

Chapter 6

India Country Report

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CHAPTER 6

INDIA COUNTRY REPORT

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1. Background

India is located in South Asia and has a land area of 2973 thousand square kilometers. It had a population of around 850 million in 1990 which grew at an average annual rate of 1.6 percent per year to reach 1171 million in 2010. India's GDP increased at an average annual rate of 6.6 percent from US\$275 billion in 1990 to US\$996 billion (2000 constant price) in 2010. The services sector and the industry sector are the largest contributors to India's GDP.

1.1. Energy Situation

India's total primary energy consumption was 524 Mtoe in 2010. In 2010, coal represented the largest share of primary energy at 55.0 percent, followed by oil at 31.0 percent. Coal is mainly consumed for power generation and by industry. The remaining shares were: natural gas (10.1 percent), hydro (1.9 percent), nuclear (1.3 percent) and others (0.7 percent). Compared with 1990, the share of coal and oil decreased marginally. Conversely, the share of natural gas increased.

India generated almost 960 TWh of electricity in 2010. The average annual growth in electricity generation between 1990 and 2010 was almost as high as growth in GDP. The share of generation from coal in 2010 amounted to 68.0 percent, natural gas 12.3 percent, hydro 11.9 percent, oil 2.8 percent, nuclear 2.7 percent and others (wind, solar PV and other renewable energy sources) 2.3 percent.

India's final energy demand grew by 4.6 percent per year from 118.2 Mtoe in 1990 to 288.7 Mtoe in 2010. Between 1990 and 2010, the residential and

commercial (others) sectors grew by 4.2 percent per year, the industry sector by 4.8 percent a year and the transport sector by 3.6 percent per year. Non-energy use¹ had the fastest growth, increasing by 6.1 percent a year.

Oil was the most consumed product with a share of 44.5 percent of total final energy demand in 1990, and a similar share in 2010. The share of coal declined from 35.4 percent in 1990 to 26.3 percent in 2010. The share of electricity increased from 15.4 percent in 1990 to 21.2 percent in 2010. Similarly, the share of natural gas increased from 4.8 percent in 1990 to 7.9 percent in 2010.

Primary energy consumption in India grew at a higher rate than the final energy demand, increasing by 5.4 percent per year from around 183.3 Mtoe in 1990 to 523.9 Mtoe in 2010. Among the major energy sources, the fastest growing were natural gas and nuclear energy. Natural gas grew at an average annual rate of 8.4 percent while nuclear grew by 7.5 percent per year. Coal, oil and hydro consumption increased but at slower annual average rates of 5.3 percent, 5.0 percent and 2.4 percent, respectively. “Others”² increased by 18.5 percent a year, but from a very small base - their collective share in total primary energy consumption was 0.7 percent in 2010.

2. Modelling Assumptions

India’s GDP is assumed to grow at an average annual rate of 7.0 percent from 2010 to 2035 while population is assumed to increase by 1.0 percent a year.

With regards to future electricity supply, the share of electricity generation output from natural gas-fired and nuclear power plants are projected to increase to 2035 whereas the shares of coal, oil, hydro, and others are expected to decrease.

India’s energy saving goals are expected to be attained through the implementation of energy efficiency programs in power generation and energy end-use sectors. For the industry sector, energy savings are expected from improvements

¹ Non-energy use refer to consumption of energy products for non-energy purposes such as feedstock to the petrochemical industry for the production of ethylene and lubricants in the transportation and industrial sector, etc.

² Others constitute wind, solar, solid and liquid biomass and other renewable energy sources as well as electricity imports or exports.

in highly energy-intensive industries and in inefficient small plants. In the residential and commercial sectors, efficient end-use technologies and energy management systems are assumed to induce significant savings. In the transport sector, efficiency improvements will be achieved through improved vehicle fuel economy and more effective traffic management.

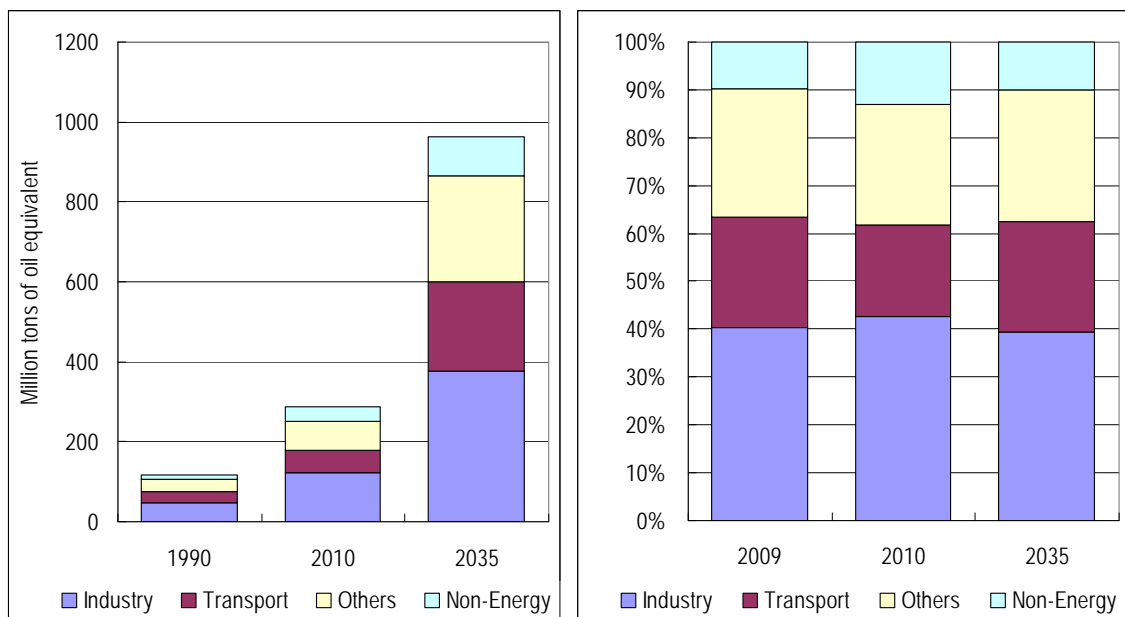
3. Outlook Results

3.1. Business as Usual (BAU) Scenario

Total Final Energy Consumption

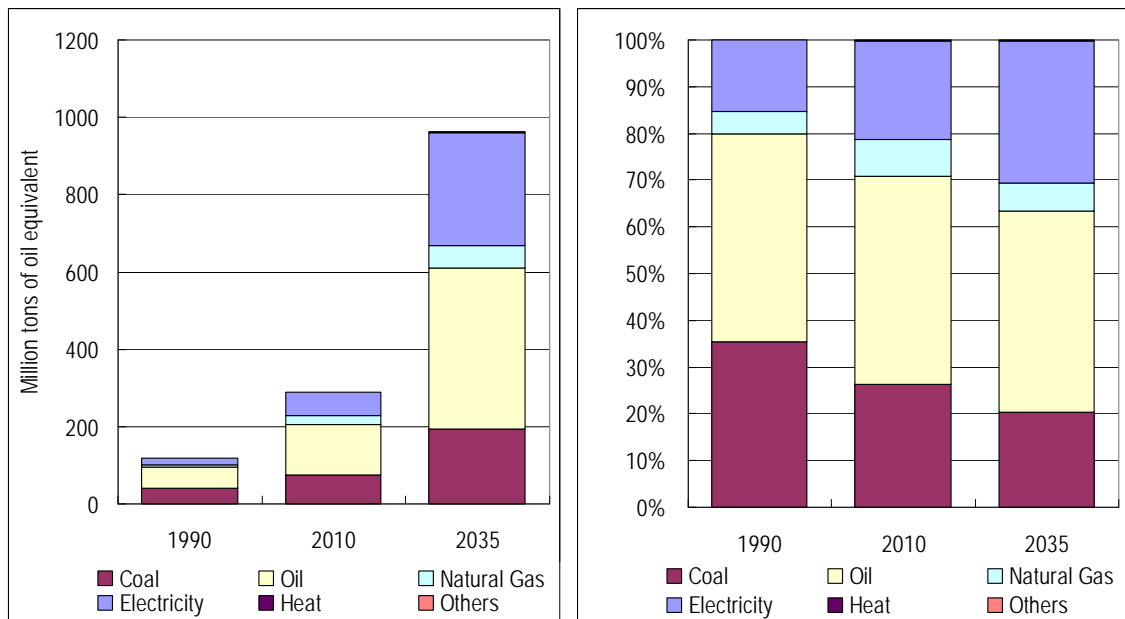
With assumed strong economic growth and a rising population, India's final energy demand is projected to increase at an average rate of 4.9 percent per year from 288.7 Mtoe in 2010 to 961.8 Mtoe in 2035 (Figure 6-1). The strongest growth is projected to occur in the transport sector, increasing at 5.7 percent a year between 2010 and 2035. Strong growth is also expected in the other (5.3 percent a year), industry sector (4.6 percent a year and non-energy consumption (3.8 percent a year).

Figure 6-1: Final Energy Demand and Shares by Sector



Electricity is projected to have the fastest growth, increasing by 6.5 percent per year over the period 2010-2035 (Figure 6-2). Oil is projected to increase at the second highest rate of 4.8 percent per year, followed by coal (3.8 percent a year) and natural gas (3.6 percent a year).

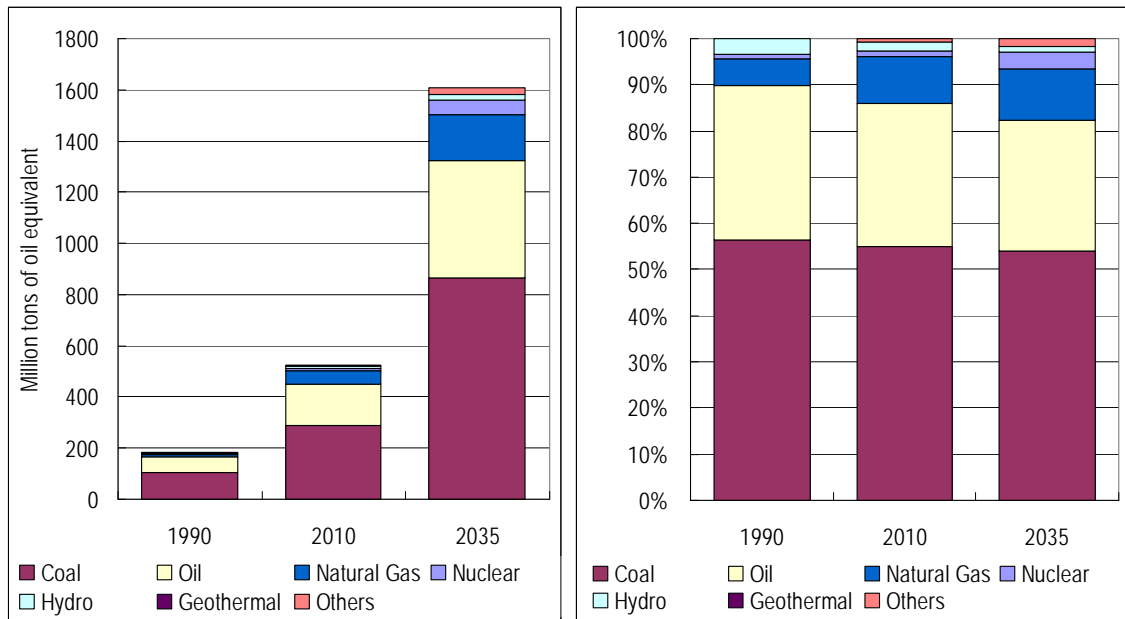
Figure 6-2: Final Energy Demand and Shares by Source



Primary Energy Demand

Under the BAU scenario, India’s primary energy demand is projected to increase at an average annual rate of 4.6 percent to 1607.5 Mtoe in 2035. Nuclear energy is expected to grow the fastest at an average annual rate of 9.1 percent. Others, including solar and wind, is projected to increase by 7.9 percent a year through to 2035, but its share will remain small at 1.6 percent. Natural gas consumption is projected to increase by 4.9 percent per year between 2010 and 2035.

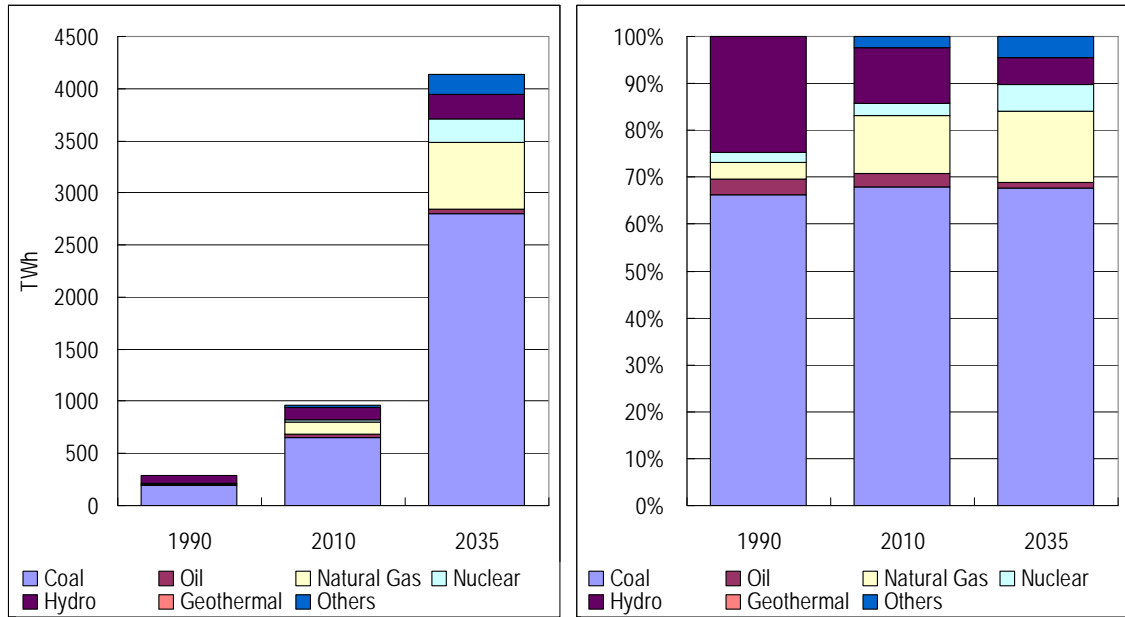
Figure 6-3: Primary Energy Demand by Source and Shares by Source



Power Generation

In 2010, power generation in India was 959.9 TWh. Under the BAU scenario, India’s power generation is projected to increase at an annual rate of 6.0 percent per year to 4134.6 TWh in 2035. Coal will continue to dominate India’s power mix, maintaining its share at above 65%. Hydro’s share in India’s power generation mix will decline from 11.9 percent in 2010 to 5.7 percent in 2035, and oil’s share will decline from 2.8 percent in 2010 to 1.2 percent in 2035. In contrast, the share of natural gas-fired generation will increase from 12.3 percent to 15.3 percent, nuclear power will increase from 2.7 percent to 5.6 percent, and new energy will increase from 2.3 percent to 4.6 percent.

Figure 6-4: Power Generation, BAU



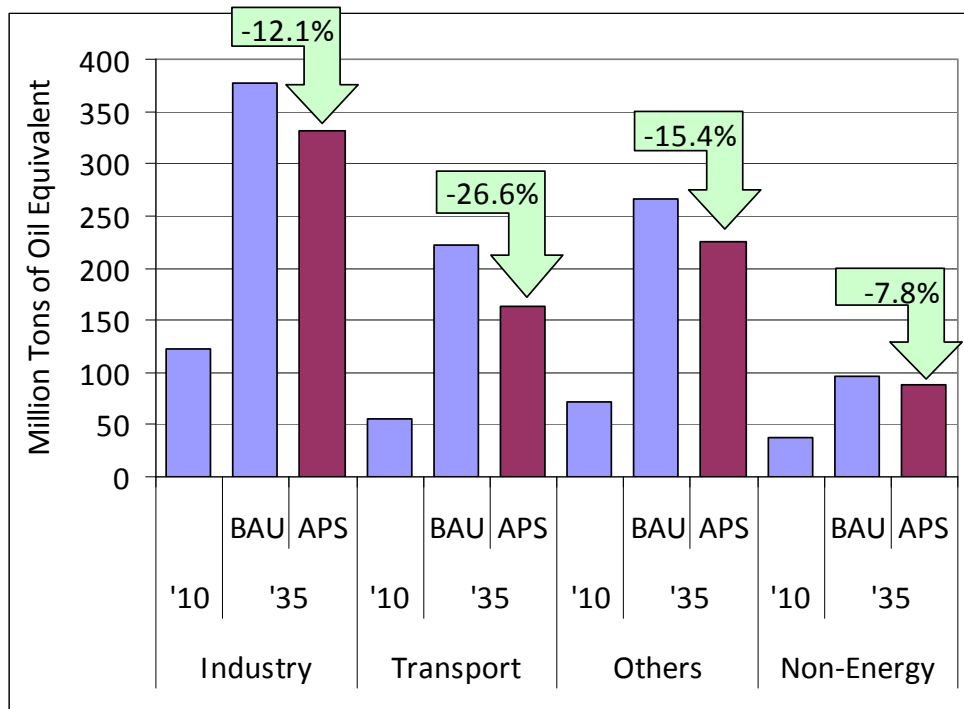
3.2. Energy Saving and CO₂ Reduction Potential

3.2.1. Final Energy Demand

Under the Alternative Policy Scenario (APS), final energy demand is projected to increase at a slower rate of 4.2 percent per year from 288.7 Mtoe in 2010 to 808.6 Mtoe in 2035. This is some 153 Mtoe or 15.9 percent lower than that under the BAU. The slower growth in demand is expected to occur across all end-use sectors, especially in the others (residential and commercial sectors) and transport sectors, reflecting improvements in end-use technologies and the introduction of energy management systems.

In 2035 under the APS relative to the BAU scenario, there is an estimated saving of 45.7 Mtoe (12.1 percent) in the industry sector, 59.2 Mtoe (26.6 percent) in the transport sector, and 40.8 Mtoe (15.4 percent) in the others sector.

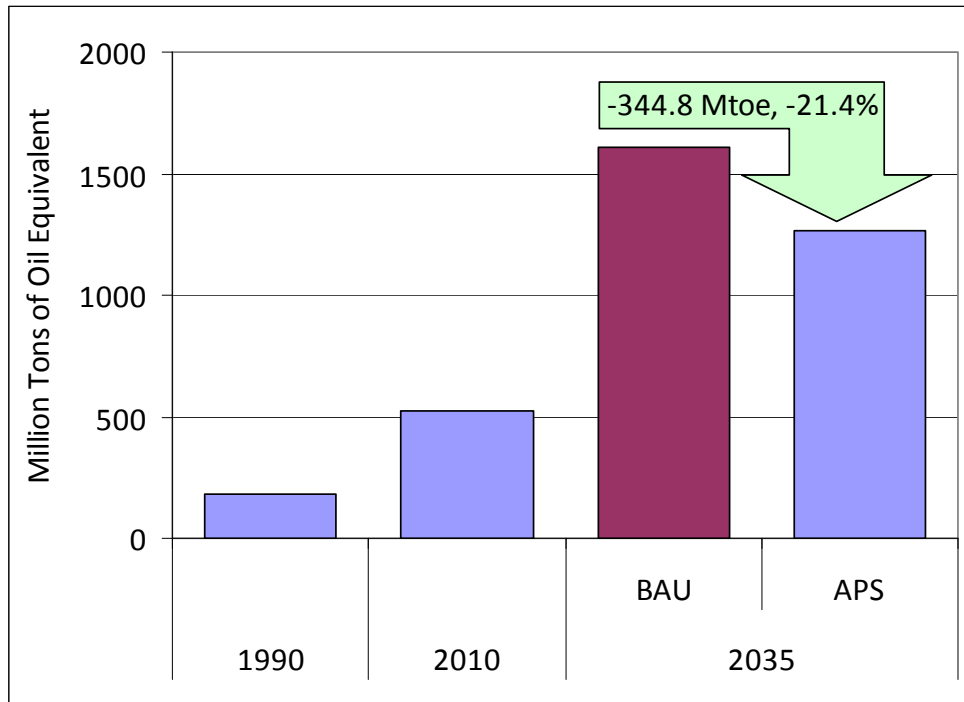
Figure 6-5: Final Energy Demand by Sector, BAU and APS



3.2.2. Primary Energy Demand

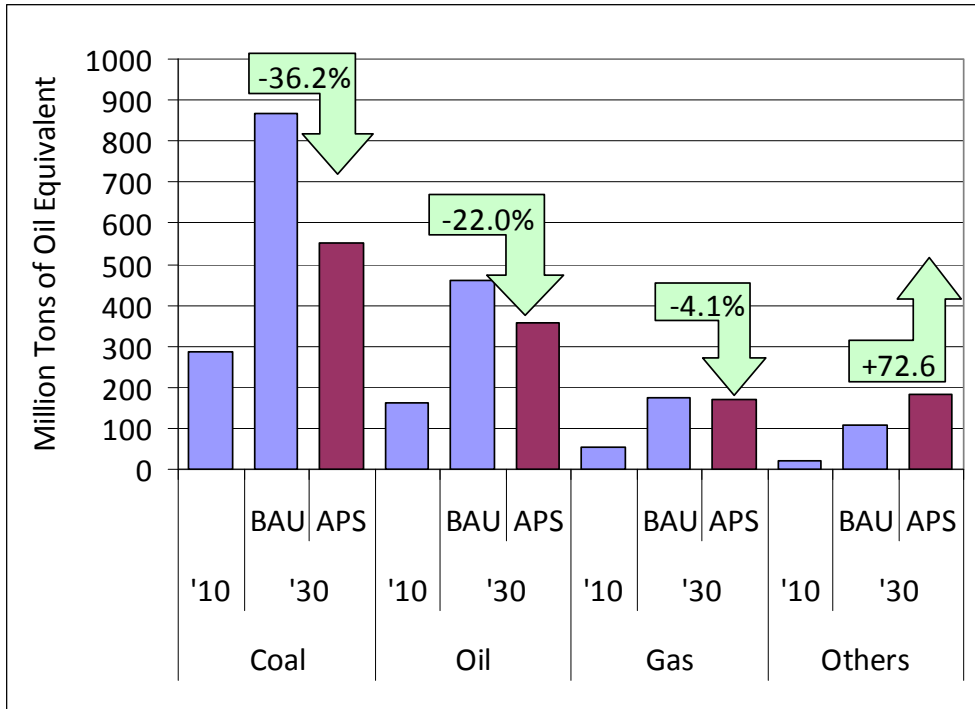
Under the APS relative to the BAU, India's primary energy demand is projected to increase at a slower rate of 3.6 percent per year to 1262.7 Mtoe in 2035. The difference between primary energy demand under the BAU scenario versus the APS in 2035 is 344.8 Mtoe (21.4 percent).

Figure 6-6: Net Primary Energy Supply, BAU and APS



In the APS, nuclear will be the fastest growing energy source, increasing at 12.0 percent per year, followed by natural gas at 4.8 percent per year. Oil, coal and hydro will grow at slower annual rates of 3.2 percent, 2.6 percent and 2.9 percent, respectively. Other energy will also make its mark in the primary energy mix, increasing by 10.6 percent a year. Consequently, its share will increase from 0.7 percent in 2010 to 3.8 percent in 2035.

Figure 6-7: Primary Energy Demand by Source, BAU and APS

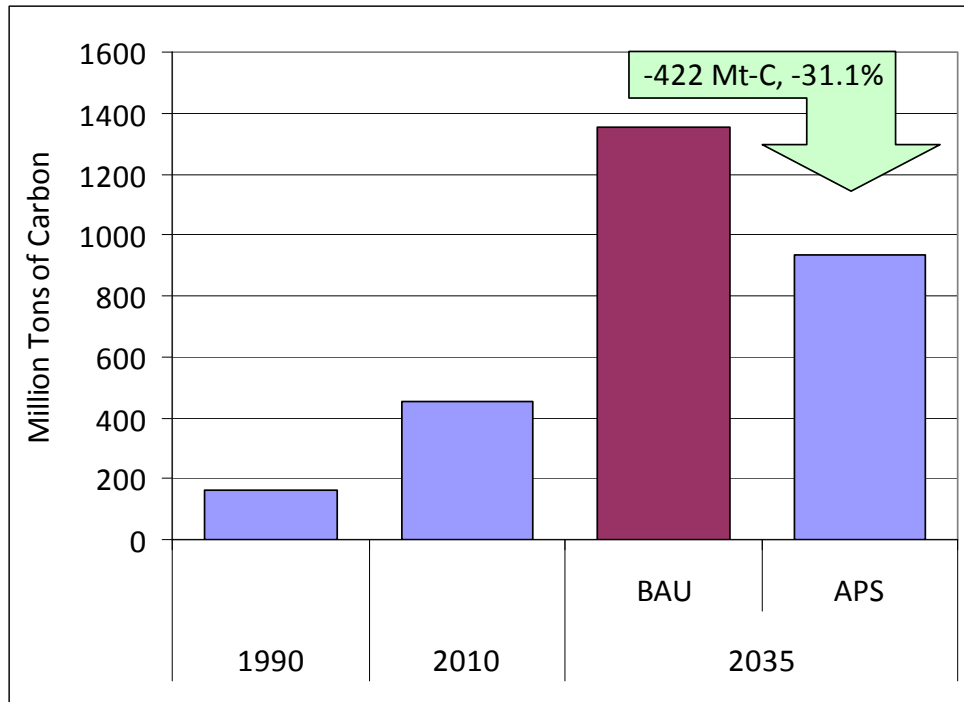


3.3. CO₂ Emissions from Energy Consumption

Under the BAU, CO₂ emissions from energy consumption are projected to increase by 4.5 percent per year from 451.9 Mt-C in 2010 to 1356.5 Mt-C in 2035. The projected growth in emissions is less than the projected growth in primary energy consumption reflecting the expected increased use of less carbon intensive energy sources in India.

In the APS, the annual increase in CO₂ emissions from 2010 to 2035 is projected to be 2.9 percent. The lower growth rate between the APS and the BAU scenario indicates that the energy saving goals and action plans of India are effective in reducing CO₂ emissions.

Figure 6-8: CO₂ Emissions from Energy Combustion, BAU and APS



4. Implications

- Energy security and access to energy are key challenges to India. Enhanced domestic production of energy is necessary.
- Hydrocarbons, particularly coal and oil will continue to dominate the energy mix in both BAU and APS. Use of domestic coal for secure supply as well as more efficient coal technologies such as IGCC, USC, etc. would be necessary. In long and medium-terms, R&D on cleaner energy development will play a key role.
- Energy efficiency and demand side management are important.
 - Industry will account for 38% of the incremental energy use to 2035; energy efficiency programs should be focused in this sector. Broadening the scope of PAT (Perform, Achieve, Trade) scheme will be important way in achieving this.
 - There are huge potential savings in the power sector. Advance technologies for power generation should be used

- Curtail growth in energy consumption in the transport sector
- Decrease distribution losses by using better technologies
- Rationalizing energy prices across fuels and sectors is necessary.