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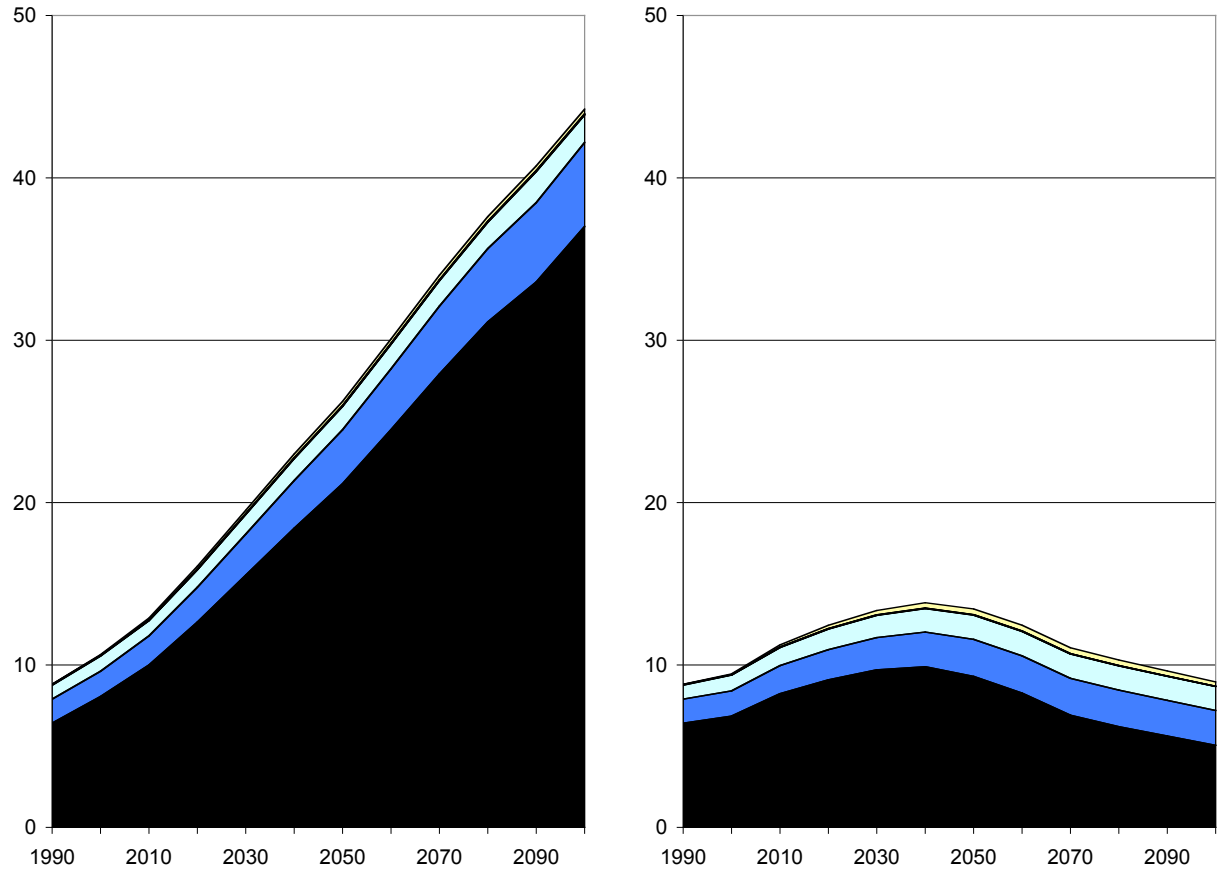
Synergies between air pollution control and greenhouse gas mitigation

Global GHG emission paths

IPCC SRES ”no climate measures” scenarios [Gt C-eq/yr]

A2
Fossil fuel intensive scenario



B1
Sustainable development scenario

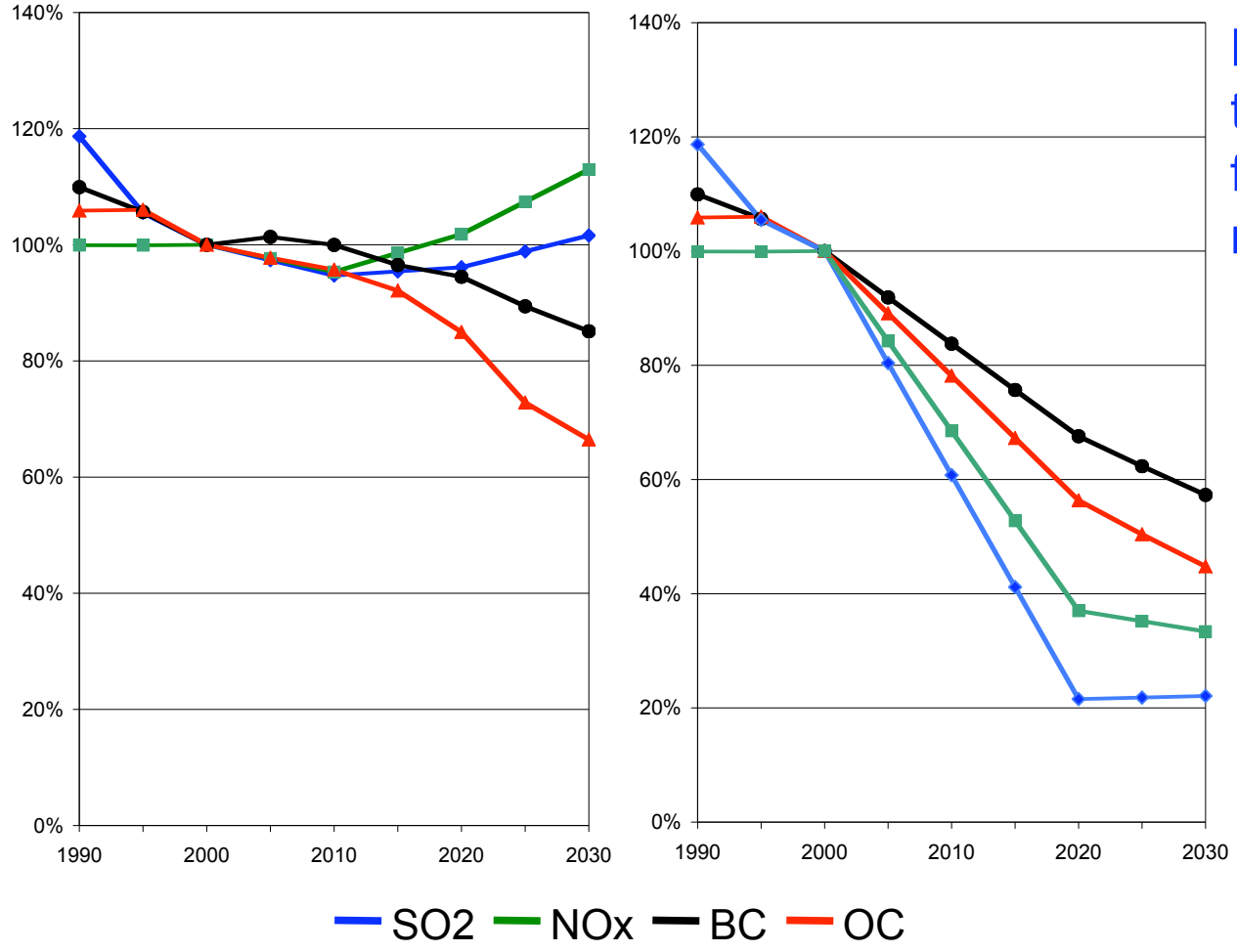
CO2 CH4 N2O CF4 SF6 HFC-134e

Based on 100-yrs GWP

Projections of global SO_2, NO_x, BC and OC emissions

from anthropogenic sources, relative to 2000

Business as usual, with recent air quality legislations



Maximum technically feasible reductions

Source: IIASA, Cofala *et al.*, 2005

GAINS: **G**HG-**A**ir pollution **IN**teractions and **S**ynergies

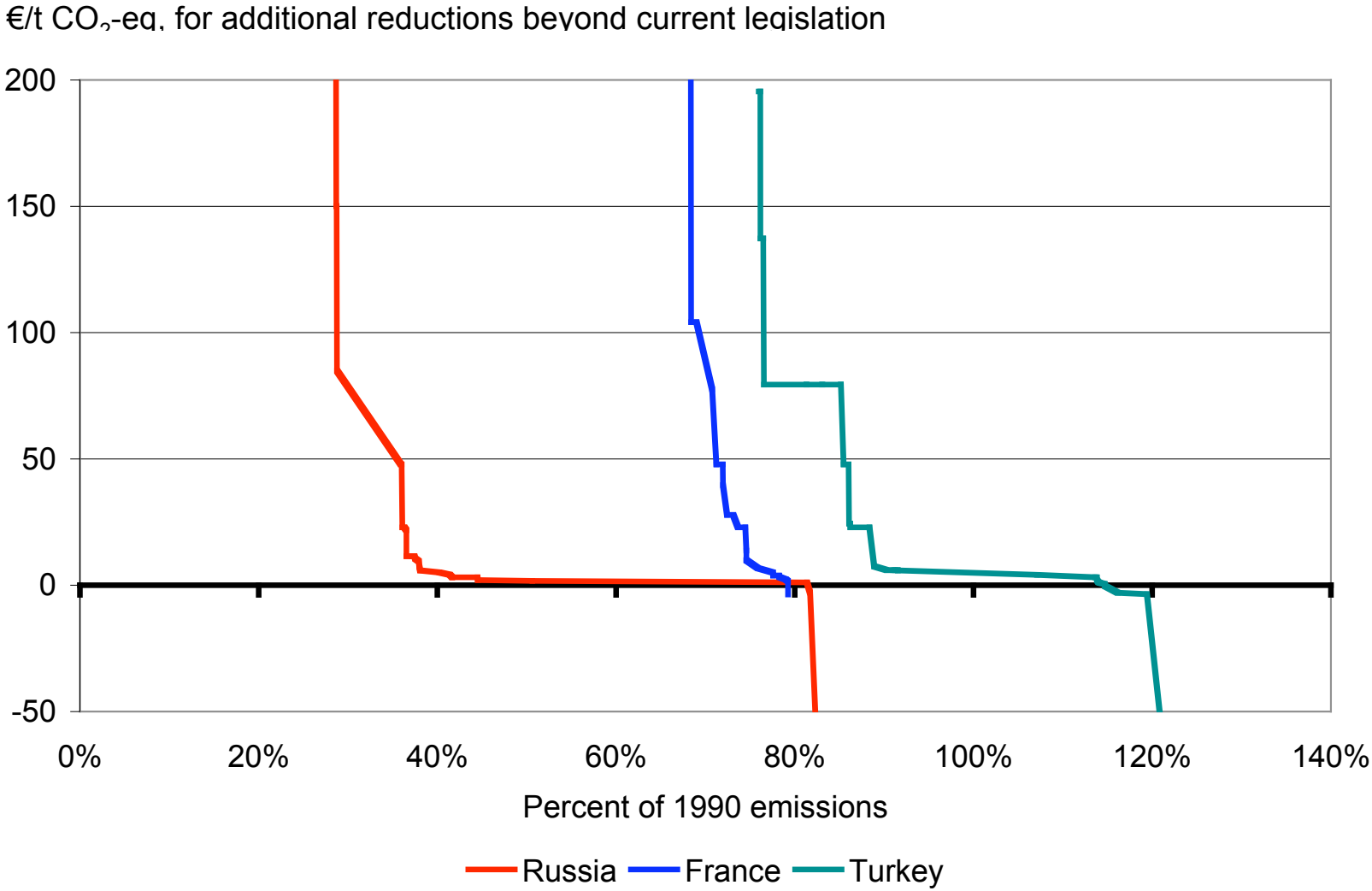
- **Focus on cost-effective mitigation measures and co-benefits**

- **Focus on policy-relevant scales of analysis:**
  - **Up to 2030**
  - **Country-by-country (currently implemented for 43 countries in Europe, plans for China and India)**

- **Extension of RAINS(-Asia) integrated assessment model for air pollution to GHGs:**
  - **Model the chain of pollution from sources to effects**
  - **Assessment of emission reduction potentials and costs:**
    - RAINS: SO_2, NO_x, VOC, NH_3, PM (~400 control options)
    - GAINS: CO_2, CH_4, N_2O, HFC, PFC, SF_6 (260 control options)

National cost curves for CH_4

Marginal costs for national activity projections 2020

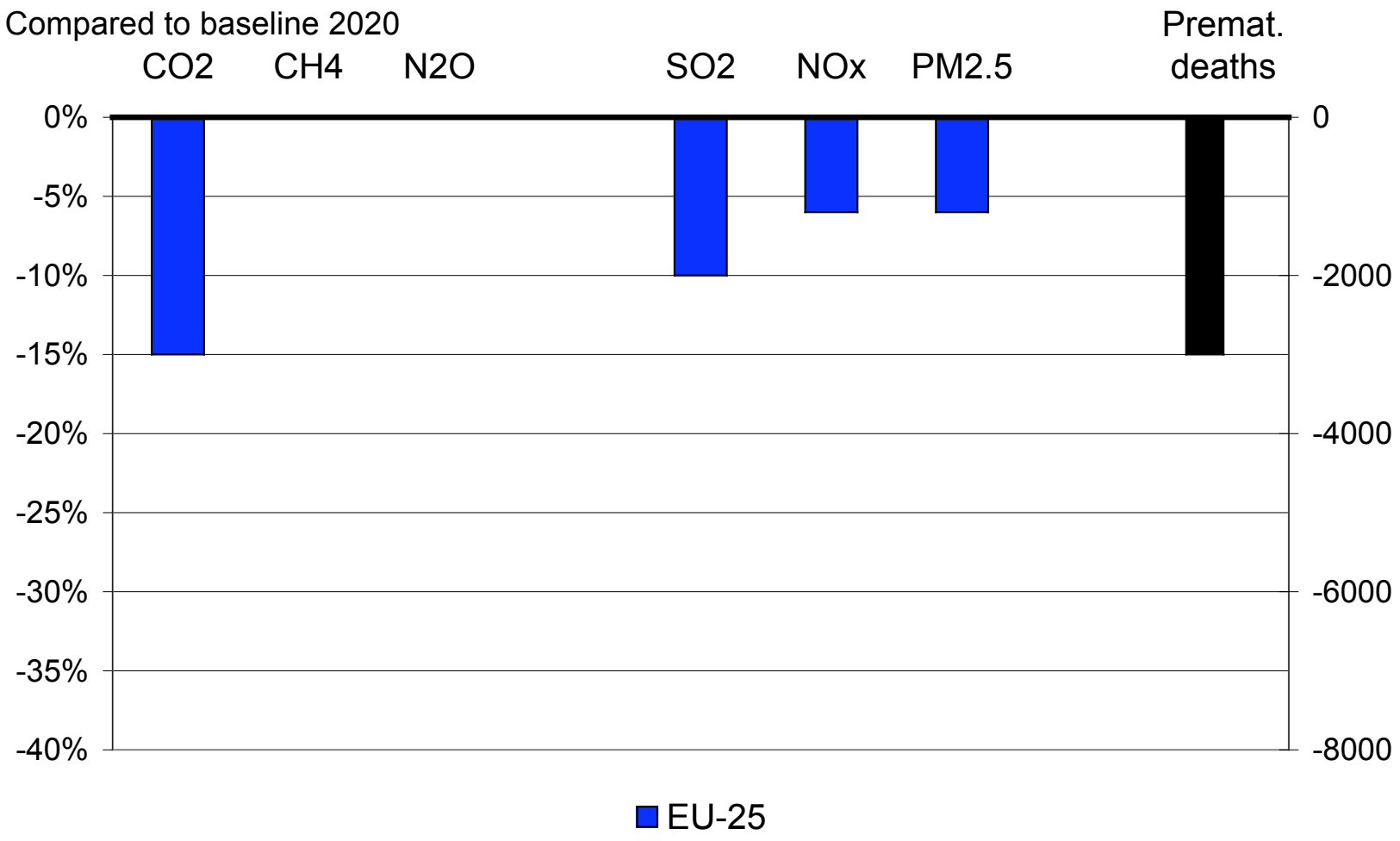


Initial illustrative examples

- For all 43 European countries including Turkey
- Recent real-world energy and cost data of EU Clean Air For Europe (CAFE) programme
- Starting point (baseline): National activity projections for 2020
- Three cases:
  1. 15% GHG reduction with CO_2 measures only
  2. 15% GHG reduction through CO_2+CH_4+N_2O
  3. CO_2 reduction through increased use of bio-fuels

Change in emissions and AQ impacts in EU-25

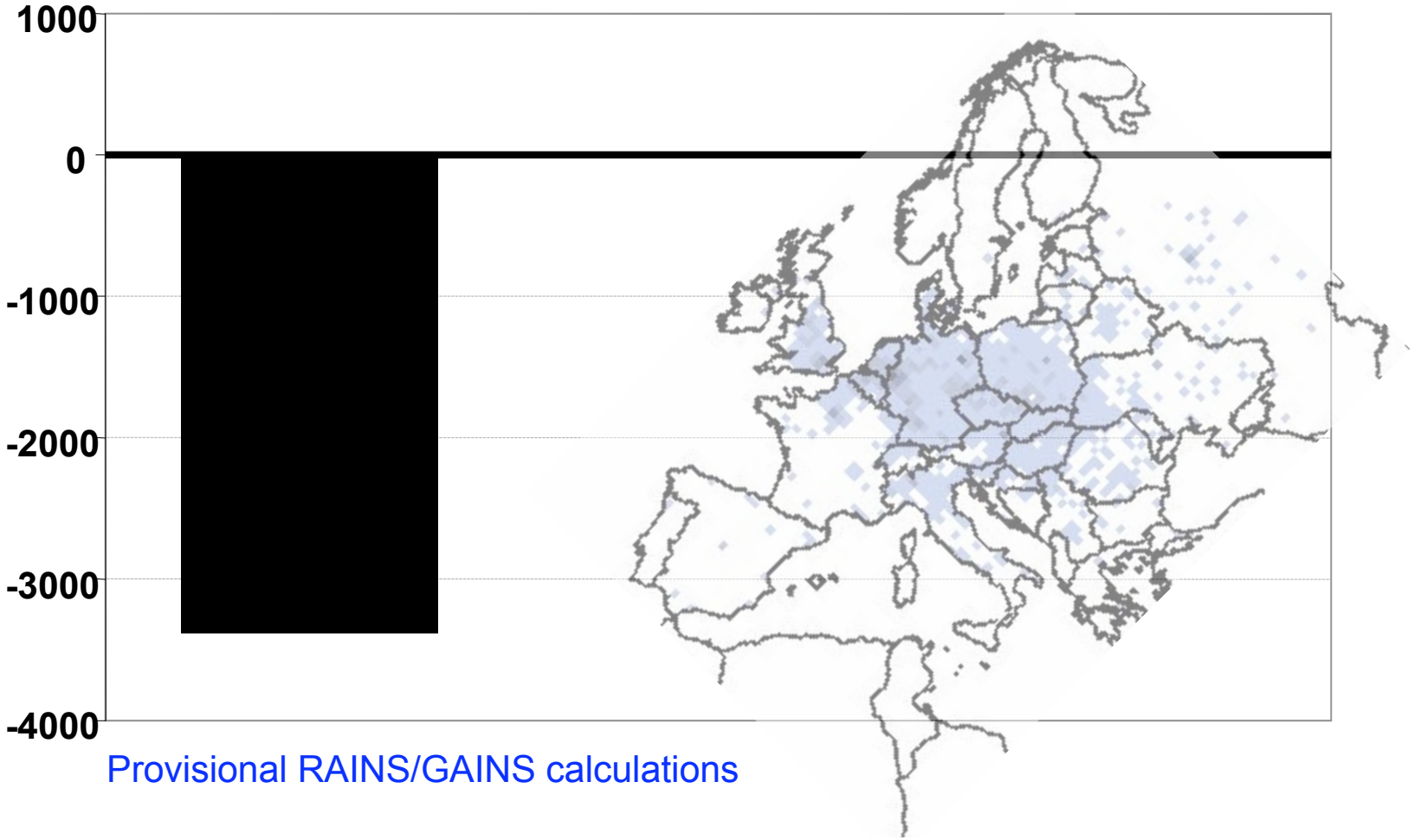
accompanying the 15% CO_2 reduction



Avoided premature deaths attributable to PM2.5

accompanying the 15% CO_2 reduction

Cases/year compared to baseline 2020



Provisional RAINS/GAINS calculations

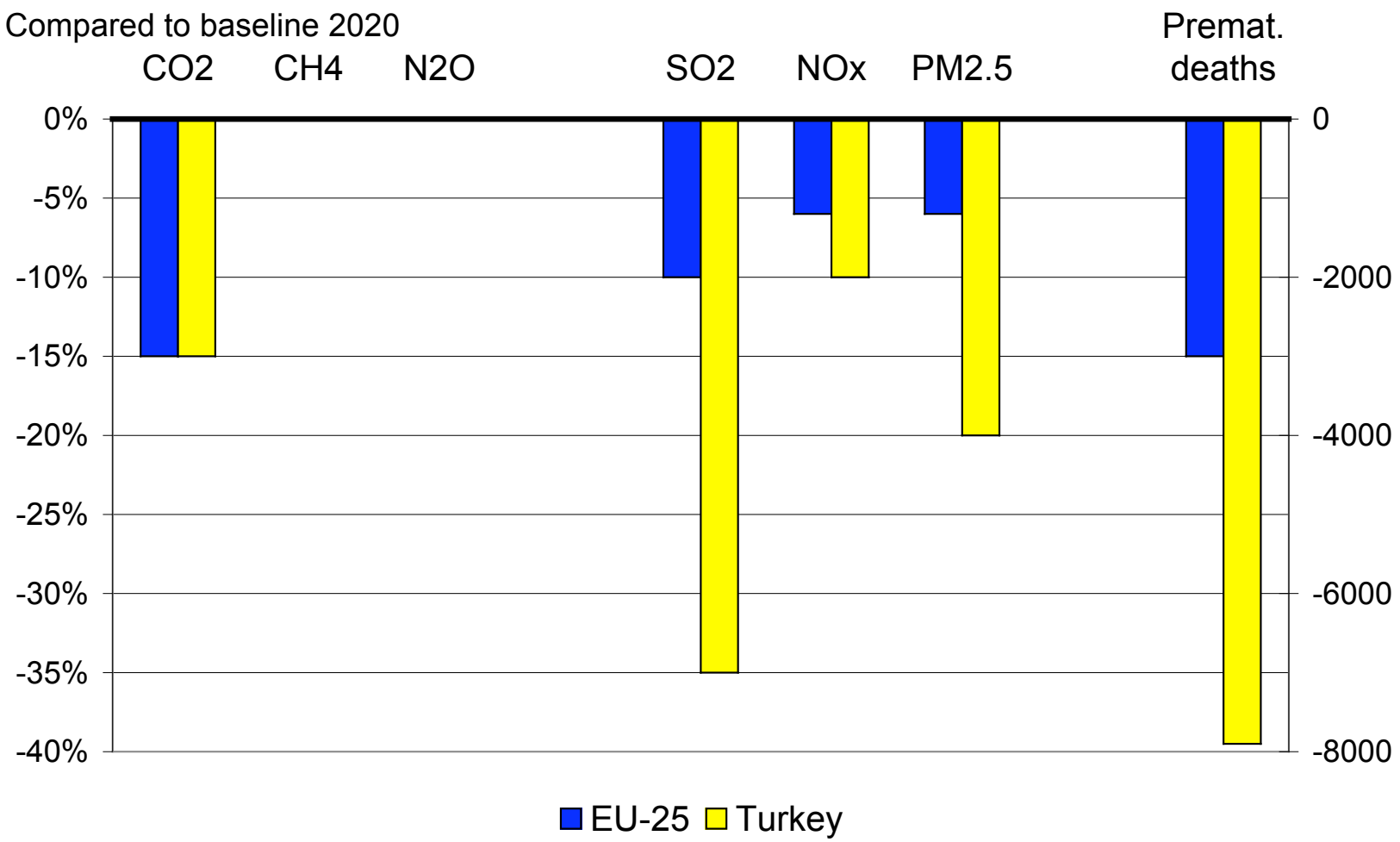
Costs for the 15% CO_2 reduction

compared to baseline [billion €/yr]

			EU-25
Direct costs for GHG mitigation	CO_2		+23.6
Emission control costs for air pollutants	SO_2	-2.0	
	NO_x	-2.9	
	PM	-1.1	
	Total		-6.0
Net mitigation costs			+17.6
Health benefits			-3.0

Turkey: Change in emissions and health impacts

accompanying the 15% CO_2 reduction



Costs for the 15% CO_2 reduction

compared to baseline [billion €/yr]

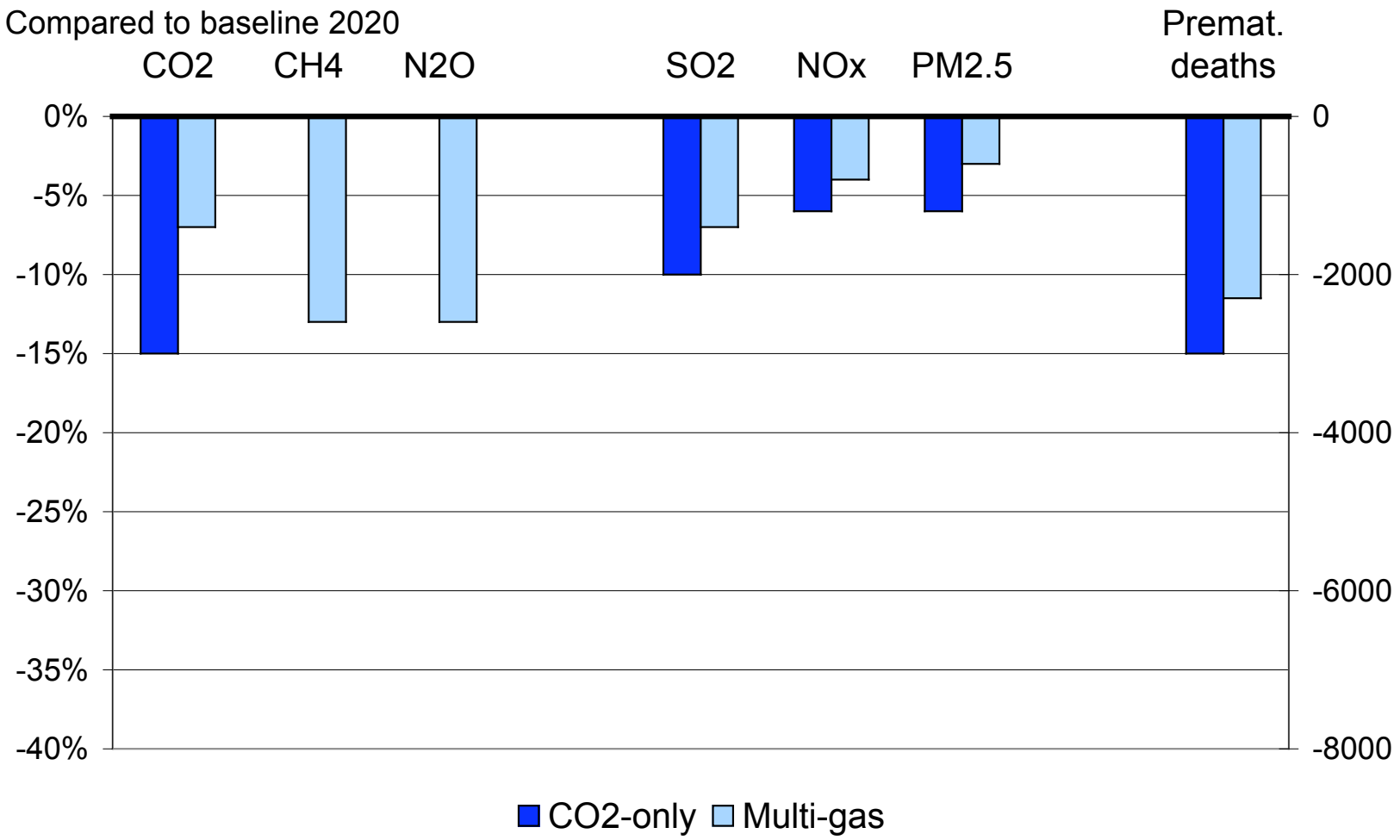
			EU-25	Turkey
Direct costs for GHG mitigation	CO_2		+23.6	+2.2
Emission control costs for air pollutants	SO_2	-2.0		
	NO_x	-2.9		
	PM	-1.1		
	Total		-6.0	0
Net mitigation costs			+17.6	+2.2
Health benefits			-3.0	-8.0

Case 2: Multi-gas mitigation

- 15% reduction in total GHG emissions, based on 100yrs GWP
- Achieved by measures for CO_2, CH_4 and N_2O

Change in emissions and health impacts, EU-25

accompanying the 15% multi-GHG reduction



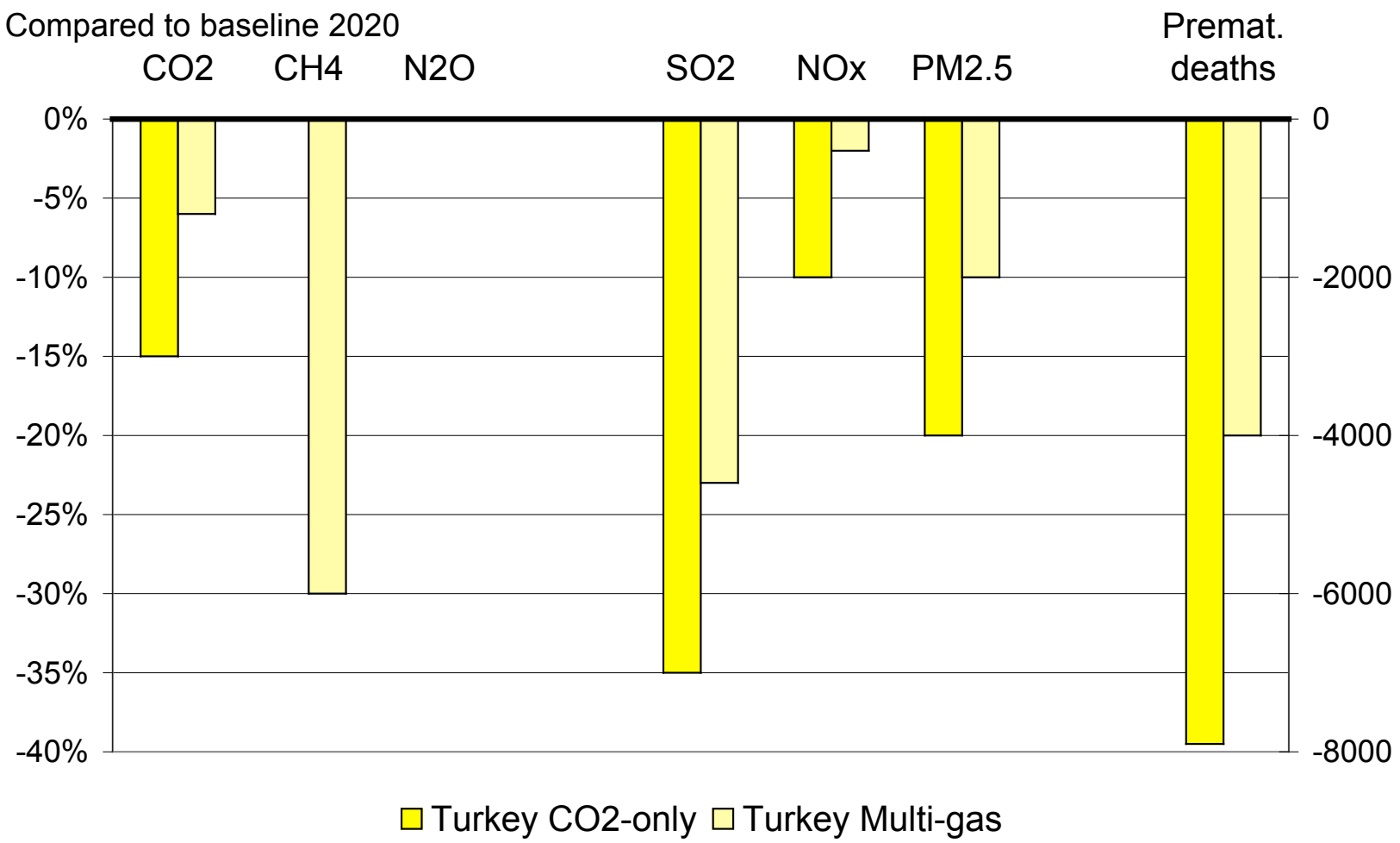
Costs for the 15% GHG reduction, EU-25

compared to baseline 2020 [billion €/yr]

		CO_2 only		Multi-gas	
Direct costs for GHG mitigation	CO_2	+23.6		+5.7	
	CH_4			+0.7	
	N_2O			+0.4	
	Total		+23.6		+6.8
Emission control costs for air pollutants	SO_2	-2.0		-1.6	
	NO_x	-2.9		-1.4	
	PM	-1.1		-0.7	
	Total		-6.0		-3.7
Net mitigation costs			+17.6		+3.1
Health benefits			+3.0		-2.3
Net costs			+14.6		+0.7

Change in emissions and health impacts, Turkey

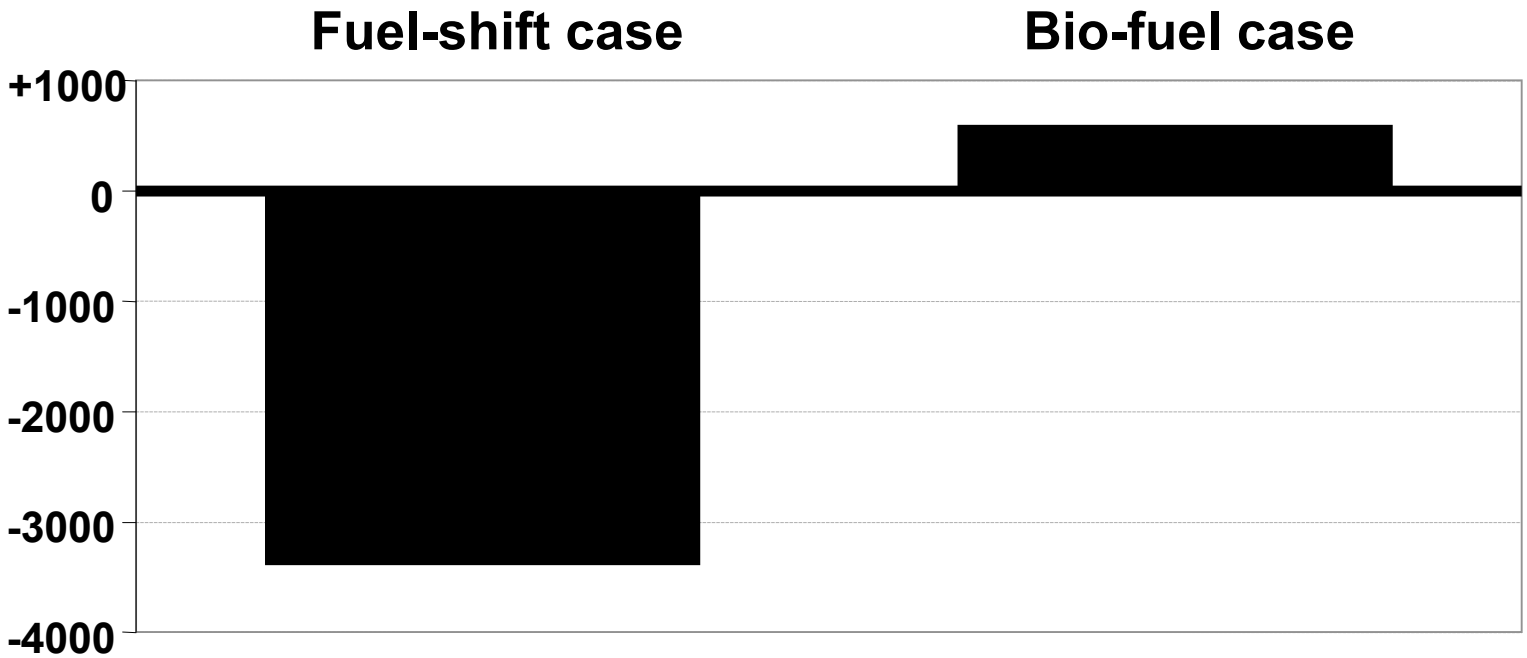
accompanying the 15% multi-GHG reduction



Case 3: Increased use of bio-fuels

10% of light heating oil in EU-25 is replaced by bio-fuels (wood), burned in most advanced boilers: Higher PM2.5 emissions!

Differences in premature deaths
compared to baseline [cases/year]



Conclusions

- Inclusion of non-CO_2 gases, air pollutants and co-benefits make GHG mitigation economically more viable.
  - Developing countries: non-CO_2 gases, health benefits
  - Industrialized countries: direct cost savings for air pollution control
- Multi-gas GHG strategies have less CO_2 co-benefits, but better cost-effectiveness ratio (and additional co-benefits on ozone, not yet considered here!)
- These examples are driven from a climate perspective. However, in developing countries policy priorities are reverse. Cases also work in opposite direction: co-benefits of air pollution control on greenhouse gas emissions.

More information:

www.iiasa.ac.at/rains