FONDAZIONE ENI ENRICO MATTEI

Rio + 20: What prospects for climate policy?

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Some Basic Facts

- In 1997 all UNFCCC countries (189) approved the Kyoto Protocol that entered into force in 2006. The Kyoto Protocol however has a minor impact on GHG concentrations and temperature.

- At the G8 meeting in L'Aquila, then in Pittsburgh at MEF, and finally in Copenhagen at COP XV, main countries agreed to stabilise temperature increase at 2° C (no more than 2° C...)

- Same principles have been reaffirmed in Cancun at COP XVI. However, G8/G20 countries failed to deliver an international agreement on policy and measures to achieve such target.

- What will happen in Durban? What can climate policy deliver?

Concentrations and temperature

Present level

Concentrations of GHG (ppm CO_2-eq)	Most Likely	Very Likely Above (>90%)	Likely in the Range (>66%)
350	1.0	0.5	0.6 - 1.4
450	2.1	1.0	1.4 - 3.1
550	2.9	1.5	1.9 - 4.4
650	3.6	1.8	2.4 - 5.5
750	4.3	2.1	2.8 - 6.4
1000	5.5	2.8	3.7 - 8.3
1200	6.3	3.1	4.2 - 9.4

Table 1. Most likely, likely and very likely bounds/ranges of global mean equilibrium surface temperature increase in degrees Celsius above pre-industrial temperature for different levels of CO_2 equivalent concentrations (ppm). Source: IPCC Fourth Assessment Report, WG I, Chapter 10, Table 10.8 .

The present level of concentrations is about 430 ppm CO2-eq

However, uncertainty on the emissions-temperature nexus is relevant

Is the 2° C target feasible?

- According to IPCC, in order to keep temperature increase below 2° C with good probability, concentrations of GHGs **should not exceed** 380-390 ppm CO_2-eq.
- If we accept the possibility of **overshooting the target**, the level of concentrations can be higher but not greater than 450 ppm.
- The present level of GHG concentration is 430 ppm CO_2-eq (390 CO_2 only), well above the 380-390 ppm level necessary to make a temperature increase above 2° C unlikely.
- 450 ppm CO_2-eq will be reached within six years, whatever world leaders decided in Cancun or will decide in Durban.
- If 550 ppm CO_2-eq are reached, there is little chance to stay below 2° C, unless technologies to **reduce the stock of emissions** are developed

Cumulative PROBABILITY OF GLOBAL AVERAGE SURFACE AIR WARMING from 2000 to 2100 *(400 IGSM forecasts per case)*

Source: MIT JP Report 180, 2010

	ΔT > 2°C (values in red relative to 1860 or pre-industrial)	ΔT > 4°C	ΔT > 6°C
No Policy at 1400	100% (100%)	85%	25%
Stabilize at 900 (L4)	100% (100%)	25%	0.25%
Stabilize at 790 (L3)	97% (100%)	7%	< 0.25%
Stabilize at 660 (L2)	80% (97%)	0.25%	< 0.25%
Stabilize at 550 (L1)	25% (80%)	< 0.25%	< 0.25%

Policy options to achieve 450 ppm CO2-eq

1) **Mitigation 1**: Reduce (the **flow** of) emissions soon and cooperatively (agreement among all main emitting countries)

2) **Mitigation 2**: Delay emission reductions => **negative emissions later** (i.e. reduce the **stock** of emissions)

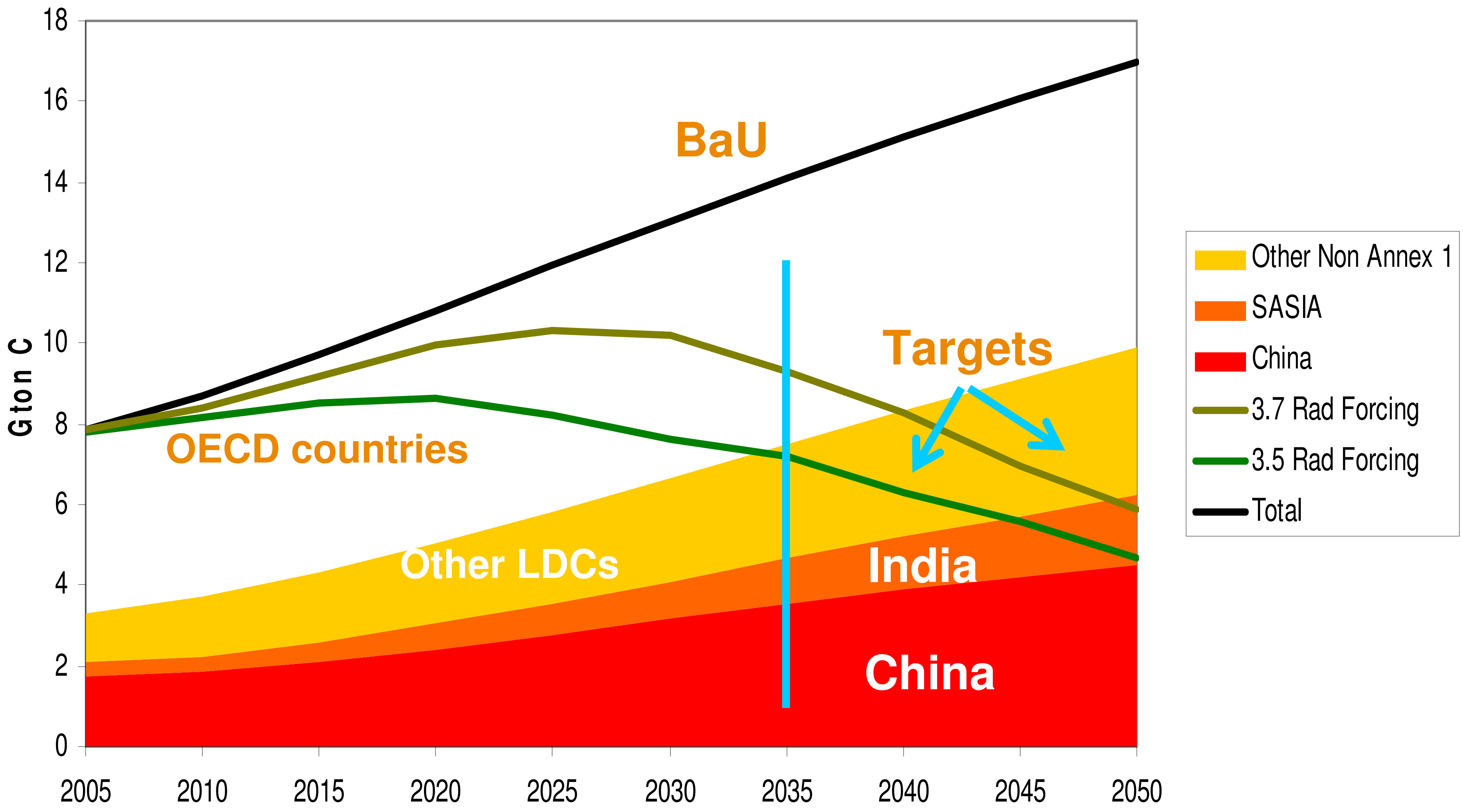
3) **Adaptation:** Invest in infrastructures and measures to adapt to climate change

Mitigation 1

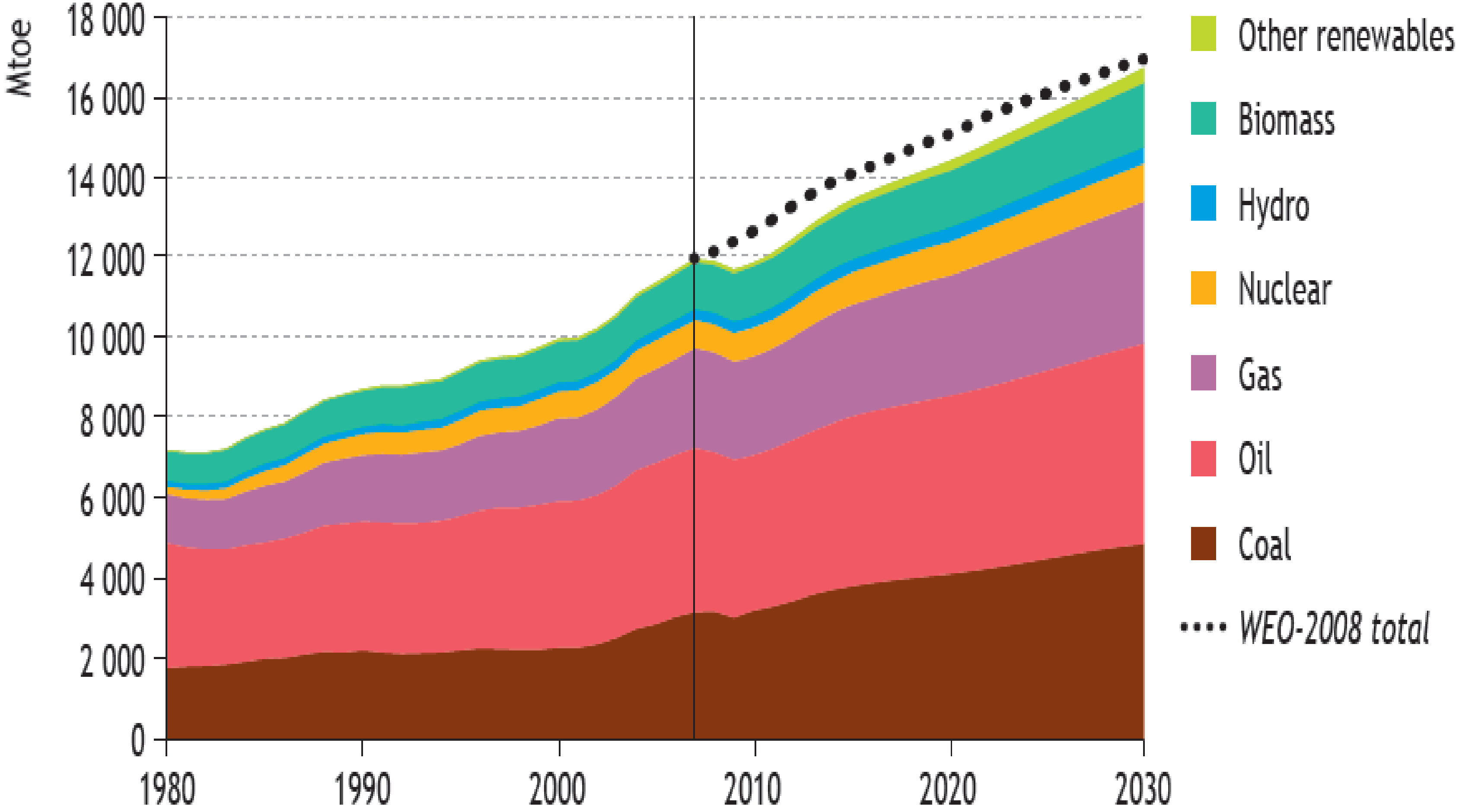
- If the focus is only on the **flow of emissions** (no overshooting), simple calculations show that 450 CO2 eq cannot be achieved unless drastic measures are taken **rapidly** and by **most** world countries (at least 20 major emitters)

- **Reality check**:
    - no international agreement => action will be delayed
    - energy mix unlikely to change drastically soon
    - crucial technologies (nuclear, CCS) not available as much as desirable
    - large expected increase of energy demand

If China and India don't reduce their own emissions, there is no chance to reach even the 550 ppm target



Total World Energy Demand



Source WEO 2009

Energy Poverty

More than **1.4 billion people** worldwide over 20% of the global population do not have access to **electricity**; 85% of them in rural areas of Asia and Africa (WB 2010).

The number of people relying on the **traditional use of biomass** (wood, charcoal, coal, and dung for cooking and heating) is projected to rise from 2.7 billion in 2010 to 2.8 billion in 2030.

It is estimated that **household air pollution** from the use of biomass in inefficient stoves would lead to over 1.5 million premature deaths per year, over 4 000 per day, in 2030, greater than estimates for premature deaths from malaria, tuberculosis or HIV/AIDS (WHO, 2010)

15% of the world's population still lack access to energy , the majority of them living in Sub-Saharan Africa

Reaching universal access to modern energy services by 2030 will require new capital investment of up to $40 billion annually in new investments

Number of people without access to electricity and relying on the traditional use of biomass, 2009 (million)

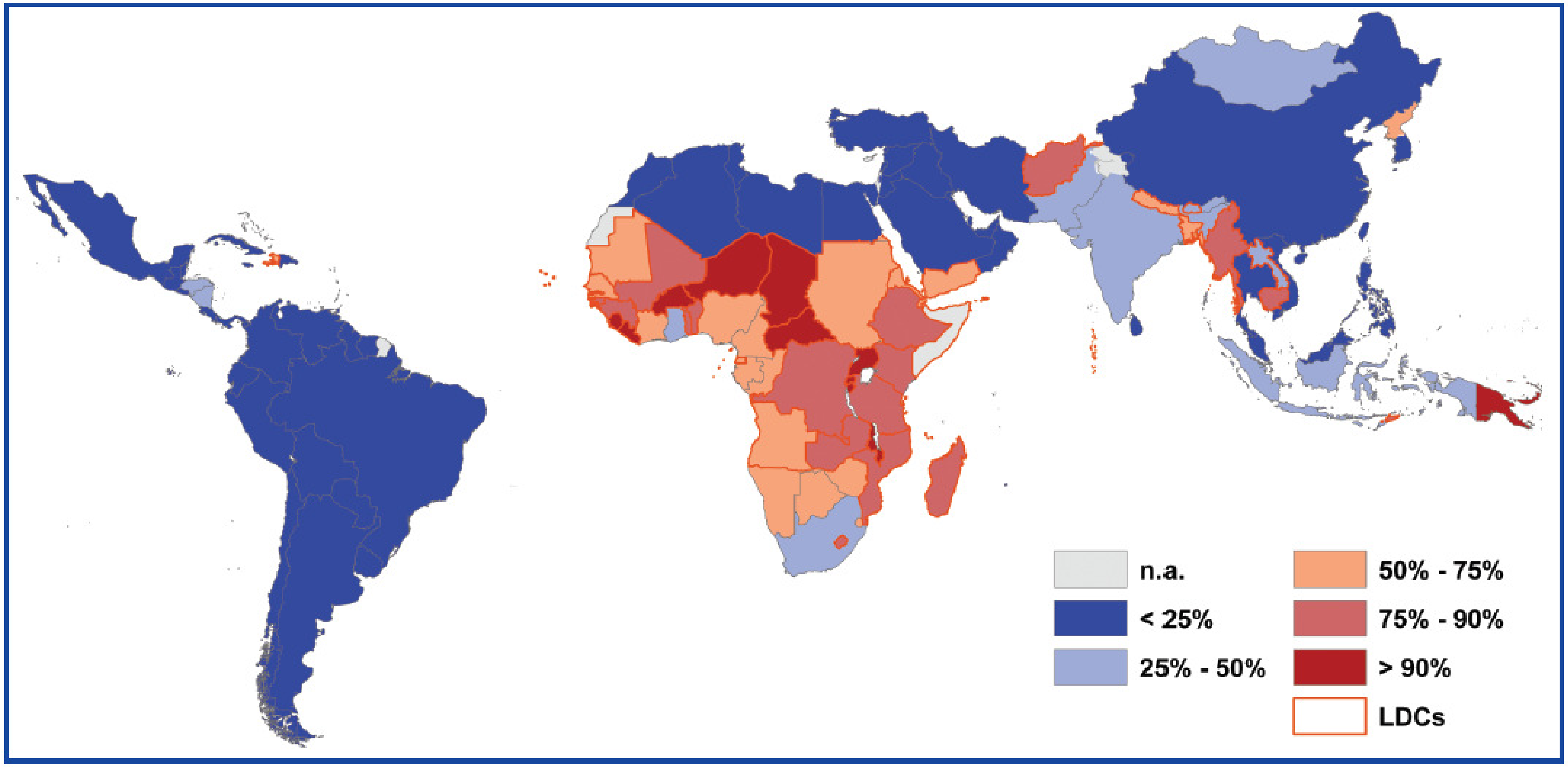
	Number of people lacking access to electricity	Number of people relying on the traditional use of biomass for cooking
Africa	587	657
Sub-Saharan Africa	*585*	*653*
Developing Asia	799	1 937
China	*8*	*423*
India	*404*	*855*
Other Asia	*387*	*659*
Latin America	31	85
Developing countries*	1 438	2 679
World**	**1 441**	**2 679**

*Includes Middle East countries. **Includes OECD and transition economies.

Note: The *World Energy Outlook* maintains a database on electricity access and reliance on the traditional use of biomass, which is updated annually.

Source: IEA databases and analysis.

Share of people without electricity access for developing countries, 2008



N.A. = not available.

Source: UNDP (2009)

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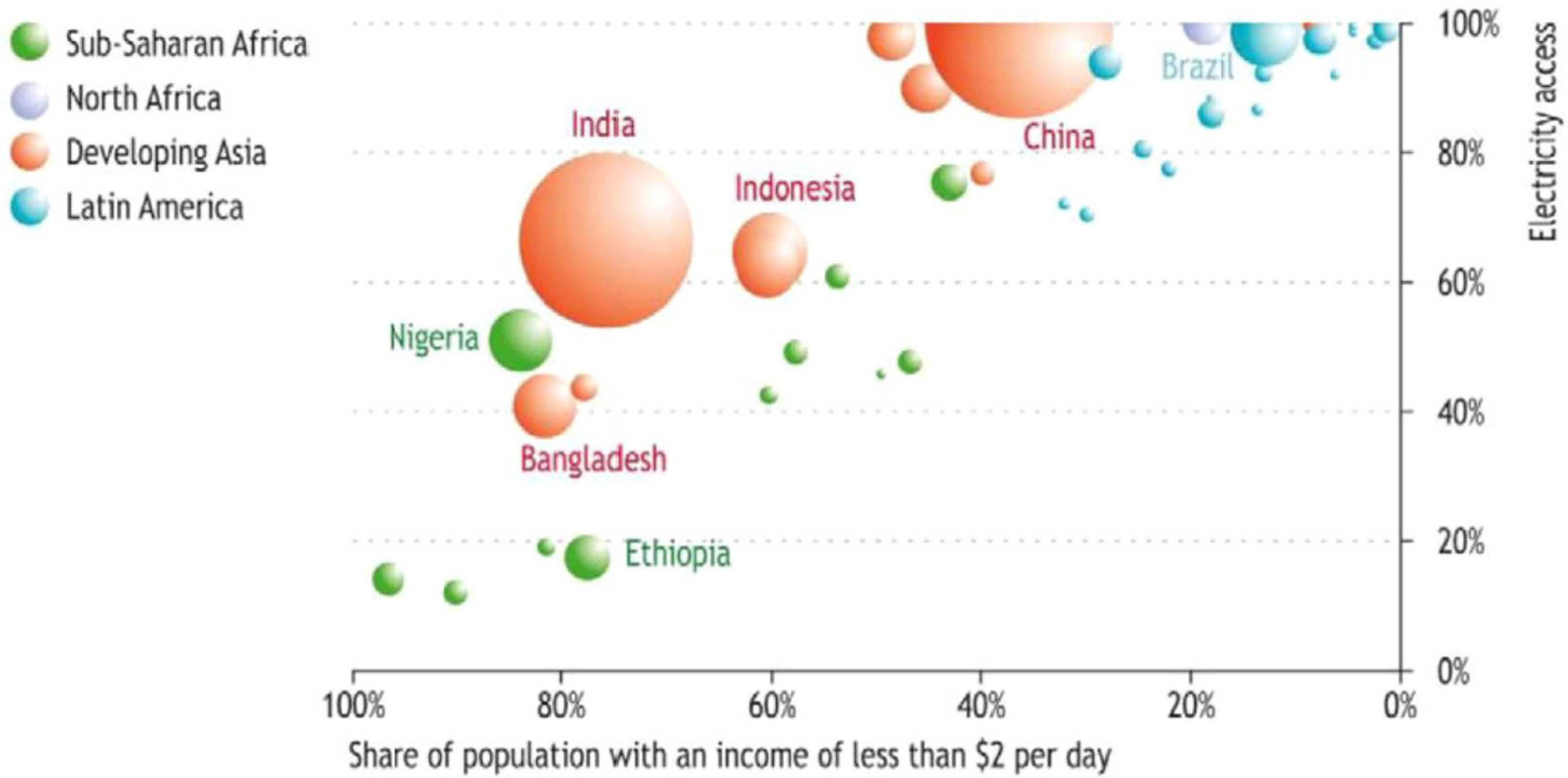
Energy and Development

Access to energy is essential for the provision of clean water, sanitation and healthcare

Access to energy provides great benefits to development through the provision of reliable and efficient lighting, heating, cooking, mechanical power, transport and telecommunication services.

There is a close correlation between income levels and access to modern energy: countries with a large proportion of the population living on an income of less than $2 per day tend to have low electrification rates and a high proportion of the population relying on traditional biomass.

Household income and electricity access in developing countries



Note: The size of the bubble is proportional to population.

Source: OECD/IEA 2010

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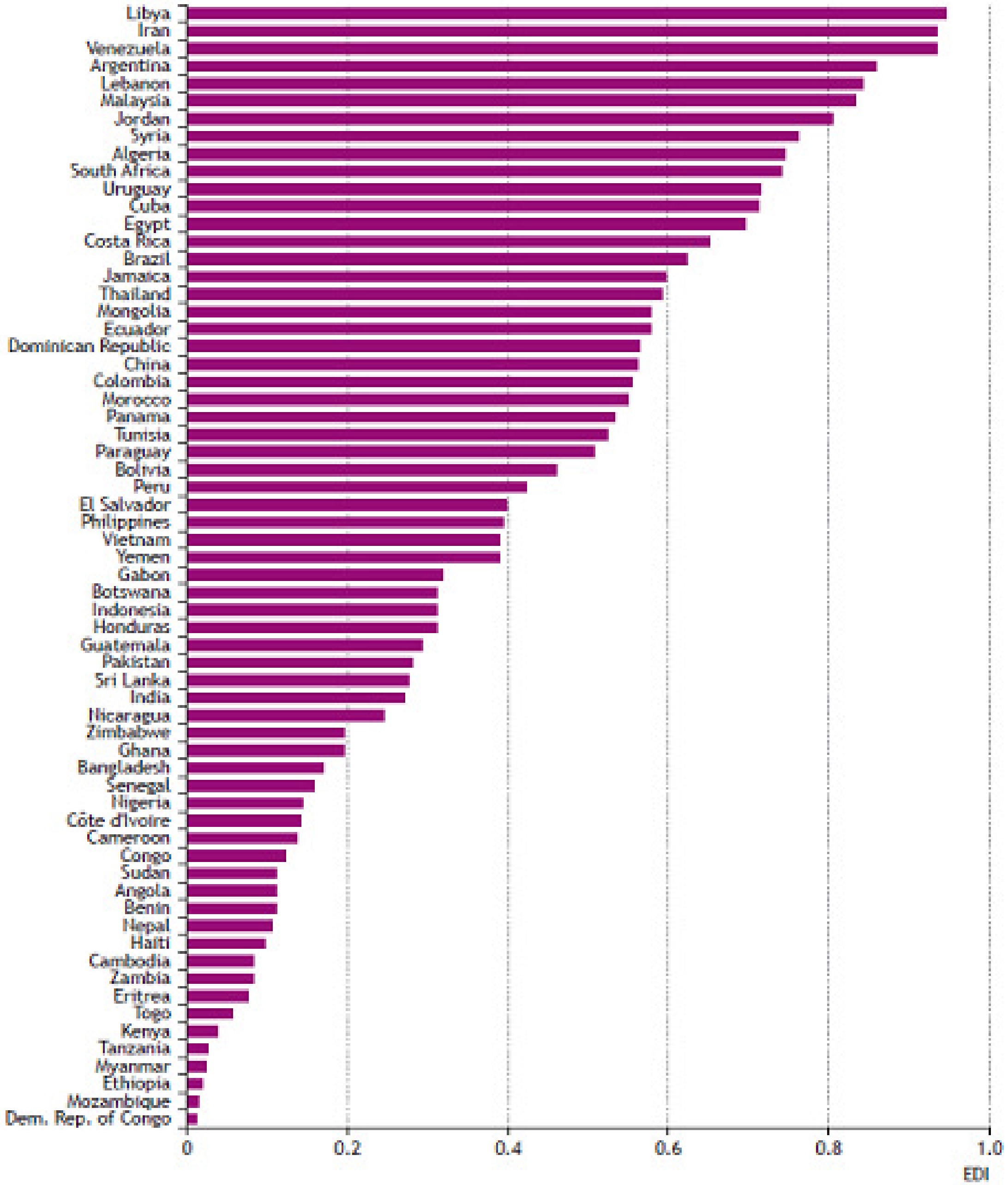
Energy Development Index –ranking 2009



Source: OECD/IEA 2010

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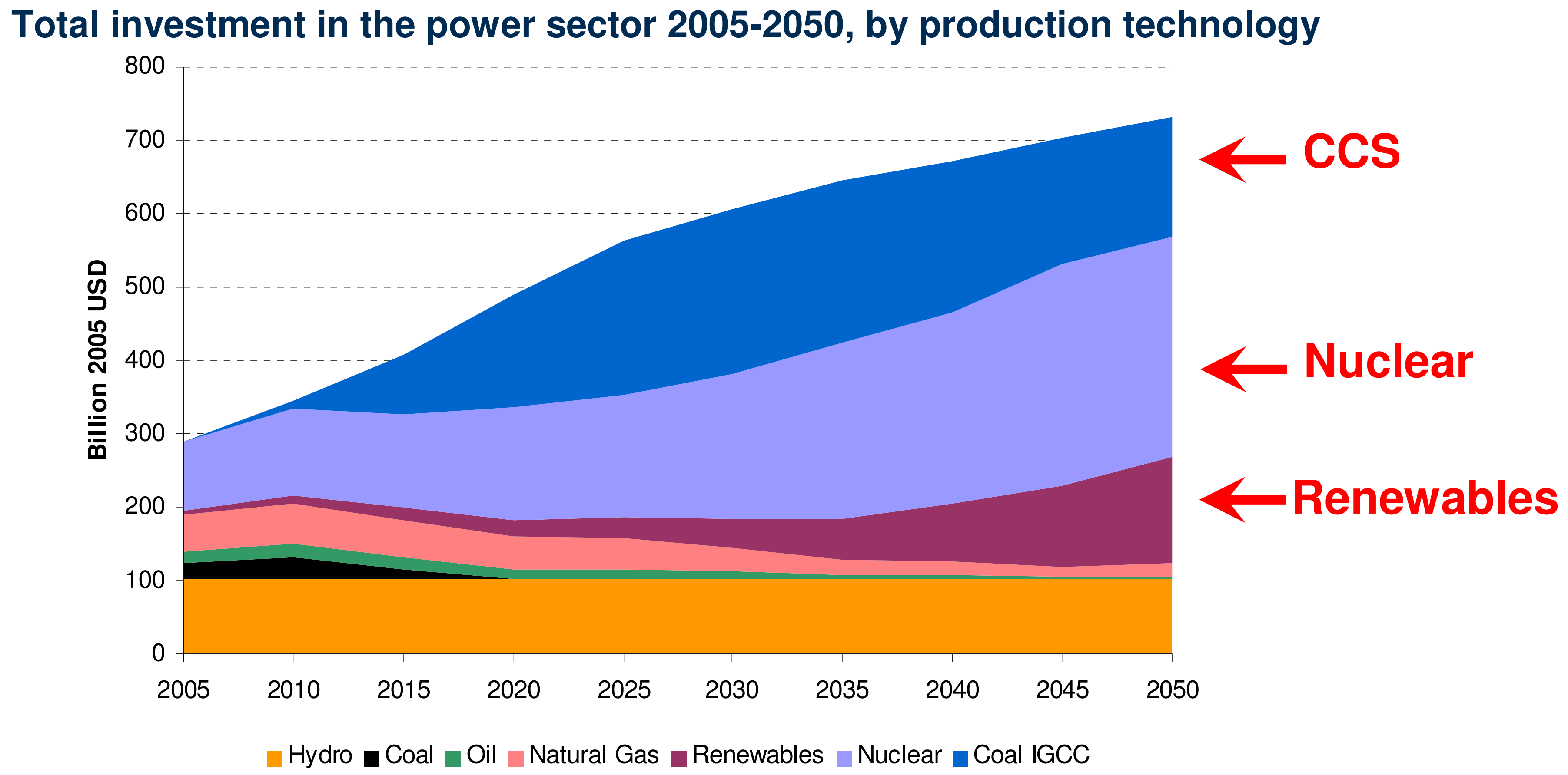
Transforming the Power Sector: Technologies

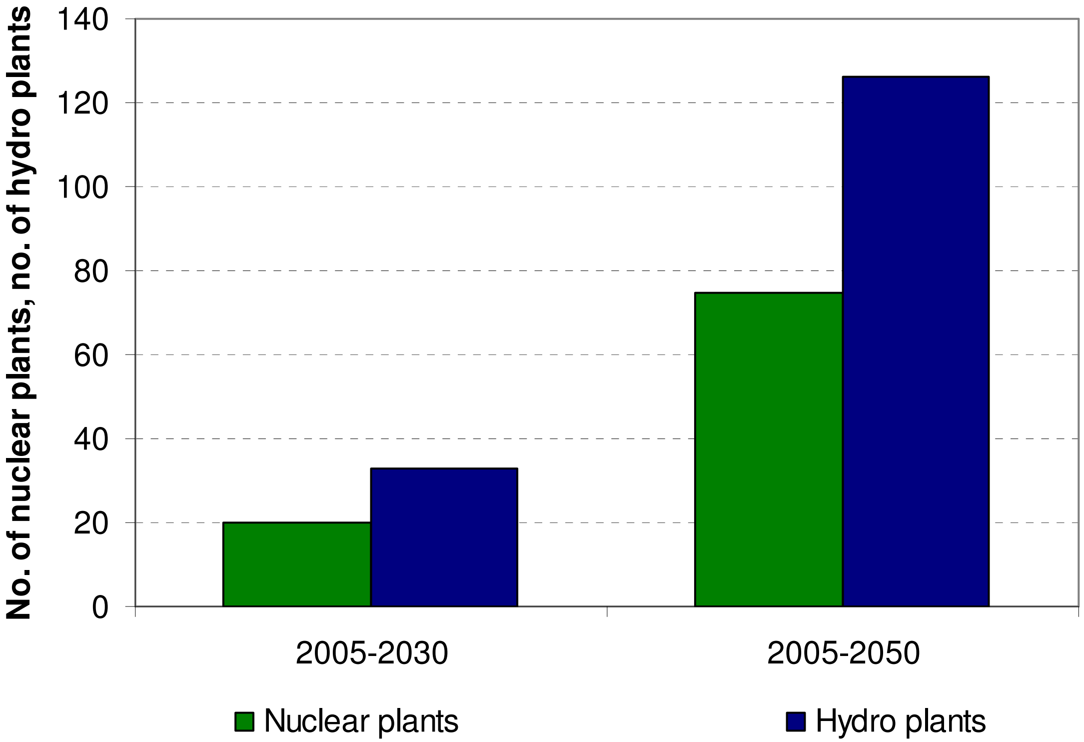


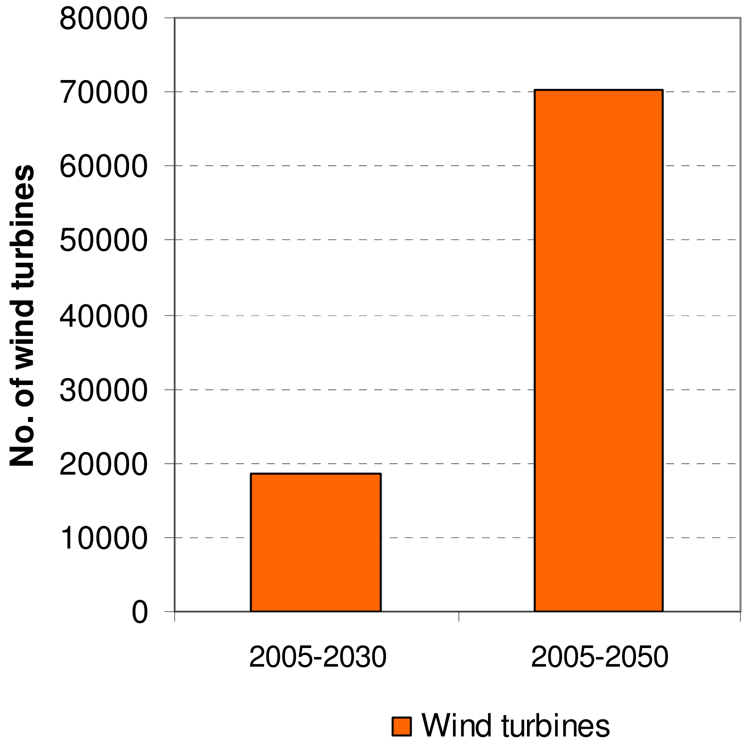
The decarbonisation of energy supply asks for a completely new energy mix:

- Conventional fossil fuels power plants are progressively substituted by nuclear, coal power plants with CCS and renewables

The Challenge of Transforming the Power Sector: Plants

Number of same-kind power plants necessary to build, each year, to cover additional capacity in 450 ppm scenario





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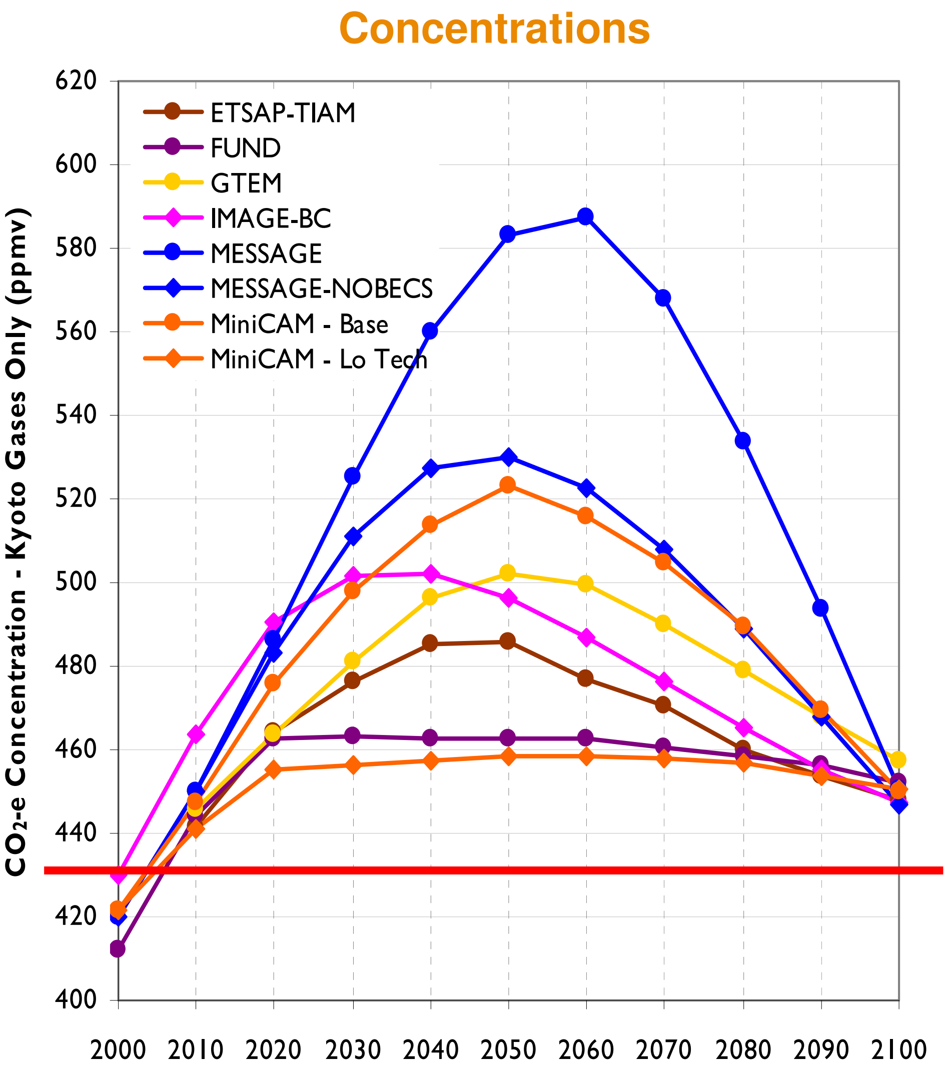
Mitigation 1

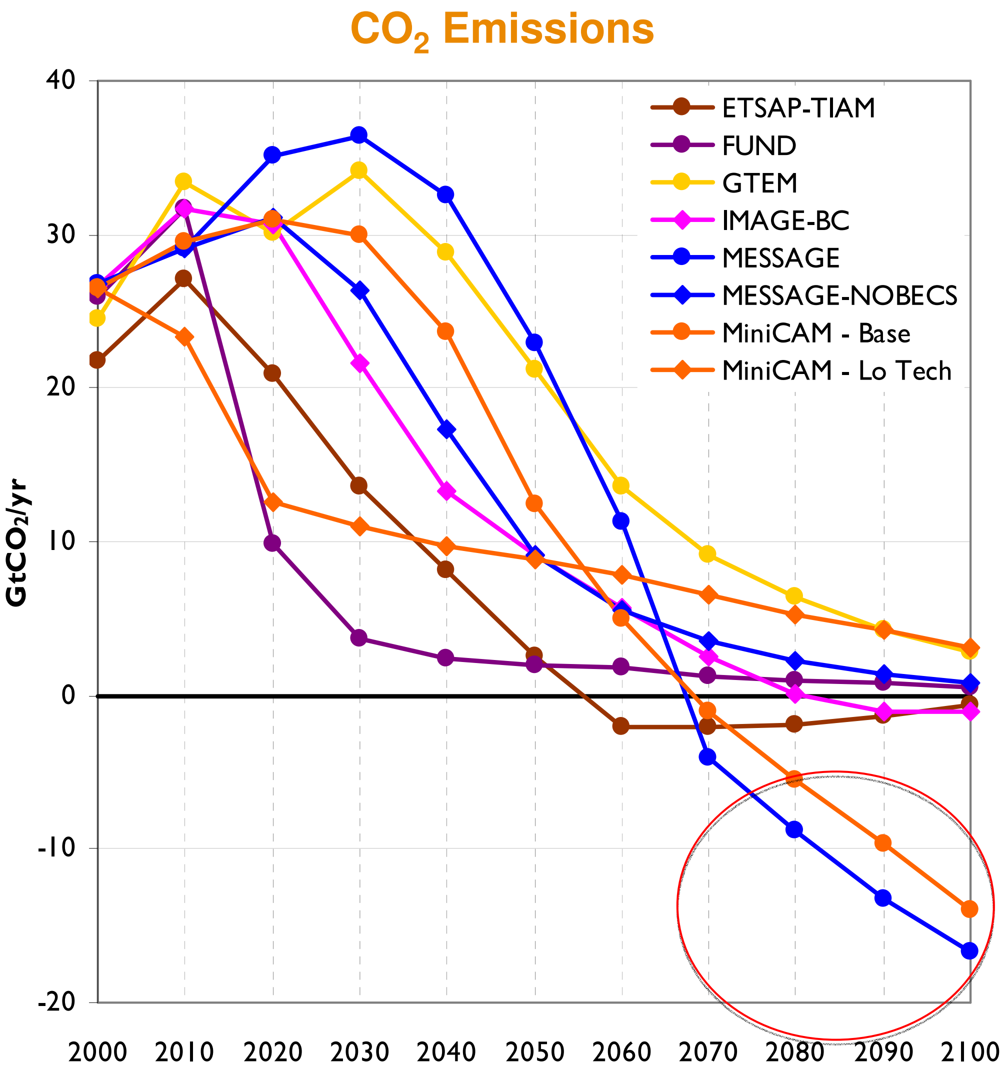
- Nonetheless some options for mitigation (reducing the flow of GHG emissions) are still available
  - Better city management/sustainable cities
  - Better agriculture management/sustainable agriculture
  - Investments in research and innovation
  - Environmental consciousness in all production, consumption and investment activities/green jobs

Mitigation 2

- More time and more options available if large scale reductions of the **stock of emissions** are feasible (overshooting).
- Then, emission reductions can be delayed and mitigation costs are much lower
- However, no technology available for large scale carbon dioxide removal

CDR (Carbon Dioxide Removal): Overshooting concentrations and timing of mitigation





In order to achieve the 2.0 C target, it is necessary to reduce the stock of GHGs, i.e. negative emissions

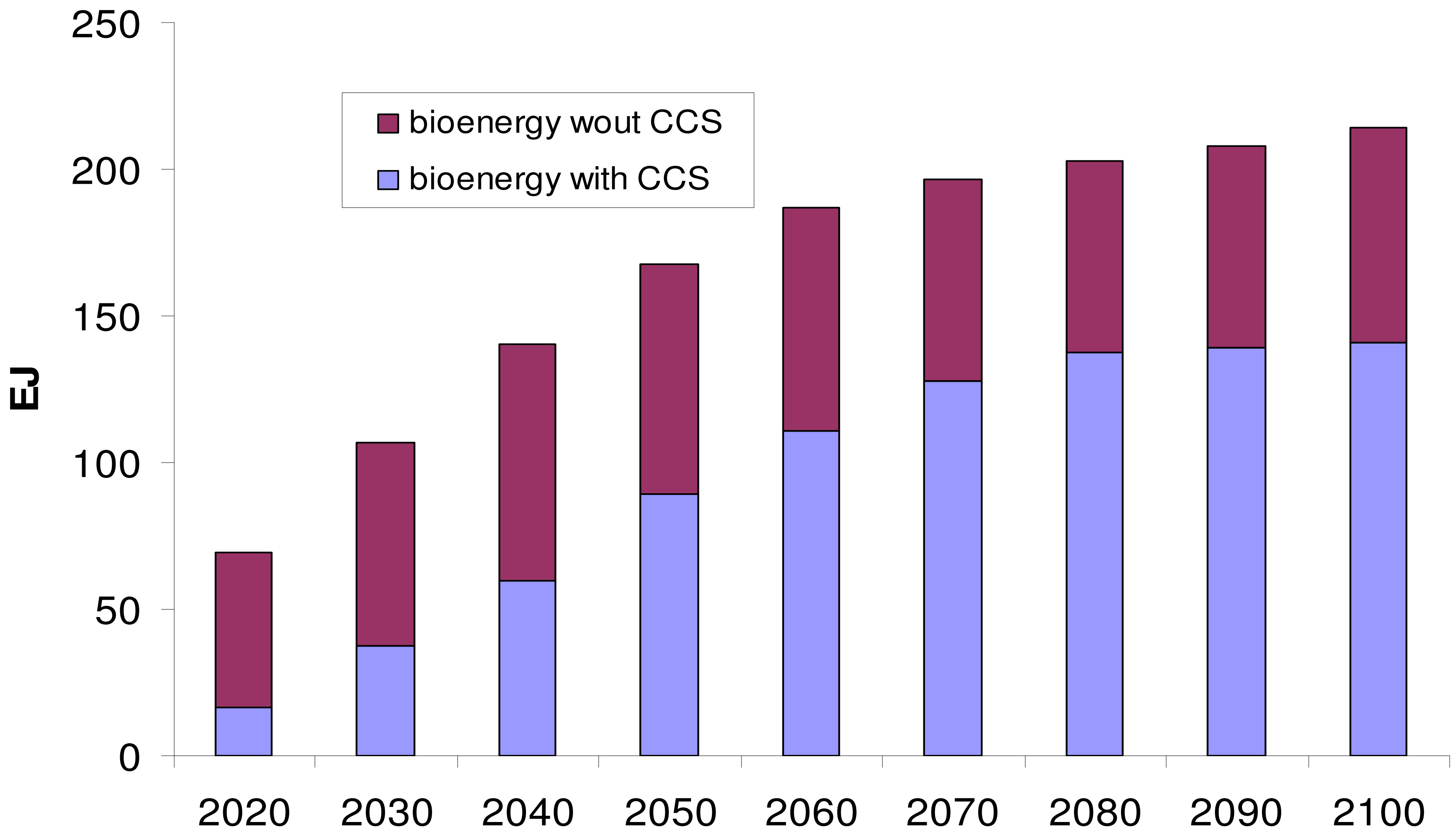
Options to achieve negative emissions

The most promising ones are terrestrial biological:

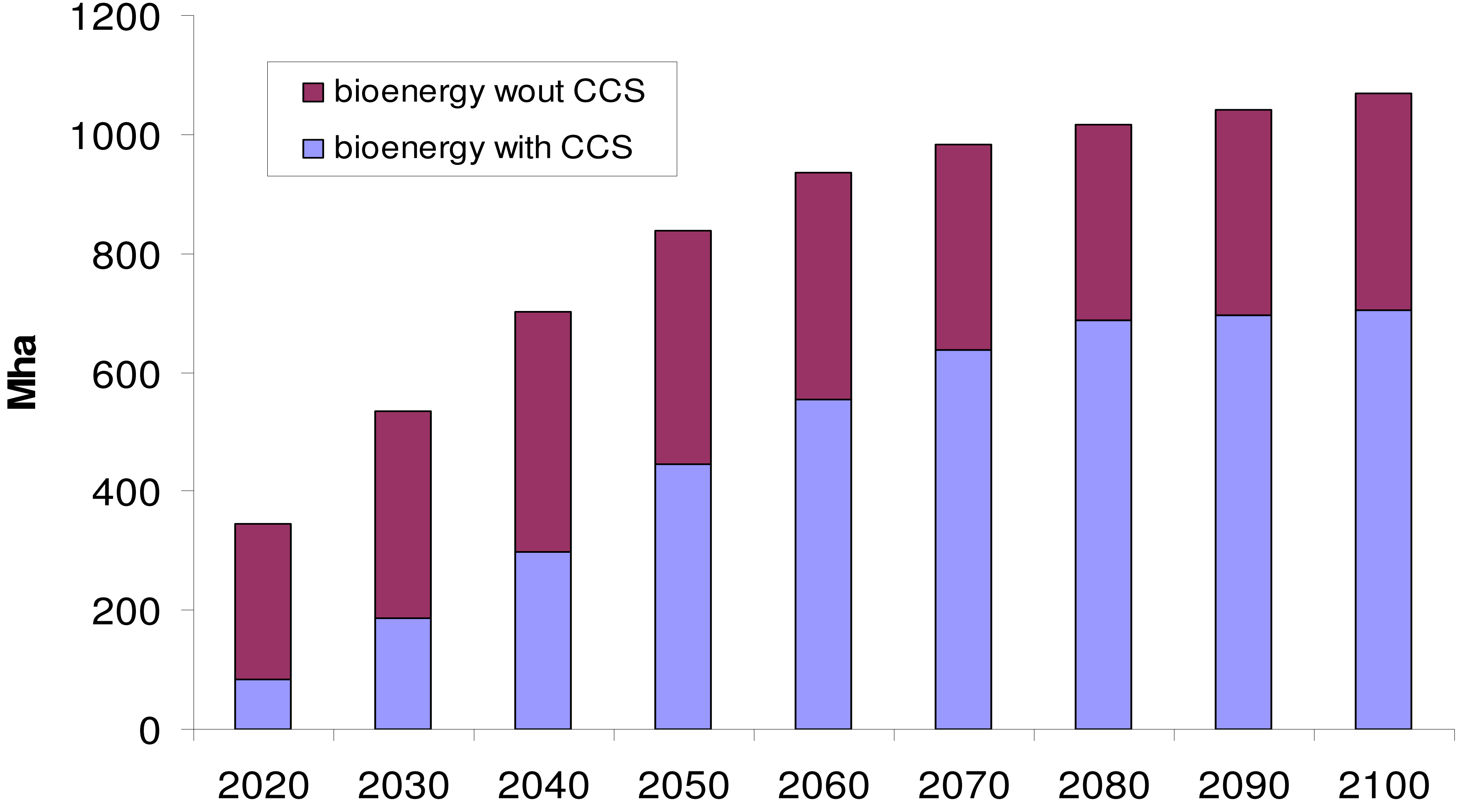
- **Land use and afforestation**
- **Bioenergy with CCS (BECS)**
- **Biomass and biochar**

but unlikely to achieve the necessary scale of operation…

PRIMARY BIOENERGY in the 450ppm-eq scenario



BIOENERGY LAND USE in stringent climate stabilization scenarios can reach 1000 Mha (@ 10 tons dry matter/ha). Total arable crop land today is approx. 1500 Mha



How can we get the needed yield improvements?

• **Increase yield where they very low** (especially in some developing countries). The potential output increase is large: maize(plus 50%), rice (plus 40%), wheat (plus 60%) (Licker et. Al. 2010)

• **Innovation,** also needed to develop climate change compatible crops, but expect some controversies (e.g. GMO)

• **Economics.** Over the past several decades, crop prices have not grown significantly. Price response could be important for both demand and supply, depending on the relative price elasticities (Hertel 2010). But it could have adverse distributional consequences, with important social repercussions (e.g. social unrest).

Adaptation

- Very uneven impacts climate change.
  Developing countries are much more vulnerable
- Lower free-riding incentives
- Likely to be necessary whatever mitigation policy is undertaken
- To a certaint extent, less costly

Investments in the energy sector to stabilize GHG concentrations at 450 CO2 eq. (IEA, 2010)

Level	**additional annual investment** needs in low-carbon technologies and energy efficiency relative to Reference Scenario to meet 450 Scenario in **2020**	**total investment** in the 450 scenario in low-carbon power generation over **2010-2030**	incremental investment cost in **GDP terms**
World	**$430 bln**	almost $ 6600 bln (72% renewable, 19% nuclear, 9% CCS)	2020: 0.5% of GDP 2030: 1.1% of GDP
OECD+	$220 bln	almost $ 3100 bln (65% renewable, 20% nuclear, 15% CCS)	2020: 0.4% of GDP 2030: 0.8% of GDP
US	$ 90 bln	almost $ 1100 bln (53% renewable, 27% CCS, 19% nuclear)	2020: 0.5% of GDP 2030: 1% of GDP
EU	$ 70 bln	almost $ 1300 bln (77% renewable, 7% CCS, 16% nuclear)	2020: 0.3% of GDP 2030: 0.6% of GDP
Japan	$ 17 bln	almost $ 200 bln (50% renewable, 4% CCS, 46% nuclear)	2020: 0.3% of GDP 2030: 0.6% of GDP
China	$ 80 bln	almost $ 1500 bln (73% renewable, 5% CCS, 22% nuclear)	2020: 0.8% of GDP 2030: 1.5% of GDP
India	$ 25 bln	almost $ 550 bln (83% renewable, 2% CCS, 16% nuclear)	2020: 0.9% of GDP 2030: 1.4% of GDP
Russia	$ 8 bln	almost $ 220 bln (58% renewable, 12% CCS, 30% nuclear)	2020: 0.3% of GDP 2030: 1% of GDP

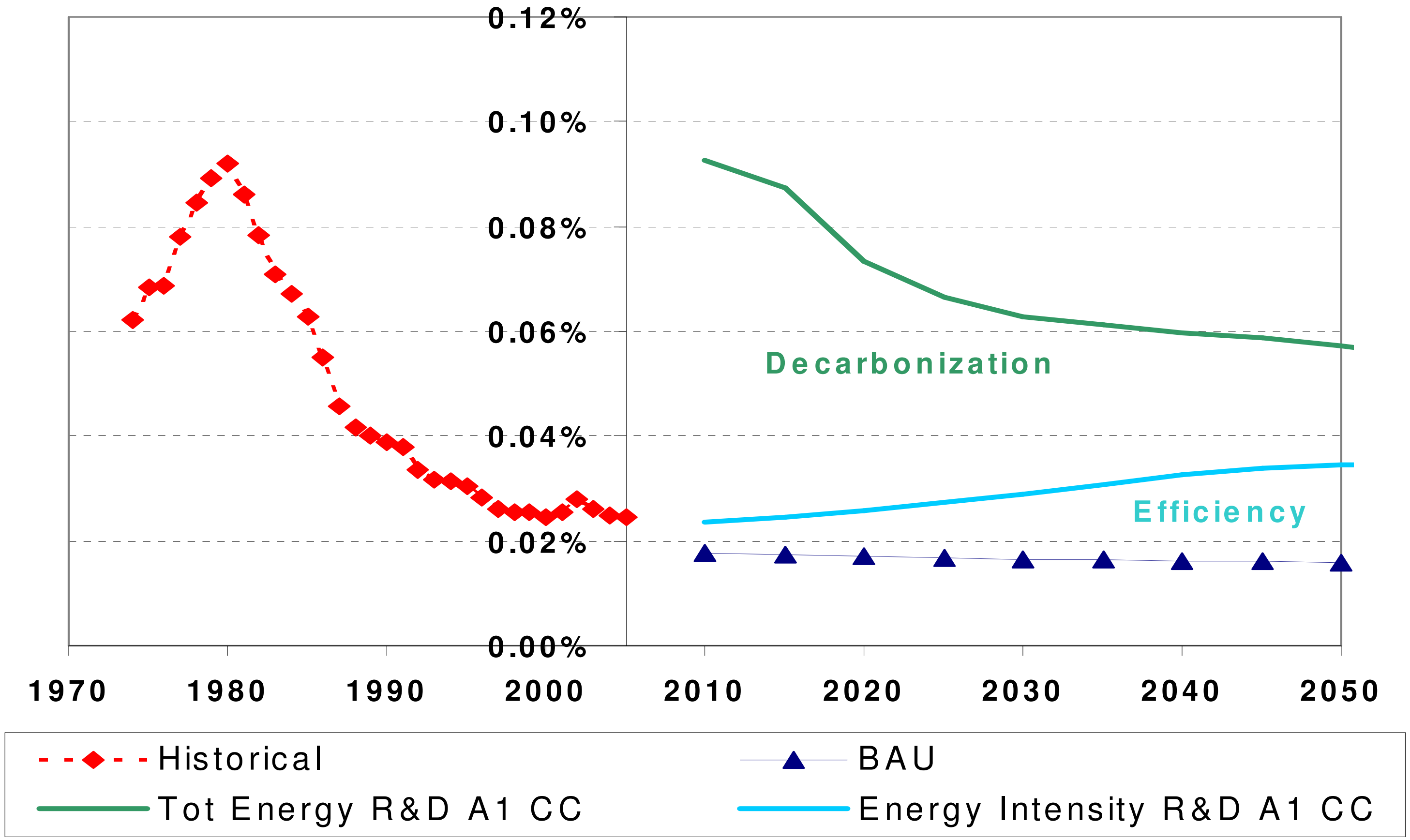
Investments to adapt to climate change

Source IIED (2009)

Sectors	UNFCCC estimates	Sources of underestimations	New IIED cost estimates
Agriculture	$11.3-12.6 billions/year	Adaptation deficit → recovering it could cost up to $40-60 billions	$11.3-12.6 + $40-60 billions
Water	$11 billions/year	Transfer of water across countries, no adaptation to altered flood risk	Significant underestimation, more studies needed
Human health	$4-12 billions/year	Population grows but share of illness-related deaths remains constant	30-50% increase in costs
Coasts	$11 billions/year	Sea level rise (SLR) faster than foreseen, residual damage estimation ($1 billion/year) too optimistic	Overall costs could double depending on speed of SLR, residual damage costs t $2-3 billions/year
Infrastructures	$8-130 billions/year	Infrastructural deficit → removing could cost up $315 billions/year	Besides deficit, $16-63 billions/year
Ecosystems	$65-80 billions/year for protected areas	Exclusion of adaptation costs for non-protected areas ($290 billions/year)	$65-80 + $290 billions/year

About 175 billions per year

R&D investments



Roughly 50 Blns a year of energy innovation investments in the next two decades

Source: WITCH model

➔ **for a total of about 650 billions/year…**

Investments: some conclusions

- Climate policy will induce much **higher investments** in the energy sector

- Low-carbon world requires a **new energy mix**: conventional fossil fuels power plants are substituted by nuclear, coal power plants with CCS and renewable sources

- Large investments have to be diverted – in a relatively short time frame – towards **complex and risky** technologies

- Significant **innovative efforts** are required especially outside the power sector and industrial sectors (transport, urban planning, agriculture…).

Future challenges:

- More energy, to meet an increasing energy demand
- A “clean” energy, to control climate change
- A more equally distributed energy to favour economic development in poorer region and thus global economic growth

Thanks !