

# India's Future Energy Technology Trajectories

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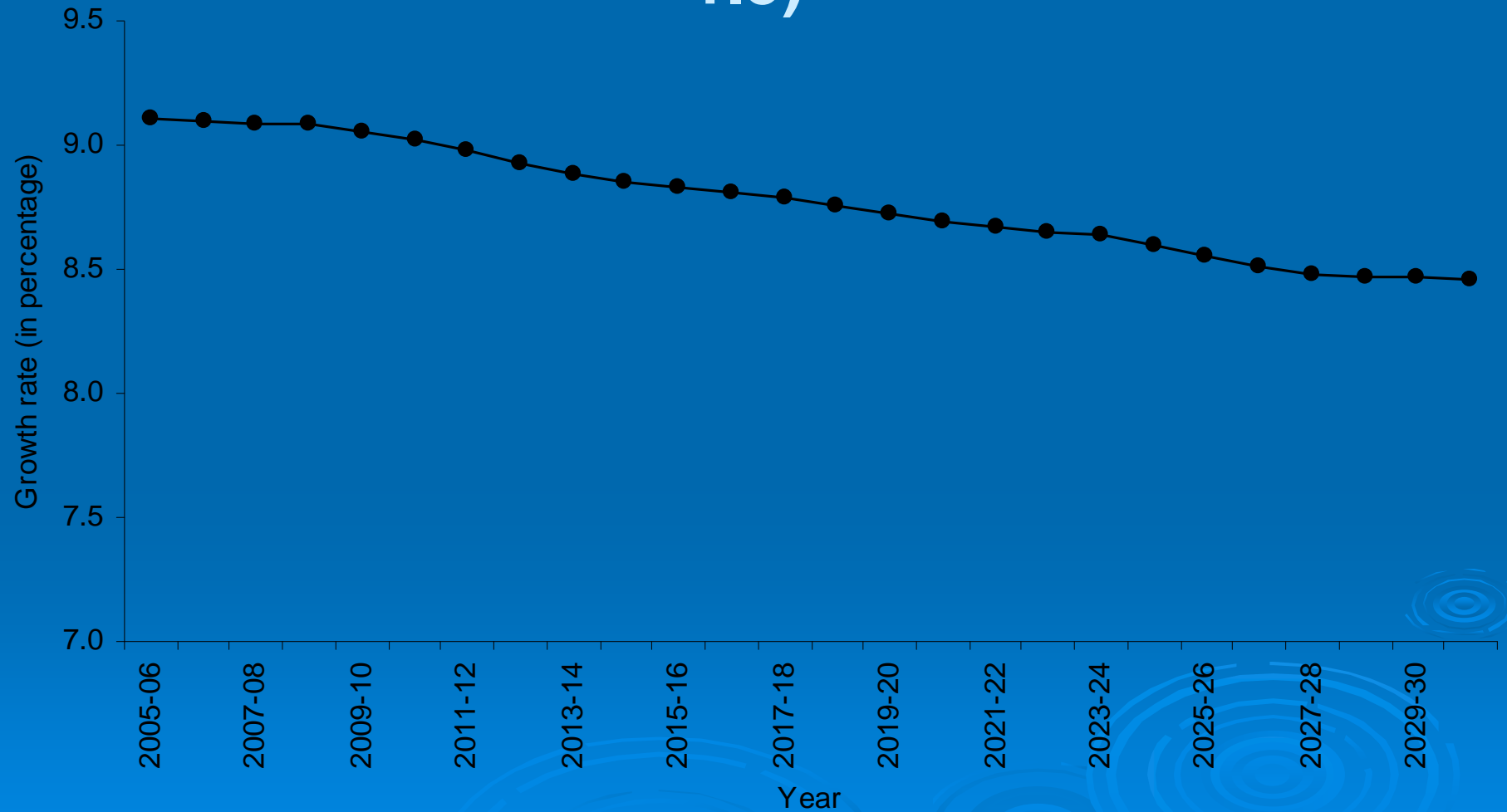
# Overview

- Presents results of linked CGE (top-down) and MARKAL (bottom-up) Model studies for India's energy and GHG emissions trajectory 2010-2030
- CGE Modeling: National Council of Applied Economic Research (NCAER)
- MARKAL Modeling: The Energy & Resources Institute (TERI)

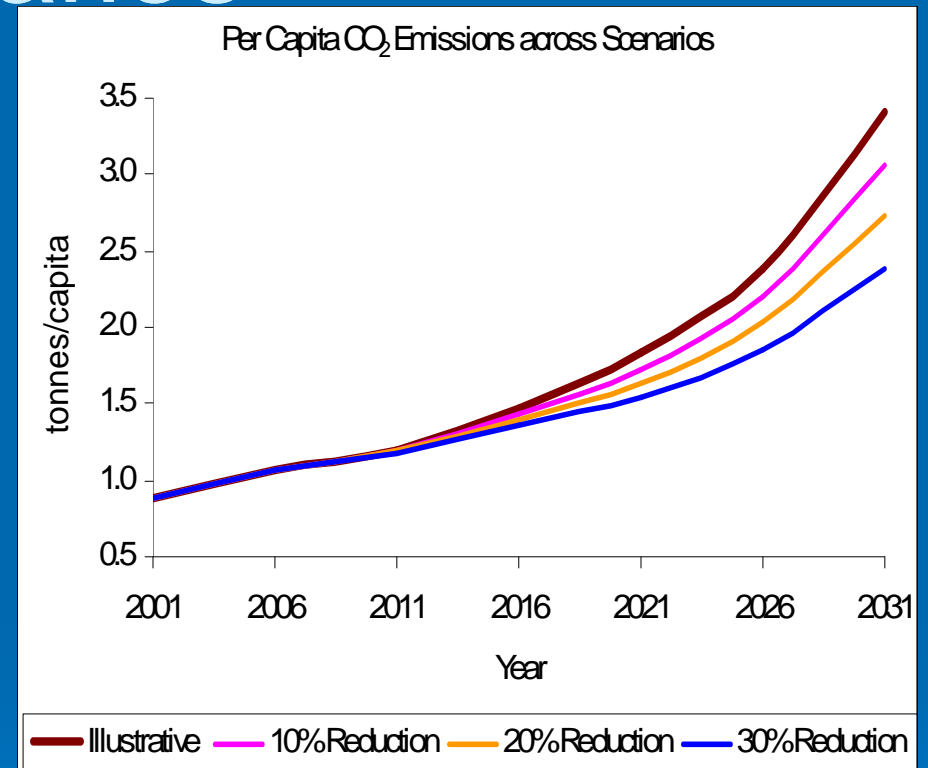
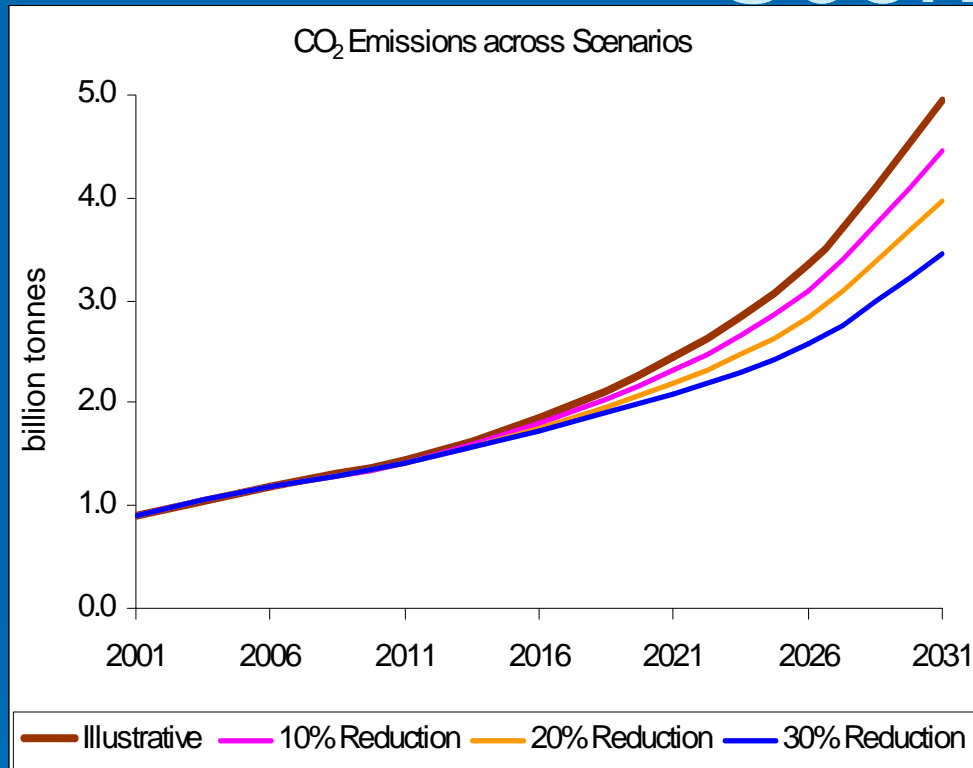
# Key Inputs/Assumptions

- GDP projections: From CGE model results
- Population projection (till 2026): Office of the Registrar General and Census Commissioner, extrapolation at the same annual rate
- International fuel prices projection: World Energy Outlook
- Domestic fuel prices: From CGE model results
- Total Factor Productivity Growth (TFPG) of 3% per year
- Autonomous energy efficiency improvement of 1.5% per year for each technology, subject to feasible limits based on expert judgment
- Data base of > 300 specific technologies with India specific performance and cost parameters

# GDP Growth: CGE Results Illustrative Scenario (TFPG-3, AEEI- 1.5)



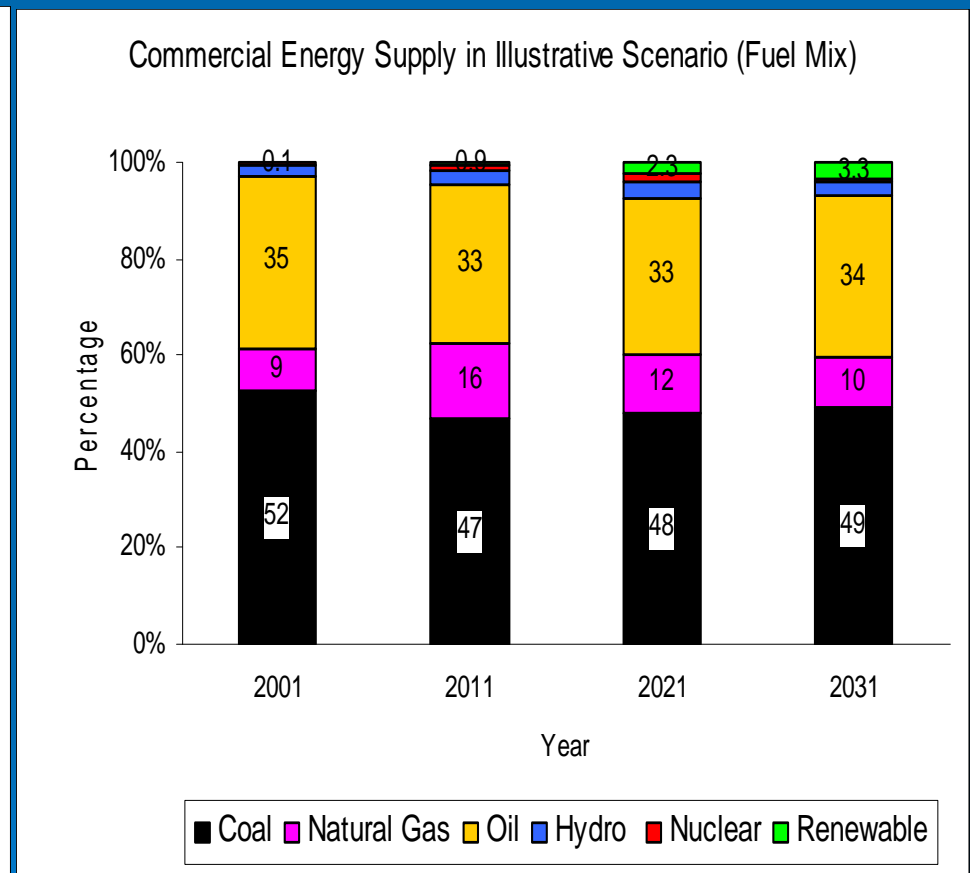
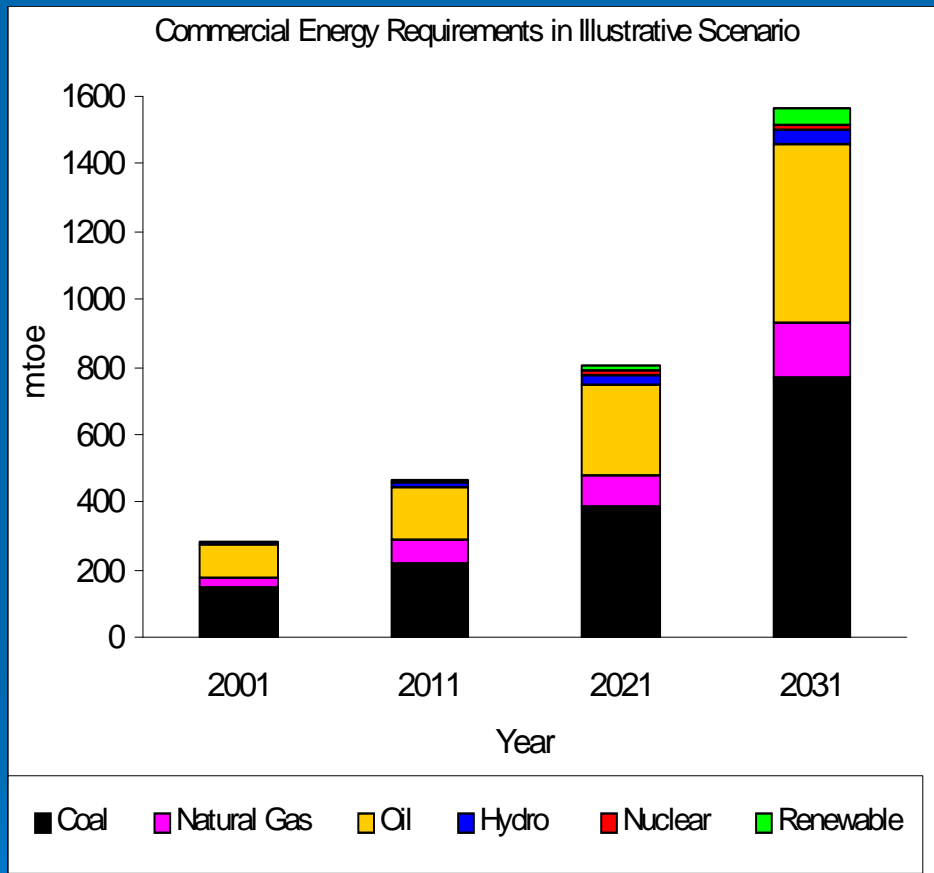
# CO<sub>2</sub> Emissions across Scenarios



Total CO<sub>2</sub> emissions increase to about 4.9 billion tonnes in 2031 under illustrative scenario

Per capita CO<sub>2</sub> emissions in 2031 increases to 3.4 tonnes

# Commercial Energy Requirements under Illustrative Scenario

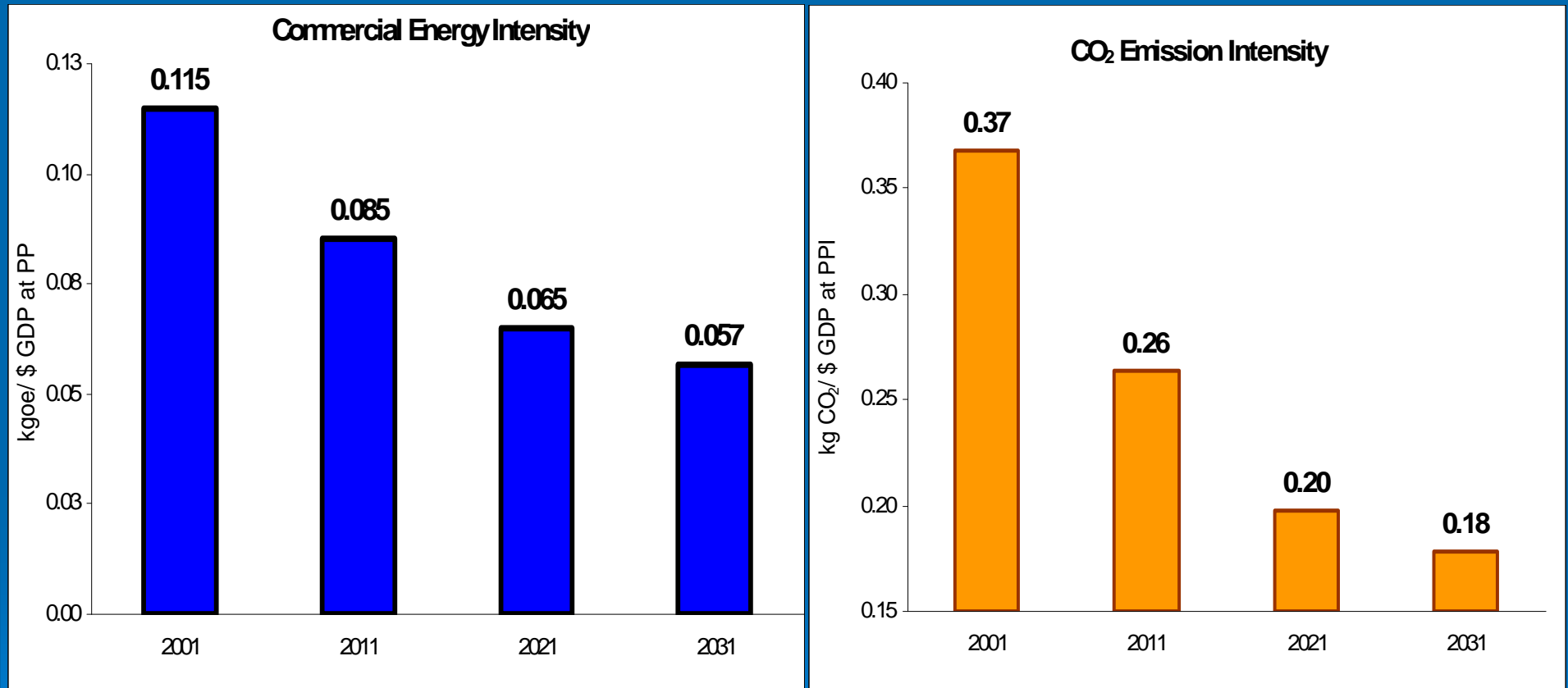


Coal and Oil remain the dominant fuels

Share of coal decreases from 52% in 2001 to 49% in 2031

Share of non-traditional renewables in commercial energy supply increases to around 3% by 2031

# Reducing Trend of Energy and CO<sub>2</sub> Emissions Intensity under Illustrative Scenario

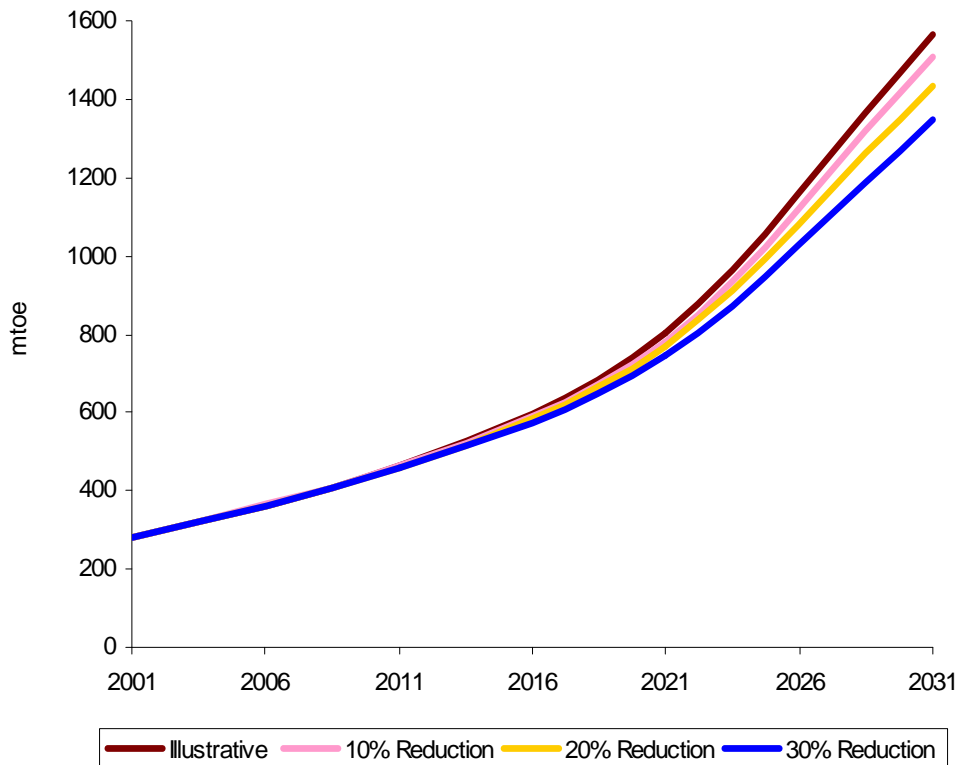


Commercial energy intensity: ~51% reduction from 2001 to 2031 (2.3% CAGR)

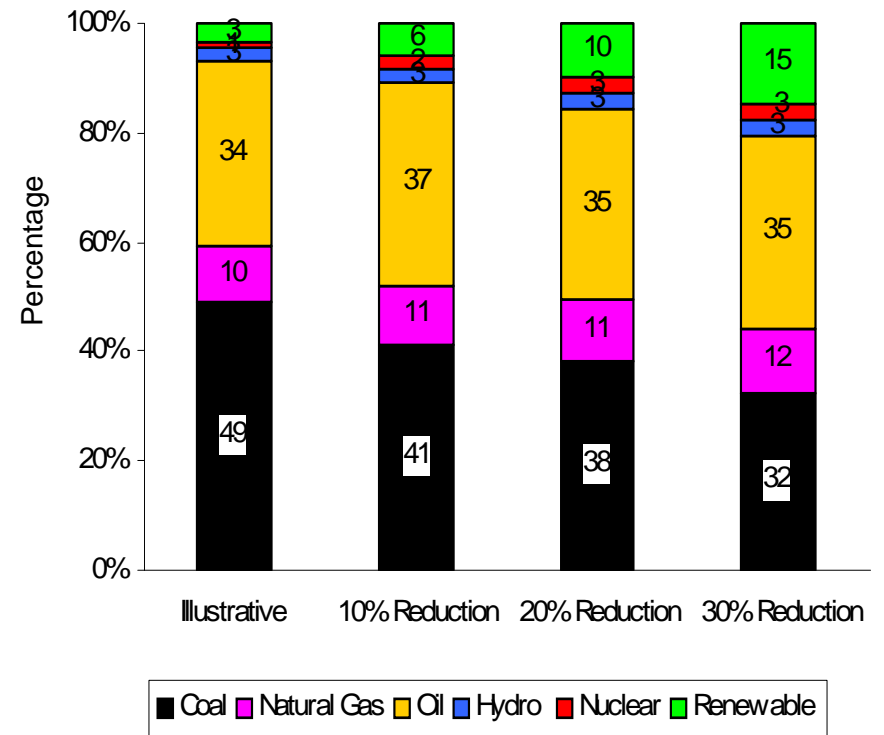
CO<sub>2</sub> emission intensity: ~51% reduction from 2001 to 2031 (2.4% CAGR)

# Impact of CO<sub>2</sub> emissions constraints on energy supply

Commercial Energy Requirement across Scenario (mtoe)

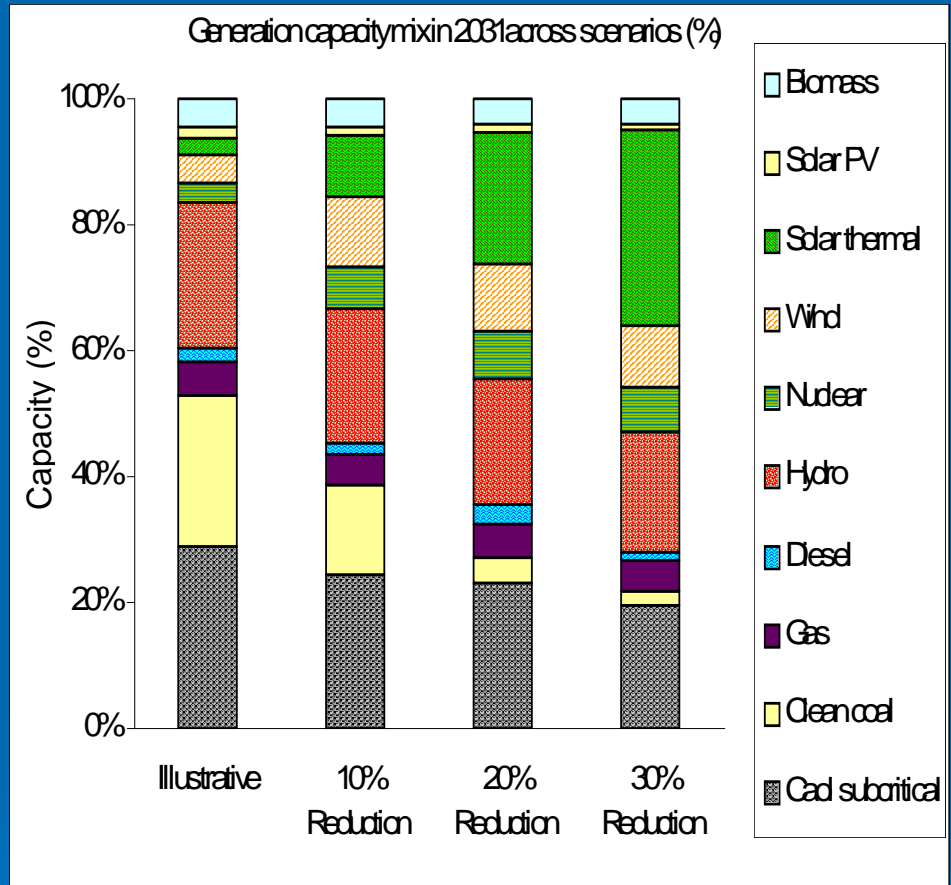
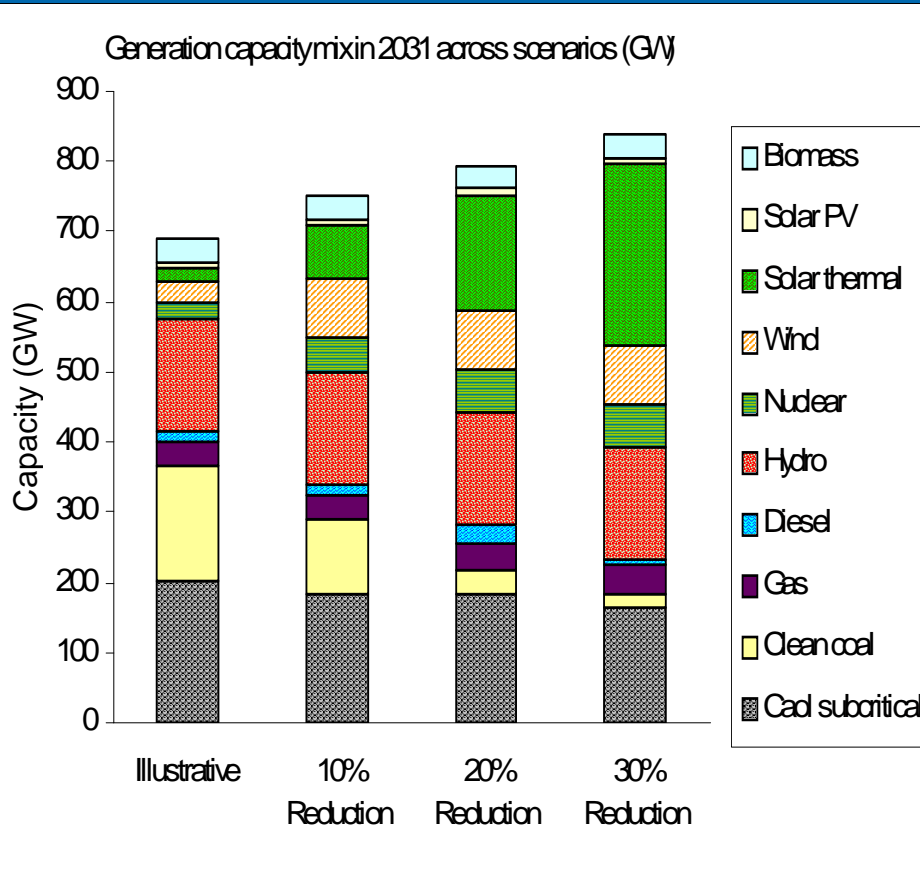


Commercial Energy Fuel Mx in 2031 across Scenarios



CO<sub>2</sub> emissions constraints leads to reduction in energy supply as well as shift towards renewable energy sources

# Power Generation Capacity

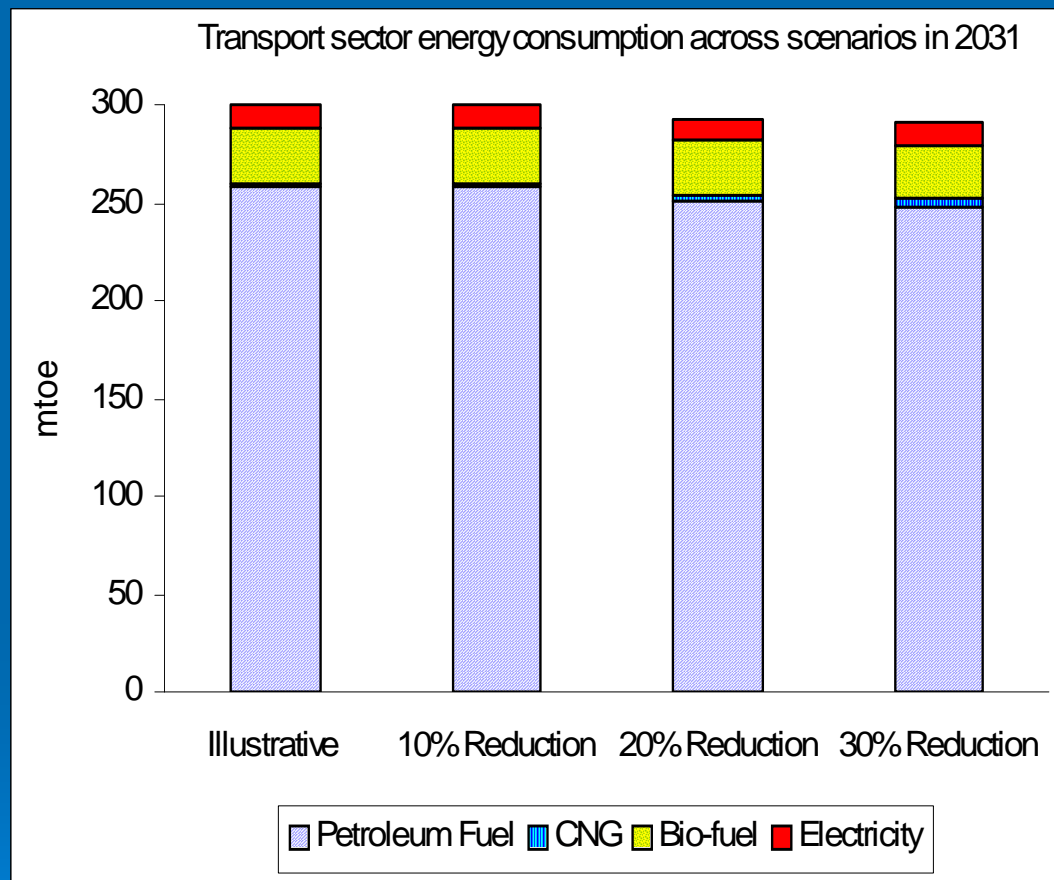


Move away from coal based capacity

Renewables and solar thermal is the key

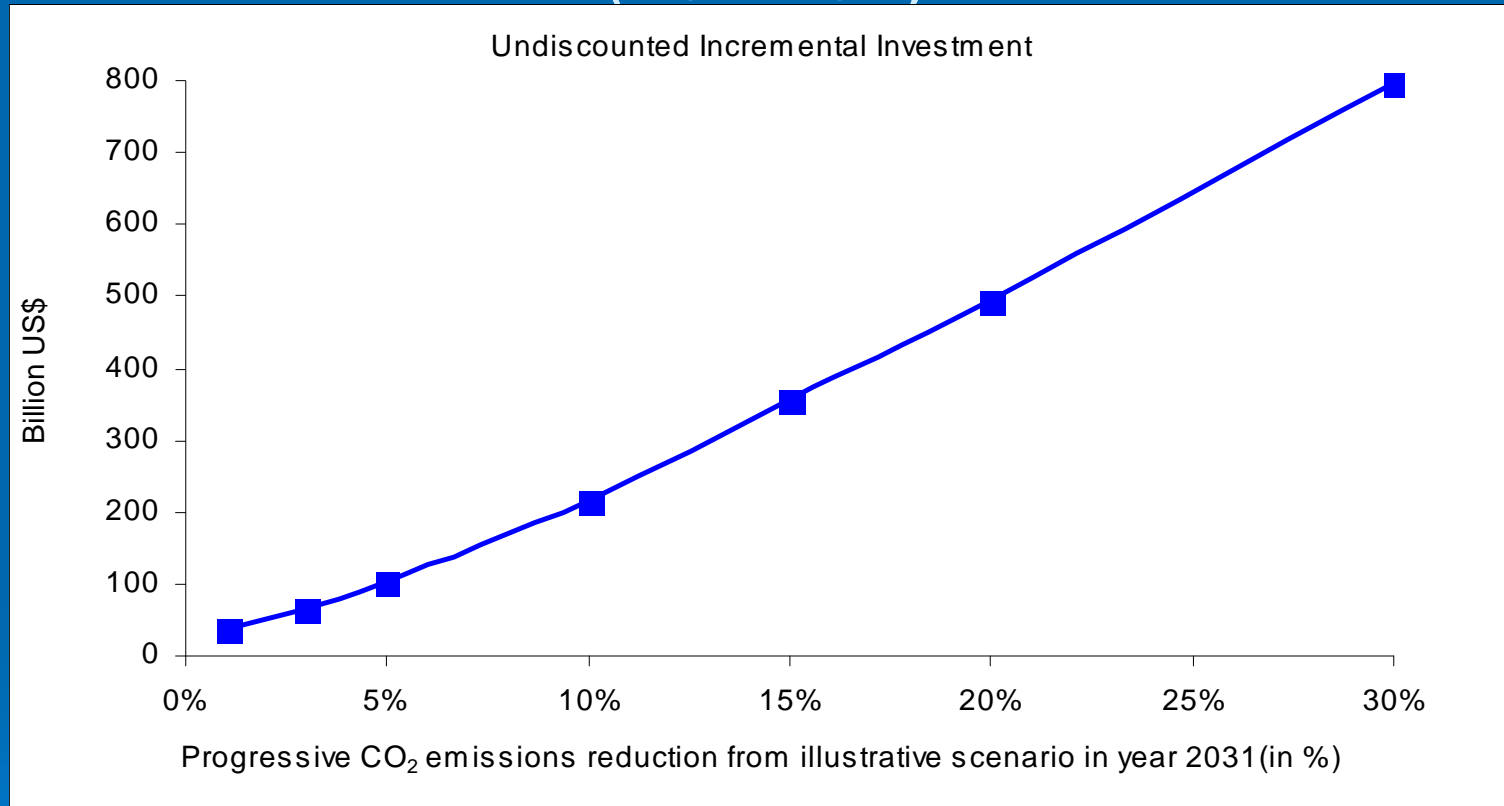
Nuclear will play a more important role in the long term

# Fuel mix in transport sector



Share of bio-fuel will increase marginally up to 9-10%

# Undiscounted Incremental Investment Cost for CO<sub>2</sub> Reductions from Illustrative Scenario (2011-31)

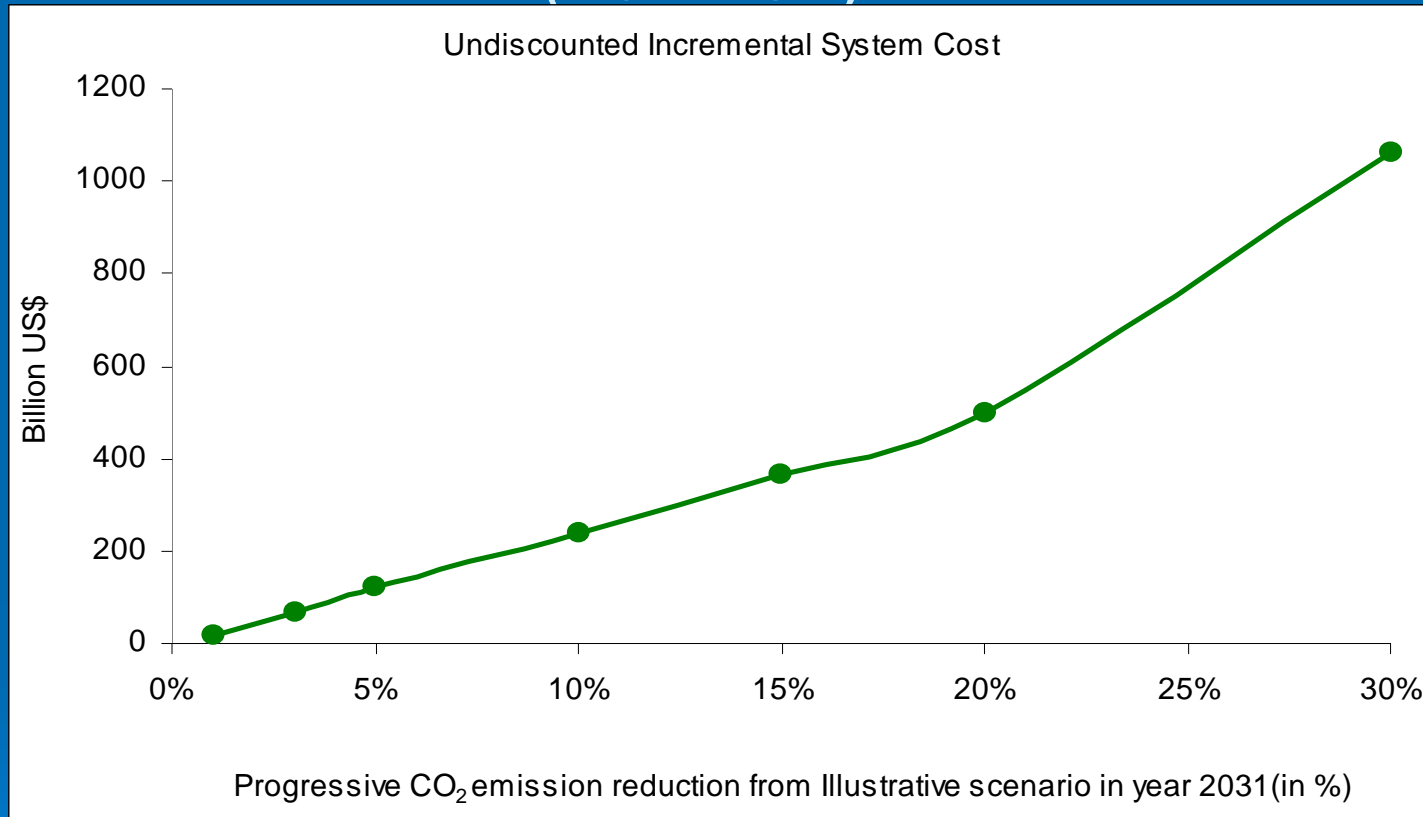


10% reduction: ~ US\$ 215 Billion

20% reduction: ~ US\$ 493 Billion

30% reduction: ~ US\$ 798 Billion

# Undiscounted Incremental Energy System Cost for CO<sub>2</sub> reductions from Illustrative Scenario (2011-31)



10% reduction: ~ US\$ 240 Billion

20% reduction: ~ US\$ 499 Billion

30% reduction: ~ US\$ 1062 Billion

**Thank you for your attention!**

