Low Carbon Strategy for Inclusive Growth

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The Background

- India’s economy needs to grow at 8 % to 10 % per year for two to three decades to meet its human development needs.

- Growth coupled with growing population puts significant stress on natural resources & environment.

- Major threat to sustainability of India’s development arises from energy use.
India’s Growth Imperative

Many poor with low levels of well being indicators

<table>
<thead>
<tr>
<th>Well-being Indicator</th>
<th>India</th>
<th>High HDI Countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>HDI</td>
<td>0.554</td>
<td>0.905</td>
</tr>
<tr>
<td>LEB</td>
<td>65.8</td>
<td>80.1</td>
</tr>
<tr>
<td>IMR</td>
<td>48</td>
<td>5</td>
</tr>
<tr>
<td>Mean years of schooling</td>
<td>5.48</td>
<td>11.5</td>
</tr>
<tr>
<td>Access to water</td>
<td>90.5</td>
<td>100</td>
</tr>
<tr>
<td>Improved sanitation</td>
<td>47.2</td>
<td>100</td>
</tr>
<tr>
<td>Clean cooking fuels - Rural</td>
<td>11.9</td>
<td>100</td>
</tr>
<tr>
<td>Clean cooking fuels - Urban</td>
<td>65.5</td>
<td>100</td>
</tr>
<tr>
<td>Durable hous - urban</td>
<td>68</td>
<td>100</td>
</tr>
<tr>
<td>Access to electricity - Rural</td>
<td>55.3</td>
<td>100</td>
</tr>
<tr>
<td>Access to electricity - Urban</td>
<td>92.7</td>
<td>100</td>
</tr>
<tr>
<td>Poverty headcount ratio b</td>
<td>29.8</td>
<td>0</td>
</tr>
</tbody>
</table>
India’s GHG Emissions in the Global Context

- The total GHG emissions from India in 2007 were 1727.7 million tonnes of CO2 equivalent.

- India’s total CO2 emissions in 2007 were less than one fifth that of USA and China.

- In per capita terms India emitted 1.18 tonnes of Co2, China four times as much and US 16 times as much.

- Emission intensity of India is 0.28 kg of CO2/$ of GDP in purchasing power parity (PPP) terms, USA’s and China’s more than twice as high.
Not Responsible, But Vulnerable

- We have an interest in an effective global compact
- PM’s statement at Gleneagles
- India’s promise at Copenhagen
- Also our concern for energy security
The Structure of India’s Emissions

GHG emissions by sector

- Electricity accounted for 38% and Agriculture 18% of the GHG emissions in 2007.

- Electricity accounted for 51 %, Transport 10 % and Manufacturing industries 29 %.
12th Plan (2012-17) Environmental Targets

- Increase green cover by 5 million hectares
- Add 30,000 MW of renewable energy capacity
- Reduce emission intensity by 20% to 25% per cent over 2005 levels by 2020.
Low Carbon Strategy for Inclusive Growth

- Energy efficiency
- Lighting, Labeling of Appliances
- Buildings ECBC
- Industrial targets – Perform, Achieve and Trade (PAT scheme)
- Freight shift to Railways
- Vehicle Fleet Fuel Efficiency Norms
- Mass Transport
- Green India Mission
- Renewable power
## Projected Emission Intensity Reduction over 2005 levels

<table>
<thead>
<tr>
<th>Growth Scenarios: 2020</th>
<th>8% growth</th>
<th>9% growth</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Higher and Lower Ends of the Range</strong></td>
<td><strong>2005 Emissions</strong></td>
<td><strong>DE</strong></td>
</tr>
<tr>
<td><strong>Emission Intensity (grams CO2eq/Rs GDP)</strong></td>
<td>56.21</td>
<td>42.47</td>
</tr>
<tr>
<td><strong>(%) Reduction</strong></td>
<td>24.4%</td>
<td>34.4%</td>
</tr>
</tbody>
</table>
Policy Options

Promoting Energy Efficiency

Lighting

- A compact fluorescent lamp (CFL)
- costs 7 to 10 times as much as IL
- An LED lamp consumes even less of electricity than a CFL but costs much more.

Energy Efficient Appliances

- Energy rating scheme.
- The label - electricity consumed and energy efficiency.
- Private individuals and firms can buy on Life cycle cost.
- But not procurement officers of public sectors firms or government departments buy on first cost basis.
Spread of star rated ACs

Percentage share of AC sold in the year 2007-08 to 2011-12

- 2007-2008
- 2008-2009
- 2009-2010
- 2010-2011
- 2011-2012

Legend:
- 1 star
- 2 star
- 3 star
- 4 star
- 5 star
Present Discounted value in Rupees of saving over no star model over 5 years at discount rate. Air conditioners

<table>
<thead>
<tr>
<th>Star rating</th>
<th>10 %</th>
<th>15 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1168</td>
<td>1032</td>
</tr>
<tr>
<td>2</td>
<td>3226</td>
<td>2853</td>
</tr>
<tr>
<td>3</td>
<td>4977</td>
<td>4401</td>
</tr>
<tr>
<td>4</td>
<td>6490</td>
<td>5739</td>
</tr>
<tr>
<td>5</td>
<td>7805</td>
<td>6902</td>
</tr>
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</table>
Economic Attractiveness

<table>
<thead>
<tr>
<th>Appliances</th>
<th>Base Rating</th>
<th>Rs 4/ kwhr</th>
<th>Rs 6/ kwhr</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Life of equipment in years</td>
<td>Life in years</td>
</tr>
<tr>
<td>AC</td>
<td>1*</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>2*</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>3*</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>4*</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>5*</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>
Promoting Energy Efficiency in Industry

- Concentrating on new industries to set up energy efficient plants is an attractive option.

- Labeling for industrial equipment, such as variable speed drives, can be effective if energy prices are competitively determined.

- Trade parity prices for fuels.

- Perform achieve and trade (PAT) has been introduced for industries. It covers only some 450 large firms.

- The BEE is examining some 25 clusters to see how there SMEs can be incentivized to improve energy efficiency.
Electricity Supply

- National Solar Mission to make Solar Electricity cost competitive to coal based electricity by 2020 or latest by 2030.

- Firms are required to bid for the feed in tariff they need and the first auction has already lowered the feed in tariff to Rs 15/ kWhr from the ceiling of Rs 15. Bids in rounds: 13.5, 11, 9.5, 7.5

- State electricity regulatory commissions announced renewable portfolio obligation and the certificates can be traded, for which power exchanges provide electronic trading platforms.
Energy Conservation in Buildings

- Appropriate design using natural sunlight and appropriate orientation, insulation and natural sources of cooling and heating. 30% saving expected.

- BEE in India enacted an energy conservation building code (ECBC).

- Experience shows the savings can be more.

- Mandatory in commercial buildings.

- How to enforce it.
The stock of automobiles has been growing at more than 20% in recent years and two wheelers even faster.

Shift long distance freight movement from trucks to trains: Moving a billion tonne-km of goods by rail compared to road can save 30 Mt of diesel and save 54 Mt of CO2.

Improve mass transport in urban areas of quality that induces vehicle owners to travel by it.

Design cities that reduce need for travel and encourage walking and cycling.

Improve fuel efficiency of vehicles.
Long Term Projections Using a Model

- Limiting Emissions is Different from Reducing Intensity
- What would be the implications?
- Use a Multi-sectoral, inter-temporal bottom-up top-down optimizing model developed at IRADe
  - 29 commodities, 41 activities, 20 consumer expenditure classes with LES for each, endogenous Consumption distribution
  - Covers 2005 to 2050, maximizes PDV of consumption
Visionary Inclusive Development (VD)

- Clean drinking water and sanitation
- Better health services and education
- Level of education
- Access to electricity
- Access to clean cooking fuel
- Housing for all
- Cash transfer to the poor
## Welfare Indicators in VD

<table>
<thead>
<tr>
<th>Indicator</th>
<th>2020</th>
<th>2030</th>
<th>2040</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEB (Female) – years</td>
<td>73</td>
<td>78</td>
<td>80</td>
<td>80</td>
</tr>
<tr>
<td>LEB (Male) - years</td>
<td>70</td>
<td>74</td>
<td>76</td>
<td>76</td>
</tr>
<tr>
<td>IMR per 1000 live births</td>
<td>25</td>
<td>7</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Mean years of Schooling</td>
<td>6.3</td>
<td>8.7</td>
<td>10.7</td>
<td>12.1</td>
</tr>
<tr>
<td>Millions poor - Rural</td>
<td>25</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Millions poor - Urban</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Per Capita Consumption Expenditure in DAU and VD (2003-04 prices)
GDP in DAU and VD (2003-04 Prices)
CO2 Emissions Per Year

Million Tonnes

- DAU
- VD

Years:
- 2020
- 2030
- 2040
- 2050
VD is Attainable

- With Little cost
- Effectively implemented policies
- We had assumed 100% targeting effectiveness for cash transfer
- No particular efficiency improvement assumed in other welfare schemes

However, the CO2 emissions are high, What if we were to limit carbon emissions?
Per Capita CO2 Emissions
LCIG Path with Carbon Budget

- Global carbon space allocated on a per capita basis on base year population.
- 1990 to 2050 will give India a share of cumulative emissions of **156 GT over 2010 to 2050 (LC1)**
- 2010 to 2050 will give India a share of cumulative emissions of **133 GT over 2010 to 2050 (LC2)**
- This is not strictly equitable. Equity would require allocating **GT-years** of space
Low Carbon Policies

- AEEI rate increased
- New Renewable technologies, Ultra super critical coal
- TFPG at trend rate but higher for solar & wind
- Nuclear restricted to 11000 MW
- Minimum penetration rate of renewables
- Rail share in freight increased to 67% from 35%
- Double Fuel Efficiency of Motorized vehicles
- Mass transport and walking, cycling reduces private fuel demand
Low Carbon Policies (contd)

- Alternative transport fuel – gas and electricity reduce petro prod demand by 2% per year

- Higher energy efficiency of commercial building

- Increase green cover faster to increase sequestration

- Energy efficient appliances
Per capita Emissions of CO2

- VD
- LC1
- LC2

Tonnes/Person

<table>
<thead>
<tr>
<th>Year</th>
<th>VD</th>
<th>LC1</th>
<th>LC2</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020</td>
<td>2</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>2030</td>
<td>4</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2040</td>
<td>8</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2050</td>
<td>10</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>
GDP in DAU, VD, LC1 and LC2

INR Billions

Years

DAU
VD
LC1
LC2

2020  2030  2040  2050
Decomposition of CO2 Reduction
In LC1 Compared With VD
Decomposition of CO2 Reduction In LC2 Compared With VD
Emission Reduction Compared to VD: Per cent Contribution

<table>
<thead>
<tr>
<th>Year</th>
<th>CO\textsubscript{2}</th>
<th>GDP</th>
<th>CO\textsubscript{2}/Energy</th>
<th>Energy/GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>-19.3</td>
<td>7.23</td>
<td>-18.9</td>
<td>-7.64</td>
</tr>
<tr>
<td>2020</td>
<td>-49.6</td>
<td>-16.74</td>
<td>-32.81</td>
<td>0</td>
</tr>
<tr>
<td>2030</td>
<td>-54</td>
<td>-25.24</td>
<td>-30.31</td>
<td>1.59</td>
</tr>
<tr>
<td>2040</td>
<td>-61.5</td>
<td>-25.21</td>
<td>-21.17</td>
<td>-15.07</td>
</tr>
<tr>
<td>2050</td>
<td>-46.7</td>
<td>-0.61</td>
<td>-13.93</td>
<td>-32.12</td>
</tr>
</tbody>
</table>
Emission Reduction Compared to VD: Per cent Contribution

<table>
<thead>
<tr>
<th>Year</th>
<th>CO₂</th>
<th>GDP</th>
<th>CO₂/Energy</th>
<th>Energy/GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>-21.4</td>
<td>6.9</td>
<td>-20.7</td>
<td>-7.6</td>
</tr>
<tr>
<td>2020</td>
<td>-52.9</td>
<td>-24.3</td>
<td>-30</td>
<td>1.4</td>
</tr>
<tr>
<td>2030</td>
<td>-57.2</td>
<td>-35</td>
<td>-28.2</td>
<td>5.9</td>
</tr>
<tr>
<td>2040</td>
<td>-68.3</td>
<td>-31.5</td>
<td>-21.3</td>
<td>-15.5</td>
</tr>
<tr>
<td>2050</td>
<td>-56.4</td>
<td>-11.5</td>
<td>-14.9</td>
<td>-30</td>
</tr>
</tbody>
</table>
Conclusion

- Possible to live within a carbon Budget
- At high cost
- PDV of GDP difference ranges from US$8000 to US$ 10000 billions over 2010 to 2050, but adaptation costs in VD not included
- CO2/energy is limited as CCS not introduced
- Also nuclear restricted
- Need to make renewables more cost efficient
- Technology should be made globally available
Thank You