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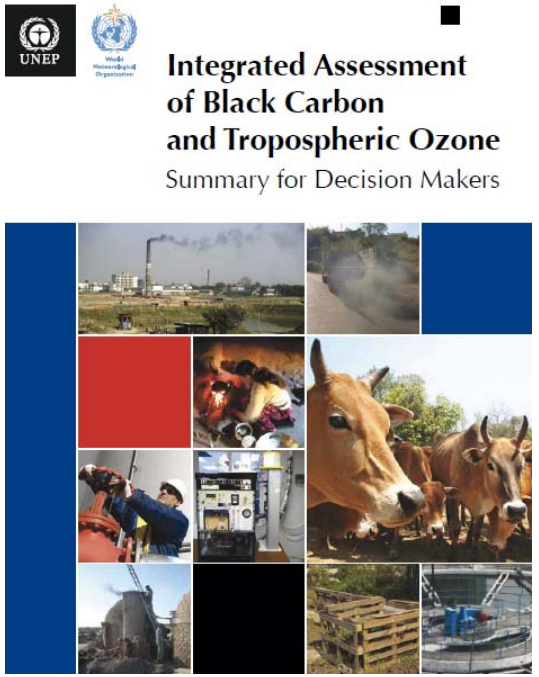
The UNEP/WMO Integrated Assessment of Black Carbon and Tropospheric Ozone

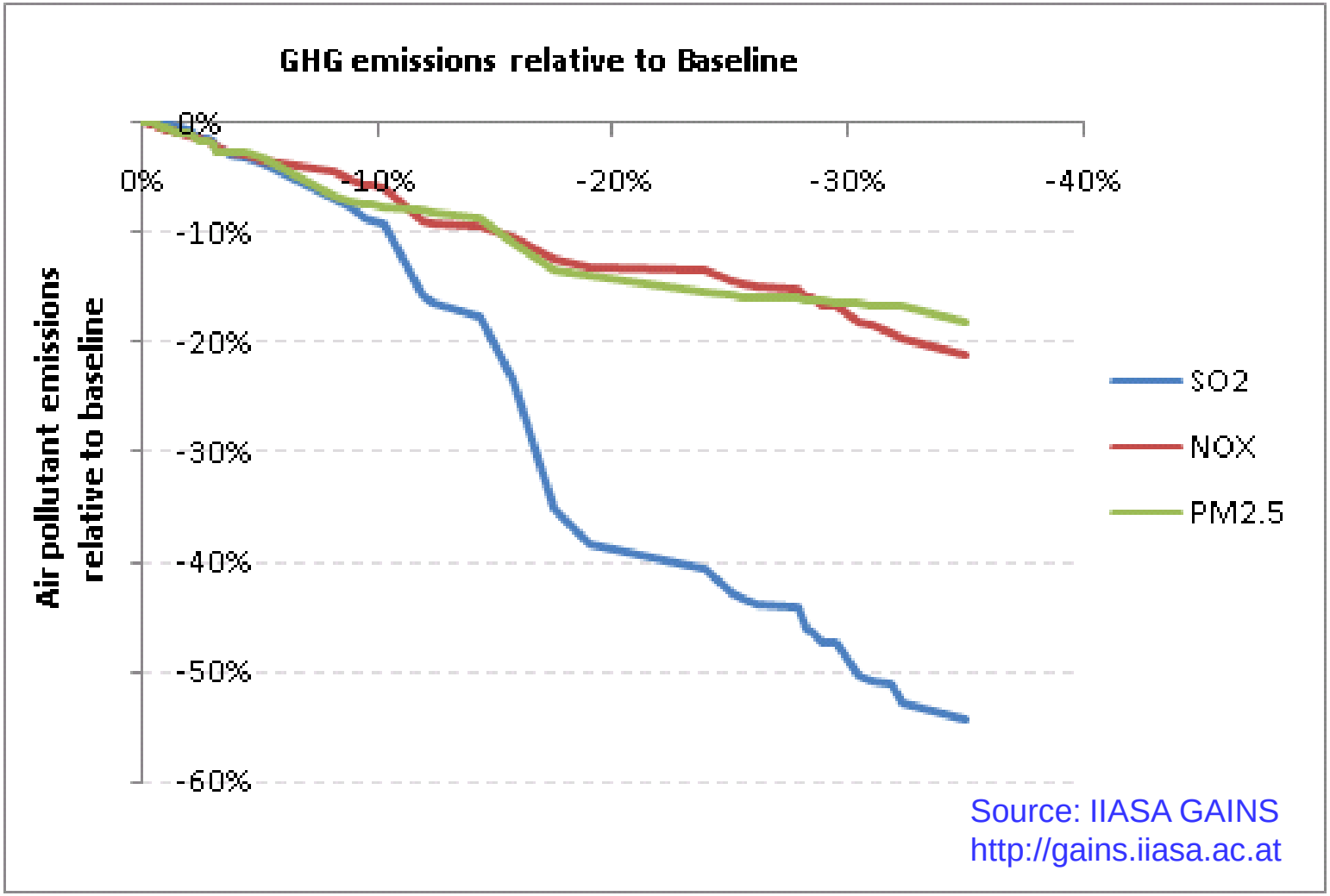


39th Meeting of the Task Force for Integrated Assessment Modelling

Stockholm, February 23-25, 2011

Co-control of GHGs and air pollutants

Annex I parties of UNFCCC, 2020

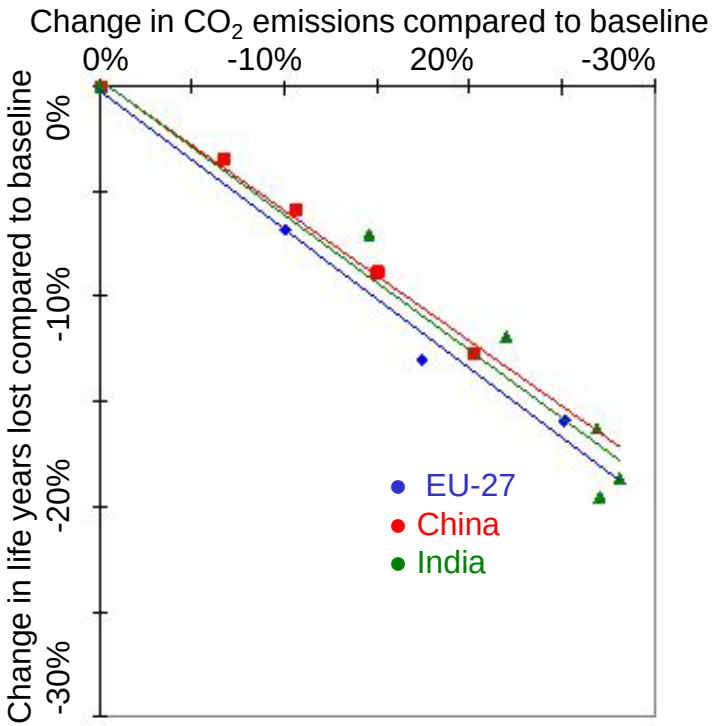


Low carbon strategies have significant co-benefits on human health - in Europe and in Asia

Low CO_2 strategies result in

- less SO_2, NO_x and PM emissions,
- lower damage to health and vegetation from reduced air pollution,
- cost savings for air pollution control equipment, compensating for up to 40% of GHG mitigation costs.

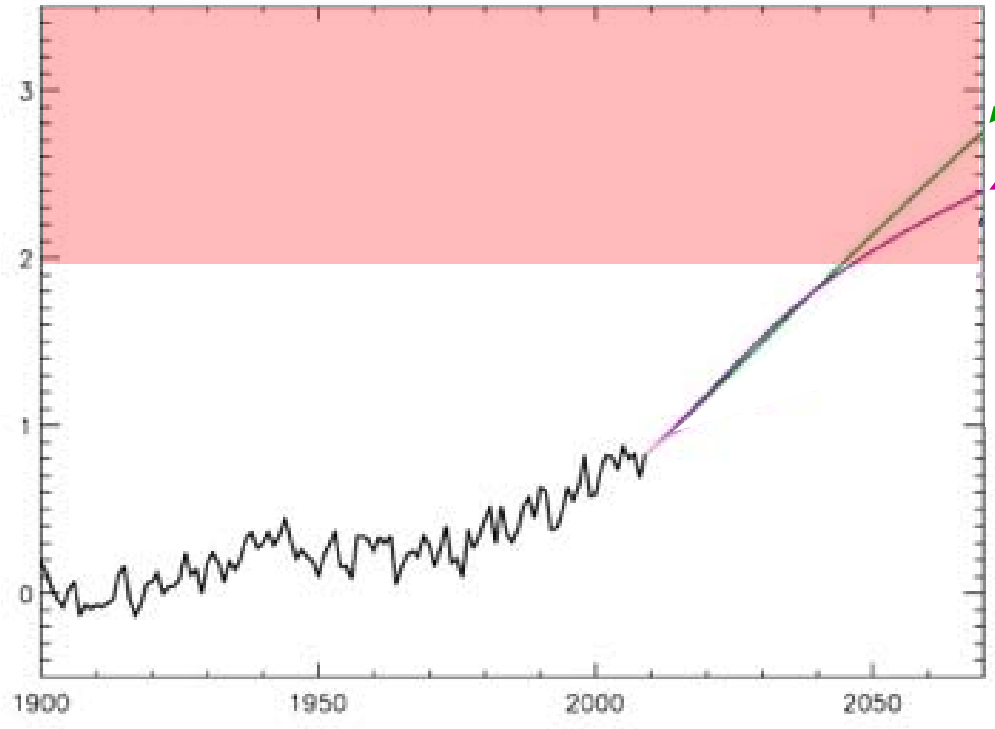
CO_2 emissions vs. health impacts (YOLLs)



Source: IIASA GAINS

Control of CO_2 is unlikely to reduce temperature increase in the near-term

Global temperature 1900-2070



Source: UNEP Black Carbon Assessment, forthcoming 2011

Reference scenario:
IEA World Energy Outlook 2009

CO_2 measures:
IEA 450 ppm scenario 2009

Temperature increase in the near-term is determined by:

- CO_2 in the atmosphere as a result of historic emissions of CO_2
- Change in emissions of short-lived substances, esp. co-control of SO_2 (leads to warming)

‘Win-win’ air quality measures with co-benefits on climate change

Radiative forcing from short-lived air pollutants:

- Warming: BC, CO, O_3 precursors (CH_4, CO)
- Cooling: SO_2, OC
- Only little net effects: NO_x, VOC

These substances are often co-emitted, and control measures affect several substances at the same time.

Which air quality <u>measures</u> would also reduce radiative forcing?

Approach developed for UNEP/WMO BC Assessment

1. Compile literature values on radiative forcing/GWP for each substance
2. For each of 2000 air pollution control measures in GAINS, estimate their impacts on CH_4/BC/OC/CO/SO_2/VOC/NO_x emissions and their net effect on radiative forcing
3. Determine their mitigation potential for the baseline emission projection
4. Select the 'top 15+ measures' that reduce most SLCF forcing globally
5. Estimate their temperature impact with GCMs

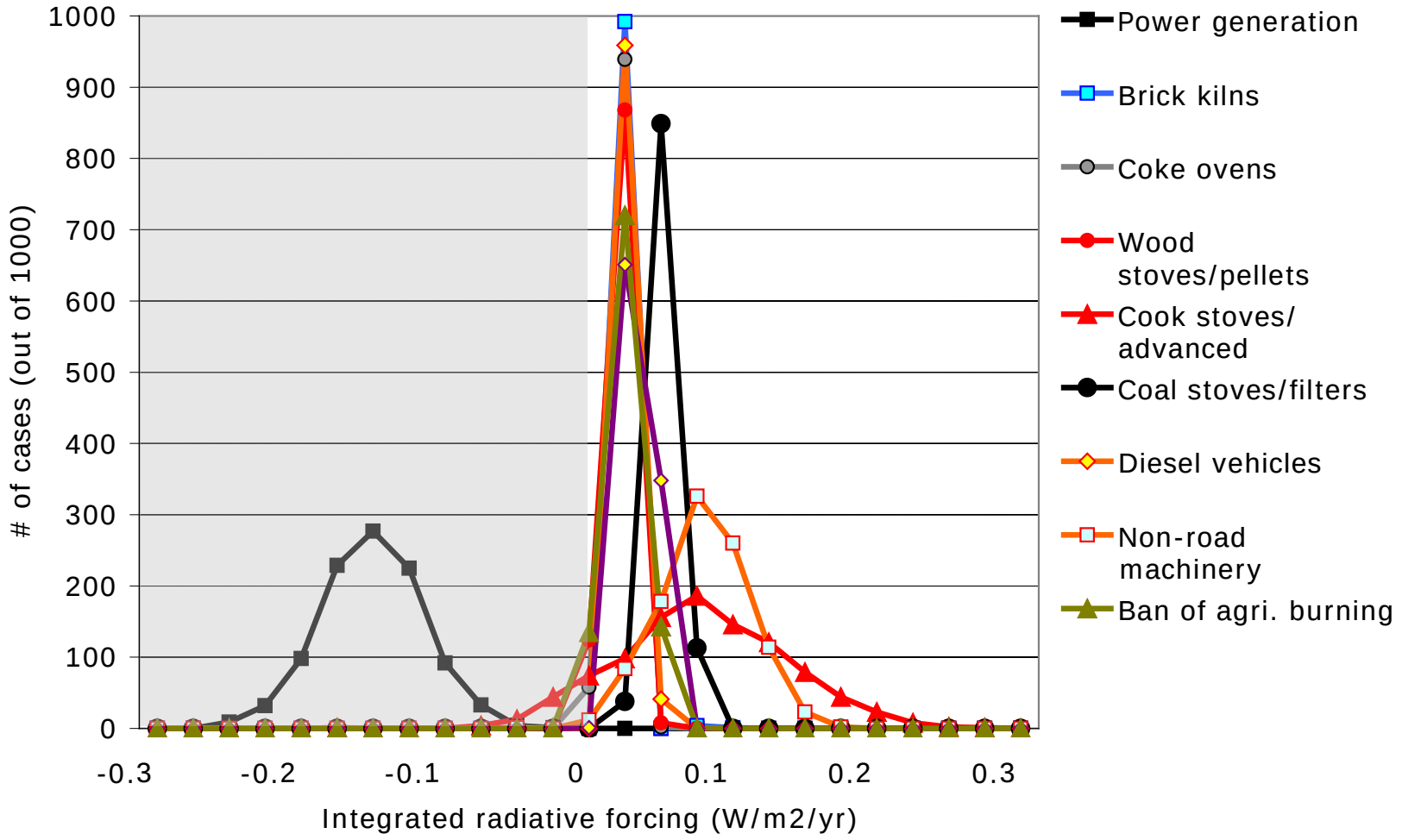
Radiative forcing of GHGs and air pollutants

Literature ranges of GWP100

	Mean value		*Range*	*Reference*
CO_2	1	IPCC, AR4		
CH_4	25	IPCC, AR4	16 - 34	IPCC AR4
CO	1.9	IPCC, AR4	1 - 3	Range from AR3, cited in AR4
VOC	3.4	IPCC, AR4	2 - 7	IPCC AR4, ref. to Collins et al. 2002
BC	680	Bond & Sun, 2006	210 - 1500	Bond & Sun, 2006
SO_2	-40	Fuglestvedt et al., 2009	-24 - -56	Schulz et al. 2006, (±40%)
OC	-69	Schulz et al., 2007	-35 - -104	Bond et al. (±50%)
NO_x	~0			

Net impacts of BC measures on integrated radiative forcing

Monte-Carlo analysis for literature ranges of GWP



Three groups of promising measures

CH_4 measures

1. Recovery of coal mine gas
2. Production of crude oil and natural gas
3. Gas leakages at pipelines and distribution nets
4. Waste recycling
5. Wastewater treatment
6. Farm-scale anaerobic digestion
7. Aeration of rice paddies

Technical BC measures

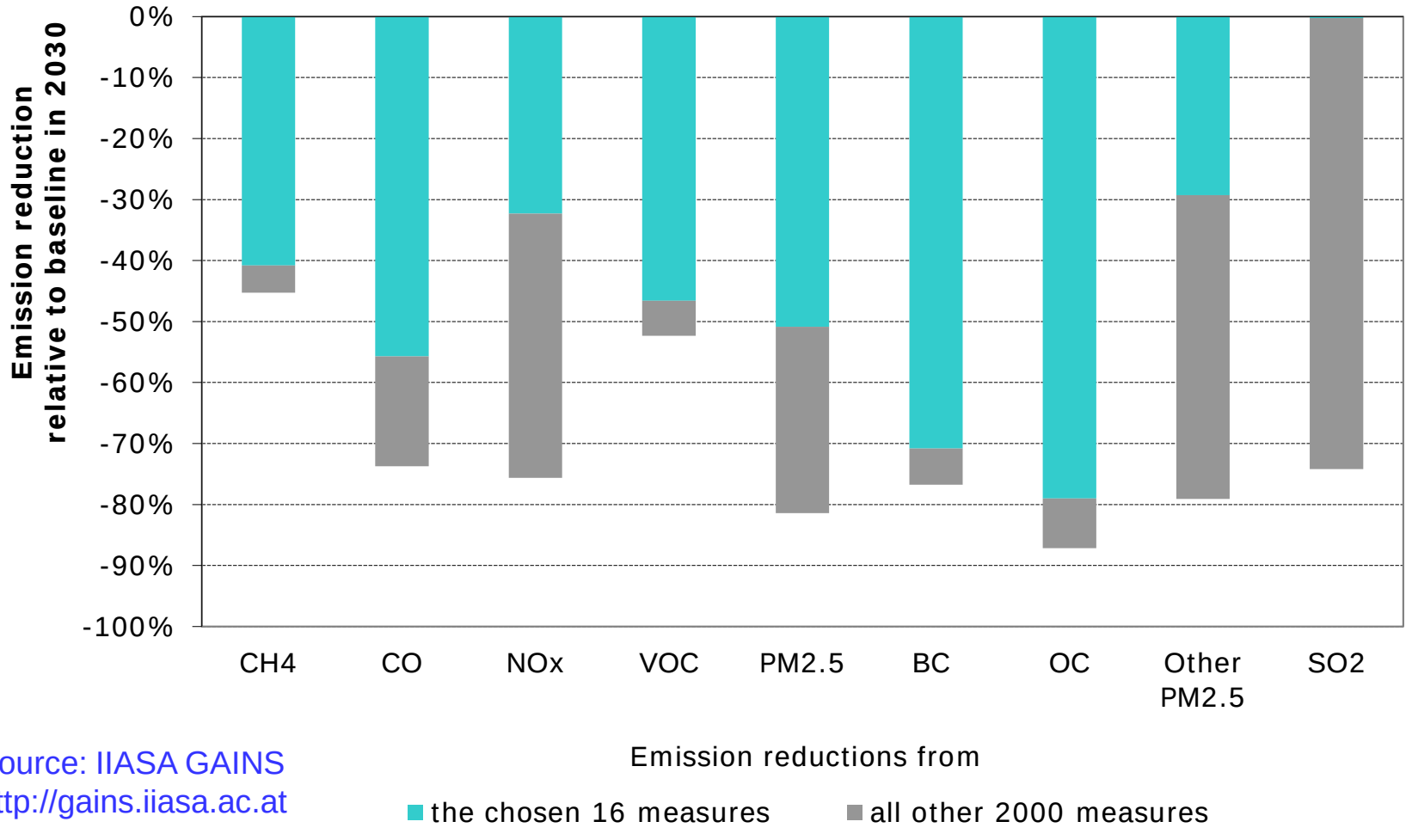
1. Modern coke ovens
2. Modern brick kilns
3. Diesel particle filters
4. Briquettes instead of coal for heating
5. Improved biomass cook stoves
6. Pellets stoves and boilers (in industrialized countries)

Non-technical measures

1. Ban of high-emitting vehicles
2. Ban of open burning of agricultural waste
3. Elimination of biomass cook stoves

Mitigation potentials in 2030

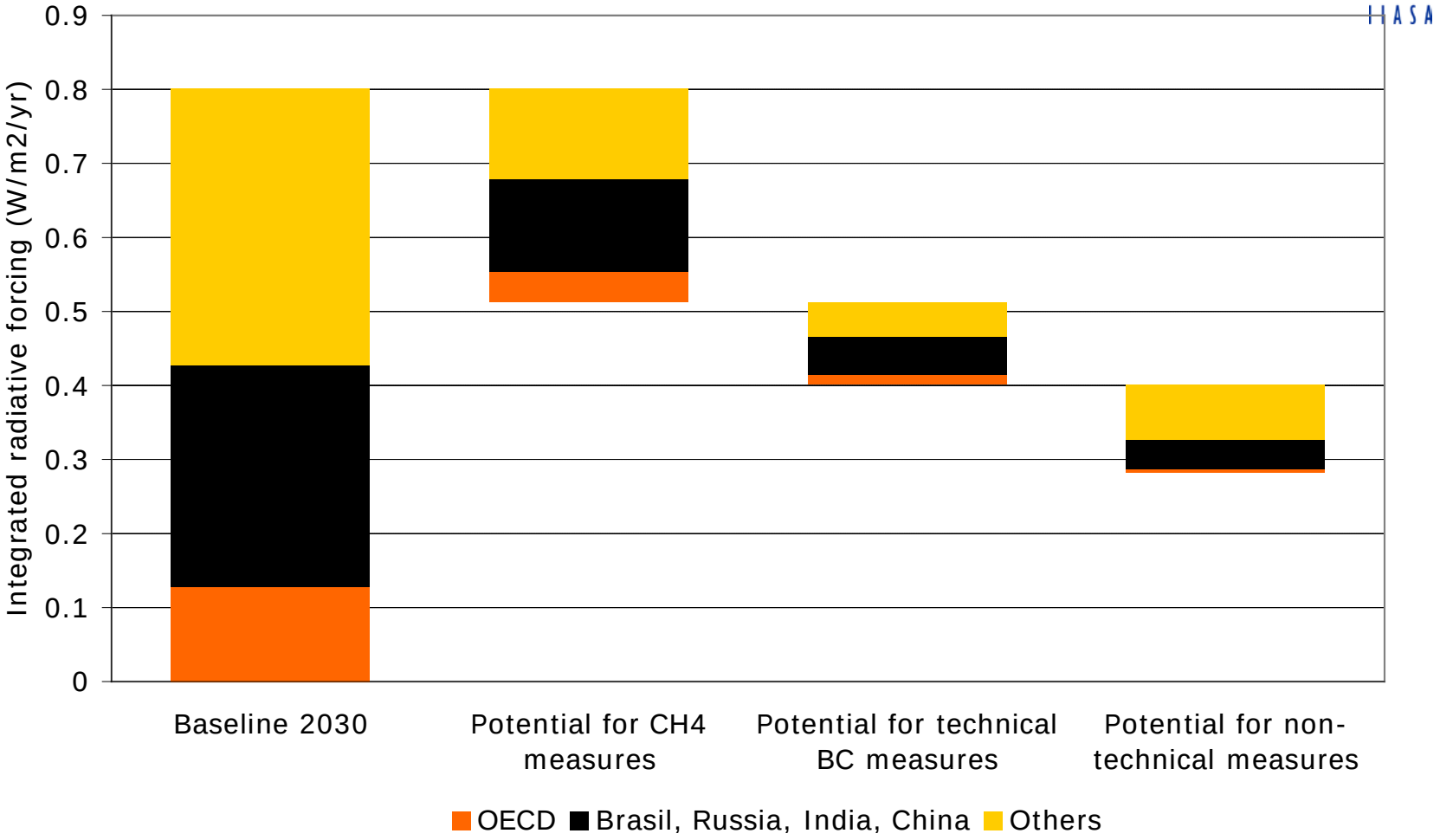
World, relative to baseline projection



Source: IIASA GAINS
http://gains.iiasa.ac.at

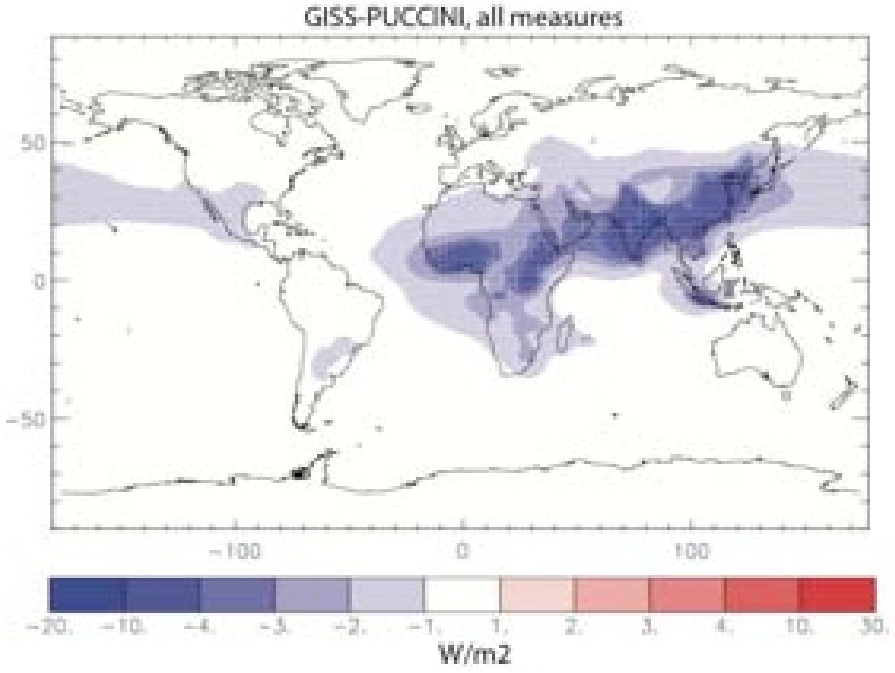
Mitigation potential for radiative forcing from SLCF, by region

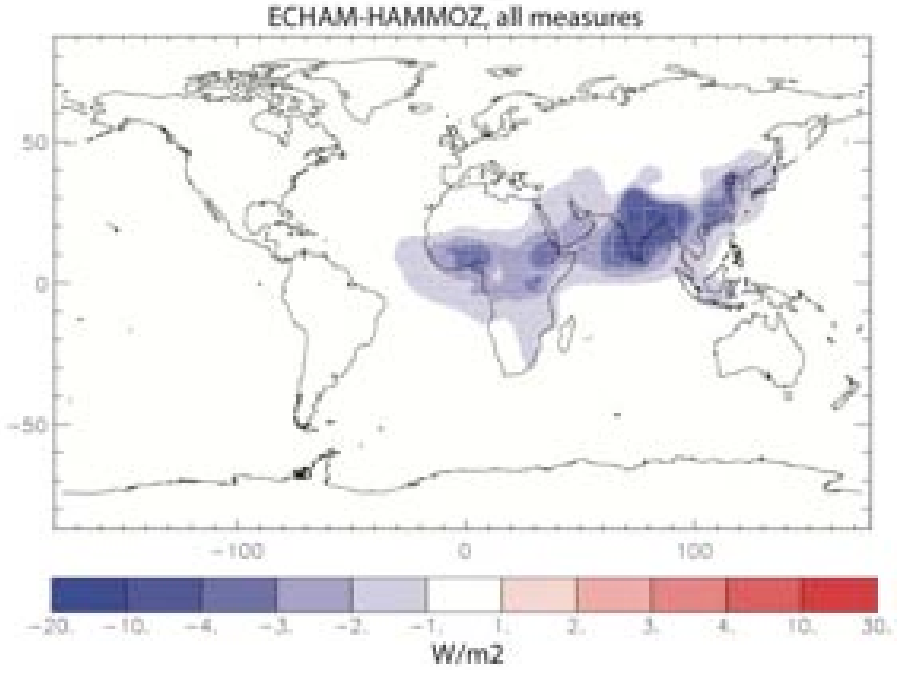
IEA World Energy Outlook 2030, global



For comparison, forcing of CO_2 emissions of 2030 is estimated at 3.6 W/m^2/yr

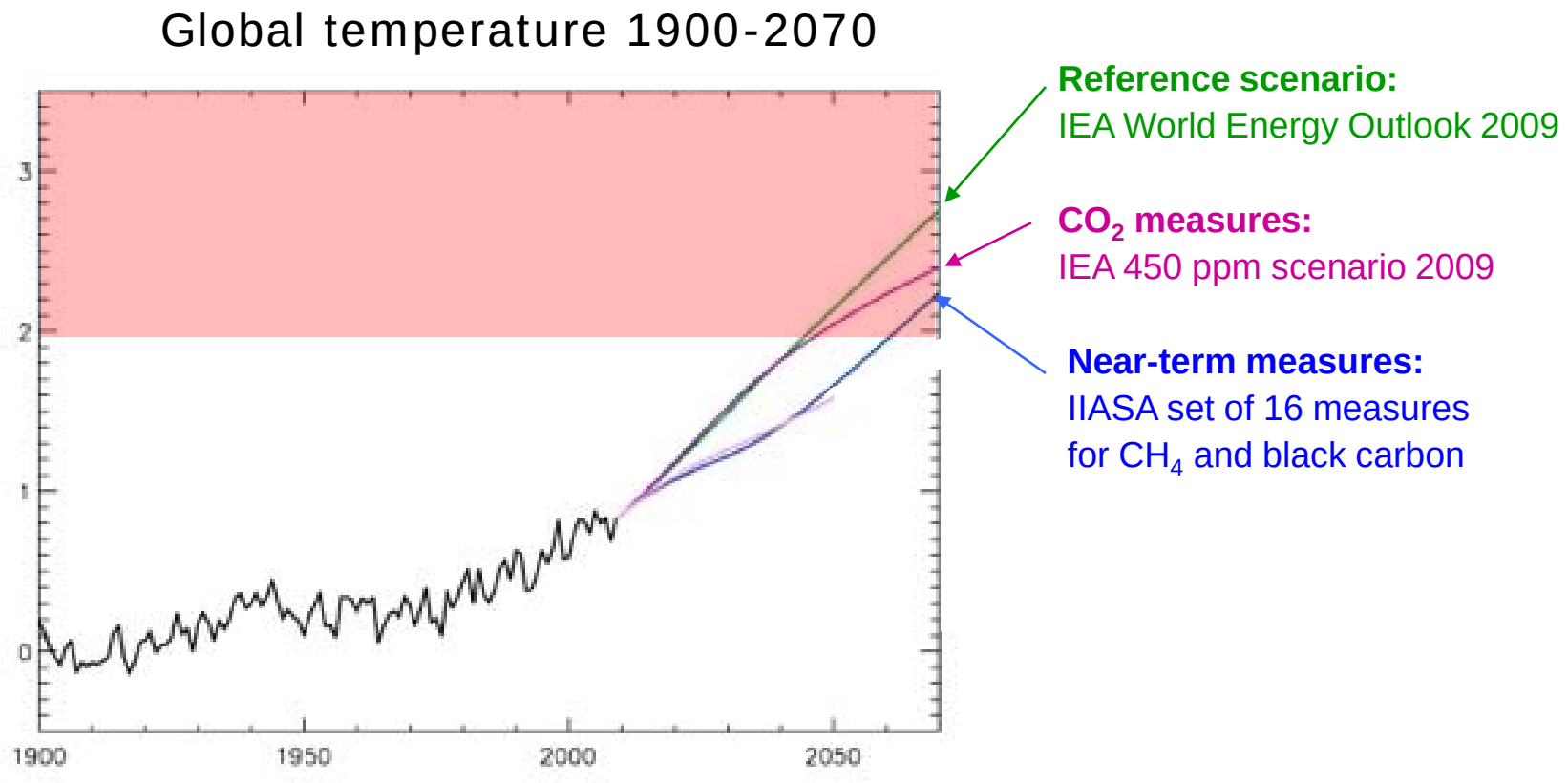
Difference in radiative forcing in 2030 from the chosen 16 measures





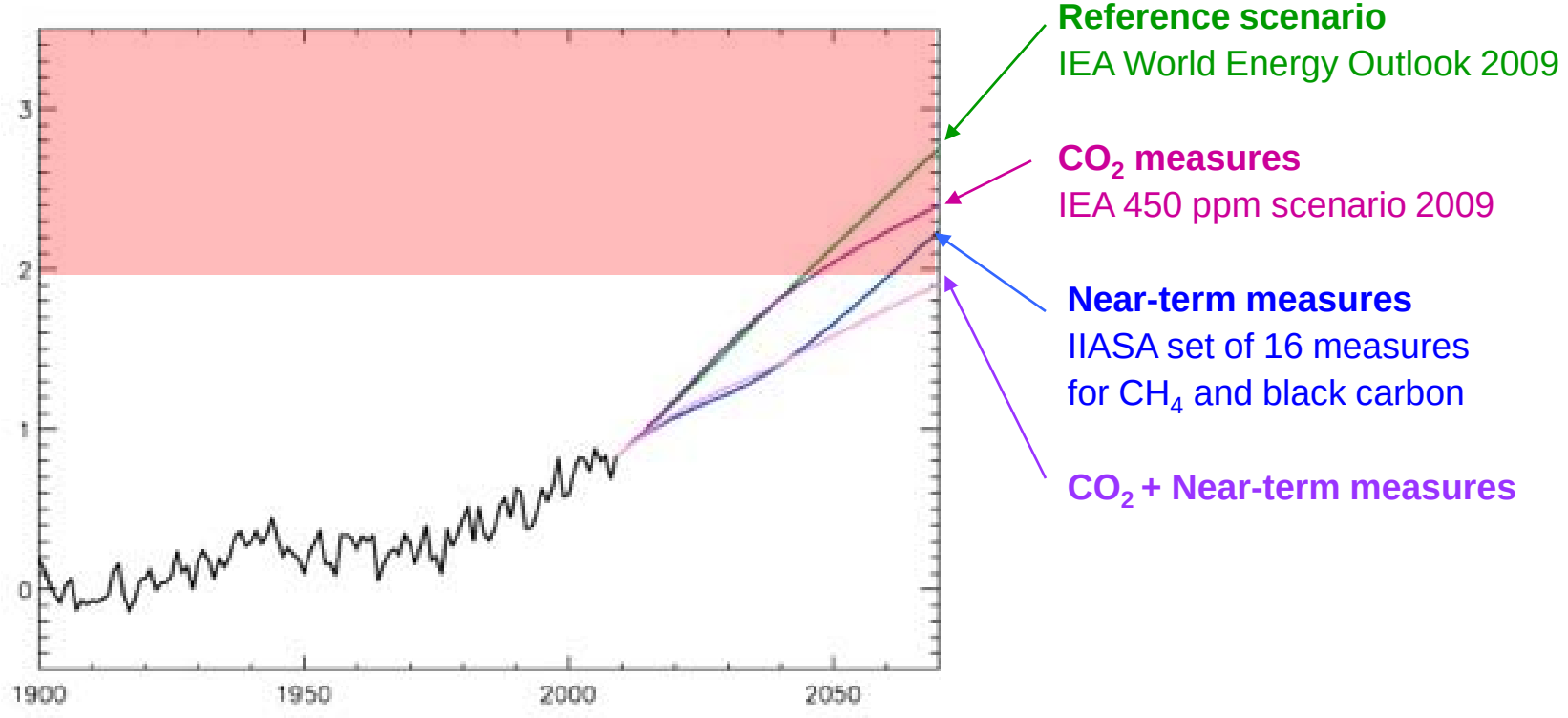
Source: UNEP Black Carbon Assessment, forthcoming 2011

The 16 measures could significantly reduce the rate of temperature increase in the next decades



Source: UNEP Black Carbon Assessment, forthcoming 2011

Together with aggressive CO_2 strategies, they increase chances to stay below the 2º target



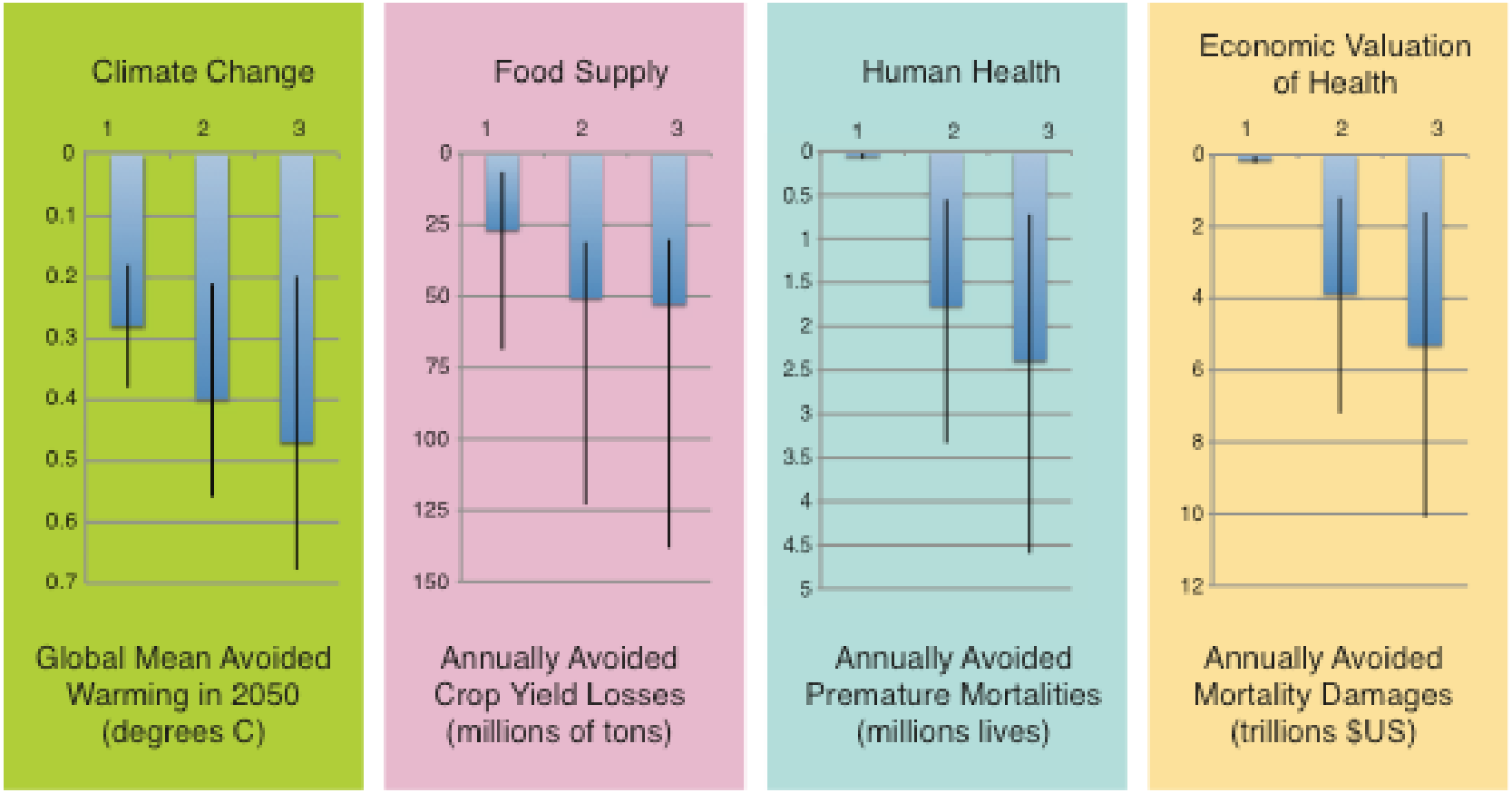
Source: UNEP Black Carbon Assessment, forthcoming 2011

In addition to their climate benefits,

they also contribute to important development objectives

Global Impacts of Additional Emissions Controls on Methane and Products of Incomplete Combustion

1: Methane measures, 2: 1+BC technical measures, 3: 2+Non-technical measures



Source: UNEP Black Carbon Assessment, forthcoming 2011

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Climate change

Piecemeal possibilities

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Pollution and global warming

Climate change in black and white

When air pollution hurts people's health and heats up the climate it makes sense to do something about it. But what about pollution that cools the planet?

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AN IDEAL fossil-fuel power-plant would produce power, carbon dioxide and nothing more. Less-than-ideal ones—not to mention other devices for the combustion of carbon, from [illegible] and stoves burning dung—also emit various gases and gunk. These often cause local environmental problems, damaging lungs, hurting crops and

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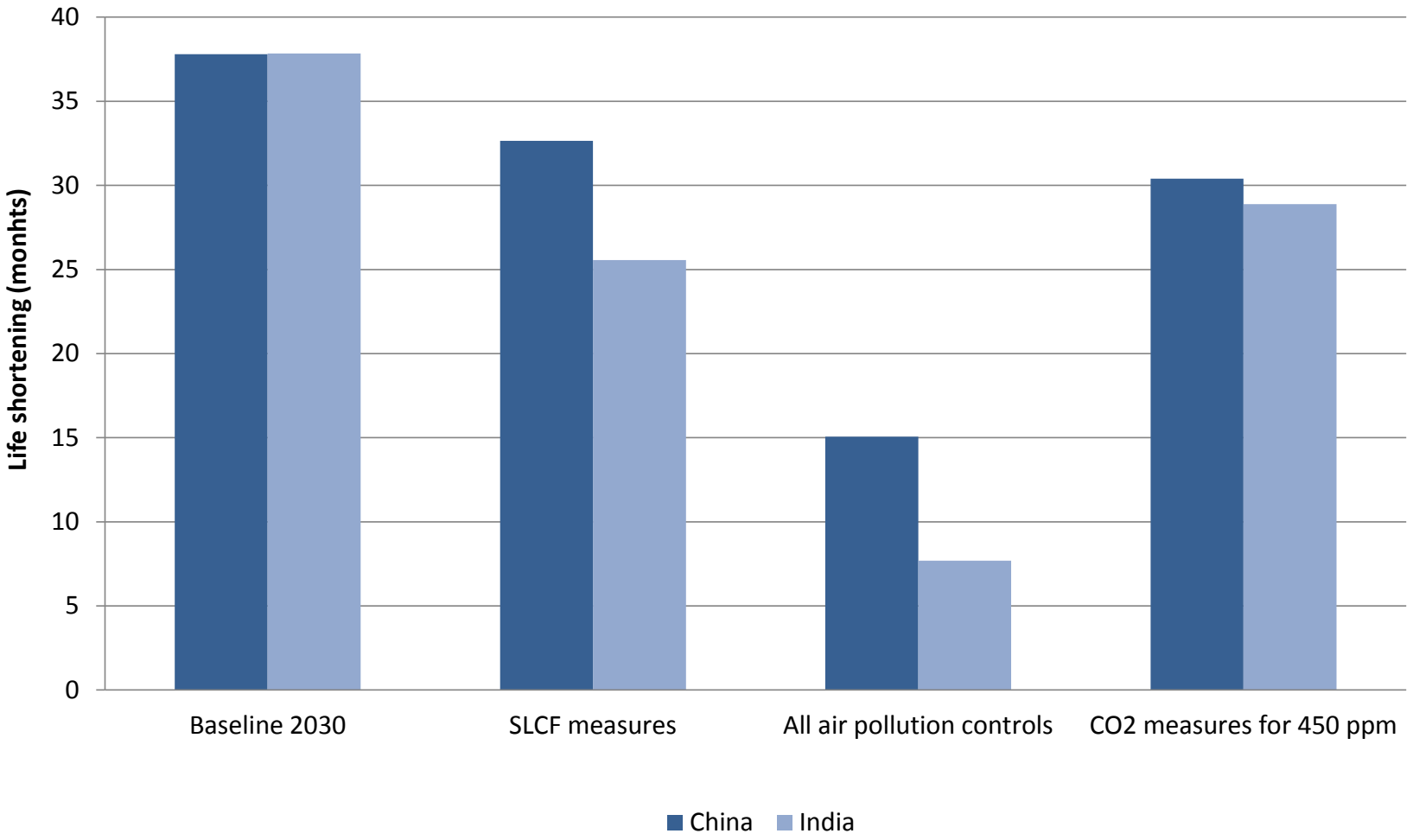
But: Control of short-lived gases will not resolve all air quality problems!

Loss in statistical life expectancy from PM2.5 (Source: GAINS-Asia)



Conclusions

- 16 practical measures have been identified that, if globally implemented, could reduce radiative forcing from short-lived substances by about two thirds. These measures exhaust about 90% of the technically available mitigation potential.
- All these measures are already applied in practice; most are low-cost.
- These measures do not only reduce radiative forcing, but also improve local air quality and contribute to other development objectives.
- However, these measures will not resolve all air quality problems. Further air quality improvements must involve SO_2 controls.
- Their negative climate impacts could be diminished if cuts in SO_2 controls are achieved through structural measures that reduce energy consumption and thereby also lower CO_2 emissions.
- This would reinforce CO_2 mitigation strategies, which are indispensible for long-term climate objectives.