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Current Emissions and Baseline Projections of Black Carbon in UNECE area

GAINS model – working progress

UNECE TFEIP
Stockholm, May 2-3, 2011

Outline

- GAINS model
- Geographical coverage of UNECE area in GAINS model
- Recently implemented mid-term regional and global projections
- Example baseline scenario:
  PM2.5, BC, OC emission estimates for 1990-2030
- Brief discussion of selected key parameters for BC emission calculation
- Concluding comments

The **GAINS** approach

for identifying cost-effective emission control strategies

(**G**HG-**A**ir pollution **IN**teractions and **S**ynergies)

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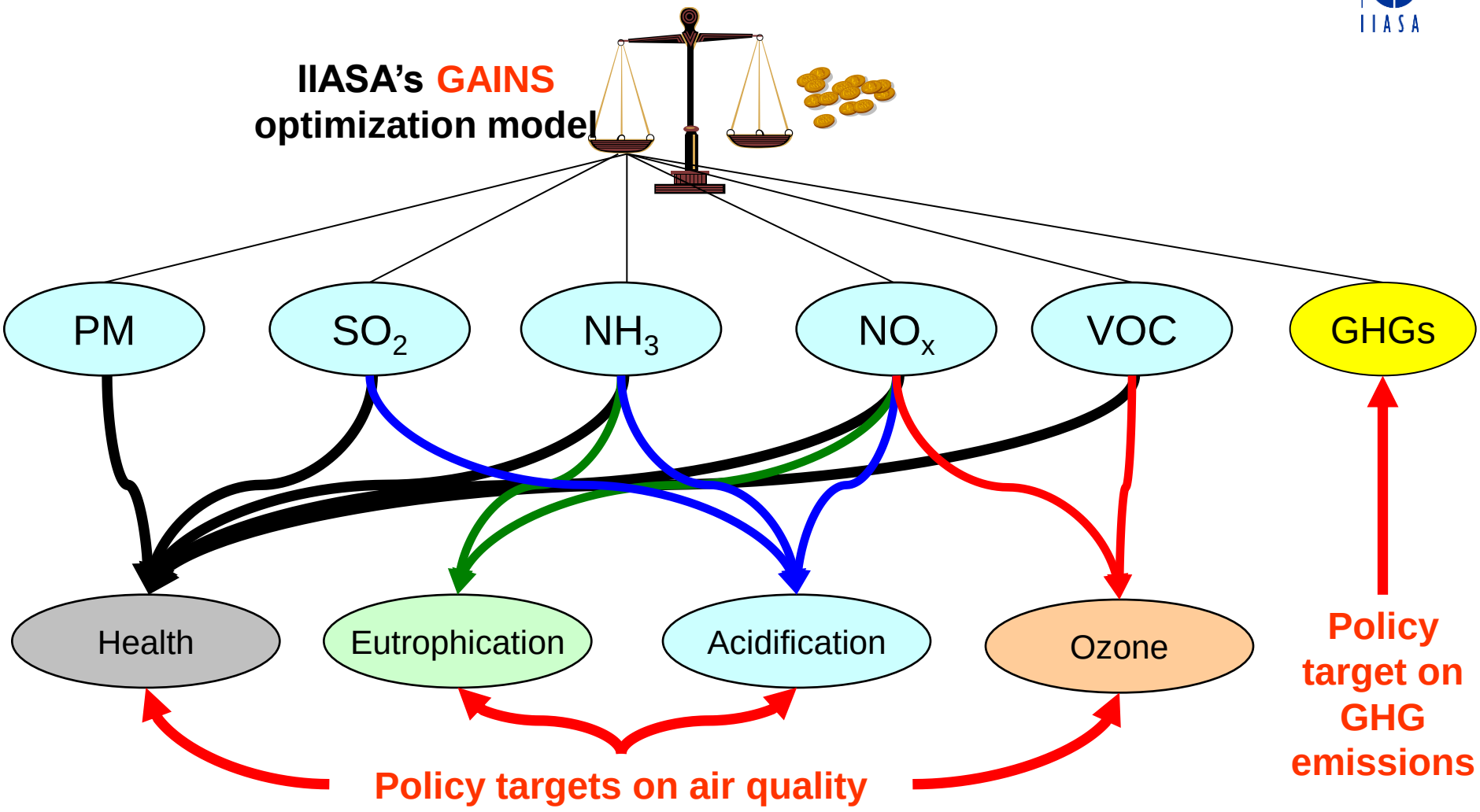

Extension of the GAINS multi-pollutant/multi-effect framework to include near-term climate impacts

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	PM (BC, OC)	SO_2	NO_x	VOC	NH_3	CO	CO_2	CH_4	N_2O	HFCs PFCs SF_6
Health impacts: PM (Loss in life expectancy)	√	√	√	√	√					
O_3 (Premature mortality)			√	√		√		√		
Vegetation damage: O_3 (AOT40/fluxes)			√	√		√		√		
Acidification (Excess of critical loads)		√	√		√					
Eutrophication (Excess of critical loads)			√		√					
Climate impacts: Long-term (GWP100)							√	√	√	√
Near-term forcing (in Europe and global mean forcing)	√	√	√	√	√	√				
Black carbon deposition to the arctic	√									

Geographical coverage

- Nearly all (51 of 56) UNECE member countries represented in GAINS
- Russia split into European and Asian part
- Tajikistan, Turkmenistan, and Uzbekistan represented as one region
- Serbia and Montenegro as one region
- Not included: Andorra, Lichtenstein, Monaco, San Marino, and Israel

Recently implemented (in GAINS) mid-term regional and global projections (1)

- National activity projections (Europe);
  Work within the revision of the UNECE CLRTAP Gothenburg Protocol
- PRIMES Baseline with Climate and Energy Policy (Europe);
  Achieves 20% reduction of CO_2 by 2020 without renewable energy targets (20% renewable by 2020)
- IEA World Energy Outlook 2009 – Baseline;
  Includes national climate policies
- IEA World Energy Outlook 2009 – 450 ppm;
  Climate stabilization scenario

Recently implemented (in GAINS) mid-term regional and global projections (2)

- National activity projections available for 16 countries:
  - Austria, Belgium, Croatia, Czech Republic, Denmark, Finland, Greece, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and United Kingdom

Sharing of BC related information, included in GAINS model, with UNECE country experts has been initiated

- Country specific data sets were prepared
  - Principal INPUT parameters (domestic and transport sectors)
    - Energy data
    - Technology shares in different years
    - Emission factors of PM2.5, BC and OC
  - Current Gothenburg baseline results (OUTPUT)
    - Emissions by SNAP sectors, including high emitting vehicles
    - Emissions by GAINS sectors
    - Emissions and implied emission factors by sector-activity for 2005
- The data sets were sent for review in June 2011 (via chairs of BCEG)

Sharing BC relevant information - feedback

- Countries that have given feedback/asked additional questions so far:
  - Denmark
  - Finland
  - Norway
  - Switzerland
  - UK
  - US
  - Canada

Example baseline scenario

- IEA World Energy Outlook 2009 – Baseline;
  Includes national climate policies
- Emissions of PM2.5, BC, and OC
  - By sector (SNAP) and pollutant for the whole modelling period
  - By country for 2005 and 2030
  - Results do not include high emitters in transport

Emissions of BC/OC/PM2.5 in the UNECE area

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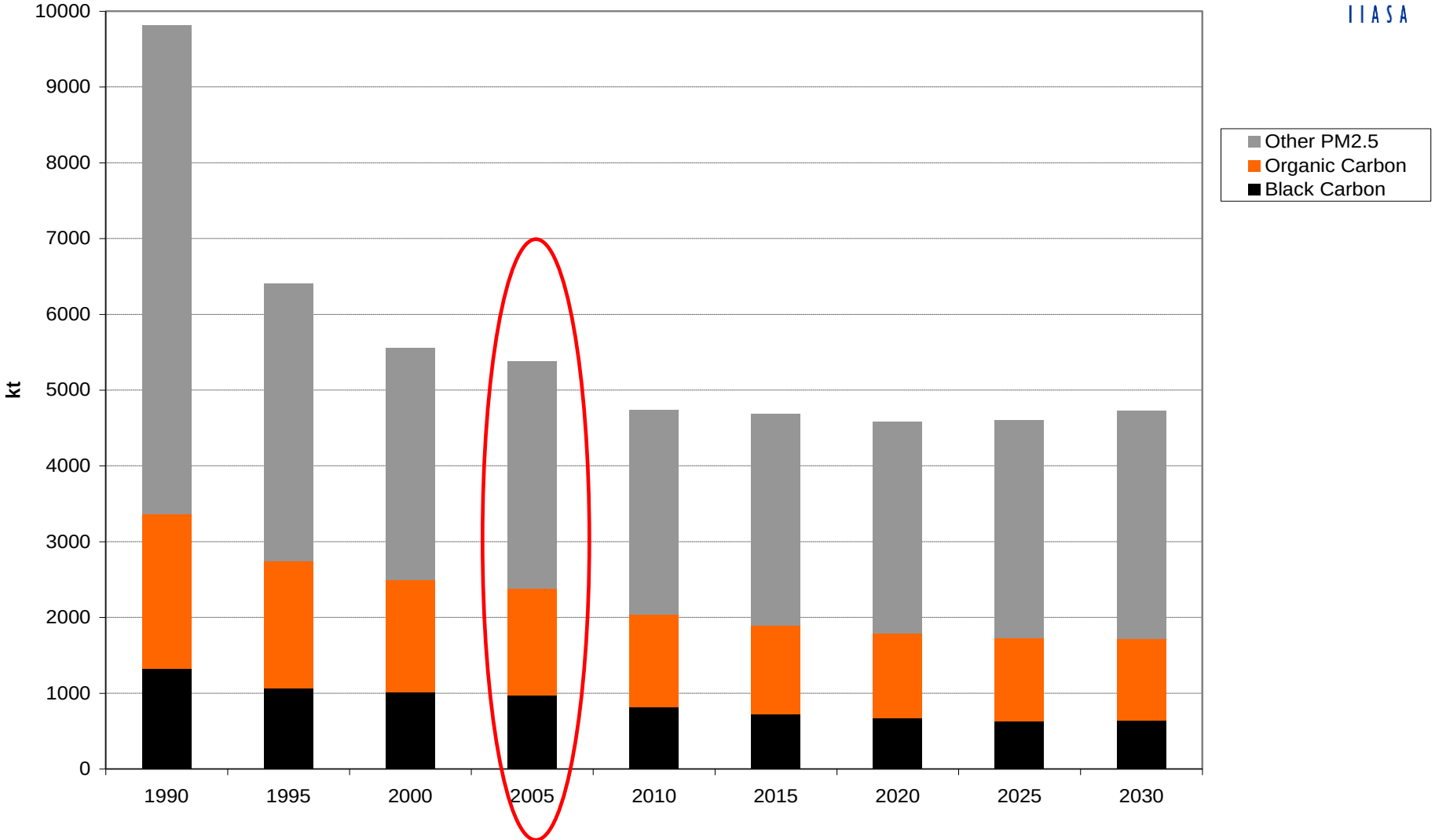

Emissions of PM2.5/BC/OC in the UNECE area in **2005**

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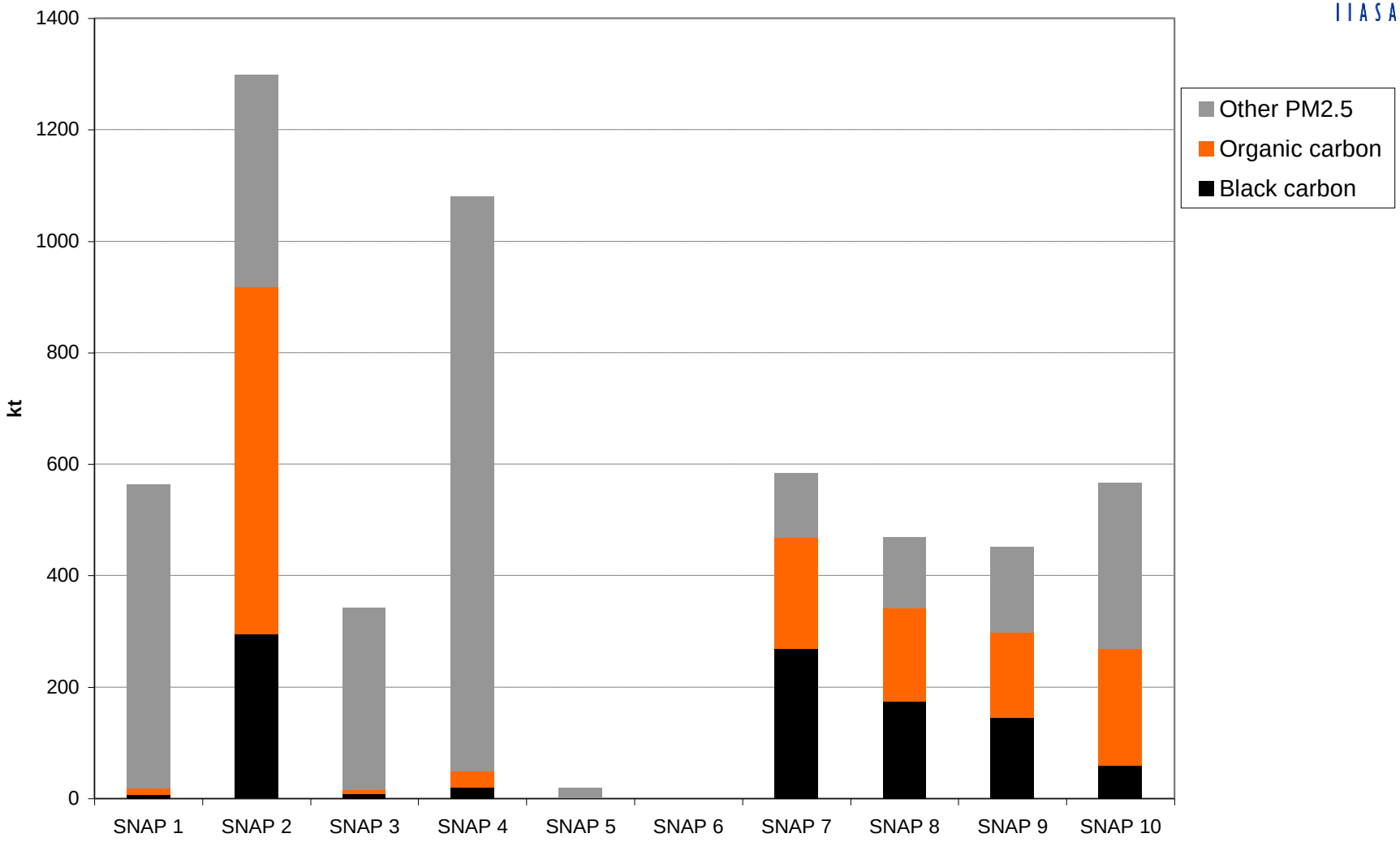

EC and OC annual emission (tonnes) for Europe in 2005 by source sector

(van der Hon et al, 2011; in prep)

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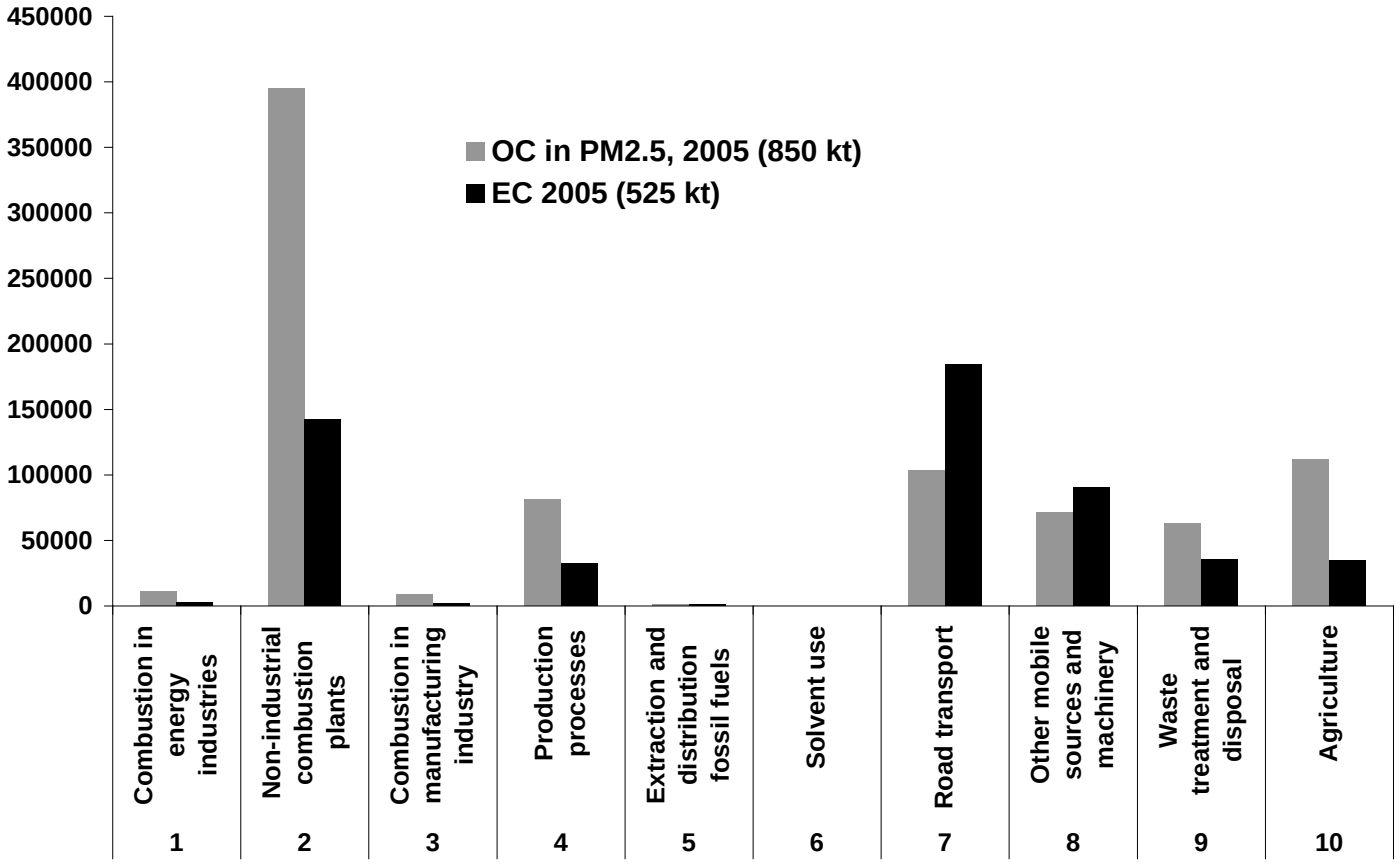

Emissions of BC/OC/PM2.5 in the UNECE area in **2005**

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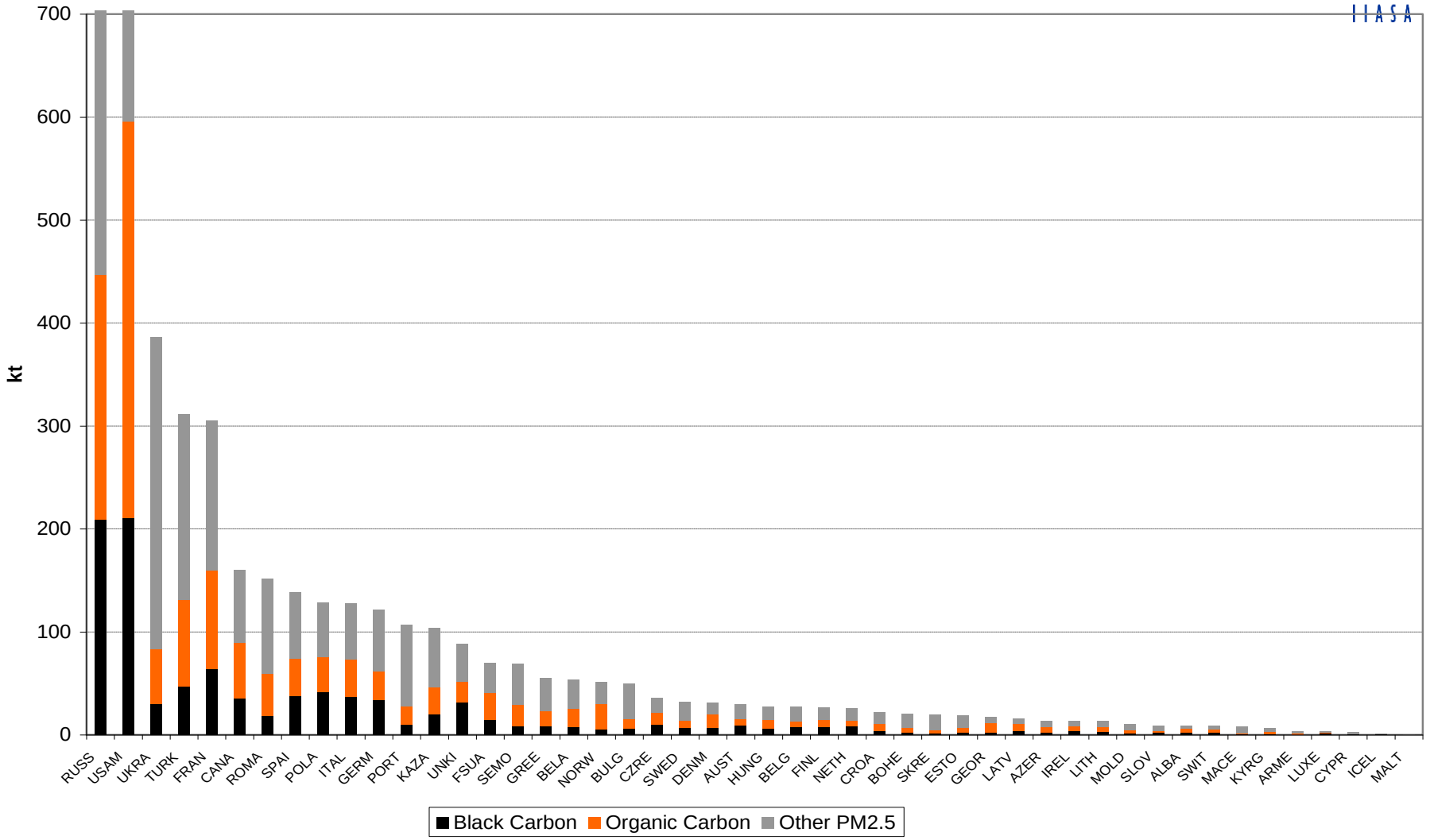

BC emission contribution in 2005

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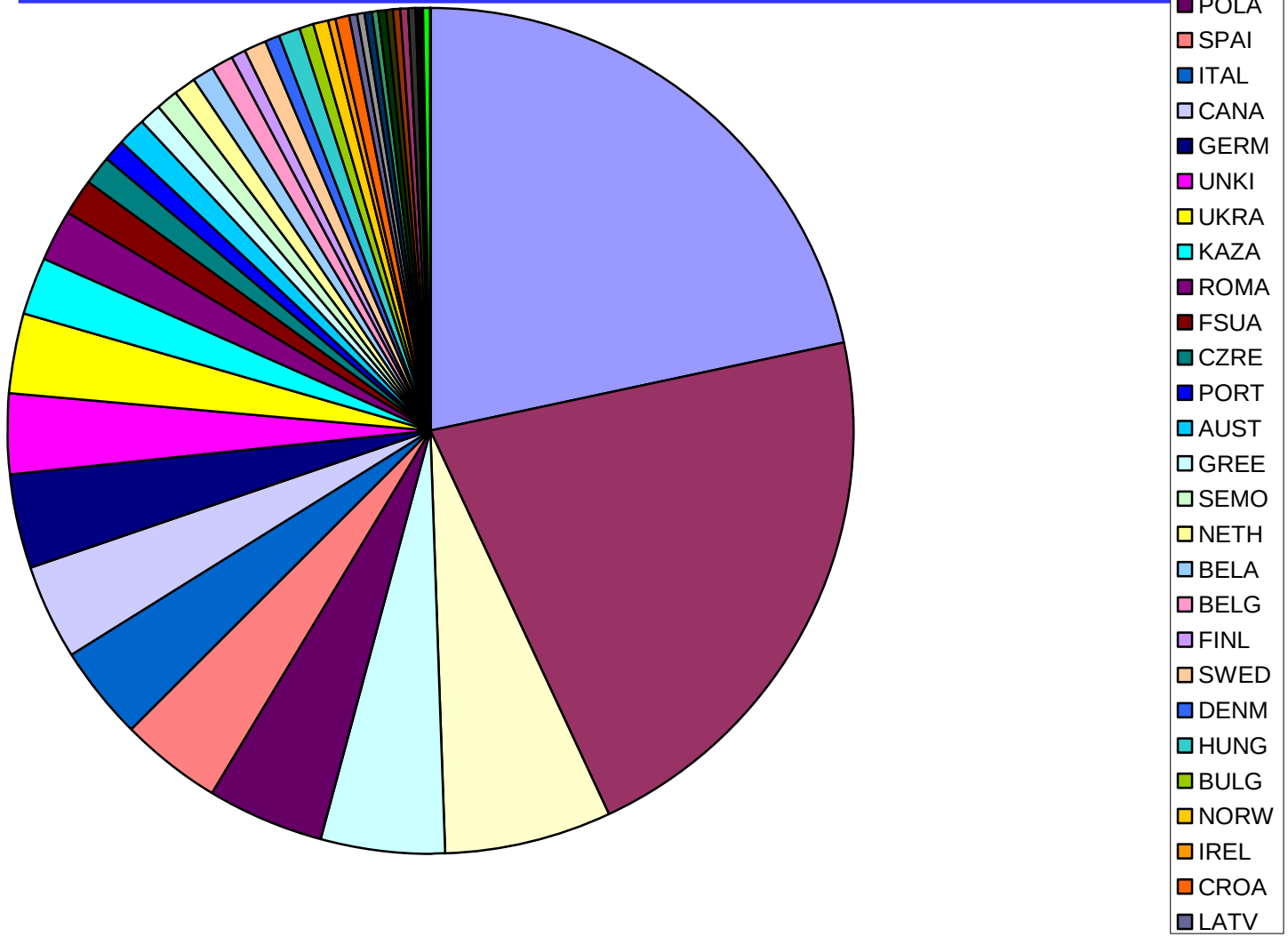

Emissions of PM2.5, BC, OC in the UNECE area

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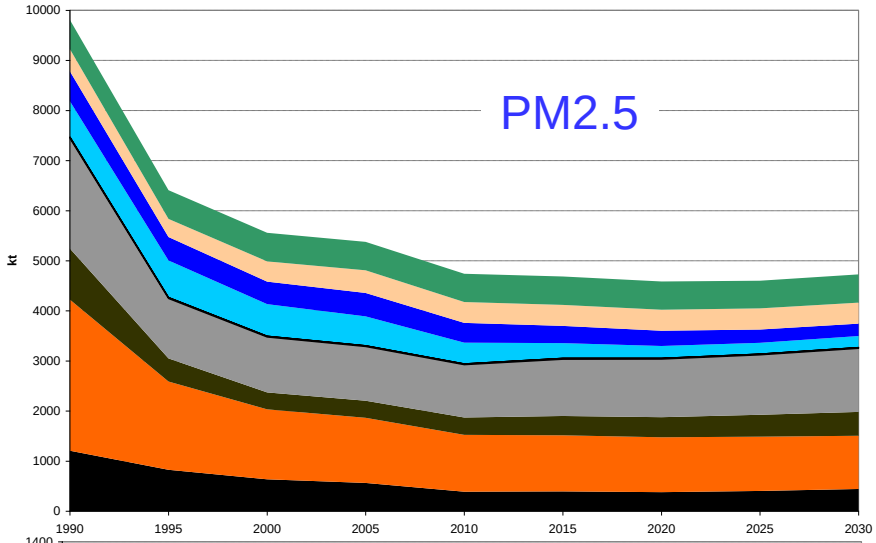
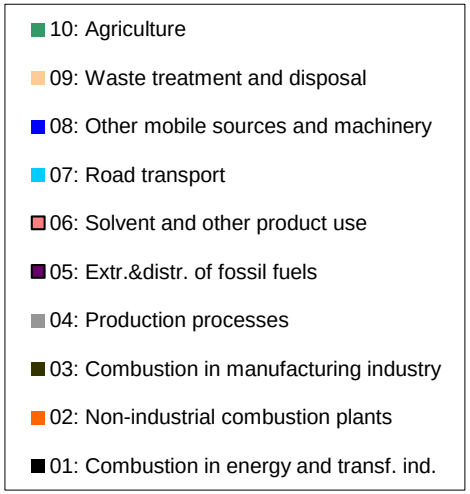


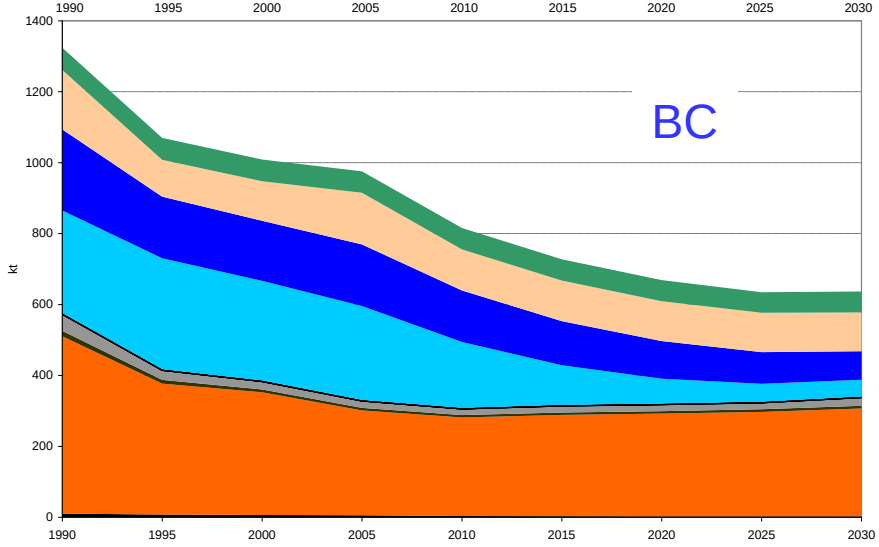


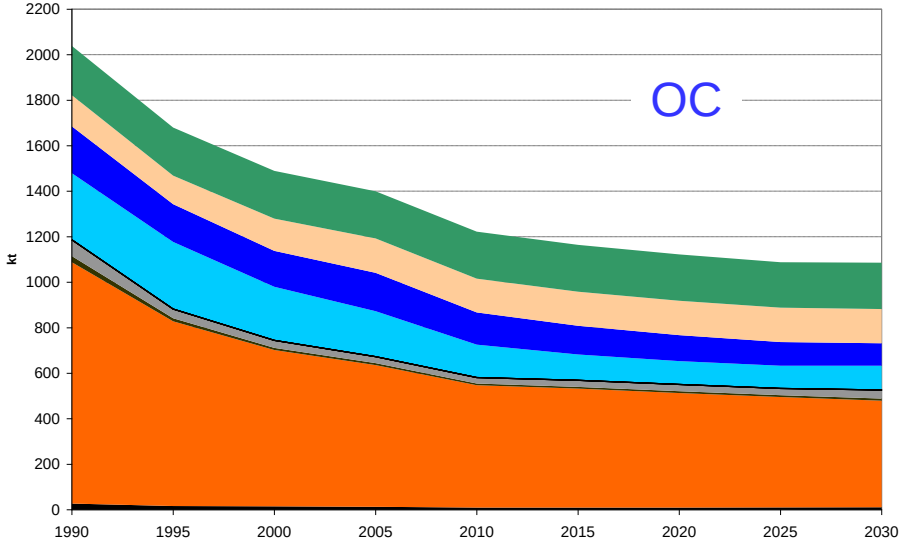
Reduction 2030/2005

PM2.5 -12%

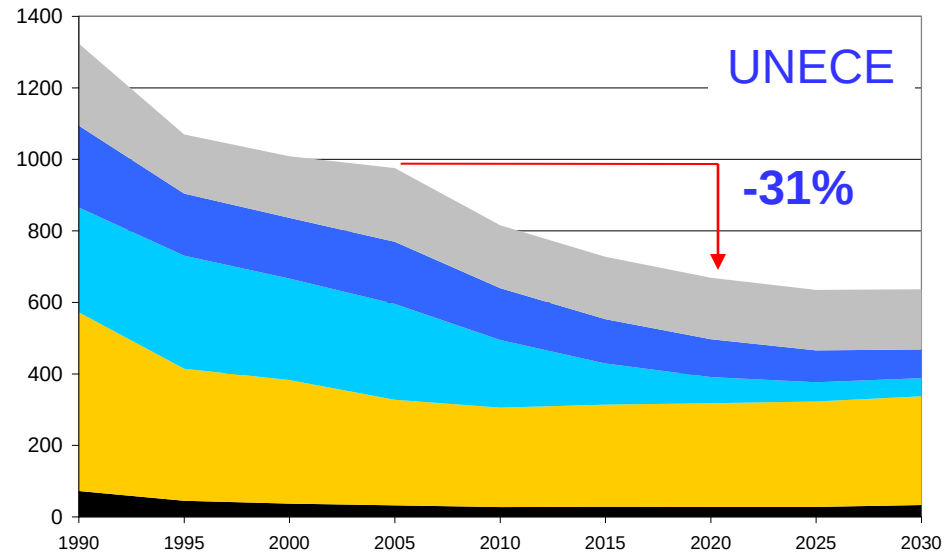
BC - 35%

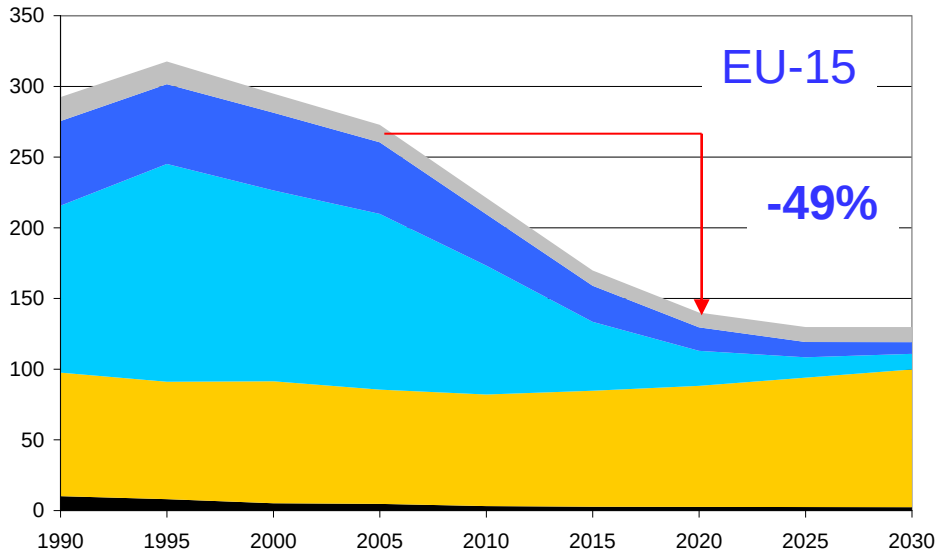
OC - 22%

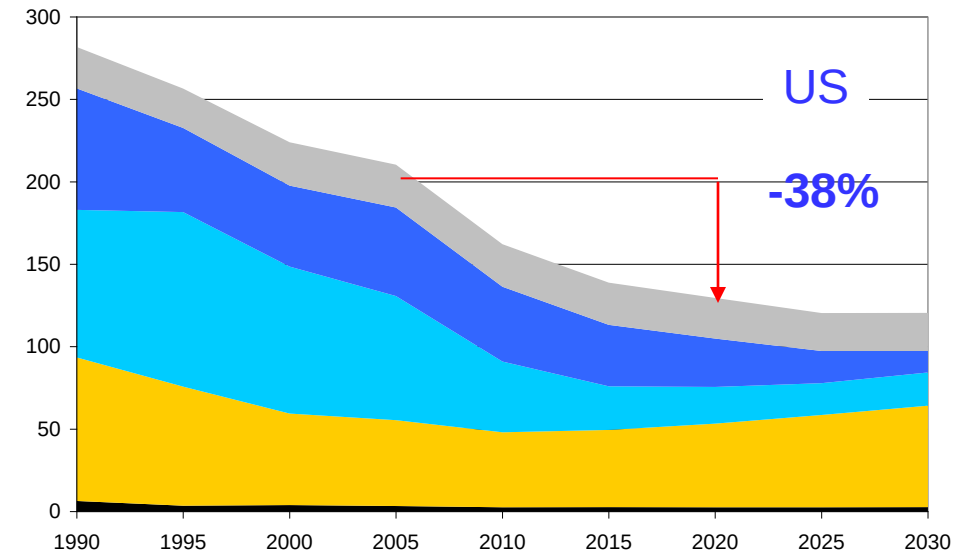


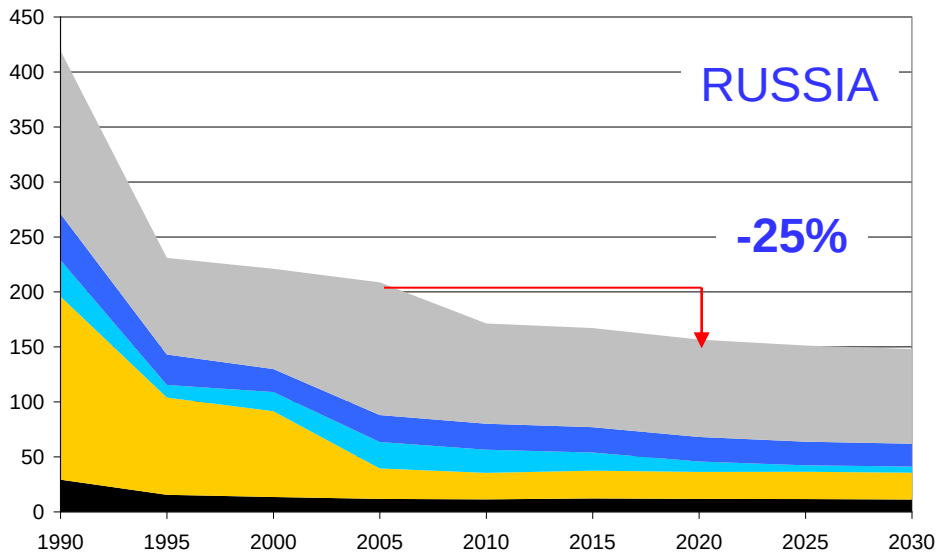


Structure of BC emission in various regions and CLE reduction until 2030









Industry Residential Transport - Road Transport - Off-Road Other

Arctic BC and co-emitted species in the control scenarios

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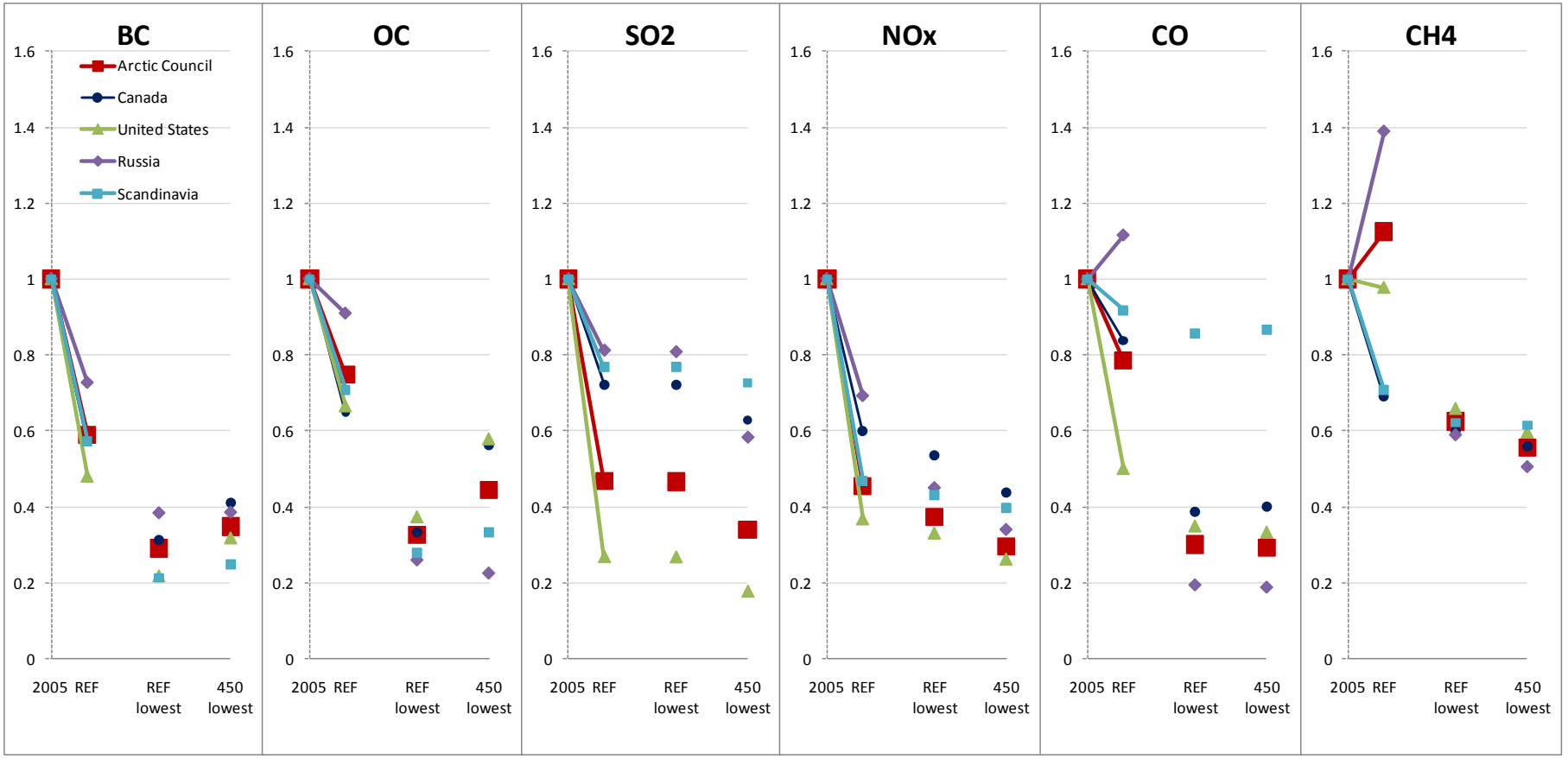

Comparison of global BC inventories
By region

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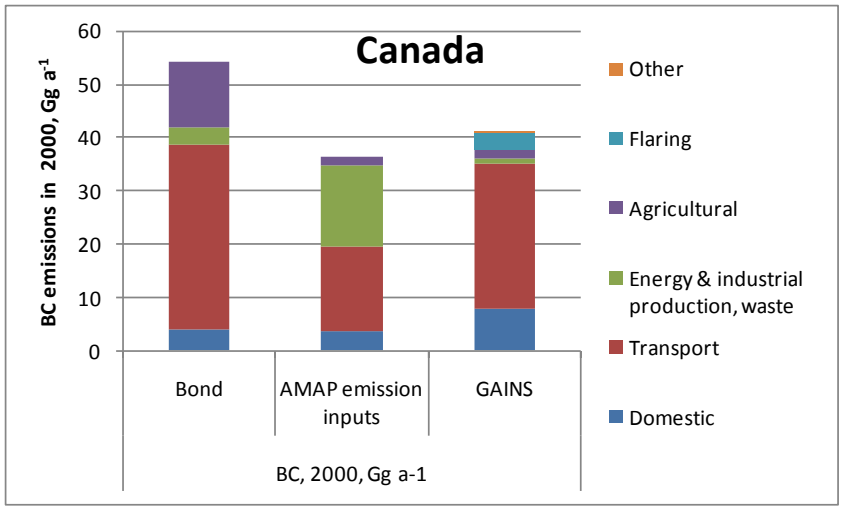

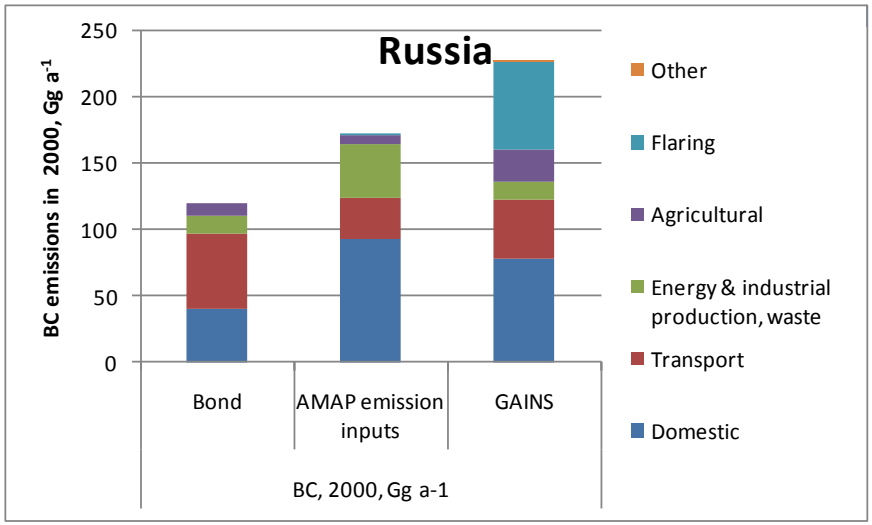

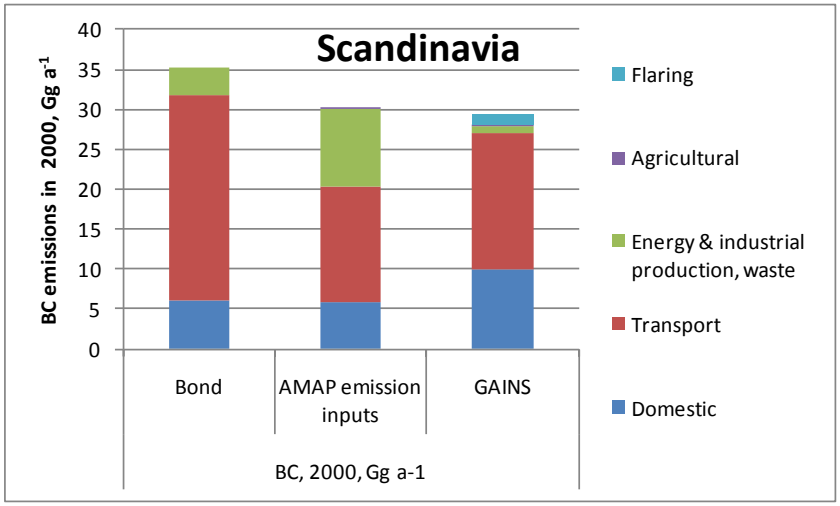

Discussion of key parameters for BC emission calculation

- Emission factors, emission factors, emission factors, … is it?

- Plenty of other factors are poorly known too and DO influence emissions:
  - Off-road (total gasoline, diesel consumptions, type and age of equipment used)
  - Residential sector (structure, i.e., poor stove vs. good stove and their evolution in time, type of wood, non-commercial wood consumption)
  - Transport (how important are high-emitting vehicles?)
  - Open agricultural burning (how much?)
  - Flaring (everything)
  - Industrial processes (everything)

Household fuel consumption data in GAINS

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Table 1.

Fuels	Non-specific	Open pit	Fireplace	Stove*	Small boiler		Medium boiler	
					Manual	Auto	Manual	Auto
Gaseous fuels	●							
Liquid fuels	●							
Charcoal	●							
Coal				●	●	●	●	●
Biofuels								
- Fuelwood		●	●	●	●	●	●	●
- Agr. Residue		●		●		●		●
- Dung		●		●				

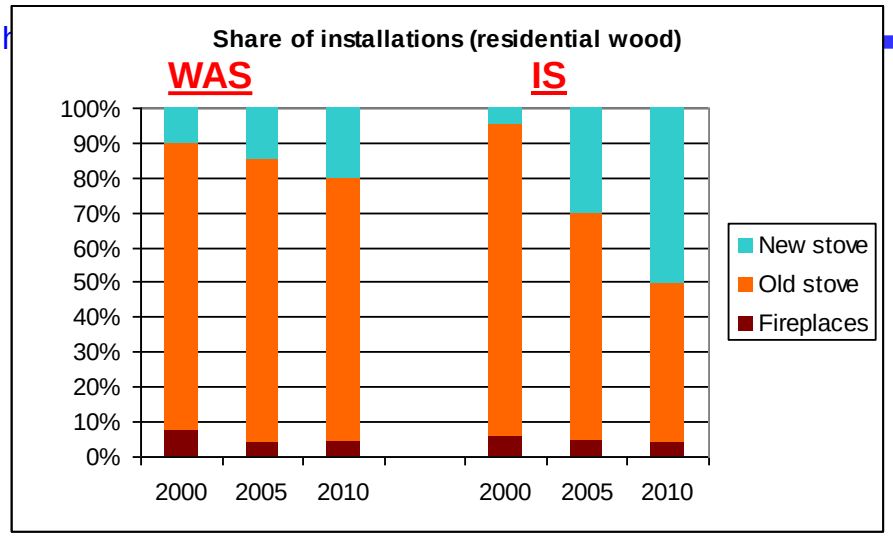
* - distinguishing cooking stoves and heating stoves as separate categories

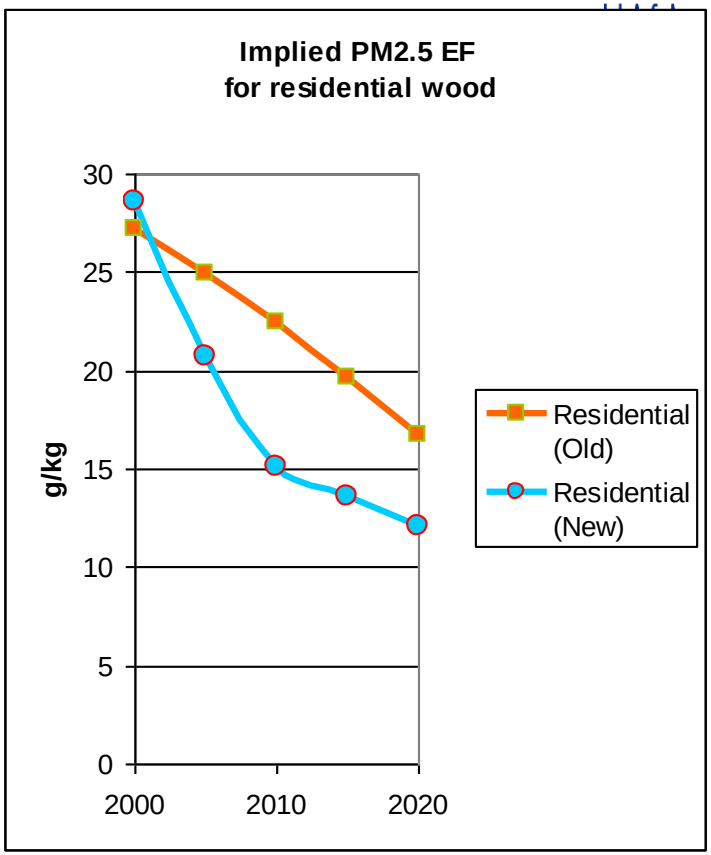
Emission control options for household fuel use considered in GAINS

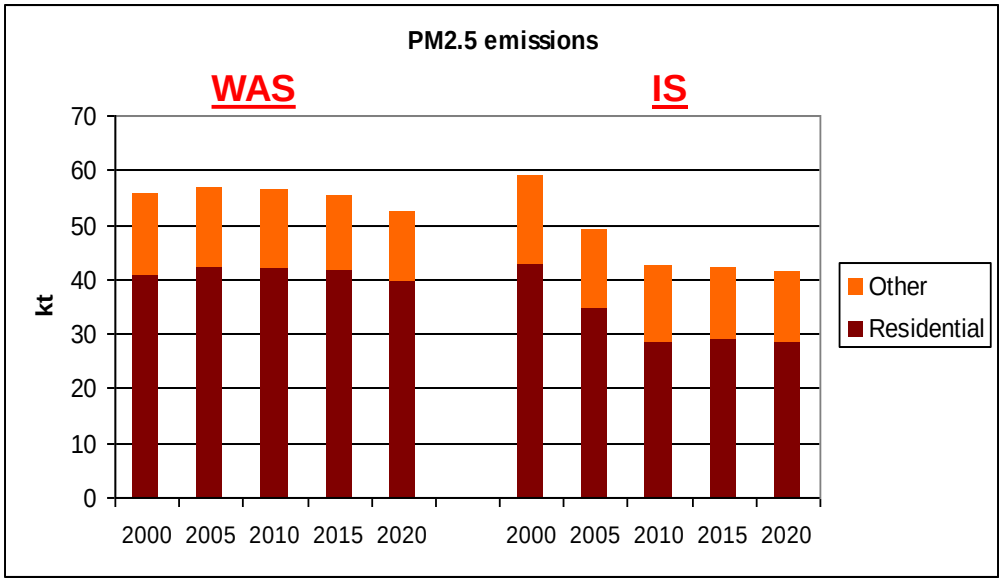
Table 2. Simplified matrix of combustion technology-control option since some options are not available for specific fuels.

Control options	Non-specific	Open pit	Fireplace	Stove		Small boiler		Medium boiler	
				Cooking	Heating	Manual	Auto	Manual	Auto
Improved	●		●	●	●	●			
New			●	●	●	●			
Pellets					●	●	●	●	●
Cyclon								●	●
ESP					●	●	●		●

Example:
Norway, National scenario, PM2.5







Example (BC emissions, kt):
How important are high emitting vehicles?

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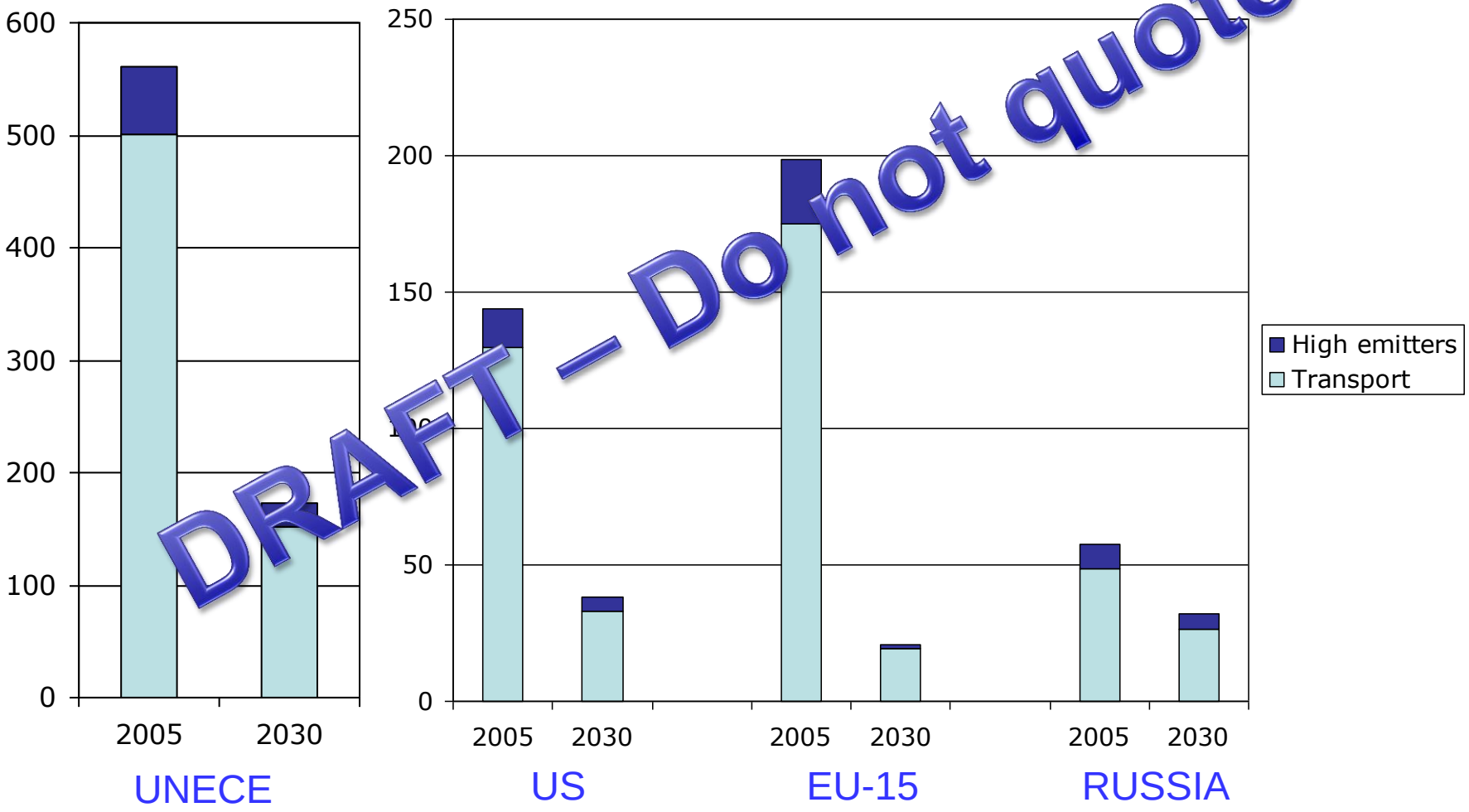

General comments – *Emissions and mitigation*

- Impact of current air pollution and climate policies on future emissions of BC
  - Effective implementation of current policies will exhaust reduction potential for several technologies in some regions
  - Significantly different regional structure of emissions in the future will determine mitigation strategies; there might not be 'one for all' recipe
  - Evaluation of projections with increased use of biofuels necessary

- Understanding future technology transitions is essential, including conscious incorporation in projections