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The inclusion of near-term radiative forcing into a multi-pollutant/multi-effect framework

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emep

Co-operative programme for monitoring
and evaluation of the long-range
transmissions of air pollutants in Europe



Air pollutants have also effects on climate change in the near-term



There are concerns about climate effects of air pollutants:

1. Near-term forcing of air pollutants

- Warming: BC, CH₄, O₃ (i.e., CH₄, CO, VOC, NO_x)
- Cooling: SO₂, OC
- accelerate or delay ongoing climate change at the regional scale,
- change regional weather circulation and precipitation patterns.

2. Increase arctic melting through deposition of (black) carbon

How could near-term climate effects be introduced into GAINS?



- Near-term climate impacts could be included into the GAINS multi-pollutant/multi-effect concept as **an additional effect of air pollutants**
- Relevant precursors:
SO₂, NO_x, NH₃, VOC, O₃, PM2.5, BC, OC, CO, CH₄
- Note that many pollutants are co-emitted, and isolated reductions of single pollutants (e.g., BC) are often not possible in reality.
GAINS captures these interdependencies!

Potential impact indicators



- As there is significant scientific uncertainty on the quantification of actual climate impacts, indicators should refer to physical indicators that can be quantified with reasonable robustness.
- **Potential metrics (impact indicators):**
 - 1. Instantaneous radiative forcing of sustained emissions (at regional and global scales)**
 - 2. Deposition of (black) carbon in the arctic.**
- These metrics would not interfere with UNFCCC objectives (long-term stabilization, reflected through 100 years GWP)
- As they do not involve CO₂, no conflict between control of air pollutants and CO₂ mitigation could be constructed

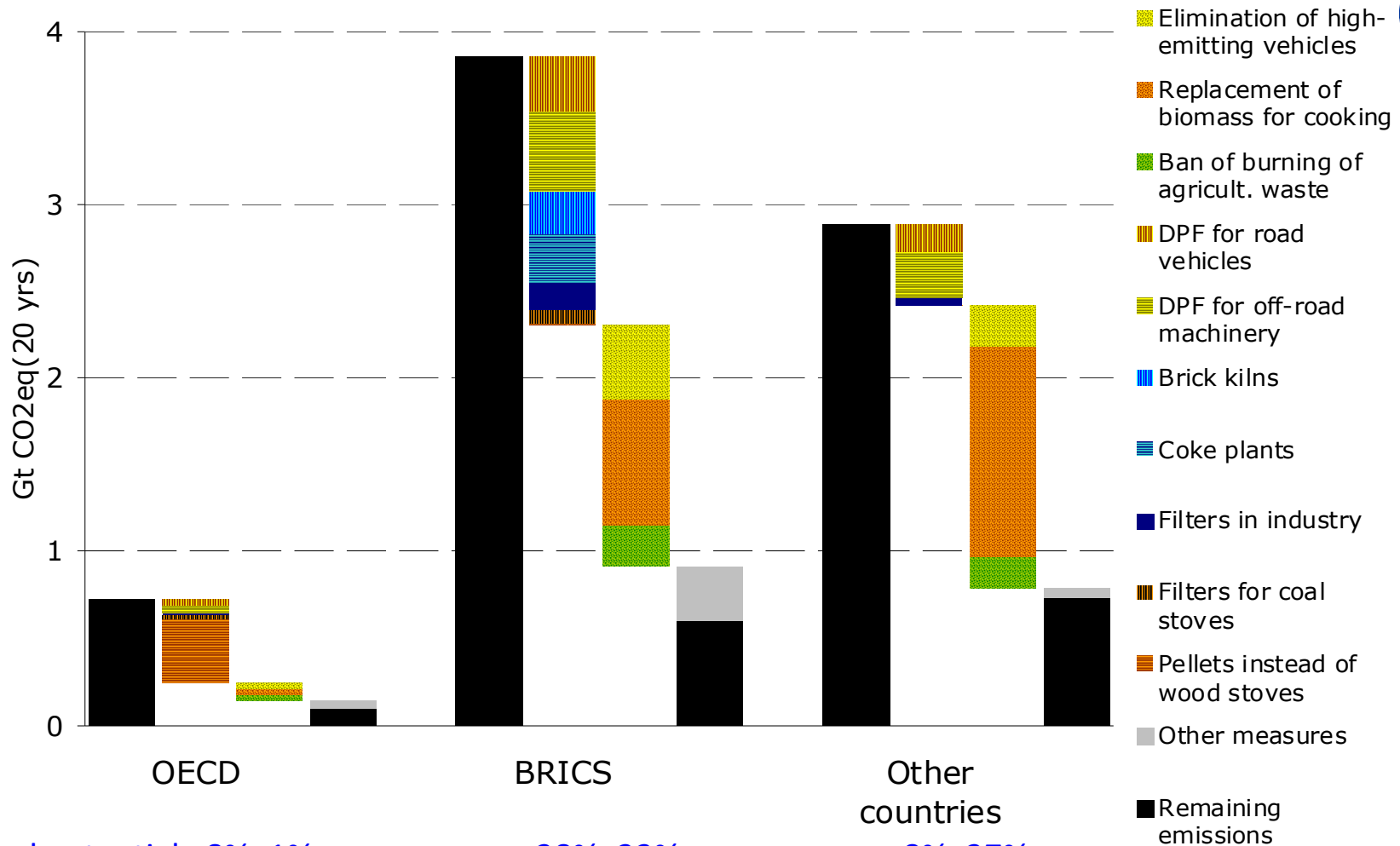
Work elements



- Development of cost curves for BC, OC, CO (CIAM)
- Quantification of source-impacts relationships (between national emissions and regional forcing)
 - Calculation of source-receptor relationships between (country) precursor emissions and (grid) column concentrations (MSC-W)
 - Estimation of (regional) radiative forcing from (grid) column concentrations (Uni.Oslo)
- Extension of GAINS optimization routine (GAINS)

Mitigation potentials for BC+OC in 2030

Net impact on GWP20, IEA WEO2009 baseline



Of global potential: 8%+1%

28%+23%

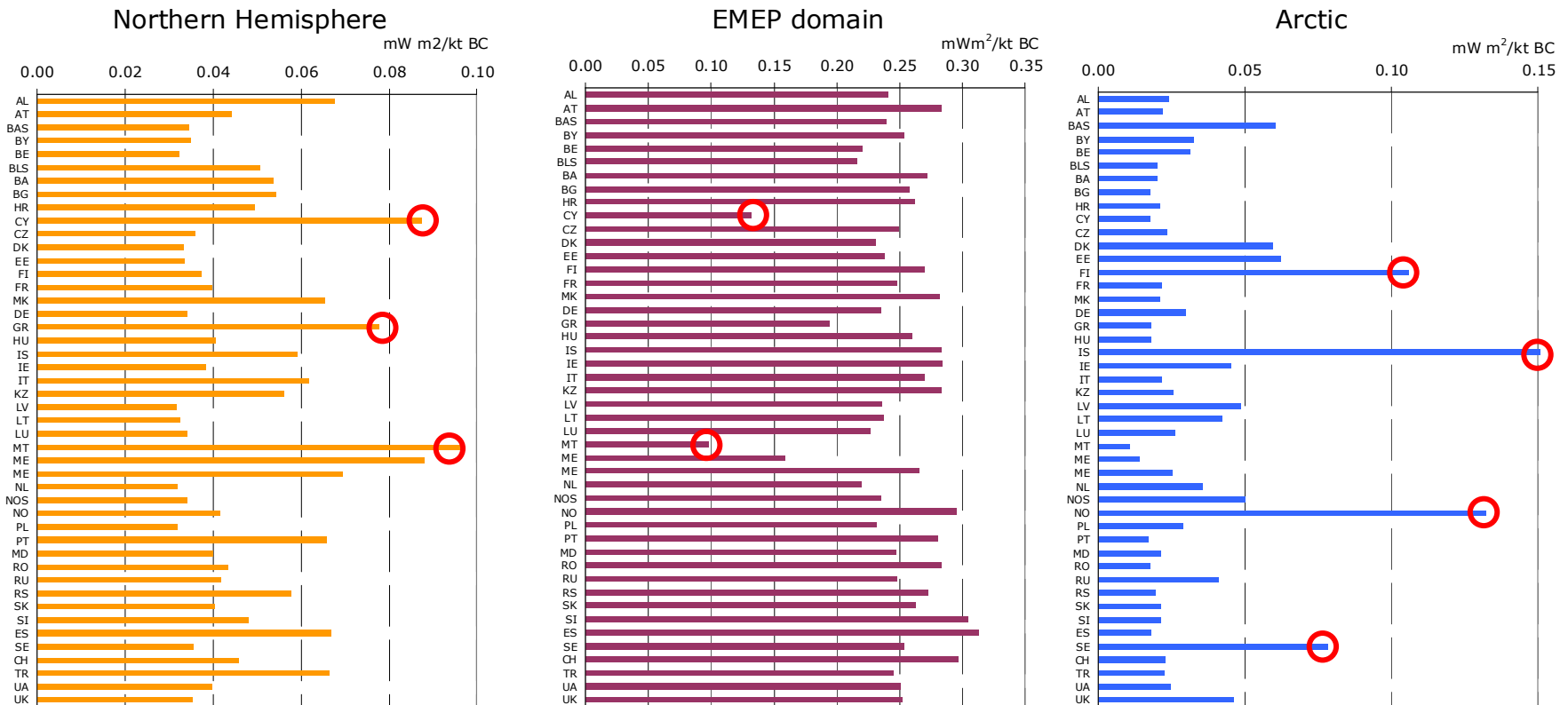
8%+27%

Impact on instantaneous forcing of 1 kt BC

Source: EMEP/MSC-W, UniOslo, IIASA



Instantaneous forcing over



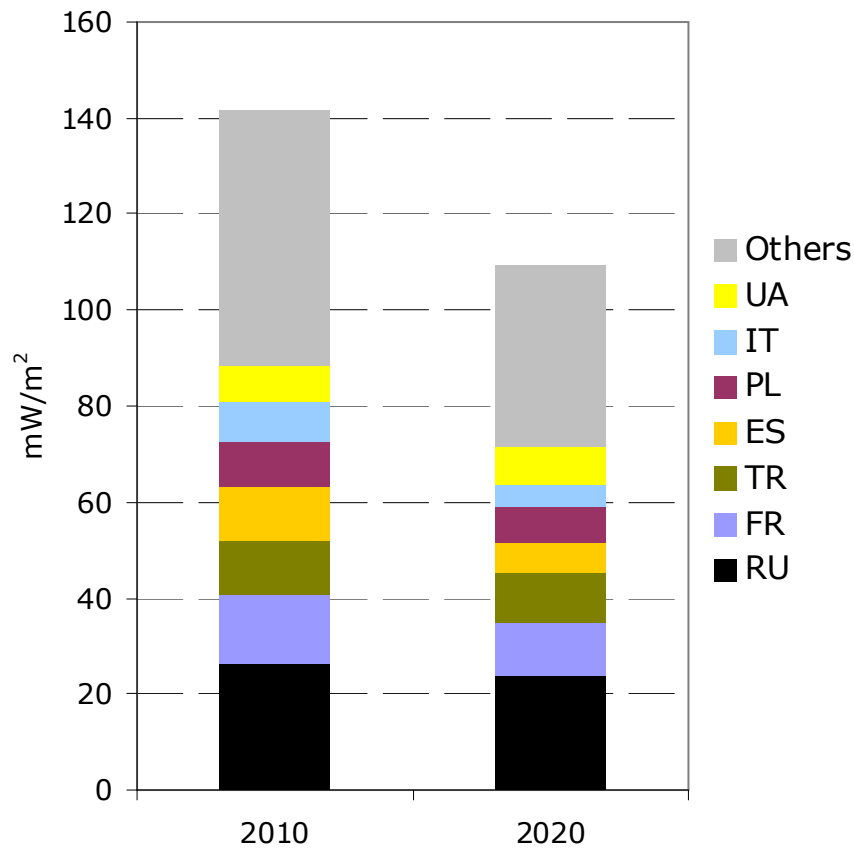
Preliminary results!

Instantaneous forcing from BC

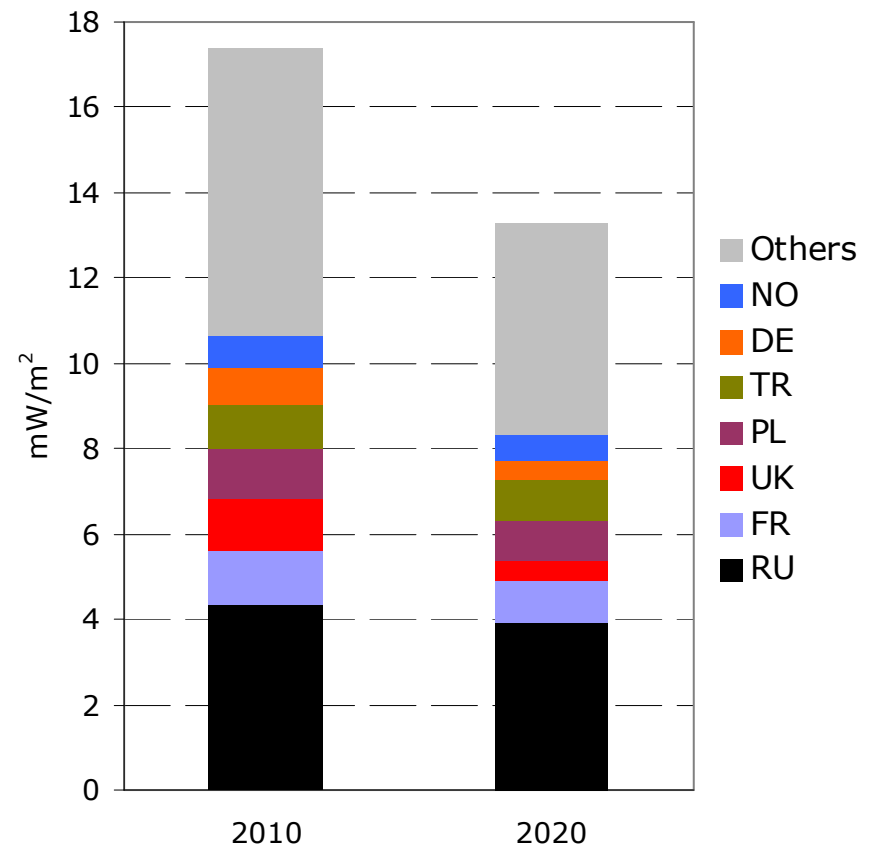
Contributions from countries of the EMEP domain



Forcing over the EMEP domain



Forcing over the Arctic



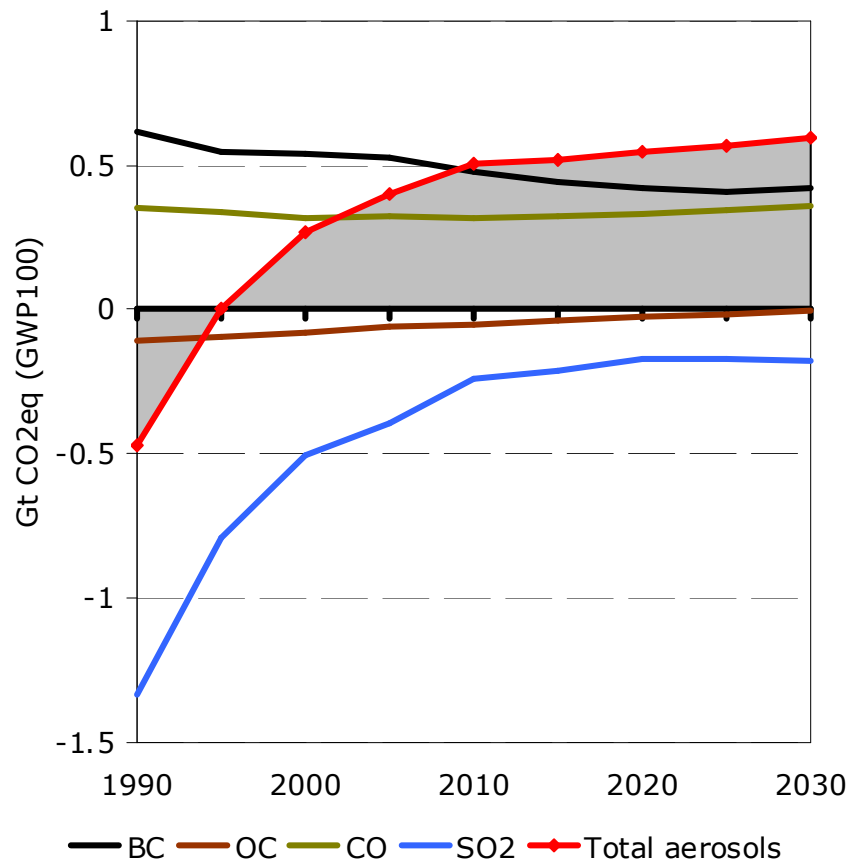
Preliminary results!

Forcing from aerosols compared to Kyoto-gases

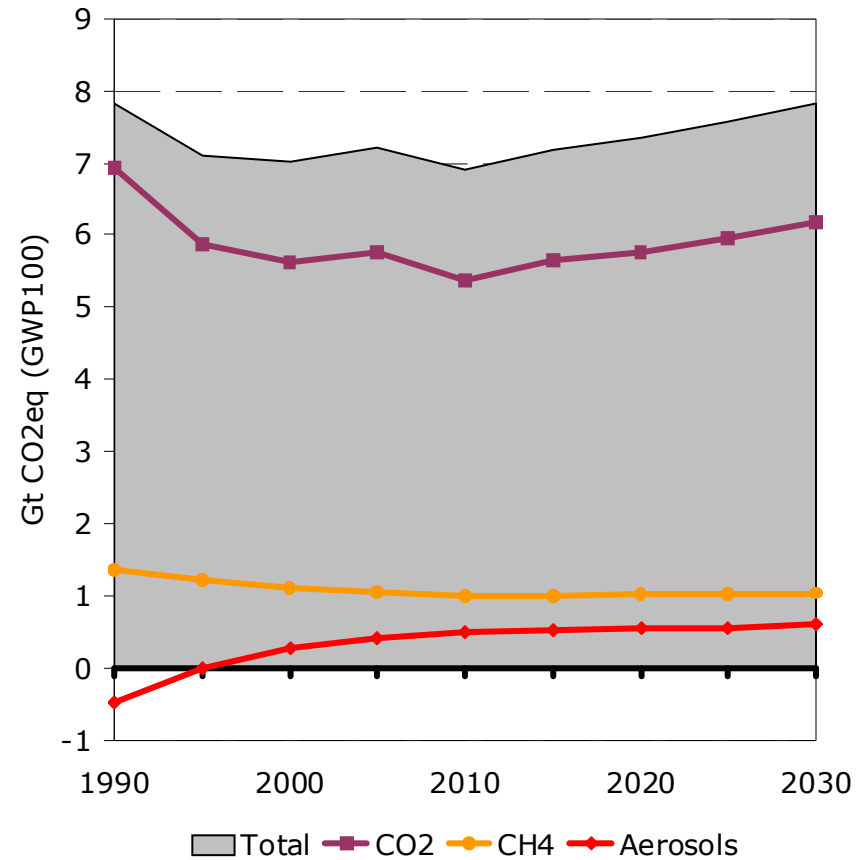
EMEP domain, IEA WEO2009 baseline



Time-integrated forcing from aerosols

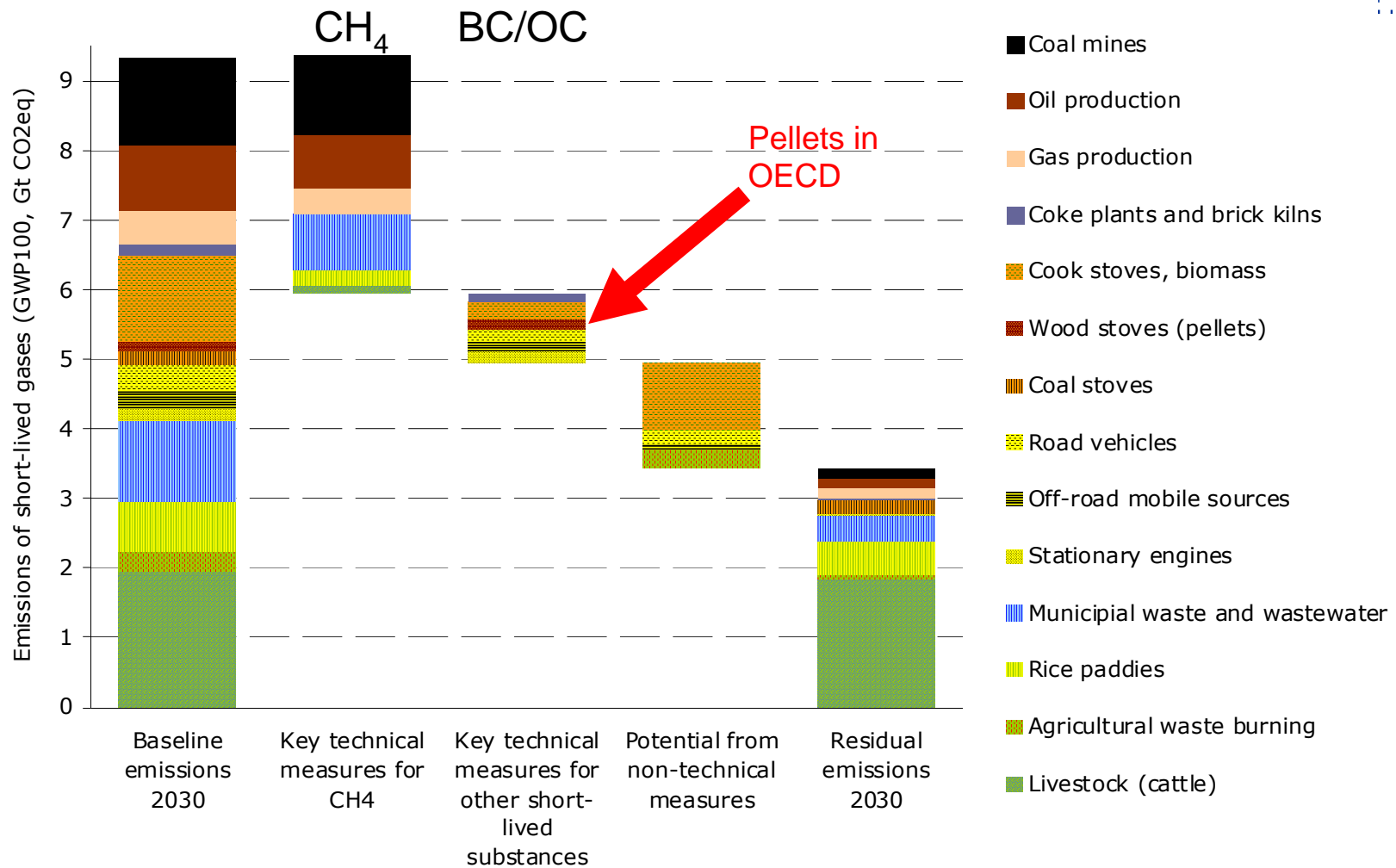


Total time-integrated forcing



Mitigation potential from short-lived forcers

Top 15 measures to reduce GWP100 globally, IEA REF 2030



Potential approaches for GAINS optimization for CLRTAP protocol



Starting from an energy scenario that achieves given (long-term) climate objectives (expressed through GWP_{100}):

Option 1:

- Optimize for environmental targets on
 - health and ecosystems (as before),
 - + near-term forcing and BC deposition to the arctic.

Option 2:

- Optimize for environmental targets on
 - health and ecosystems (as before),
 - under the condition that net near-term forcing and/or BC deposition is minimized (or will not deteriorate, or ...)

Conclusions



- Near-term forcing and carbon deposition to the Arctic could be included as an additional effect of air pollutants into the existing GAINS multi-pollutant/multi-effect framework
- Suggested metrics:
 - Instantaneous radiative forcing at the regional/global scale
 - Carbon deposition to the Arctic
- A prototype version is currently being developed
- In a first step, such information could be used to prioritize reductions of precursor emissions to reduce PM_{2.5} levels