

Mitigating BC

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Based on paper in prep. by Rypdal,
Rive, Berntsen and Klimont
All results preliminary

Questions

- Is mitigation of PM from the perspective of health concerns – in line with current policies - sufficient to also address the concerns we may have for Radiative Forcing (RF) caused by BC?
- What would be an efficient global strategy to reduce Radiative Forcing caused by BC taking into account effects and abatement costs?

Global abatement opportunities

- Largest emissions and abatement opportunities in Asia (China, India)
- Low-cost measures already implemented in EU-17 and North America
- Open burning, transport industrial processes and domestic burning key sources to target mitigation
 - Large regional variations

A global strategy

- Should take on board regional differences in
 - Radiative properties (climate impact)
 - Abatement costs

Regional radiative properties

- Represented by GWPs
 - Regional values
 - Arbitrary time-horizon
- *Direct effect* of BC in air
- *Indirect effect* of BC deposited on snow in the Arctic
- *Efficacies*: Temperature response of one unit RF of BC deposited on snow is larger than for the direct component
 - Here we have multiplied the indirect GWP value by 3 (Flanner et al. JGR, 2007)

Regional radiative forcing

Regions	GWP direct	GWP albedo	Total GWP
Europe	384	1210	1594
Russia (RUS)	430	96	526
North America (NAM)	413	244	656
Latin America (LAM)	666	64	730
Asia (China and India)	430	96	526
South Asia (SAS)	612	64	676
Africa (AFR)	691	64	755

Source: Reddy and Boucher (2007)

Abatement costs

- Consider marginal costs of technical measures to abate BC
- Marginal abatement costs for Europe available from the IIASA RAINS model
 - Per source, fuel and technology
 - Emission scenarios
 - Approximate data for other world regions
- Fuel switch is an important additional option for reducing BC emissions

Open burning and OC

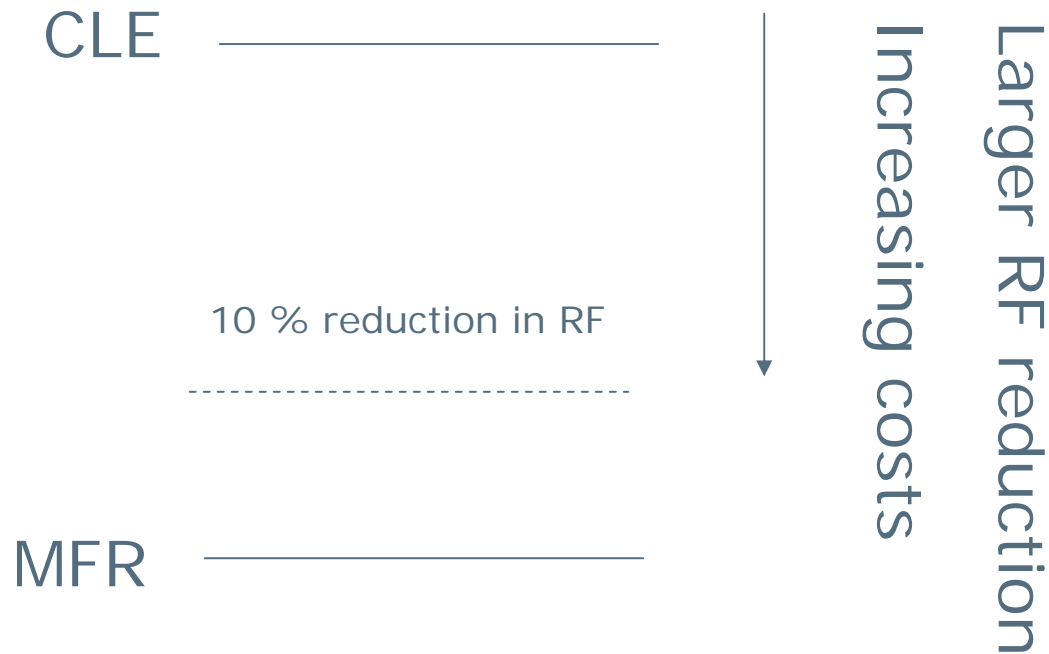
- Inexpensive BC and PM₁₀ reduction opportunities
- When BC is abated OC is abated as well
- Due to OC negative forcing, mitigating BC from *biomass burning* has no or little benefit in reducing net RF

Seek to maximize reductions in global RF from BC



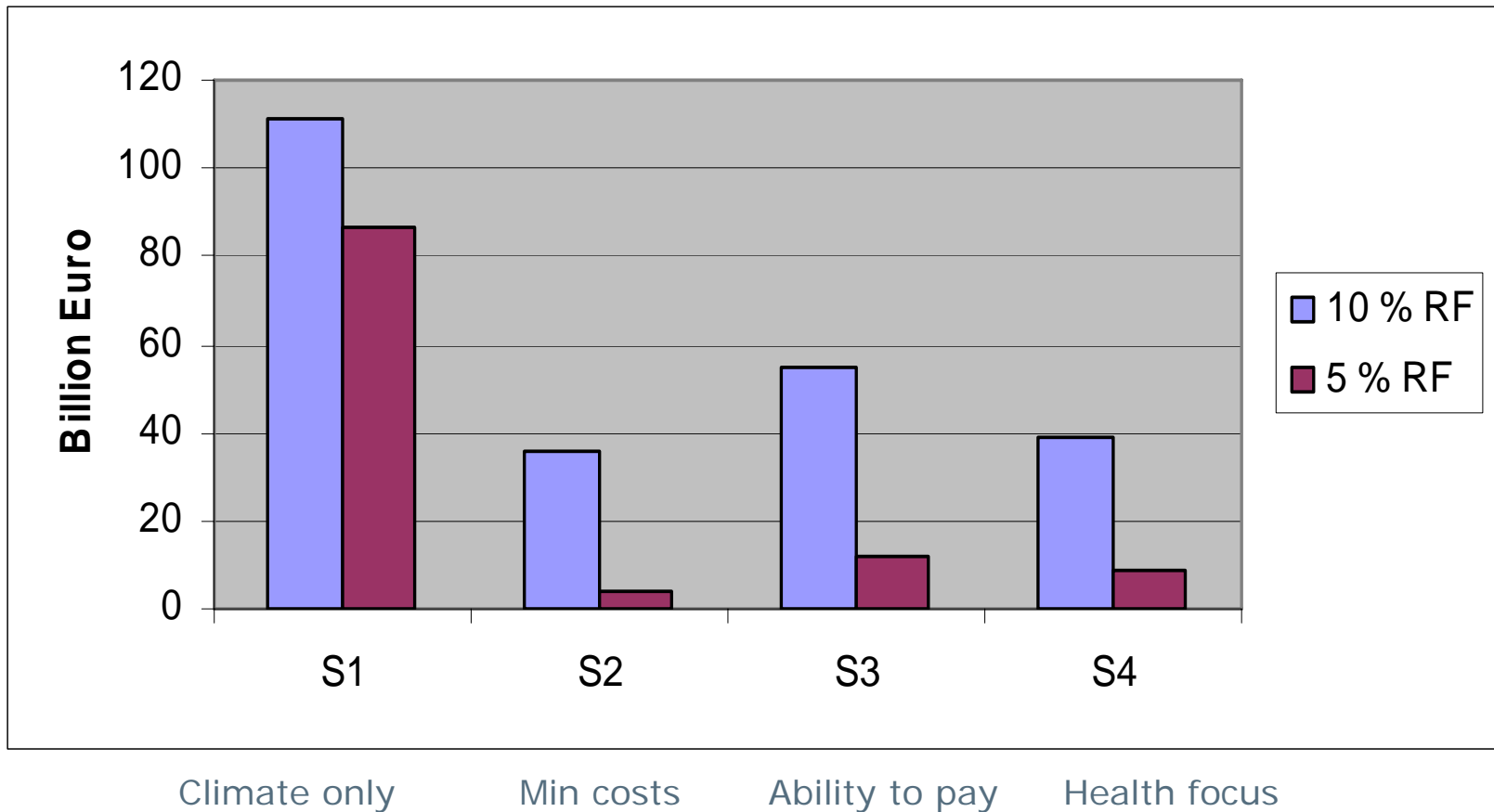
CLE = Current Legislation; MFR = Maximum Feasible Reduction

Seek to maximize reductions in global RF from BC

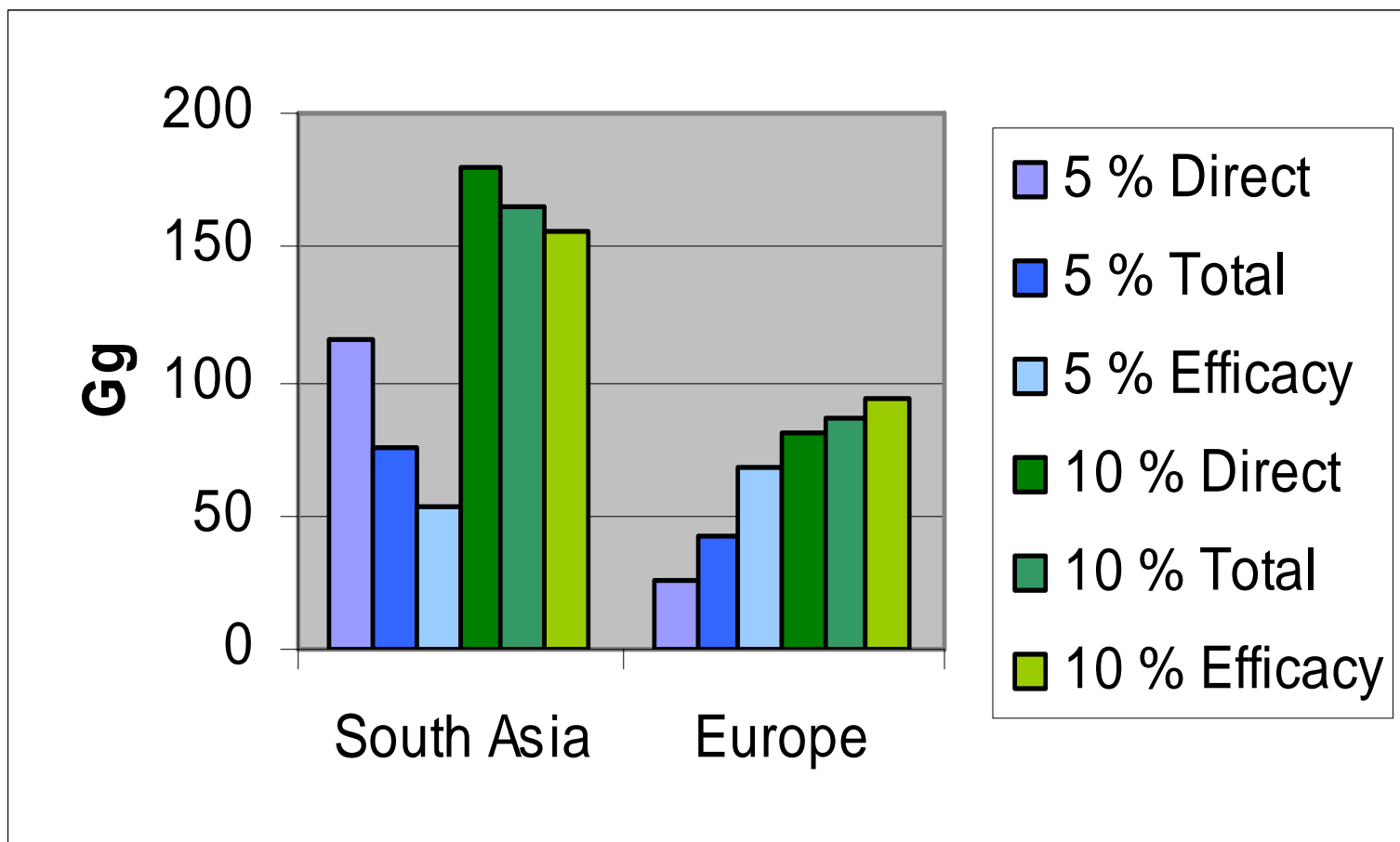


1. Undertake reductions first in regions where the climate benefits are the largest
2. As 1, minimizing global *costs*
3. As 2, considering regional *ability to pay* for abatement
4. *Health*: Emphasize sources where PM exposure is large

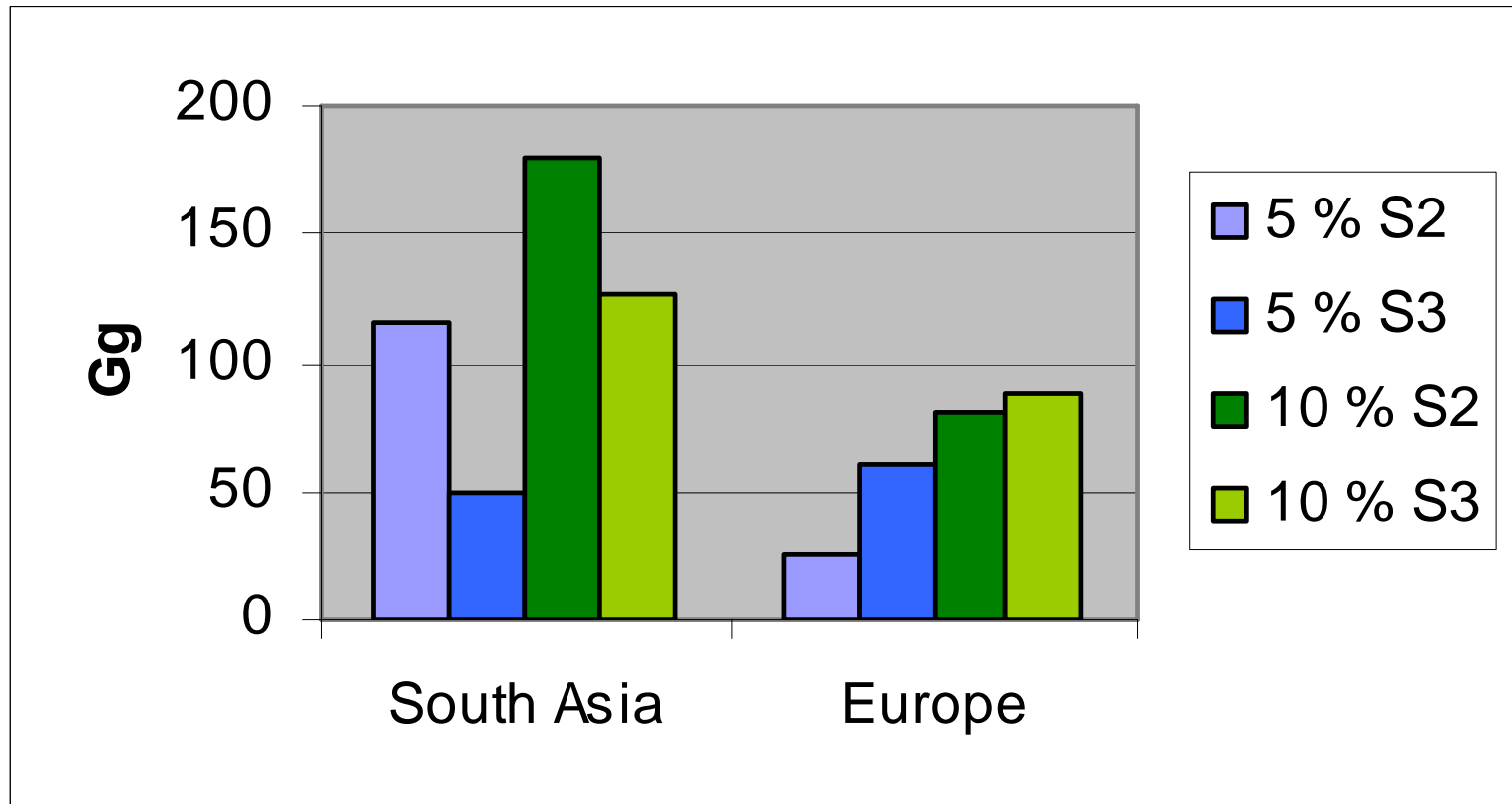
Costs (direct GWP only)



Regional abatement efforts

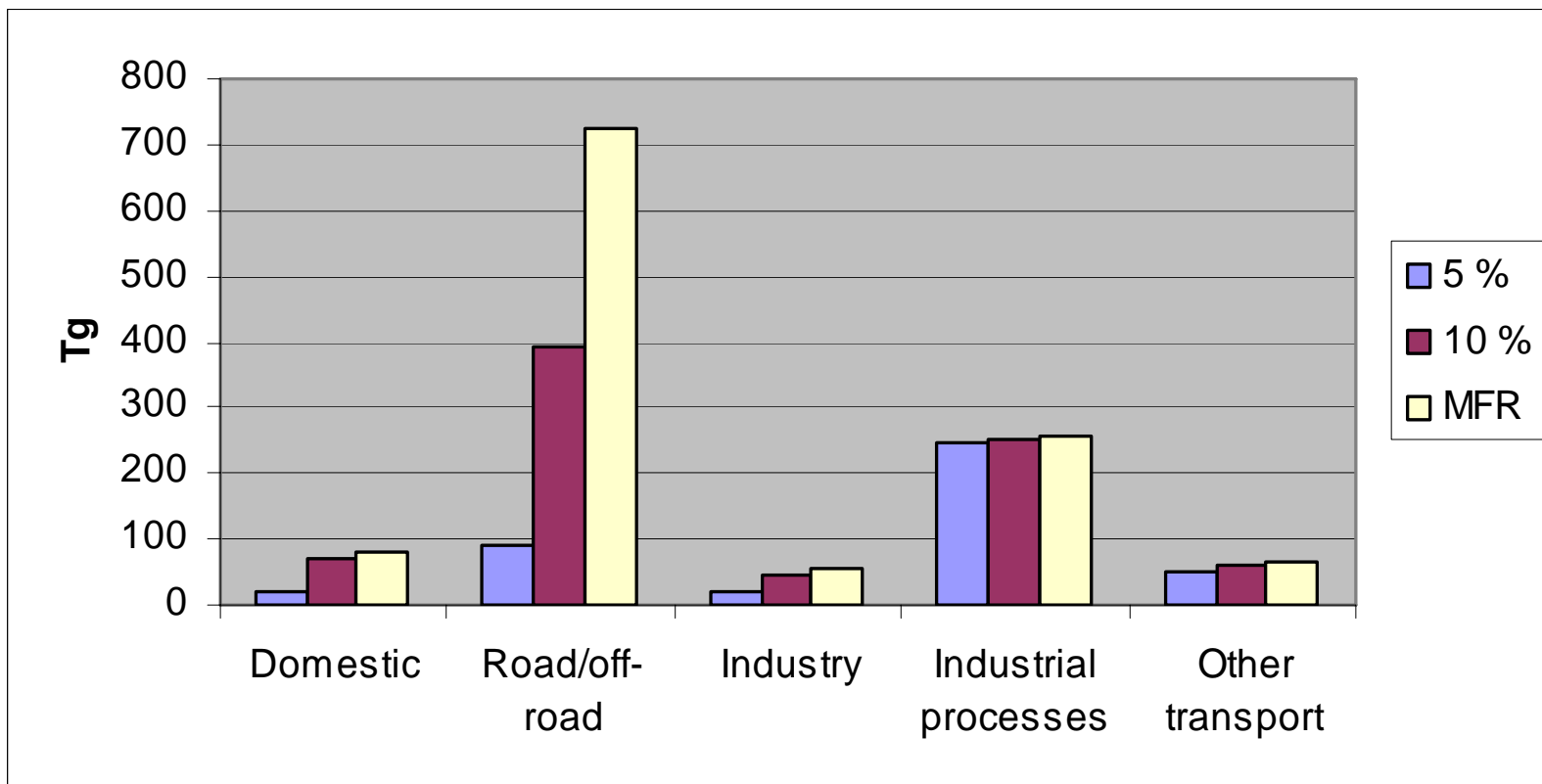


Correction for income



S2 = cost-effective; S3 = corrected for GDP

Sectoral abatement (S2)



Abating BC instead of CO₂?

- Complicated question!
- 100 years time horizon
 - 5 % reduction in BC RF is inexpensive
 - 10 % reduction in BC RF is
 - Expensive considering the direct effect only
 - Within the higher range of expected ETS prices considering the total GWP (30-40 Euro per tonnes)
 - Efficacies: In the range of expected CO₂ ETS prices (20-30 Euro per tonnes)

Conclusions

- Primary focus on health concerns may not target sources where RF benefits are the largest
- Focus on abatement in Asia
 - Most cost-effective in terms of reducing global RF
 - Highest co-benefits in terms of reduced PM₁₀ emissions
 - Benefits for the Arctic?

Conclusions

- Considering the indirect component of GWP from BC on snow and the climate efficacy should lead to higher abatement efforts in Europe
 - Increases European abatement costs, but not the global
 - Adds overall justification to abating BC in comparison to other forcing agents