Global Trade Analysis Project

GTAP-Power Data Base: Version 10

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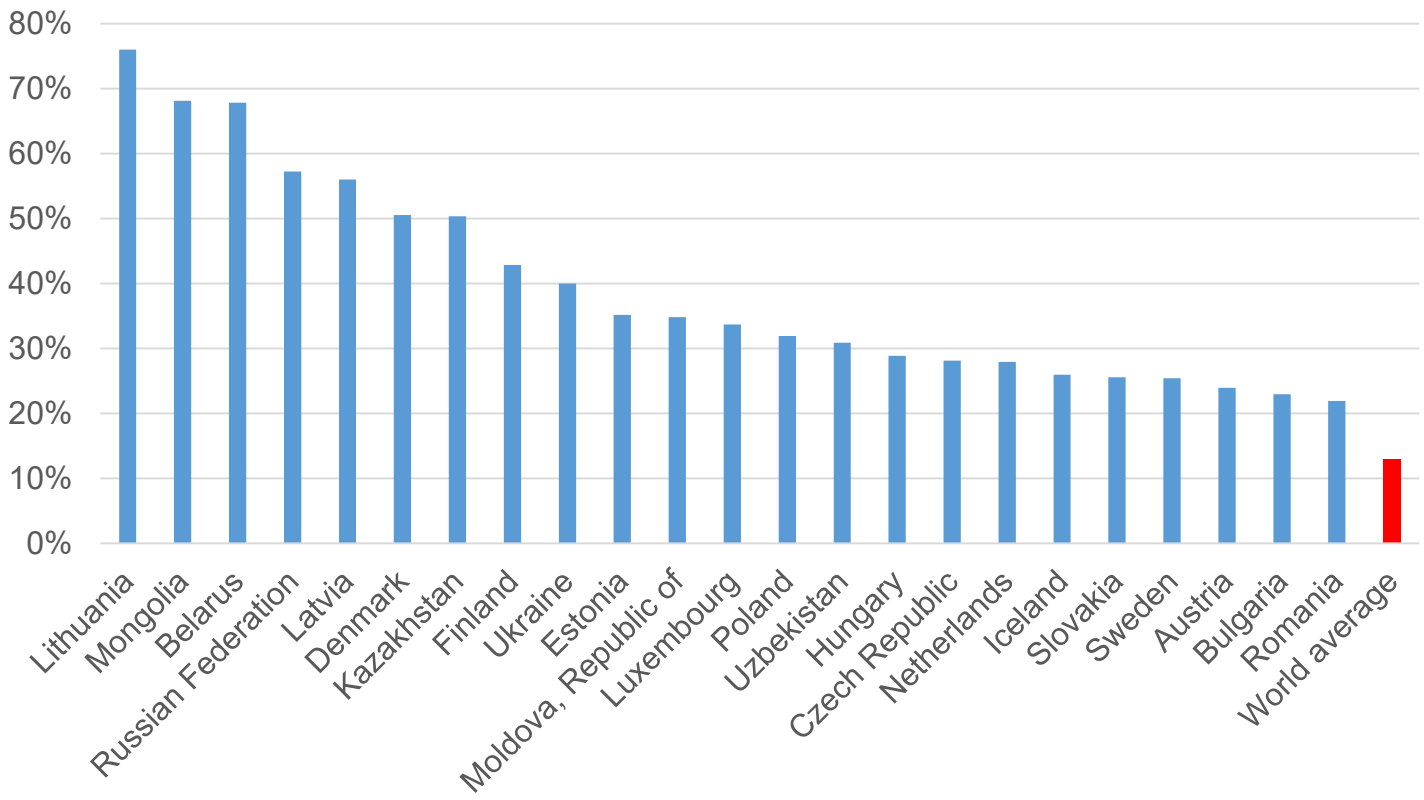
Outline

1. Introduction
2. Key features of the constructed database
3. Illustrative application: carbon intensity of the power generation
4. Summary and next steps
5. Other GTAP environmental extensions

1. GTAP-Power 10a: Introduction

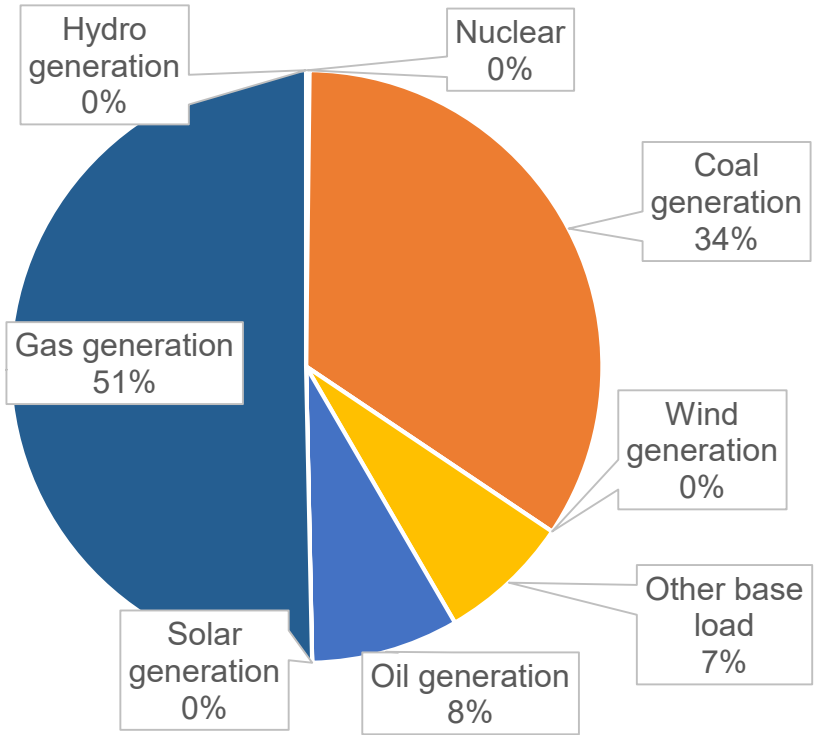
- **Explicit representation of various generation technologies in a CGE framework is an essential feature for the consistent environmental policies assessment**
- **GTAP-Power 9 database (Peters, 2016) disaggregated electricity sector into 11 generation technologies + transmissions and distribution.**
- **GTAP-Power 10a database addresses several limitations identified in GTAP-Power 9, including:**
  - A) Both heat and electricity generation volumes are used to provide GTAP "ely" sectors split.
  - B) Country and year-specific shares of transmission and distribution costs in electricity tariff are introduced.
  - C) Levelized costs of electricity (LCOE) generation are updated and made year-specific (IEA/NEA (2010) is used for 2004, 2007 and 2011; IEA/NEA (2015) is applied for 2014).

2.1. GTAP-Power 10a: Treatment of the co-generation



Share of heat generation in aggregate electricity and heat production by selected countries in 2014, %

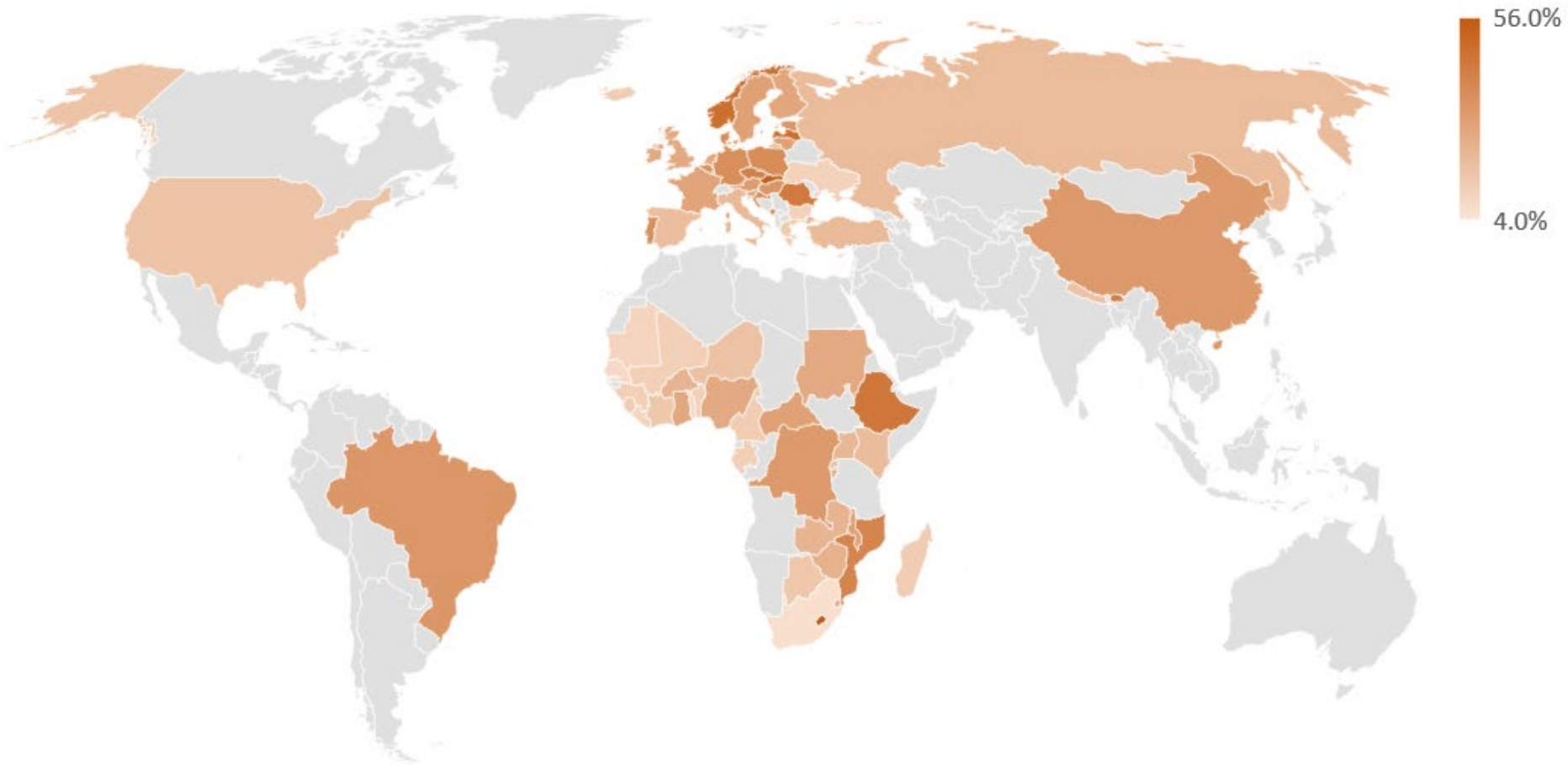
Source: IEA (2015).



World average shares of heat generation by technologies

Source: IEA (2015).

2.2. GTAP-Power 10a: Transmission and distribution costs

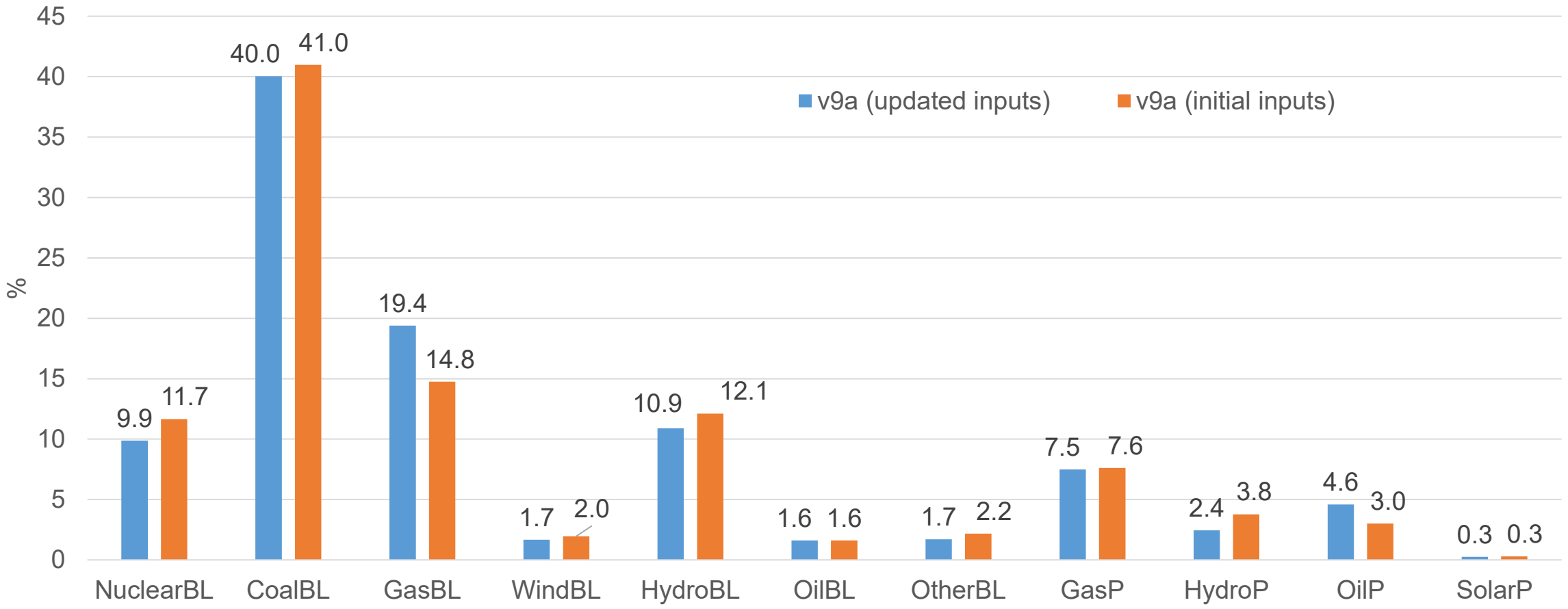


Shares of transmission and distribution in the total non-tax value of electricity output by countries in 2014 (or closest available year)

Source: Developed by author using EIA (2013), EIA (2018), Trimble et al. (2016), Eurostat (2019), ENTSO-E (2017), NERC (2015), NERC (2014), He et al. (2015), Siyambalapitiya (2018), ADB (2010), EY (2018), WB (2019) and NEEA (2008).

Note: Countries colored in grey do not have available data.

2.3. Comparisons for the GTAP-Power 9a database (1)

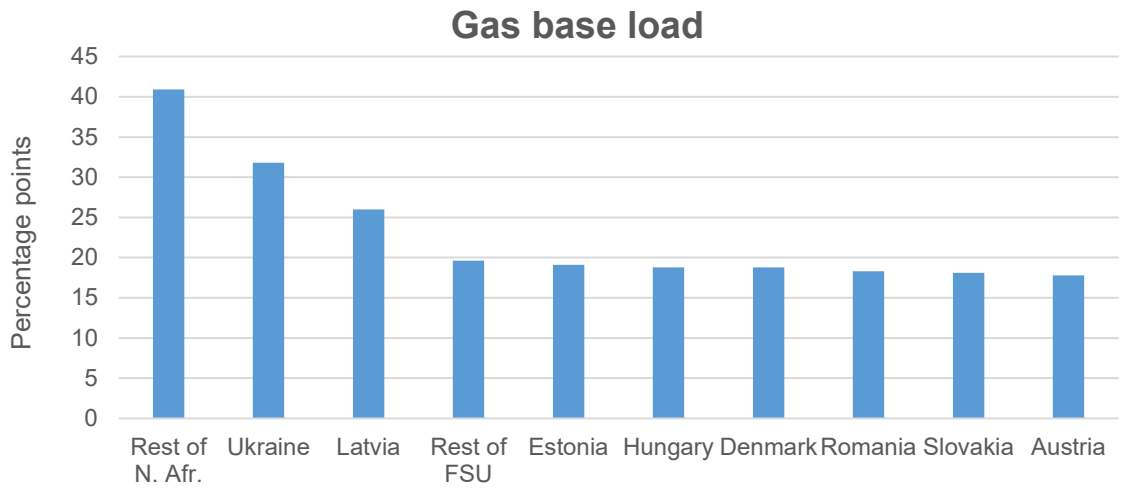


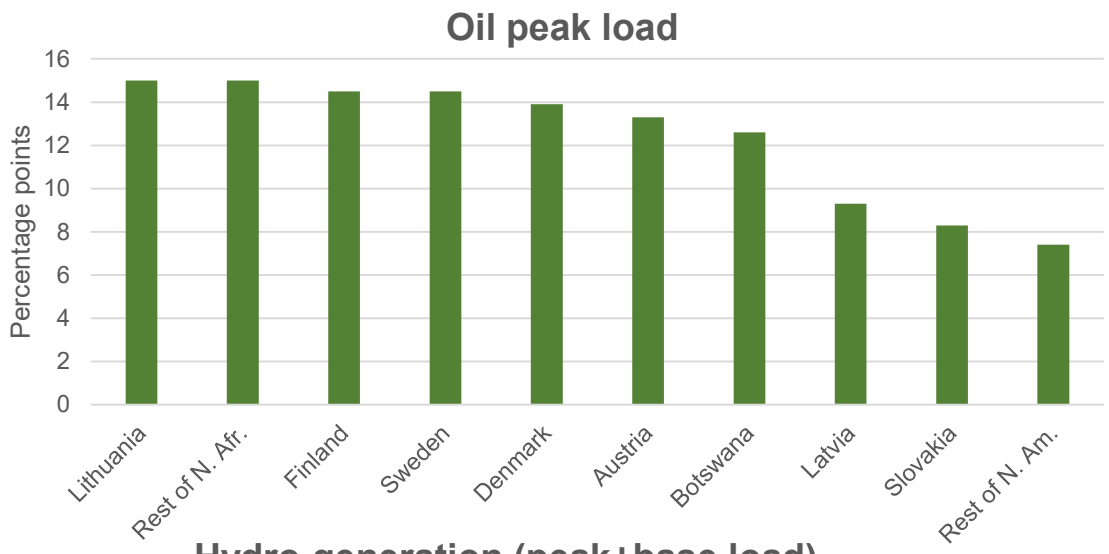
Shares of global electricity and heat generation from different technologies reported in GTAP-Power 9a for 2011 reference year under different input data assumptions, %

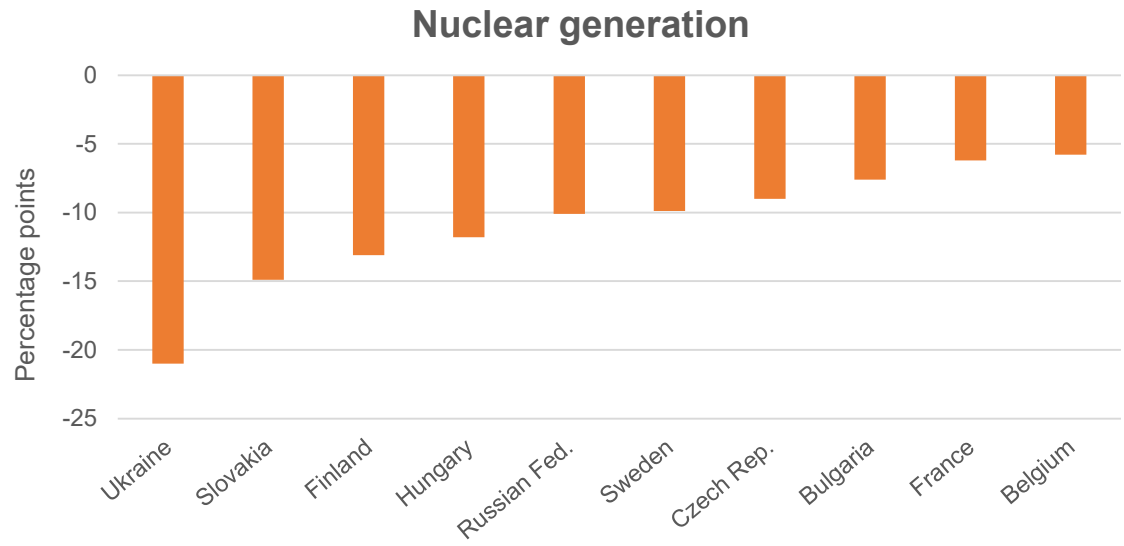
Source: GTAP-Power Data Base, erp.har, header: GWHR.

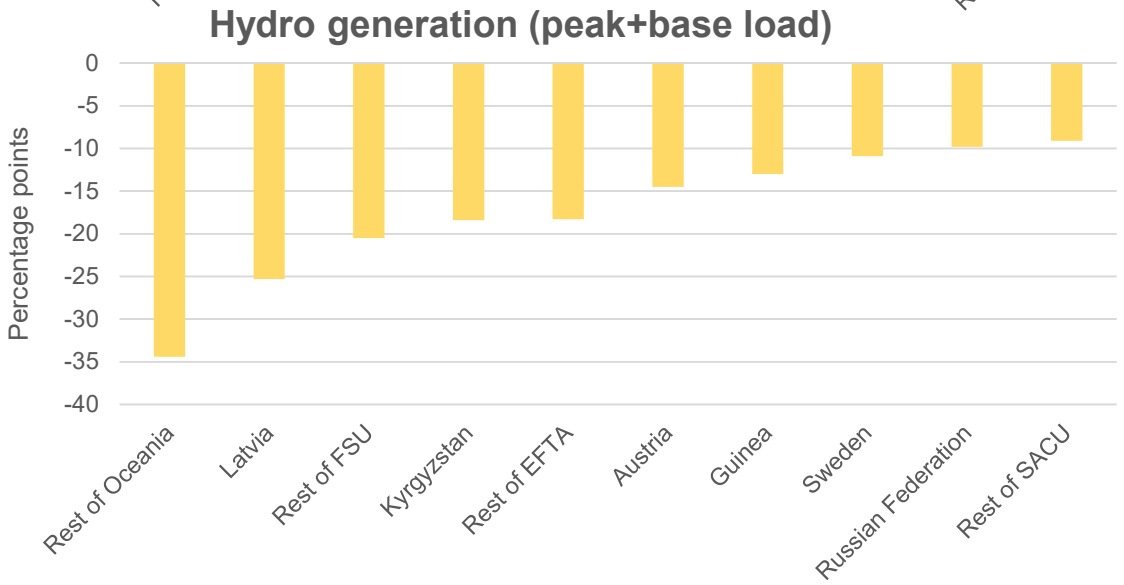
Note: "v9a (updated inputs)" corresponds to the database developed in this note; "v9a (initial inputs)" corresponds to the database developed in Peters (2016). In Peters (2016) only electricity generation is reported in the "GWHR" header.

2.4. Comparisons for the GTAP-Power 9a database (2)





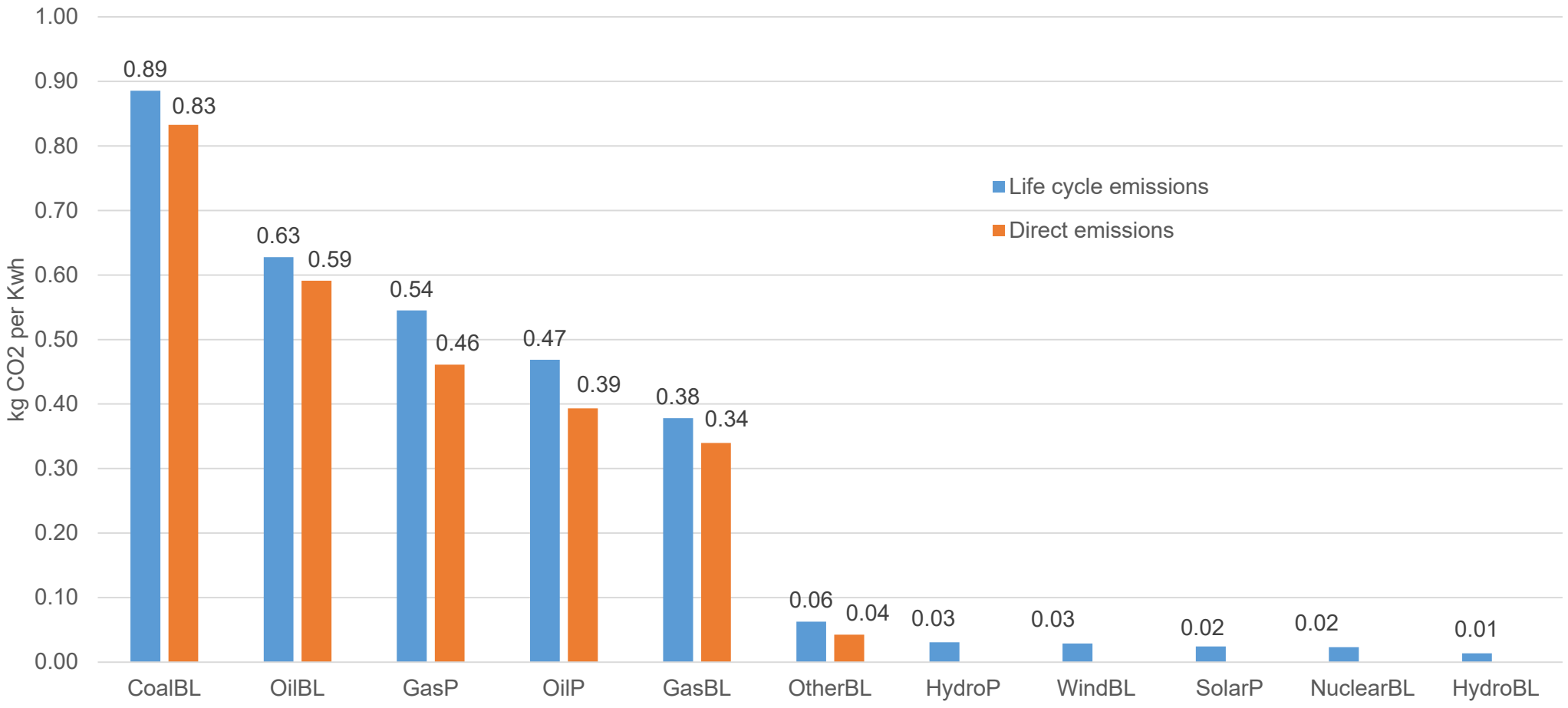




Change in shares of electricity and heat generation by technologies and regions for 2011 (GTAP-Power 9 with original inputs vs GTAP-Power 9 with updated inputs)

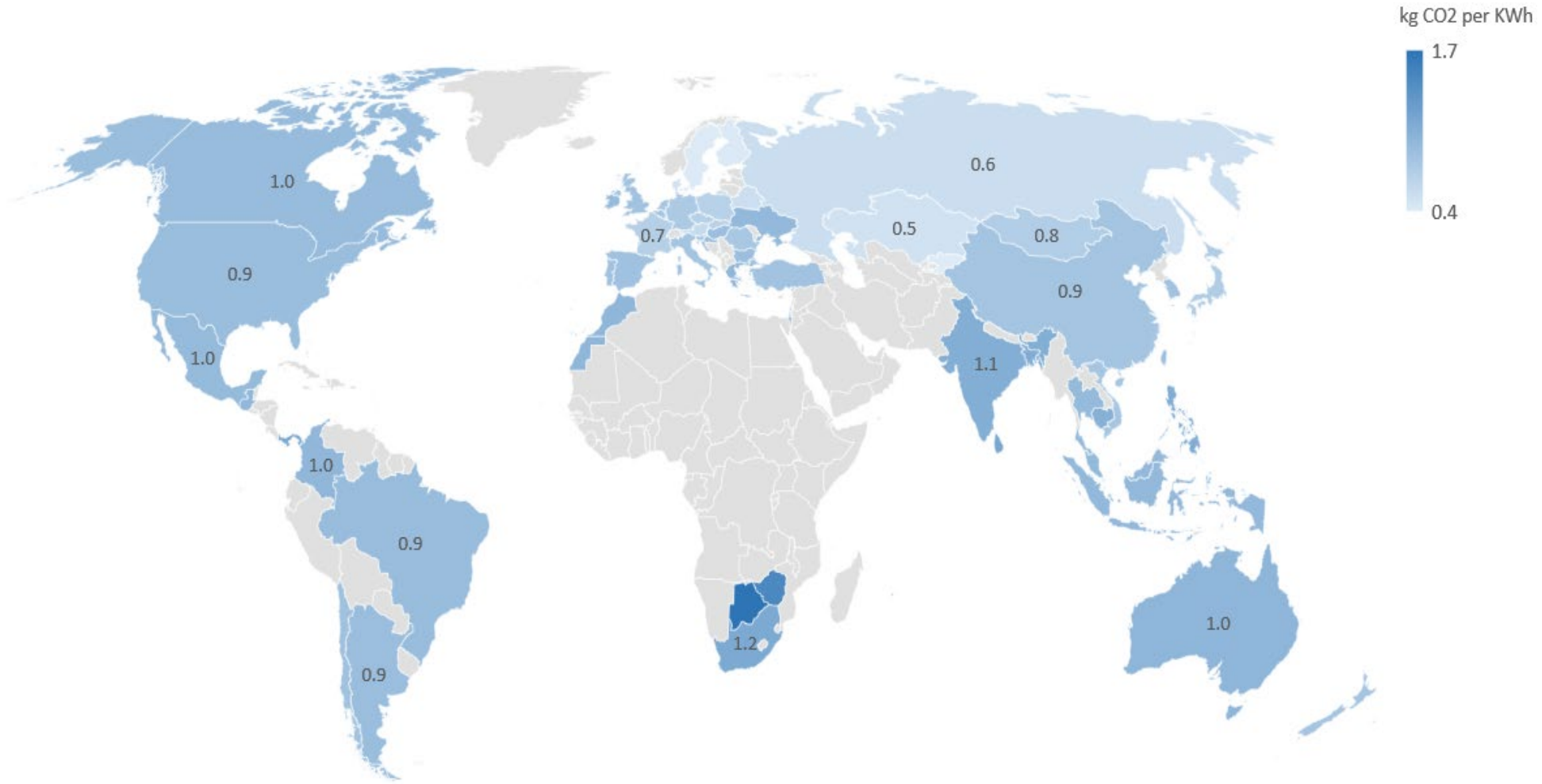
Note: Top 10 regions with the largest change in shares are reported for each technology.

3.1. Illustrative application: carbon intensity by generation technologies



Global average intensities of the CO2 emissions embodied into the final consumption of domestic electricity and heat in 2014 by generation technologies, kg CO2 per Kwh

3.2. Illustrative application: carbon intensity of the coal power



Intensities of the CO_2 emissions embodied into the final consumption of domestic electricity and heat from coal base load generation in 2014 by countries, kg CO_2 per Kwh

Note: Only individual countries with coal base load generation over 100 GWh per year are plotted on the map. Countries colored in grey do not have available data or have coal base load generation below 100 GWh per year.

4. Summary and next steps

- **GTAP-Power 10 addresses several limitations identified in the previous version of the GTAP-Power:**
  - Utilizes both heat and electricity generation volumes to introduce data splits.
  - Implements country and year-specific shares of transmission and distribution.
  - Updates LCOE generation and makes them year-specific.
- **Other potential improvements:**
  - Splitting of the electricity and heat generation into separate technologies.
  - Representation of the future alternative technologies (e.g. CCS, hydrogen).
  - Introduction of the additional technological details on the energy use side (e.g. EVs in transportation).

5. Ongoing work on other GTAP environmental extensions

- **Merging of the GTAP-Power and GTAP-BIO Data Bases**
  - ➢ Currently under development at a fully disaggregate regional level.
- **GTAP non-CO_2 GHG and air pollutant emissions:**
  - Both datasets are available to GTAP users. Ongoing work on linking corresponding emission flows with the GTAP-E/Power models.
  - Non-CO_2 database is updated to include industrial CO_2 emissions.
  - Ongoing work on the introduction of the non-CO_2 MACCs.
- **Development of the GTAP circular economy (CE) Data Base:**
  - ✓ Will split selected GTAP sectors (metals and plastics) into primary and secondary parts, also splitting extraction sector and recycling activities.
- **GTAP model extensions (GTAPv7 Power, GTAP-E/Power-RD, GTAP-E-MRIO).**

Recent updates and ongoing work on other more broad environmental accounts:
GTAP land use and land cover data, GTAP nutritional database, etc.

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Thank you!

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