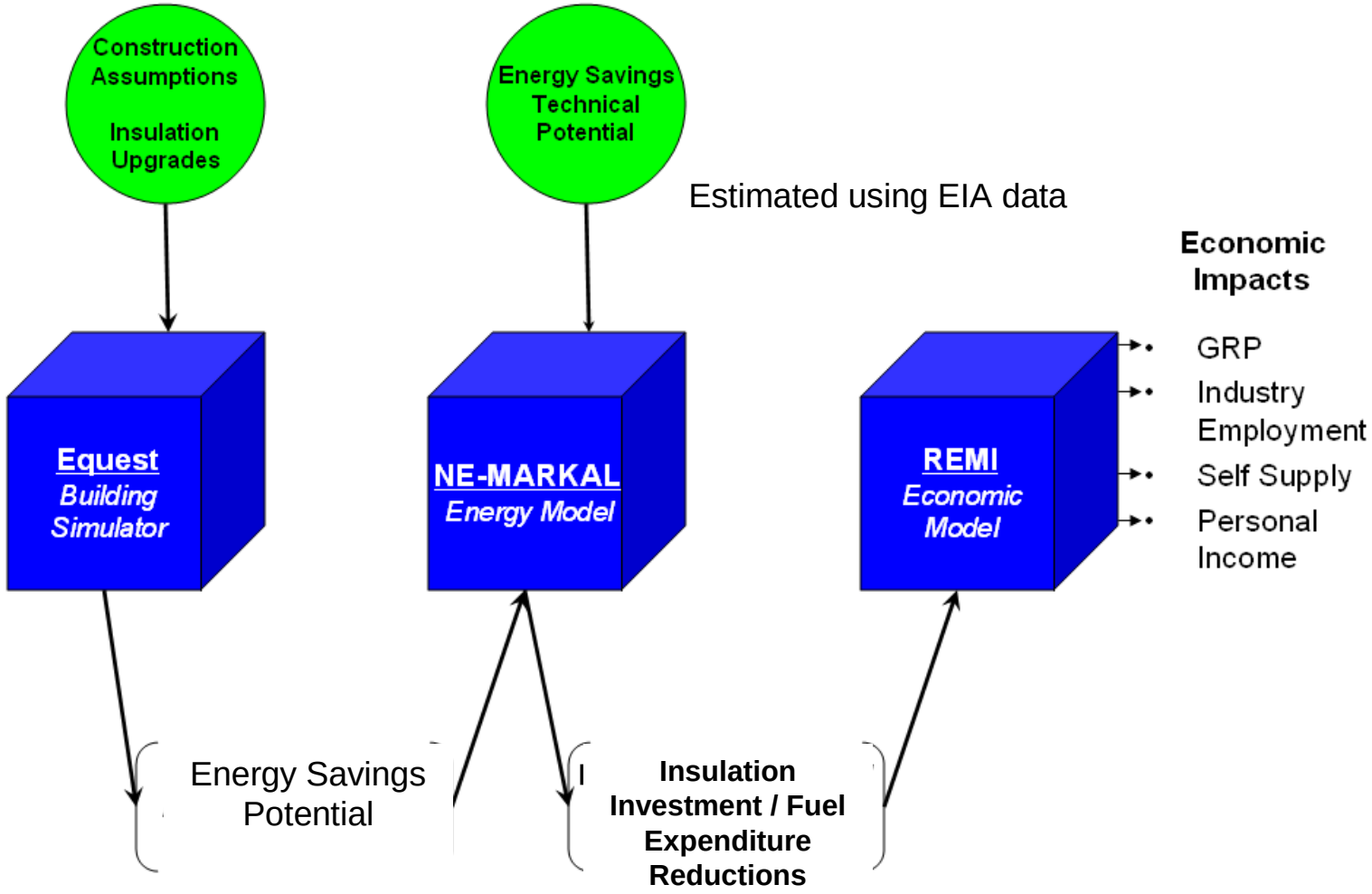
Presentation Outline

- Overview/Motivation
- Methodology
  - Energy / Economic / Environmental
  - Models and Model Linkages
- Modeling Runs
- Results/Findings

Why New England?

- Potential for energy savings and economic and environmental benefits in residential heating sector in New England….
  - Cold winters
  - Region's high use of heating fuel
    - 44% of NE households use fuel oil compared to 8% US average
    - NE consumes 18% of the nation's residential fuel oil
  - Relatively old and poorly insulated housing stock
    - At least 15% of the 5.5 million households in New England significantly lack insulation. (Estimated using RECS data, EIA)
      - Significantly Lacking Insulation: Households that reported in the Residential Energy Consumption Survey (EIA) having no insulation, poor insulation, and homes being "too drafty" in the winter.

Energy / Economic / Environmental Modeling



E-quest Building Simulator Model

- E-Quest is a building simulator which models hourly energy consumption patterns in residential and commercial building types.
  - Consumption is driven by a number of user specified parameters including.
    - Load patterns for lighting, plugs and appliances
    - Thermostat settings
    - Construction design
    - Typical yearly weather patterns

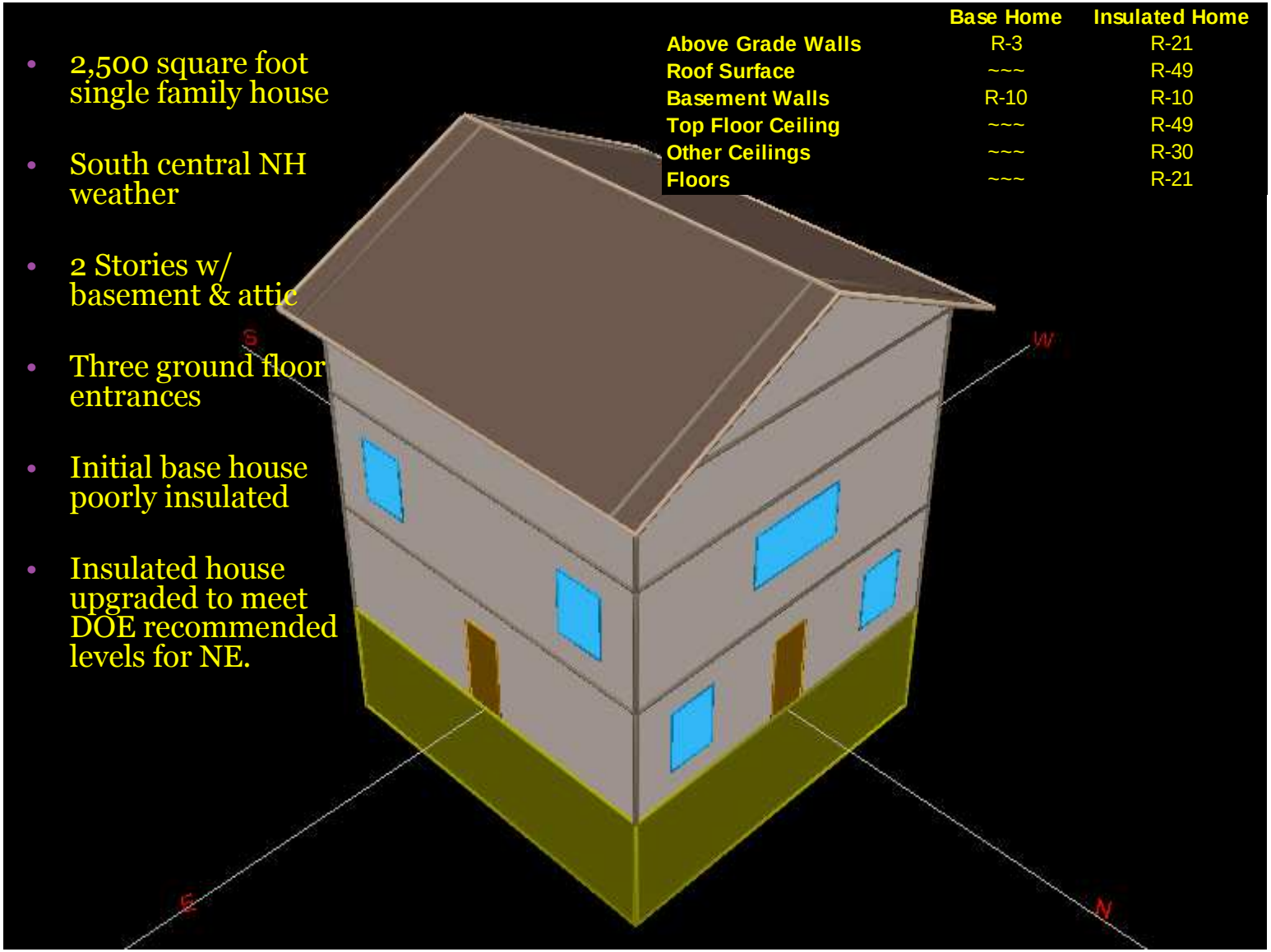
- eQUEST was used to estimate how much energy a poorly insulated 2,500 square foot single family house would save by purchasing the DOE recommended level of insulation for the Northeast climate zone.

- These estimates were used to represent insulation upgrades for poorly insulated homes in NE – MARKAL.
  - **Range of Insulation Costs**($2,840 / $3,500 / $4,500)
  - **Estimated** the energy saved by upgrading to the DOE recommended level. $/energy saved

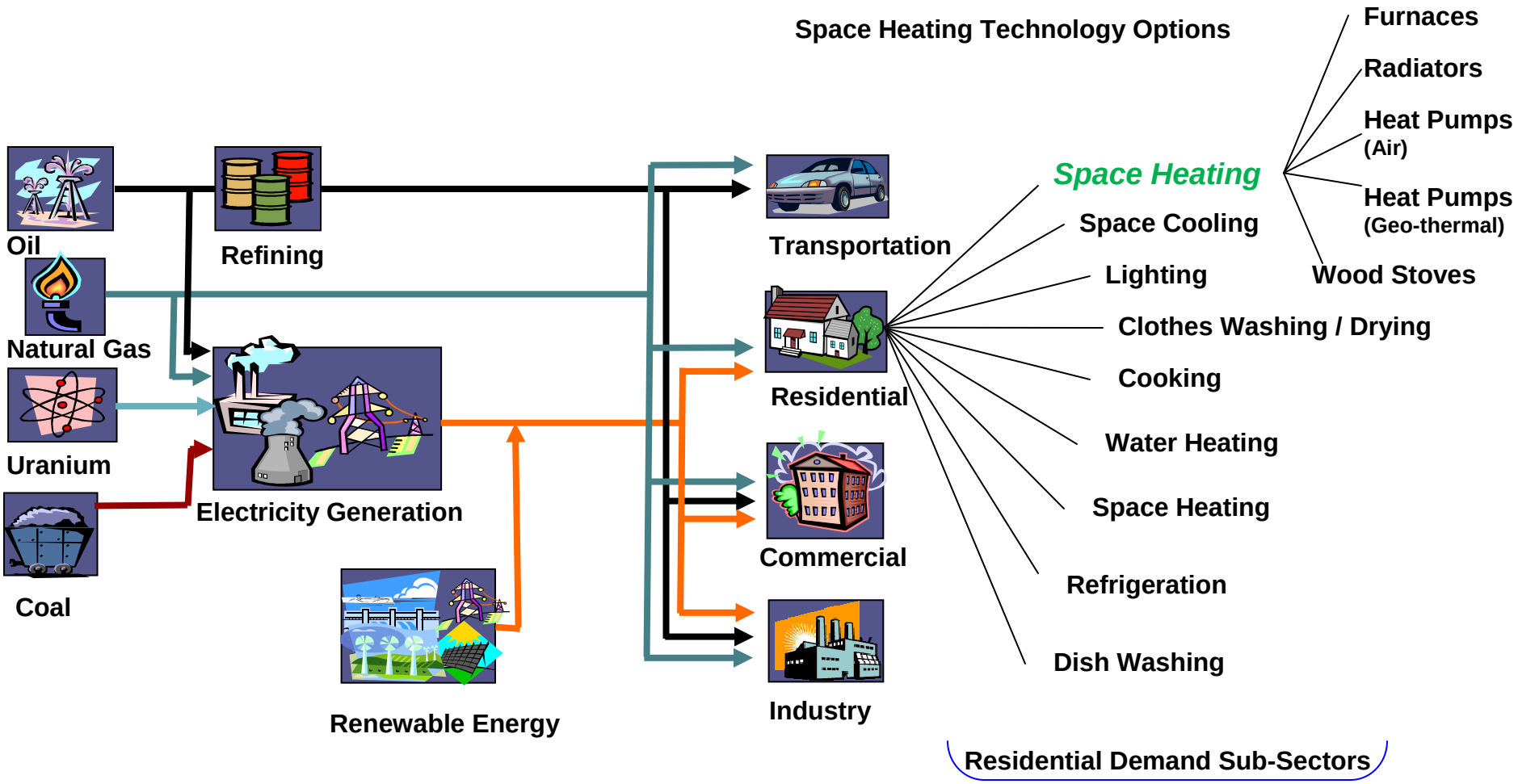
Housing Modeling Assumptions

- 2,500 square foot single family house
- South central NH weather
- 2 Stories w/ basement & attic
- Three ground floor entrances
- Initial base house poorly insulated
- Insulated house upgraded to meet DOE recommended levels for NE.

	Base Home	Insulated Home
Above Grade Walls	R-3	R-21
Roof Surface	~~~	R-49
Basement Walls	R-10	R-10
Top Floor Ceiling	~~~	R-49
Other Ceilings	~~~	R-30
Floors	~~~	R-21



MARKAL Reference Energy System



MARKAL Model Characteristics

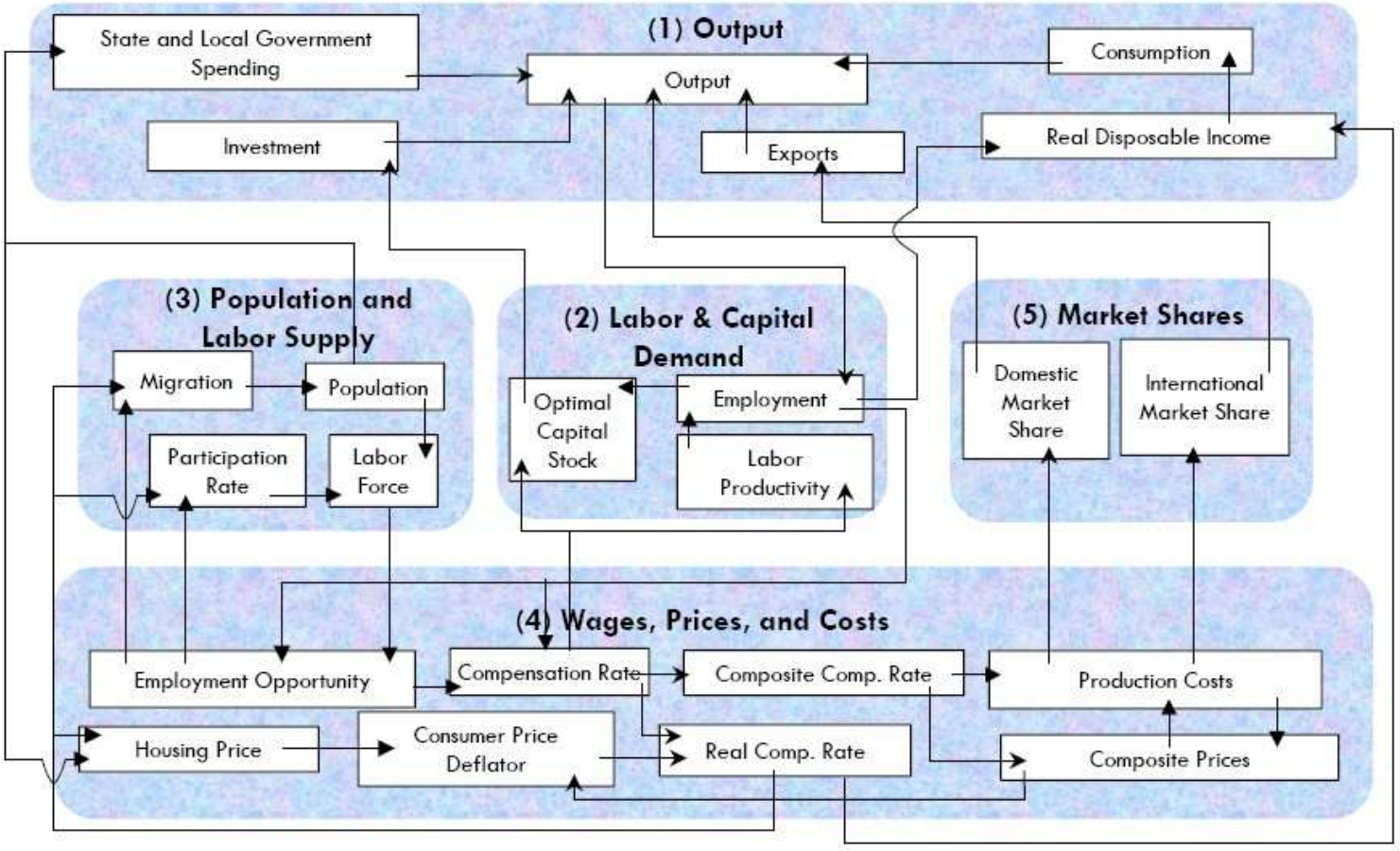
- Encompasses entire energy system from resource extraction through to end-use sectors.
  - End use sectors: Commercial & Residential buildings, Industry and Transportation
- Identifies most cost-effective pattern of resource use and technology deployment over time.
- Level of detail can range from municipality through to entire country, or multi-country to global.
  - NE-MARKAL represents the six northeast states
- Technology rich energy model – essence is technology choice among competing technologies.
- Typically run out 20-50 or more years into future.
- Depicts production, trade, transformation and use of energy and materials, and associated emissions, as a Reference Energy System (RES) network

MARKAL Model Characteristics (Cont.)

- Provides framework for exploring and evaluating alternative futures, and role of various technologies, trade and policy options.
  - Renewable Portfolio Standard, RGGI, Energy Price Assumptions…..
- Able to interact with other models used to assess regional issues, most notably environmental impacts models, forestry/agriculture models and more detailed econometric models.
- An open and widely accepted approach to both data assumptions and modeling technique.

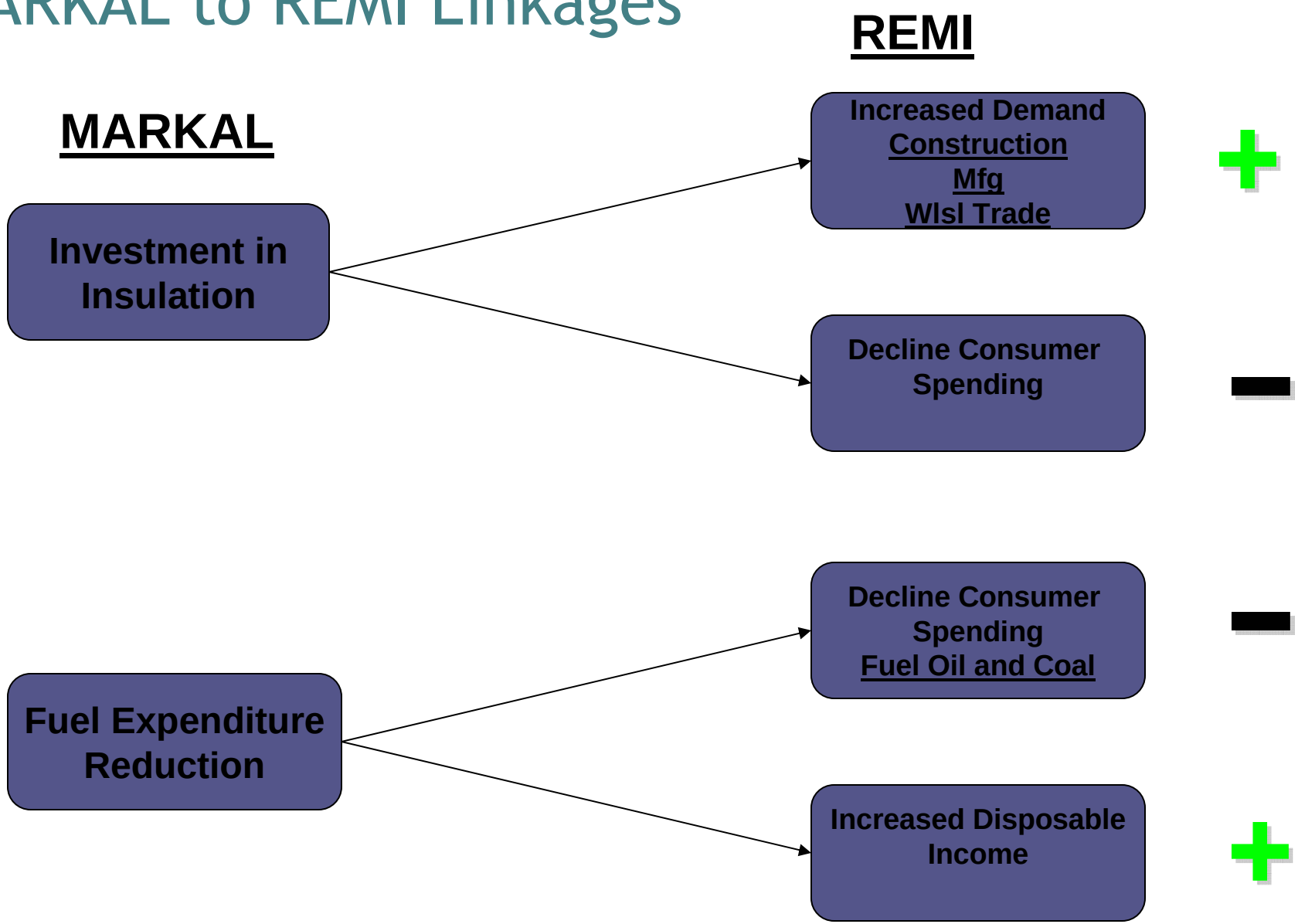
The Economic Model

- A regional economic policy analysis tool (REMI) which provides forecasts of key economic indicators out to 2050.
- Households maximize utility and business maximizes profits.
- REMI explicitly accounts for the cause and effect relationships depicted below



Source: REMI inc.

MARKAL to REMI Linkages



NE-MARKAL Modeling Runs

- **Unconstrained** is policy case representing the availability of a low interest loan for insulation purchases. The policy is represented by lowering the implicit discount rate to 3%.
  - Cumulative cap on total investment of 15% of New England's households
  - Least cost optimization determines investment timing

- Runs to consider the interaction between investment patterns and insulation cost estimates.
  - Investment patterns considered:
    - Investment starts high and fades out (**High to Low**). Cumulative investment still the same as in unconstrained case.
    - Investment ramps up (**Low to High**). Same cumulative limit.

  - Installed cost of insulation estimates considered:
    - $2,840
    - $3,500
    - $4,500

NE-MARKAL 2002-2030 Result Summary

Insulation Cost: $3,500

	Residential Fuel Expenditures	Percent Reduction Relative to Reference	Insulation Investment	Savings to Investment Ratio
Reference Case	44			
Unconstrained	38	-13%	3.5	1.5
Low to High	41	-6%	3.9	0.6
High to Low	39	-11%	3.6	1.3

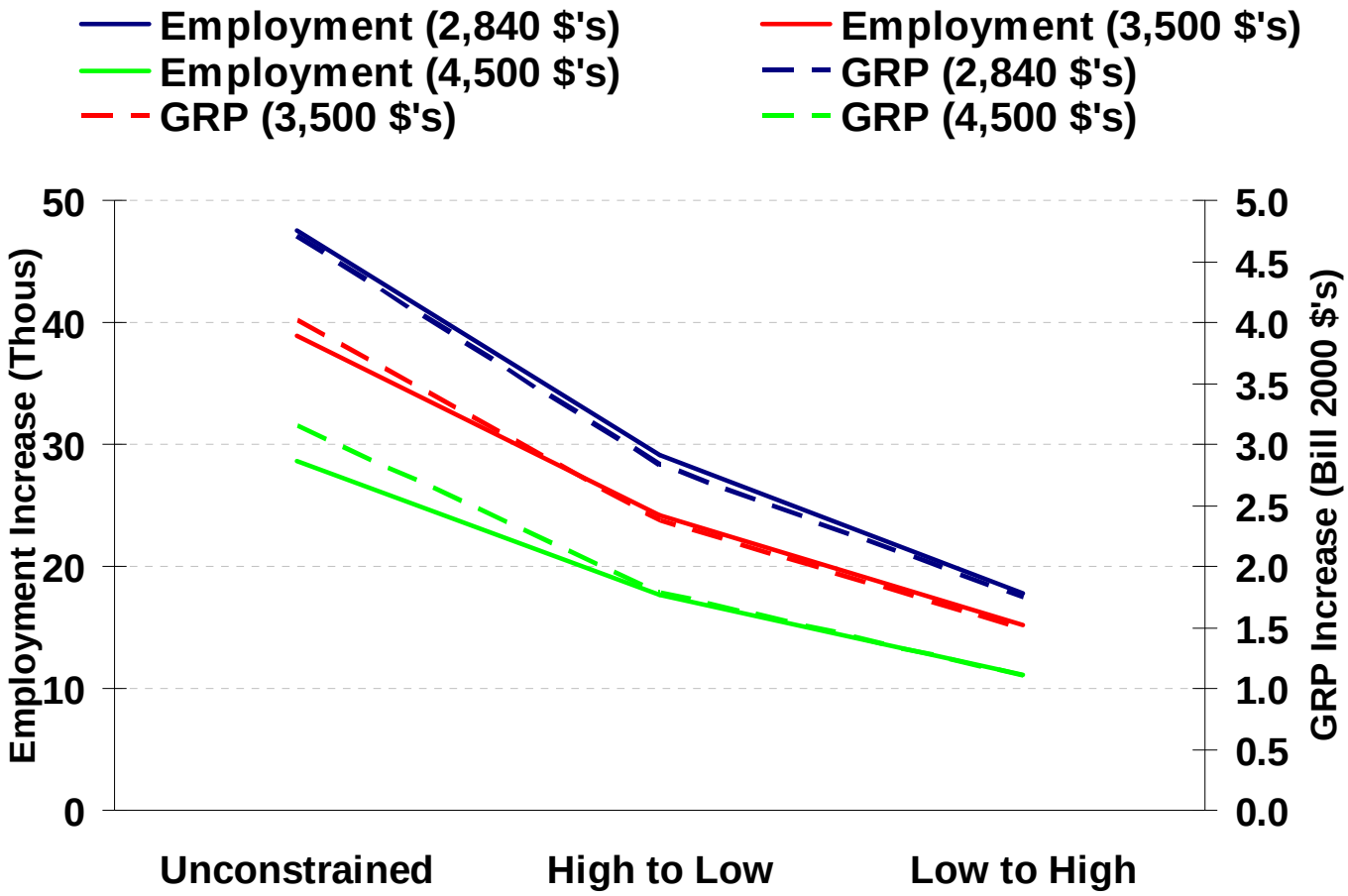
Bill 2002$'s

- In unconstrained case insulation investments are made predominantly in the first 5 years of the modeling time frame leading to the most significant energy savings.

- Savings to investment ratio favorable as investments are made early
  - Unconstrained returns $1.50 for each dollar invested
  - High to Low returns $1.30 for each dollar

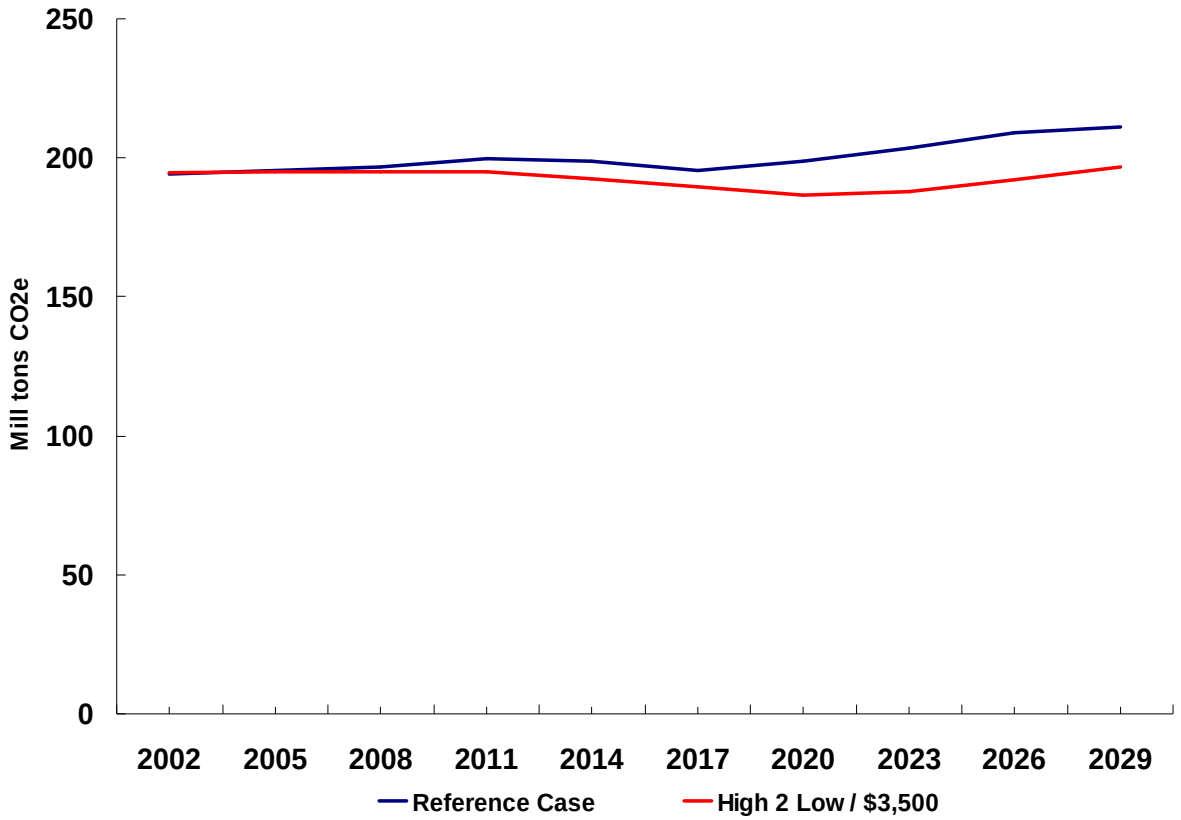
Net Economic Benefits, 2005-2030

- Consumer cost savings is most significant contributing factor.
- Net Economic Benefit. Less than 1% addition to regional employment and economy.



New England Carbon Dioxide Emissions Reductions

• Weatherization program reduces 2029 total emissions 7% below the reference case.



Conclusion/Findings

- Identifying and implementing cost effective energy efficiency strategies can have a positive effect on the environment and the region's economy.
- Exploratory study suggests that "Triple-E" initiatives designed to foster "early" participation have larger benefits on the economy.
- The main economic impacts result from increasing the disposable income of consumers .
- ***Economic effects will be relatively small and widely distributed***
- ***This can make it difficult to generate strong political support… but the economic value will be positive and can complement environmental and energy benefits***

Questions?