



Climate Change and Economic Development in the 21st Century

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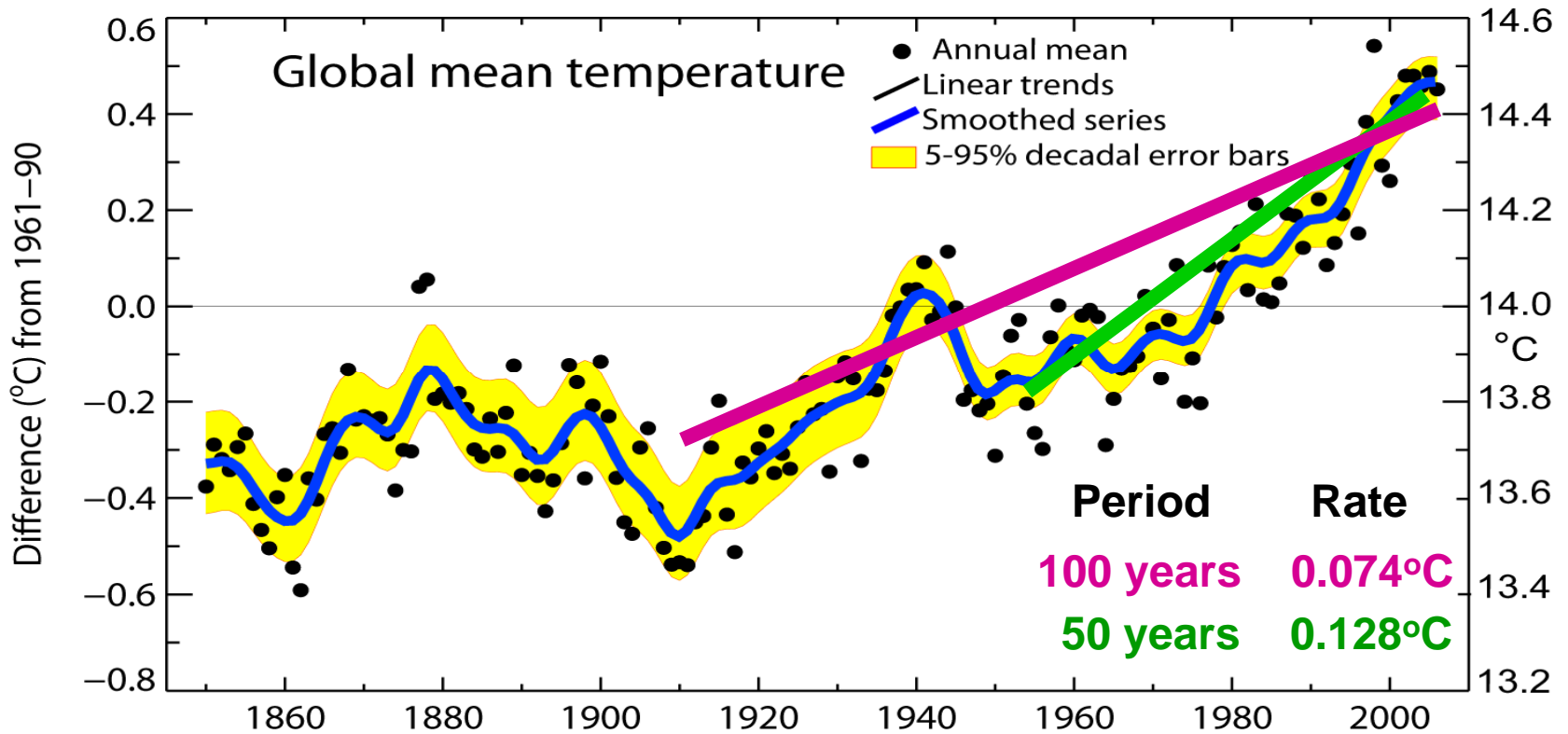
Shri R. Venkataraman
Endowment Lecture

Madras School of Economics
11th April 2009



The challenge of climate change

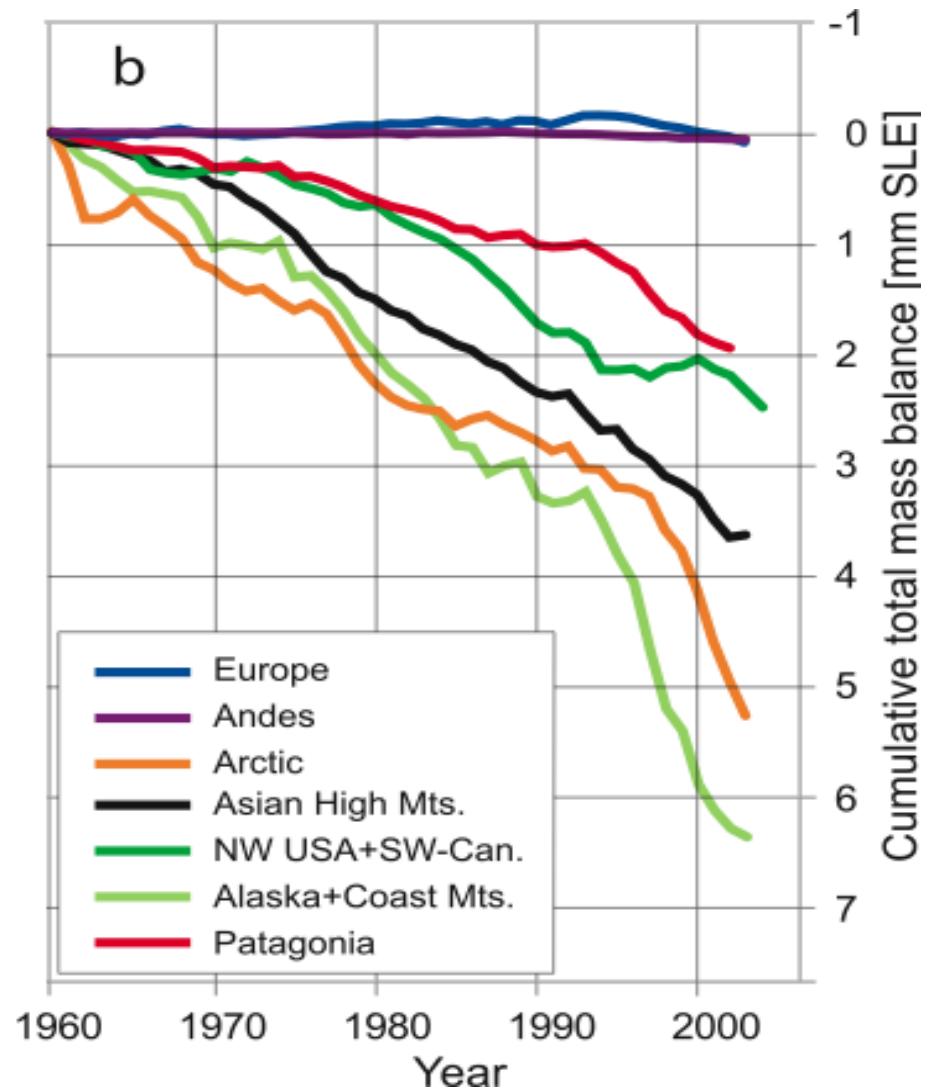
Changes in global average surface temperature



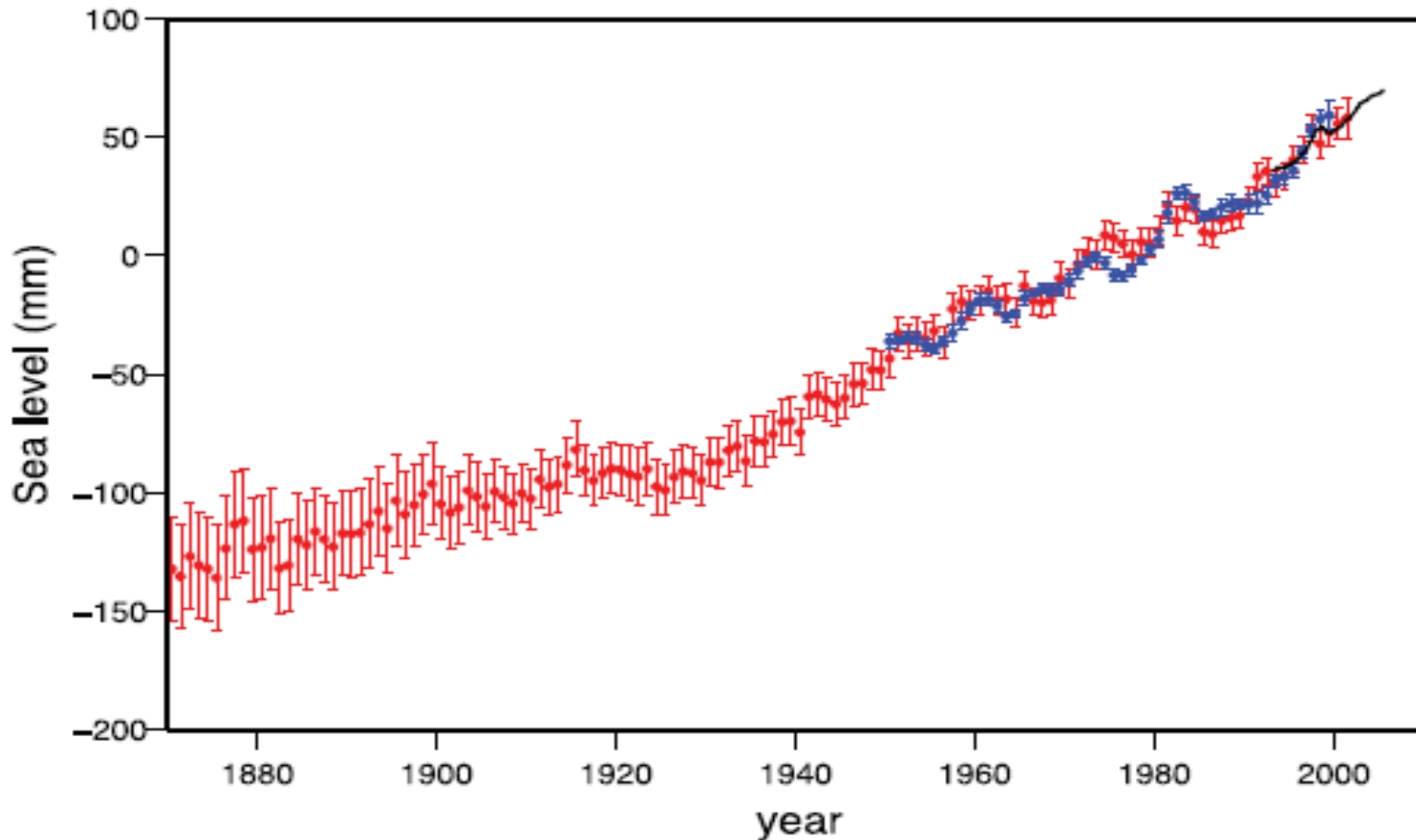
Eleven of the last twelve years rank among the twelve warmest years in the instrumental record of global surface temperature

Cumulative balance of glacier mass

Water supplies stored in glaciers are projected to decline in the course of the century



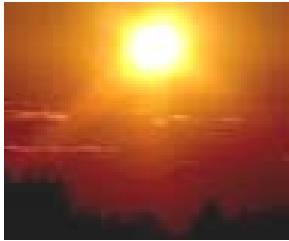
Changes in global average sea level



Global average sea level has risen since 1961 at an average rate of 1.8mm/yr and since 1993 at 3.1mm/yr

Observed climatic changes in India

Increase in frequency of **heat waves**



- 18 heat waves reported between 1980 and 1998
- Heat waves in Andhra Pradesh, 2003: 3000 deaths

Lower number of rainy days along east coast and **droughts** in delta regions



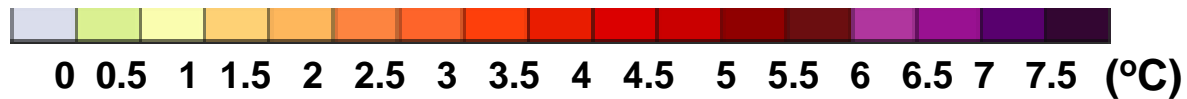
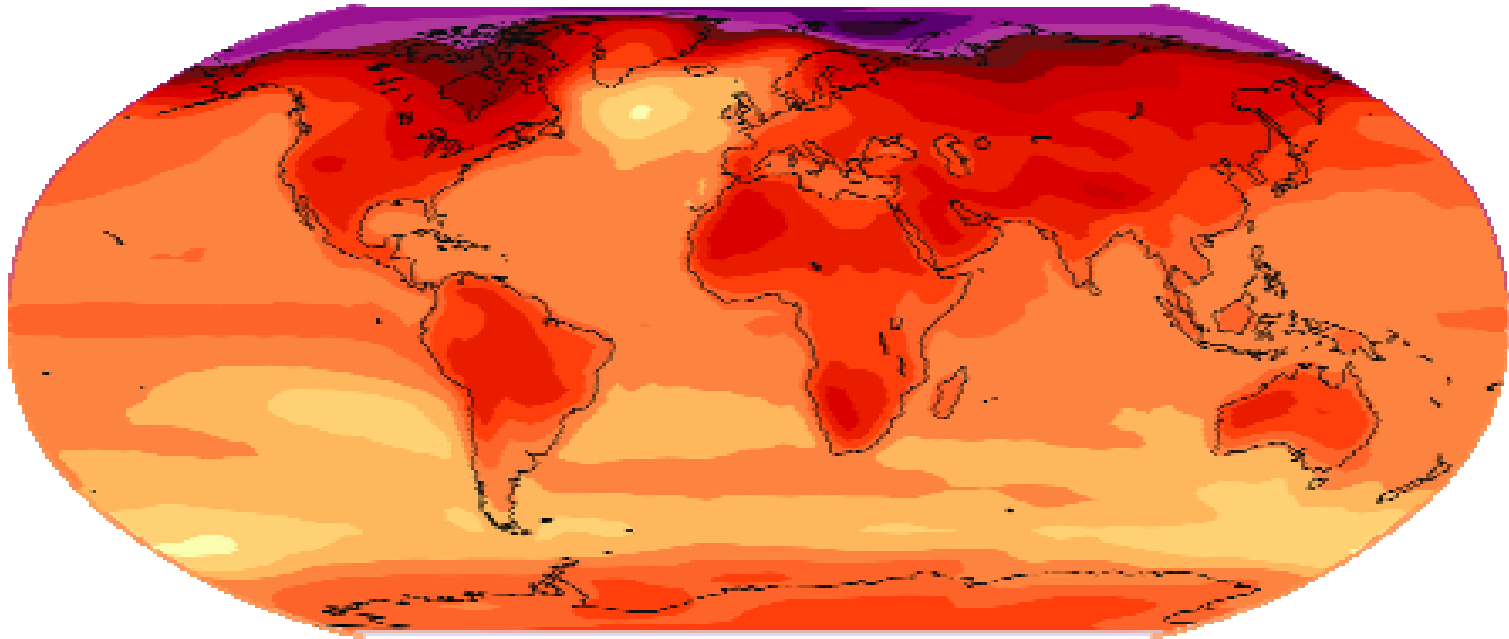
- Exacerbation of existing water stress
- Severe degradation of ecosystems

Increase in **extreme rains** in north during monsoon



- Serious and recurrent floods in north-east states
- Rainfall in Mumbai, 2005: 1000 deaths

Projected surface temperature changes (2090-2099 relative to 1980-1999)



**Continued emissions would lead to further warming
of 1.1°C to 6.4°C over the 21st century**

Examples of impacts associated with global average temperature change relative to 1980-1999

	0	1	2	3	4	5°C
WATER						
ECO-SYSTEMS						
FOOD						
COASTS						
HEALTH						

Some systems, populations and regions are likely to be especially affected



Tundra, mountains, coral reefs



Poor and marginalised communities



The Arctic, Africa, small islands



Coastal systems and mega-deltas

Expected impacts on India

Losses in agricultural productivity

- Wheat yields could decrease by 5-10% per one-degree rise in temperature

Decrease in freshwater availability

- Gross per capita water availability will decline from 1820 m³/yr in 2001 to 1140 m³/yr in 2050

Endemic morbidity and mortality

due to heat stress, floods, diarrhoeal disease and cholera

Implications for coastal areas

The impact of climate change on coasts is exacerbated by increasing **human-induced pressures**

Anticipated **climate-related changes** include:

- accelerated rise in sea level (no upper bound assessed)
- intensification of tropical and extra-tropical cyclones
- larger extreme waves and storm surges
- further rise in sea surface temperatures by up to 3°C

The potential impacts of 1 m sea-level rise include inundation of 5,763 km² in **India**



Climate change & development

Climate change will impede nations' abilities to achieve **sustainable development** pathways as measured, for example, by long-term progress towards the Millennium Development Goals

Climate change will adversely impact **basic needs**:

- Access to food and resources
- Stable health conditions
- Security of settlements

Adaptation and mitigation

Key adaptation strategies

Developing **knowledge** on impacts and vulnerabilities

Integrating adaptation in wider policies
(Ex. Integrated Coastal Zone Management)

Improving **disaster preparedness** and management

Improving **health care** systems

Promoting **good governance** including responsible decision making and communities empowerment

✘ Poverty is the largest barrier to developing the capacity to cope and adapt

Development & adaptation

Adaptation to the impacts of climate change & promotion of sustainable development share **common goals & determinants**:

- Access to resources and equity
- Stocks of human and social capital
- Access to risk-sharing mechanisms
- Institutional capacity

Social and environmental issues are often left without effective support when **economic growth** takes precedence

- ➡ **Appropriate policies** are key factors for improved sustainability & adaptive capacity

Adaptation is necessary to address impacts resulting from the warming which is already unavoidable due to past emissions

But **adaptation alone cannot cope** with all the projected impacts of climate change

➡ **Need for a mix of strategies including adaptation and mitigation of GHG emissions**

Characteristics of stabilisation scenarios

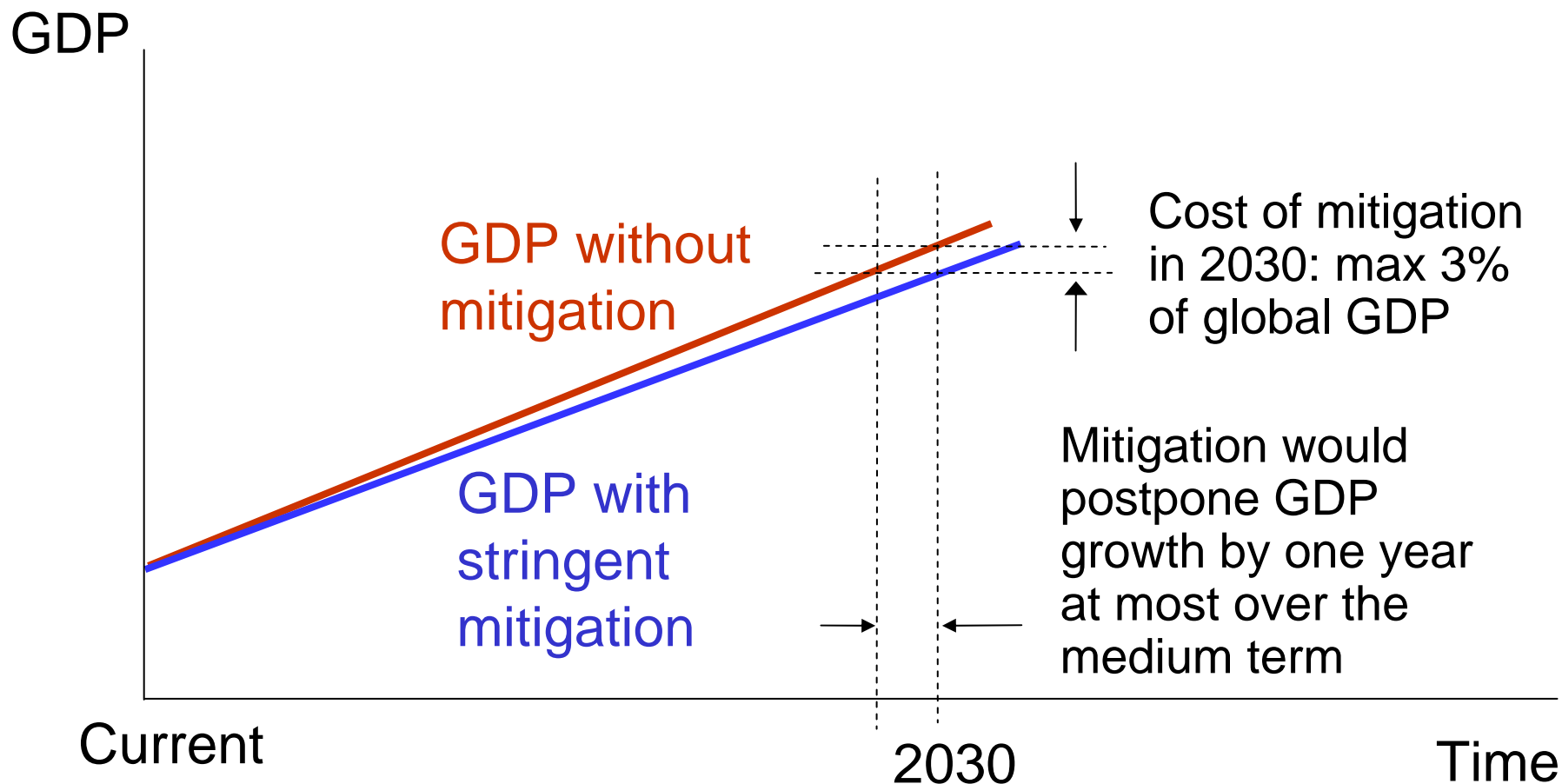
Stabilization level (ppm CO ₂ -eq)	Global mean temp. increase (°C)	Year CO ₂ needs to peak	Global sea level rise above pre-industrial from thermal expansion (m)
445 – 490	2.0 – 2.4	2000 – 2015	0.4 – 1.4
490 – 535	2.4 – 2.8	2000 – 2020	0.5 – 1.7
535 – 590	2.8 – 3.2	2010 – 2030	0.6 – 1.9
590 – 710	3.2 – 4.0	2020 – 2060	0.6 – 2.4

Estimated global costs in 2030

Stabilisation levels (ppm CO ₂ -eq)	Range of GDP reduction (%)	Reduction of average annual GDP growth rates (percentage pts)
590 - 710	-0.6 – 1.2	< 0.06
535 - 590	0.2 – 2.5	< 0.1
445 - 535	< 3	< 0.12

**Mitigation measures would induce 0.6% gain
to 3% decrease of GDP in 2030**

Impacts of mitigation on GDP growth



Co-benefits of mitigation

- ✓ **Health** co-benefits from reduced air pollution
- ✓ Increased **energy security**
- ✓ More rural **employment**
- ✓ Increased **agricultural production** and reduced pressure on **natural ecosystems**
- ➡ **Co-benefits provide the opportunity for no-regrets policies and reduce mitigation costs**

Opportunities for a low-carbon growth

Main drivers to industrial mitigation

- ✓ **Return** on investments
 - E.g. energy-efficiency improvements showing economic payout
- ✓ **Technology** development & transfer
 - Huge demand in developing countries to upgrade facilities
- ✓ Legally **mandated** mitigation
 - To avoid competition of mitigation against other company goals
- ✓ Stable, transparent **policies**
 - To address economic barriers to technology realisation
- ✓ Shift in **consumer** attitudes
 - Essential prerequisite to building sustainable societies



All stabilisation levels assessed can be achieved by deployment of a portfolio of **technologies that are currently available or expected to be commercialised** in coming decades



This assumes that **investment flows, technology transfer and incentives** are in place for technology development



Sectors of investments

Clean energy

- Power generation & storage, infrastructure, transport & biofuels

Environmental resource management

- Water, agriculture, waste management

Energy & material efficiency

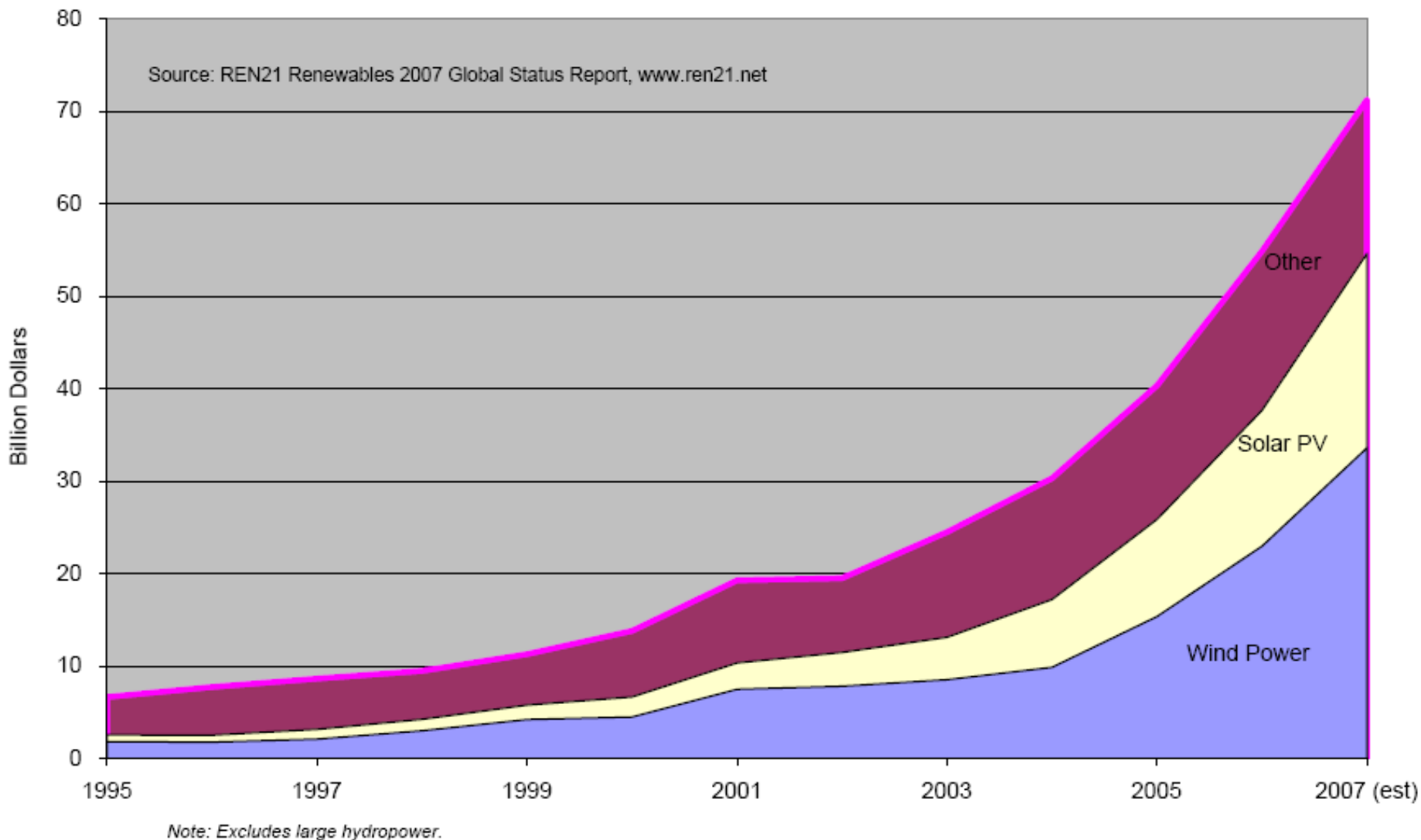
- Advanced materials, building efficiency, power grid efficiency

Environmental services

- Environmental protection, business services

➤ These sectors represent a fast-growing **multi-hundred billion dollar market-place** with numerous opportunities

Annual investment in new renewable energy



Employment opportunities

Energy-efficiency investments have positive effects on employment:

- Directly by creating new business opportunities
- Indirectly through the effects of spending the money saved on energy costs in other ways

Renewable-energy technologies are more labour-intensive than conventional technologies for the same energy output

- Solar PV and wind-energy generate 5.7 person-years of employment per 1 million US\$ investment (over ten years); while coal industry generates only 4

Towards a new development path

The **dominant path to industrialisation** has been characterised by high concurrent GHG emissions

Committing to alternative development paths requires **major changes** in a wide range of areas:



- Economic structure
- Geographical distribution of activities
- Consumption patterns
- Demography

Political support for green growth

Policy landscape

Policy targets for **renewable energy** exist in at least 66 countries¹

- EU target: 20% of final energy by 2020

At least 60 countries some type of policy to promote **renewable power generation**¹

- Most common policy: feed-in tariffs


63 countries have enacted **energy efficiency** policies²

- Fastest growing policy: labelling & minimum energy performance standards

Energy + Efficiency

Manufacturer Model	Logo ABC 123
More Efficient	
A	
B	
C	
D	◀ D
E	
F	
G	
Less Efficient	
Energy Consumption kWh/year <small>(Based on standard test results for 24h) (Actual energy consumption will depend on how the appliance is used, and where it is located)</small>	575
Fridge/Freezer Refrigerator Freezer	◀ * (x x x)
Storage Volume Fresh Food Frozen Food	150 L 125 L
Noise	62 dB (A)

A fiche giving details is contained in product brochures.
from EN 138 May 95
refrigerator size: directive N° 90/269/EEC



Some decisions of the Bali Roadmap (2007)

- ✓ “Recognizing that **deep cuts** in global emissions will be required [...]”
- ✓ Conclusion of a **post-Kyoto treaty** by 2009
- ✓ Stage for a strategic programme on **deforestation** and **technology transfer**
- ✓ Stage for commitments by **developing countries** to measurable and verifiable national mitigation actions
- ✓ On-going work to implement **existing commitments**

Barack Obama's New Energy for America plan (2008)

- ✓ Create 5 million new **green jobs** by investing \$150 billion over the next 10 years
- ✓ Ensure 10% of electricity comes from **renewable** sources by 2012, and 25% by 2025
- ✓ Get 1 million **hybrid cars** on the road by 2015
- ✓ Implement an economy-wide **cap-and-trade** program to reduce greenhouse gas emissions 80% by 2050

Hu Jintao's perspective on China's "conservation culture" (2007)

- ✓ Accelerate the building of an **energy-efficient** and **environmental-friendly society**
- ✓ Follow a **new-type pattern of industrialisation**

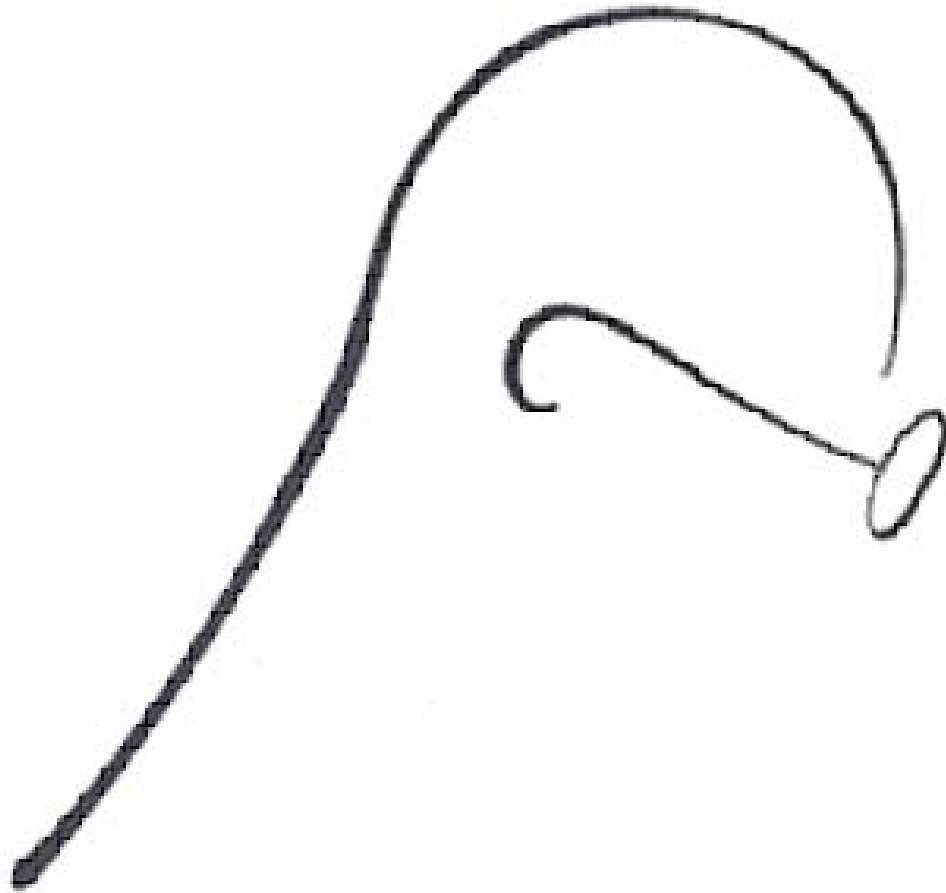
Lee Myung-Bak's green growth strategy for Korea (2008)

- ✓ Reduce 50% of **energy intensity** by 2030
- ✓ Increase the use of **new and renewable energy** from 2% to more than 20% by 2050
- ✓ Invest 2.7 billion US\$ in the next five years to foster **green energy sector**

Indian National Action Plan on Climate Change (2008)

Establishment of **National missions** for:

- Solar Energy
- Enhanced Energy Efficiency
- Sustainable Habitat
- Water
- Sustaining the Himalayan Ecosystem
- Green India
- Sustainable Agriculture
- Strategic Knowledge for Climate Change



Gandhi was once asked if he expected India to attain the same standard of living as Britain. He replied:

It took Britain half the resources of the planet to achieve this prosperity. How many planets will a country like India require!