Environment Center
Charles University
in Prague

Valuation of ancillary effects of GHG mitigating policies

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Subtask 2.1.2: Valuation of ancillary effects of GHG mitigating policies

Objective

- To assess the ancillary air quality benefits of climate mitigation policies

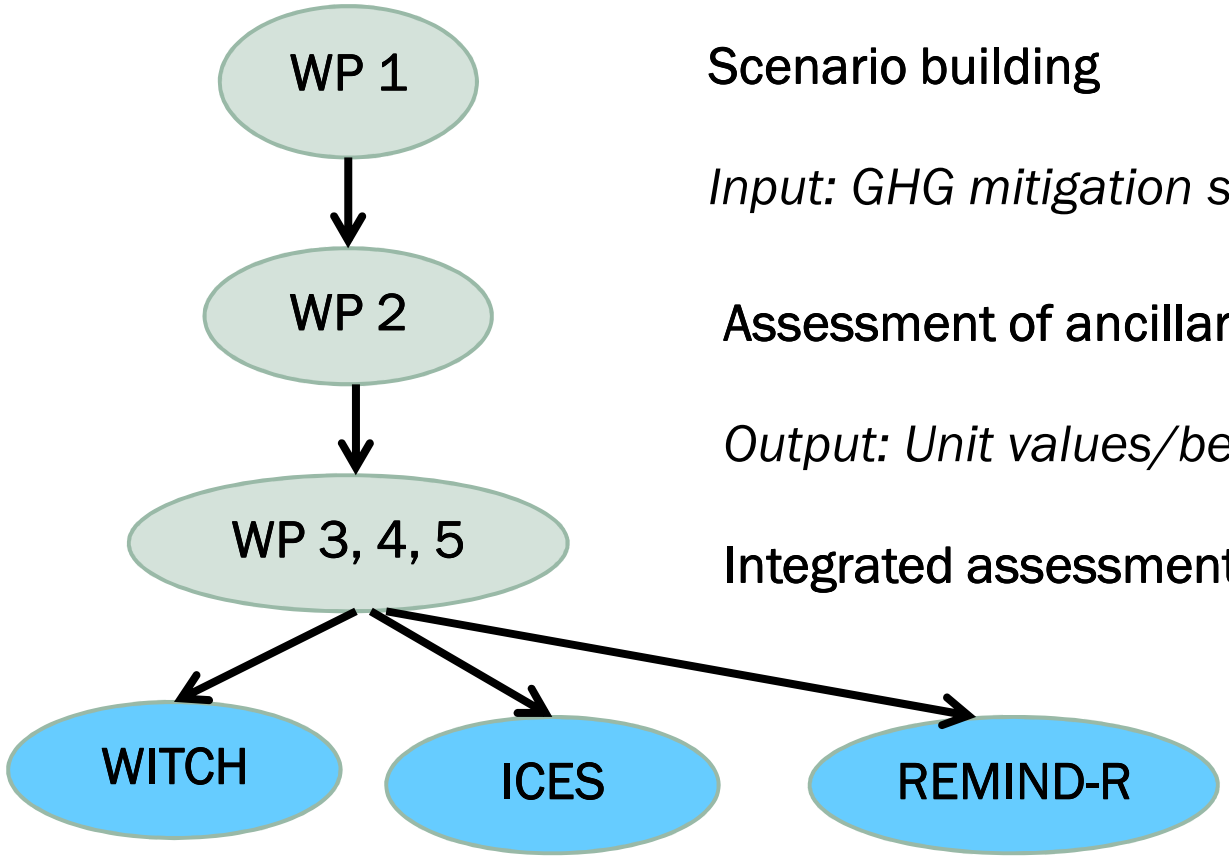
Structure

- Review of interactions and synergies between GHG mitigation and air pollution control
- Review of the latest results on external cost quantification around Europe (ExternE project series)
- Update of monetary values on physical impacts caused by air pollution and micropollutants
- Assessment of avoided impacts and ancillary benefits of mitigation policies
- Linking our impact/welfare assessment with IAM framework

Deliverable

- Physical and monetary unit estimates for regional air pollutants and heavy metals

Interactions with other WPs



Scenario building

Input: GHG mitigation scenarios

Assessment of ancillary benefits

Output: Unit values/benefits per air pollutant

Integrated assessment modeling

Energy sector
Climate system
Climate damage function

GHG gases

Energy system
GHG emissions

Backround

- Climate mitigation policies lead to reductions in the regional air pollutant emissions $\Rightarrow$ air quality improves

- Mitigation actions (energy sector)
  - Fuel substitution $\Rightarrow$ carbon-free fuels or fuels with low carbon content (e.g. renewables, nuclear energy)
  - Fuel efficiency improvements $\Rightarrow$ cogenaration (CHP), Integrated Gasification Combined Cycle (IGCC)
  - Carbon capture

CO2 control measures with impacts on more than one pollutant

	Reduced emissions	Increased emissions
Structural measures:		
Energy savings, efficiency improvements, banning of certain activities	All pollutants	
Increased use of natural gas	CO_2, SO_2, VOC, NO_x, PM	CH_4
Biomass	CO_2	VOC, PM, CH_4 N_2O
Stationary sources:		
Integrated Gasification Combined Cycle (IGCC)	CO_2, SO_2, NO_x, PM	
Combined Heat and Power (CHP)	All pollutants	
Selective and non-selective catalytic reduction (SCR, SNCR)	NO_x, CO	NH_3, N_2O
Fluidized bed combustion	SO_2, NO_x	N_2O
New residential boilers	VOC, PM, CO, CH_4	
Mobile sources		
Euro emission standards	NO_x, VOC, PM, CO	NH_3, N_2O
Low sulfur fuels	SO_2, PM	
Diesel	CO_2	PM
Agricultural sources		
Low emission pig housing	NH_3, CH_4	N_2O
Covered storage of slurry	NH_3	CH_4
Injection of manure	NH_3	N_2O
Anaerobic digestion (biogas)	CH_4, CO_2, N_2O	NH_3

Amann, 2011

Covered impatcs

The study covers mainly the following impacts:

- on human health (increased morbidity, reduction in life expectancy)
- on agricultural production
- damage to building materials
- loss of biodiversity
- effect of heavy metals on human health

The impacts of air pollution - mortality

Pollutant / Burden	Effects
PM_{10}, $PM_{2.5}$, SO_2, O_3	Reduction in life expectancy due to short and long time exposure
Heavy Metal, Benzene, Benzo-[a]-pyrene 1,3-butadiene	Reduction in life expectancy due to short and long time exposure

ExternE, 2012

The impacts of air pollution - morbidity

Pollutant / Burden	Effects
PM_{10}, $PM_{2.5}$, O_3, SO_2	Respiratory hospital admissions
PM_{10}, $PM_{2.5}$, O_3	Restricted activity days
PM_{10}, $PM_{2.5}$, CO	Congestive heart failure
Benzene, Benzo-[a]-pyrene 1,3-butadiene, Heavy Metal	Cancer risk (non-fatal) Osteroporosia, ataxia, renal dysfunction
PM_{10}, $PM_{2.5}$	Cerebrovascular hospital admissions, Cases of chronic bronchitis, Cases of chronic cough in children, Cough in asthmatics, Lower respiratory symptoms
O_3	Asthma attacks Symptom days

ExternE, 2012

The impacts of air pollution – other impacts

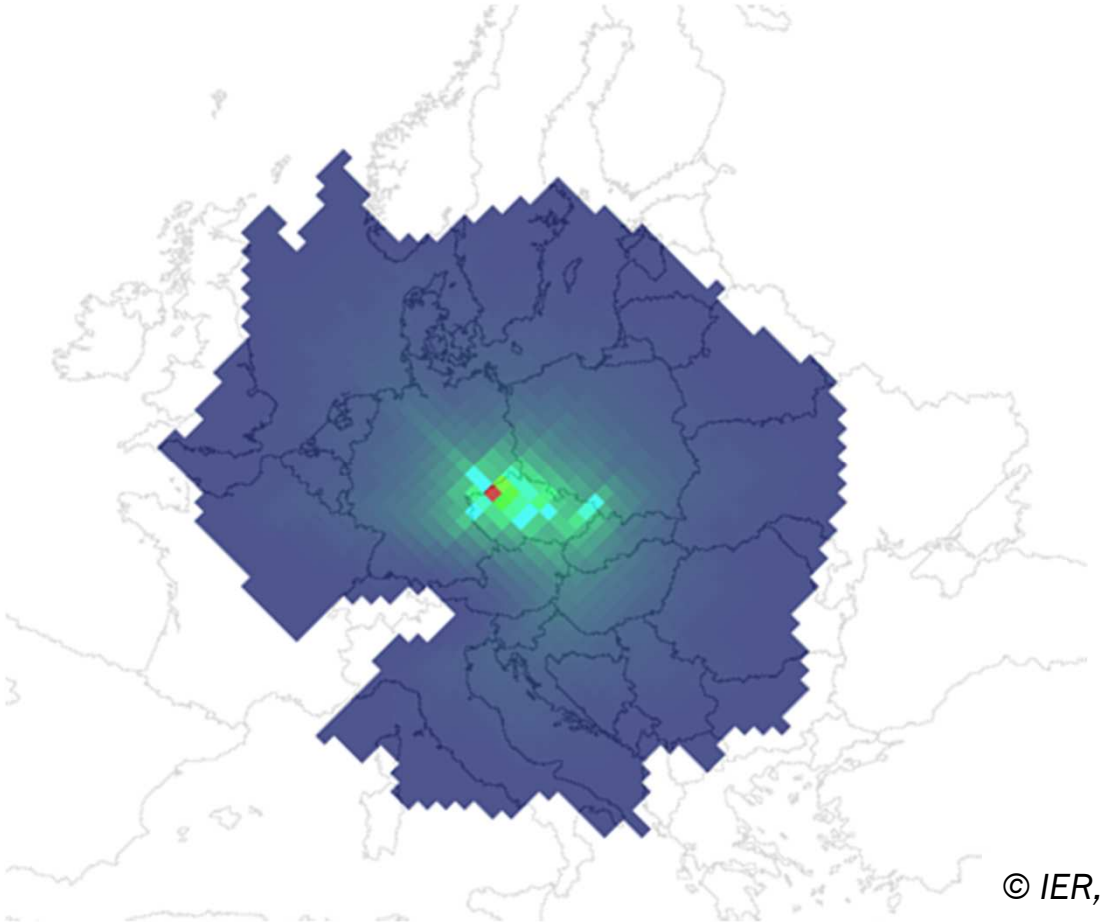
Pollutant / Burden	Effects
Building Material	
SO_2, Acid deposition	Ageing of galvanised steel, limestone, mortar, sand-stone, paint, rendering, and zinc for utilitarian buildings
Combustion particles	Soiling of buildings
Crops	
NO_x, SO_2	Yield change for wheat, barley, rye, oats, potato, sugar beet
O_3	Yield change for wheat, barley, rye, oats, potato, rice, tobacco, sunflower seed
Acid deposition	Increased need for liming
N, S deposition	Fertilising effects
Ecosystems	
SO_2, NO_x, NH_3	Acidity and euthrophication

ExternE, 2012

GHG mitigation benefits vs. ancillary air quality benefits

- **Benefits of GHG reductions** $\Rightarrow$ experienced by future generations at the global level
- The **ancillary air quality benefits** $\Rightarrow$ current generation and are local or regional in nature
- We will concentrate mainly on the assessment of air quality benefits for Europe

ATMOSPHERIC DISPERSION MODELLING OF PARTICULATE MATTERS PM_{10} USING EcoSenseWeb V1.3 (v µg /m^3)



ExternE methodology

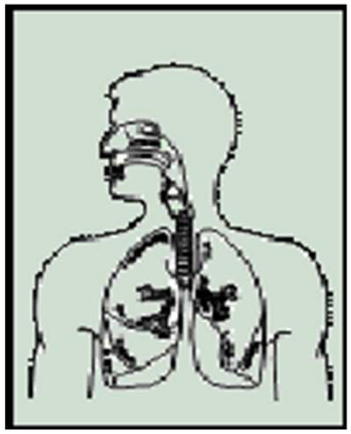
- **ExternE** (*Externalities of Energy*) methodology ⇒ is developed and used over 20 years in the European research projects for monetary valuation of external costs arising from electricity and heat production (more www.externe.info)
- Based on the **impact pathway analysis** (*Impact Pathway Approach, IPA*) ⇒ analysis of externalities from bottom up, so called *bottom-up* approach
- Atmospheric dispersion of pollutants and calculation of external costs ⇒ **software EcoSenseWeb 1.3** (http://ecosenseweb.ier.uni-stuttgart.de/)
  - Local, regional and North-hemispheric module
  - Emission scenario for 2020, meteorological year – future

Methodology used – Impact Patway Analysis

Release of emissions

Transport & chemical transformation

Physical impats



Monetary valuation

Source: European Commission (2005)

One example from ClimateCost project

- Ancillary air quality benefits of GHG mitigation policies
- Mitigation scenario - a greenhouse gas reduction scenario with global CO2 emissions reduced by 60% in 2050 compared to 1990. T
- a global mean temperature increase of less than 2 degrees

Emissions 2005 to 2050 in EU27, net benefits of mitigation

Net benefits of Mitigation – million tonnes and % reduction from the baseline	2005	2020	2030	2050
SO_2	0	325 (14%)	643 (31%)	1333 (60%)
NOx	0	365 (7%)	791 (20%)	1844 (46%)
$PM_{2.5}$	0	-1 (0%)	18 (2%)	167 (19%)