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ecoinvent Centre

Swiss Centre for Life Cycle Inventories

Wir schaffen Wissen – heute für morgen

Electricity technologies in version 3 of the ecoinvent database: modeling and results

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Electricity generation: country specific technology datasets for 50 countries

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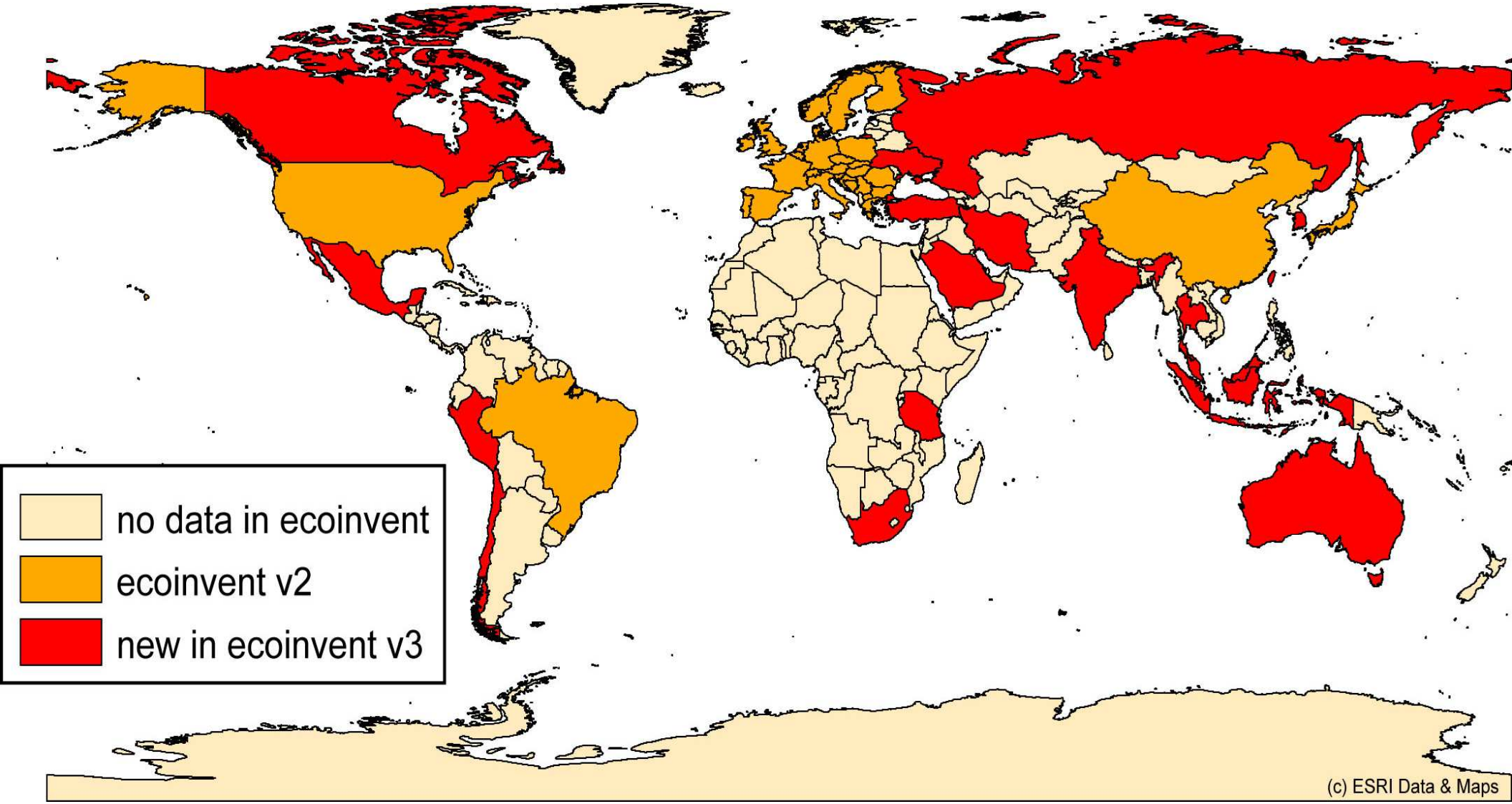
Coverage

v2: 32 countries – ca. 65% of 2004 worldwide electricity production

v3: 50 countries – ca. 83% of 2008 worldwide electricity production



Technologies

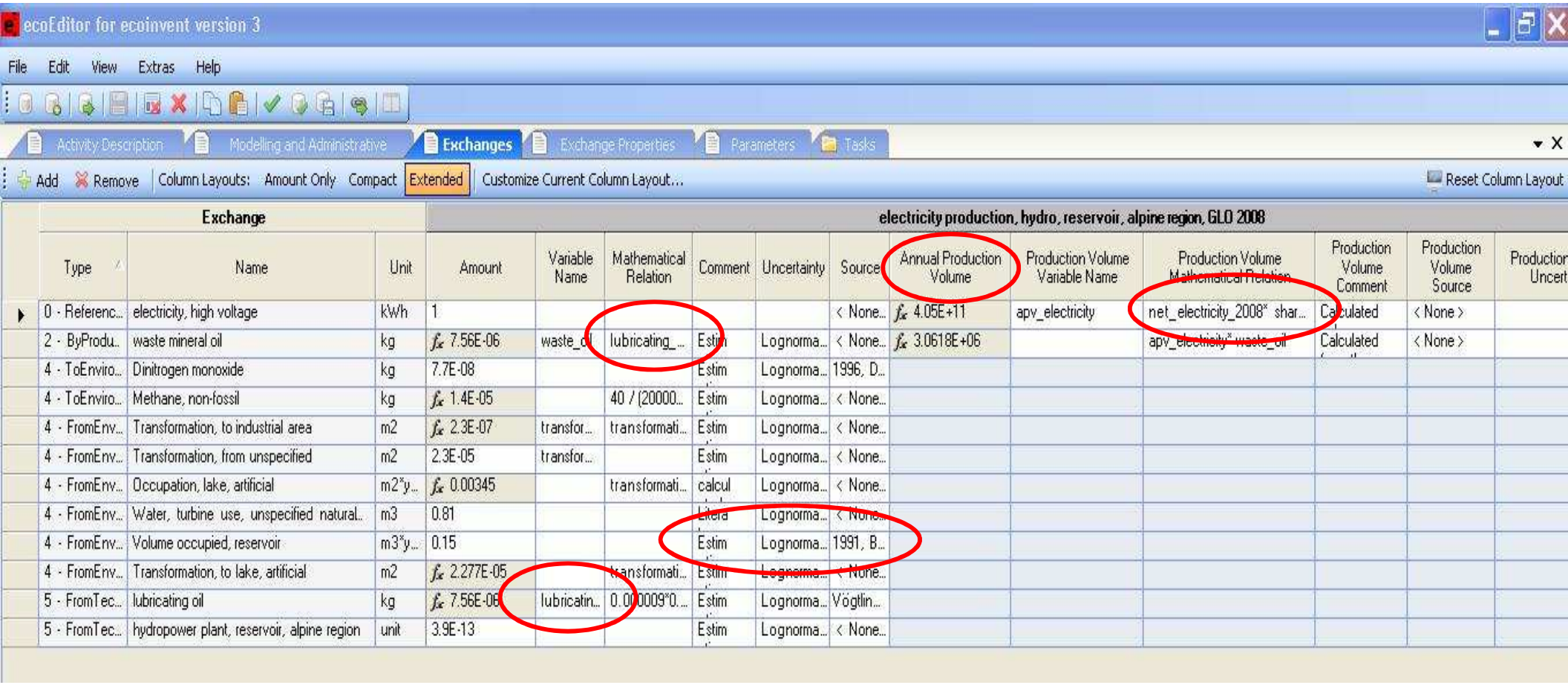
Fossil fuels	Coal	Hard coal	**Renewables**	Hydropower	Reservoir power plants: alpine/non-alpine/tropical region
		Lignite			Run-of-river power plants
		Peat			Pumped storage power plants
	Industrial gases	Blast furnace gases		Geothermal	**Hot-Dry-Rock (EGS)**
		Coke (coal) gases		Solar	Photovoltaic: Building integrated and **open ground**
	Oil				*Solar thermal (no data)*
	Natural gas	Conventional gas power plant, without/**with CHP**		*Wave and tidal energy*	*(no data)*
		Combined cycle gas power plant, without/**with CHP**		Wind	Onshore, capacity class <1MW / **1-3MW / >3MW**
Nuclear		Pressurised water reactor (PWR)			Offshore, capacity class 1-3MW
		Boiling water reactor (BWR)		Wood	Wood chips, with/without extensive emission control
				Biogas	Biogas from biowaste, sewage sludge and landfill gases
			Waste	Waste incineration	Municipal and industrial waste

In **red**: Newly implemented technologies

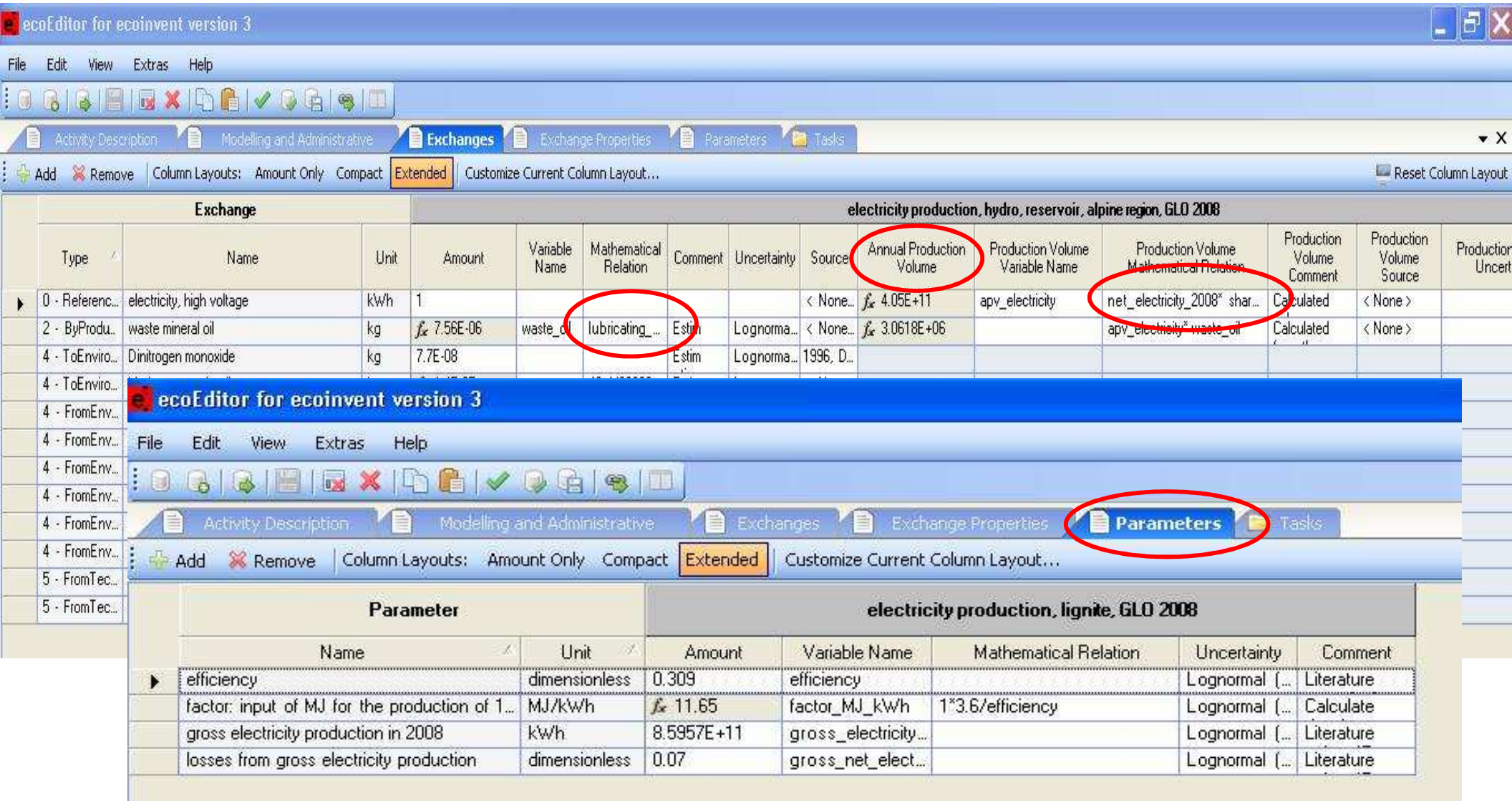
LCI – ecoEditor software

- **No ecoinvent reports** published anymore, as all necessary information are included directly in the datasets.
- **Annual production volumes** determining the shares of technologies supplying the electricity markets
- **Tags** for grouping datasets, e.g. «coal power», «nuclear power»
- **Technology level** defining the marginal mix for consequential modeling
- Use of **mathematical relations**
- Use of **parameters,** mainly:
  - net efficiencies of thermal power plants
  - yield of solar modules & wind turbines

LCI – ecoEditor software



LCI – ecoEditor software



LCI - Parameters

Wherever possible, technology-specific data was assembled:

- Electrical efficiency
- Wind load hours, solar yields
- Emissions of SO_2, NO_X, particulate matter
- Technology level

Data sources

- **Hard coal & lignite**: IEA statistics; national pollutant inventories; personal information; IEA clean coal center power plants database*
- **Natural gas**: IEA statistics; expert judgement
- **Oil**: IEA statistics
- **Nuclear**: WNA reactor database*
- **Wind power**: manufacturer‘s information; wind turbine database*
- **Photovoltaics**: ESU-services - manufacturer‘s information; IEA PVPS
- **Geothermal**: data from EGS plant in Basel
- **Hydro, wood, biogas and waste**: ecoinvent v2.2

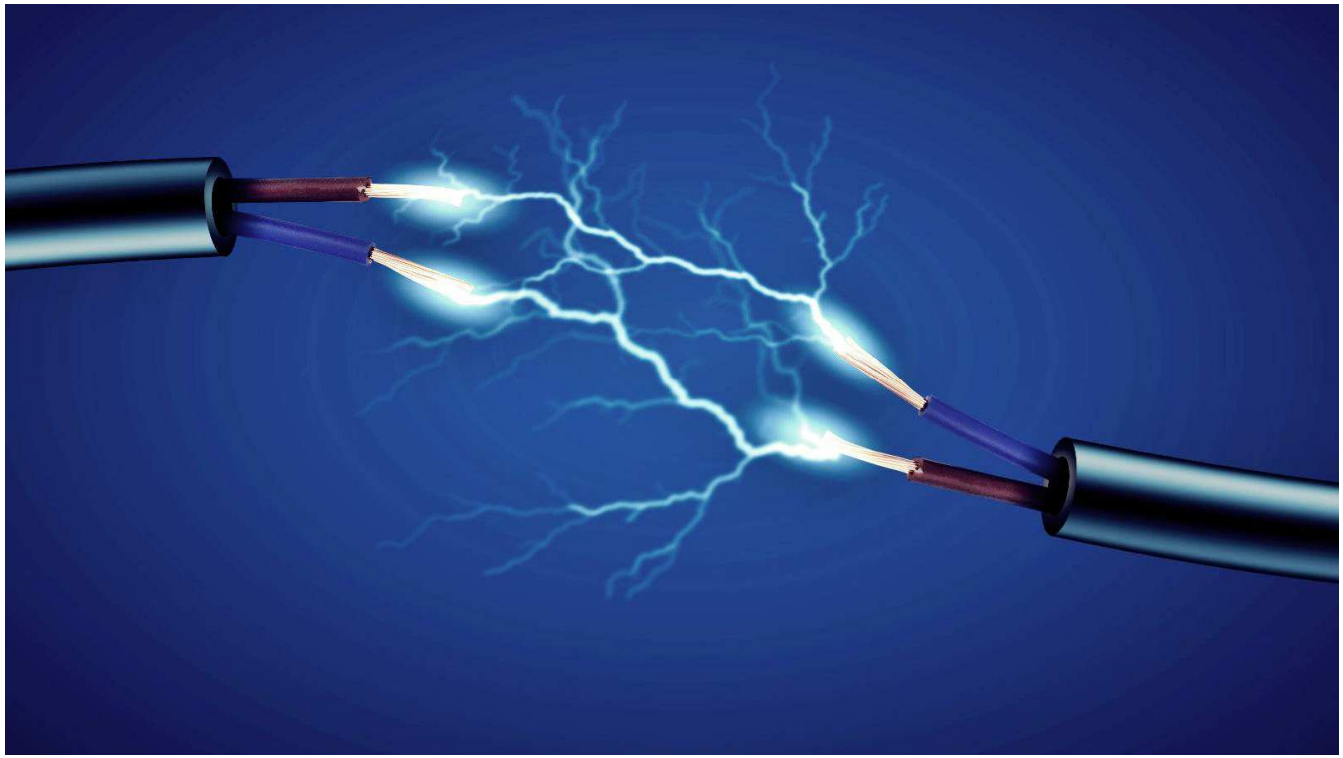
* contains data for all single plants operating

Dataset types

Modeling of electricity production – «Ordinary Transforming Activities»

- **Electricity generating activities:** Reference product 1kWh net electricity
- **Heat and power co-generation activities**:
  - Electricity as a by-product
  - Allocation: Price, true value (exergy-based)
- **Treatment activities**:
  - Electricity as a by-product
  - Electricity receives a part of the activities producing the material for treatment (economic allocation)

Selected results from the Life Cycle Inventory and the Life Cycle Impact Assessment



http://www.onsecrethunt.com/electricity/back-feeding-electricity-power.html
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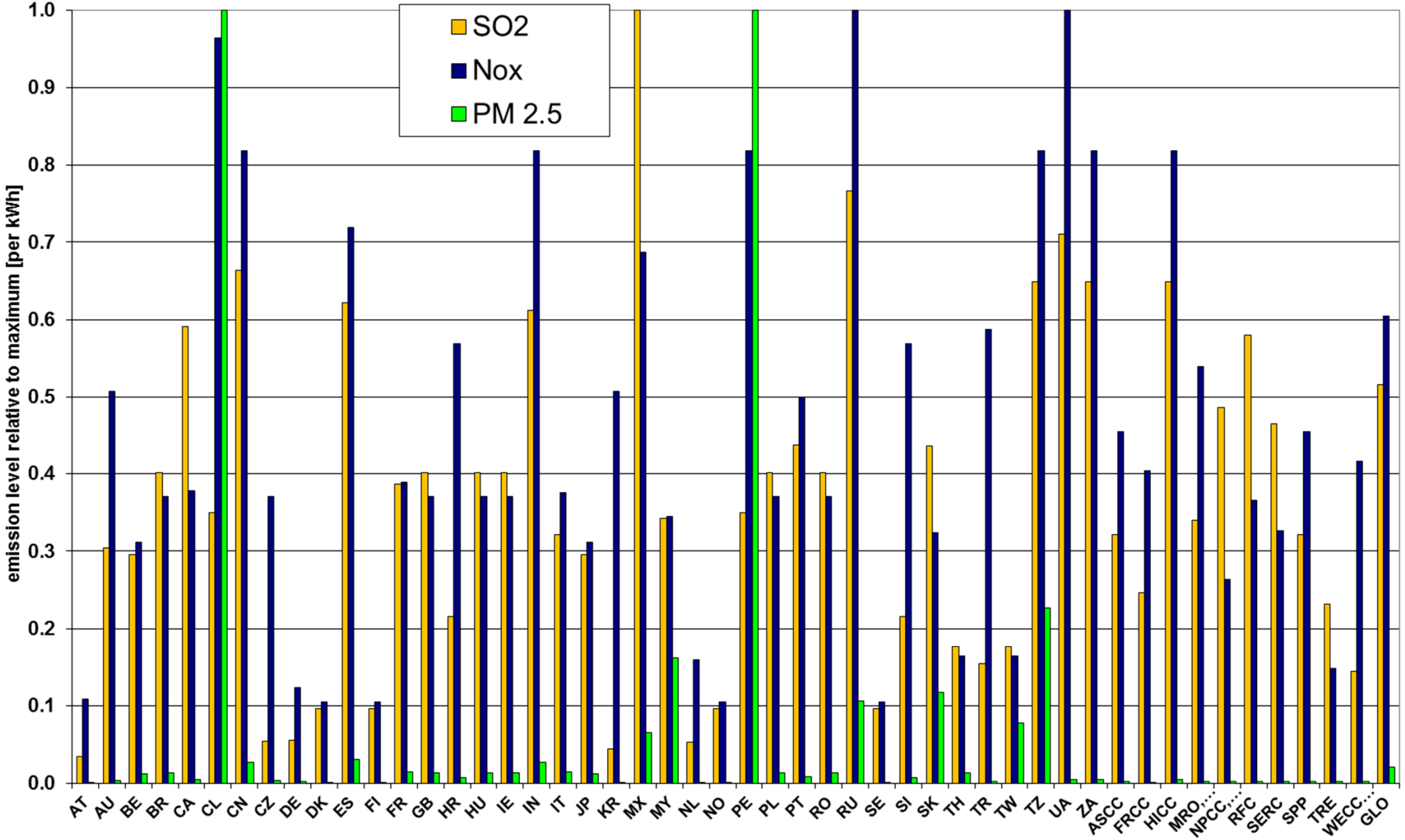
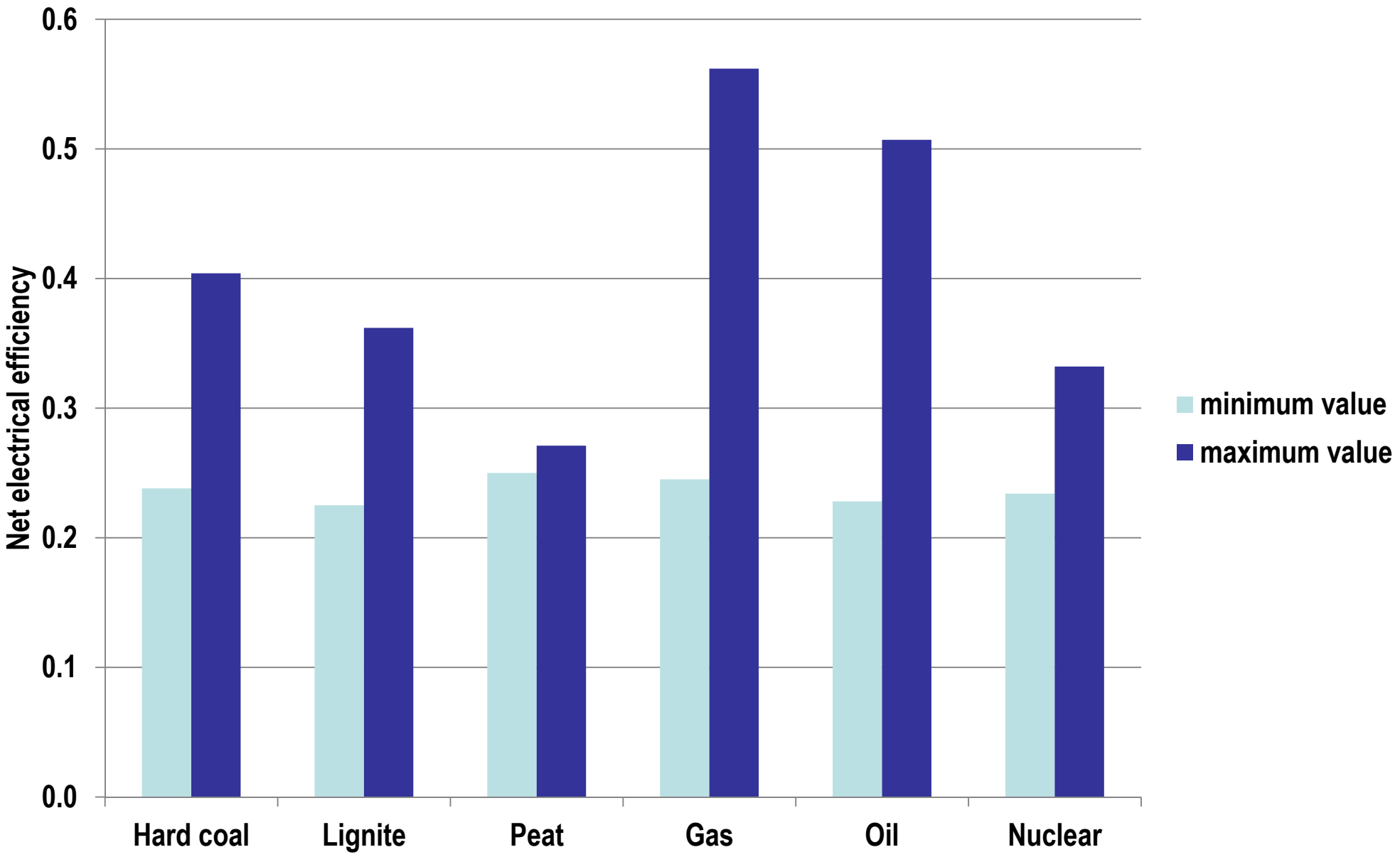
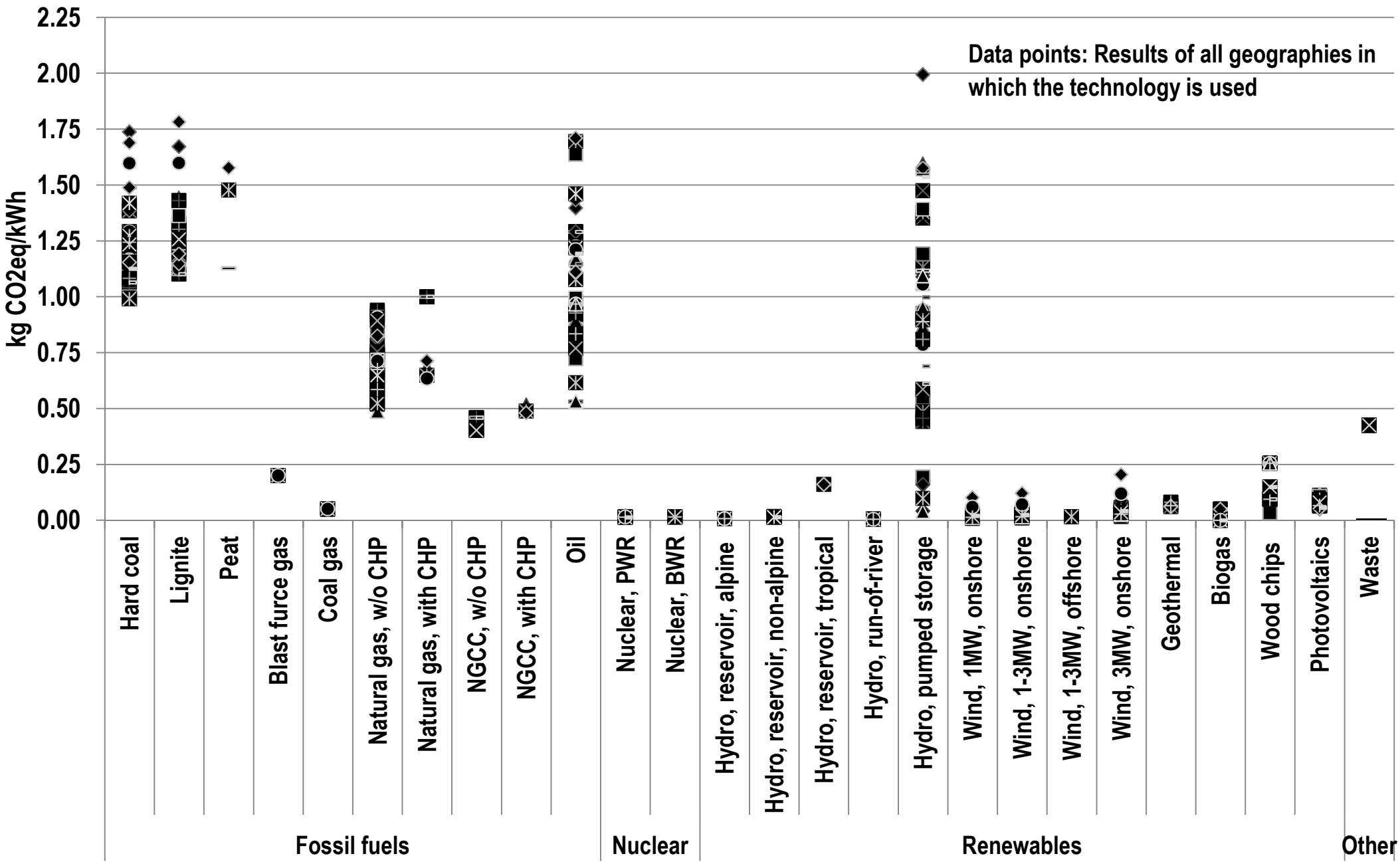
LCI – Direct emissions from hard coal burning



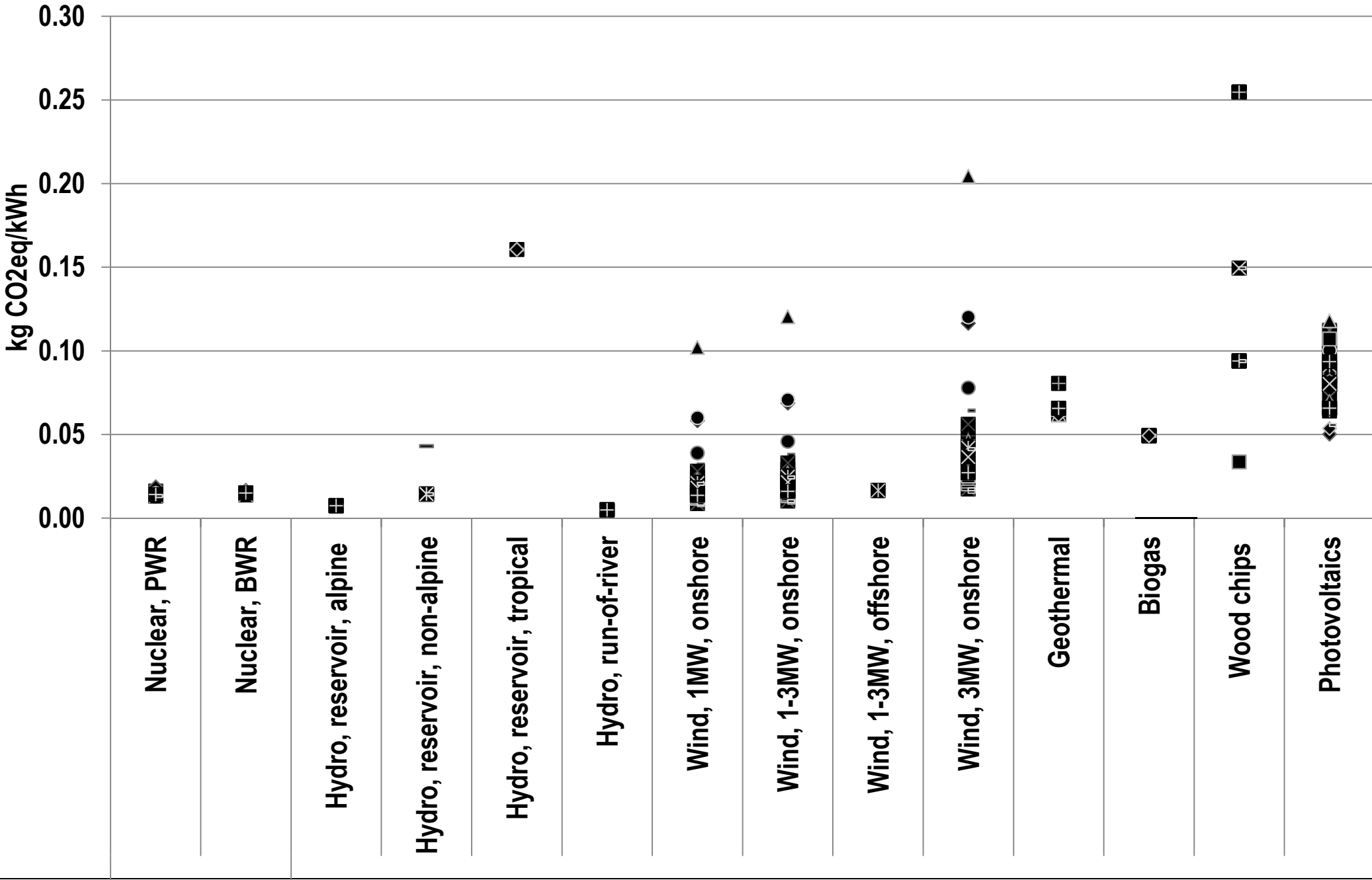
LCI – Net electrical efficiencies in the 71 geographies



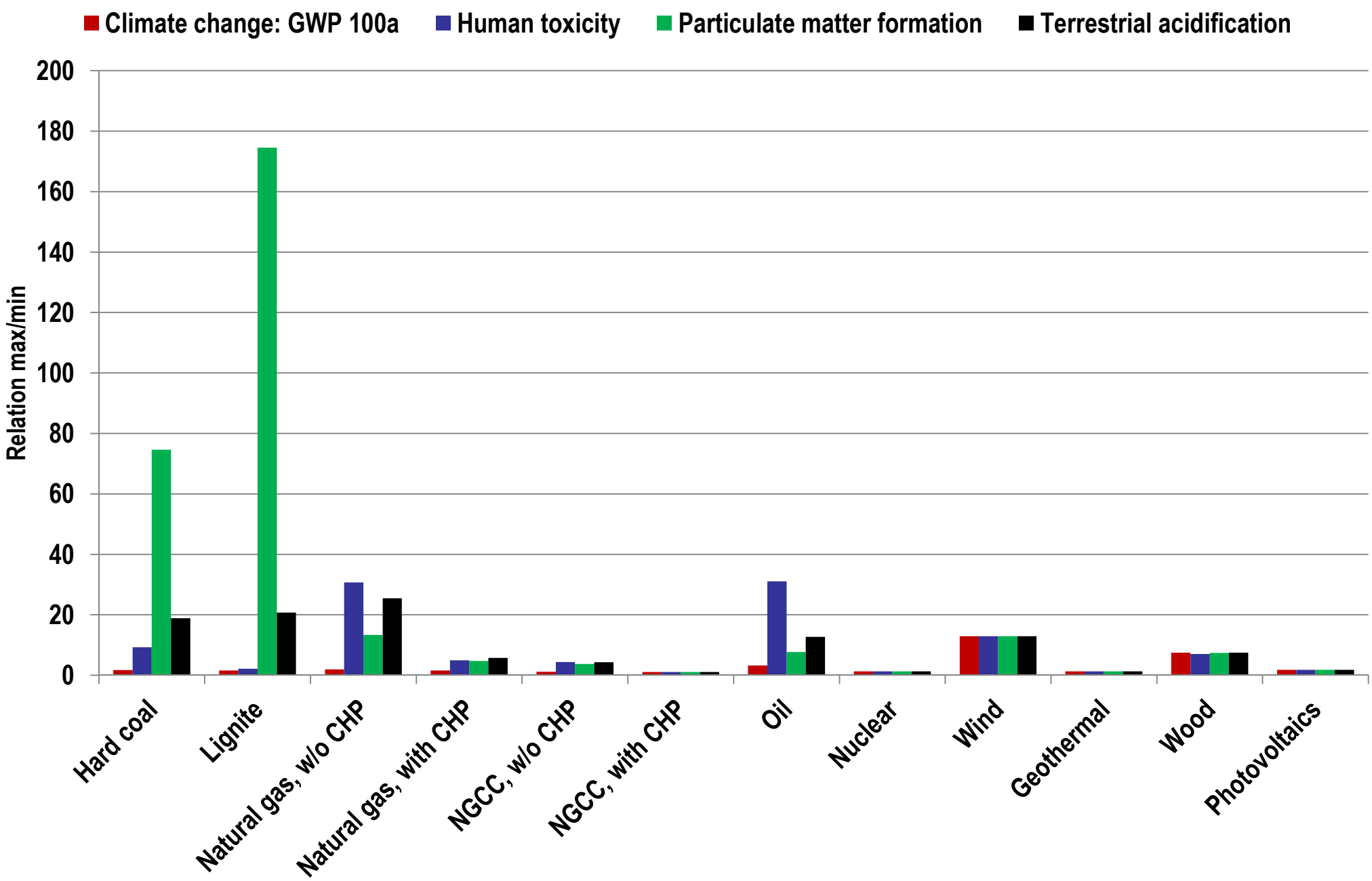
LCIA results: IPCC 2007, GWP 100a for all technologies



LCIA results: GWP 100a for technologies – zoom on nuclear and renewables



LCIA results: Relation max/min for selected ReCiPe Midpoints (H)



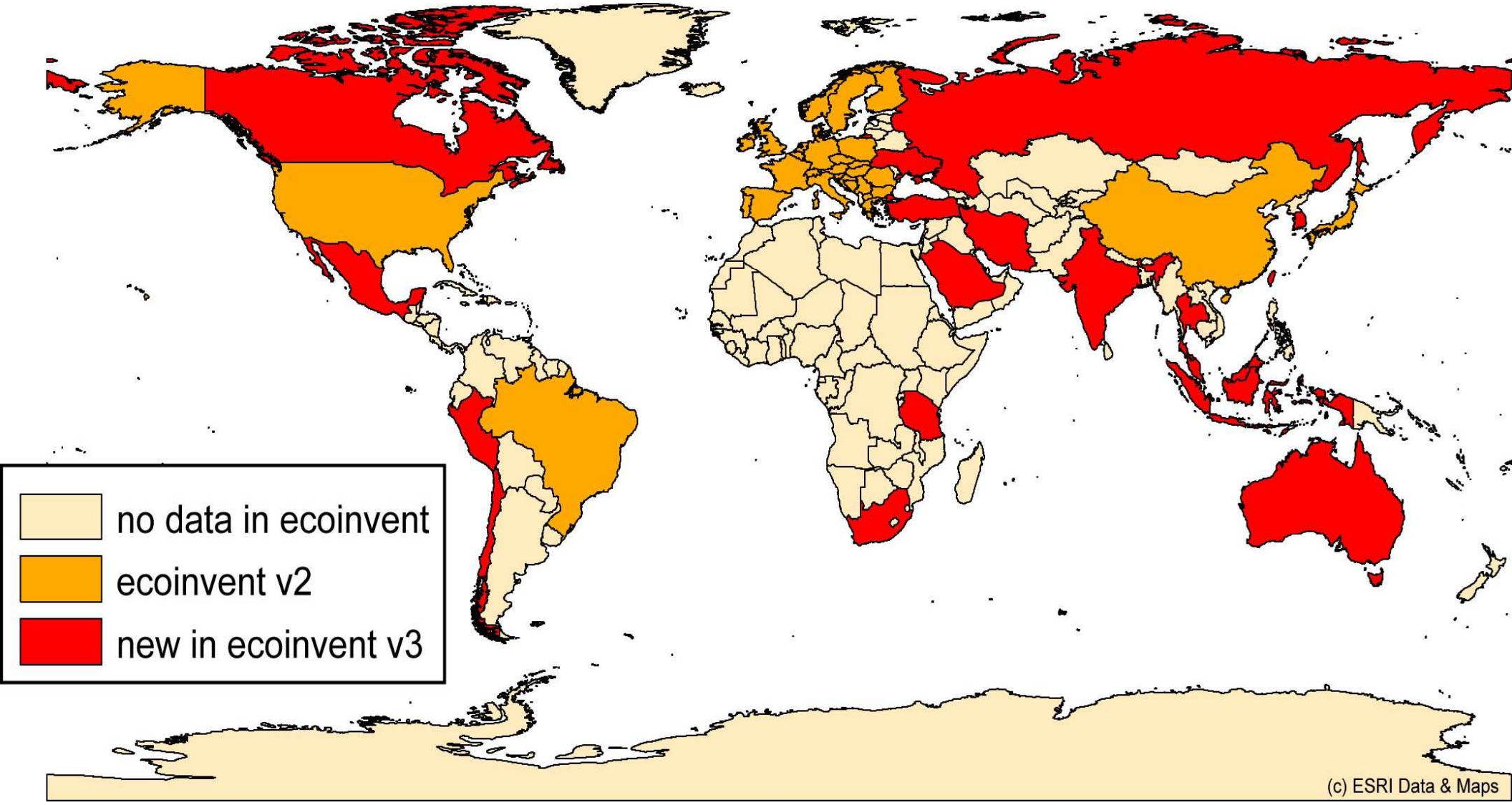
Conclusions – electricity datasets in v3

- High geographical variability of LCIA results – **regionalisation** is crucial
- ecoEditor enhances **transparency** and the possibility of local data providers to provide more accurate data
- New allocation method and gaps in the database can result in questionable LCIA results

Outlook for the electricity datasets in v3

- **Updates** are needed for refining the electricity datasets in v3:
  - Update of datasets already existing in v2
  - Fuel chain update, including considering country-specific trade information
- **Extension** of the electricity datasets in terms of
  - technologies, e.g. wave power, solar thermal
  - specific power plant types used in specific geographies
  - inclusion of more geographies/regionalisation

Thanks to ecoinvent staff for support
Thanks for your attention!



Inventories of electricity production

Transfer of datasets from v2 to v3 / new datasets in v3

- **Existing 32 countries in v2**:
  - Electricity generating datasets were transferred automatically to v3 – no updates made
  - Proxy datasets were copied and in general not adapted
  - Newly implemented technologies: New child datasets
- **18 additional, new countries in v3:**
  - Child datasets
  - Geography-specific parameters implemented where possible, e.g. efficiencies
  - Use of the functionalities of ecospold 2