

Energy-Intensive Sectors of the Indian Economy

Options for Low-Carbon Development (LCD)
Preliminary Findings



**"PATHWAYS FOR LOW
CARBON GROWTH IN
DEVELOPING COUNTRIES"**
Copenhagen, Denmark
December 11, 2009



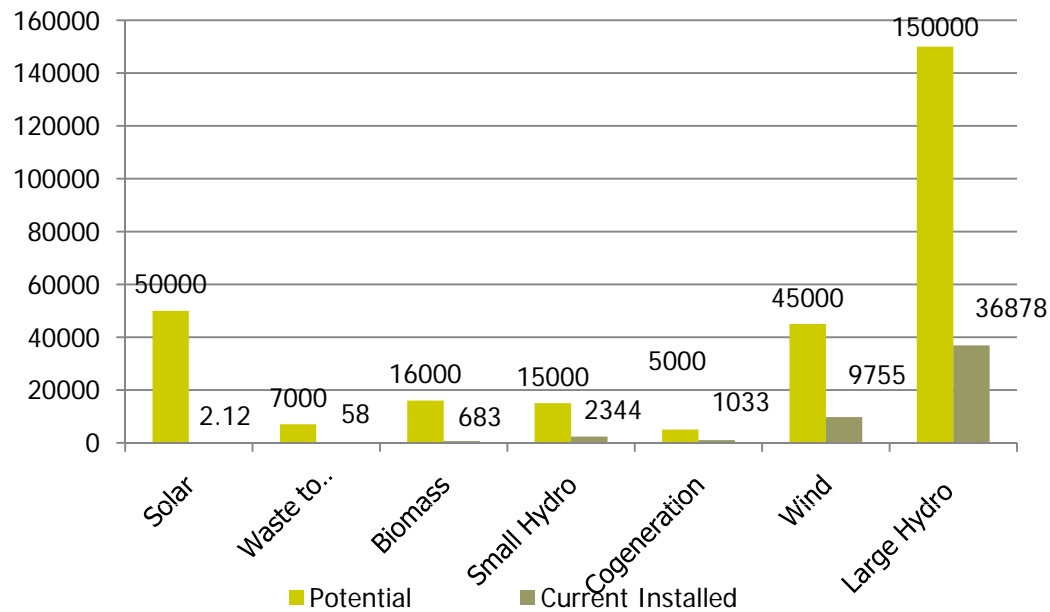


India's Current Carbon Footprint

- **India is among the top 10 emitters of CO₂** due to the size of its economy and population, but
 - per capita CO₂ emissions from fuel combustion (2007)
 - India 1.2 tonnes vs. global average of 4.4 tonnes
 - CO₂ emission intensity of GDP (PPP) on par with global average
 - India one of 20 countries exhibiting successive decline over two sub-periods
- **India's development needs are massive:**
 - 400 million people who still lack access to electricity
 - 456 million living at \$1.25 a day (in 2005, U.S. dollars at PPP).
- **Electricity supply is inadequate and unreliable**
 - 2007 electrical energy deficit of about 10 percent and peak shortages over 17 percent
 - Two thirds of households rely on biomass for cooking
 - One third of households rely on kerosene for lighting

India Has a Scarcity of Clean and Primary Fuels

- Current installed capacity of 145 GW of which 77 GW (53 %) is coal-fired
- India has plans to maximize all sources of renewable energy by 2032, and significantly increase the share of clean energy such as nuclear and solar



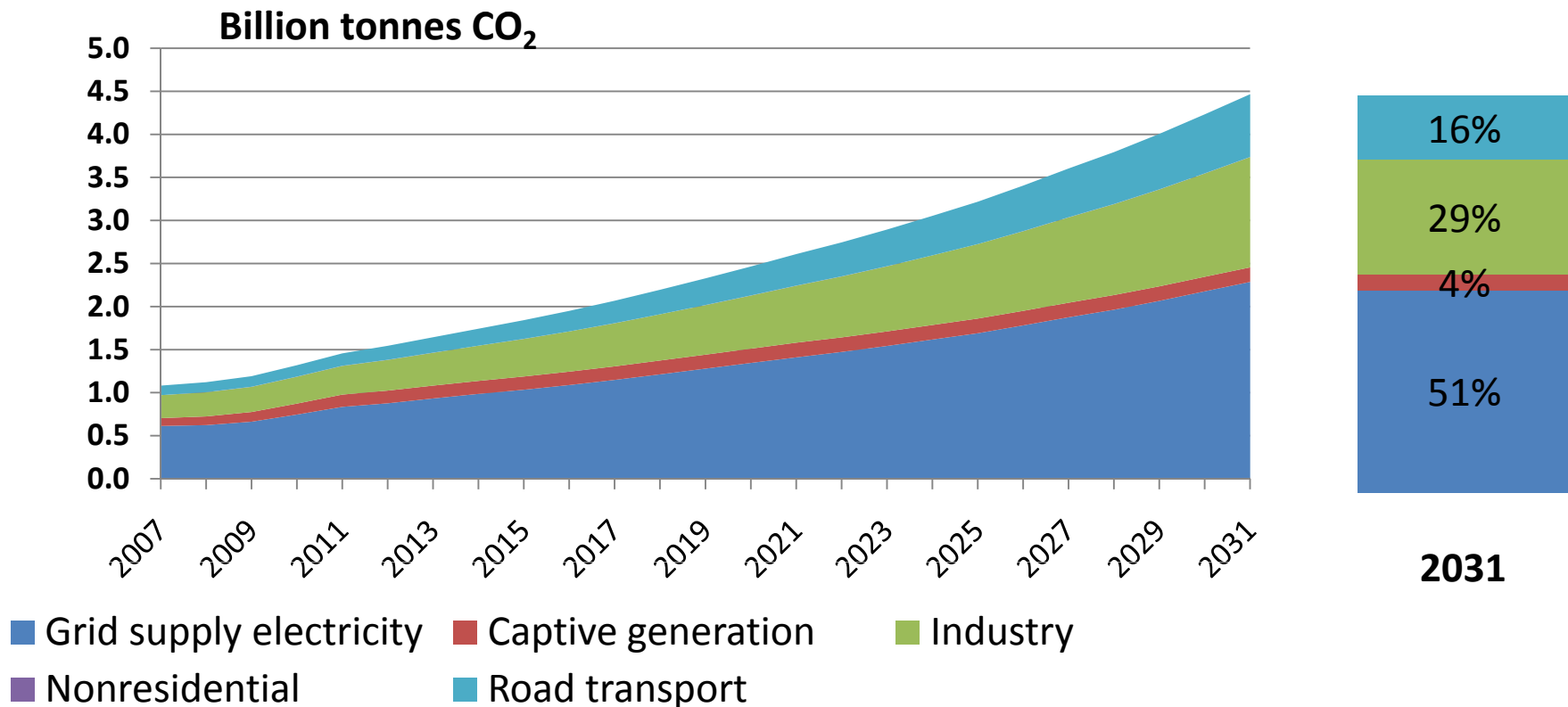
source: Ministry of New and Renewable Energy and Integrated Energy Policy

Scenarios and Sensitivity Analyses

	Scenario 1	Scenario 2	Scenario 3
	"Five-Year Plans"	"Delayed Implementation of Supply Measures"	"All-Out Stretch "
Average annual GDP growth 2009-2031	7.6 %	7.6 %	7.6 %
Power sector repair and maintenance	As per plans, historically adjusted	As scenario 1	Enhanced program
Power Sector expansion		50 % slippage in clean coal, hydro, and renewables	Additional 20 GW Solar and 20 GW imported Hydro
T&D Loss reduction		Delayed 5 years	Accelerated 10 years
Demand sectors : Industry, Household, Nonresidential, Transport		As scenario 1	Additional energy efficiency measures in each sector
Sensitivity Analyses	As scenario 1 but with reduced GDP growth (6.6%)	20% slippage	As scenario 3 plus additional carbon-neutral electricity capacity

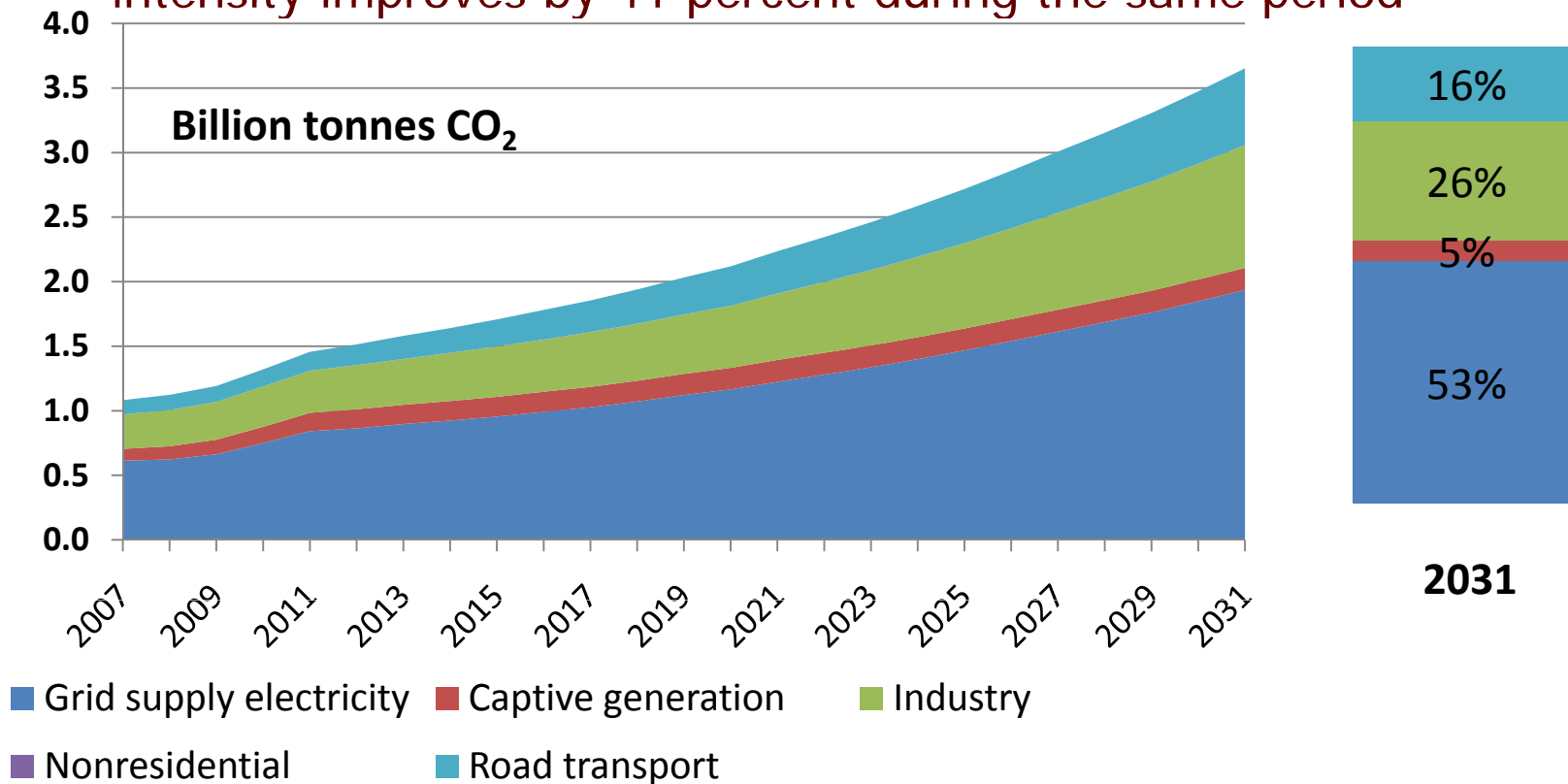
Total CO₂ Emissions in Scenario 1 Findings "Five Year Plans Scenario"

- In the five sectors, CO₂e emissions increase from 1.1 billion tonnes to 4.5 billion tonnes from 2007 to 2031; carbon intensity improves by 28 percent during the same period



Total CO₂ Emissions in Scenario 3 Findings "All-out Stretch Scenario"

- Using technologies available on commercial basis as point of departure - lowest growth of CO₂e emissions in the five sectors, increases from 1.1 to 3.7 billion tonnes from 2007 to 2031; carbon intensity improves by 41 percent during the same period



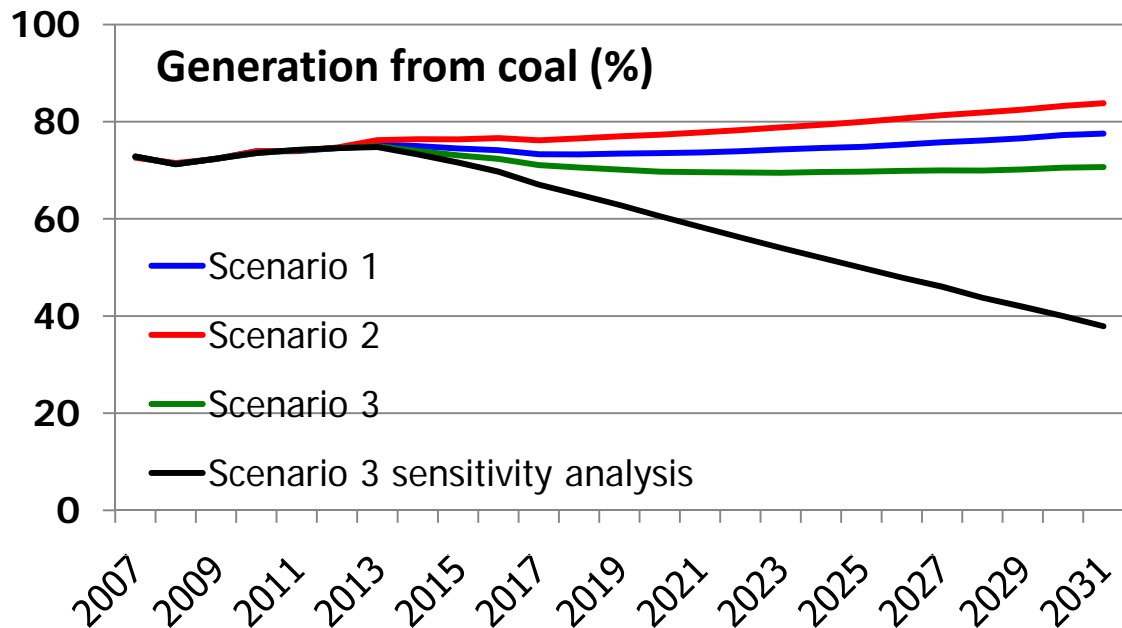
Potential for Reducing Emissions

- Implementing all the demand-side and supply-side measures in scenario 3 reduces emissions in 2031 by 815 million tonnes CO₂

Source	Scenario 1	Scenario 3	Decrease	% Decrease
Grid supply electricity	2,287	1,937	350	15
Captive generation	169	170	0	0
Industry	1,281	950	330	26
Nonresidential	1	1	0	0
Road transport	730	594	136	19
Total (in 2031)	4,468	3,653	815	18

Preliminary Findings – Power Sector

- Grid electricity generated increases by 4.3 in scenario 1 and 3.9 in scenarios 2 and 3
- Coal continues to dominate electricity generation
 - 73% in Sc1
 - 84% in Sc2
 - 71% in Sc3
- Only drops to 38% when 132 GW of carbon-neutral capacity added



Preliminary Findings – Power Sector

- **T&D loss reduction**
 - One of the most cost-effective means of improving power sector performance and reducing CO₂ emissions
 - Impact of pace of T&D Loss Reduction Program

T&D loss reduction implementation	Change in CO ₂ emissions in 2007–2031 (million tonnes)	Change 2007–2031 (billion 2007 rupees) in investment in
Accelerated by 10 years	–568	–94
Accelerated by 5 years	–248	–6
Delayed by 5 years	1,392	227

- **Delayed implementation, lowers capital expenditures for grid by about 15 percent - if shortfall is supplied by greater captive**



Emerging Conclusions and Implications on Growth

- Vast expansion needs for power generation
 - 4 to 6 times 2007 levels by 2031
 - Explosive growth in transport fuel needs
 - More than 5 times 2007 levels by 2031
- as a natural consequence of income growth and greater availability and delivery of basic services
- Despite Indian consumption expected to remain frugal:
 - Richest third of urban households in 2031 consuming one third of the EU average current electricity consumption
 - Per capita consumption of the industry products in 2030 no higher than per capita world production in 2006
 - Car ownership in 2031 of 86 / 1000, significantly lower than 300 - 765 / 1000 observed in most high-income countries today



Emerging Conclusions and Implications on Development

- Success factors for a lower-carbon development in all major sectors include:
 - Comprehensive and large-scale changes in investment, performance, and governance, particularly in the power sector
 - Improvement in implementation achievement targets
 - Strong coordination of institutions across all levels of government—federal, state, and municipal
 - Enhanced performance of the relevant institutions
 - Setting up a reliable monitoring and evaluation system
- **Without any of the above elements,**
 - one can anticipate even faster emissions growth over time compared to Scenario 2 where CO₂e emissions increase from 1.1 billion tonnes to 4.7 billion tonnes from 2007 to 2031.



Emerging Conclusions and Implications on Transport

- **Mitigation is particularly difficult**
 - Due to low private vehicle ownership rates coupled with exploding urban populations and rapid economic growth
- **Transport infrastructures has long operational life**
 - How it is implemented today will lock India into development pathways that may be difficult to change
- **Mitigation requires**
 - Difficult but fundamental changes that transform land use and transit policies
 - Adoption of high fuel economy and tight local emission standards, critical for new vehicles



Emerging Conclusions and Implications on Clean Energy

- The findings in this study underscore the challenge of expanding energy access and meeting energy needs, at affordable costs, and with limited global environmental impact ... within the menu of technological options currently available
- Study does not allow making conclusive statements about the costs of achieving different future carbon trajectories
 - But shows possibilities for significant improvements in energy efficiency in many sectors, with low or potentially negligible costs
- Decision makers in India will have to carefully consider the costs, benefits and risks of different “transformative” cleaner-energy options, notably
 - enhance regional trade in cleaner energy sources
 - Deploy aggressively new and emerging carbon-neutral energy sources

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