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Mitigation of long- and short-lived climate forcers:

Co-benefits on non-climate policy objectives

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Rationale

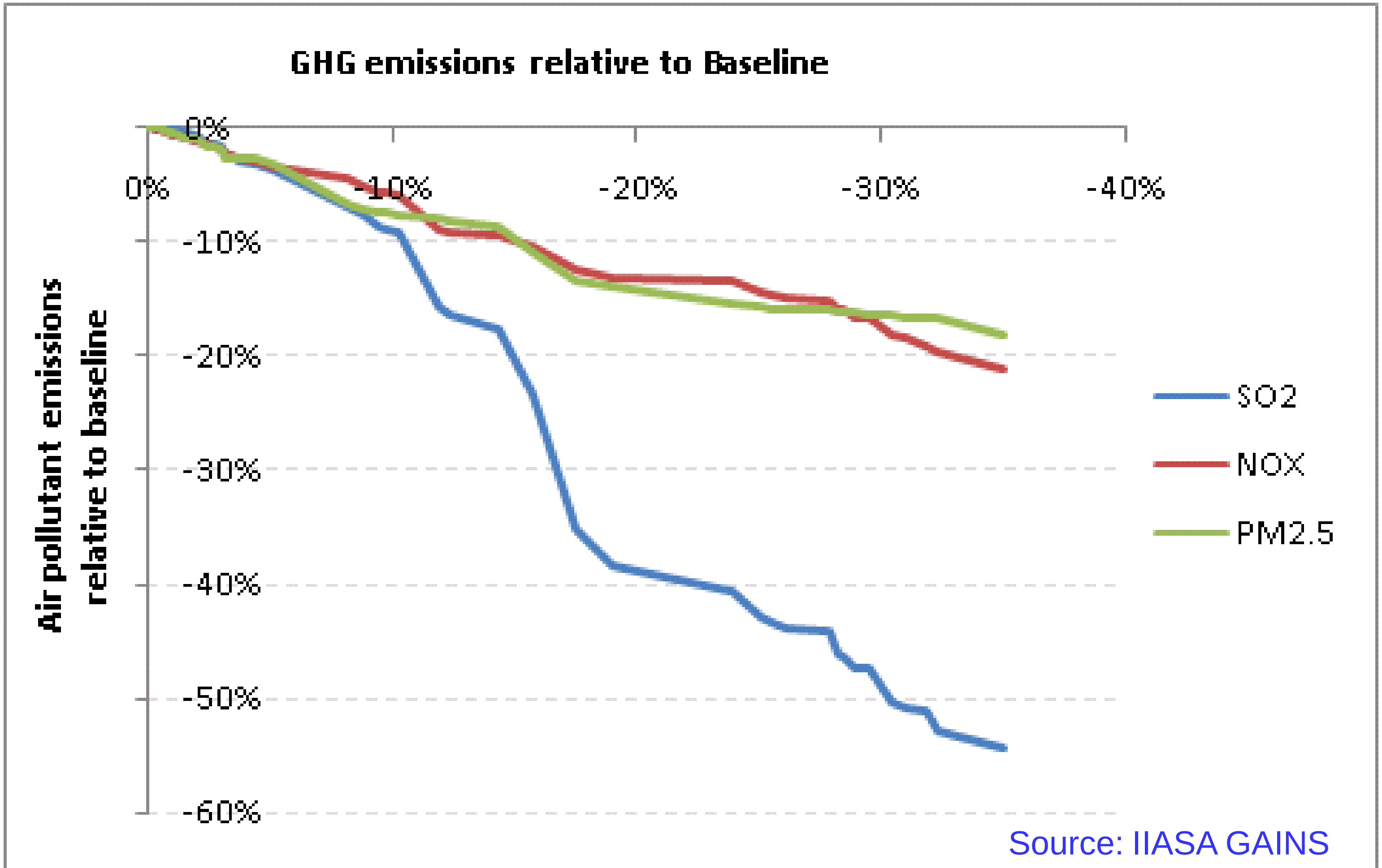
- Co-control of CO_2 and air pollutants results in significant co-benefits of GHG mitigation on human health, ecosystems and agricultural pollution

- However, accompanying reductions of cooling agents (SO_2, OC) compensate climate benefits from CO_2 mitigation in the next few decades.

- Our study explored the scope for control of short-lived substances that could complement efforts to reduce long-lived greenhouse gases and minimize the negative climate impacts of SO_2 controls.

Co-control of GHGs and air pollutants

Annex I parties of UNFCCC, 2020



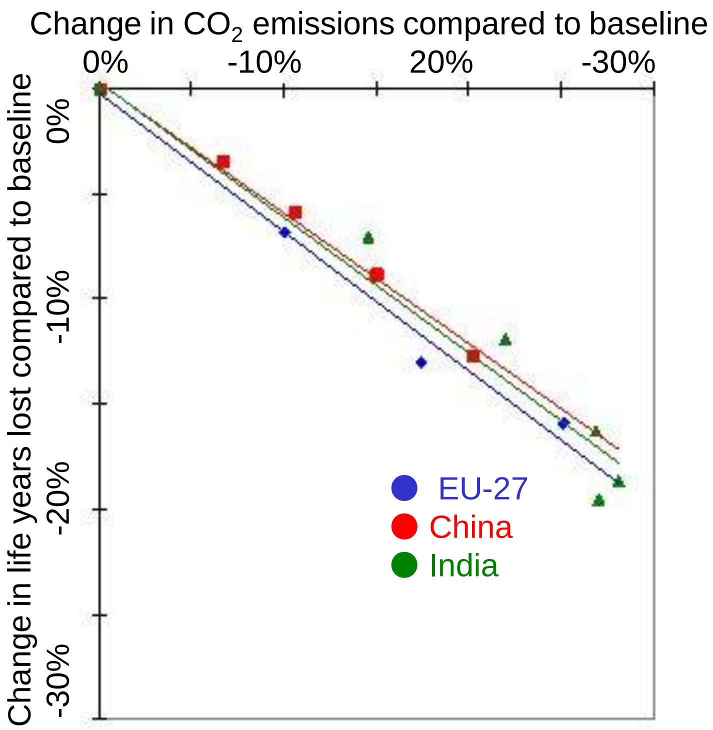
Source: IIASA GAINS
http://gains.iiasa.ac.at

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

Low CO_2 strategies result in

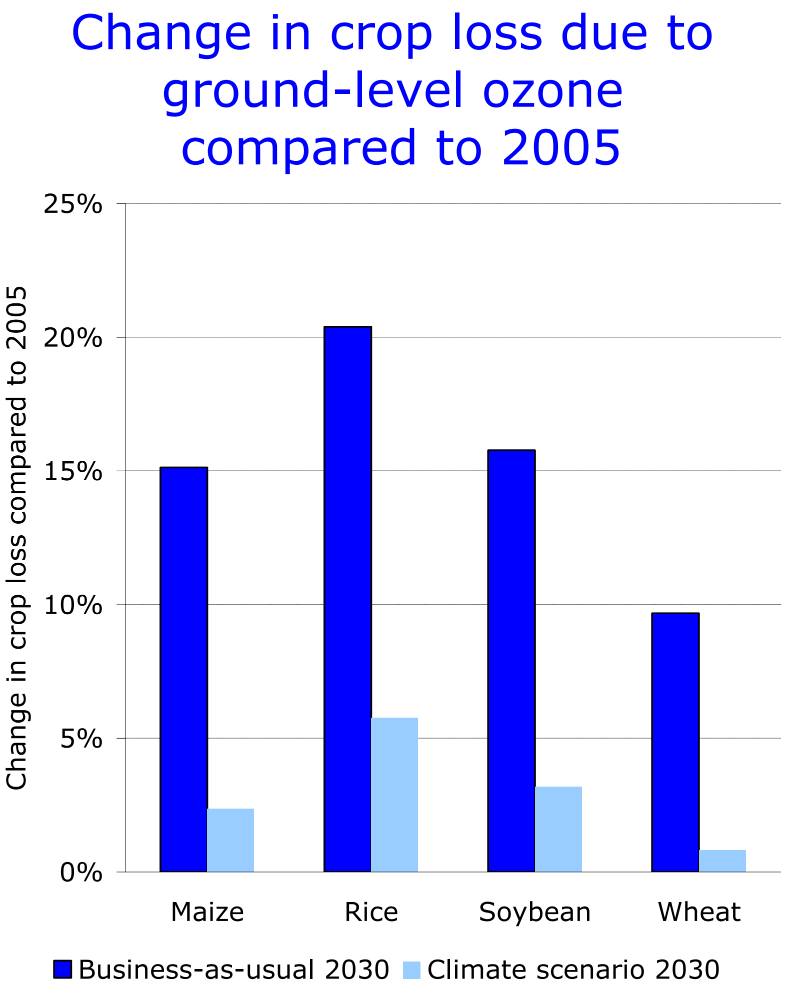
- less SO_2, NO_x and PM emissions,
- lower damage to health and vegetation from reduced air pollution,
- cost savings for air pollution control equipment, compensating for up to 40% of GHG mitigation costs.

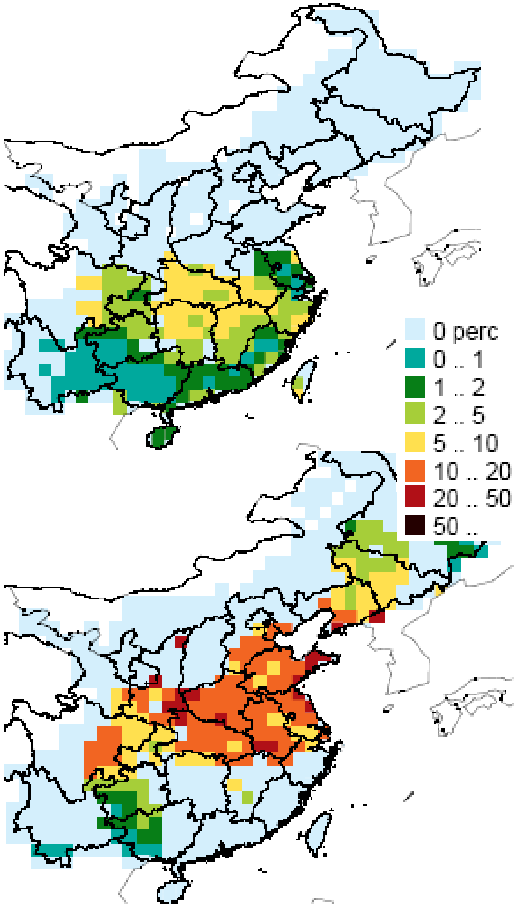
CO_2 emissions vs. health impacts (YOLLs)



Source: IIASA GAINS

Co-benefits of GHG mitigation on crop losses in China





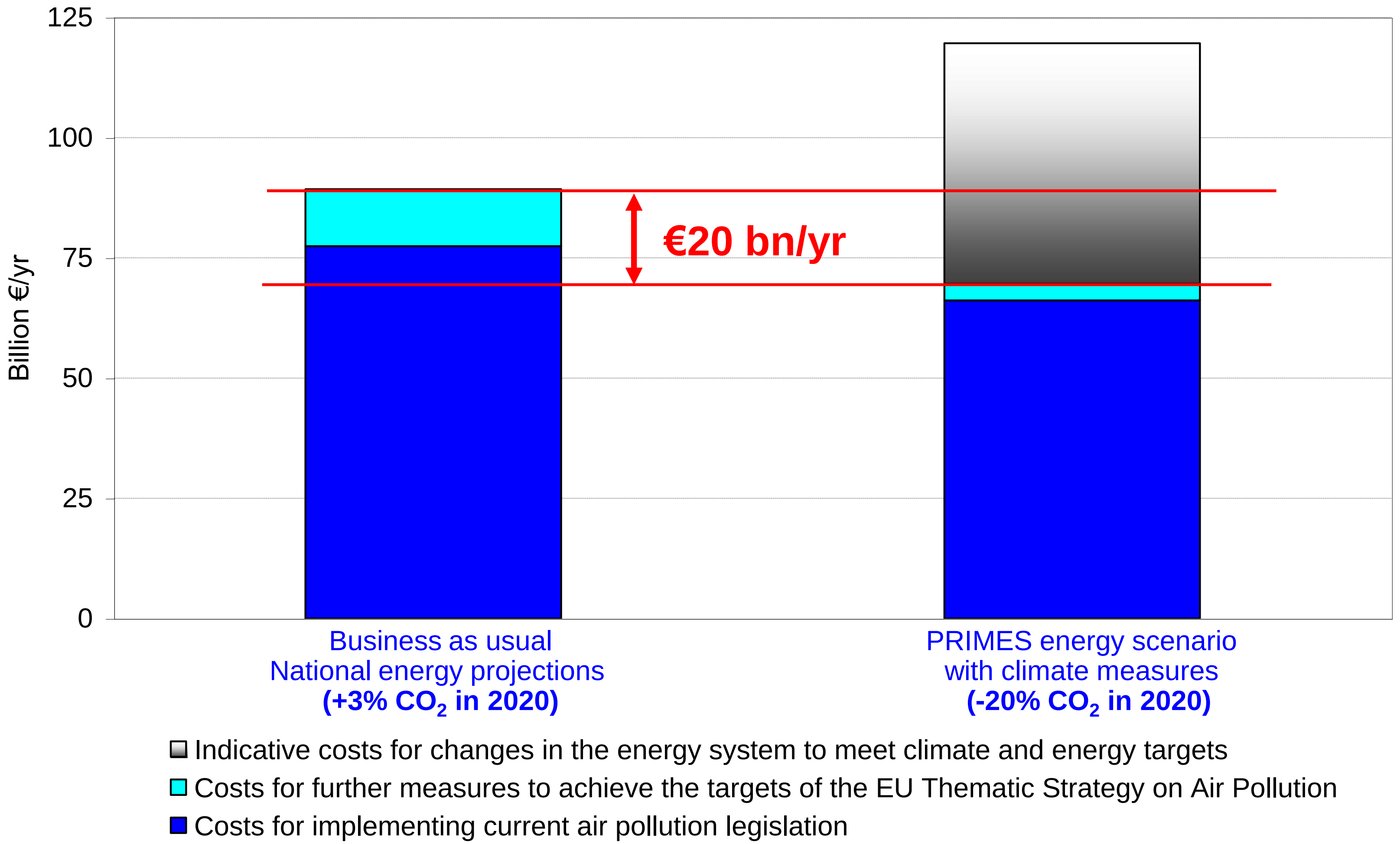
Rice: crop loss calculated for 2030 baseline

Wheat: crop loss calculated for 2030 baseline

Source: GAINS-Asia
http://gains.iiasa.ac.at

GHG mitigation reduces air pollution control costs

Costs to meet the EU air quality and climate targets (EU-27, 2020)

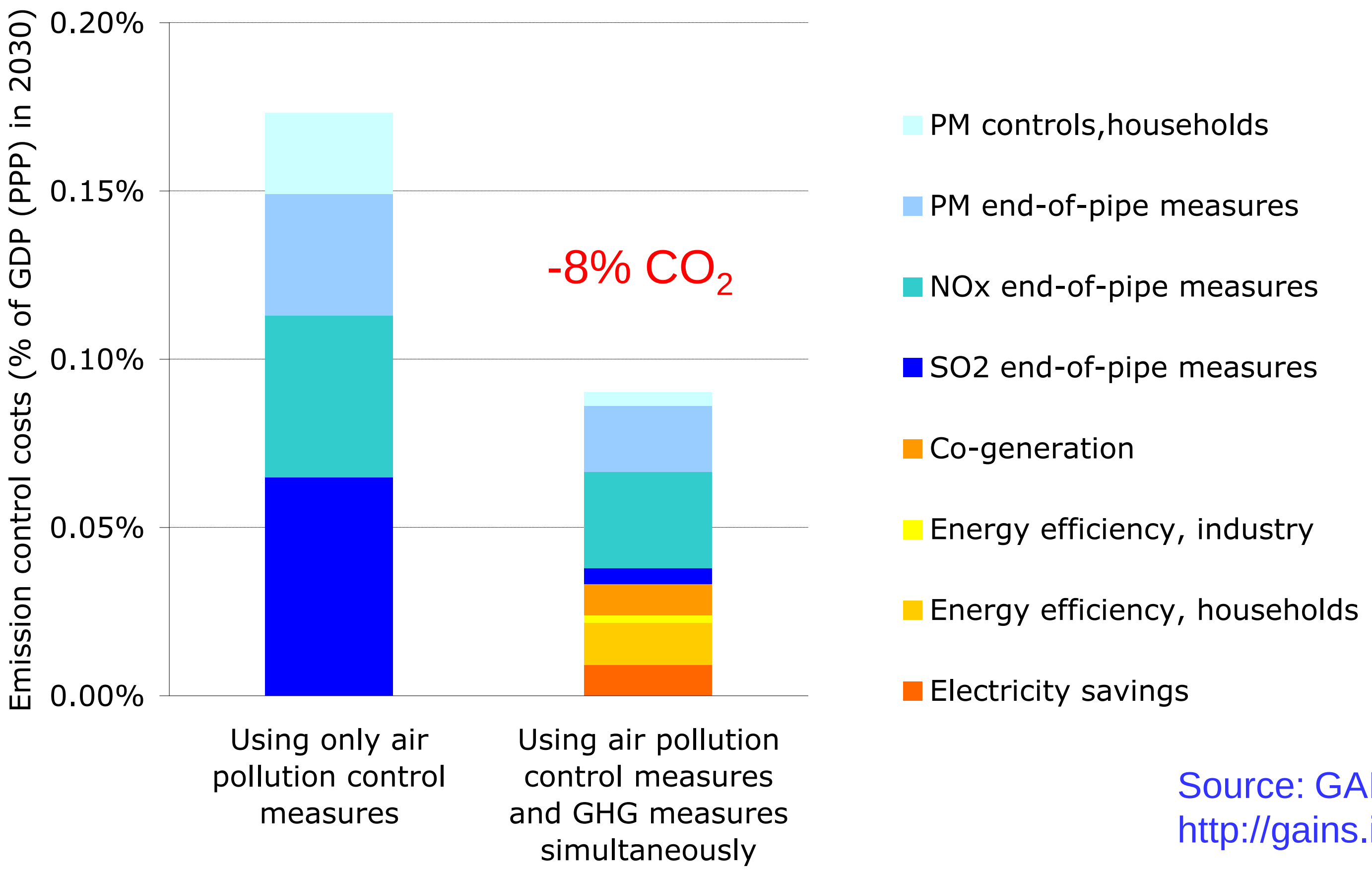


Source: IIASA GAINS

Well-designed air pollution control strategies can also reduce GHG emissions

but do they also mitigate climate change?

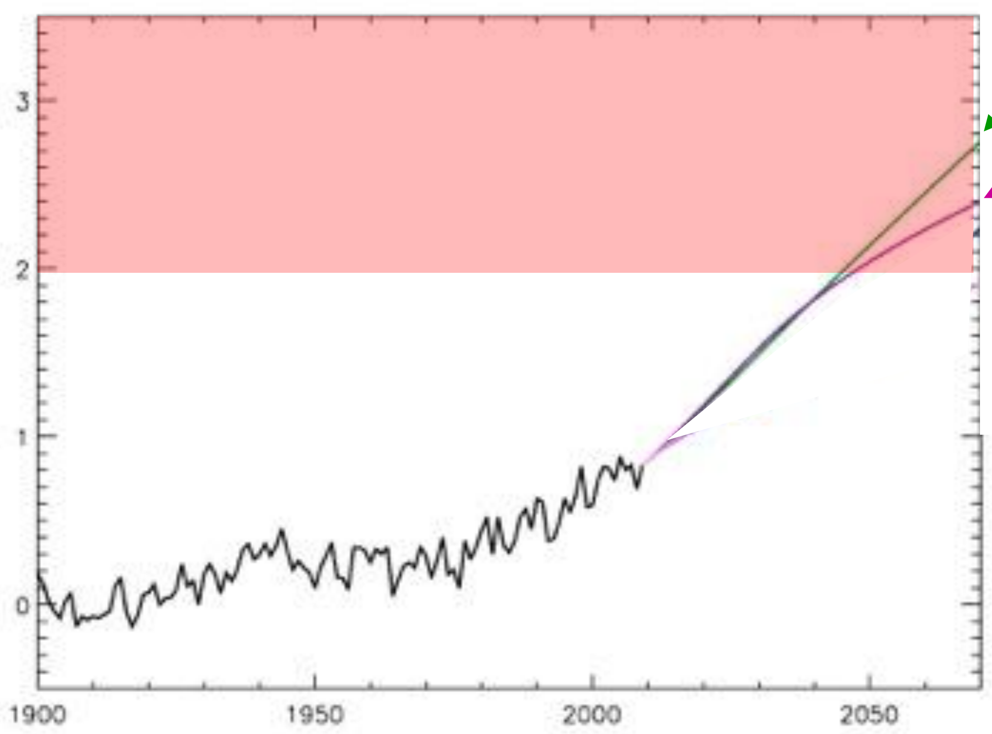
Emission control costs for reducing PM health impacts in China by 50%



Source: GAINS-Asia
http://gains.iiasa.ac.at

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 measures 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

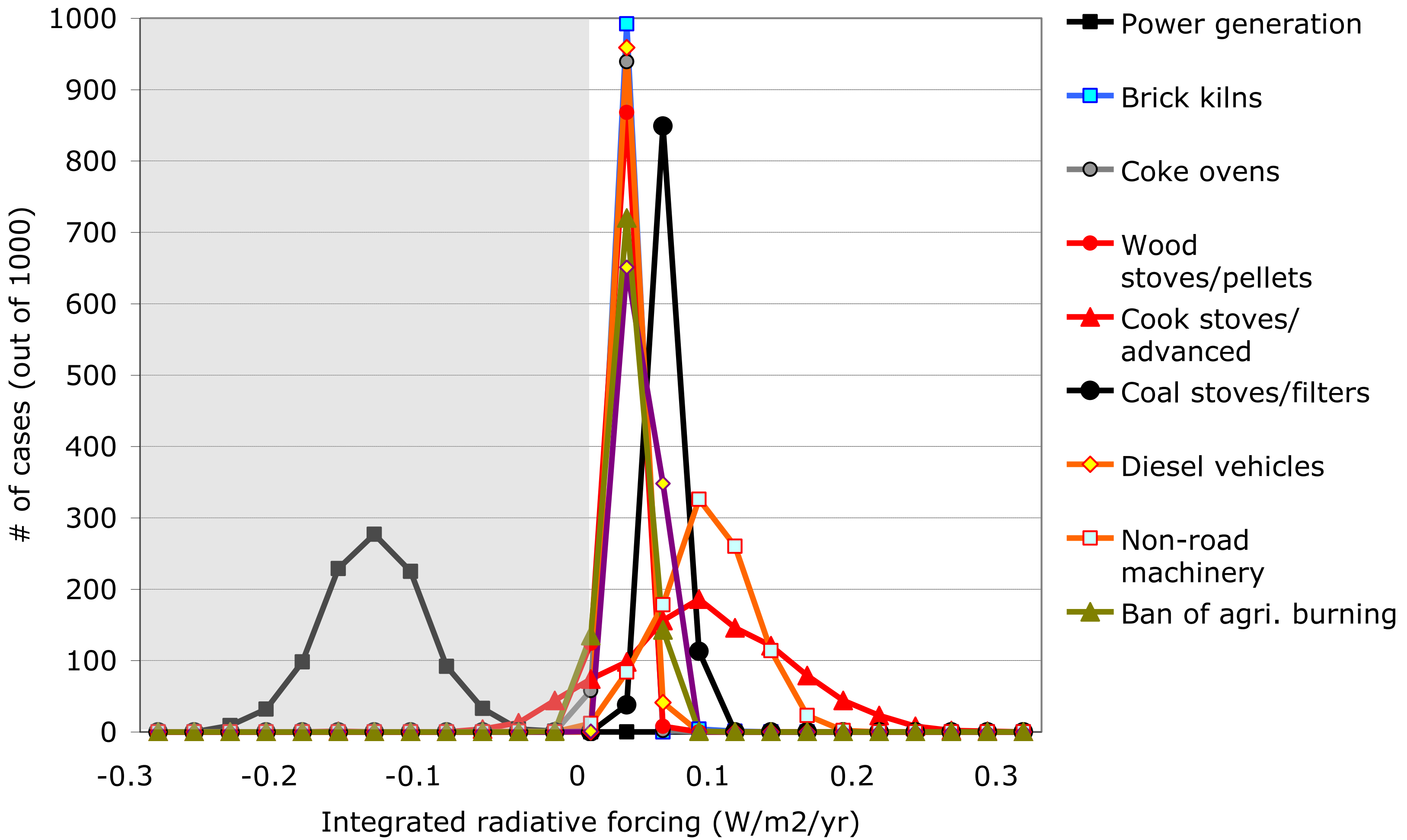
Radiative forcing of GHGs and air pollutants

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

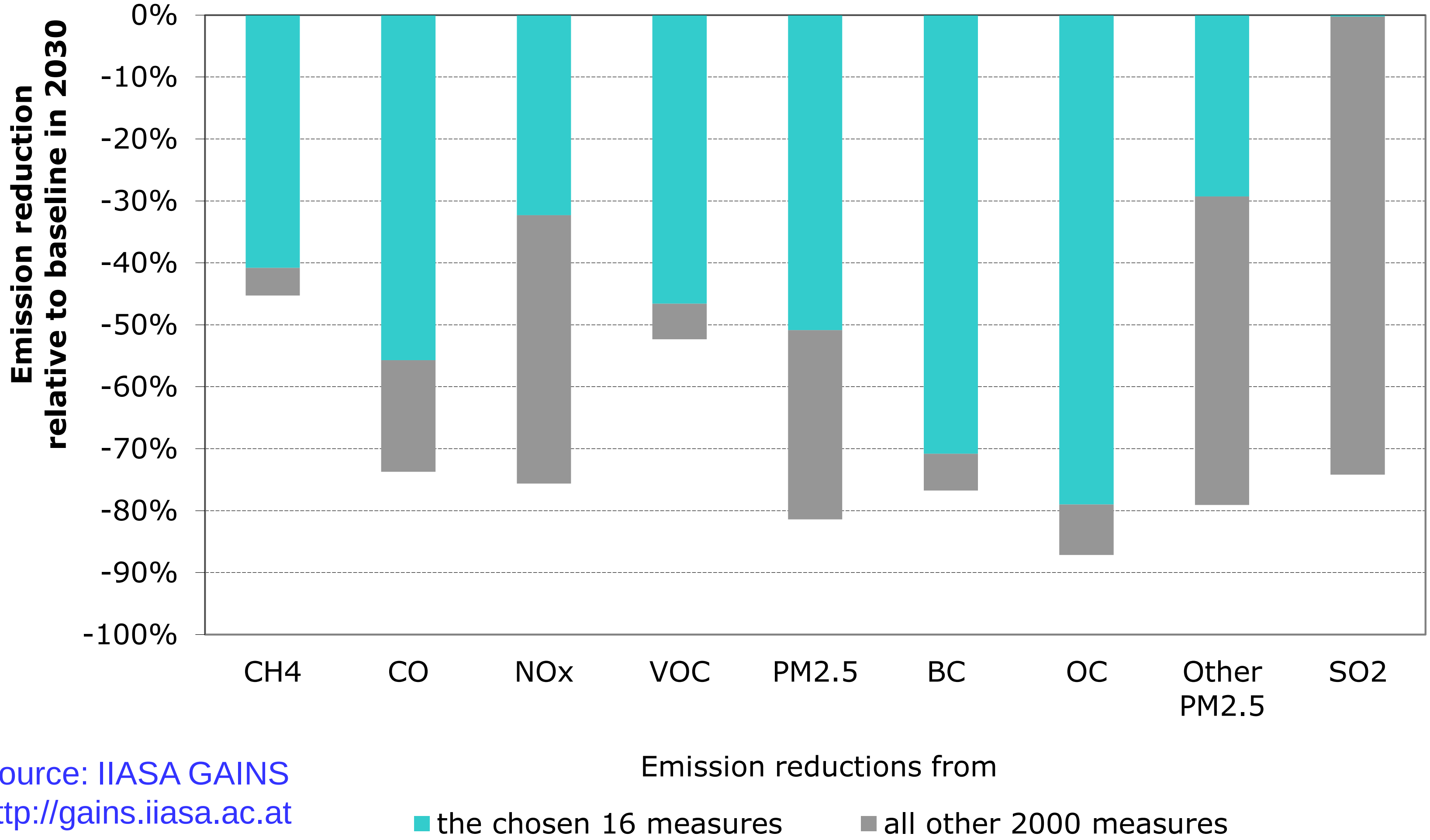
1. Modern coke ovens
2. Modern brick kilns
3. Diesel particle filters
4. Briquettes instead of coal for heating
5. Improved biomass cook stoves
6. Pellets stoves and boilers (in industrialized countries)

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



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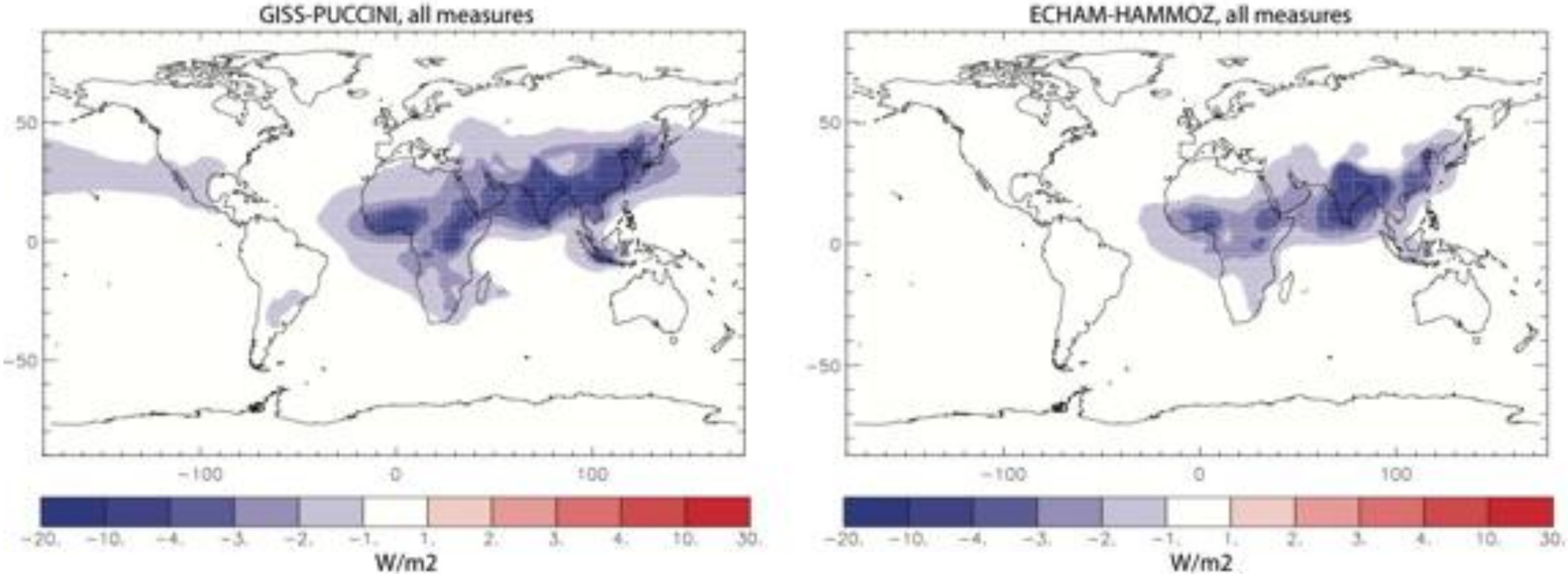
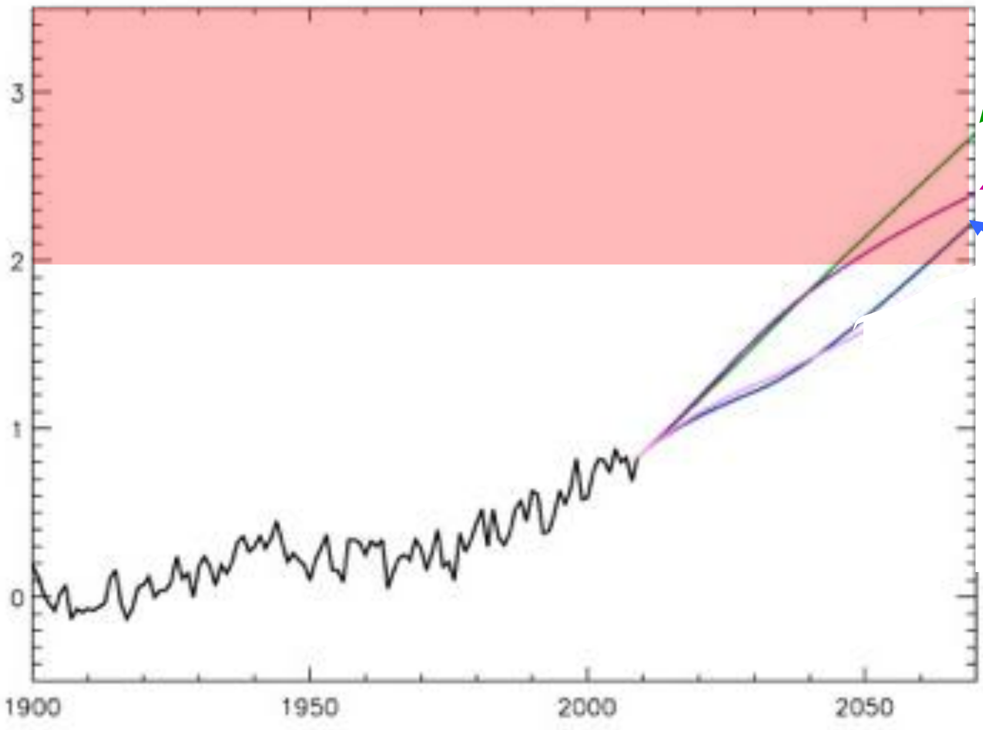
Difference in radiative forcing in 2030 from the chosen 16 measures



Source: UNEP Black Carbon Assessment, forthcoming 2011

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

Global temperature 1900-2070



Reference scenario:
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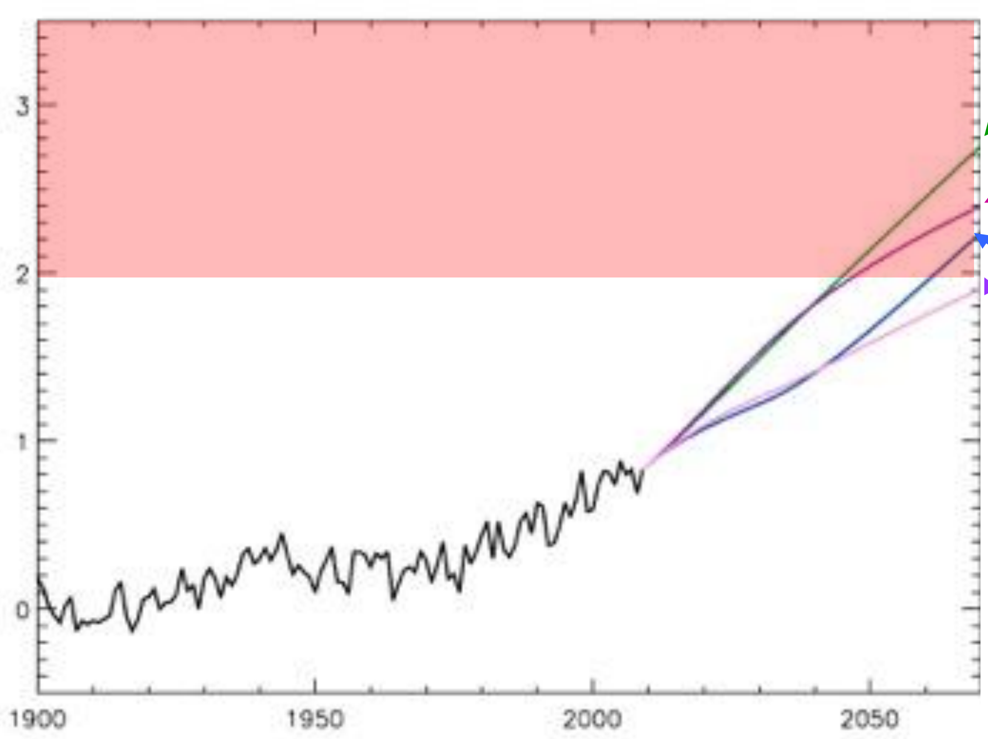
CO_2 measures:
IEA 450 ppm scenario 2009

Near-term measures:
IIASA set of 16 measures
for CH_4 and black carbon

Source: UNEP Black Carbon Assessment, forthcoming 2011

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

Global temperature 1900-2070



Reference scenario
IEA World Energy Outlook 2009

CO_2 measures
IEA 450 ppm scenario 2009

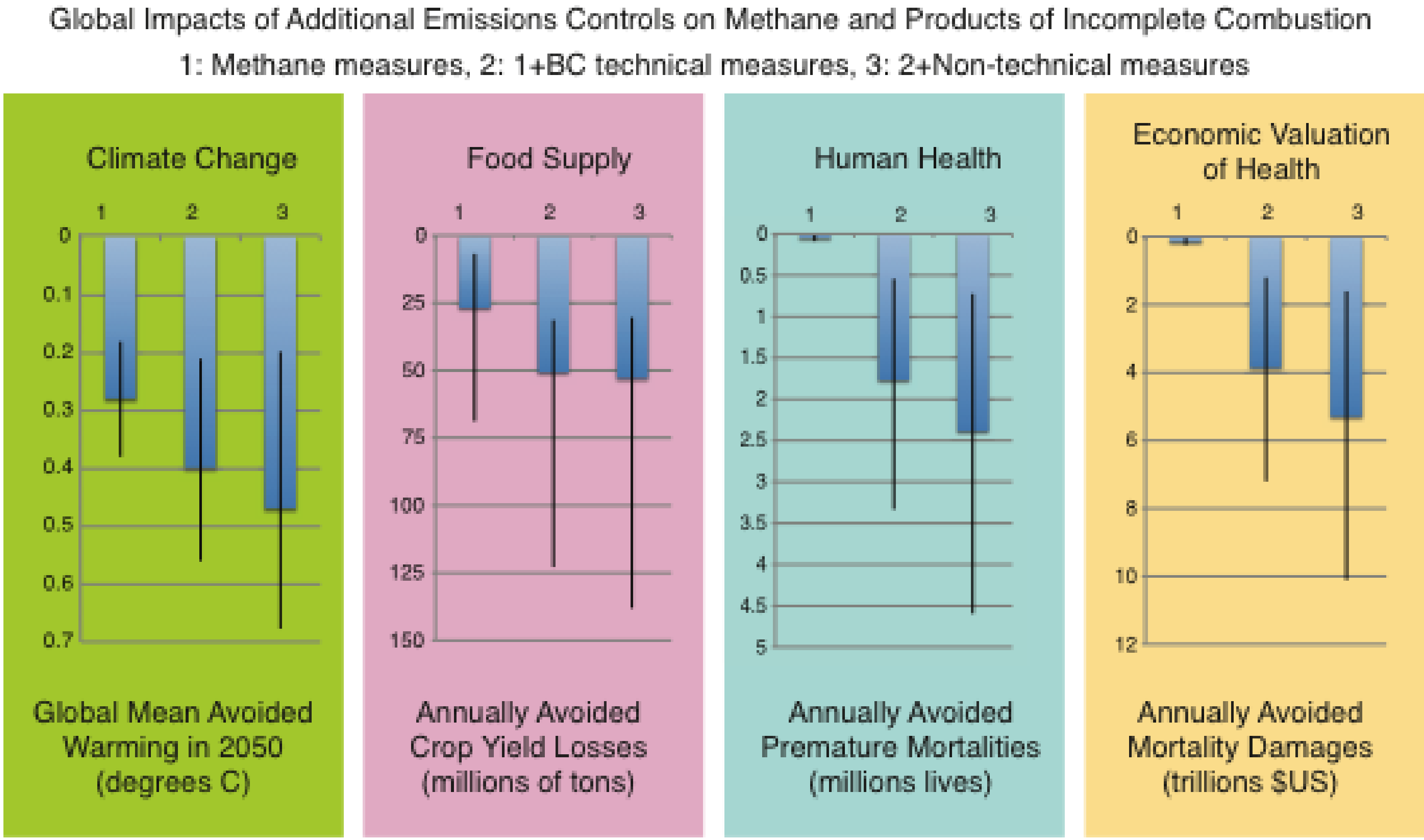
Near-term measures
IIASA set of 16 measures
for CH_4 and black carbon

CO_2 + Near-term measures

Source: UNEP Black Carbon Assessment, forthcoming 2011

In addition to their climate benefits,

they also contribute to important development objectives



Source: UNEP Black Carbon Assessment, forthcoming 2011

Conclusions

- Control of long-lived GHGs results in significant co-benefits on air pollution, including savings in air pollution control costs.
- Well-designed air pollution control strategies can also reduce CO_2 emissions at no additional costs.
- However, SO_2 controls might compensate the temperature benefits from CO_2 mitigation in the near-term.
- 16 practical air quality measures could reduce radiative forcing from short-lived substances by about two thirds (especially in Asia) and lower global temperature by about 0.5 degrees. Together with aggressive CO_2 strategies, they increase the chances to stay below the 2º target.
- These measures do not only improve local air quality, but also result in significant benefits to development objectives.
- These measures are complementary to CO_2 mitigation strategies, but cannot substitute the urgency to control long-lived GHGs.