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Integrating Air Pollution into Energy Modelling

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- **Objective Function of TIMES: minimise costs while fulfill constraints (e.g. max. greenhouse gas emissions)**

- **However:**
- **Side effects like benefits or damage due to reduction or increase of air pollution occur.**
- **Ranking and thus choice of policies and measures for climate protection change!**
- **-> inclusion of air pollution effects necessary**

Step 1: inclusion of monetized unit damage factor for uair pollutants per activity in energy model - provided by IEHIA models (integrated environmental and health impact assessment models – ECOSENSE and EVA)

TIMES PAN-EU

Generates technology specific activity data

Uses:

GHG emissions per activity unit;

External costs per activity unit

←

ECM^2, ECOSENSE, EVA

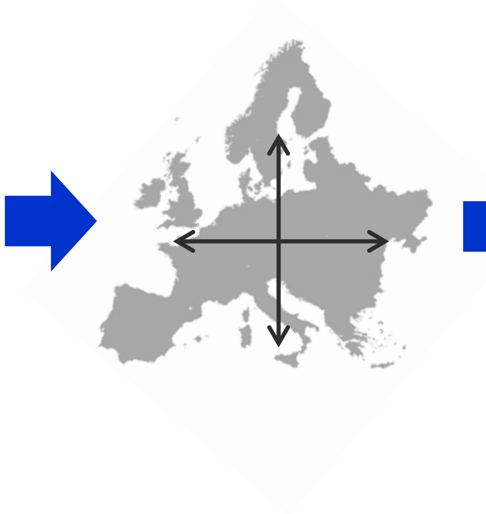
estimate external costs (monetized health and environ-mental impacts) per activity unit

How to assess risks caused by air pollution?

- **Impact pathway approach**

Emissions

Transport and chemical transformation, Exposure



Risks,Damage
Use of exposure–response-functions

Monetary valuation
With willingness-to-pay-approach

However:

activities are related to emission source classes for GHG emissions, not air pollutants;

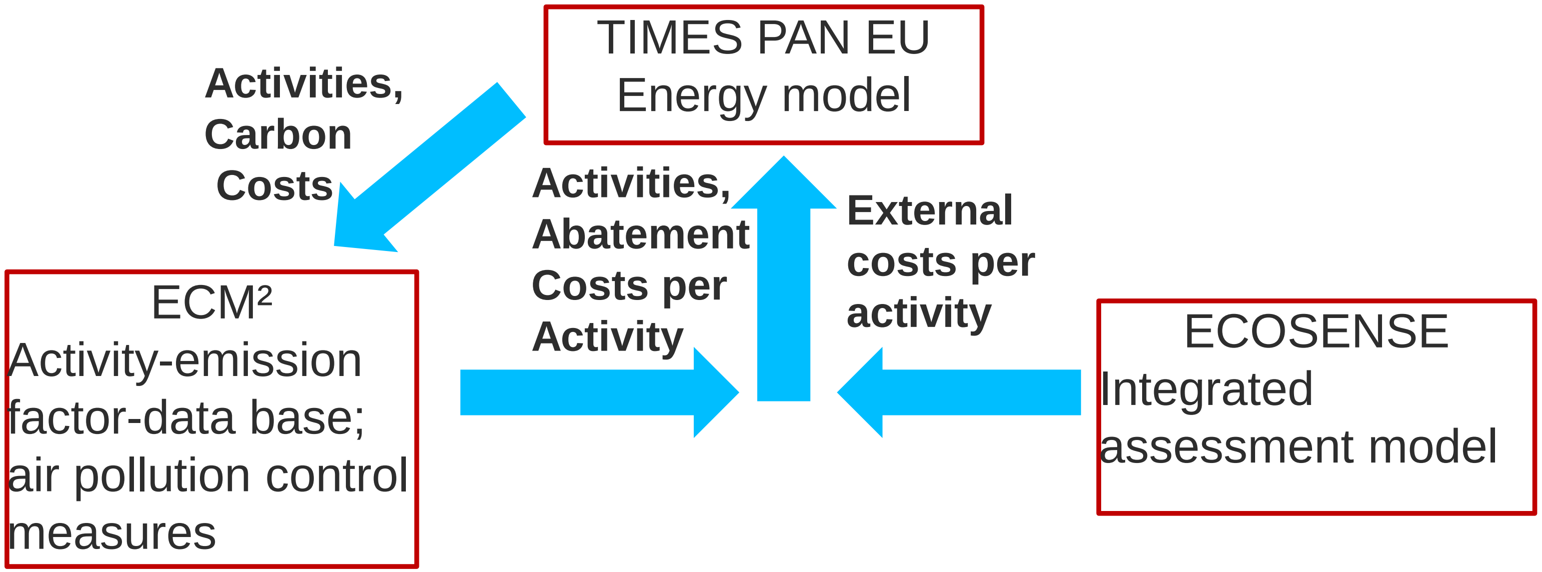
air pollution control measures not included in optimisation

Thus step 2:

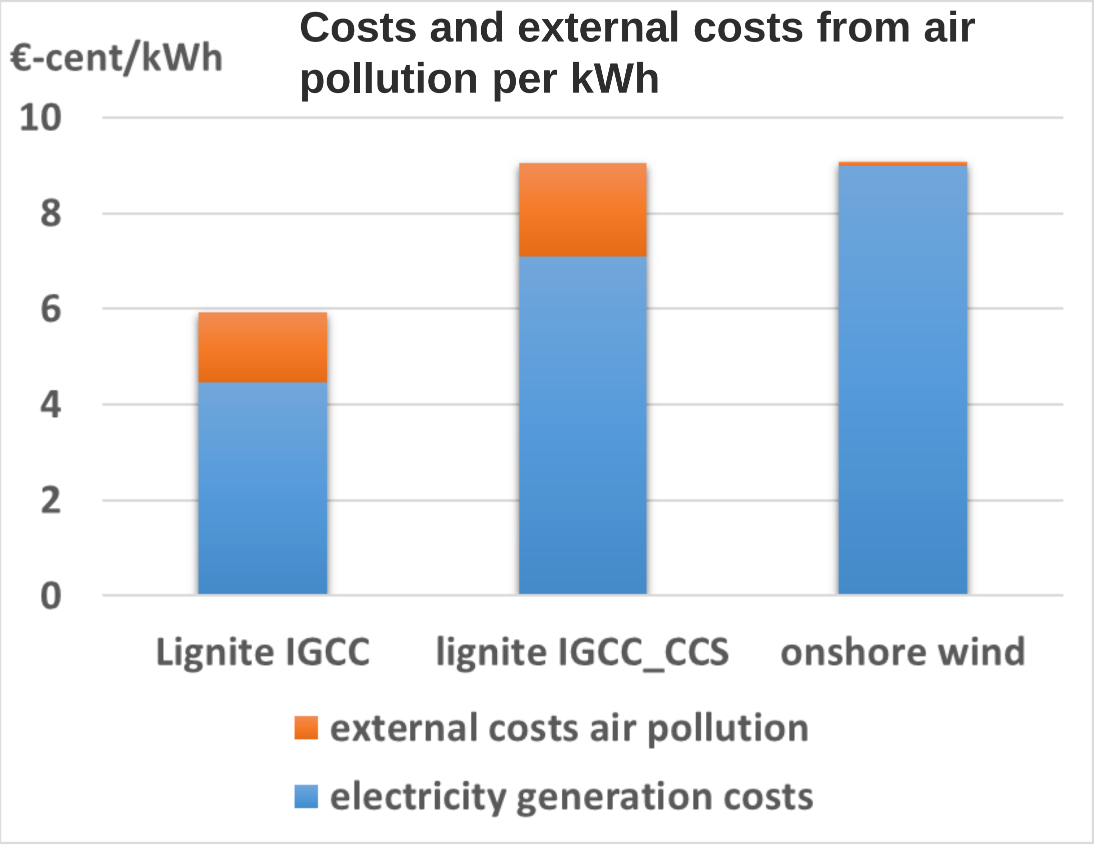
Prepare integrated environmental, health and climate protection plan.

Solution:

Satellite activity-emission factor data base with air pollution control measures



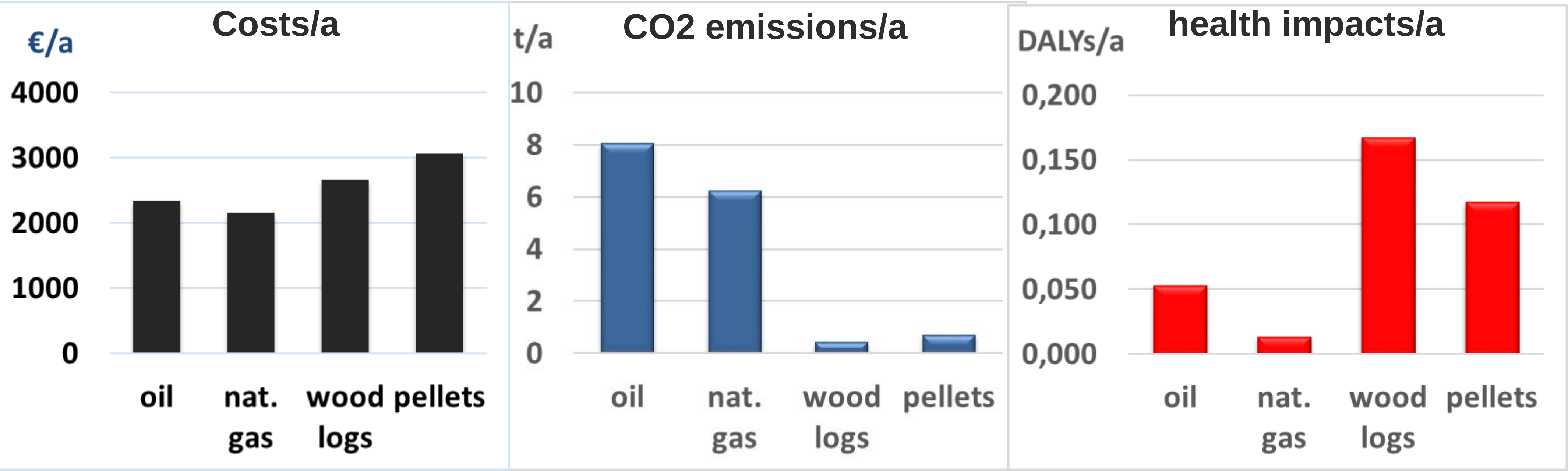
CO2 avoidance costs for using CCS with a lignite power plant and wind energy



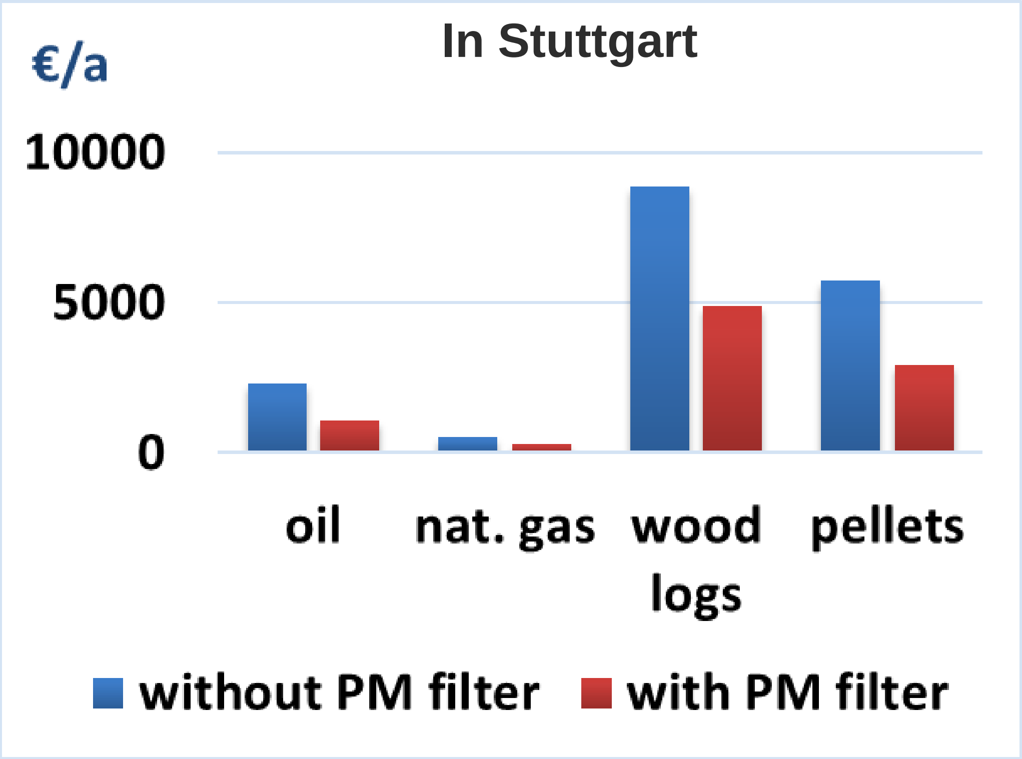
€/t CO2	lignite to wind	lignite to lignite with CCS
without air pollution	64,8	45,3
with air pollution	44,7	53,2

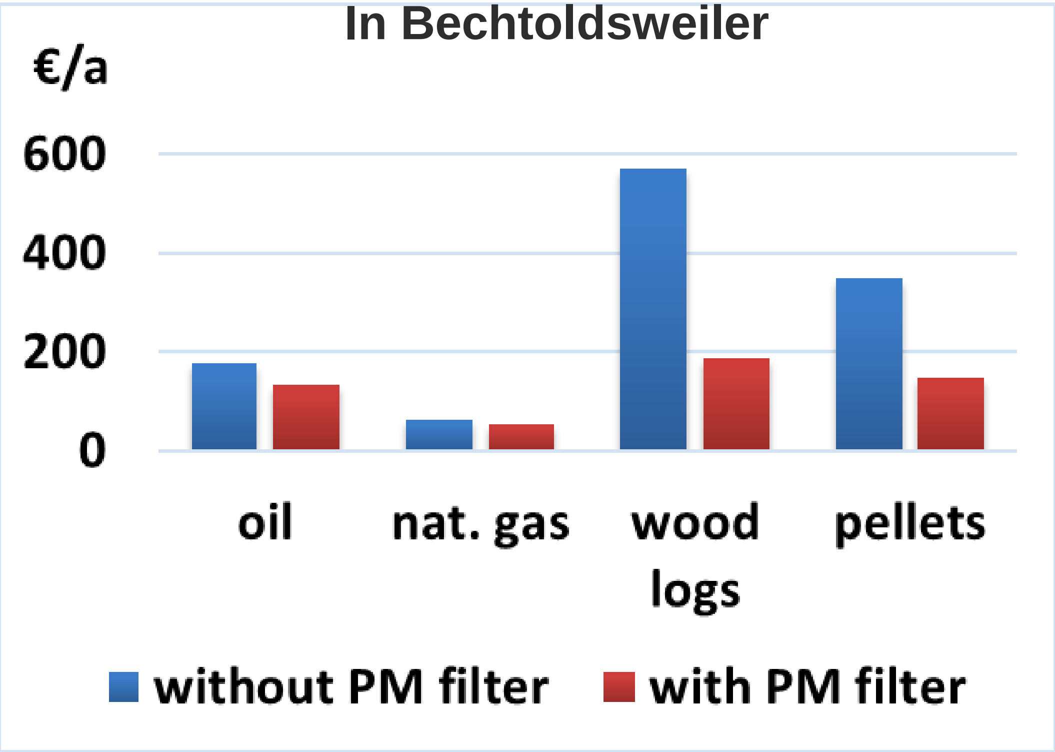
LCA emissions included!
Back-up costs included!

Features of a central heating system installed in an old single family house located in Stuttgart



Monetized health impacts of heating plants installed in an old single family house in Stuttgart and Bechtoldsweiler without and with PM filter



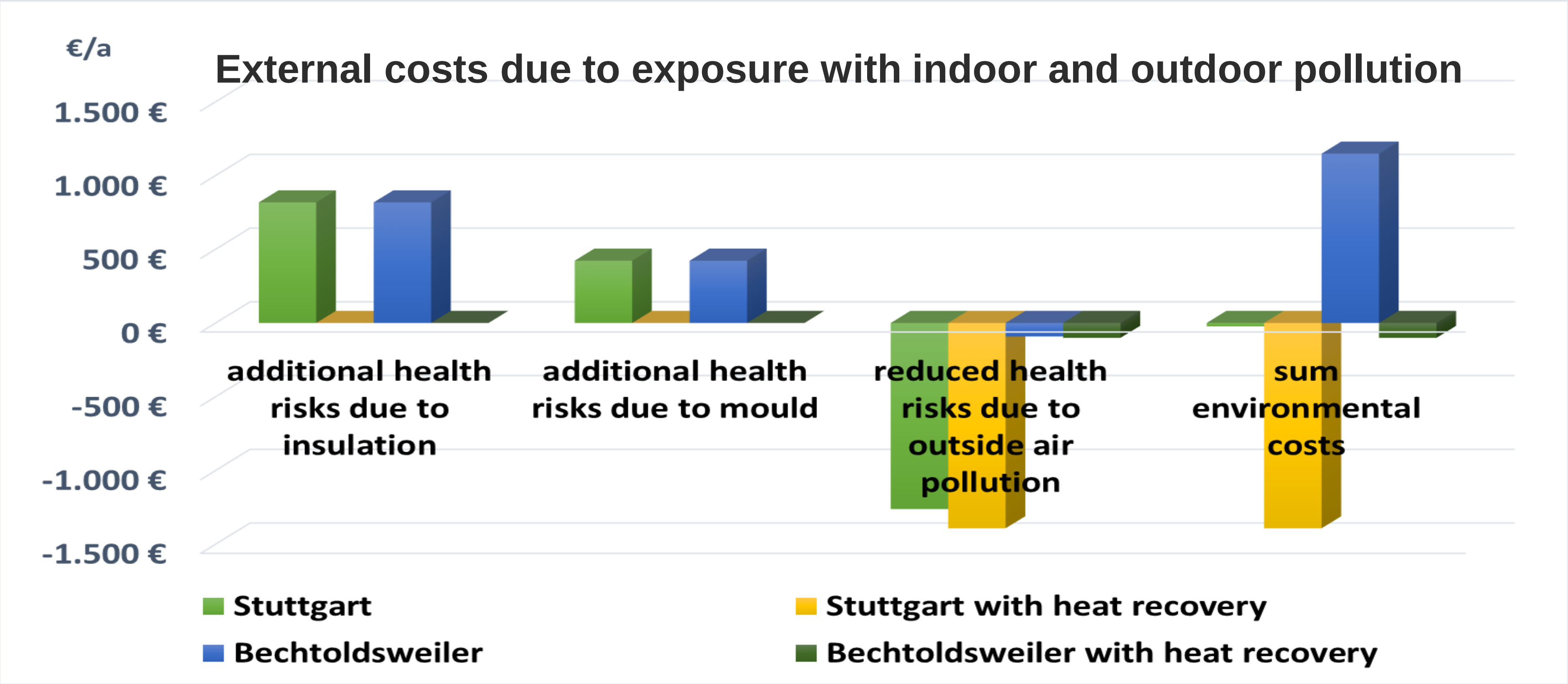


Features of a central heating system installed in an old single family house located in Stuttgart and Bechtoldsweiler

CO2 avoidance costs in t/a Stuttgart	oil to gas	oil to wood	oil to pellets
without air pollution	-101,4	41,6	97,9
with air pollution	-1065,2	904,5	564,0
with PM filter		546,8	343,2

CO2 avoidance costs in t/a Bechtoldsweiler	oil to gas	oil to wood	oil to pellets	gas to pellets
without air pollution	-123,6	28,7	65,2	127,4
with air pollution	-170,9	67,3	82,6	166,2
with PM filter		39,2	72,6	144,8

Insulation of a multi-family house without and with mechanical ventilation with heat recovery in Stuttgart and Bechtoldsweiler



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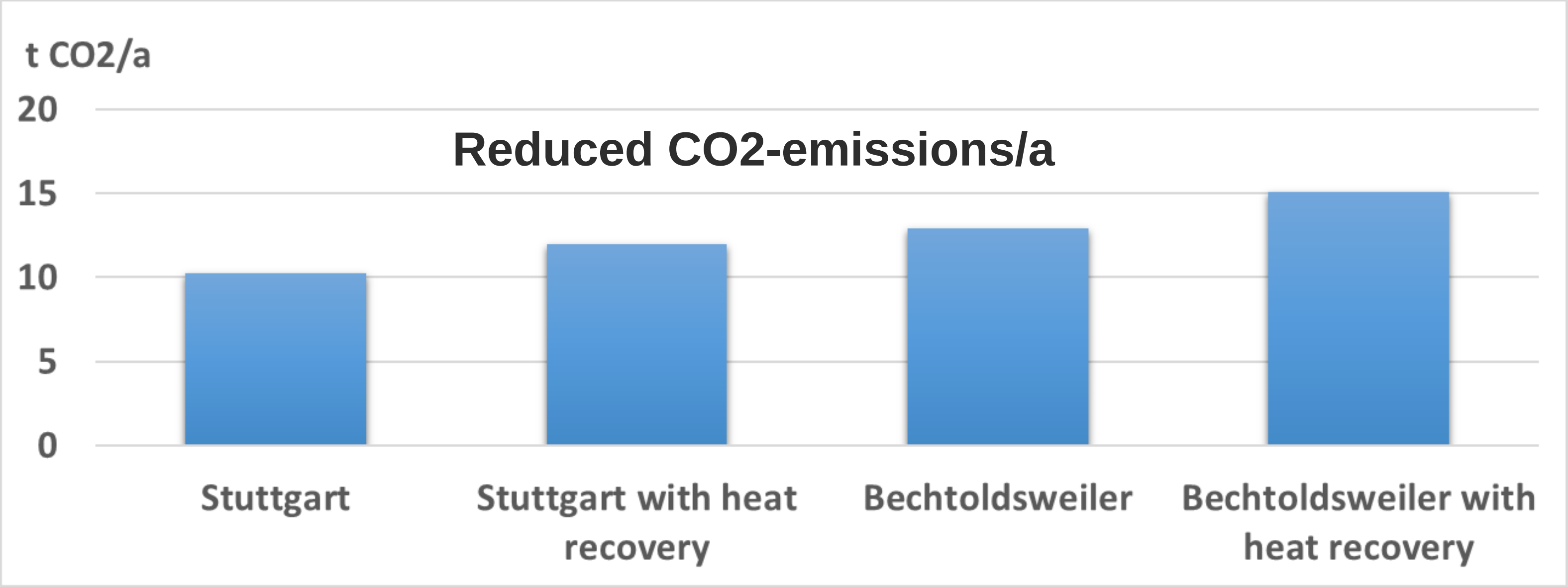


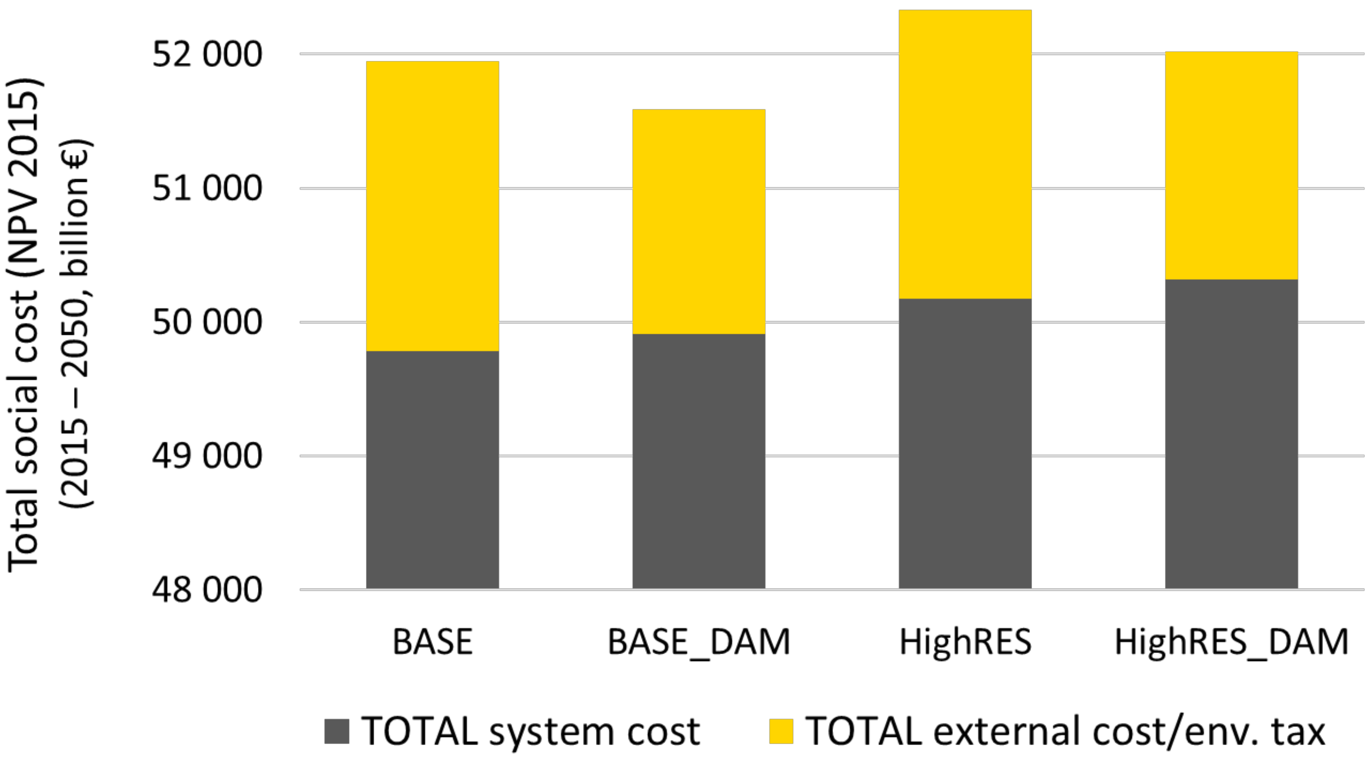
External costs per t of CO2 avoided (without investment costs)

Stuttgart	-2 €/t
Stuttgart with heat recovery	-116 €/t
Bechtoldsweiler	89 €/t
Bechtoldsweiler with heat recovery	-7 €/t

Scenarios

	BASE	HighRES	BASE_DAM	HighRES_DAM
GHG ETS	83% reduction in 2050 in EU28+NO+CH relative to 2005			
GHG NON-ETS Emissions trading system	country specific targets to reduce emissions in EU28 by 75% (2050) relative to 2005			
Share of Renewables in FEC	-	country specific targets (2050) to aim at a 75% share in EU28	-	country specific targets (2050) to aim at a 75% share in EU28
Damage costs internalized (step 1)	-	-	Yes (2015 – 2050)	Yes (2015 -2050)

Results – Social costs



Conclusions

Integrated energy modeling should take air pollution impacts into account, as this will change the assessment resp. ranking of policies and measures for climate protection.

For taking air pollution into account in an energy modelling framework, health and environmental impacts caused by emissions of air pollutants have to be monetized. Tools for this (ECOSENSE and EVA) exist and are constantly improved (e.g. by including exposure modelling).

While efficiency (in t of GHG emissions avoided per € spent) of most climate protection measures is improved, for some measures, especially the use of biomass in small firing plants, significant deteriorations occur.

To avoid inconsistencies integrated climate protection plans and clean air plans should be established (with the modelling system developed in REEEM).