Capturing the Costs of Fossil Energy in the reduction of Carbon Emissions

U.S.-China-South Korea
Economic and Environmental Modeling Workshop

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* The views and opinions of the author expressed herein do not represent those of the EIA or the U.S. Government

Outline

- Outlook of world oil market
- Challenges and opportunities in the energy market
- Benefits of diversification in improving environmental and energy security goals
- A brief description of the EIA System for the Analysis of Global energy (SAGE)

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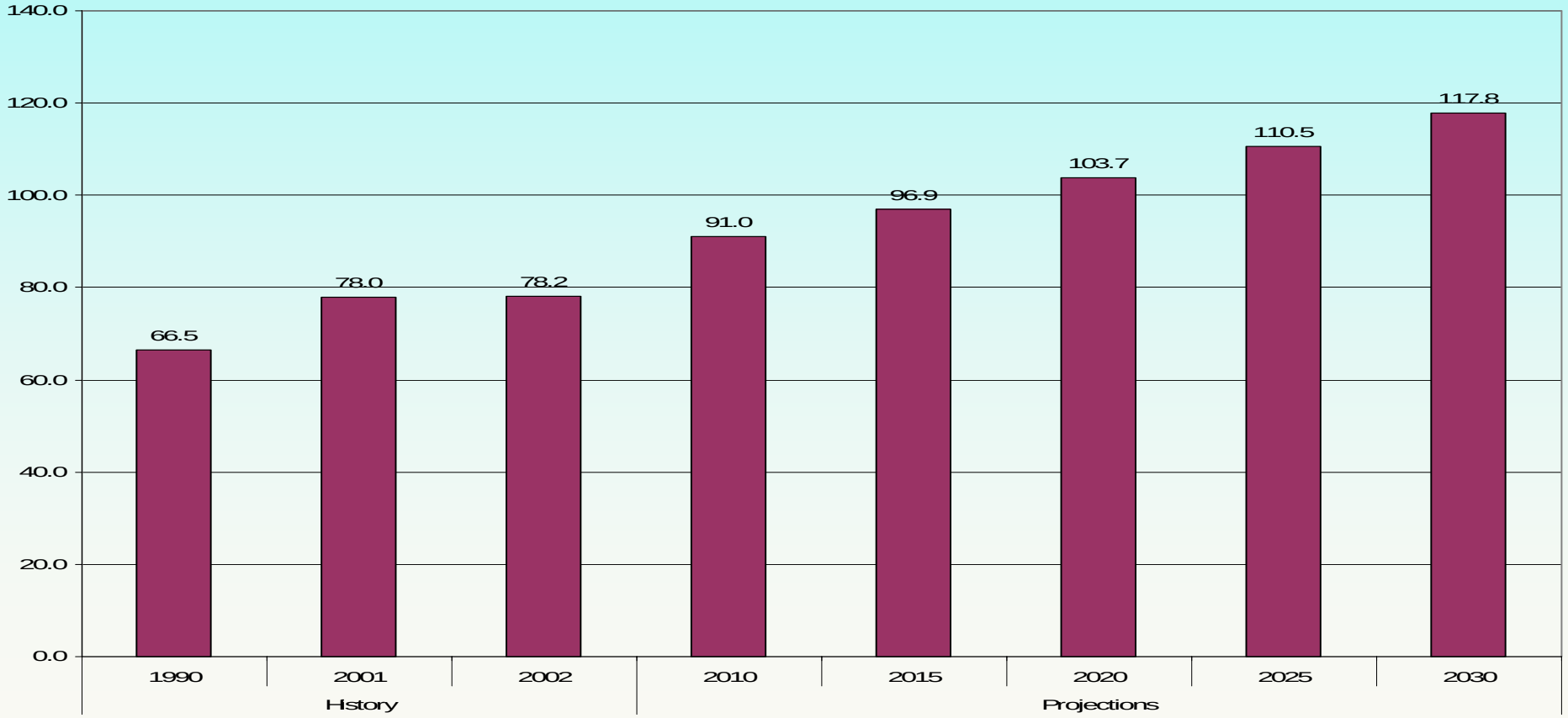
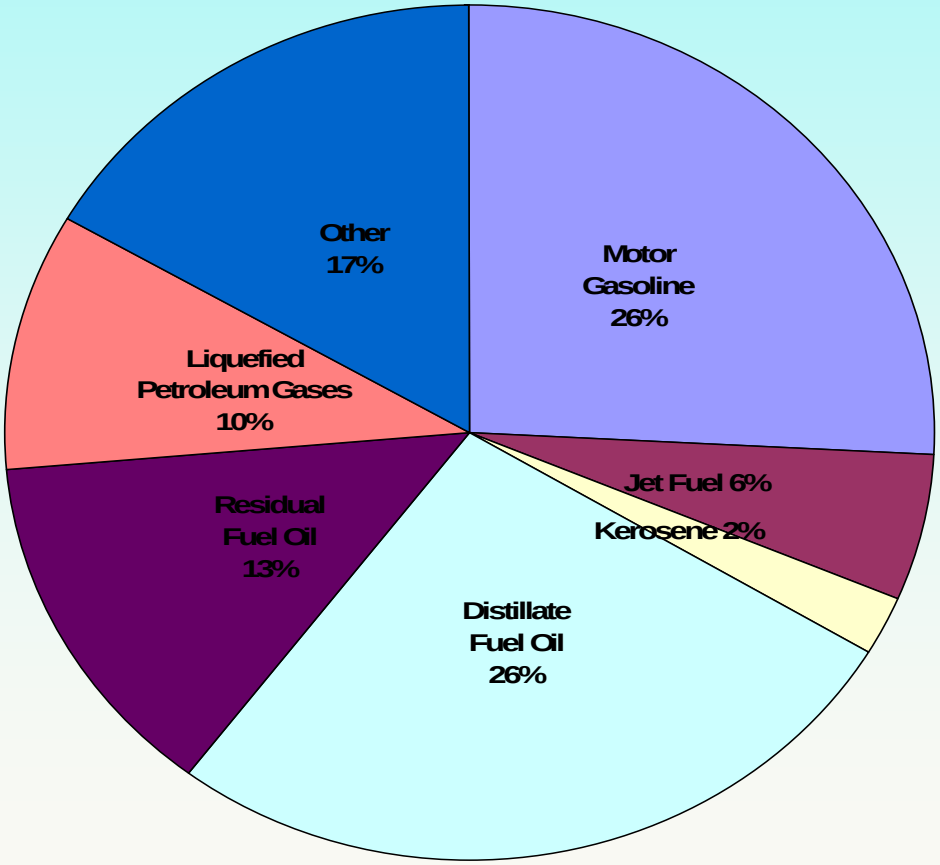
World Oil Consumption 1990-2030

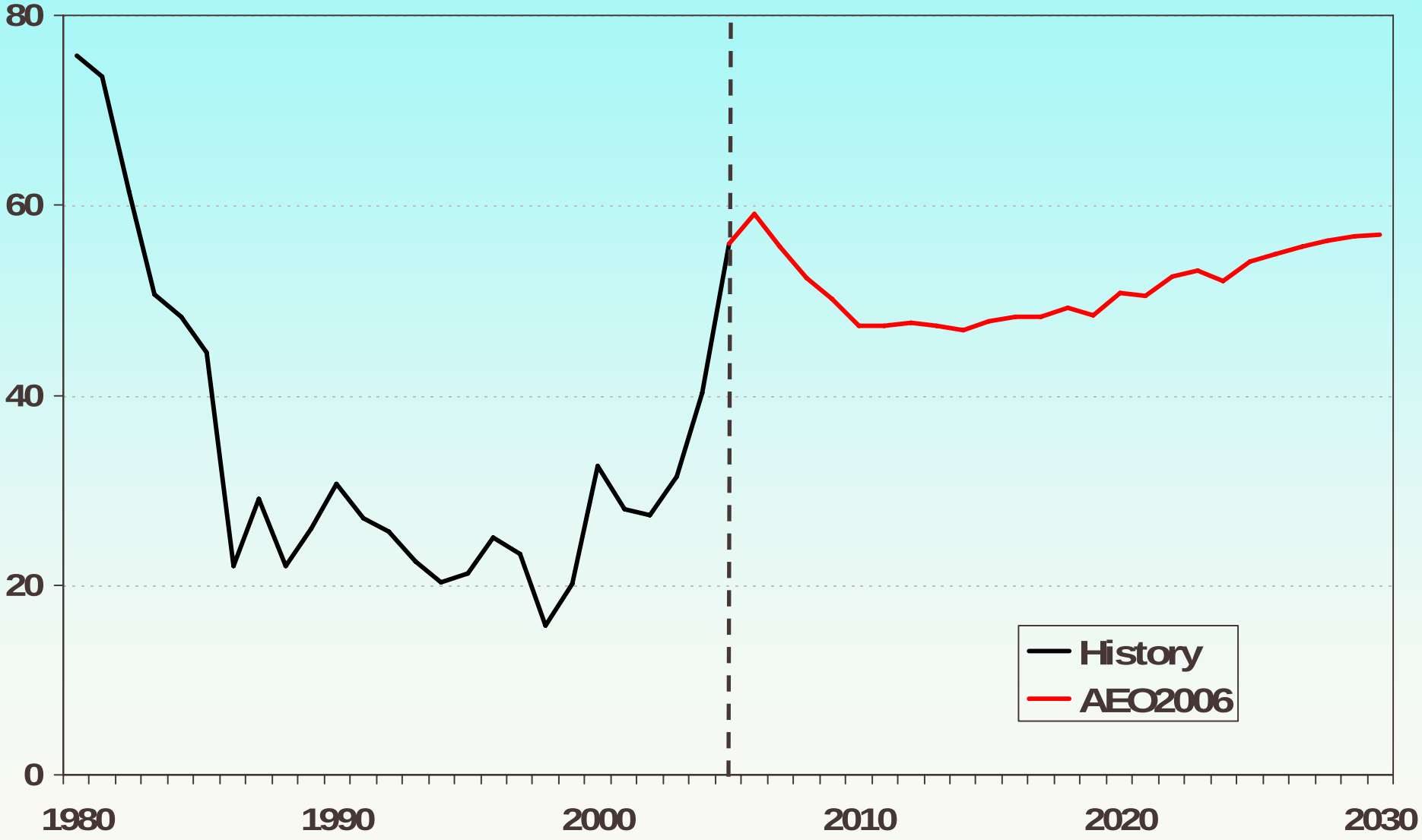
(Million Barrels per Day)



World Apparent Consumption of Refined Petroleum Products, 2002



World Oil Price*, 1980-2030
(2004 dollars per barrel)



*World oil price is the weighted average price of imported low sulfur light crude oil.

Challenges and Opportunities

- **The international Energy Agency estimates energy investment could reach a total of $16 trillion over the next 30 years**
- **Business as usual investment in oil, petroleum refining, and other fossil energy today could lock out potentially more environmentally friendly technologies**
- ***Higher projected prices of conventional fuel provide opportunities to alternative technologies:***
  - **Coal to liquids, gas to liquids, carbon capturing and sequestration, biomass to liquids**
  - ***Energy efficiency***

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Benefits of Diversification

- ***Lower emission of carbon dioxide***
  - ***Energy efficiency, CCS, and renewable energy can lower carbon dioxide emission from baseline projections***
- ***Improve energy security***
  - ***Expanding the supply sources can add flexibility to the energy system and increase elasticity of supply and demand, it would also reduce short as well as long term impacts of supply disruptions.***
- ***Lower expenditure on imported oil***
  - ***For a country such as the U.S. and China, changes in demand for petroleum products such as gasoline and diesel fuel can lower world oil prices and reduce oil import bill***

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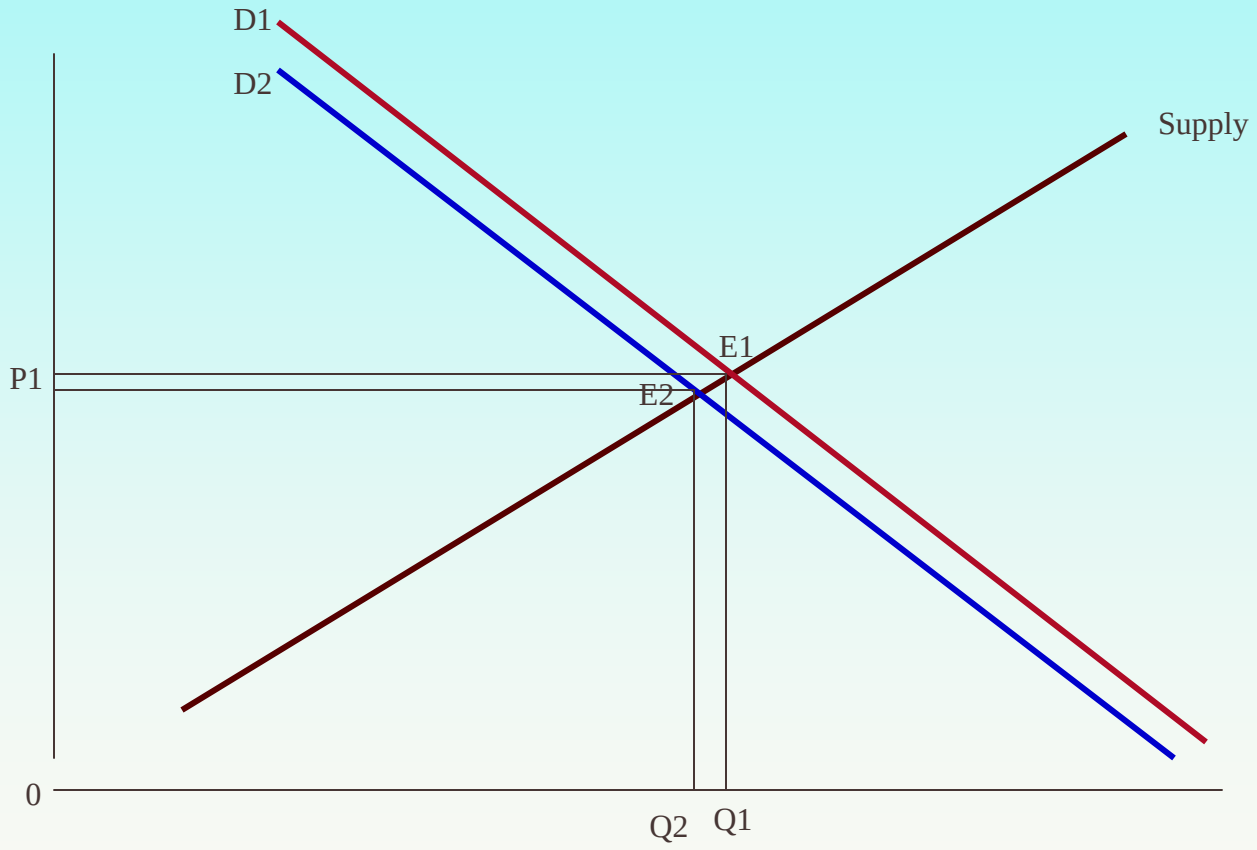
Benefits of alternative fuel on oil import bills



If a shift in demand lowers oil prices, changes in import bill could be significant

A numerical example for the U.S.

- U.S. imported about 11.85 million bbl/d in 2004
- Alcohol fuel production was about 140 thousand bbl/d
- Assuming price elasticity for oil is changes of $1-2 for one million bbl/d demand reduction, the supply of alcohol fuel effectively lower prices by $0.14-0.28
- Reductions in imports bill = $600-1200 million/year
- Seemingly cost ineffective alcohol fuel actually added benefits to the U.S. energy ec

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How do we quantify the costs and benefits?

The EIA System for the Analysis of Global Energy (SAGE) is designed to evaluate technology choices under various objectives such as:

- **reducing carbon emissions,**
- **diversifying supply sources,**
- **and optimal use of resources.**

What is SAGE? - 1

- **SAGE is a liner programming model solved for the least cost of meeting a predetermined set of energy service demands**
- **The model solves each period sequentially with limited foresight**
- **SAGE includes sixteen world demand and supply regions.**

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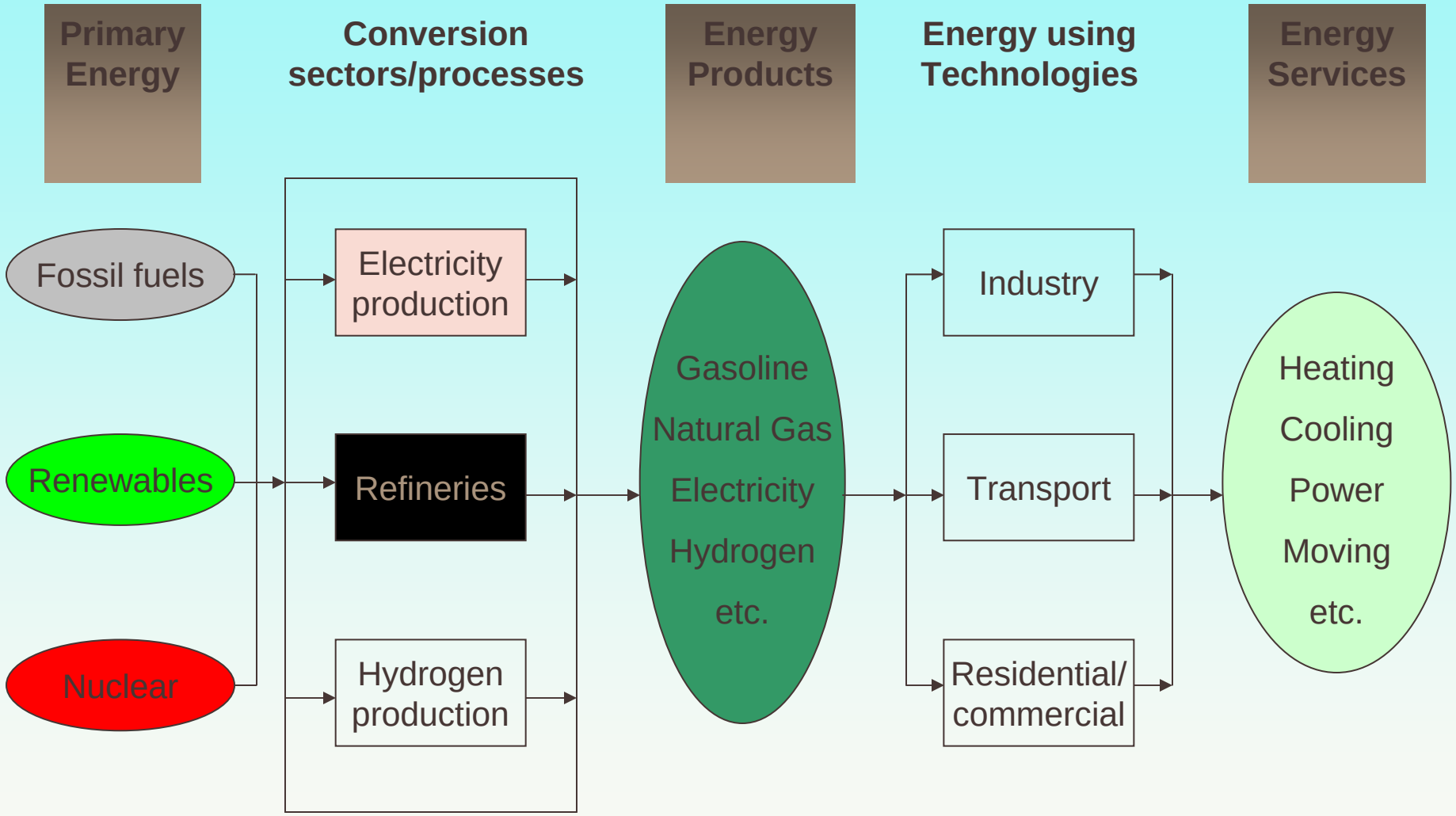
What is SAGE? - 2

- **Each region includes:**
  - Four end-use demand sectors (commercial, industrial, residential, transportation),
  - petroleum refining,
  - power generation,
  - supply of both fossil fuels and
  - renewable energy.

- **The structure of SAGE is generic;**
  - a modeler can easily increase the number of demands for energy services and introduce new technologies into the system.

A Simplified RES for a SAGE Region



How do we capture the investments?

The SAGE models investments of

- Petroleum refining
- Oil and gas production
- Electric power
- CTL, GTL, BTL, and CCS
- End use technologies

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Our future depends on technology choices today, tomorrow, and …

Optimal Choices of technology depends on:

- **Availability and prices of oil ,gas, and coal,**
- **Environmental and energy security objectives**
- **Sustainable growth path**

Long-lived capital stock can have profound lock-out effects on future technologies

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Thanks for your attention