

# Energy, Development and Climate Trends from Developing Countries

Amit Garg

([amit.garg@risoe.dk](mailto:amit.garg@risoe.dk))

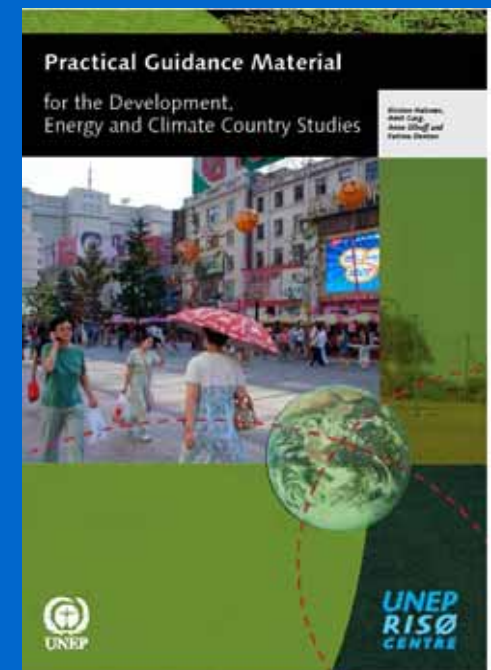
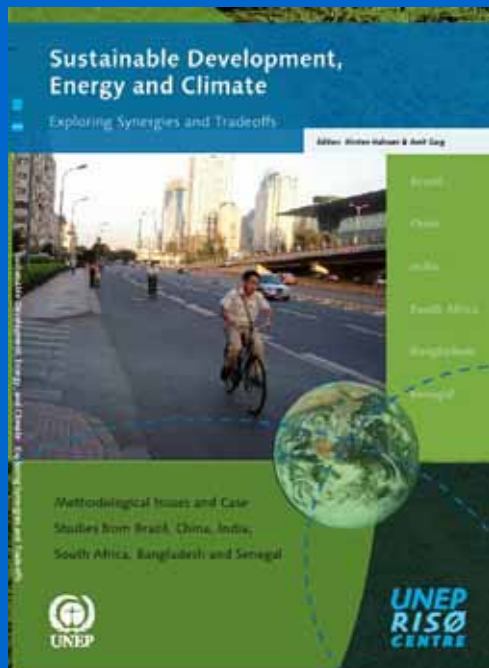


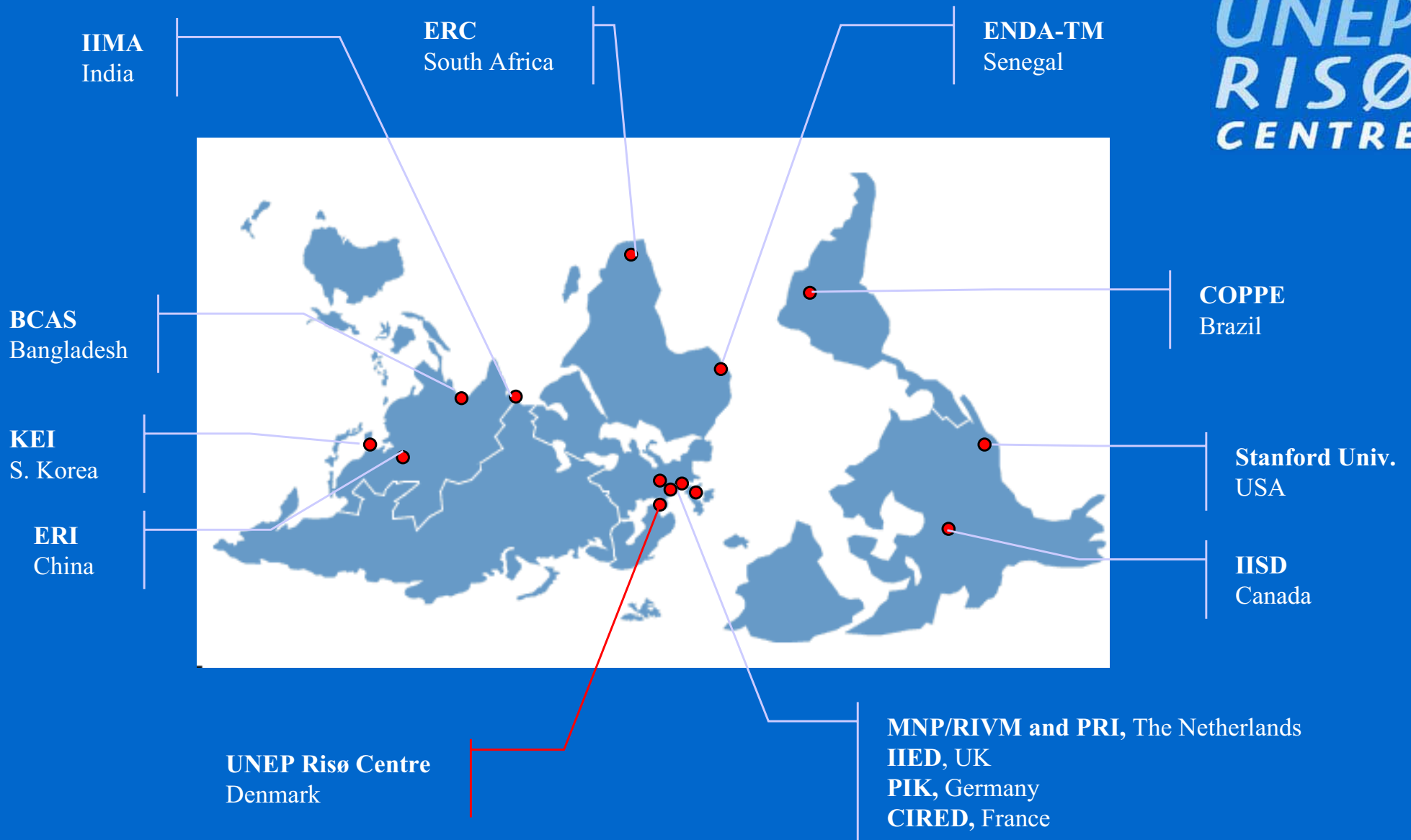
# Development Issues are Closely Linked to Climate Change

- Common driving factors, such as, Economic growth, investments, technological change.
- Vulnerability reduction and welfare enhancement (including basic human needs, equity and justice) are important for both
- Natural resources and environmental impacts.
- Alternative development pathways could influence GHG emissions considerably
- Integrated view on development goals (millennium and national) and climate change
- Institutional issues

# Development, Energy and Climate Project

- Methodological work – Link SD and Climate Change, quantitative data.
- Detailed modeling for Brazil, China, India, and South Africa.
- Case studies for Bangladesh, Brazil, China, India, Senegal and South Africa.
- Network with other Development and Climate Studies.





# Linking MDG, Energy and CC

MDGs	Energy Sectoral Themes	Examples of SD Indicators
1. To halve between 1990 and 2015, the proportion of people whose income is below 1\$ a day	<ul style="list-style-type: none"><li>- Energy for increased production and consumption</li><li>- Energy for local enterprises</li><li>- Lighting to facilitate income generation</li><li>- Energy for machinery</li><li>- Employment related to energy provision</li></ul>	<ul style="list-style-type: none"><li>- Quantity of energy supplied to enterprises, lighting, machinery etc.</li><li>- Energy costs and the share of this in household income, production costs etc.</li><li>- No of people employed</li></ul>

## Focal Study Areas

- The role of energy in SD seen in a macroeconomic context and at household level.
- Social, economic and environmental impacts of energy scenarios.
- The impacts of including GHG emission reduction in national policies.

Case study and modeling results for China, India, Brazil and South Africa are shown

# National Policies and Measures

# Policies Linked with Energy Sector

Status	Description
<b><i>Bangladesh</i></b>	
Current	Exploration of new gas fields and additional power generation opportunities through domestic and foreign direct investment.
Current	Explore and extract coal for power generation and other uses.
Current	Continuous reform of the energy sector through unbundling of the agencies and establishing a balance in generation, transmission and distribution services.
<b><i>Brazil</i></b>	
Since 1975	Brazil's biofuel programme is one of the biggest and most successful in the world
Since 1985	PROCEL (National Energy Conservation Program) target is to reduce electricity consumption and supply-side losses by approximately 8.4. TWh/year (2.5% of national consumption) by 2003
Current	Programmes to cut power transmission and distribution losses
Current	Measures to improve efficiency of residential sector

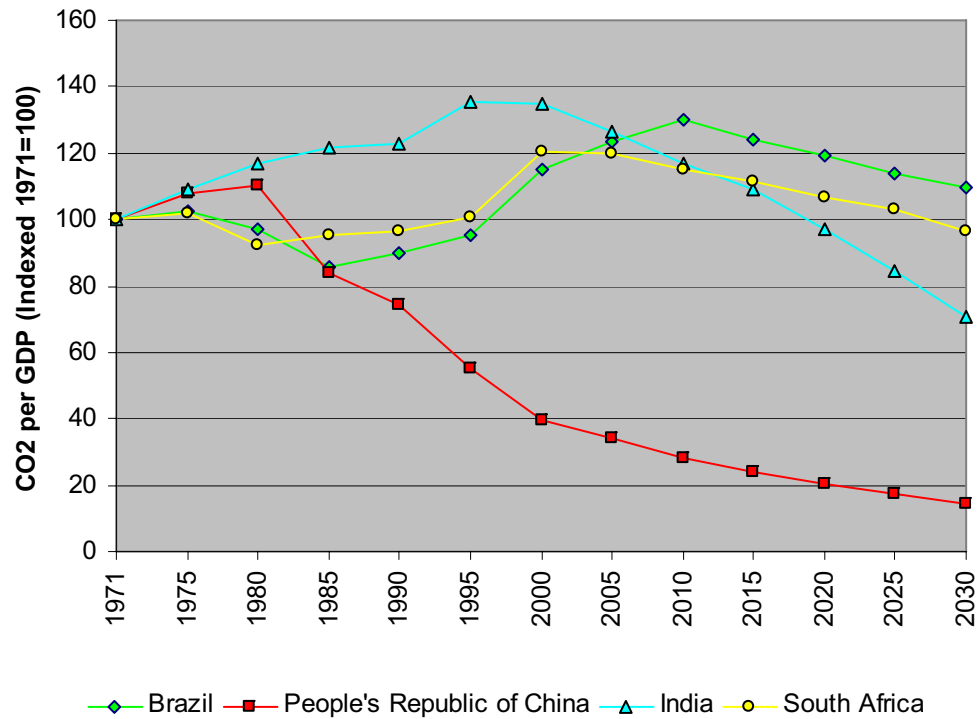
# Policies Linked with Energy Sector

<i>China</i>	
2004	Energy Medium-Long term Development programme (2004-2020), such as energy security, energy efficiency, and clean-coal.
2004	60 GW renewable power capacity by 2010 (10% of total power generating capacity) and 121 GW by 2020 (12% of total capacity)
2005	Medium-Long term Energy Conservation programme, annual energy conservation rate of 2.2% till 2020 covering various sectors.
Current	Strong economic growth, and declining population growth
Current	More efficient coal-based power generation from existing and new plants
Current	Strong thrust on energy efficiency improvement in all sectors (e.g. 20% energy intensity reduction during 2005-2010, efficiency of coal-fired power plants to increase to 40% by 2030, new building to reach 75% increase standards in 2030 etc.)
UC	Nuclear power capacity of 40 GW by 2020

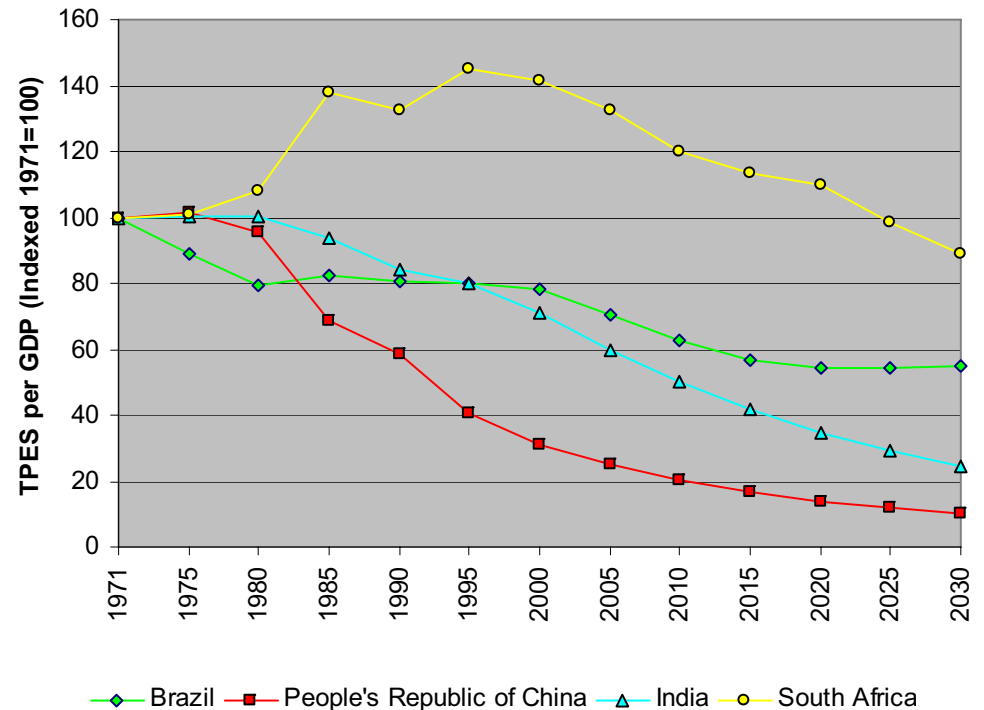
# Policies Linked with Energy Sector

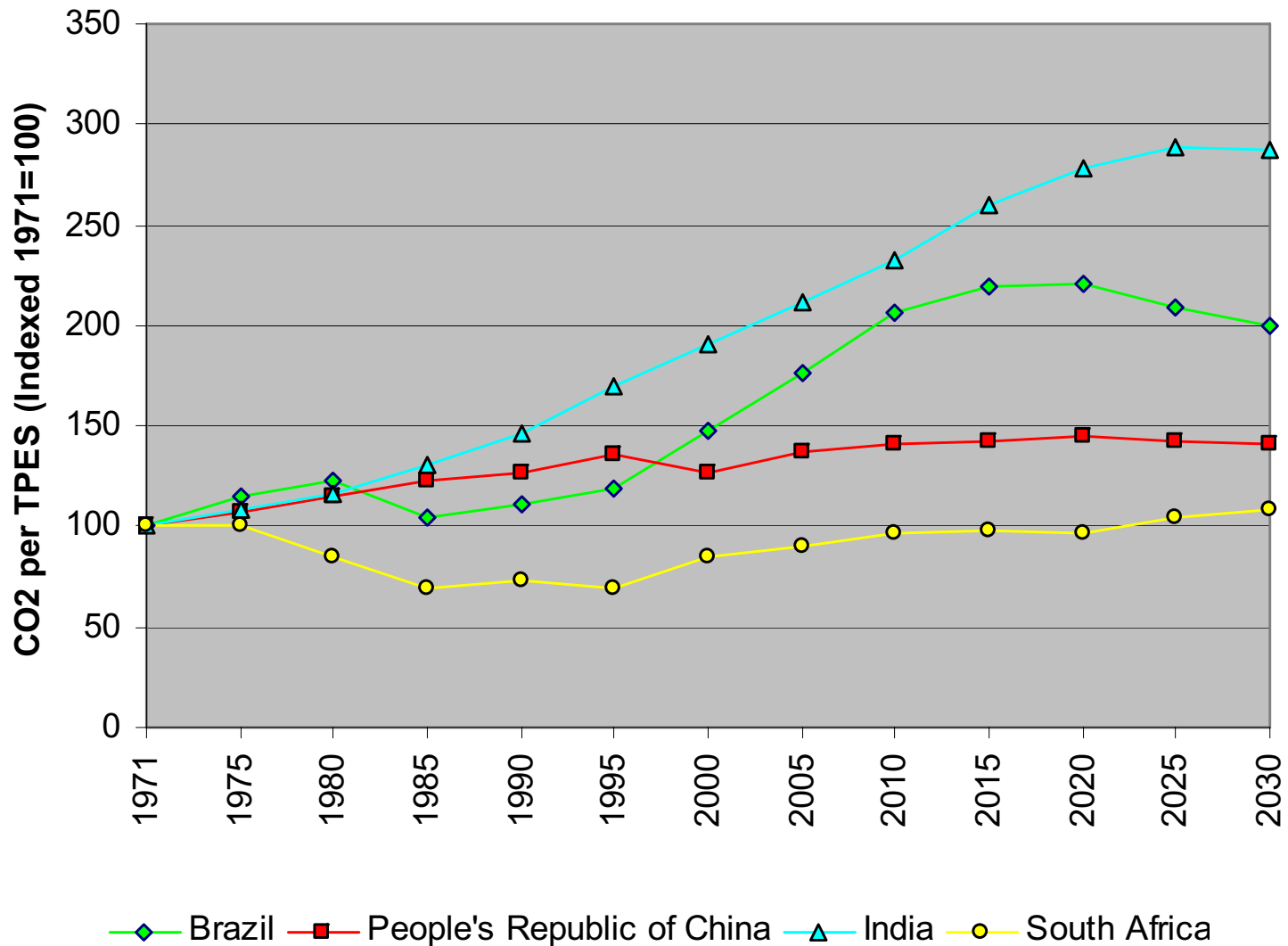
<i>India</i>	
Current	More efficient coal-based power generation from existing and new plants
2001	reduce power transmission and distribution losses
2002	10% of new power generation capacity by renewables by 2012
2002- Current	Doubling per capita income during 2002-2012, and to reduce decadal population growth rate to 16.2% between 2001-2011 (from 21.3% during 1991-2001)
2002	Auto fuel policy: Emission norms for new vehicles - Euro-3 equivalent norms from 2010 for the entire country, but for 11 large cities Euro-3 equivalent from 2005 and Euro-4 equivalent from 2010
2005	Ethanol blend in gasoline (up to 5-10% in phases), ongoing discussions for expansion
2005	100% household electrification in rural areas by 2010 covering 75 million rural households, and modernizing rural electricity infrastructure
2006	Minimum employment guarantee scheme for rural areas (100 days' employment per household per year)
UC	Nuclear power capacity of 20 GW by 2020

# Macro Trends



- GDP becomes less energy and less CO<sub>2</sub> intensive under all scenarios
- Decoupling rates, timings and extent are however different for different countries

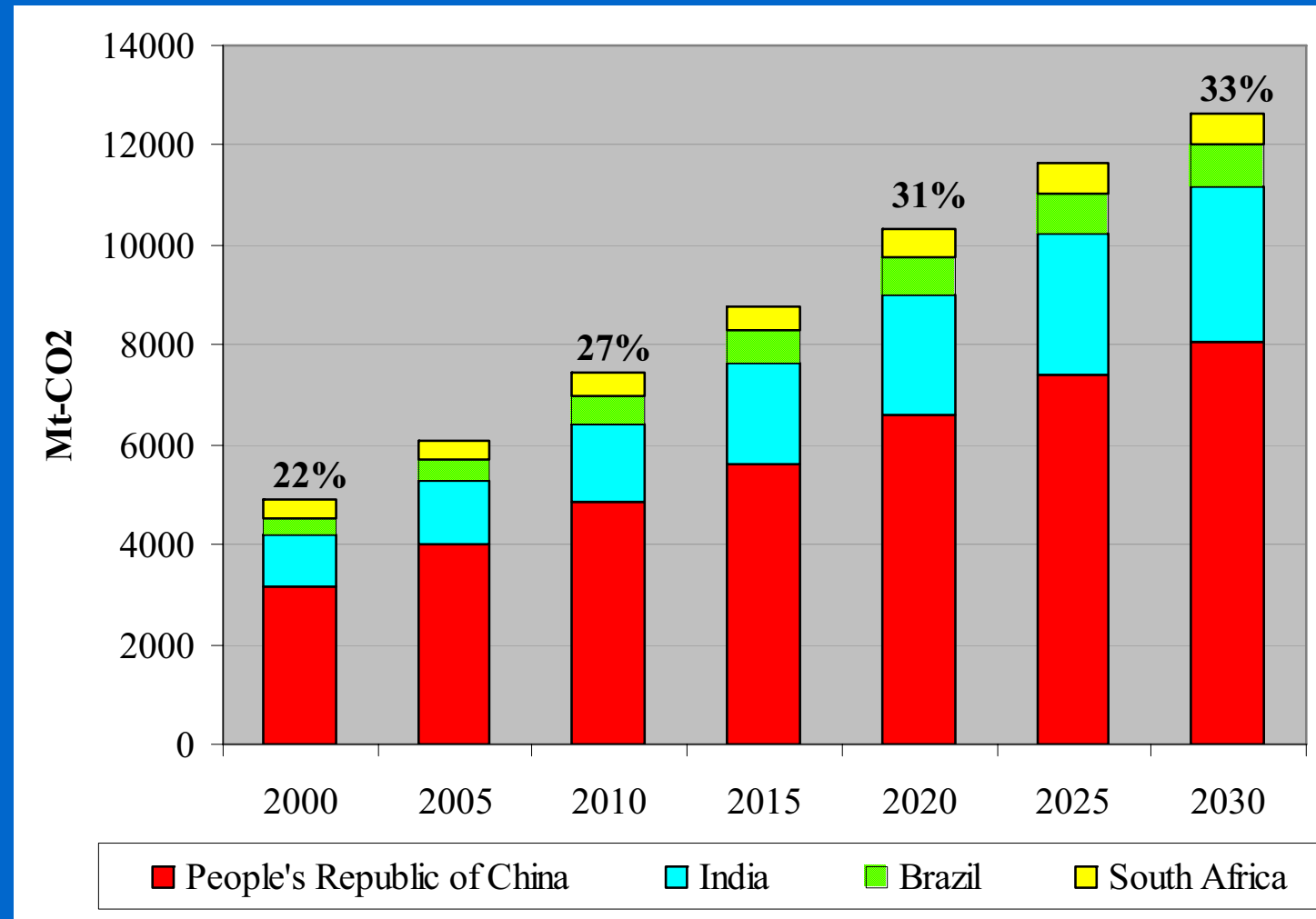




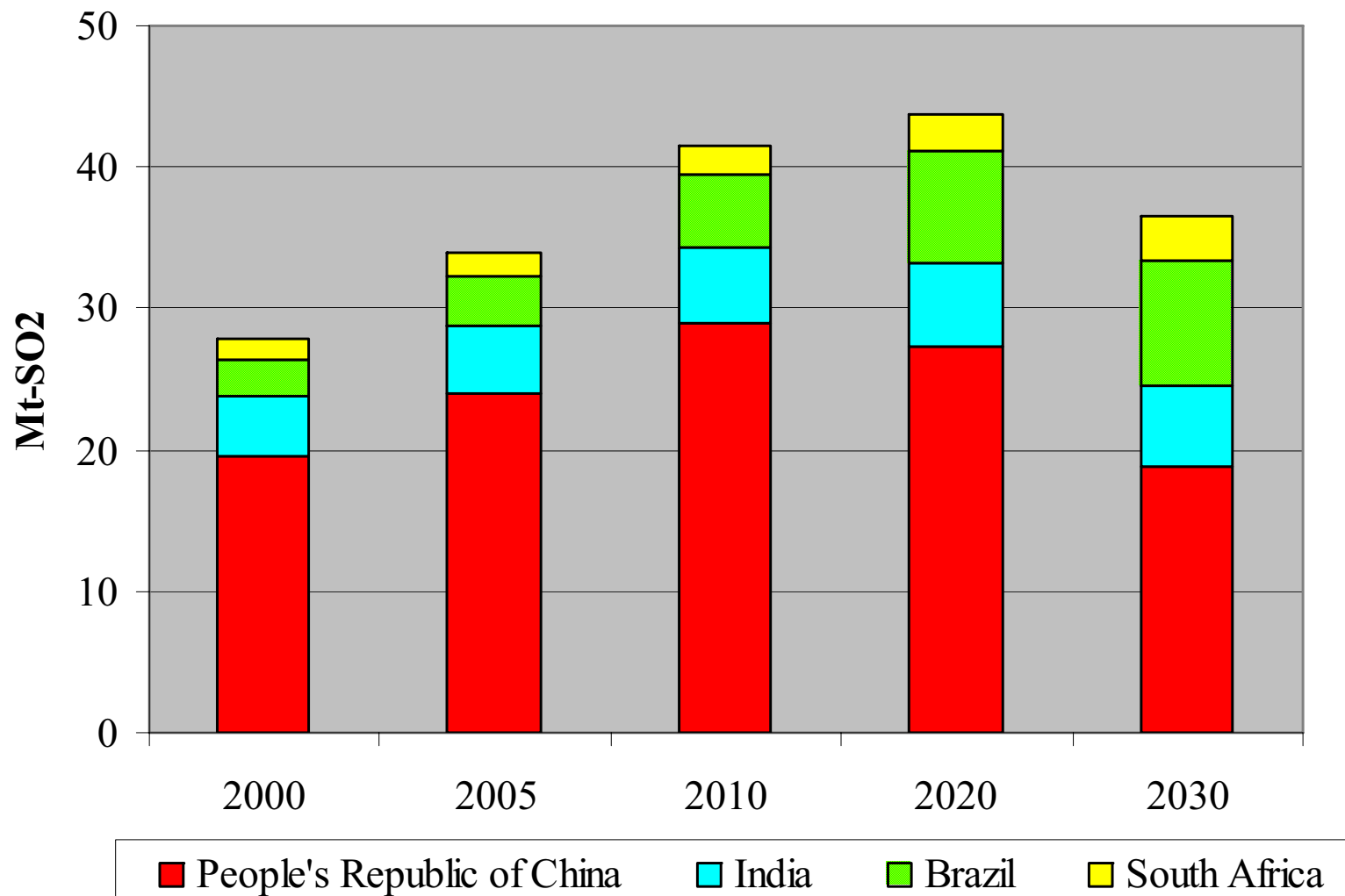
Energy and CO<sub>2</sub> emissions do not decouple much under reference scenario

# CO<sub>2</sub> Emission Projections

- Large developing countries are projected to add considerable fossil fuel based capacities during 2007-2030
- CO<sub>2</sub> emissions are projected to grow as a result

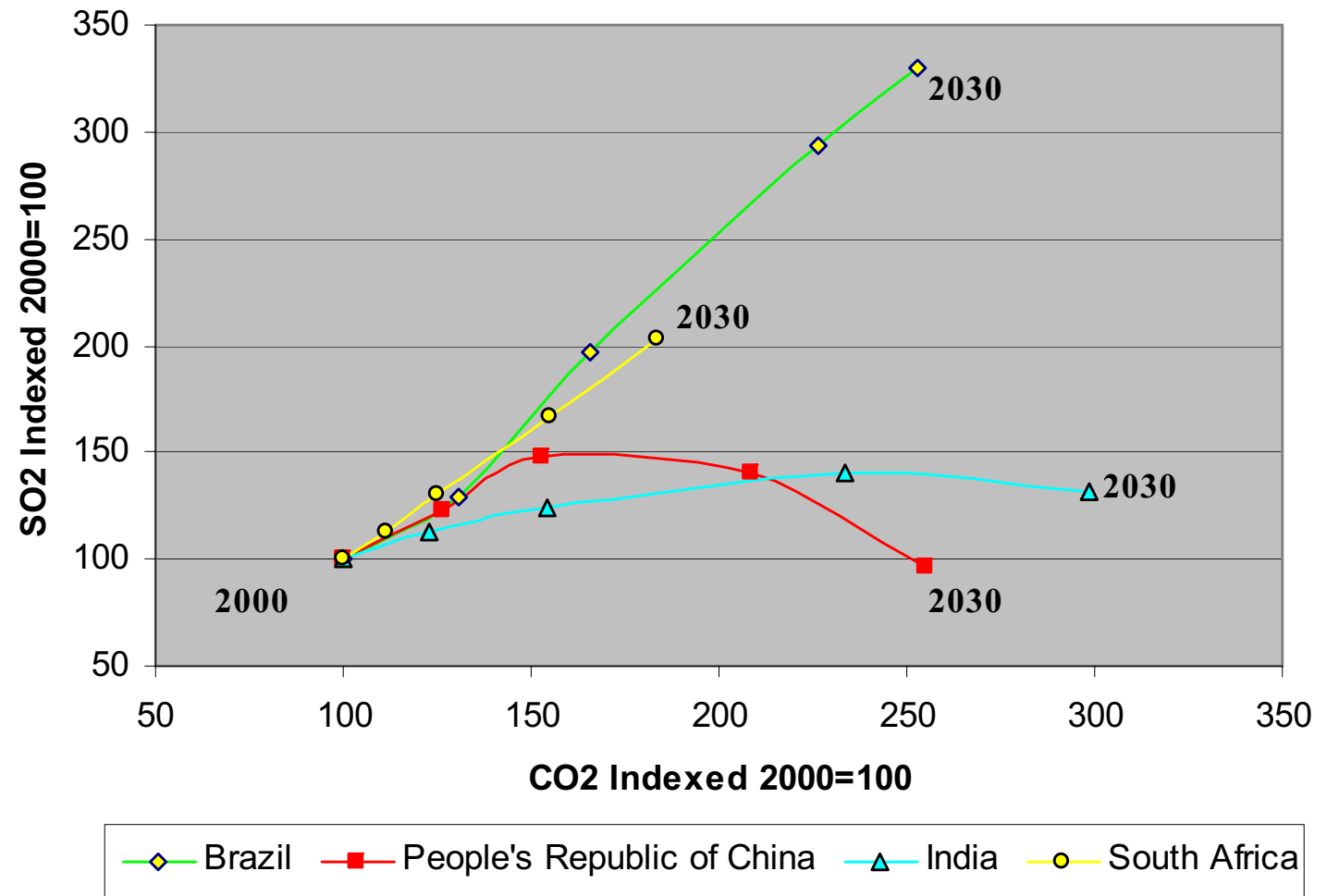


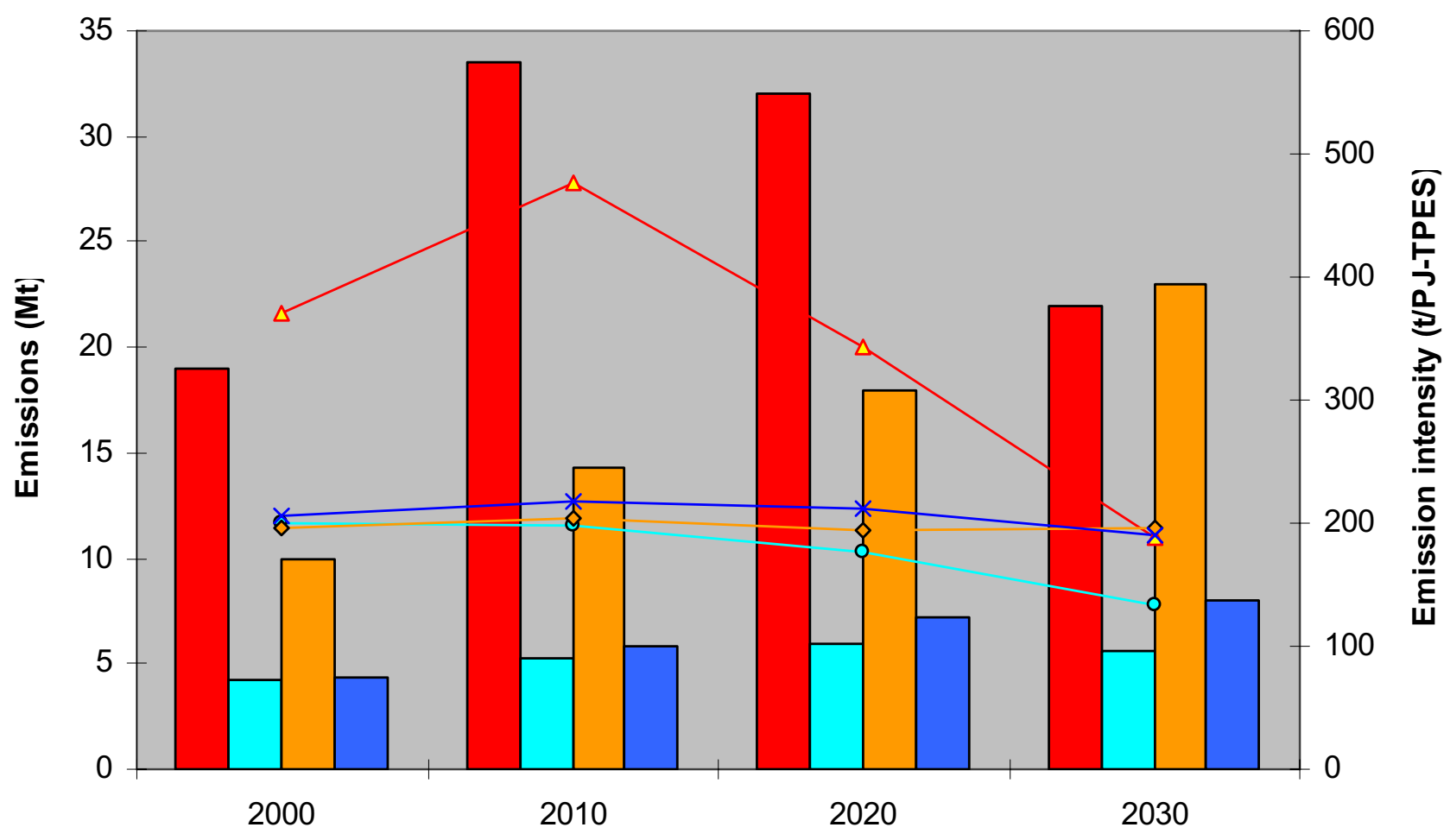
# SO<sub>2</sub> Emission Projections



# Emission Decoupling

CO<sub>2</sub> and local  
pollutant emissions  
(e.g. SO<sub>2</sub>, NO<sub>x</sub> and  
particulates)  
however do  
decouple under all  
scenarios



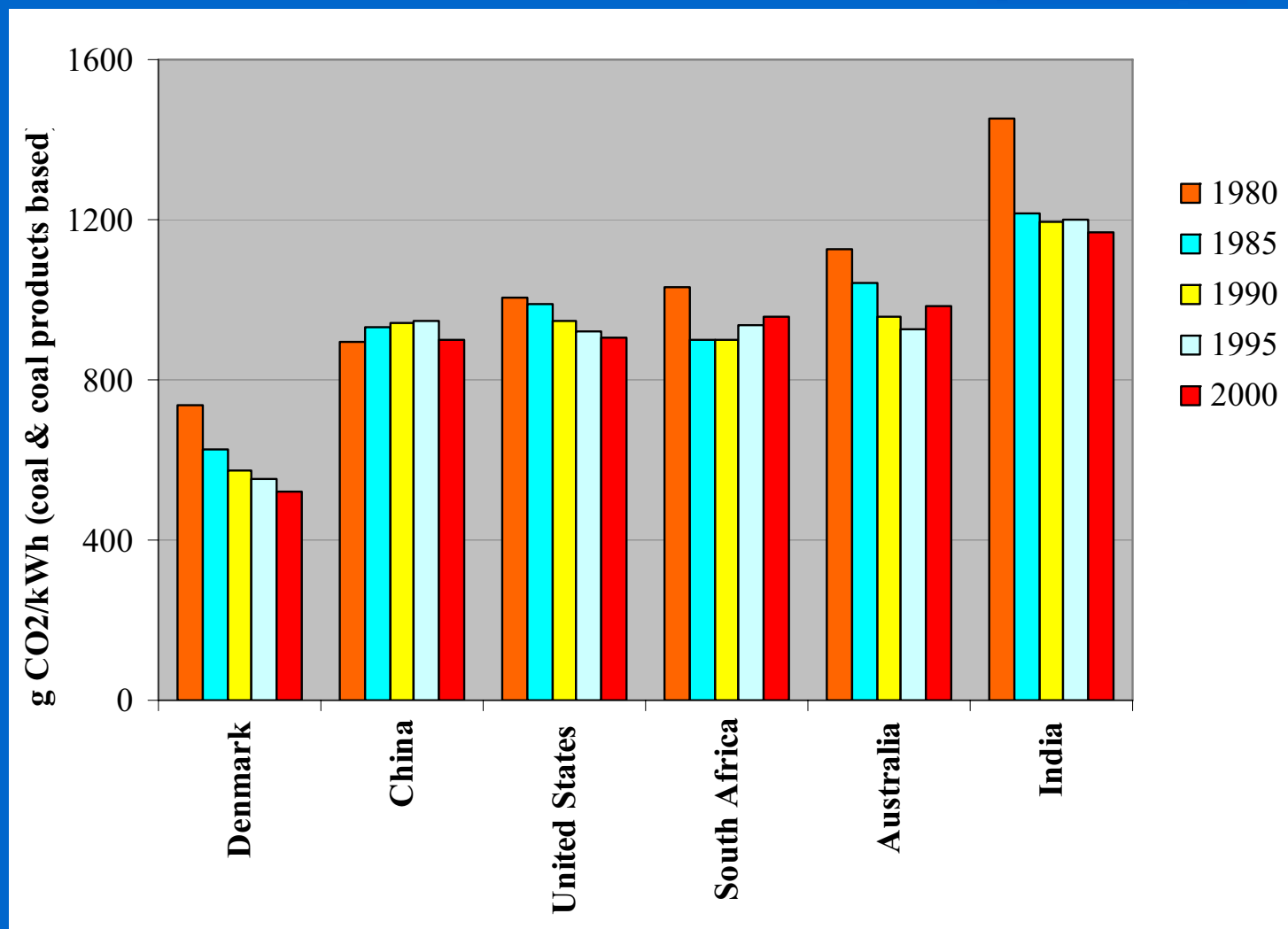


■ China SO2      ■ India SO2      ■ China NOx      ■ India NOx  
—▲— China SO2 Intensity    —●— India SO2 Intensity    —◆— China NOx Intensity    —×— India NOx Intensity

# Power Sector

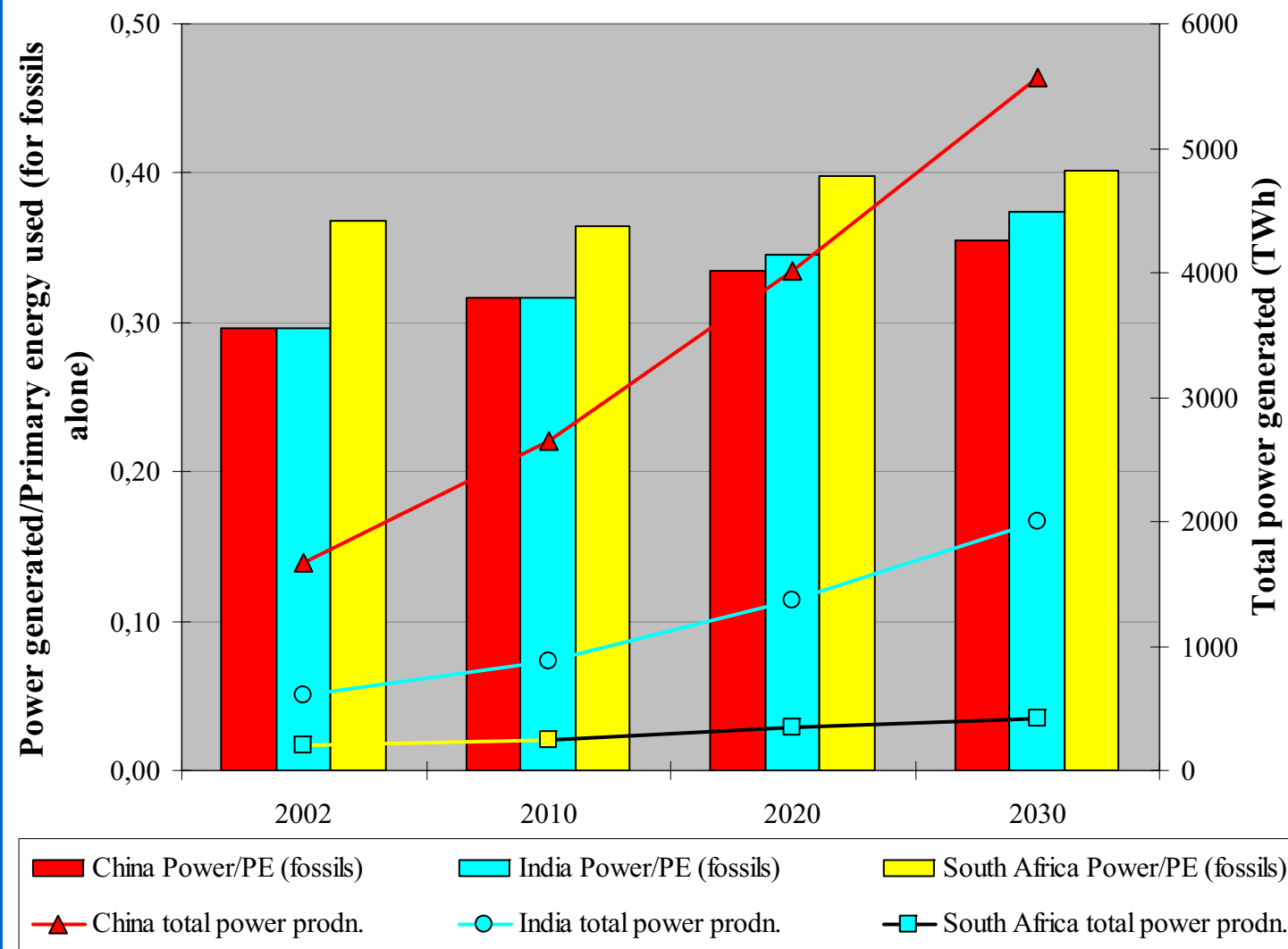
# Power Generation: Low Efficiency and Fossil Intensive

Average CO<sub>2</sub> emissions per unit of electricity generated are much higher than the best global practices



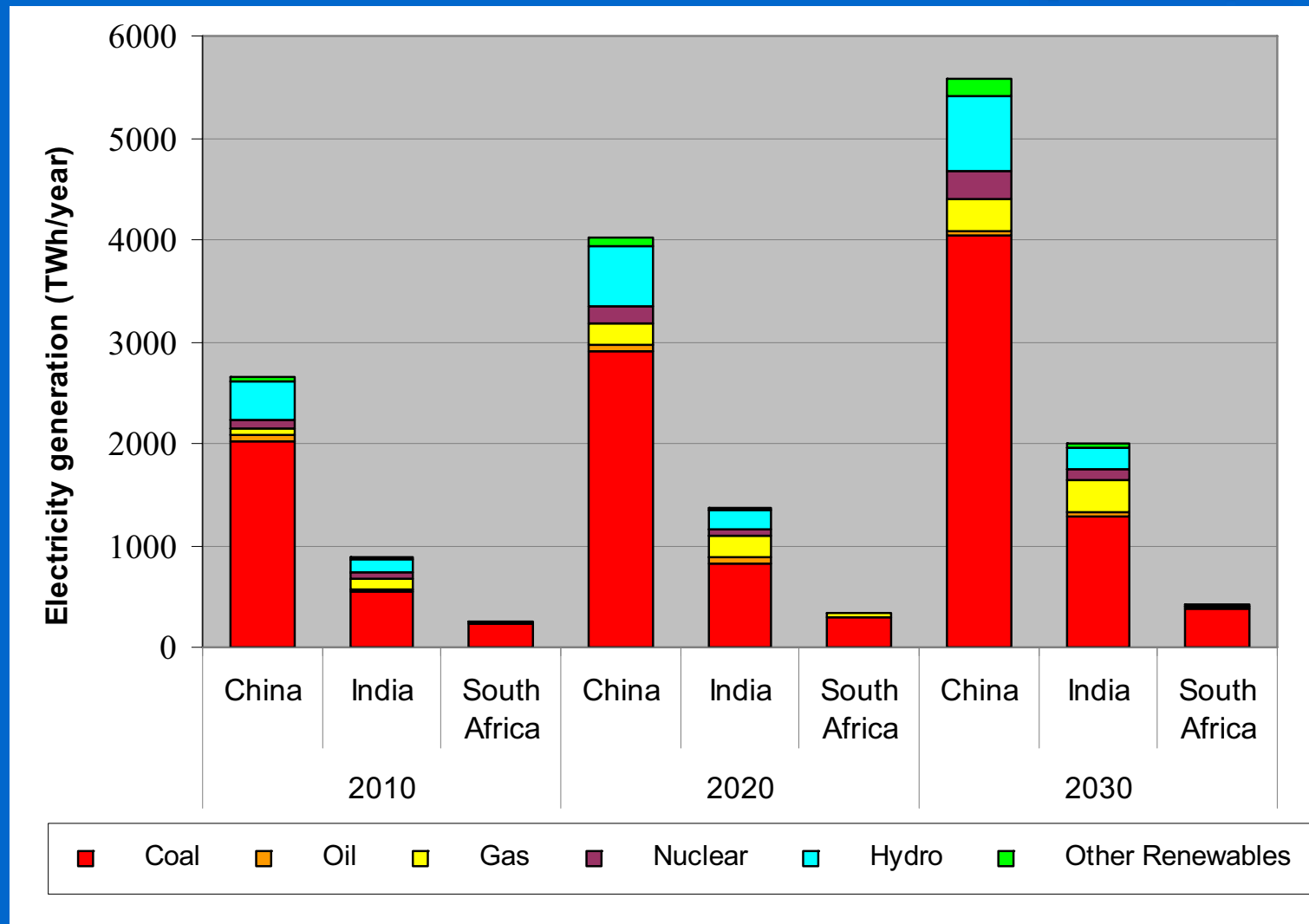
# Power Generation Projections

- Current efficiency of production is relatively lower, however projected to improve in future.
- China, India and South Africa consume over 40% of global coal, about 2/3<sup>rd</sup> is for power generation.



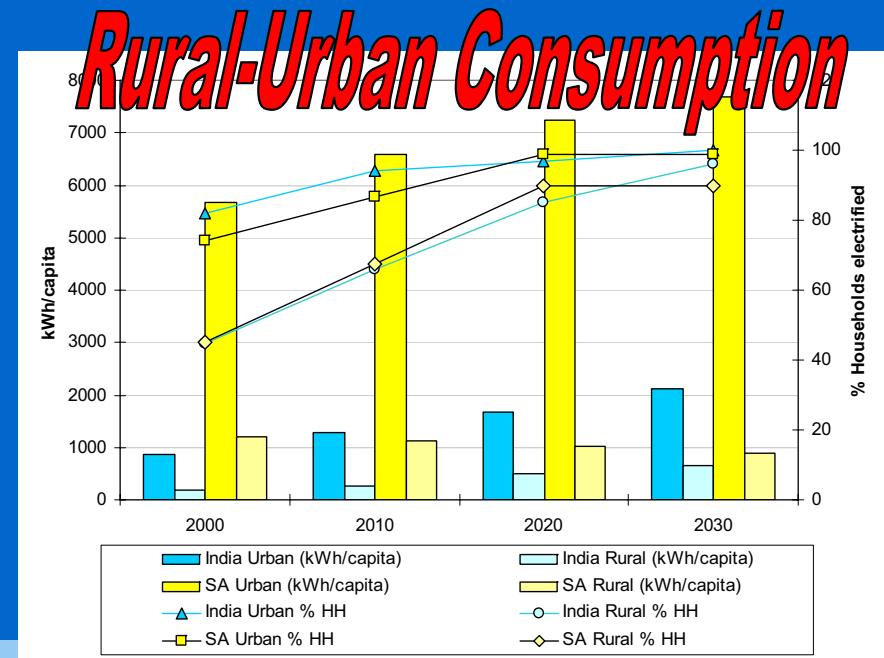
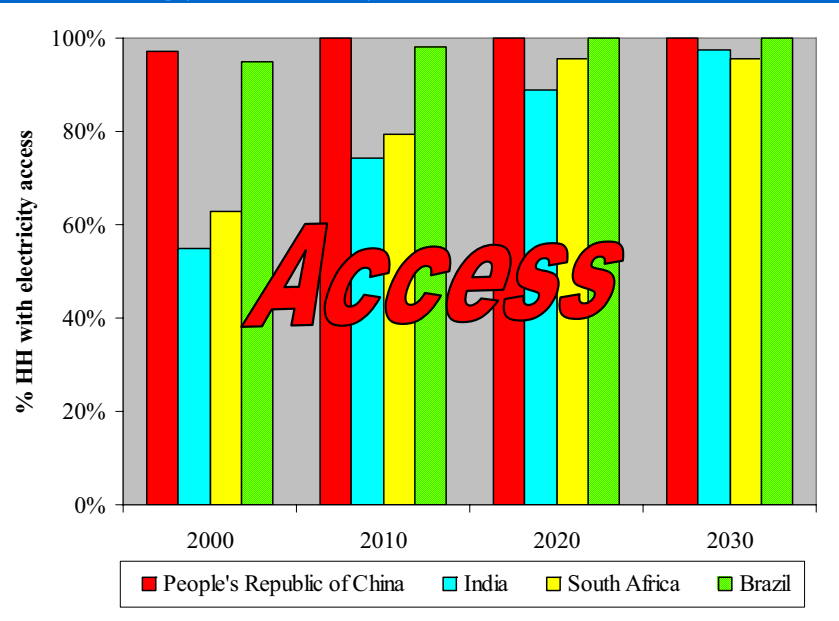
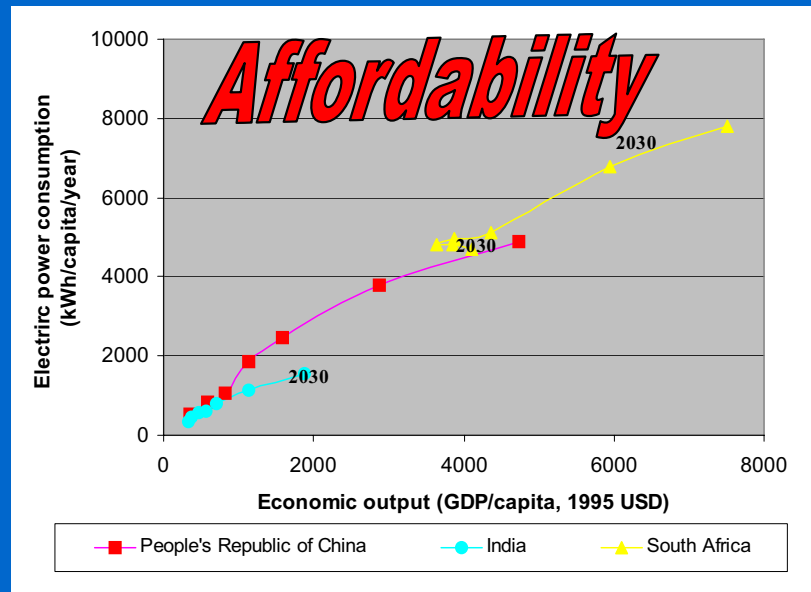
# Power Generation: Coal Projected to Dominate

China, India and South Africa are projected to add considerable fossil fuel based power generation capacities during 2007-2030



# Energy Electricity Poverty

- Reducing *energy poverty* through enhanced electricity access and consumption levels is projected to enhance electricity requirements during 2007-2030
- Coal based power is projected to remain the primary source - mainly due to energy security considerations



# Sustainable Development Indicators

# How to Capture Sustainable Development? SD Indicator approach

## ➤ Economic indicators

- National macro indicators (efficiencies)
- Energy use indicators
- Energy access indicators
- Energy investment indicators

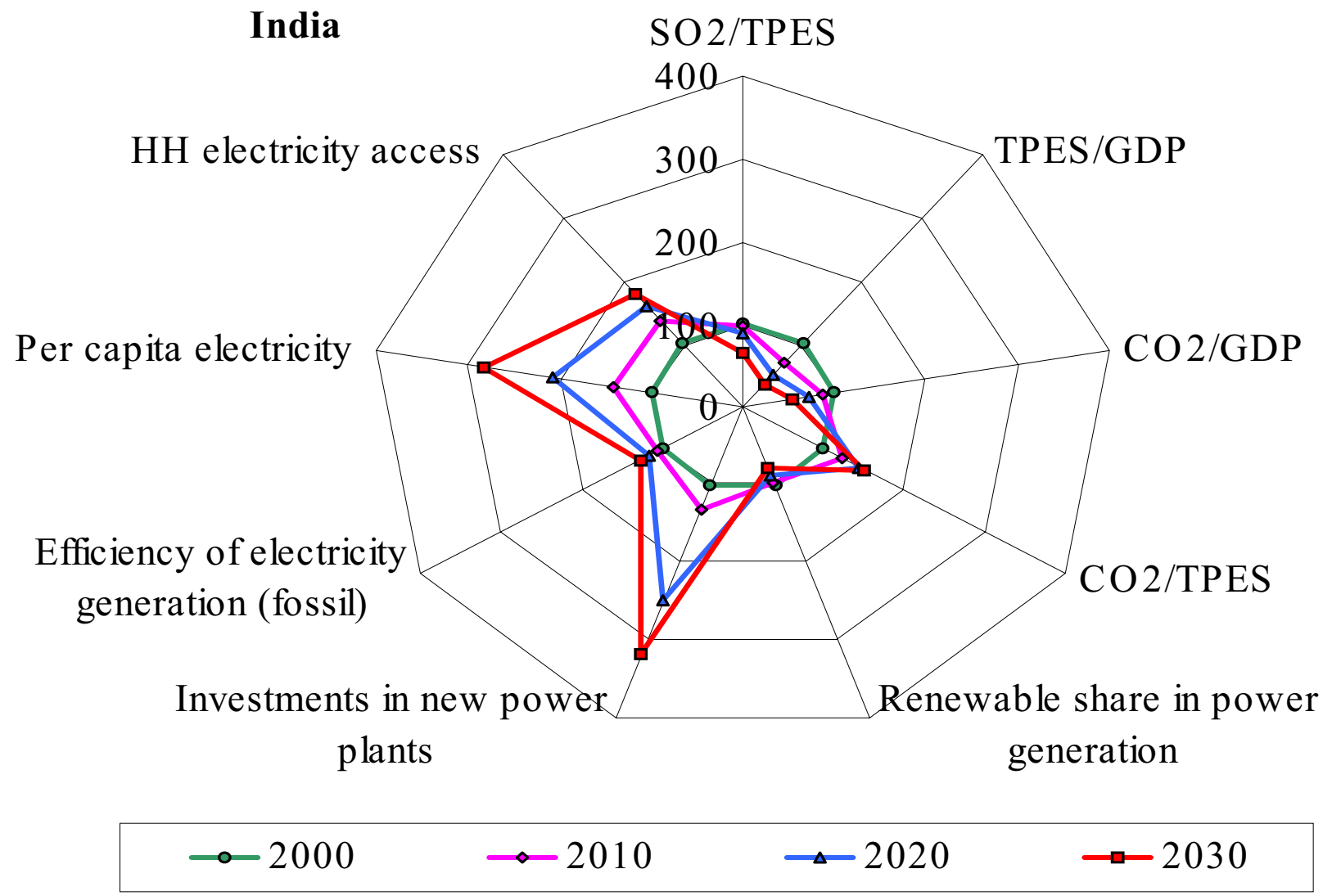
## ➤ Environmental indicators (GHG and local pollutant emissions)

## ➤ Social indicators

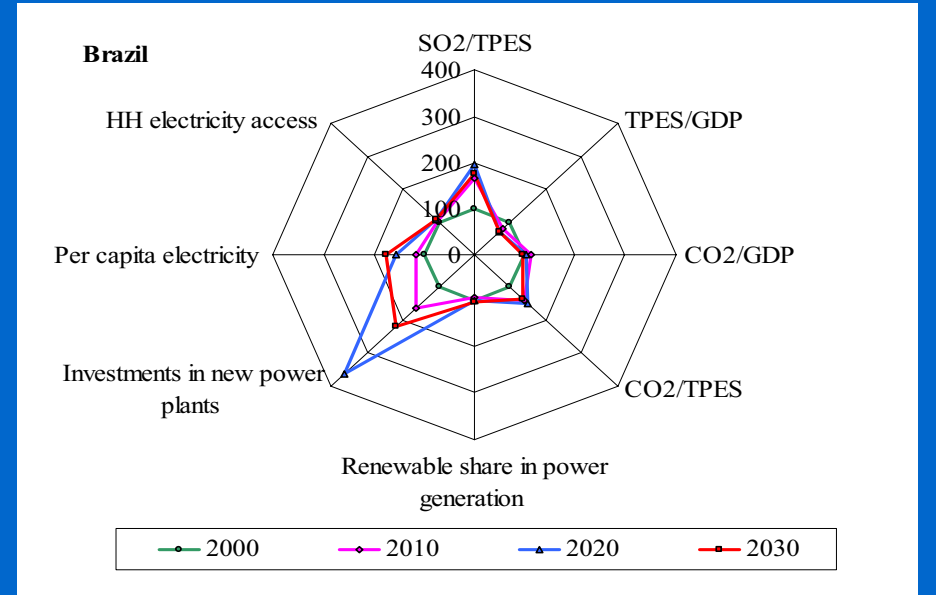
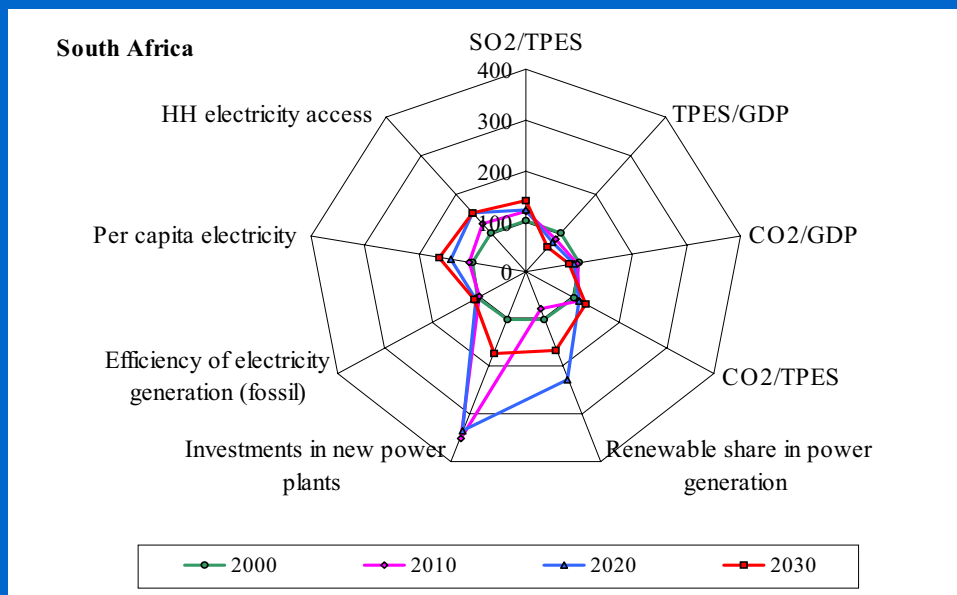
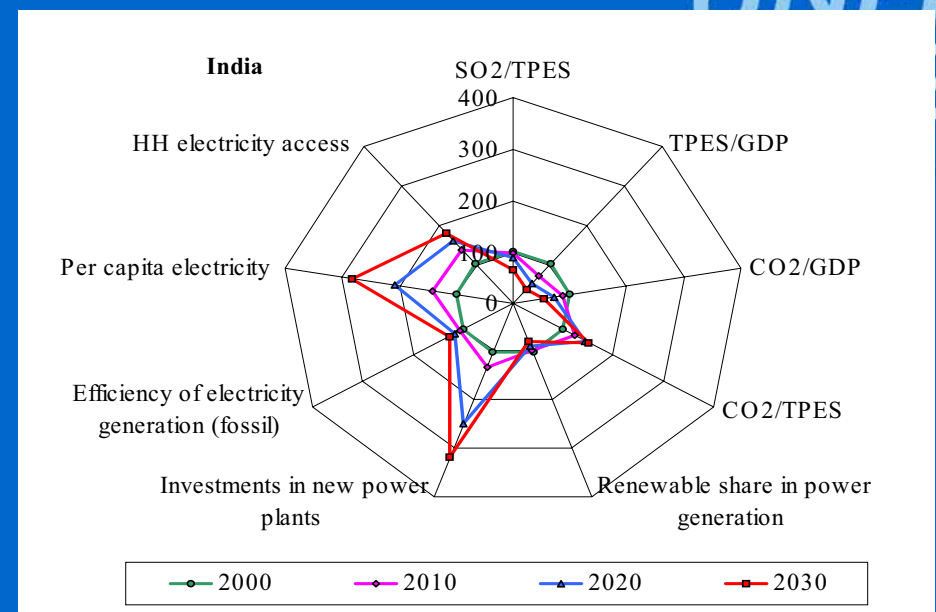
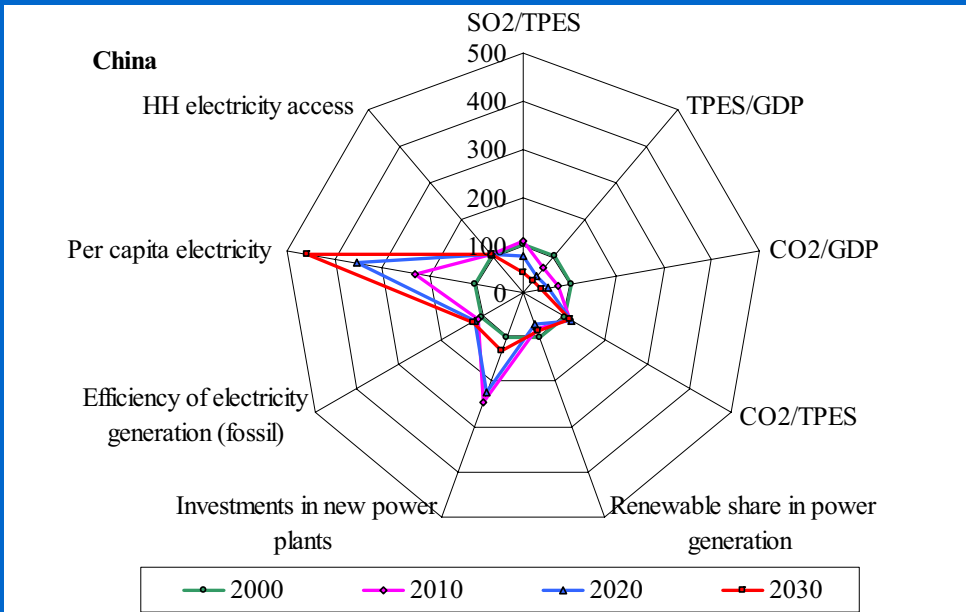
- Energy affordability indicators
- Employment indicators

## ➤ Mitigation cost curves (mitigation basket) for energy sector

# Sustainable Development Indicators



# Sustainable Development Indicators



# National Case Studies of Climate Friendly Development

# National Success Stories – Brazil

Case examples	Development impacts	Climate change mitigation/adaptation
Ethanol programme	Employment, foreign exchange savings, local air pollution	9.45 MtC saved per year (17% of energy sector emissions in 1994)
Zero tillage to ensure higher content of organic matters in soil	Increased use of herbicides, energy cost savings	60-80 Mt CO <sub>2</sub> not released in 1999, 70% reduction in diesel consumption

# National Success Stories – South Africa

Case examples	Development impacts	Climate change mitigation/adaptation
Clean energy generation mix: Gas, hydro, renewables, nuclear	Energy security benefits, local environmental improvements	Annual CO <sub>2</sub> savings in 2025: 70 Mt CO <sub>2</sub>
Industrial energy efficiency in 3 major companies	Energy cost savings, local environmental benefits	Annual CO <sub>2</sub> savings of around 0.07 mtCO <sub>2</sub>

# National Success Stories - Senegal

Case example	Development impacts	Climate change mitigation/adaptation
Expansion of LPG to substitute fuelwood	Decreased deforestation and negative social impacts from fuelwood consumption. Improved energy access	Savings of 700,000 m <sup>3</sup> wood per year from 1974-2000
Electricity reform including efficiency improvements and supply to rural areas	Reduced electricity supply costs	Reduced GHG emission intensity of power production

# National Success Stories - Bangladesh

Case example	Development impacts	Climate change mitigation/adaptation
Decentralized small NG power, biomass, solar home systems and other renewables, DSM	Supply electricity at 120 kWh/capita per year	Decreased GHG emission intensity of energy supply
Natural gas, oil and gas exploitation, biomass supply, switching from petroleum to NG, energy efficiency in industry.	Supply primary fuel at 4 million BTU/capita/year	Offset threats from climate change in terms of droughts, flooding, salinity, decreased crops, and erosion.

# National Case Studies – China and India

Case example	Development impacts	Climate change mitigation/adaptation
China: Energy efficiency in industry and power production	Local air pollution control, Energy cost savings in efficiency cases	Total SD scenario offers CO <sub>2</sub> reductions of 1.5 billion tC in 2030
India: South Asia energy-electricity market integration	Energy supply savings, cost savings, CO <sub>2</sub> and SO <sub>2</sub> emission reductions	1.4 billion tC and 50 million ton SO <sub>2</sub> saved over 30 years, Flood control, Reduced energy/electricity costs

# Move to a More Climate Friendly Development Pathway?

# Points of Intervention

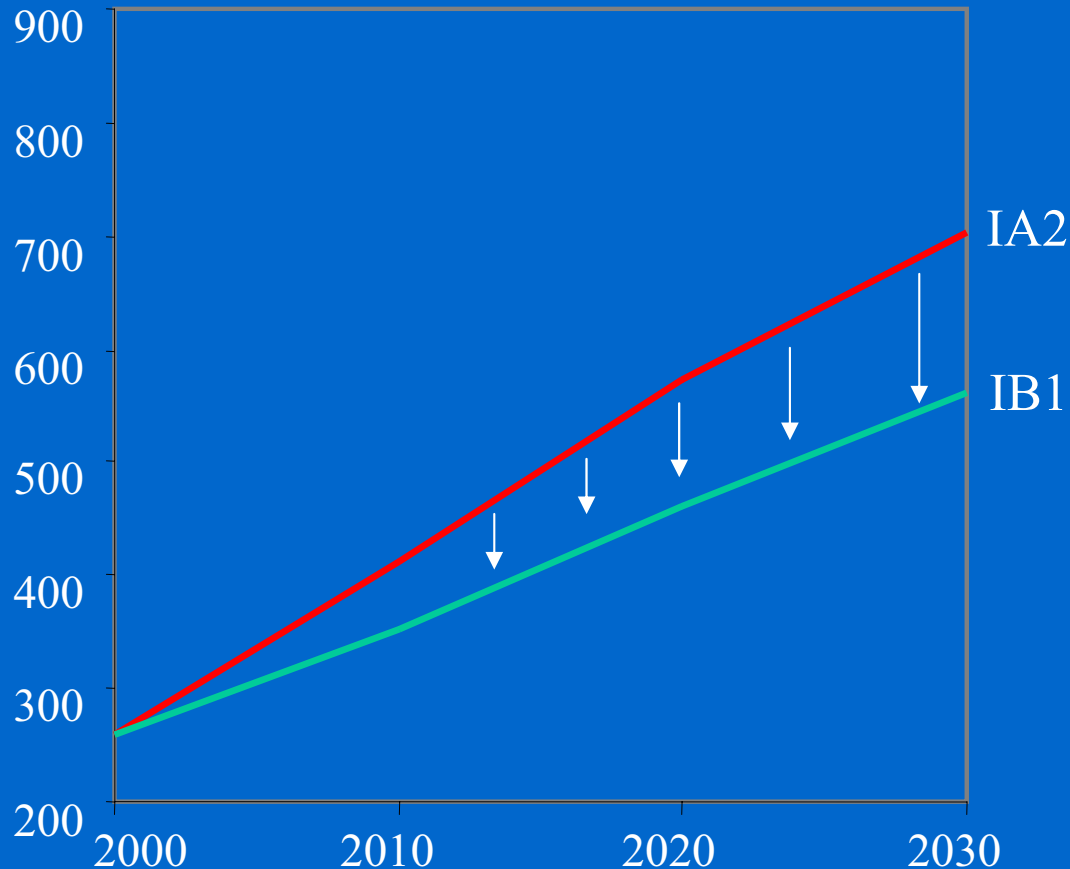
- Business-As-Usual policies will not change the path to a more climate friendly path
- We need to intervene at critical times (starting now) and through appropriate policies to change the development (and therefore emission) pathways
- These Points of Intervention could be, e.g.
  - Clean coal technologies for power generation
  - Dematerialization of product designs at all levels
  - Biofuels
  - Efficient transport (e.g. strengthening railway networks including metros)
  - Environmental education and consciousness at all levels

# Developmental Pathways: Comparative Performances

	IA1	IA2	IB1	IB2
GDP annual growth (2000-2030)	7.1%	5.5%	6.5%	4.2%
Cumulative Bt-CO <sub>2</sub> (2000-2030)	61	53	45	23
Per capita carbon, 2030 (tC)	0.63	0.49	0.47	0.39

# Development Path Transitions and CO<sub>2</sub> Emissions

Carbon Emissions ( Million Ton)



- **Mitigate 8 Bt-CO<sub>2</sub> over 2000-2030 to transit from IA2 to IB1 pathway**
- **Welfare loss due to;**
  - **Mitigation costs (up to 1.5% GDP loss)**
  - **Other development paradigms and GDP follow IA2 scenario (and not IB1)**
- **Better to follow climate friendly development path from the beginning**

# Clean Coal Technologies in China Under Alternative pathways

Sector	Technology	Share in 2030	
		Reference scenario	Alternative scenario
Power generation	Super Critical	25%	25%
Power generation	IGCC	4%	30%
Industry/Boiler	Advanced boiler	45%	75%
Industry/Kiln	Advanced kiln	38%	70%
Coal processing	Coal liquefaction	2% of total coal	10% of total coal
Desulphurization in power plants		58% of all plants	80% of all plants

# Promoting Clean Coal Technologies in China



Policy impacts on development, energy and climate change:

- Energy security.
- Large employment to low income families that are employed with the production of the technologies (7.6 million people in 2004 and 7.8 million people in 2030).
- Establishment of a strong position for China on international markets for cleaner coal technologies.
- Reduction in local and global emissions.

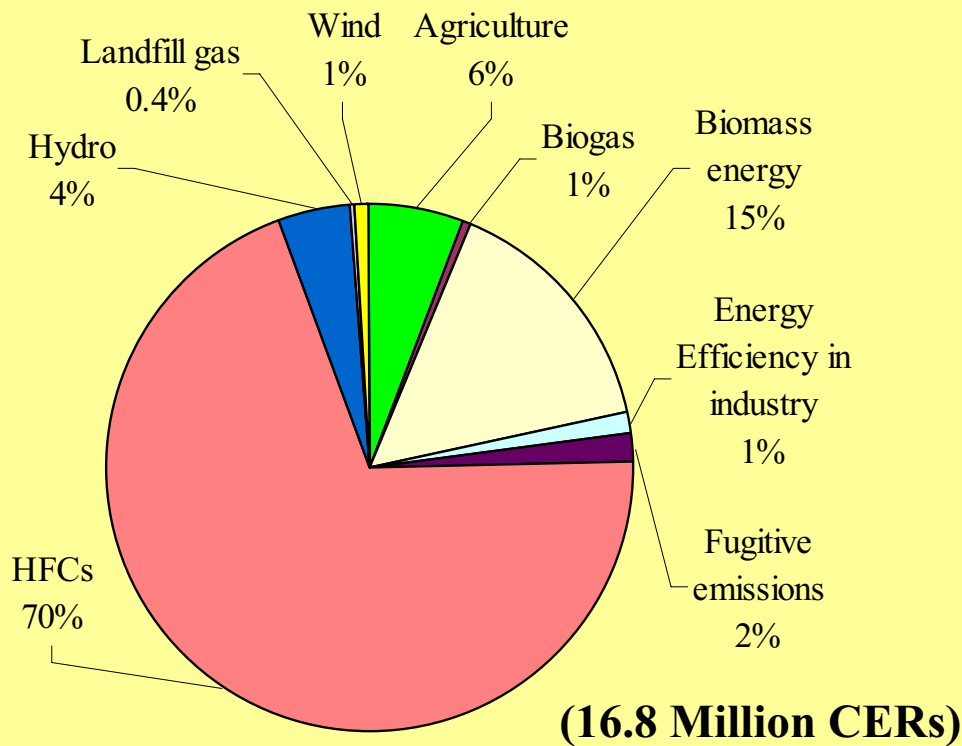


# Are Current Mechanisms (e.g. CDM) *Conducive* to Changing Development Pathways?

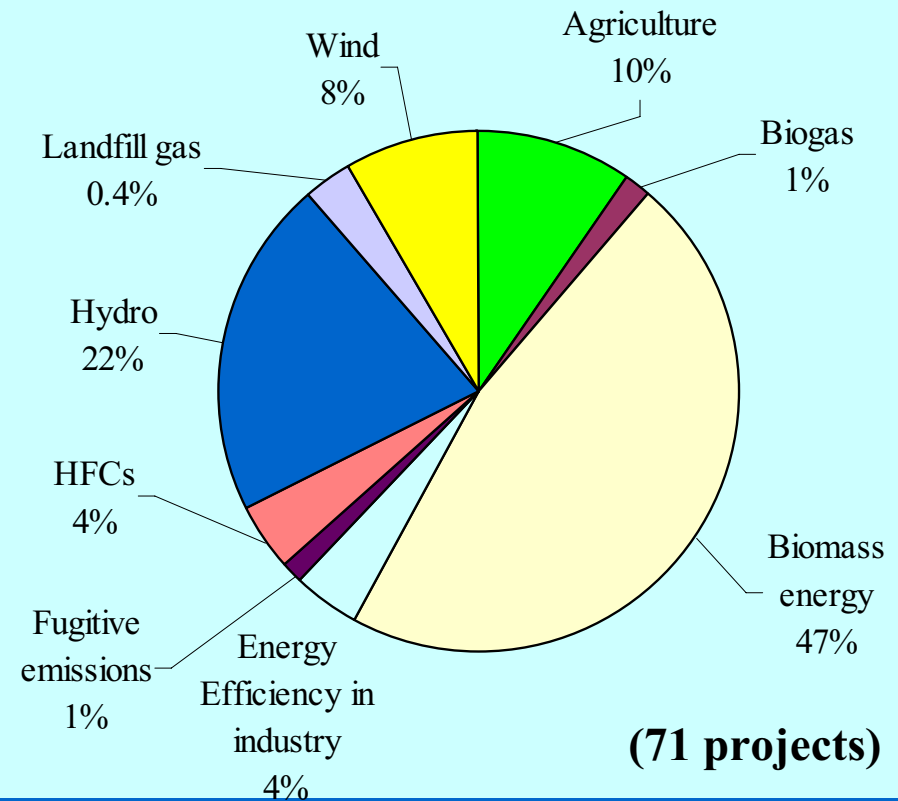
# Current CDM Project Profile

(with CERs Issued)

Issued CERs (kt)



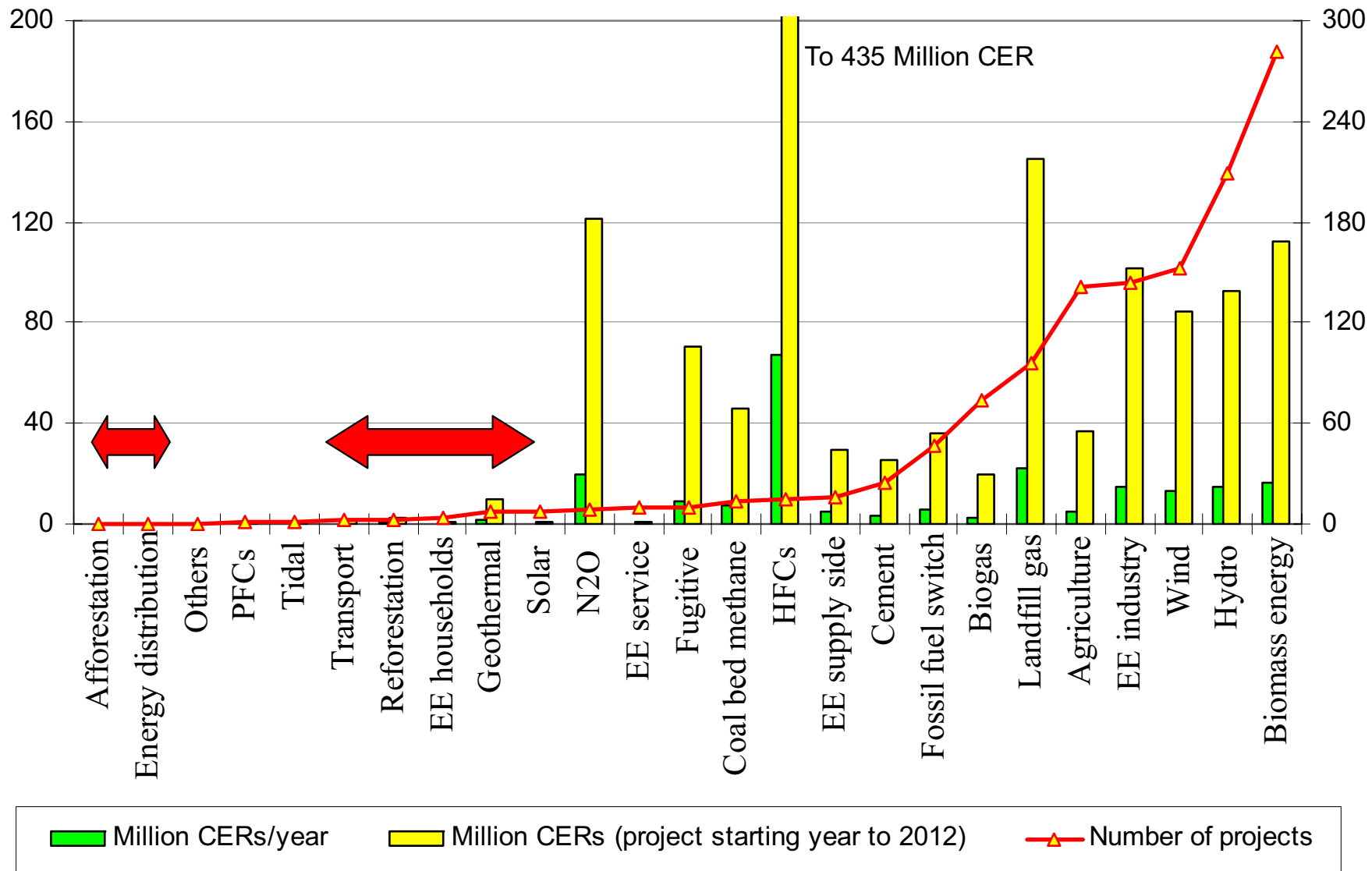
Number of Projects with CERs Issued



- Diversity of opportunities, projects and approaches
- Wide sectoral coverage.

Source: <http://uneprisoe.org/>

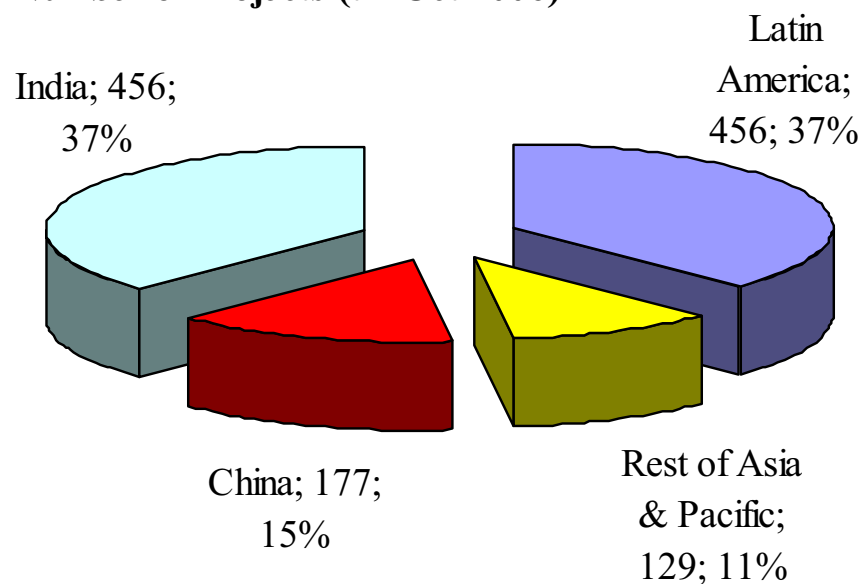
# Profile of all CDM Projects in the Pipeline



# Regional CDM Project Profile

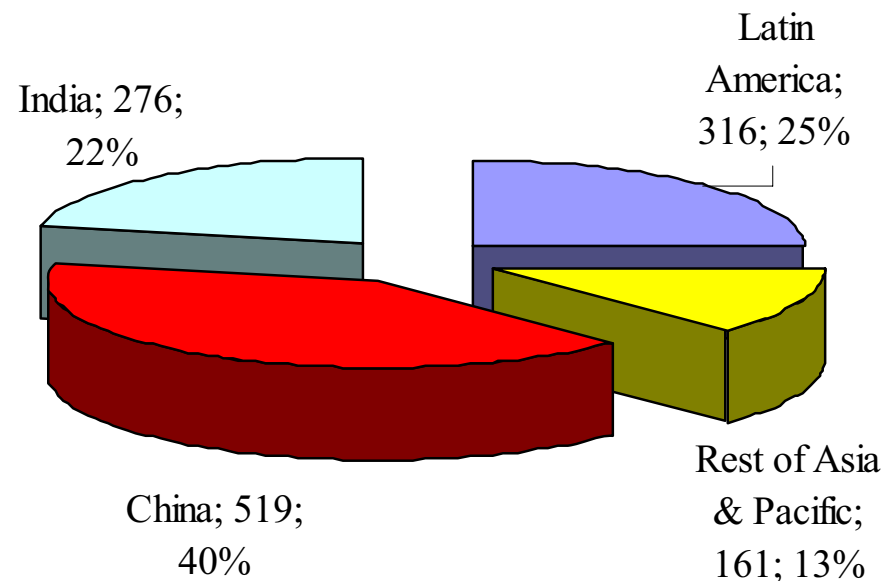
(updated till 20 October 2006)

## Number of Projects (till Oct 2006)



(1218 projects)

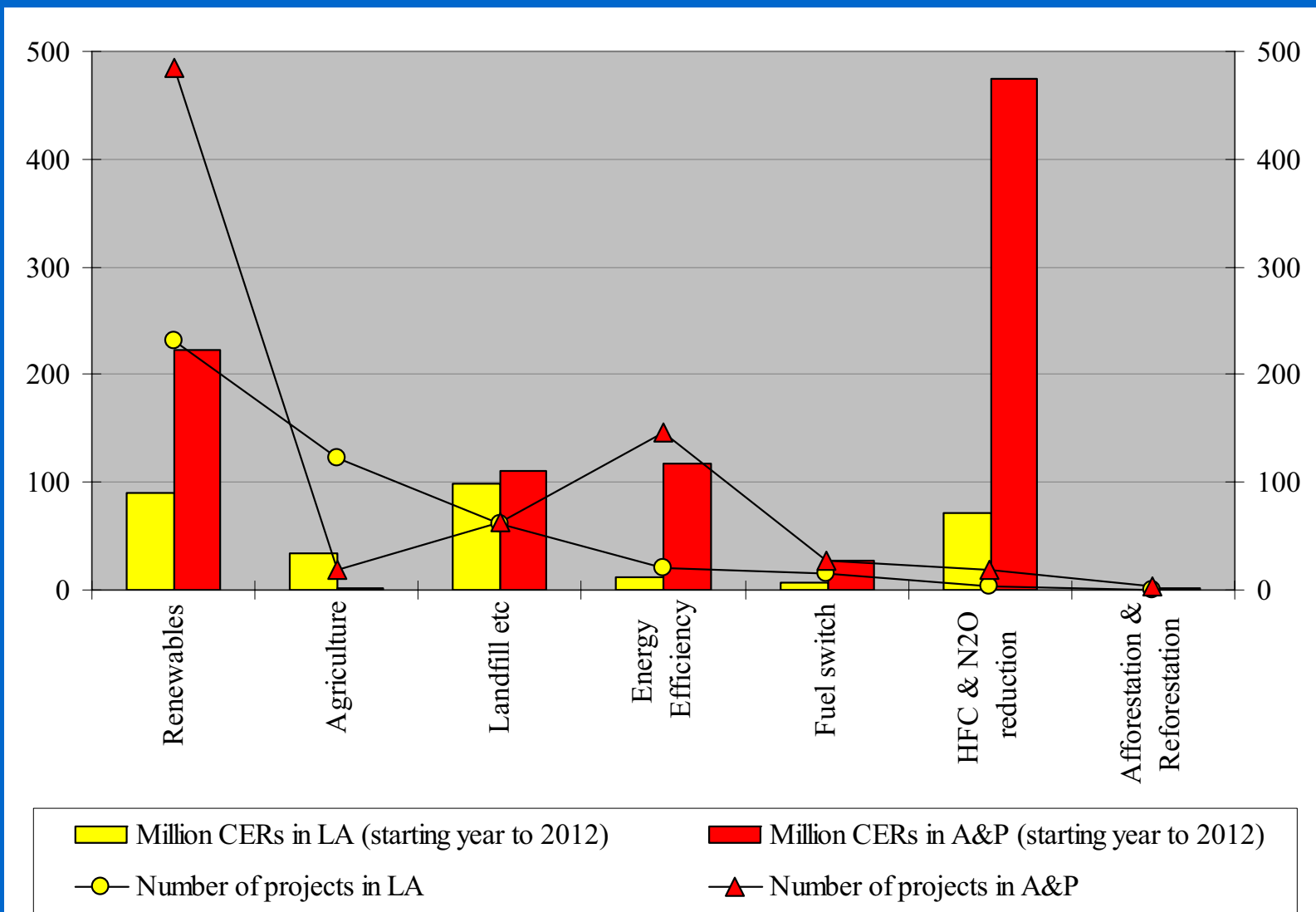
## Million CERs (project starting year to 2012)



(1272 Million CERs)

Source: <http://uneprisoe.org/>

# Sectoral CDM Project Profile for various Regions (updated till 20 October 2006)



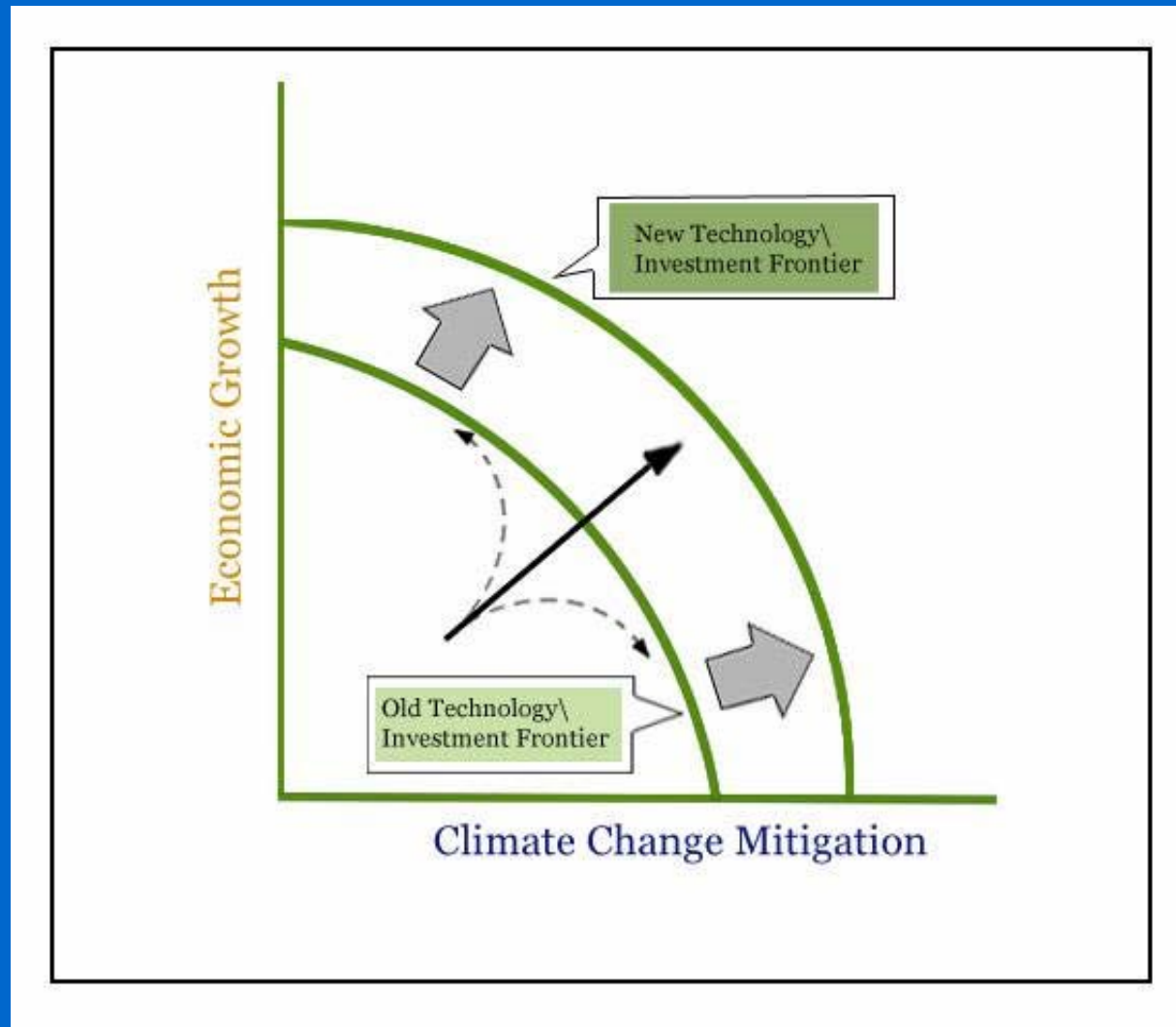
Source: <http://uneprisoe.org/>

# Conclusions

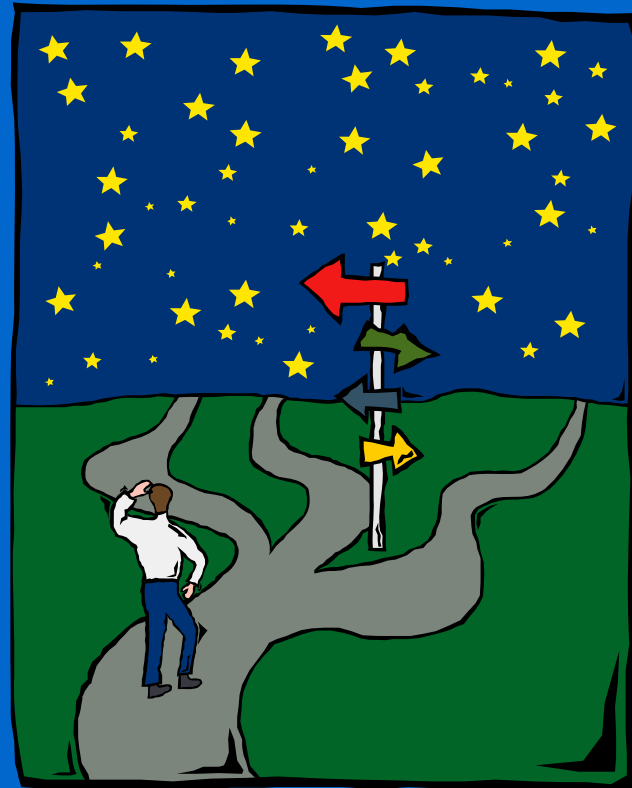
# Key Lessons Learned

- ‘Development’ could be one of the most promising approach for bringing in developing countries as it aligns and delivers mitigation and adaptation.
- This ‘non-climate’ route for international climate change policy making is feasible and cost-effective.
- Diversity of opportunities, projects and approaches exist
- Policies and measures can facilitate alter BAU pathways to more climate friendly development pathways
- There is no silver bullet to alter development pathways.
- Current CDM project profile may need some “corrections” for changing the development paths

# Development, Climate and Technology Frontier



# Time to Choose Path



More information at: [www.developmentfirst.org](http://www.developmentfirst.org)