CASES –

Assessment of External Costs per kWh_{el} of Different Technologies

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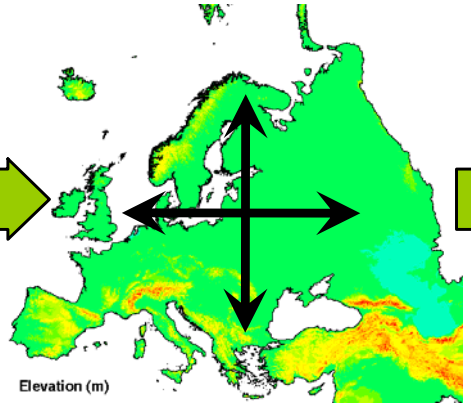
Presentation Outline

- **How to calculate external costs:**
→ Impact Pathway Approach (IPA) implemented in EcoSenseWebV1.3 computer tool
- **Results: Aggregated damage: [Euro per ton] of release**
- **External Costs [Euro-Cent per kWh] at present & 2030**
- **Difference present to 2030 – Ranking**
- **Conclusions**

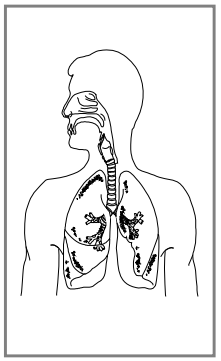
Impact Pathway Approach (IPA)

Emission

Transport and Chemical Transformation



Damage



Monetary Evaluation

Online Computer Tool for Calculating Damages According to the IPA

http://EcoSenseWeb.ier.uni-stuttgart.de

EcoSenseWeb

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OVERVIEW | STRUCTURE | EXAMPLE | I/O DATA | HOW TO GET

OVERVIEW

EcoSenseWeb is an integrated atmospheric dispersion and exposure assessment model which implements the Impact Pathway Approach developed within ExternE . It was designed for the analysis of single point sources (electricity and heat production) in Europe but it can also be used for analysis of multi emission sources in certain regions.
EcoSense was developed to support the assessment of priority impacts resulting from the exposure to airborne pollutants, namely impacts on human health, crops, building materials and ecosystems. The current version of EcoSenseWeb, covers the emission of 'classical' pollutants SO2, NOx, primary particulates, NMVOC, NH3, as well as some of the most important heavy metals. It includes also damage assessment due to emission of greenhouse gases. Impacts of 'classical' pollutants are calculated on different spatial scales, i.e. local (50 km around the emission source), regional (Europe-wide) and (northern) hemispheric scale.
The version EcoSenseWeb has a web-based user interface and was developed within the European Commission projects NEEDS and CASES.

The EcoSenseWeb and the calculation of external costs follow as far as possible the so called Impact Pathway Approach (IPA). The IPA, a bottom-up approach, is depicted in Figure 1. The IPA starts with the emission of a pollutant at the location of the source into the environment; models its dispersion and chemical transformation in the different environmental media; identifies the exposure of the receptors and calculates the related impacts which then are aggregated to external costs.

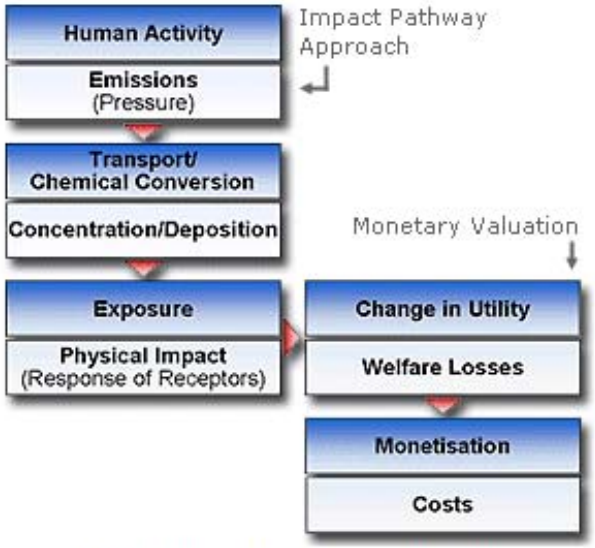
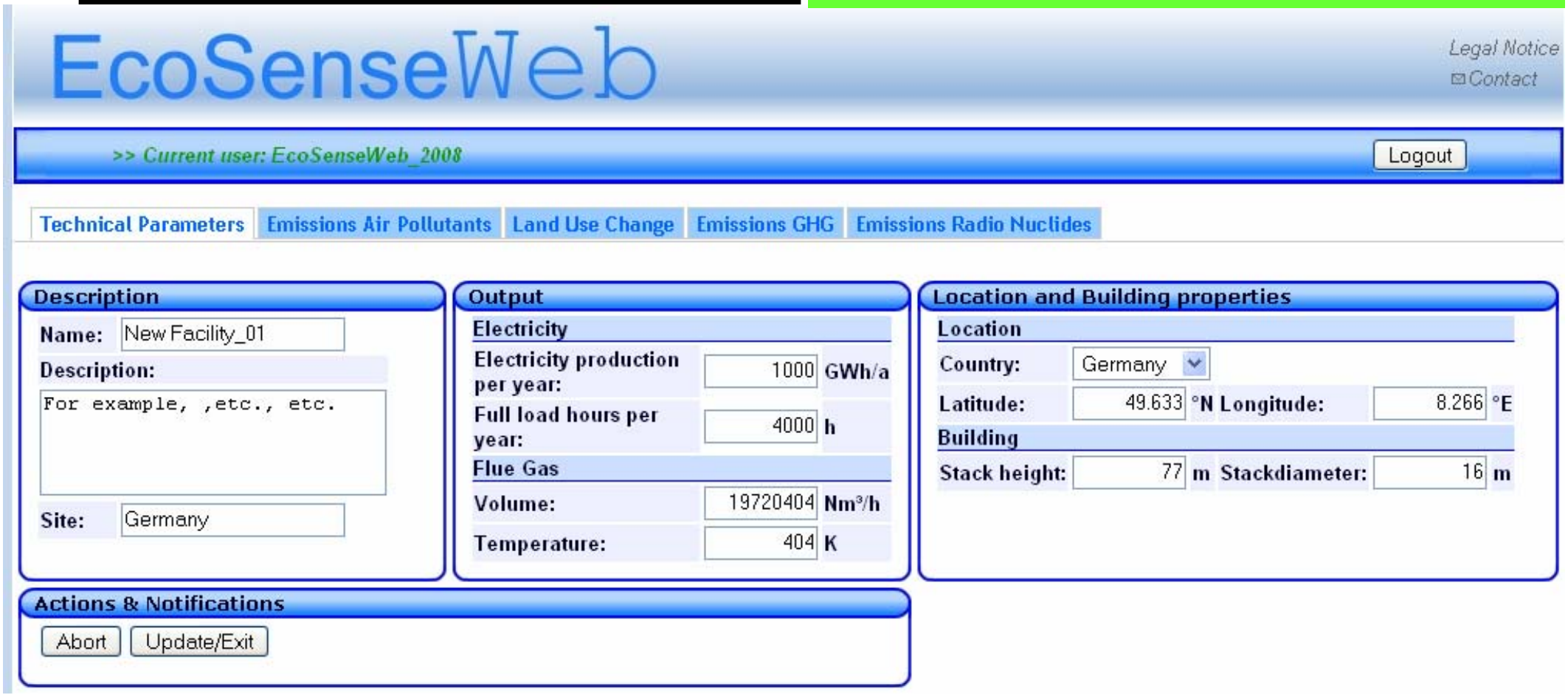


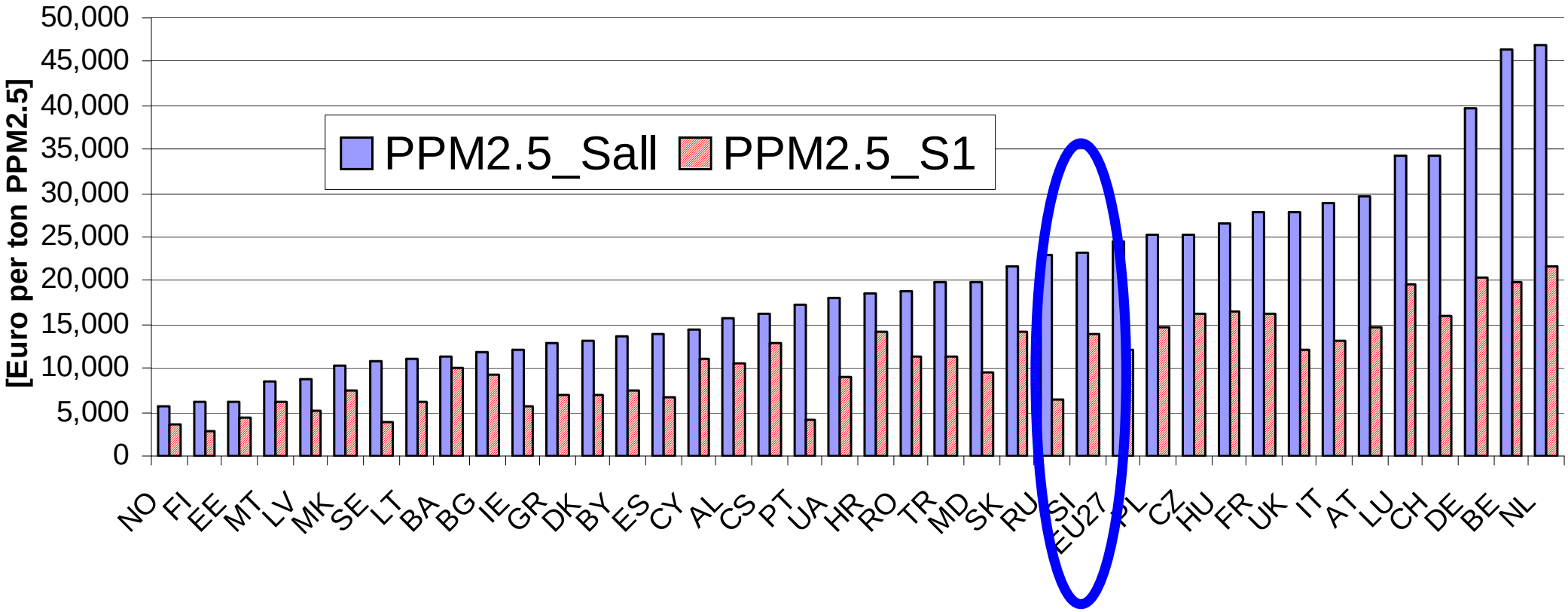
Fig. 1: Impact Pathway Approach.

http://EcoSenseWeb.ier.uni-stuttgart.de

How does it work?



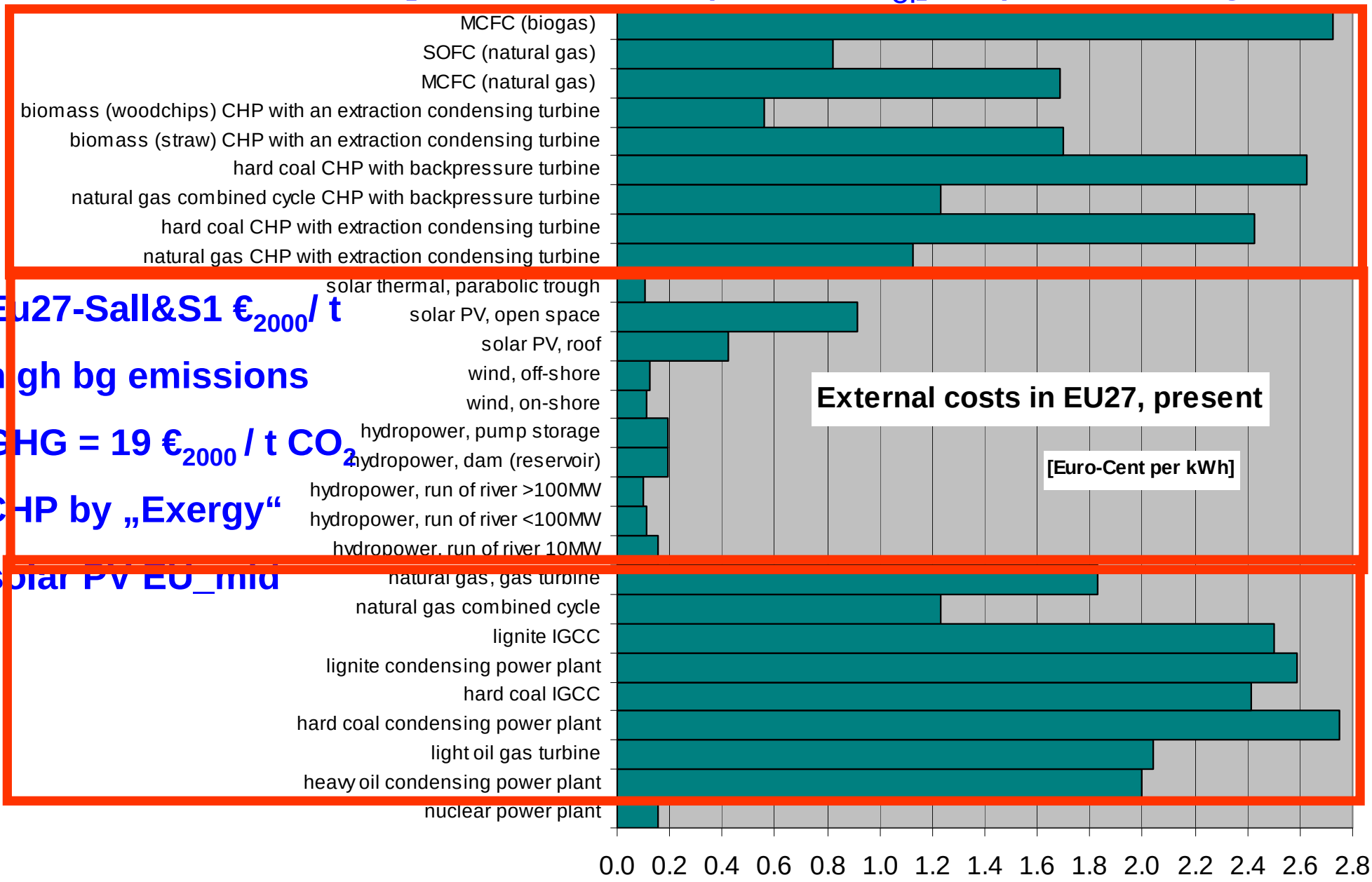
Aggregated results: Human Health - per ton PPM2.5 Emissions from "All Sectors" vs. "High Stacks (S1)"



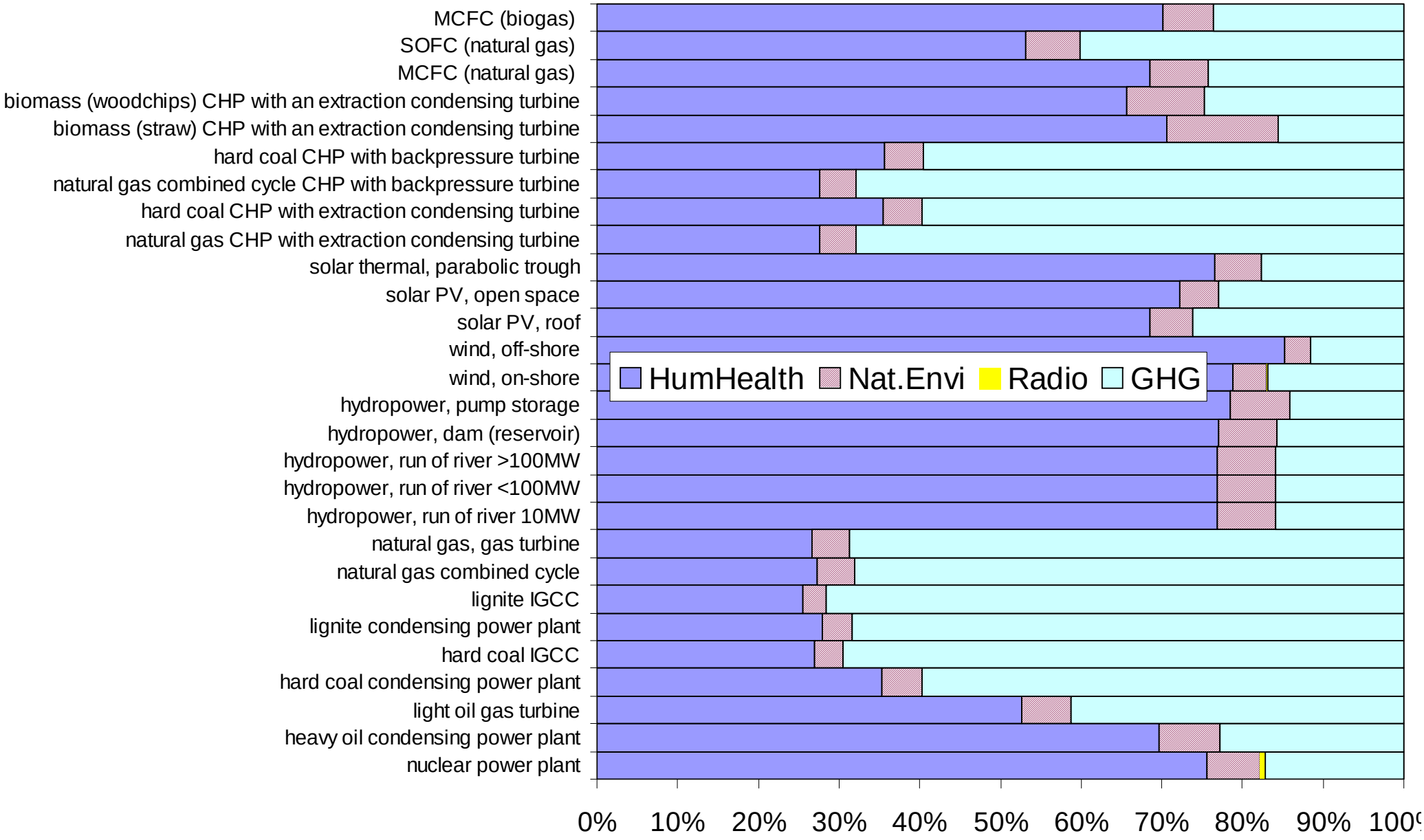
Aggregated results: Human Health per ton SO_2 (all sectors; average met.) present and future bg emission

Total External Costs [Euro-Cent$_{2000}$ per kWh$_{el}$] at present b.ground

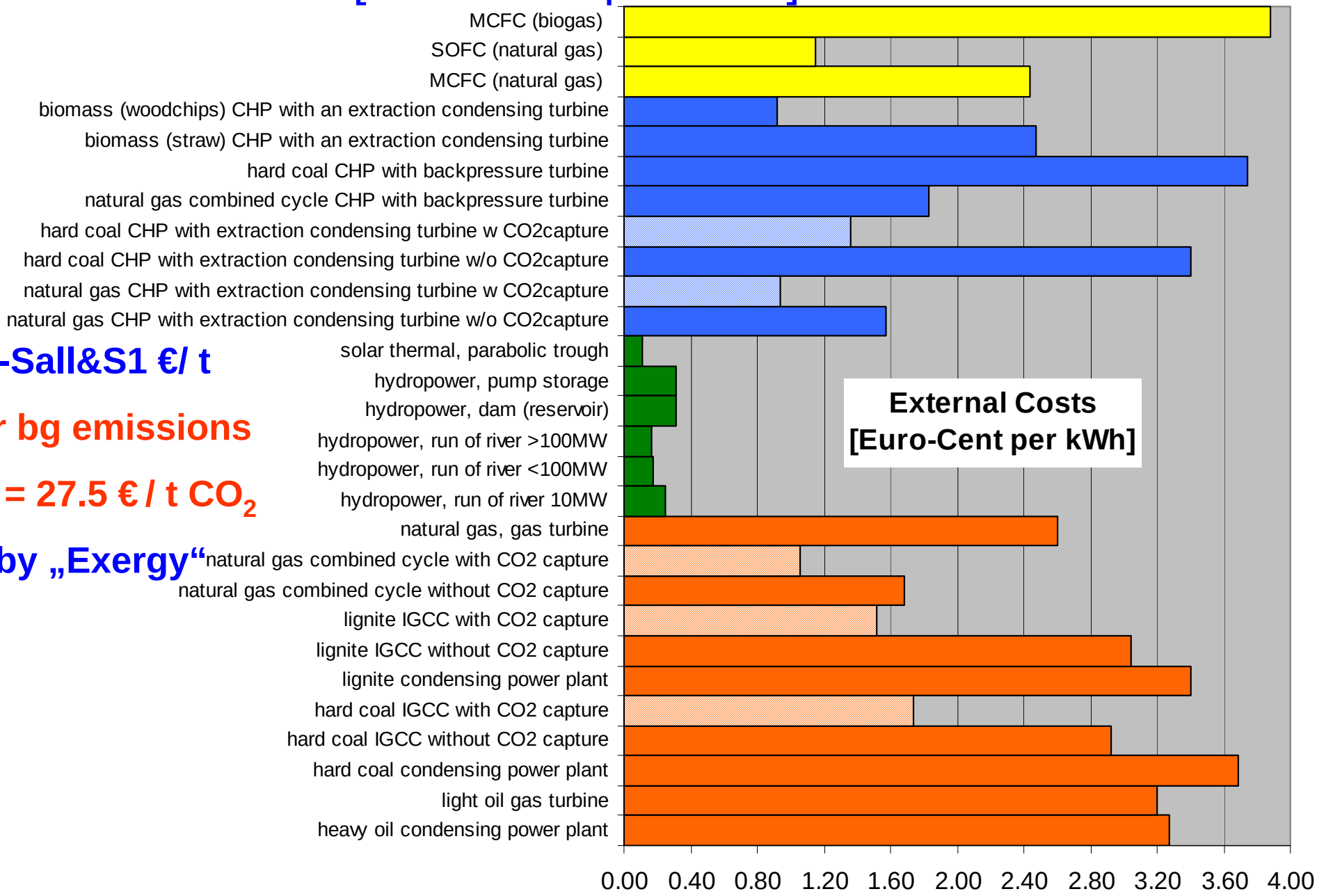
- ✓ Eu27-Sall&S1 €$_{2000}$/ t
- ✓ high bg emissions
- ✓ GHG = 19 €$_{2000}$ / t CO_2
- ✓ CHP by „Exergy“
- ✓ solar PV EU_mid



Shares of Different Categories – at present, GHG at 19 Euro / ton of CO_2

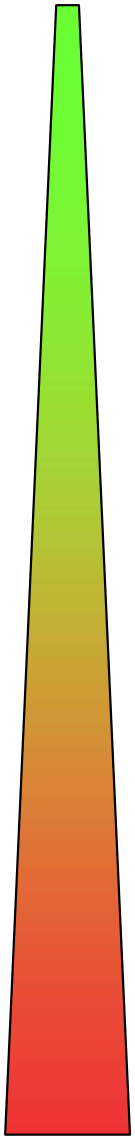


Total External Costs [Euro-Cent per kWh] in 2030



- ✓ **Eu27-Sall&S1 €/ t**
- ✓ **lower bg emissions**
- ✓ **GHG = 27.5 € / t CO_2**
- ✓ **CHP by „Exergy“**

Ranking of Technologies at Present and 2030



Future - 2030	Present
solar thermal, parabolic trough	hydropower, run of river >100MW
hydropower, run of river >100MW	solar thermal, parabolic trough
hydropower, run of river <100MW	hydropower, run of river <100MW
hydropower, run of river 10MW	hydropower, run of river 10MW
hydropower, dam (reservoir)	hydropower, dam (reservoir)
hydropower, pump storage	hydropower, pump storage
biomass (woodchips) CHP with an extraction condensing turbine	biomass (woodchips) CHP with an extraction condensing turbine
SOFC (natural gas)	SOFC (natural gas)
natural gas CHP with extraction condensing turbine w/o CO2capture	natural gas CHP with extraction condensing turbine
natural gas combined cycle without CO2 capture	natural gas combined cycle CHP with backpressure turbine
natural gas combined cycle CHP with backpressure turbine	natural gas combined cycle
MCFC (natural gas)	MCFC (natural gas)
biomass (straw) CHP with an extraction condensing turbine	biomass (straw) CHP with an extraction condensing turbine
natural gas, gas turbine	natural gas, gas turbine
hard coal IGCC without CO2 capture	heavy oil condensing power plant
lignite IGCC without CO2 capture	light oil gas turbine
light oil gas turbine	hard coal IGCC
heavy oil condensing power plant	hard coal CHP with extraction condensing turbine
lignite condensing power plant	lignite IGCC
hard coal CHP with extraction condensing turbine w/o CO2capture	lignite condensing power plant
hard coal condensing power plant	hard coal CHP with backpressure turbine
hard coal CHP with backpressure turbine	MCFC (biogas)
MCFC (biogas)	hard coal condensing power plant

Summary

- **The methodology estimates effects of technologies for energy conversion and assesses them based on preferences of the effected population for a large number of impact pathways.**
- **The methodology is already widely used for decision aid in the fields of energy conversion, transport and environmental protection.**
- **Gaps and uncertainties exist, however will be more and more reduced due to ongoing research (e.g. on dispersion models, pathways involving further toxic substances, heavy metals, biodiversity, water and soil contamination…)**
- **The presented values are based on average emission data.**
  Country specific values, e.g. for solar power can be calculated if LCI data is adjusted, and location of emissions is used for assessment.
- **More information**
  ExternE: www.ExternE.info
  EcoSenseWeb: http://EcoSenseWeb.ier.uni-stuttgart.de

Thank you for Your Attention !