Modeling Robust Economic Development Strategies: Balancing Energy-Efficiency and Energy Production

By
Donald A. Hanson (dhanson@anl.gov) and Ning Guo
Argonne National Laboratory
and
John A. "Skip" Laitner
U.S. Environmental Protection Agency

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Outline of Presentation

- **Brief Description of the Economic, Energy and Environmental Model – AMIGA**
- **Examine the advantages of a diversified set of investments in both energy supply and energy-using technologies;**
- **Simulate the possible differences between a business-as-usual reference case and a high Technology Investment case, as defined by the Pew Climate Center (*these are not simulations for the U.S. government*).**
- **Show illustrative macroeconomic impacts of incremental increases in the technology investments.**

AMIGA Is a Comprehensive Economic Model, Uniquely Integrated with Energy Markets, Able to Simulate Technologies and Policies

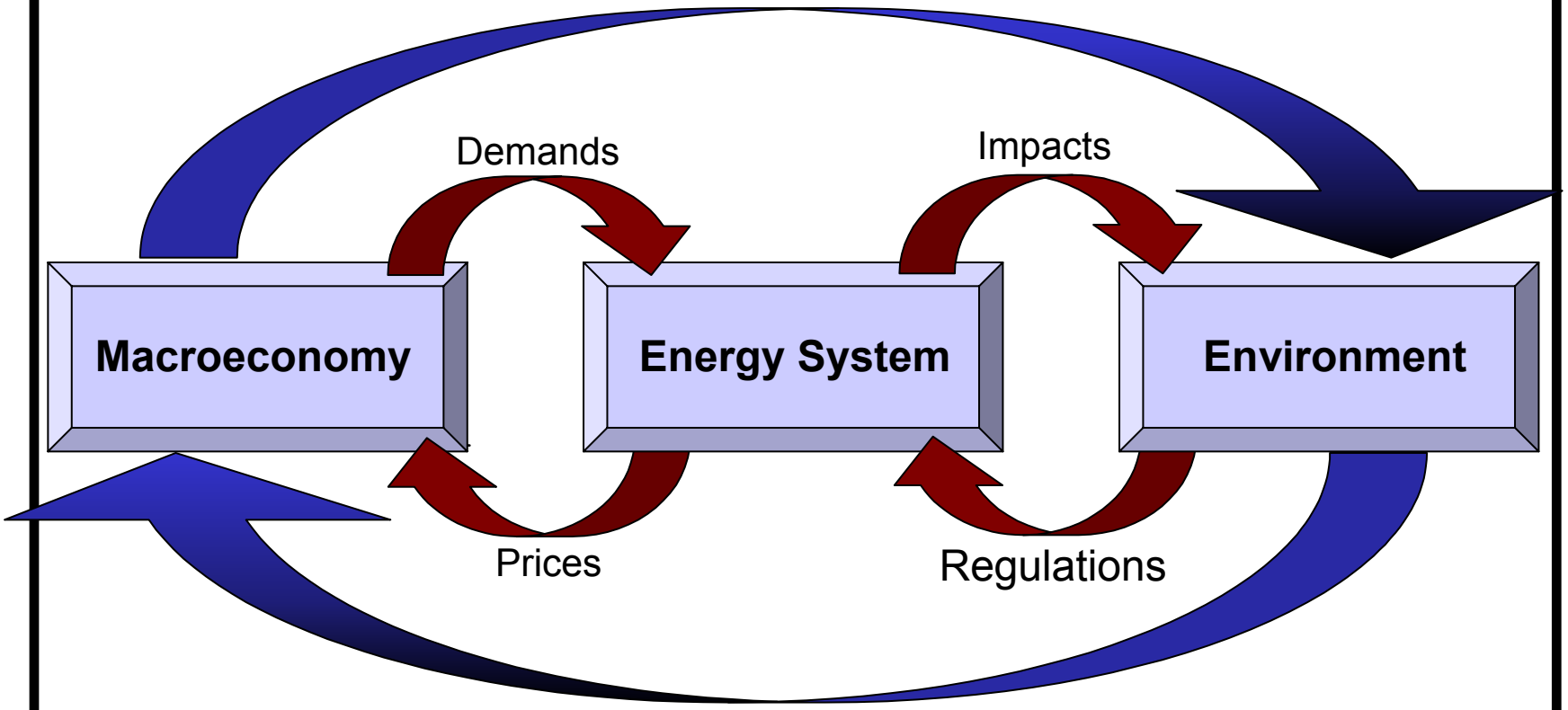
- Examines individual sectors (dollar measures, physical units, emissions),
- Integrates a detailed energy market specification within a structural economic model,
- Calculates macroeconomic aggregates (consumption, investment, govt., GDP),
- Sweeps out dynamic equilibrium paths,
- Multi-region structure,
- Calculates prices, resource allocations, benefits.

AMIGA

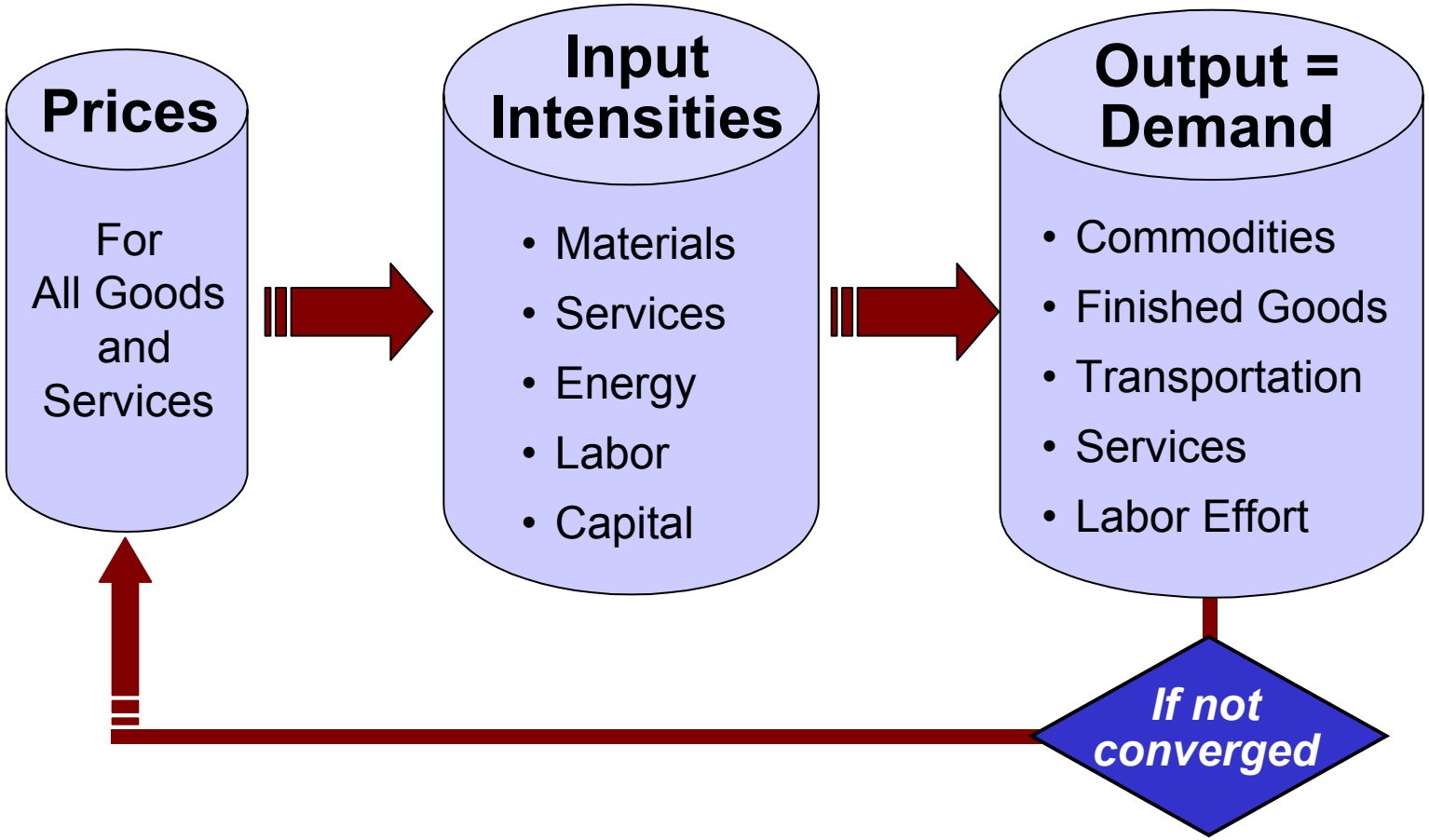
The All Modular Industry Growth Assessment (AMIGA) Model Includes

- Electric generation model and unit Inventory,
- Vehicle and Transportation Model,
- Household Demand Module,
- 200 Industry and Services Sector Outputs,
- With derived demands for capital, labor, energy, and materials,
- Expandable commodities and production processes,
- Computation of Full-employment Solution.

Economic-Energy-Environmental Models Are Generally Not Fully Integrated



AMIGA Uses Input Intensities to Calculate Both Prices and Intermediate Demand Quantities



The Model Adds Capacity in New Energy Supply Technologies

- Coal – 4 types of re-powering and gasification technologies,
- Nuclear – evolutionary and advanced designs,
- Gas – conv. NGCC, adv. NGCC, peakers, adv turbines,
- MSW,
- Large CHP by fuel type, such as biomass,
- Fuel Cells,
- Other Distributed Generation,
- Renewable Technologies
  - Wind
  - Geothermal
  - Hydroelectric
  - Biomass co-firing
  - Biomass gasification combined cycle
  - Building Integrated PV
  - Solar and other

Technology Characterizations

- Engineering Cost-of-Energy estimates
- Supply function analysis
- Accounting for Quads of Non-Fossil Primary Energy
- Joint work with University of Michigan
  - Wind
  - Biomass
  - Hydrogen
  - Regional locations
  - Transmission access and investment costs

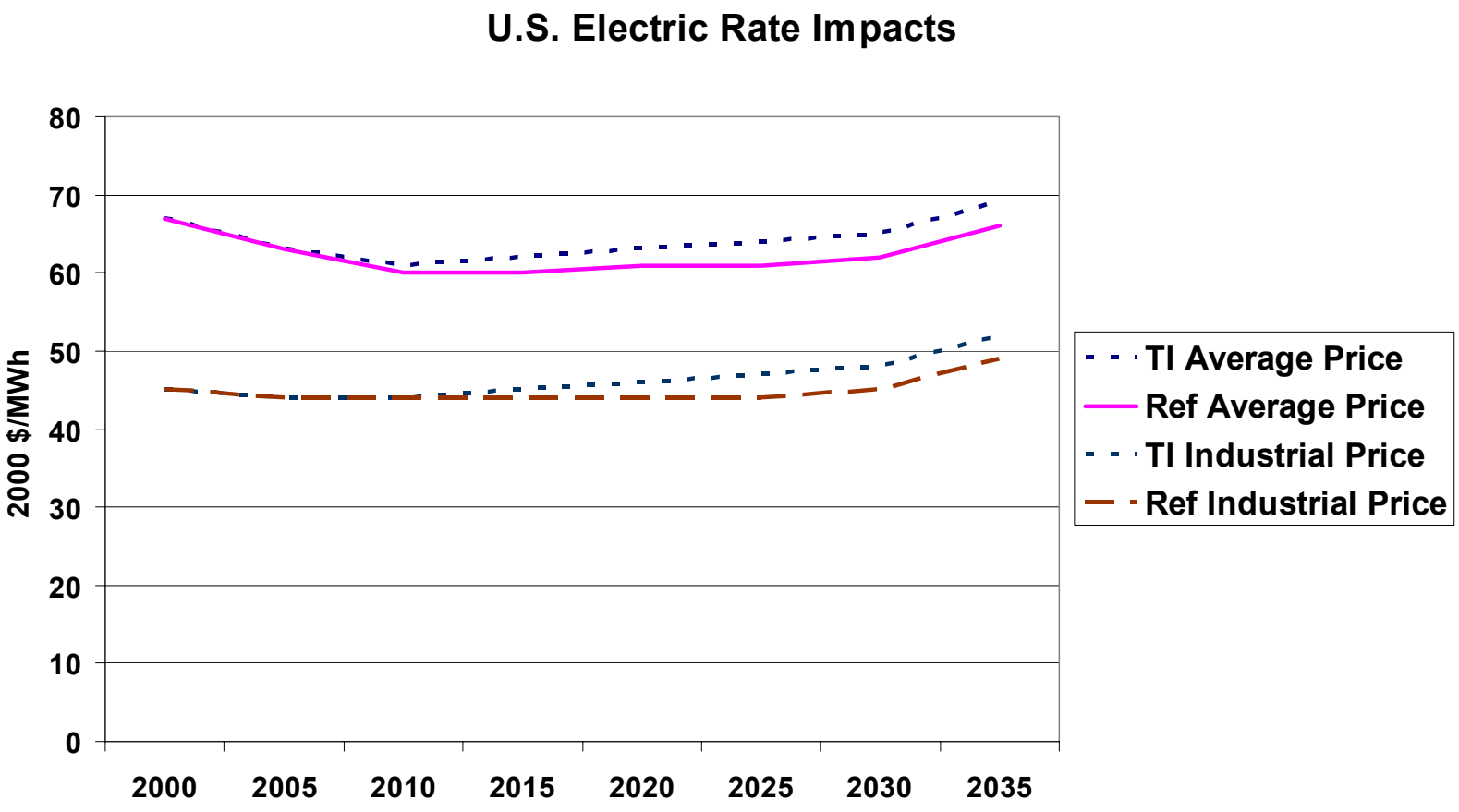
It is Important to Include a Regional Perspectives on National Issues in the U.S.

- State of Illinois Energy Workshop at Argonne, 2000,
- Illinois Commerce Commission (ICC),
- Midwest Combined Heat and Power Initiative,
- Renewable Portfolio Standards,
- Local and Regional Universities, etc,
- Regional Federal Reserve Banks

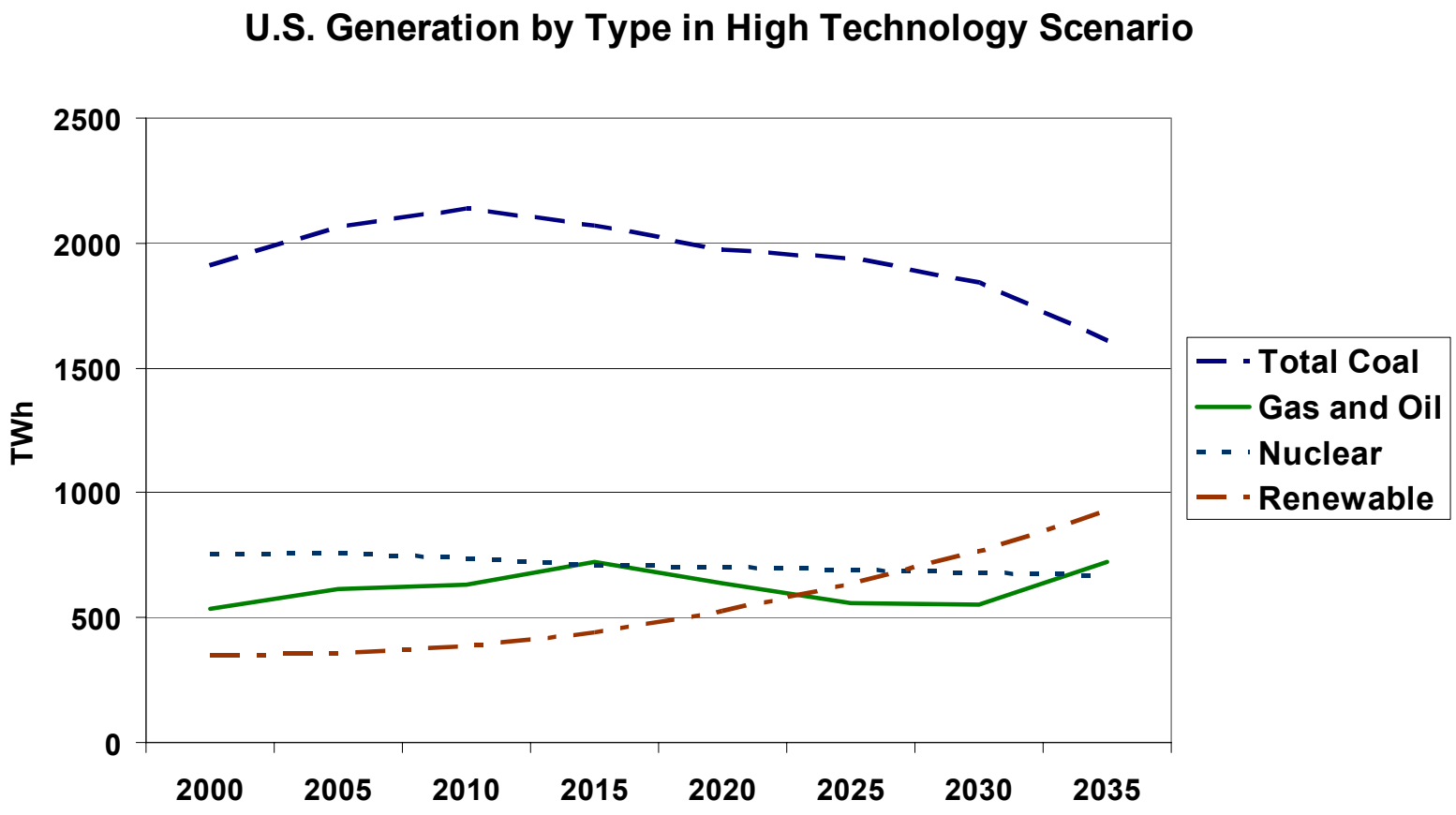
The Policy Drivers

- **Public and private sector cooperation and partnerships,**
- **Learning from adoption,**
- **The Technology Investment (TI) Scenario, including both energy supply and end-use,**
- **Advantages of a portfolio standard approach,**
  - Advanced technology generators produce credits
  - Other generators must hold credits proportional to their output,
  - Hence we have a market in these credits,
  - Little impact on electricity prices,
  - 1 cent credit price per kWh X 5% standard = 0.05 cents per kWh.

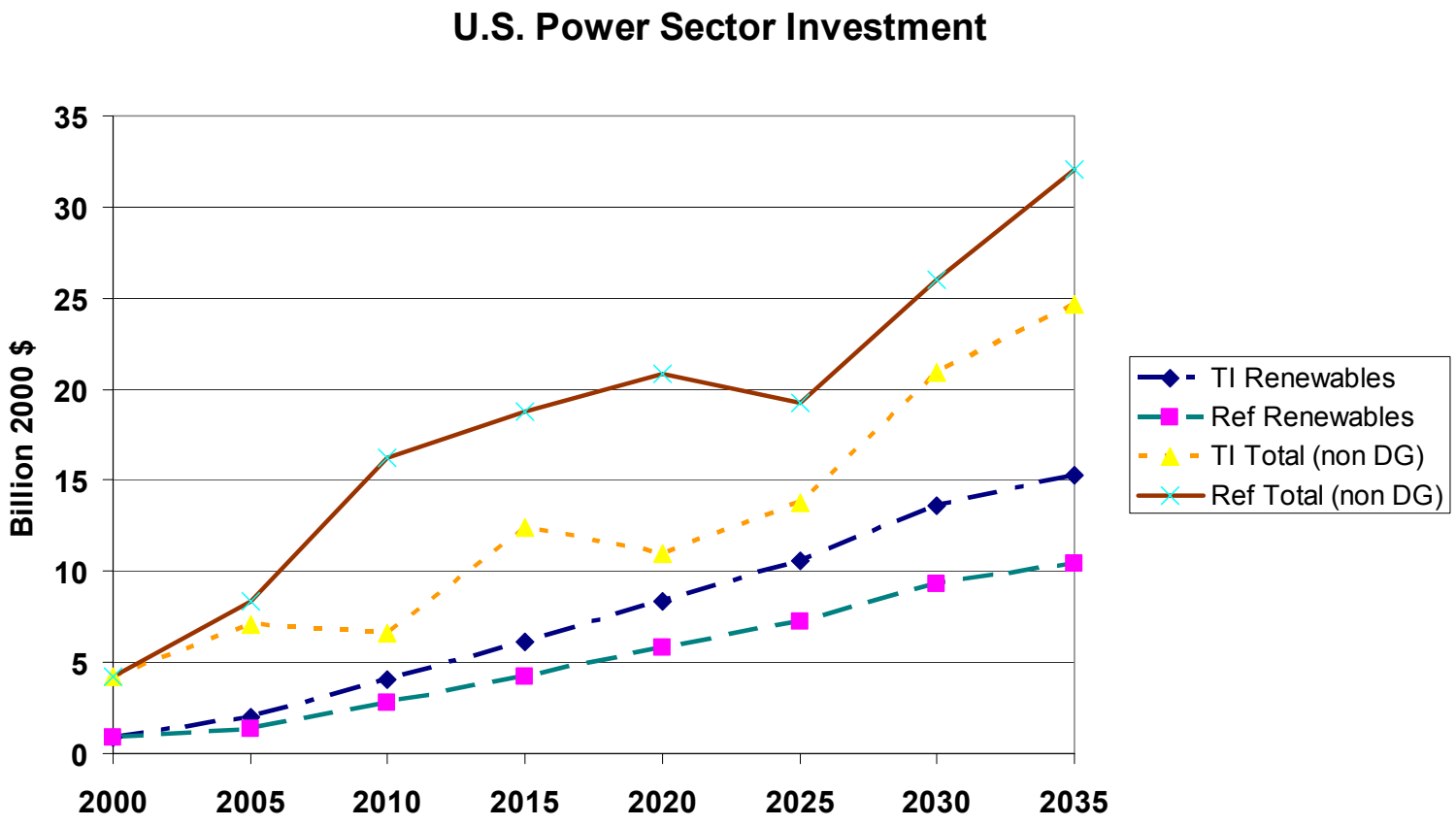
U.S. Electricity Price Changes to Obtain Advantages of Technology Diversification



Energy-Efficiency and Renewable Energy Can Reduce the Fossil Fuel Power Load



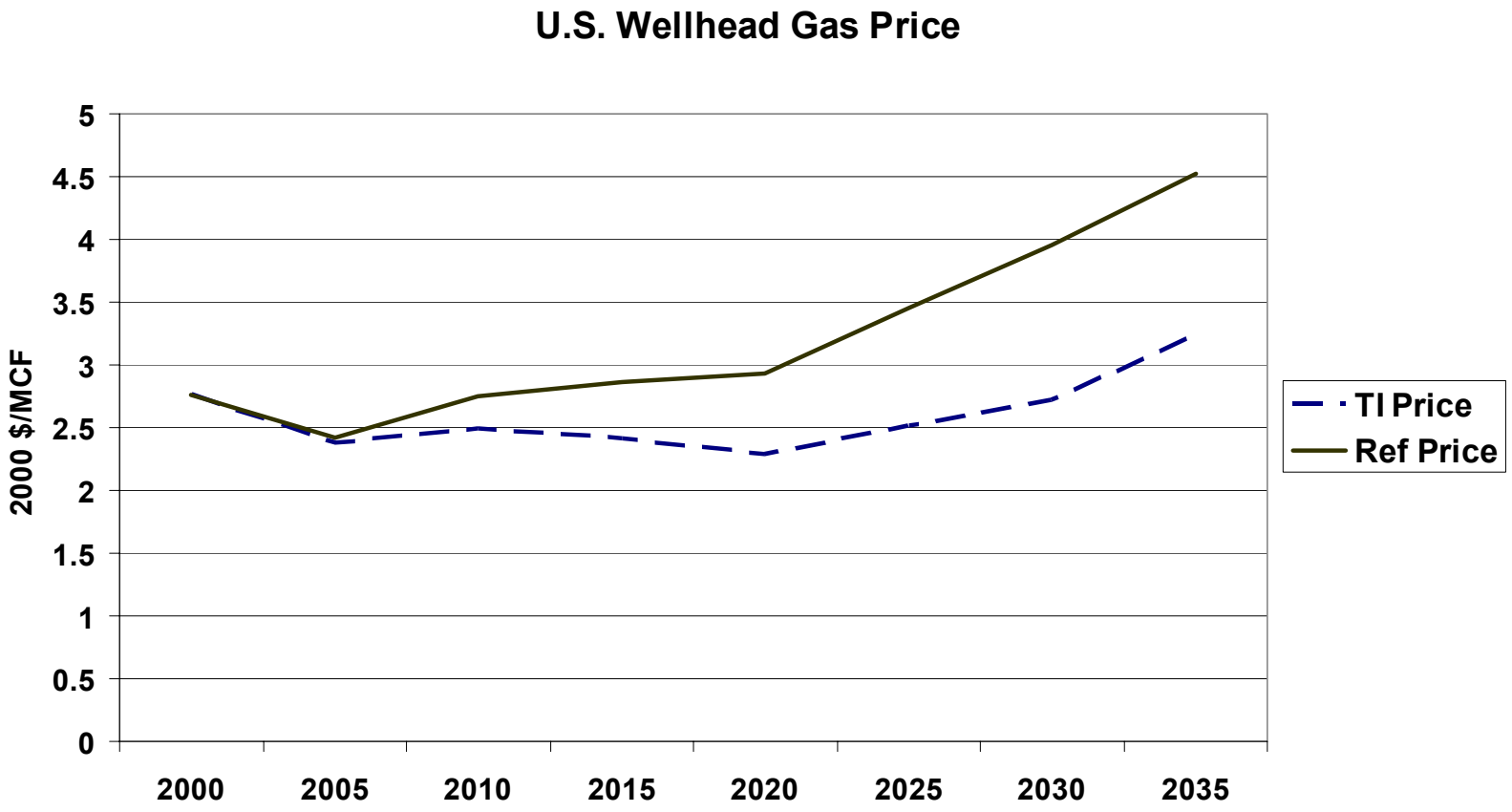
Investments In Electricity Generation Are Significant



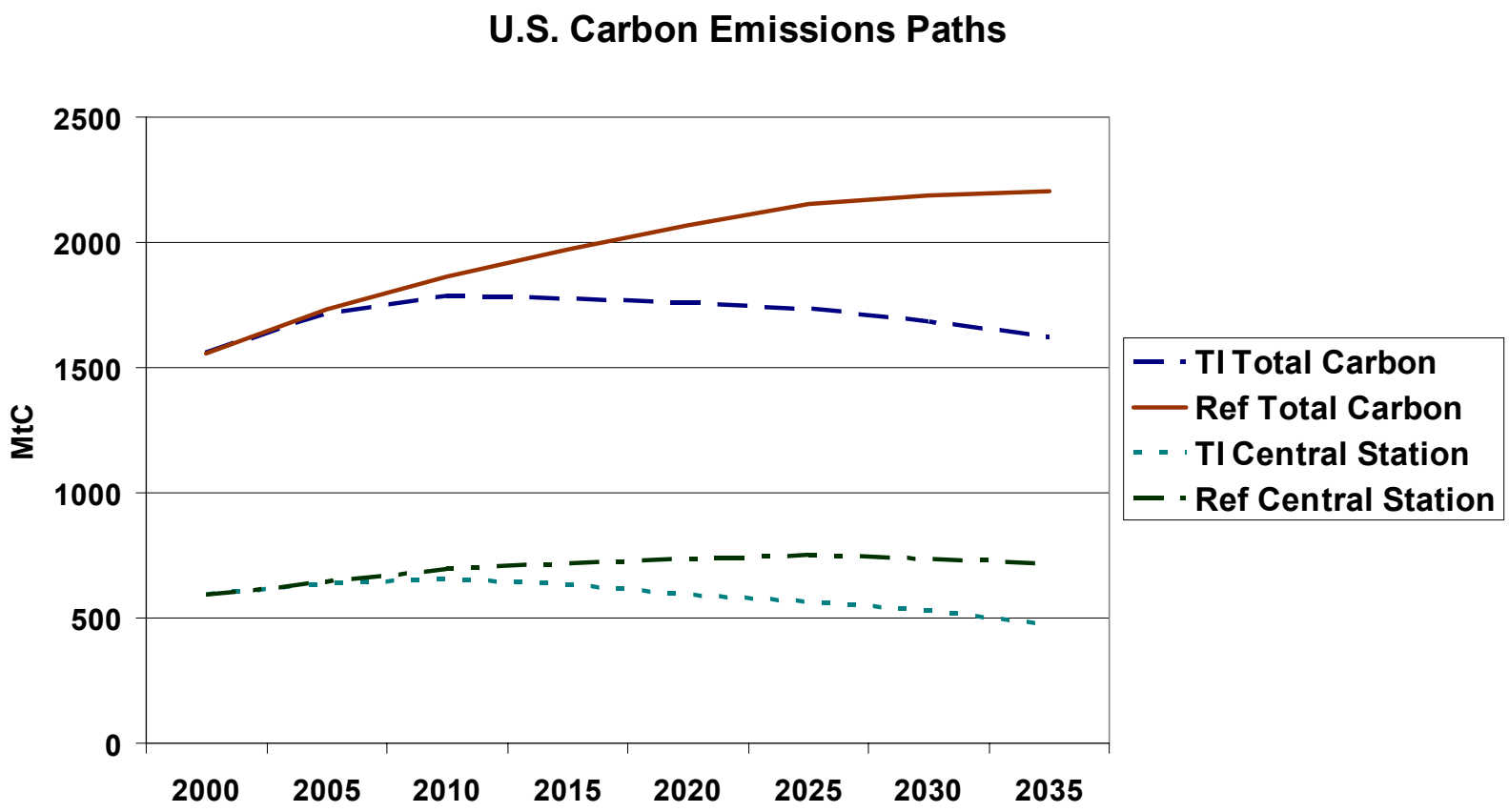
Energy Technology Portfolio Advantages

- Lower overall expenditure risk,
- Many investment types (renewable sources, IGCC) and facility locations,
- Complement generation with natural gas (stored energy),
- Energy-efficiency investments also hedge against risk,
- Effects of internal and external changes.

One Benefit is Lower Gas Prices



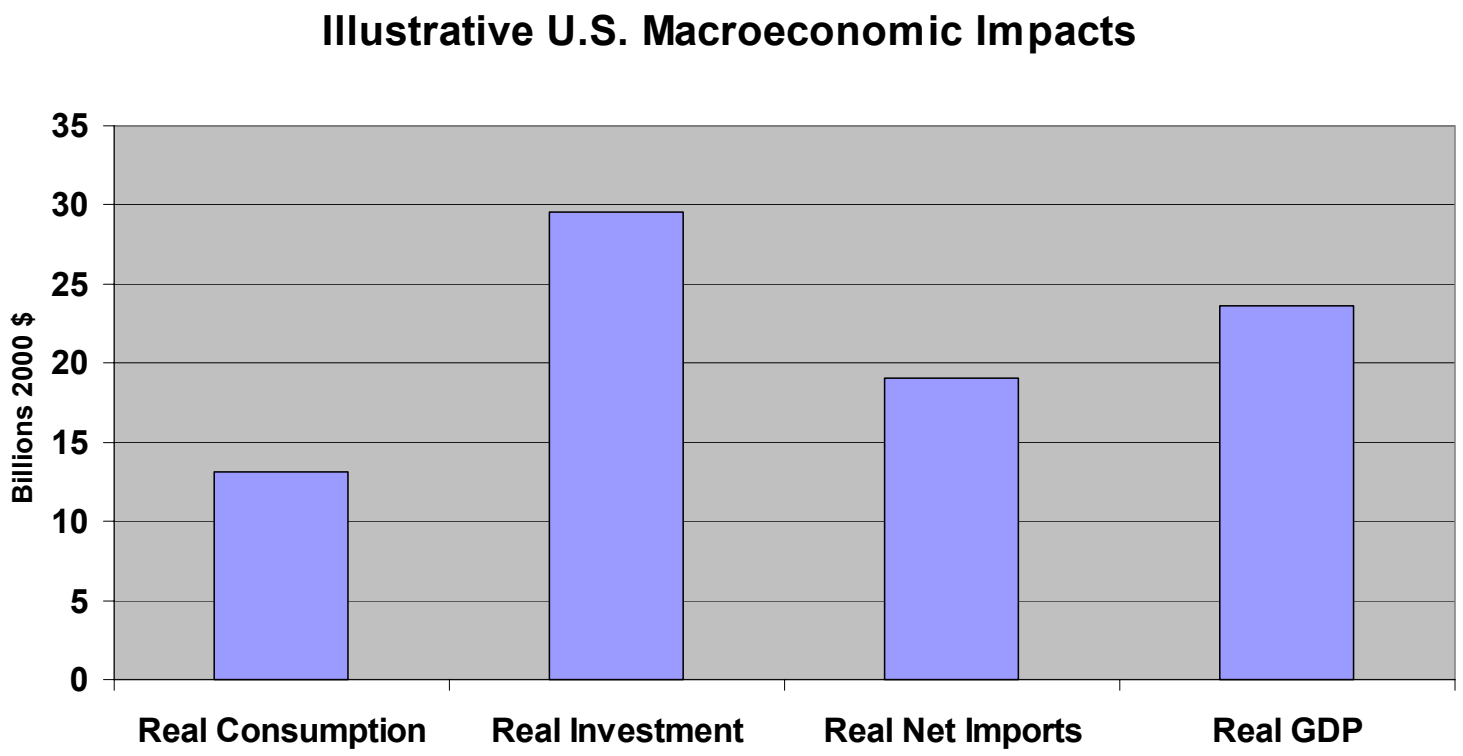
Another Benefit of Technology Investment is Lower Emissions



Increasing the Policy and Program Effort: Sensitivity Case

- For illustration, we simulated the response to an incremental increase in Technology Investment;
- Criteria air pollutants and carbon emissions were decreased;
- Productivity in the economy increased as a result of further adoption of technology that earns a high annual rate of return;
- The next slide shows the macroeconomic results of the incremental increase in the Technology Investment policy and program package.

Increasing Technology Investment Can Also Incrementally Increase GDP



Conclusions

- Both energy supply and energy-efficiency investments create jobs in the economy;
- A portfolio of energy supply and end-use technologies position the economy for robust growth;
- Portfolio standards (with or without tradeable credits) have attractive properties;
- Capital not required to put into energy supply capacity has a high return (high opportunity value) in the non-energy sector;
- End-use energy-efficiency measures can reduce investment requirements in energy supply capacity and reduce imports of premium energy.