a new environmental accounting framework using externality data and input-output tools for policy analysis

Policy Analyses using the bottom-up approach

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Luxembourg, 12 October 2011

How to assess the environmental performance of policies?

Use of environmental pressures (emissions) for the assessment not useful, as severity of the impacts per unit of release is not known, thus

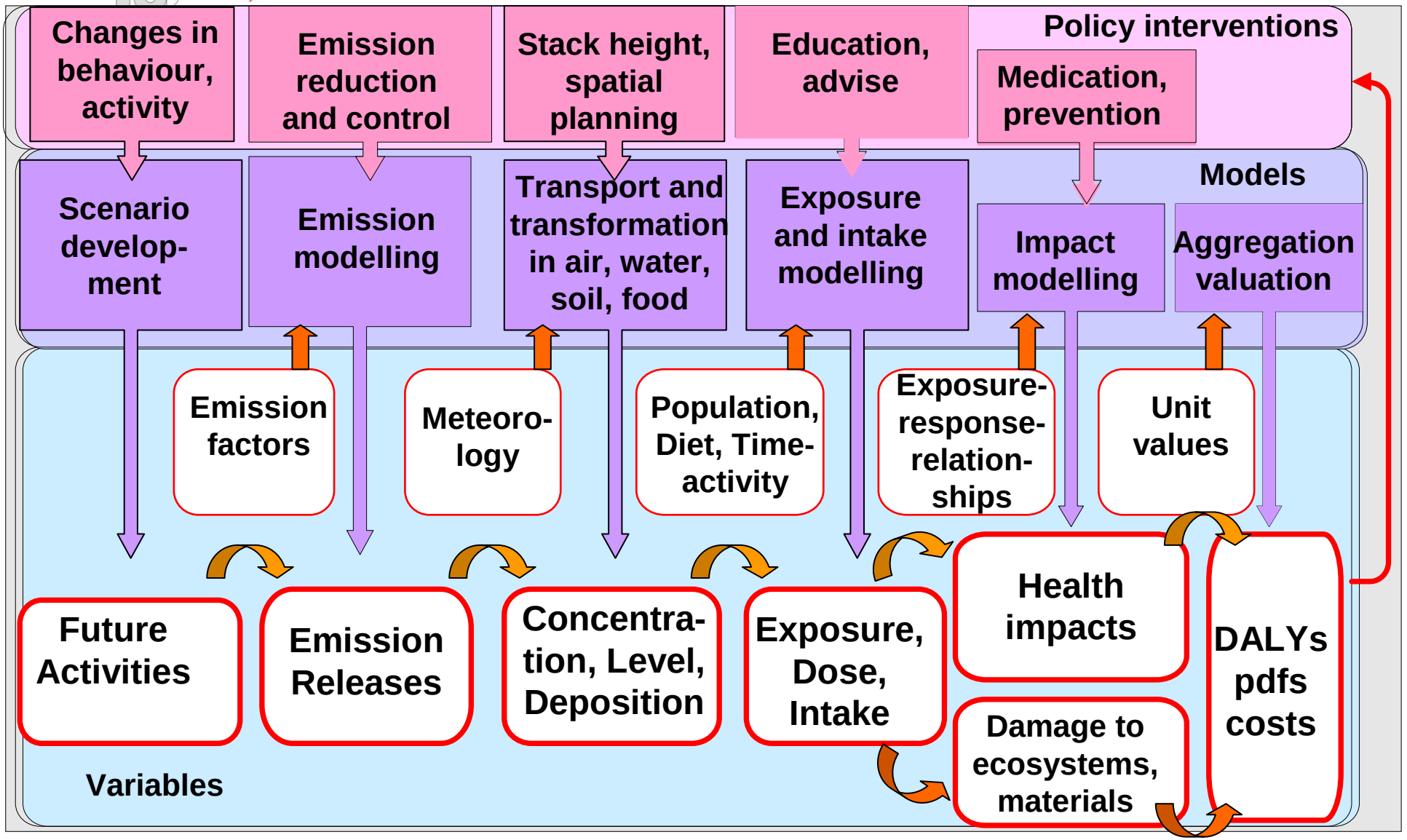
no weighting/comparison between pressures and with economic and social indicators possible;

⇒ Pressures/ emissions can not be assessed.

⇒ Impacts (damage, risks) caused by the pressures should be estimated.

- Integrated environmental impact assessment using the impact-pathway- or full chain approach
- Relation between pressure and impact non-linear and depending on site and time of pressure, processes in environmental media, concentrations of other species

The impact pathway or full chain approach



Purpose of case studies

Demonstrate the use of the EXIOPOL methods, especially the new developments.

-> climate protection policies for the agricultural sector and the energy sector chosen

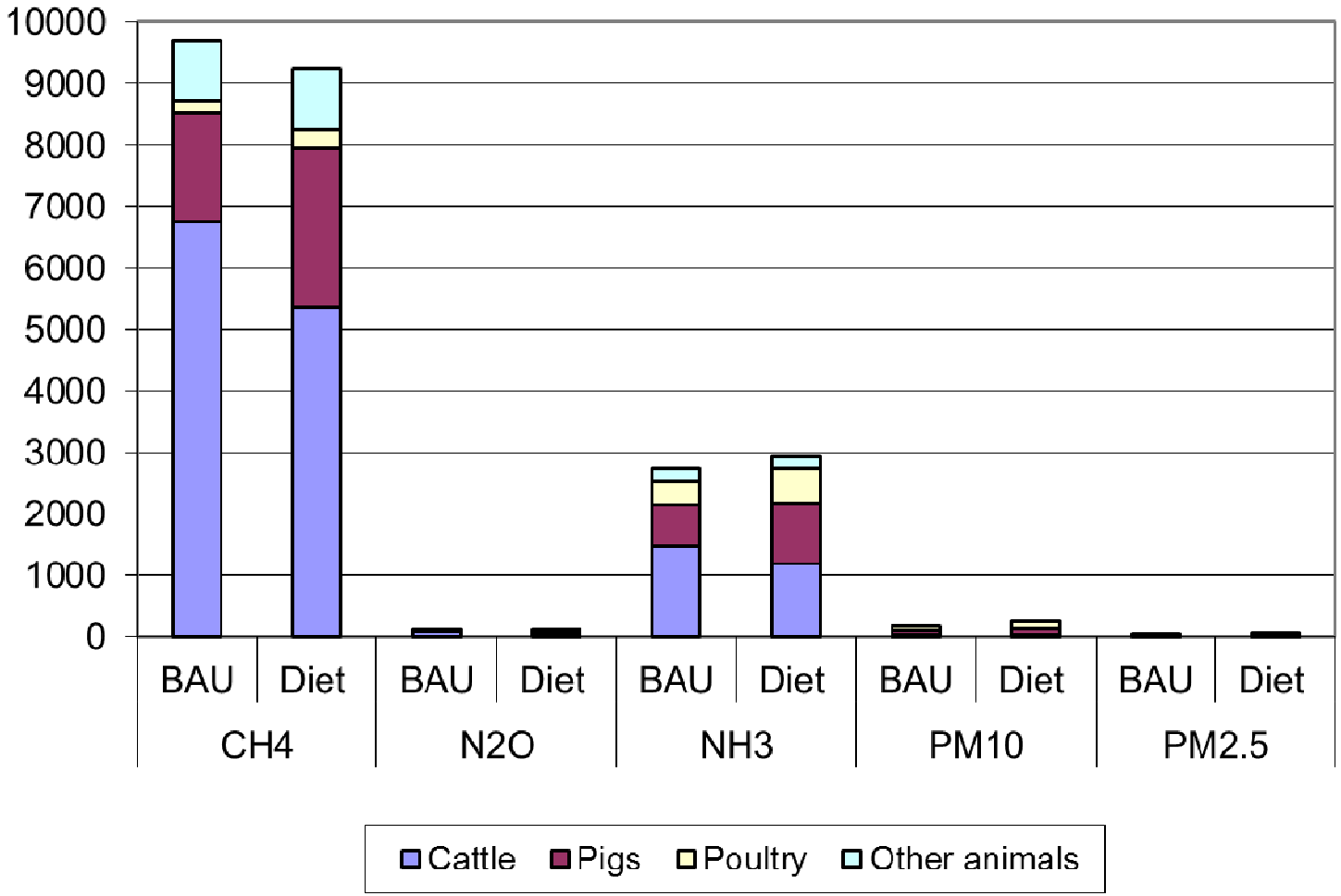
Screening result: Priority Pollutants/Pressures	Human health impacts	Ecosystem impacts	Climate change impacts
Ammonia (NH_3)	X	X	
Carbon monoxide (CO)	X		X
Dioxins, furanes	X		
Heavy metals (As, Cd, Hg, Se)	X		
Nitrogen oxides (NO_X)	X	X	X
NMVOC	X		X
Particulates ($PM_{2.5}$ and PM_{coarse}), BC, OC	X		X
Sulfur dioxide (SO_2)	X	X	X
Cancerog. VOC (Benzo[a]pyrene, PAH)	X		
Carbon dioxide (CO_2)			X
Dinitrogen monoxide (N_2O)			X
Methan (CH_4)			X
Sulfur hexafluoride (SF_6)			X
Noise	X		
Pesticides	X		
POPs	X		
Environmental Tobacco Smoke	X		
Radioactive substances incl. radon	X		

Case Study I

To avoid methane emissions from cattle, promote the use of pork and poultry meat instead of beef (- 20%).

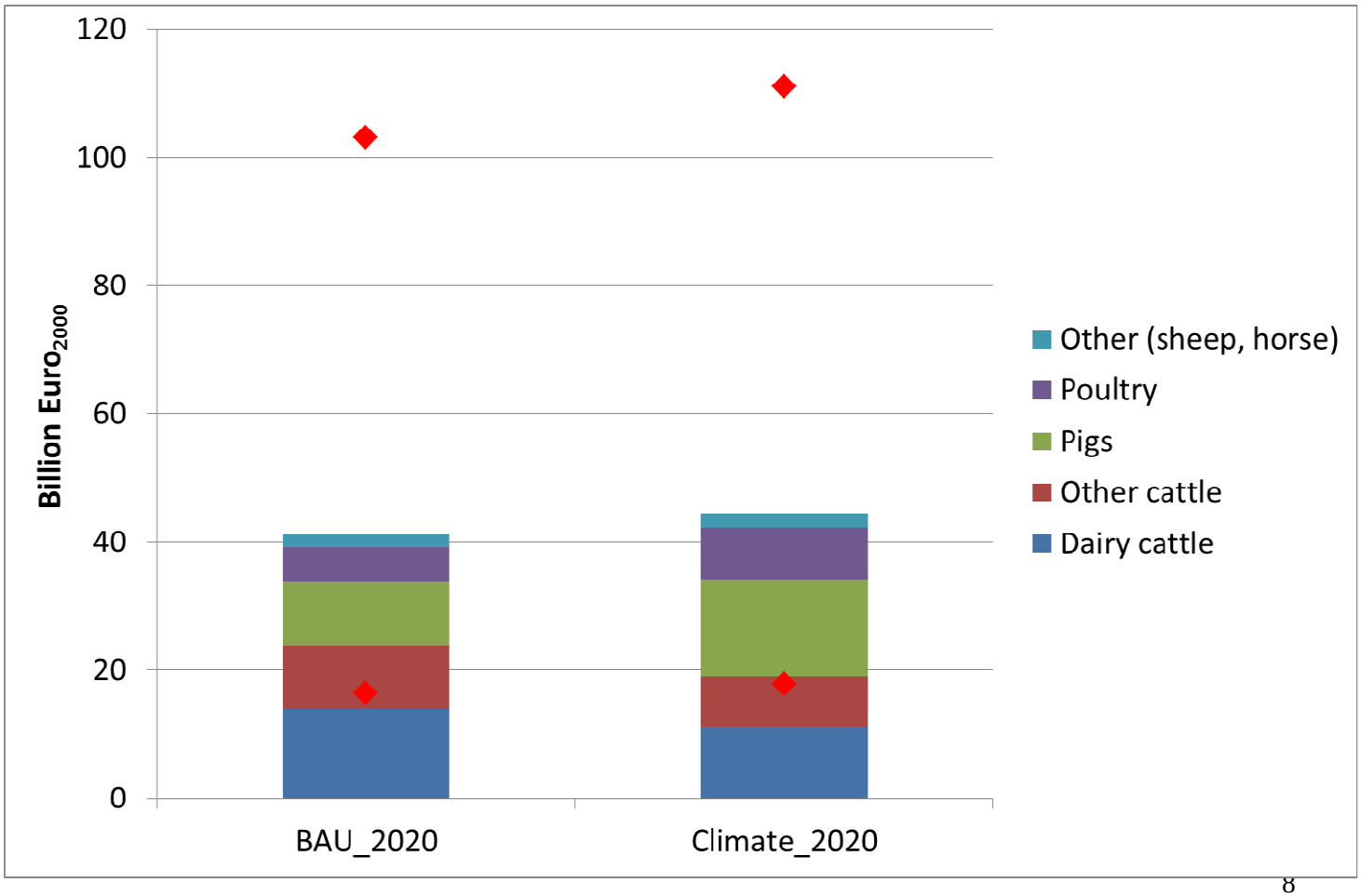
Case Study I: change in human diets

Emission (kt) in EU-27 in 2020



Agriculture: changes in human diets

Human diet: Resulting external costs in EU-27 (Million Euro$_{2000}$)



Case study I: change in human diets

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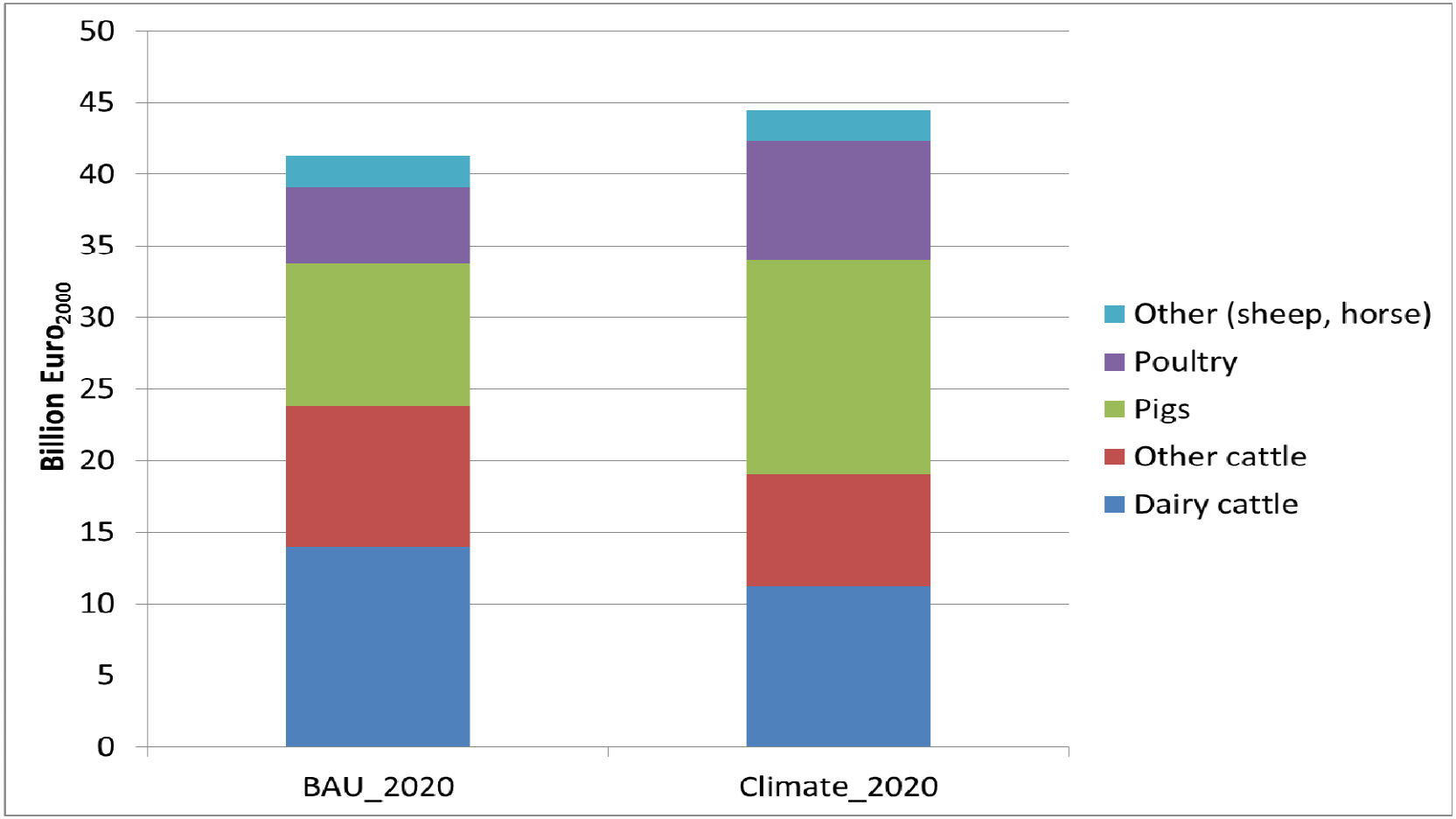


Agriculture: changes in human diets

Conclusions:

- **Additional environmental damage: 2 000 mio €**
- **Avoided GHG emissions: 10 500 kt CO2-eq.**
- **-> 190 € damage per t of CO2 avoided**
- **Effect on CH4 is smaller than expected due to increase of CH4 emissions from piggeries**
- **A better option for climate protection would be a general reduction in animal protein consumption**

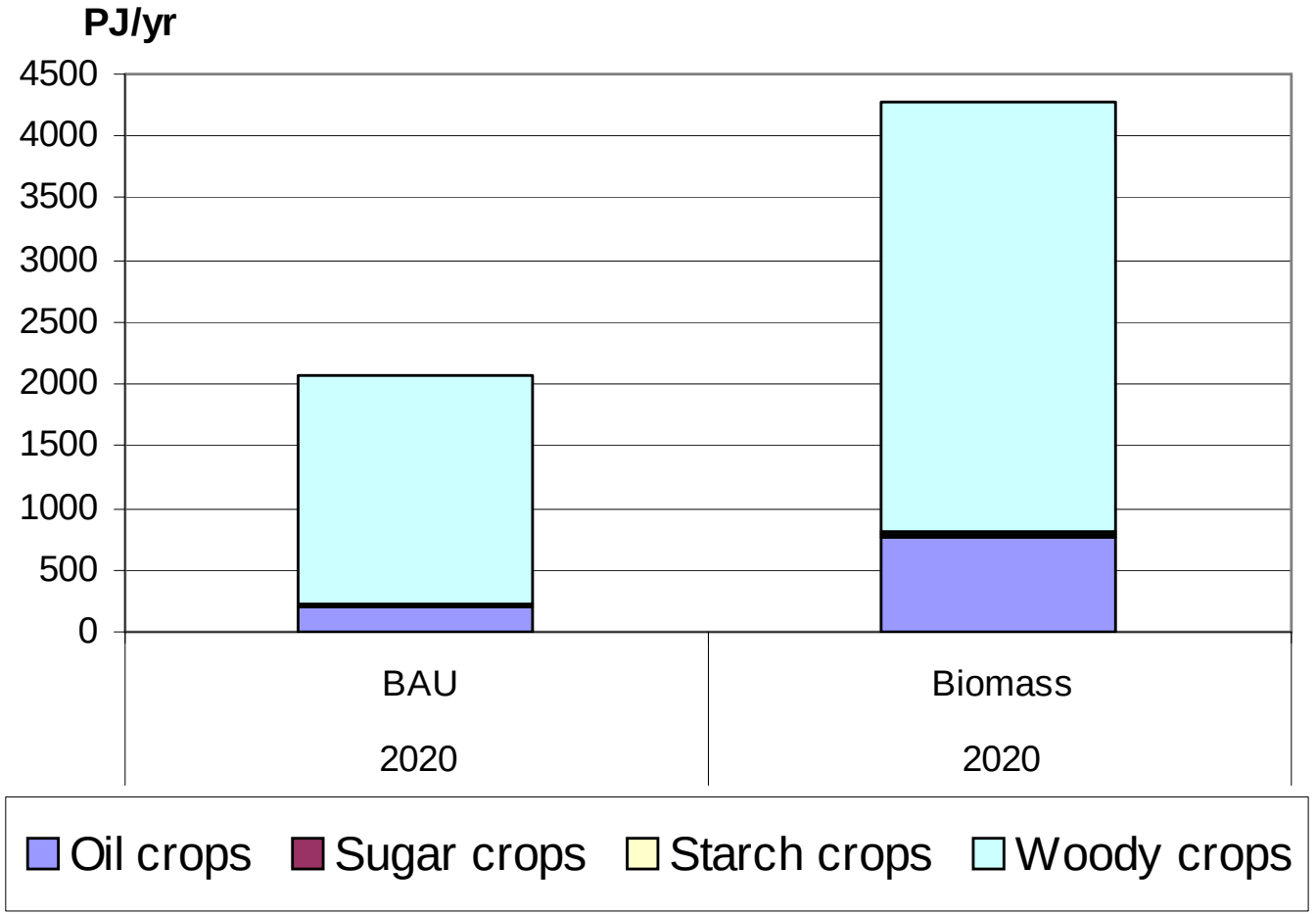
Case study II: more biomass production for energy use

- **Use of biomass within EUs 20-20-20 strategy: 20% share of renewables in all primary energy use, 20% reduction of greenhouse gases 1990 – 2020, 10% share of biofuels in transport**
- **Amount and type of biomass determined with energy model (TIMES)**

Fuel type	Biomass category (TIMES)	Crop types used
Biodiesel	Oil crops	Rape seed Sunflower seed
Bioethanol	Starch crops Sugar crops	Cereals Sugar beet, Sweet sorghum
Fischer-Tropsch (FT) Diesel	Woody biomass Grassy biomass	Poplar, Willow Miscanthus, Switchgrass

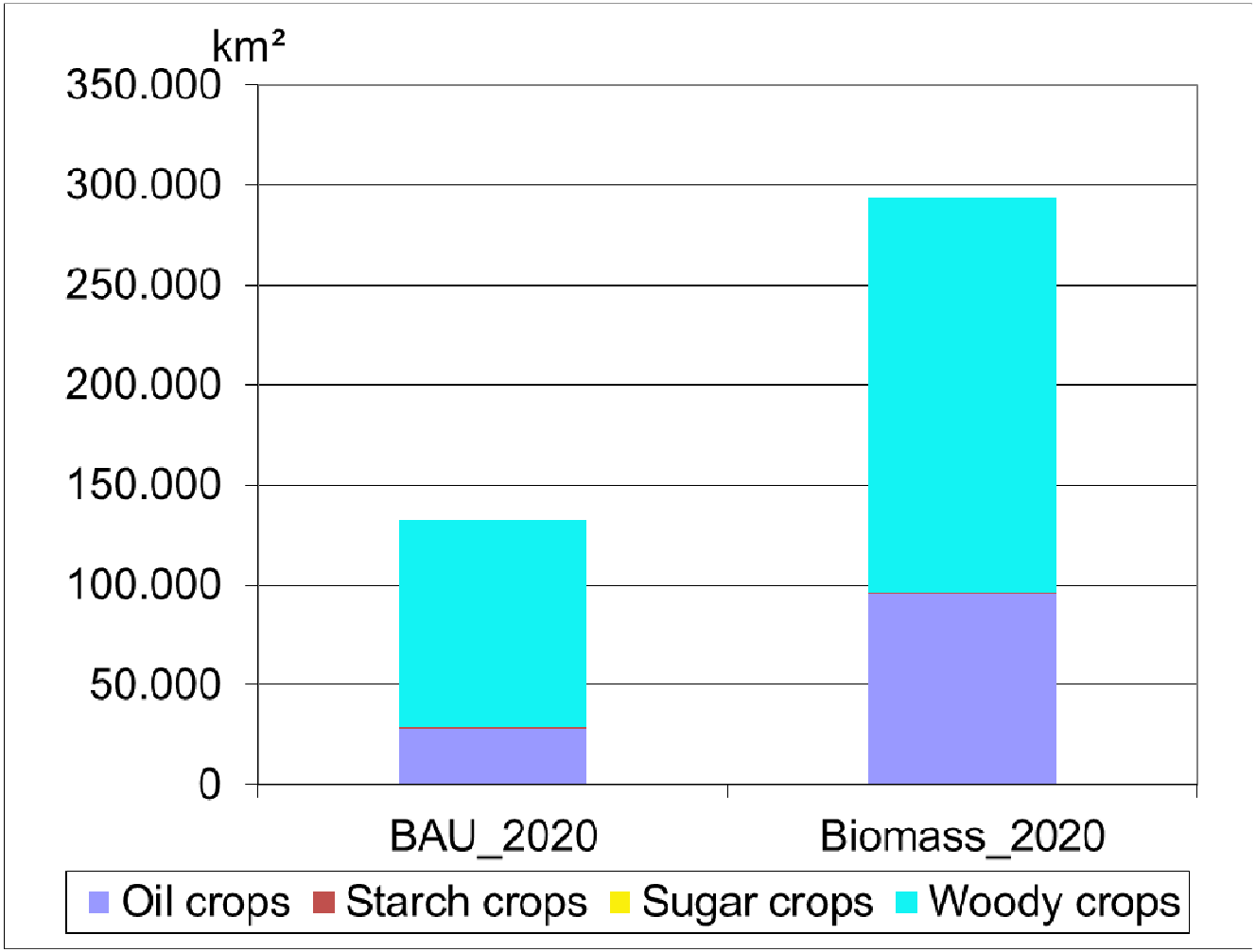
Energy Biomass Production

Demand for biomass energy (PJ) in EU-27 in 2020



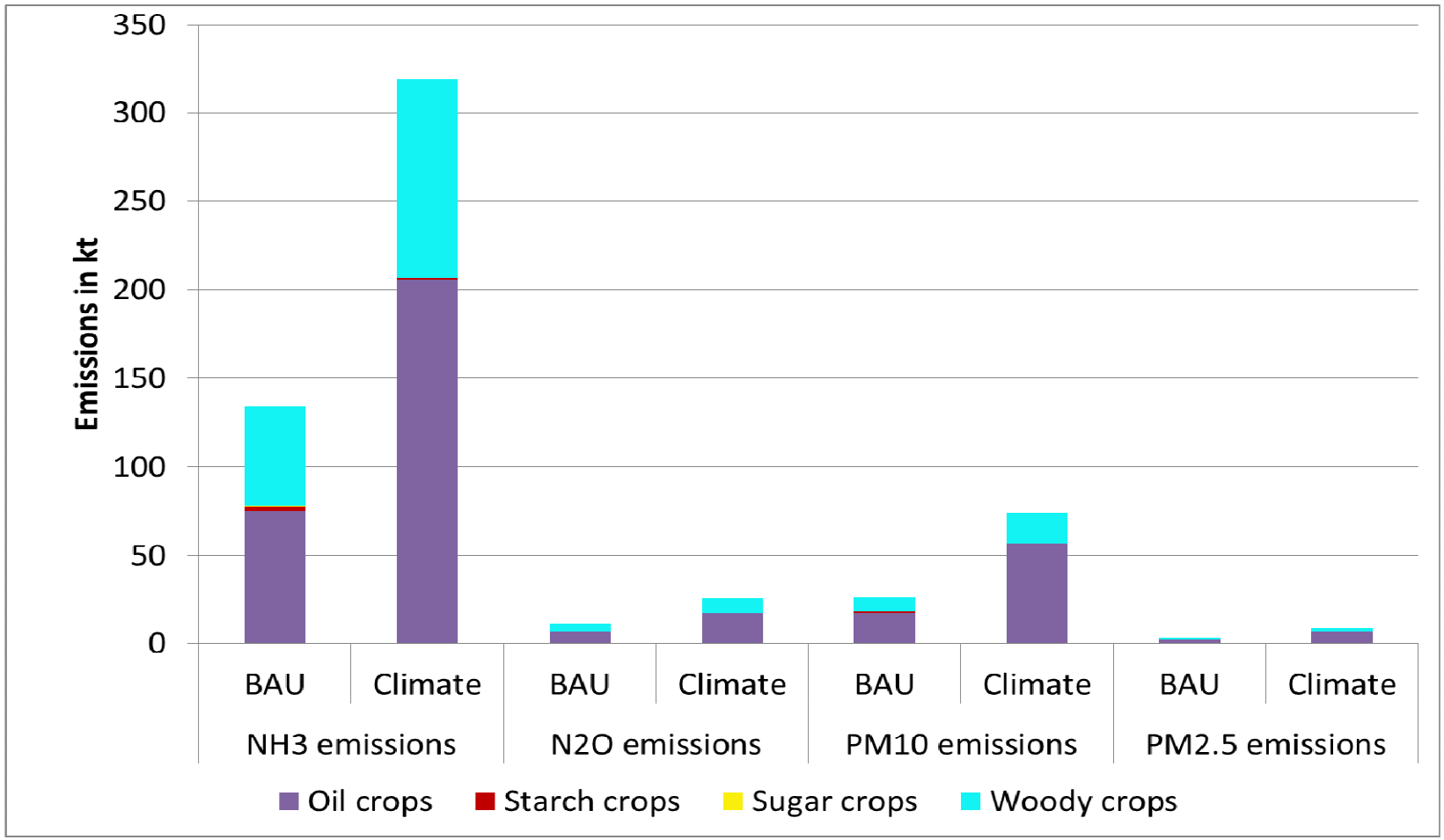
Energy Biomass Production

Land requirements (km²) in EU-27 in 2020; whole agricultural area 1,37 mio km²



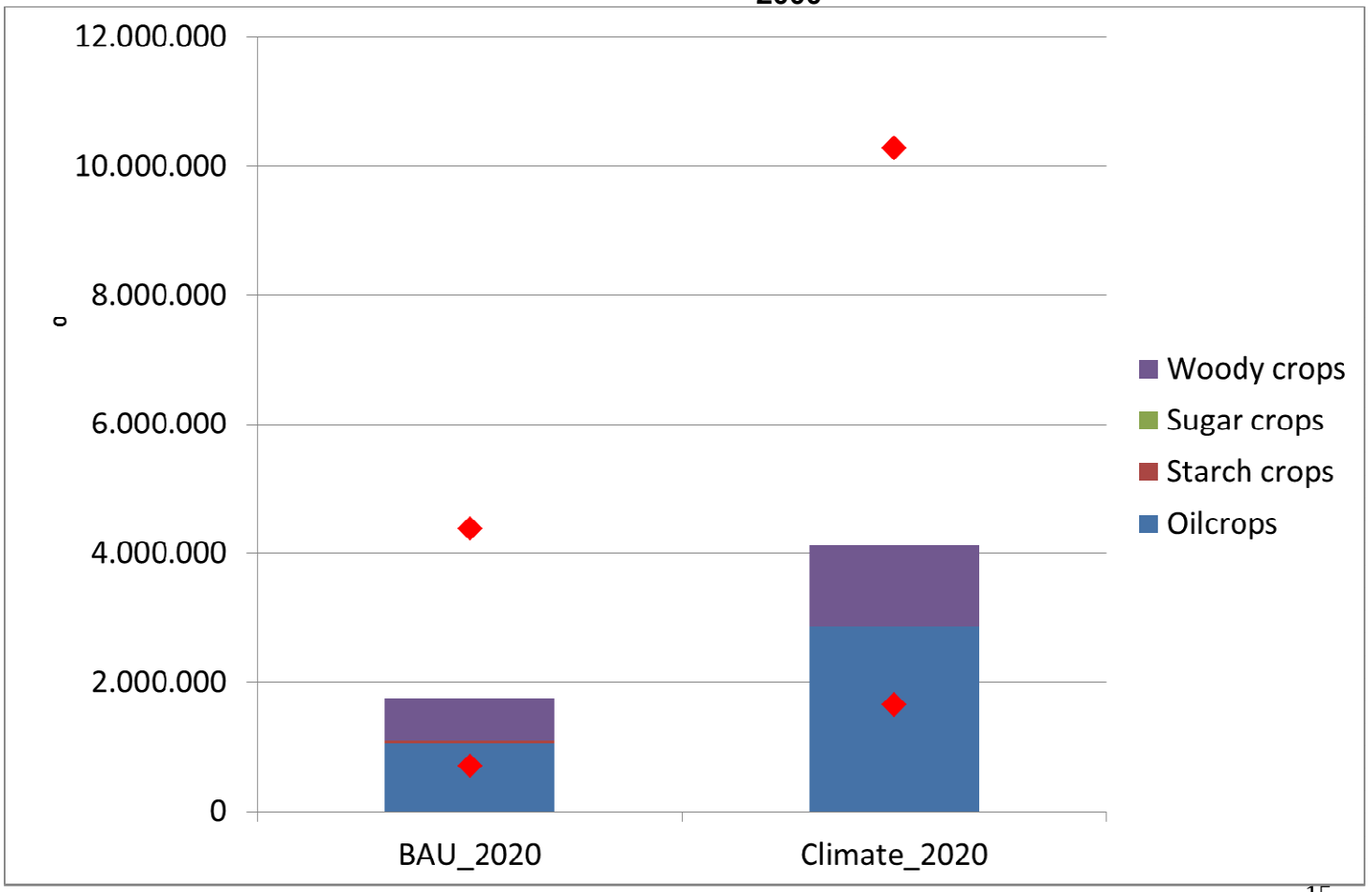
Energy Biomass Production

Emissions in kt in EU-27 in 2020



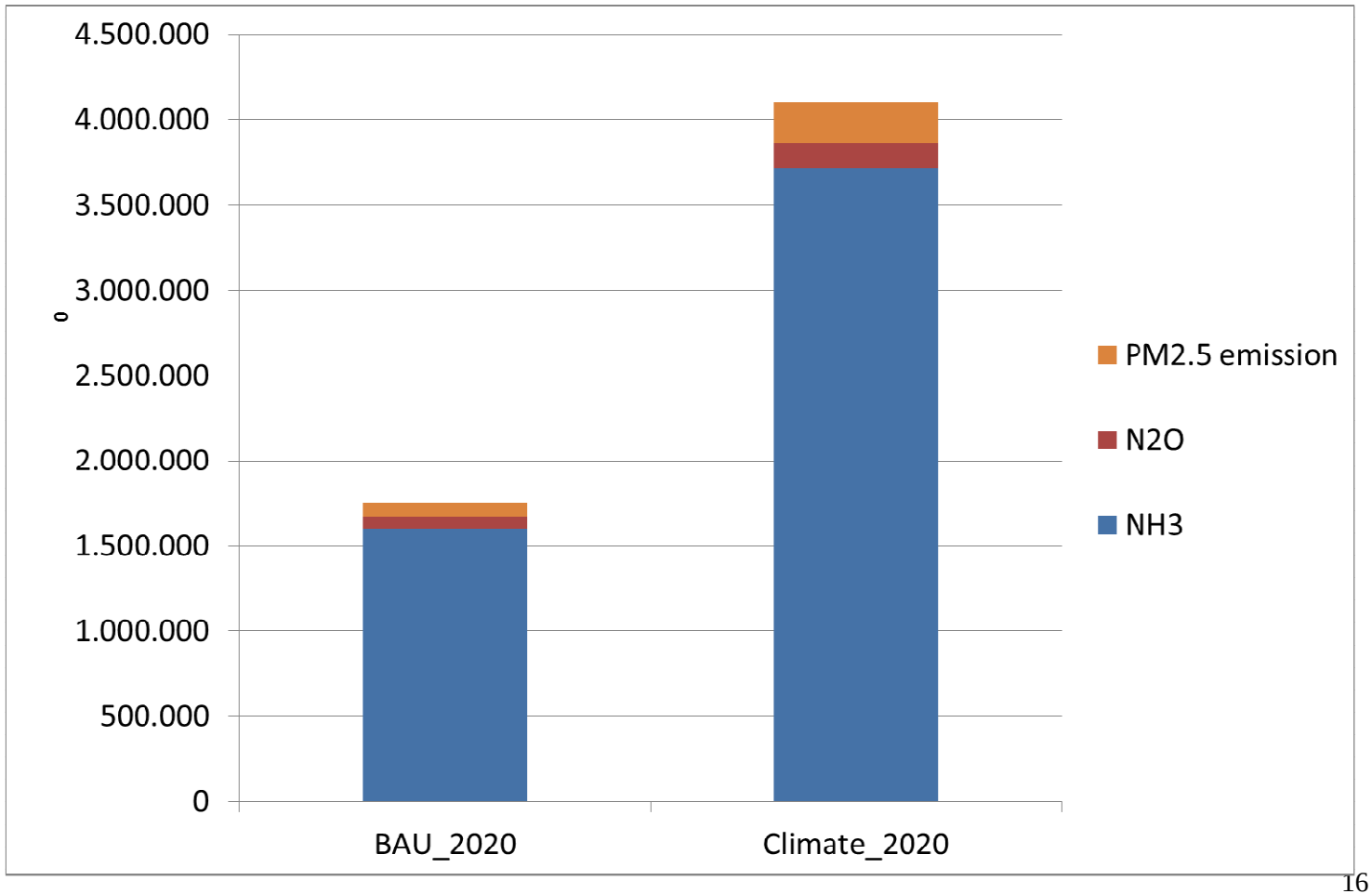
Energy Biomass Production

external costs in EU-27 (Thousand Euro$_{2000}$)



Energy Biomass Production

Biomass production: Resulting external costs in EU-27 (Thousand. Euro$_{2000}$)



Energy scenario ‚climate protection‘

450 ppm or 2° scenario (climate protection scenario):

Embedded in a worldwide emission scenario aiming at not exceeding 2° temperature increase:

Reduction of EU GHG emissions by 20% 1990-2020 (CO2 880 Mio t * 39€ = 34 billion €)

Constraints:

Share of renewable energy on final energy consumption > 20% 2020,

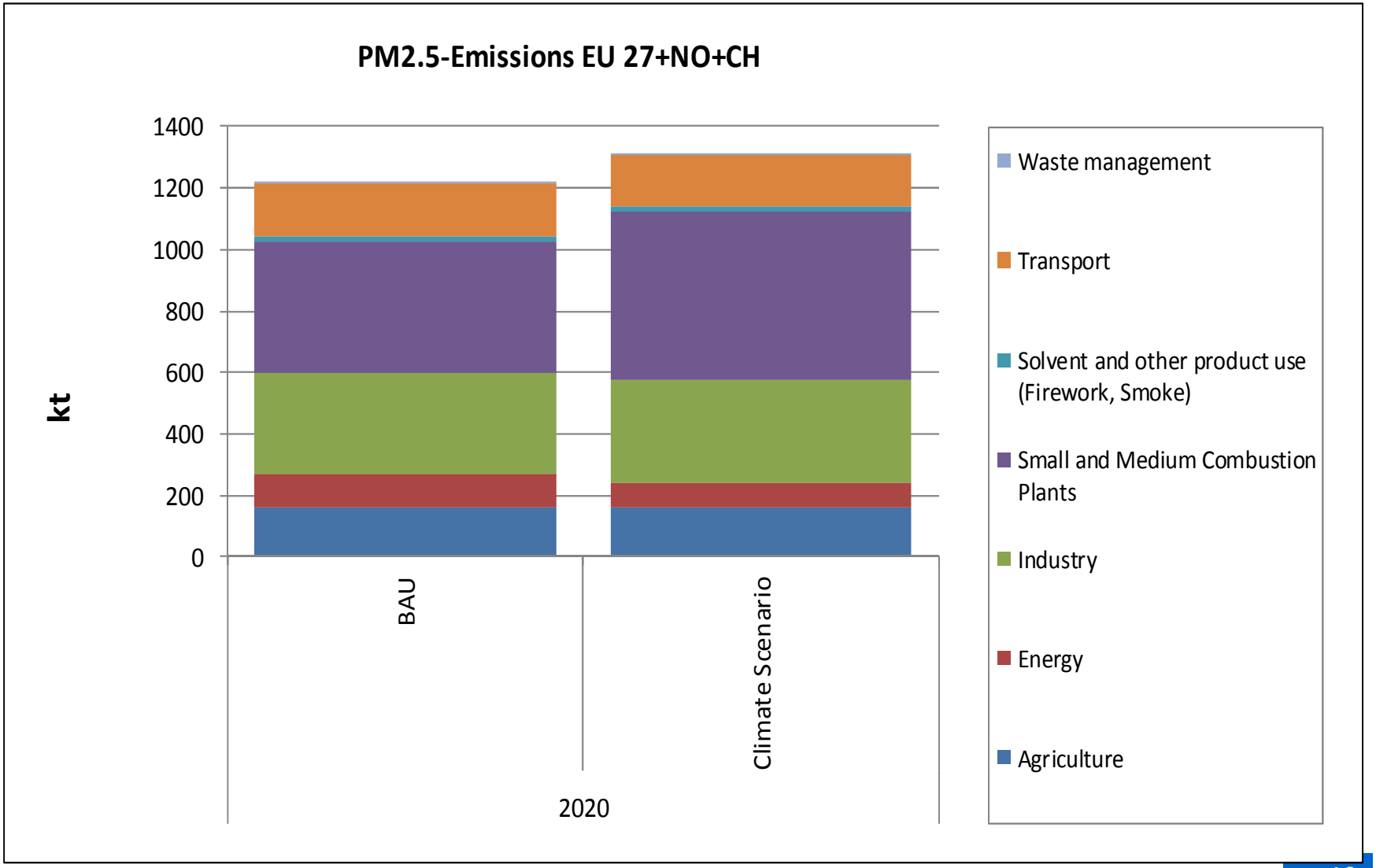
At least 10% biofuels in transport fuels 2020

Minimum market shares for electric and hybrid cars

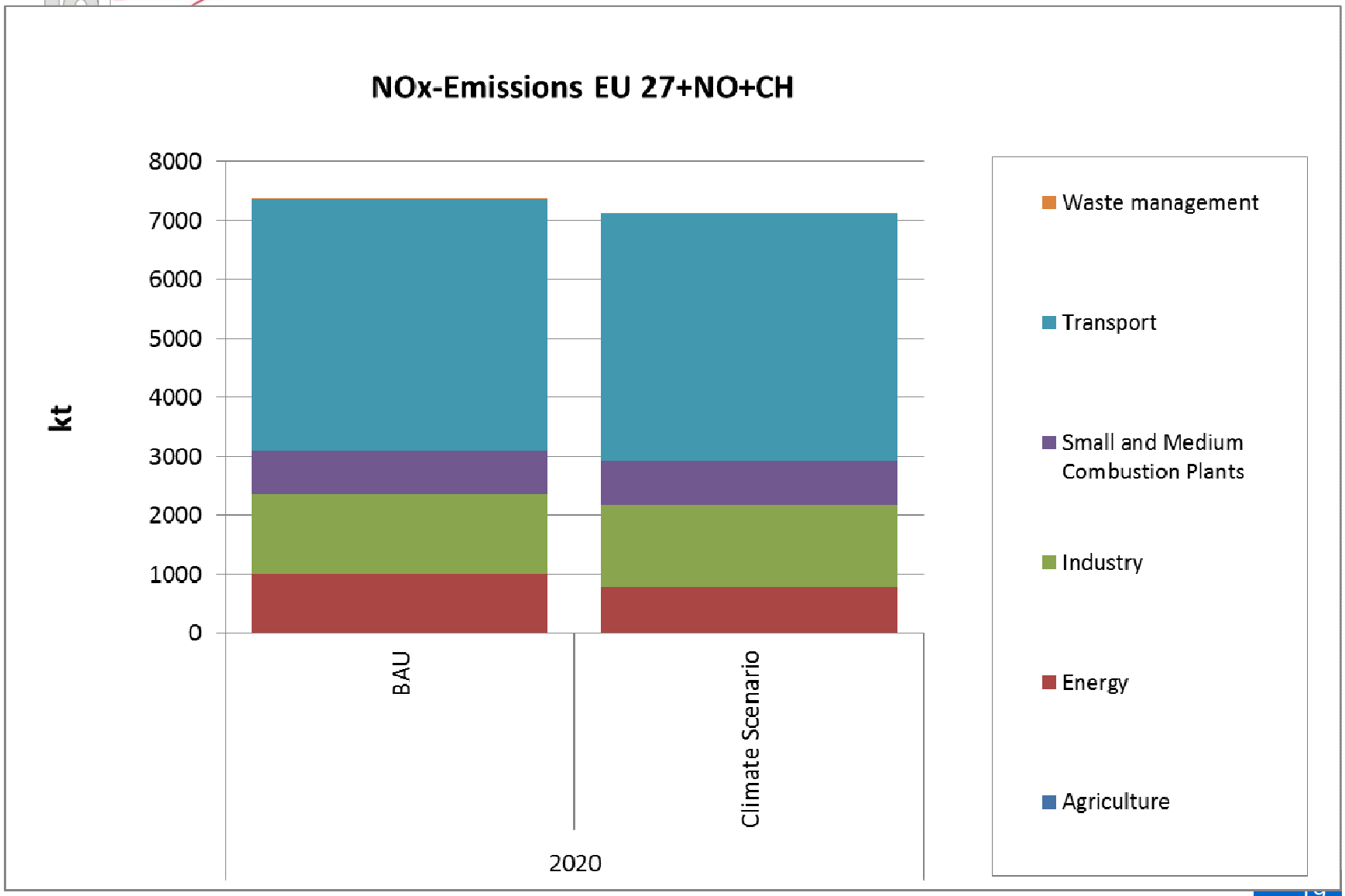
Continuation of national policies of subsidizing renewable energies (e.g. PV)

Emission trading system continues: -31.5 % 2005-2020,

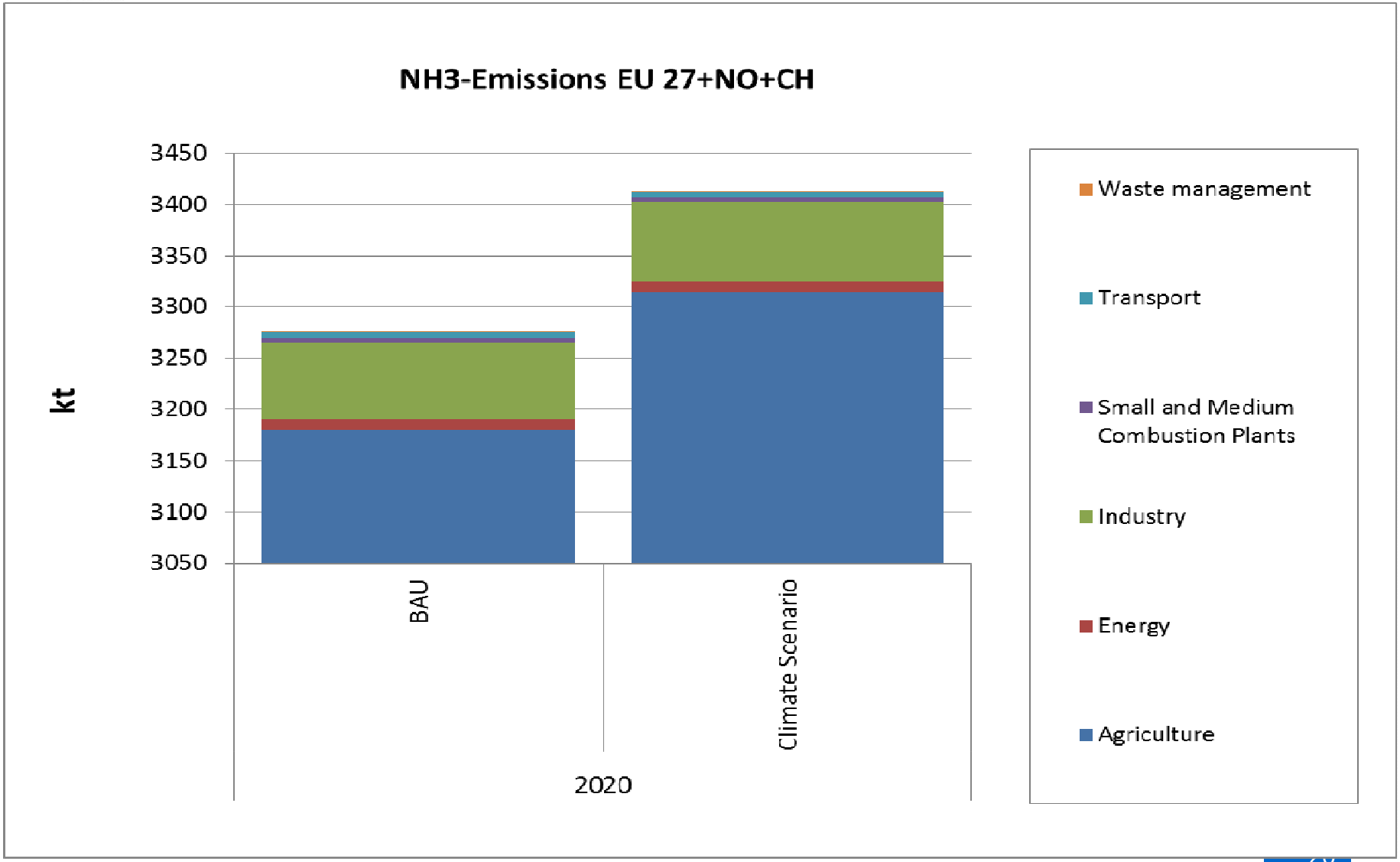
PM2.5-Emissions by Source Category for EU 29



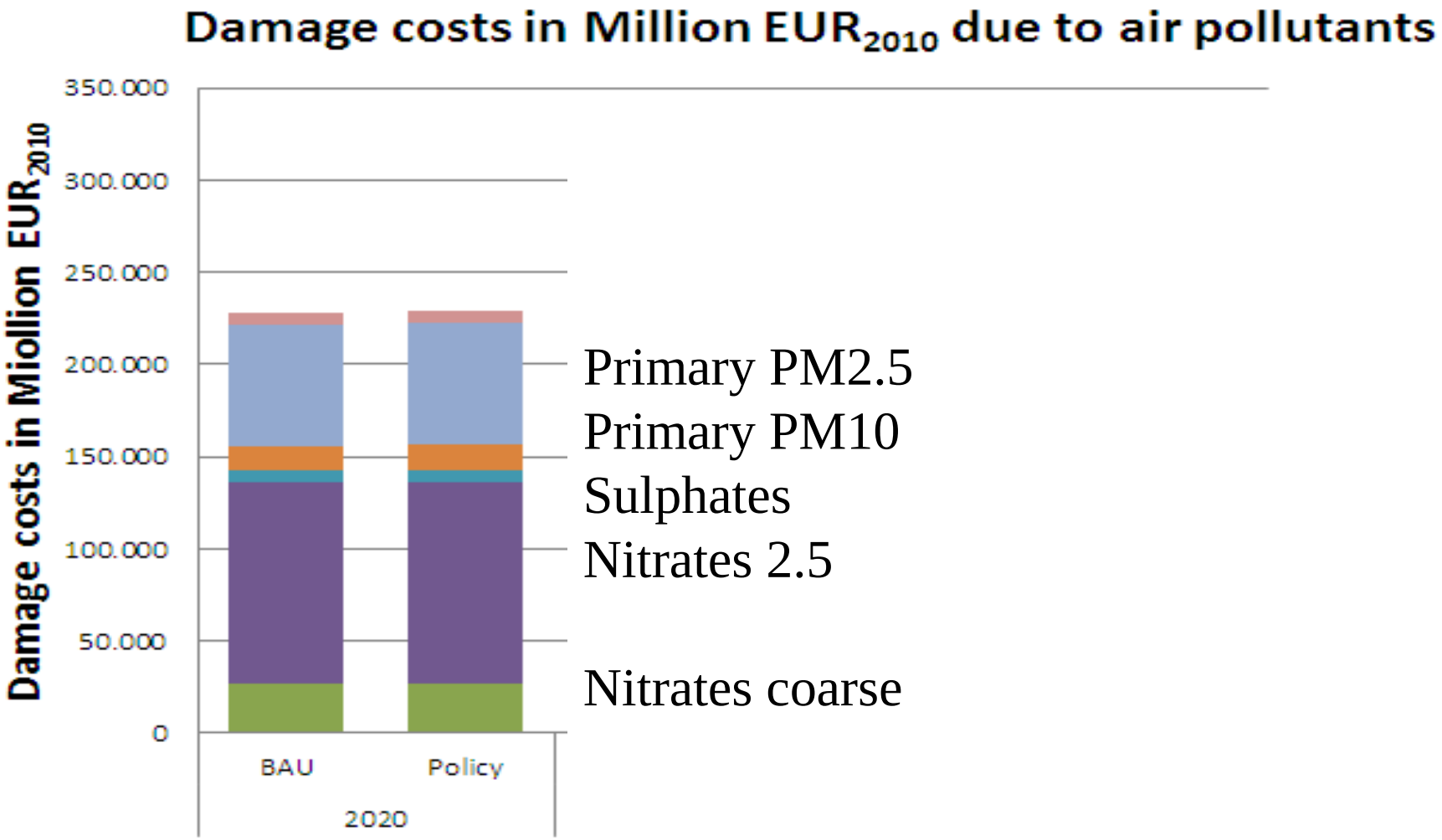
NO_x-Emissions by Source Category for EU 29



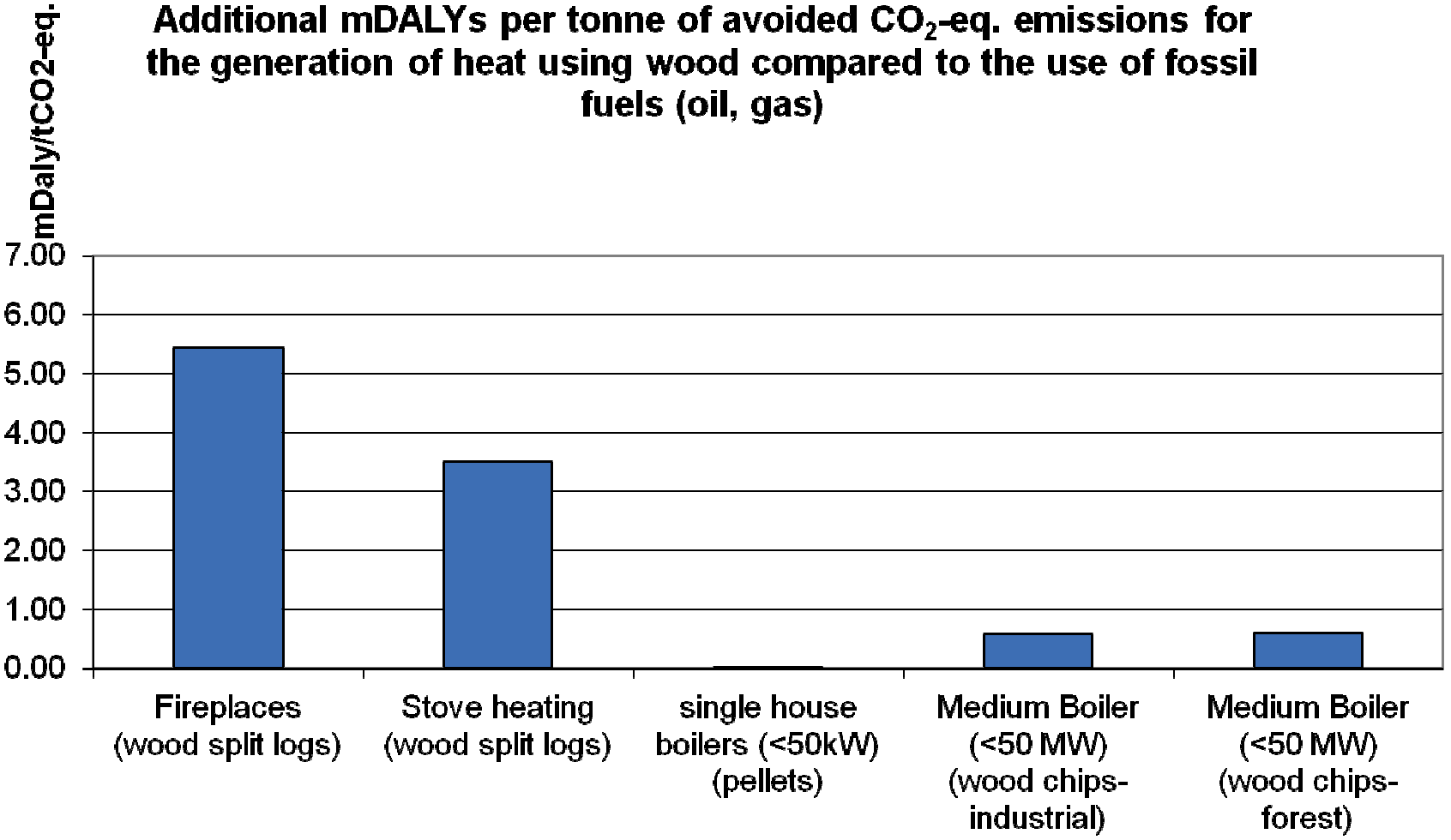
NH_3-Emissions by Source Category for EU 29 (Note: scale starts at 3000 kt)



Damage costs due to outdoor air pollutants



Additional mDALYs per tonne of avoided CO_2-eq. emissions for the generation of heat using wood compared to the use of fossil fuels (oil, gas)



Conclusions energy

- **Environmental effects as important as climate effects**
- **The Energy and Climate Policy produces considerable negative health impacts due to biomass production (mainly due to NH3) and wood burning in smaller firings (mainly due to PM).**
- **This negative effects outweigh the positive health effects of replacing fossil fuels by other renewables than biomass.**
- **However the negative effects could be reduced by using woody biomass and by burning wood in emission optimized firings (partly with particle filters**

Case study ‚pesticides‘

How important are health impacts of pesticides compared to other environmental health impacts?

Screening exercise:

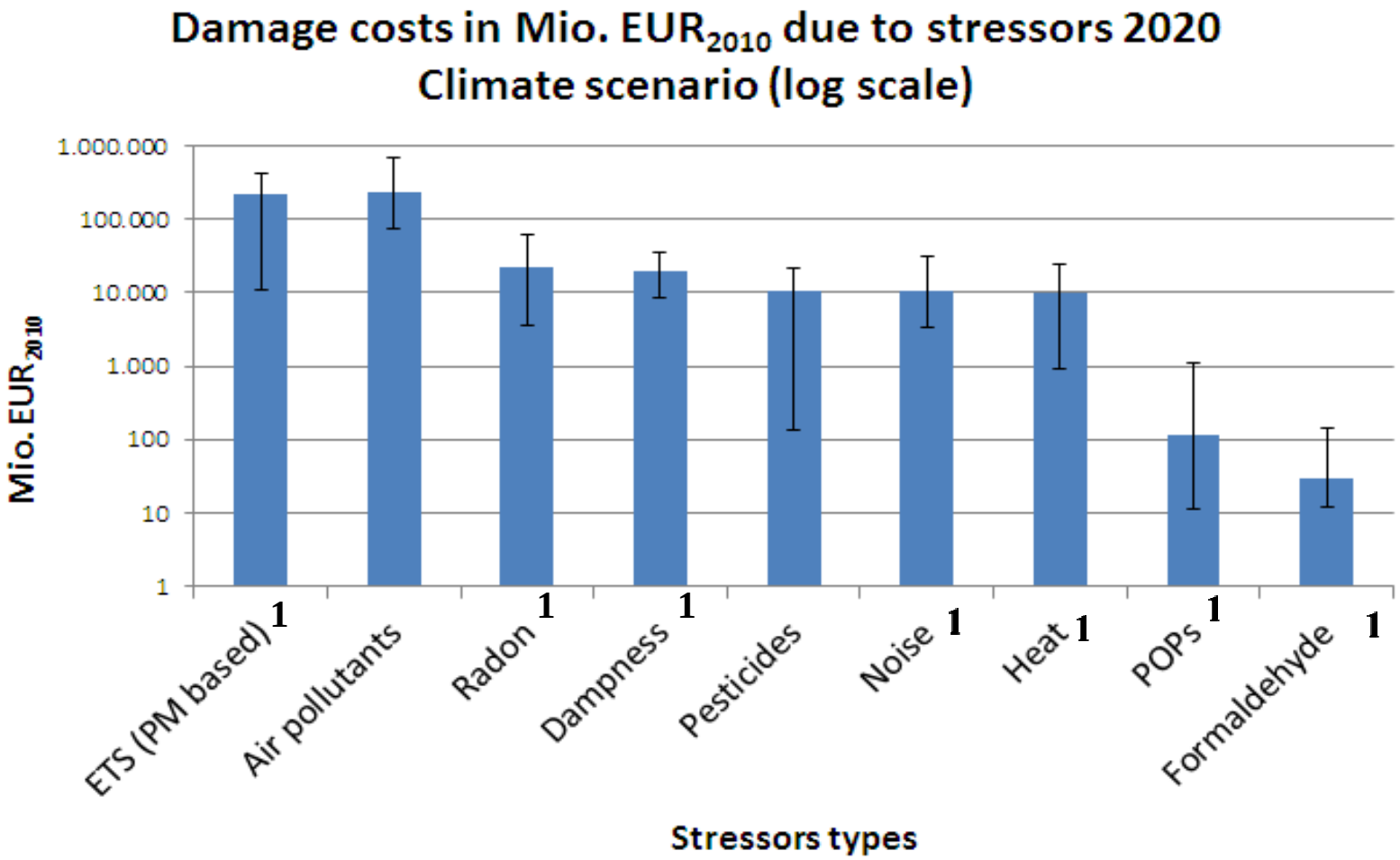
Ingestion is by far the most important health impact

Use of multimedia model to estimate damage

Dose-response relationships: carcinogenicity for selected pesticides via food (50% fatality)

Target Class	Substance Name	Slope Factor [life-time cancer risk per mg intake per kg body and day]
Fungicides	Carbendazim	0.00239
	Chlorothalonil	0.00766
	Iprodione	0.0439
Herbicides	Bromoxynil	0.103
	Isoxaflutole	0.0102
	Molinate	0.11
	Propyzamide	0.0259
	Tralkoxydim	0.0168
	Trifluralin (*only for evaluation*)	0.00293

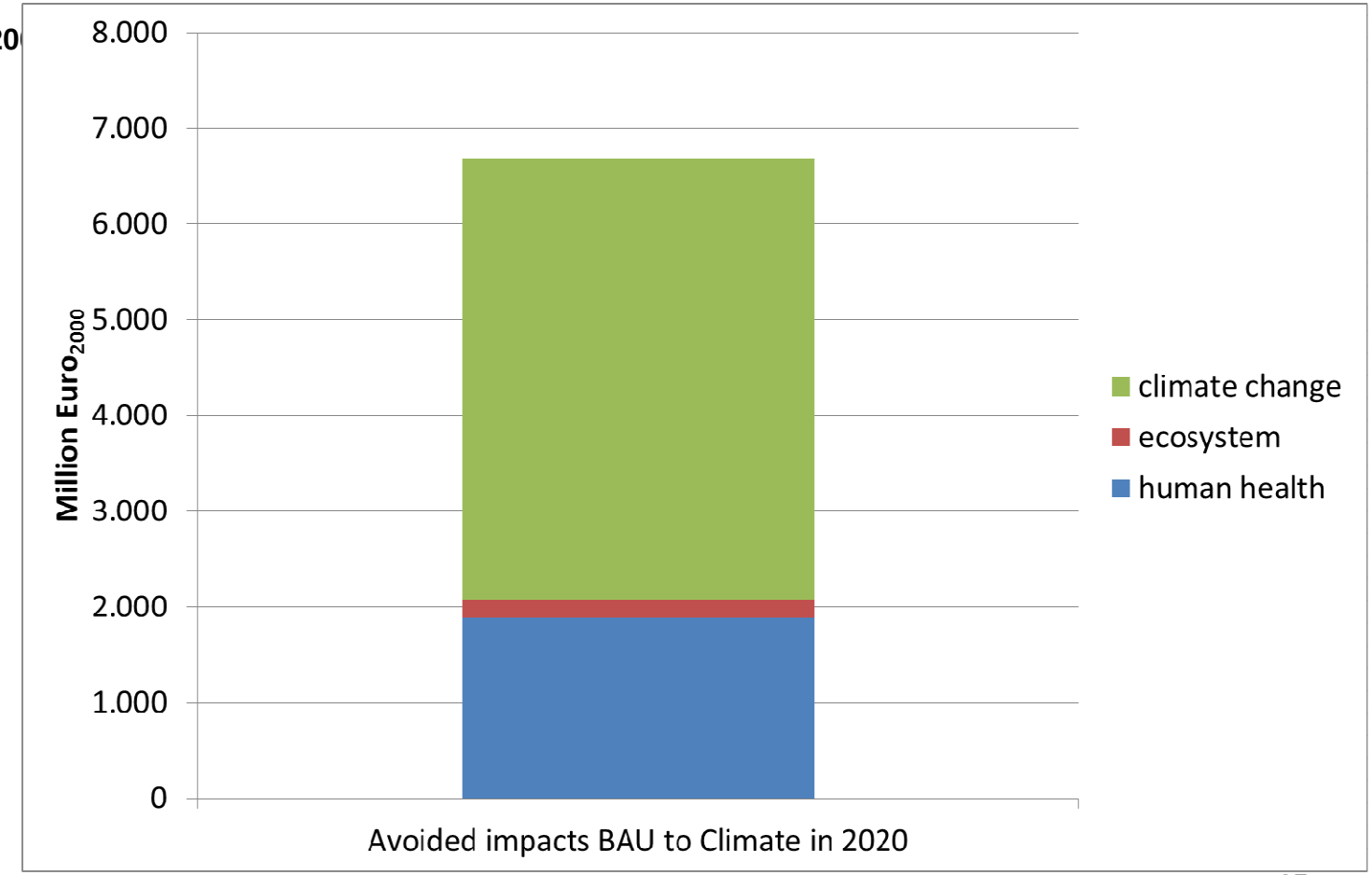
Damage costs for 2020 Climate scenario



1 Results from the HEIMTSA project

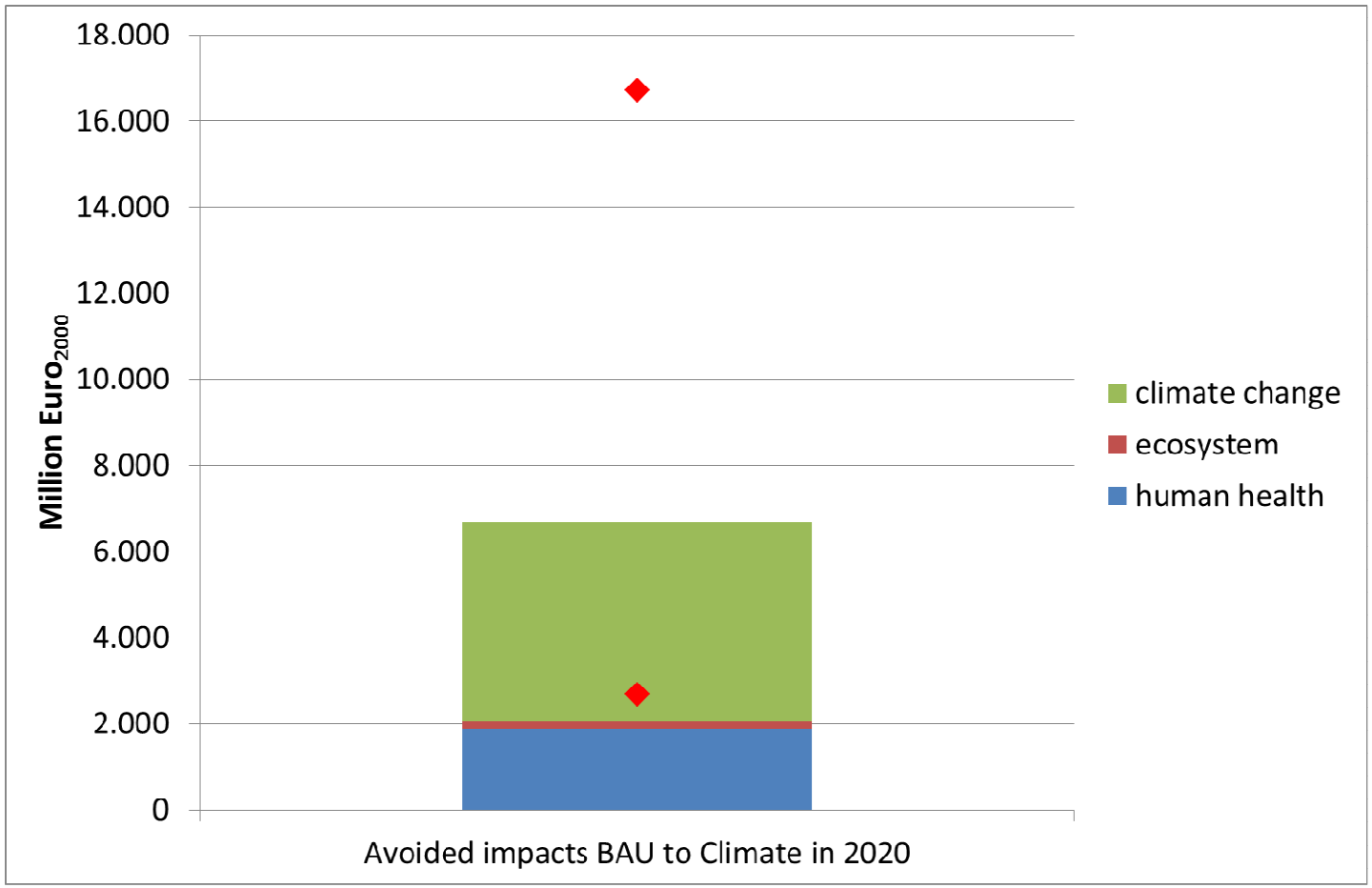
Energy policy implications on externalities

Electricity production: Resulting benefits in EU-27 in 2020 (in Mio. Euro$_{20}$



Energy policy implications on externalities

Electricity production: Resulting benefits in EU-27 in 2020 (in Mio. Euro$_{2000}$)



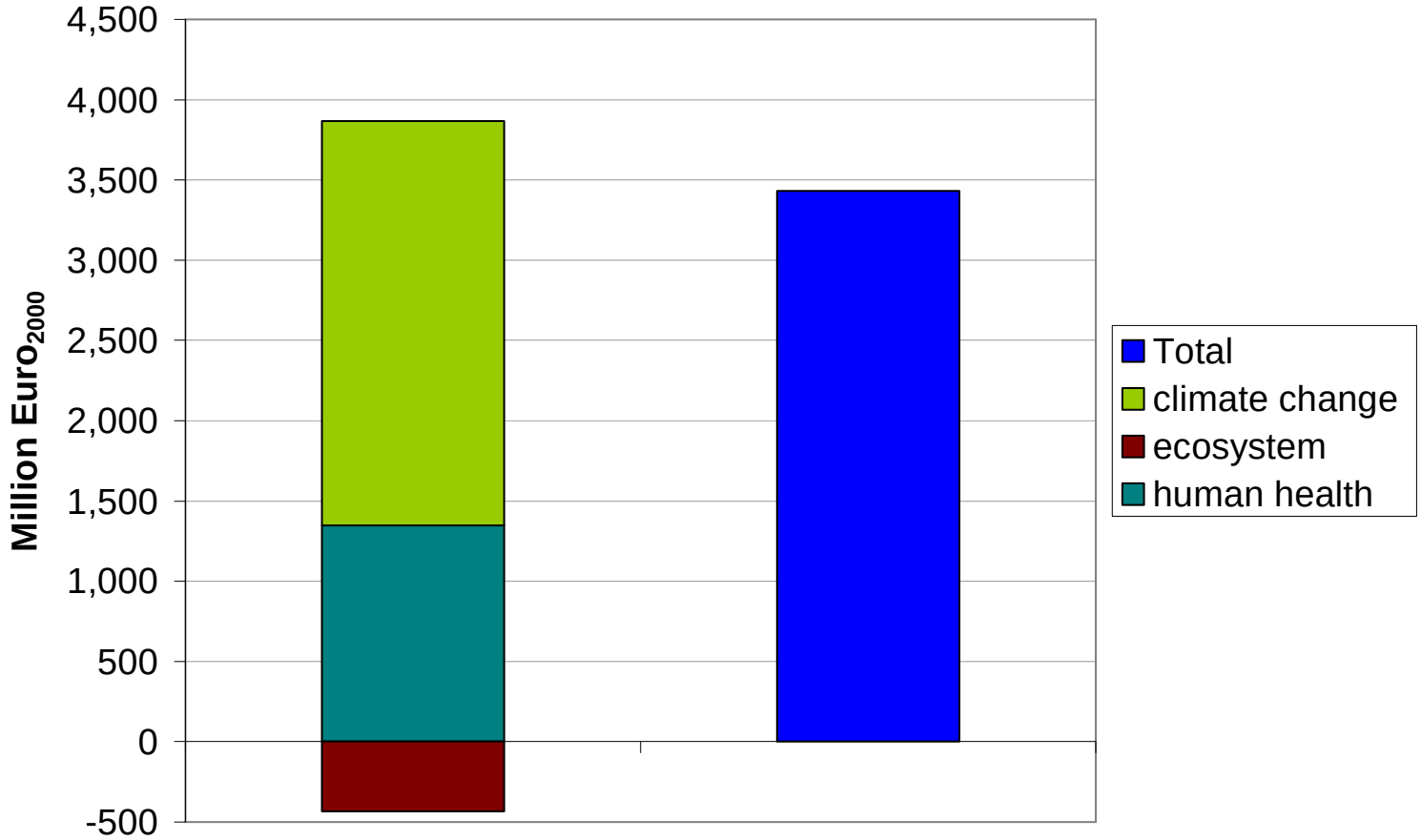
Energy policy implications on externalities

Transport:

- For **biofuel production**, the application of nutrients results in **monetised damages of about € 3.6 billion in 2020** for the EU-27.
- The **reduced production of conventional diesel and gasoline** leads to **benefits of about € 3 billion in 2020**.
- In sum, the two opposite contributions of pre-combustion activities lead to **negative impacts amount to € 0.6 billion in 2020**.
- In the **operational phase**, the changes in emissions resulting from the substitution of conventional fuels by biofuels, amount to € **4 billion in 2020.**
- In summary, the **total benefits caused by the additional use of biofuel engines** as contemplated by the Directive are about **€ 3.4 billion in 2020**, with the highest share due to climate change mitigation.

Energy policy implications on externalities

Transport: Resulting benefits in EU-27 in 2020 (in Mio. Euro$_{2000}$)



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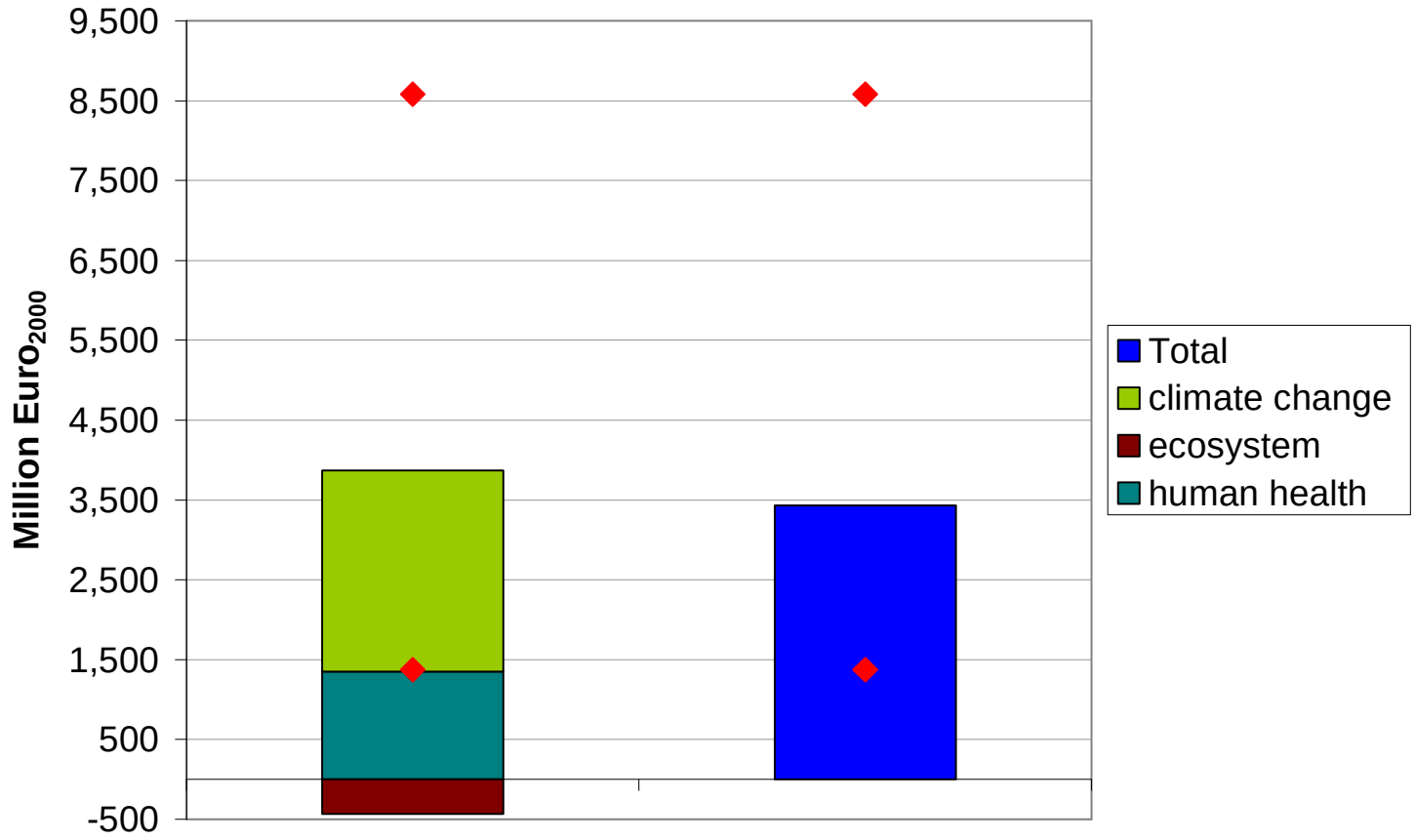
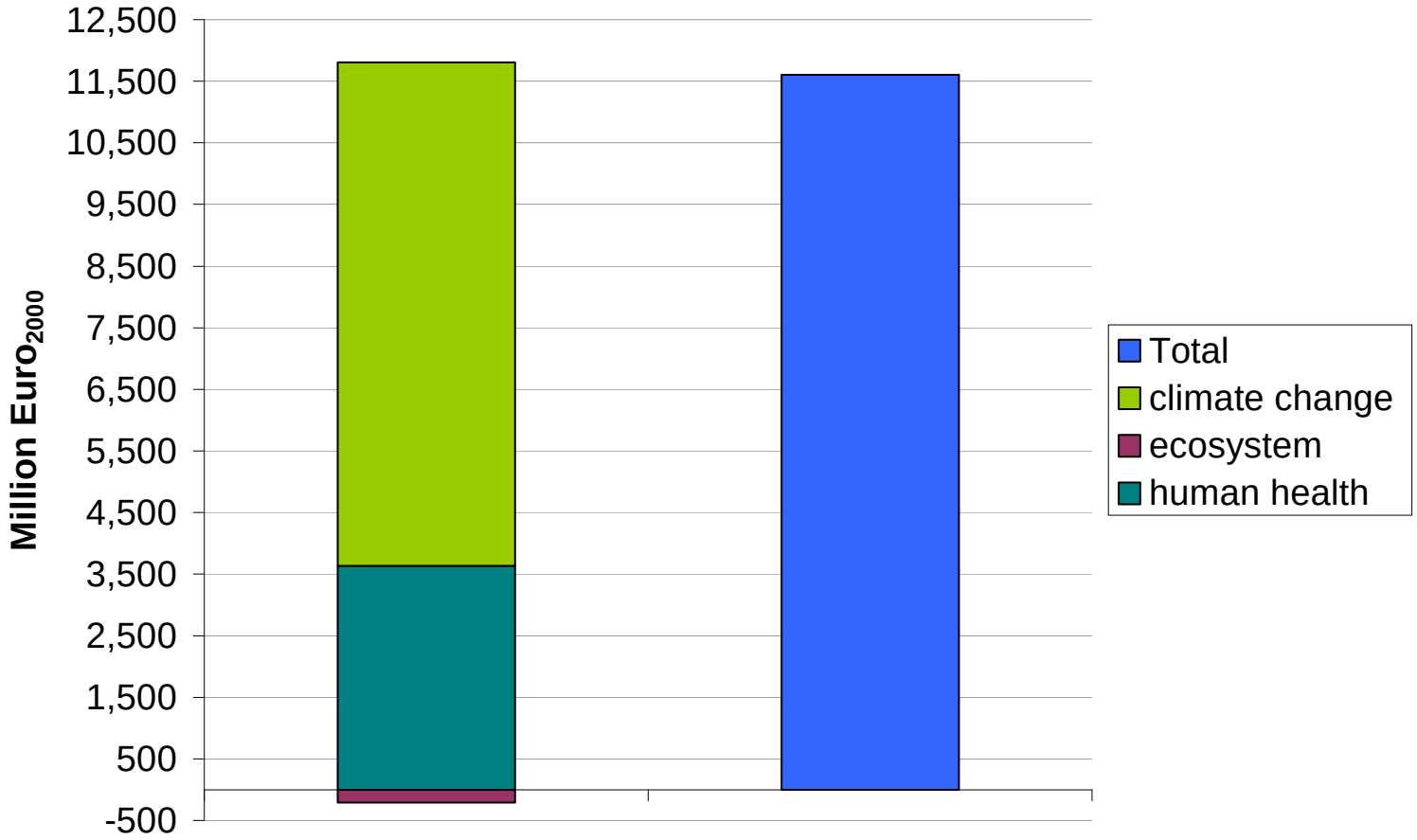


Energy policy implications on externalities

All energy related sectors: Resulting benefits in EU-27 in 2020 (in Mio. Euro$_{2000}$)



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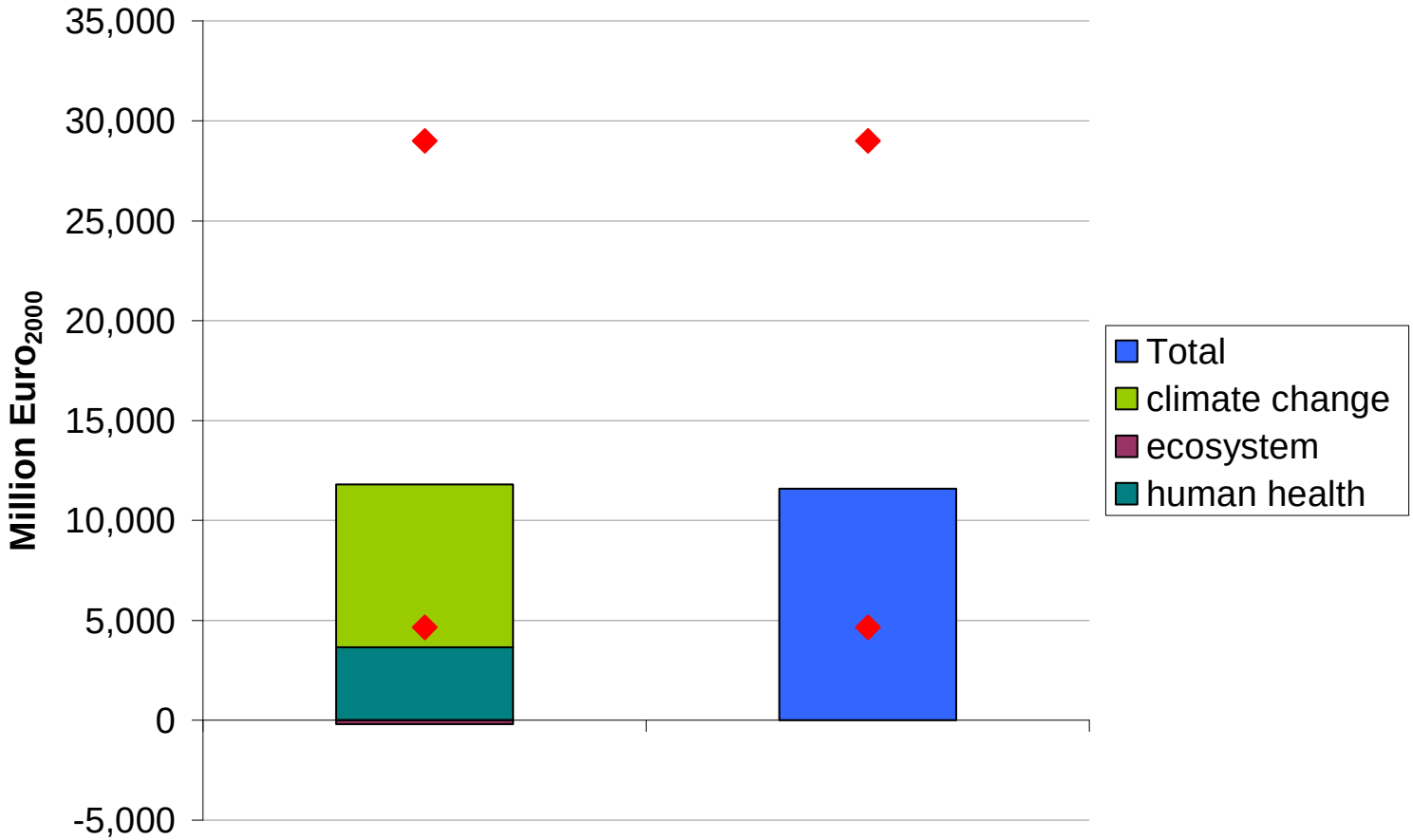

Some general conclusions

- **Environmental impact assessment using the ‚ExternE/Exiopol‘ method ready to assess the environmental performance of policies and projects especially with regard to health impacts;**

- **Further research: better estimation and assessment of biodiversity changes; for PM assessment:: exposure – reponse relationships with regard to PM species, number**