# STEP Supply-Demand Integration Model and Methodology

## STEP Assumptions and Scenario Cases

1. Energy Prices (EIA base case; higher prices to induce conservation, fuel switch)
2. Government Policies (business as usual; carbon reduction policies; R and D budgets)
3. Technology Assumptions (historical, current best, future best)
4. Pace of Capital Stock Turn-Over (autos - l0 years; homes -50 years; industry 75-100 years)
5. Energy Security/Carbon Reduction Cases (historical, current best technology, projected "best" technology)

## STEP Methodology

For different scenario cases, determine energy demand by category, energy supply, and energy supply-demand integration

1. Determine energy consumption and carbon emissions for each category (ie. economic activity x energy efficiency).
   A. Economic activity derived from macro-economic model (tons of steel) to ensure consistency of categories (ie. tons of steel consistent with autos produced) based on GNP
   B. Each demand sector has energy efficiency or carbon intensity based on technology choice (historical, current, best) determined by price and technology availability
2. Determine fuel mix for each demand category (historical and based on price of fuels and government policy)
3. Add up final demand for key demand sectors
4. Determine energy transformation sector
   A. Fuel mix for electrical generation (depends on price, government policy)
   B. Efficiency of electricity generation process (historically 33%; current 37%; best future?)
5. Add up columns (across and down) and determine "primary energy demand"
6. Determine energy supply parameters (domestic, imports or exports)
   A. Impact of price and policy on fuel choices in demand sectors
   B. Impact of price and policy on electricity
7. Determine most effective government R&D
8. Feasibility of scenarios in real-world business applications

## STEP Results

1. Each demand line item would afford opportunity to showcase key technologies (transport, commercial, residential, industrial)
2. Integration would occur as fuel choices for each sector are made (oil, coal, renewables, electricity)
3. Renewables can be both direct (remote power) or part of electrical transformation (large-scale)
4. Total energy (energy efficiency) and total carbon output is thus determined by demand sectors, supply options and energy transformation
5. Alternative Scenarios chosen would bracket
   A. Base EIA case—no change in policy
   B. 450 ppm reduction case—what set of assumptions would be required to achieve this case (economic growth, energy prices, technology success).
6. Leads to the conclusion that 450 ppm case can be achieved if . . .
7. What are the costs and benefits of this? Key issue is to quantify the externalities of not achieving this 450 ppm case (and lower oil imports)
8. A key factor is the discount rate used for the future. A high interest rate devalues the future and makes adjustments very expensive.
9. Translate model results into practice in the presentation

## STEP Goals

1. STEP endeavors to seek efficiency in energy and carbon in every cell of this matrix
2. STEP seeks to ensure consistency of forecast (economic, policy)
3. STEP seeks to showcase key technologies in each cell
4. STEP seeks to determine what sets of assumptions achieve 450 ppm and the costs/benefits
5. STEP approach allows for framework to discuss government-business partnership
6. STEP methodology enables comparison of US with other nations, a framework for bilateral/IPCC/IEA discussions

| Major Sectors | Petroleum | Natural Gas | Electricity | Coal | Renewable Sources* | Nuclear | TOTAL |
|---|---|---|---|---|---|---|---|
| **Transportation** | | | | | | | |
| Light-duty vehicles | | | | | | | |
| Commercial light trucks | | | | | | | |
| Bus Transportation | | | | | | | |
| Freight Trucks | | | | | | | |
| Passenger Rail | | | | | | | |
| Freight Rail | | | | | | | |
| Domestic Shipping | | | | | | | |
| International Shipping | | | | | | | |
| Recreational Boats | | | | | | | |
| Air | | | | | | | |
| Military Use | | | | | | | |
| Lubricants | | | | | | | |
| Pipeline Fuel | | | | | | | |
| Other | | | | | | | |
| **Industrial** | | | | | | | |
| Manufacturing | | | | | | | |
| Aluminum | | | | | | | |
| Cement | | | | | | | |
| Chemicals | | | | | | | |
| Computers, Electronics, Appliances, Electrical Equipment | | | | | | | |
| Fabricated Metals | | | | | | | |
| Food and Beverage | | | | | | | |
| Forest Products | | | | | | | |
| Foundries | | | | | | | |
| Glass and Fiber Glass | | | | | | | |
| Heavy Machinery | | | | | | | |
| Mining | | | | | | | |
| Petroleum Refining | | | | | | | |
| Plastics and Rubber Products | | | | | | | |
| Steel | | | | | | | |
| Textiles | | | | | | | |
| Transportation Equipment | | | | | | | |
| Other | | | | | | | |
| **Commercial** | | | | | | | |
| Space Heating | | | | | | | |
| Space Cooling | | | | | | | |
| Water Heating | | | | | | | |
| Ventilation | | | | | | | |
| Cooking | | | | | | | |
| Lighting | | | | | | | |
| Refrigeration | | | | | | | |
| Office Equipment (PC) | | | | | | | |
| Office Equipment (non-PC) | | | | | | | |
| Other | | | | | | | |
| **Residential** | | | | | | | |
| Space Heating | | | | | | | |
| Space Cooling | | | | | | | |
| Water Heating | | | | | | | |
| Refrigeration | | | | | | | |
| Cooking | | | | | | | |
| Clothes Dryers | | | | | | | |
| Freezers | | | | | | | |
| Lighting | | | | | | | |
| Clothes Washers | | | | | | | |
| Dishwashers | | | | | | | |
| Color Televisions and Set-Top Boxes | | | | | | | |
| Personal Computers and Related Equipment | | | | | | | |
| Furnace Fans and Boiler Circulation Pumps | | | | | | | |
| Other | | | | | | | |
| **Primary Energy Demand** | | | | | | | |
| **Energy Transformation** | | | | | | | |
| Electricity | | | | | | | |
| Synthetic Gas | | | | | | | |
| Synthetic Liquids | | | | | | | |
| Heat | | | | | | | |
| Energy Sector | | | | | | | |
| **Total Energy Demand** | | | | | | | |
| **Domestic Supply** | | | | | | | |
| **Imports** | | | | | | | |
| **Exports** | | | | | | | |

*Renewable Sources currently include hydropower, solar, wind, geothermal, biomass, and ethanol.