SHRECC

SIMPLE HOURLY-RESOLUTION ELECTRICITY CONSUMPTION CALCULATION

Sabina Bednářová, Thomas Gibon, Tomás Navarrete Gutiérrez

https://pypi.org/project/shrecc/, developed at LIST

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01 | INTRODUCTION

What is SHRECC?

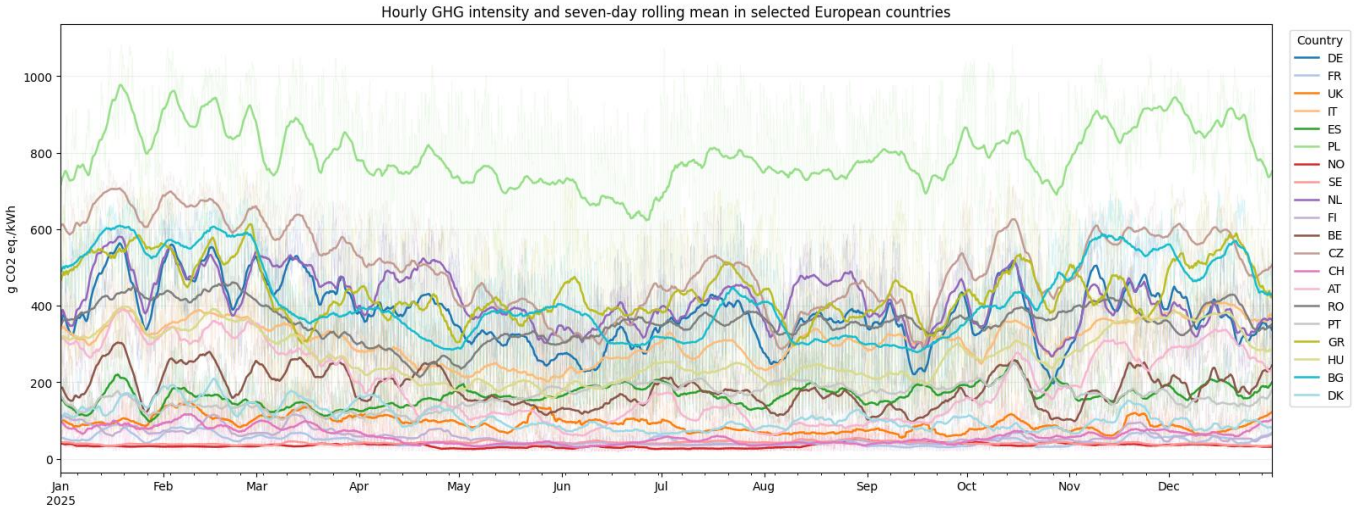
- SHRECC is a Python package to model high-definition electricity consumption in LCA
- Developed as an add-on to the Brightway LCA package
- Uses **public data** to recompose timestamped **electricity** consumption, for a given **European** country
- Supports historic (from 2015), near-live (same-day), and prospective modelling
- Data sources
  - **Historic**: Energy-Charts.info API (Fraunhofer ISI), based on ENTSOE Transparency Platform API,
  - Prospective: ENTSOE's Ten-Year Network Development Plan (TYNDP) for 2035, 2040, 2050 with support from premise

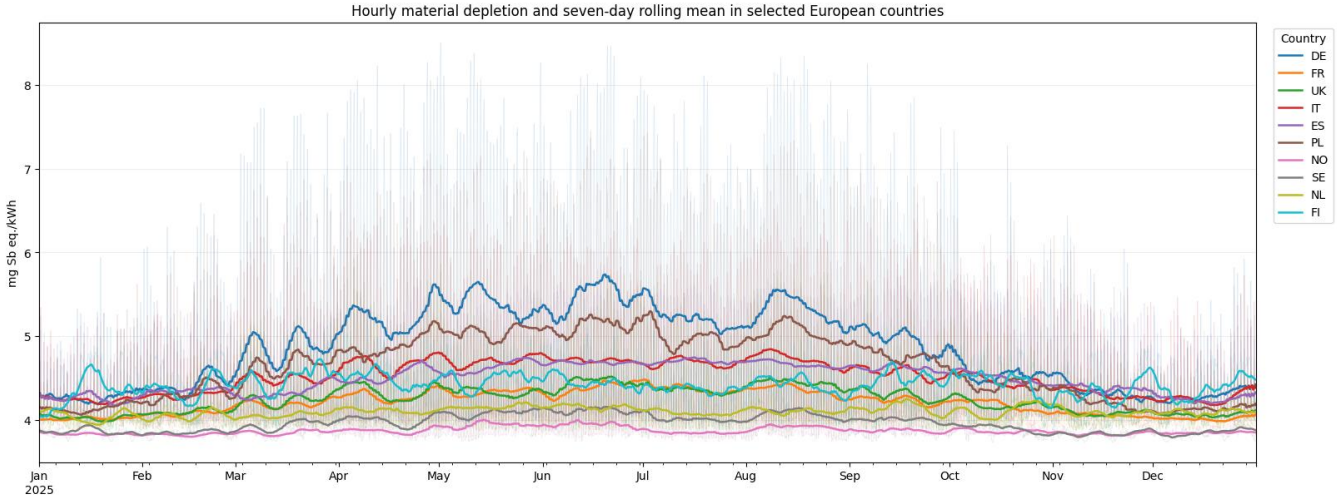
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01 | INTRODUCTION

Motivation

- Addresses the needs of LCA practitioners
  - Who want to model electricity accurately (at the hour resolution), from recent sources,
  - For whom generic database data does not provide up-to-date inventories.
- Electricity mixes are highly variable
  - Hourly, monthly, seasonally
  - Annual averages do not capture the full variability of a consumption mix
- Anticipates future regulations, guidelines, and market
  - EU Delegated Act on Hydrogen,
  - GHG Protocol Scope 2,
  - Hourly matching gaining traction for 24/7 carbon-free electricity contracts.





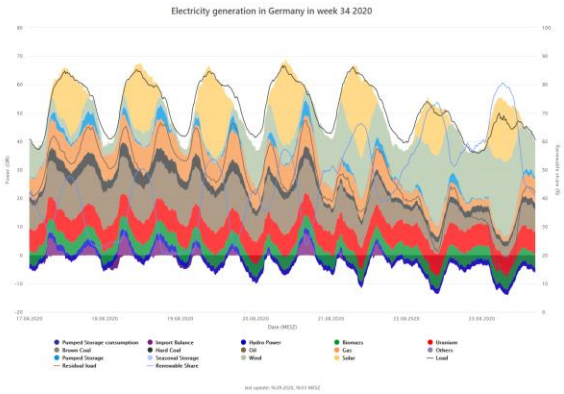
Environmental impact profiles calculated with *shrecc*, available at https://git.list.lu/shrecc_project/shrecc/-/blob/develop/notebooks/5_shrecc_inventory_resolution.ipynb

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02 | PRINCIPLES

Fully transparent pipeline

Download hourly data from energy-charts API or TYNDP repository



Create general time intervals

Solve the exchange network graph

Match ENTSO-E power sources with LCI database

User creates specific time intervals or consumption profile

Create time-aware brightway database

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03 | FUNCTIONS

One-class pipeline

My parameters

```python
# Geographical scope and common 52-week annual period
years = [2021, 2025, 2035, 2040]
countries = ["ES", "FR", "DE", "IT", "PT", "BE", "NL", "LU", "AT", "CH"]
time_range = ["2040-01-01 00:00:00", "2040-12-30 23:00:00"]
country_to_compare = "FR"

# Brightway configuration
project_name = "SHRECCei311"
my_db_name = "shrecc_annual_profiles"
bg_db_name = {
    2021: "ecoinvent-3.11-cutoff",
    2025: "ecoinvent-3.11-cutoff",
    2035: "ei_cutoff_3.11_remind-eu_SSP2-PkBudg650_2035 2026-07-10",
    2040: "ei_cutoff_3.11_remind-eu_SSP2-PkBudg650_2040 2026-07-10",
}
write_database = True

climate_method = (
    "ecoinvent-3.11",
    "EF v3.1",
    "climate change",
    "global warming potential (GWP100)",
)
```

SHRECC database object

```python
my_electricity_database = NewDatabase(
    years=years,
    scenario="DE",
    climate_year=2009,
    countries=countries,
    time_range=time_range,
    project_name=project_name,
    my_db_name=my_db_name,
    bg_db_name=bg_db_name,
)
```

Create all data tables

```
1  my_electricity_database.create()
✓ 1m 33.9s
```

Write database

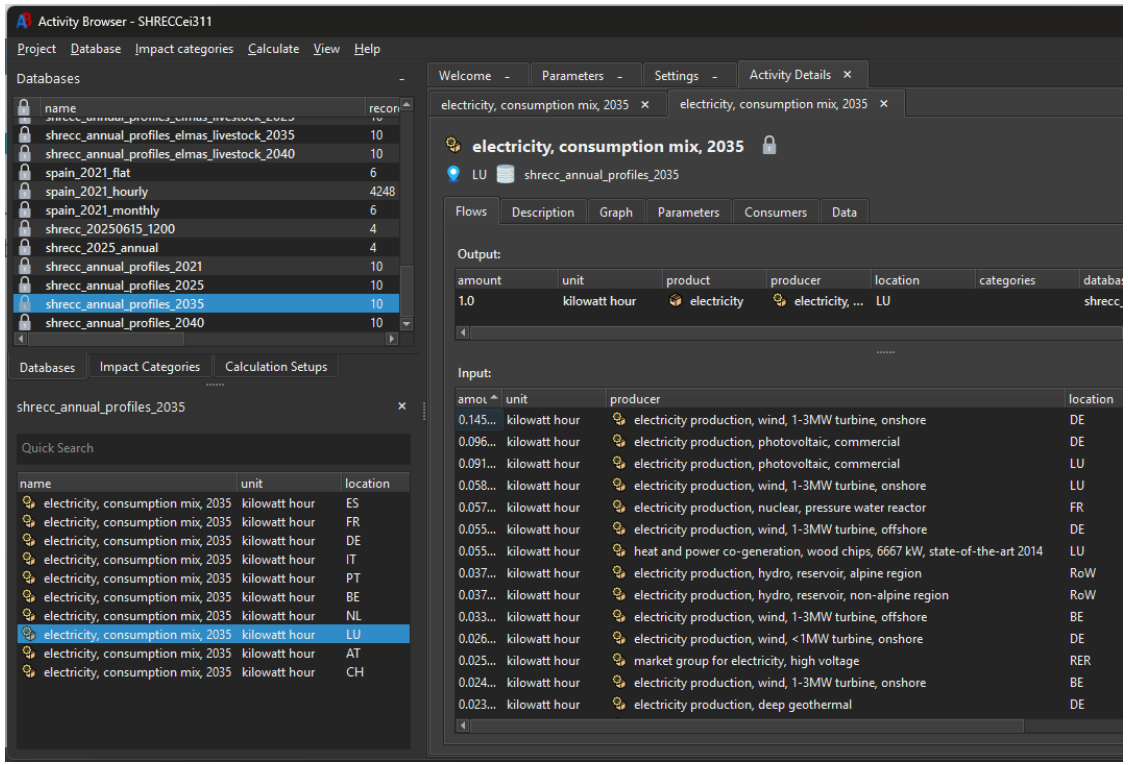
```
1  my_electricity_database.write()
2m 11.1s
```

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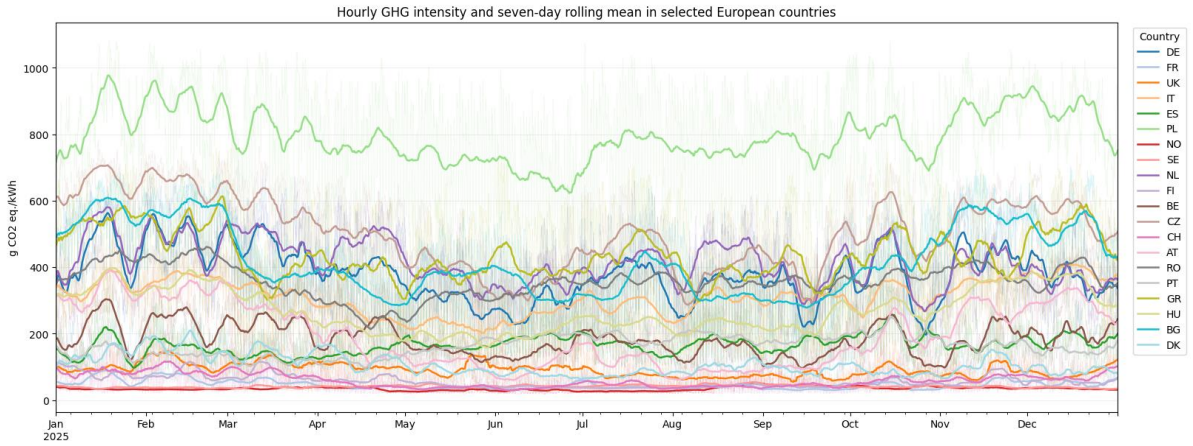
03 | FUNCTIONS

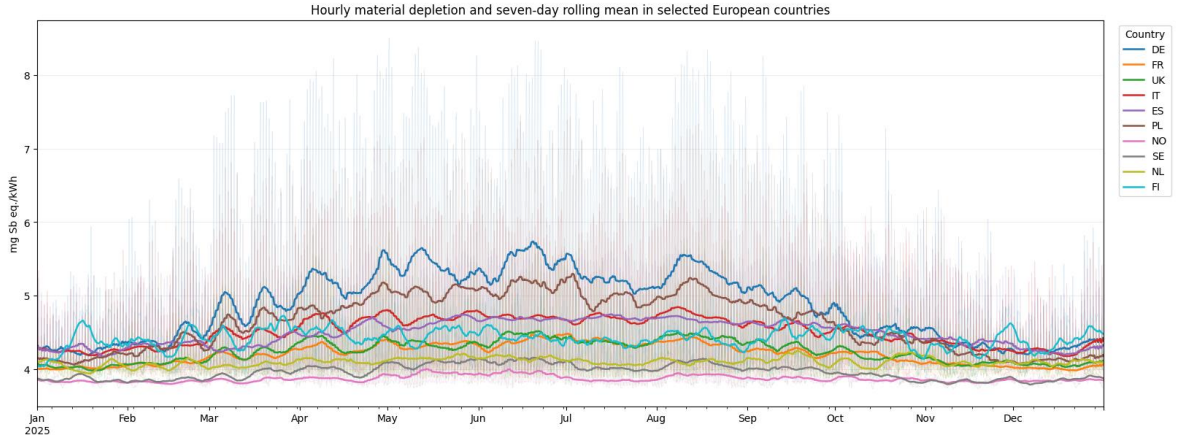
Results

- Electricity inventories directly usable in Brightway projects



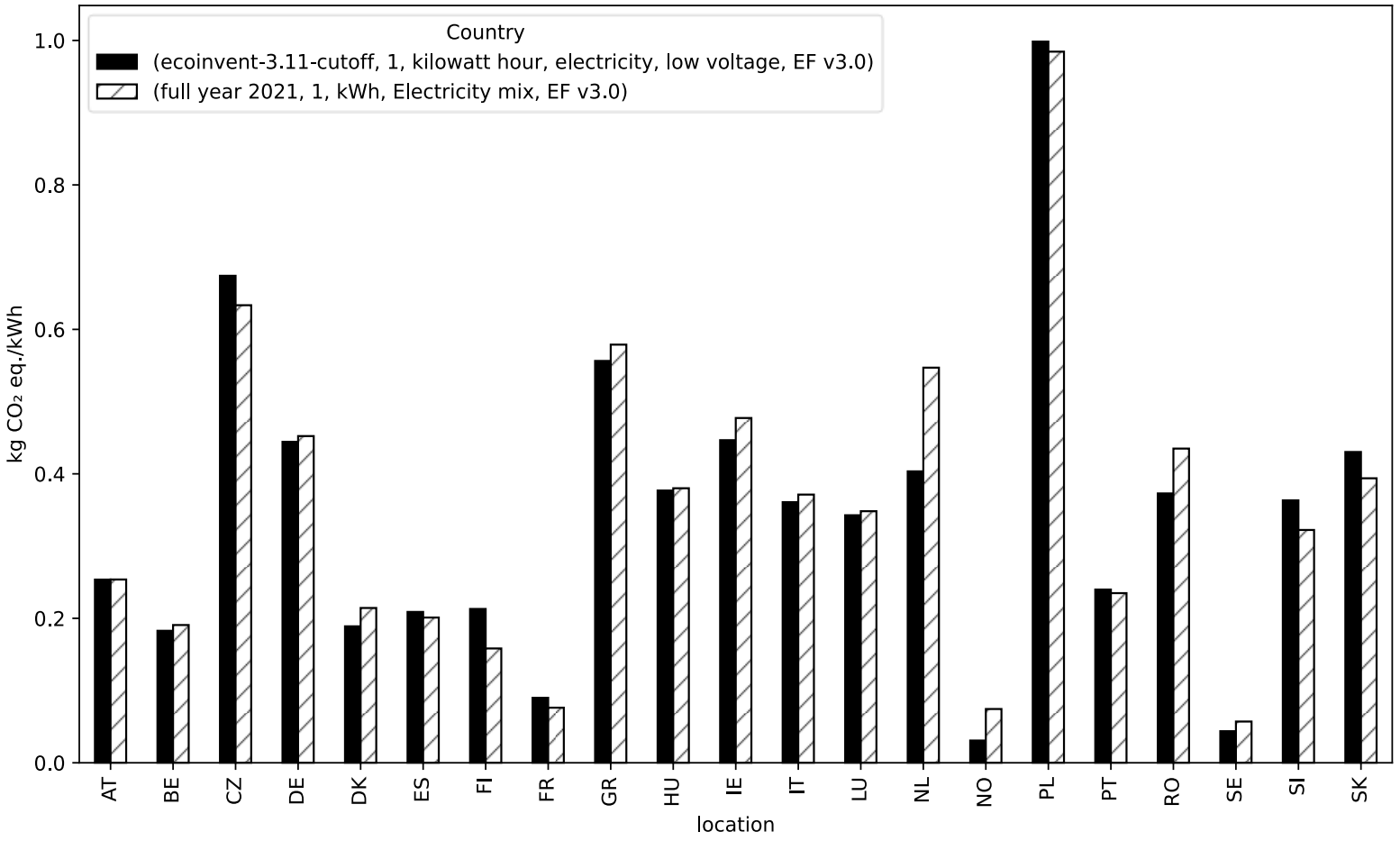
- Optimized hourly LCIA of inventories created





04 | IN PRACTICE

Benchmark: shrecc vs ecoinvent

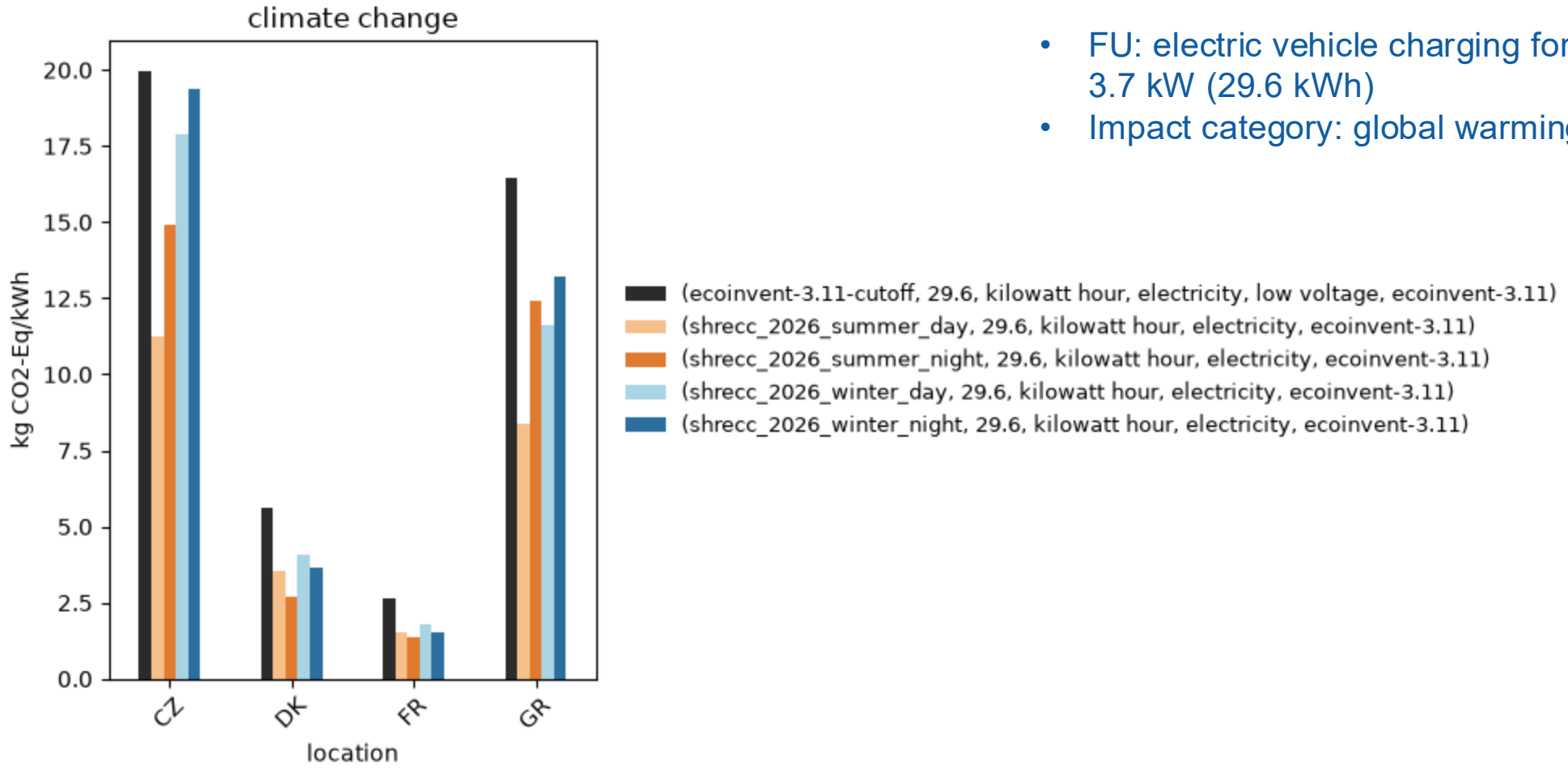


- Comparing ecoinvent 3.11 (2021) annual average vs shrecc (2021) averaged data
- 1 kWh
- global warming potential

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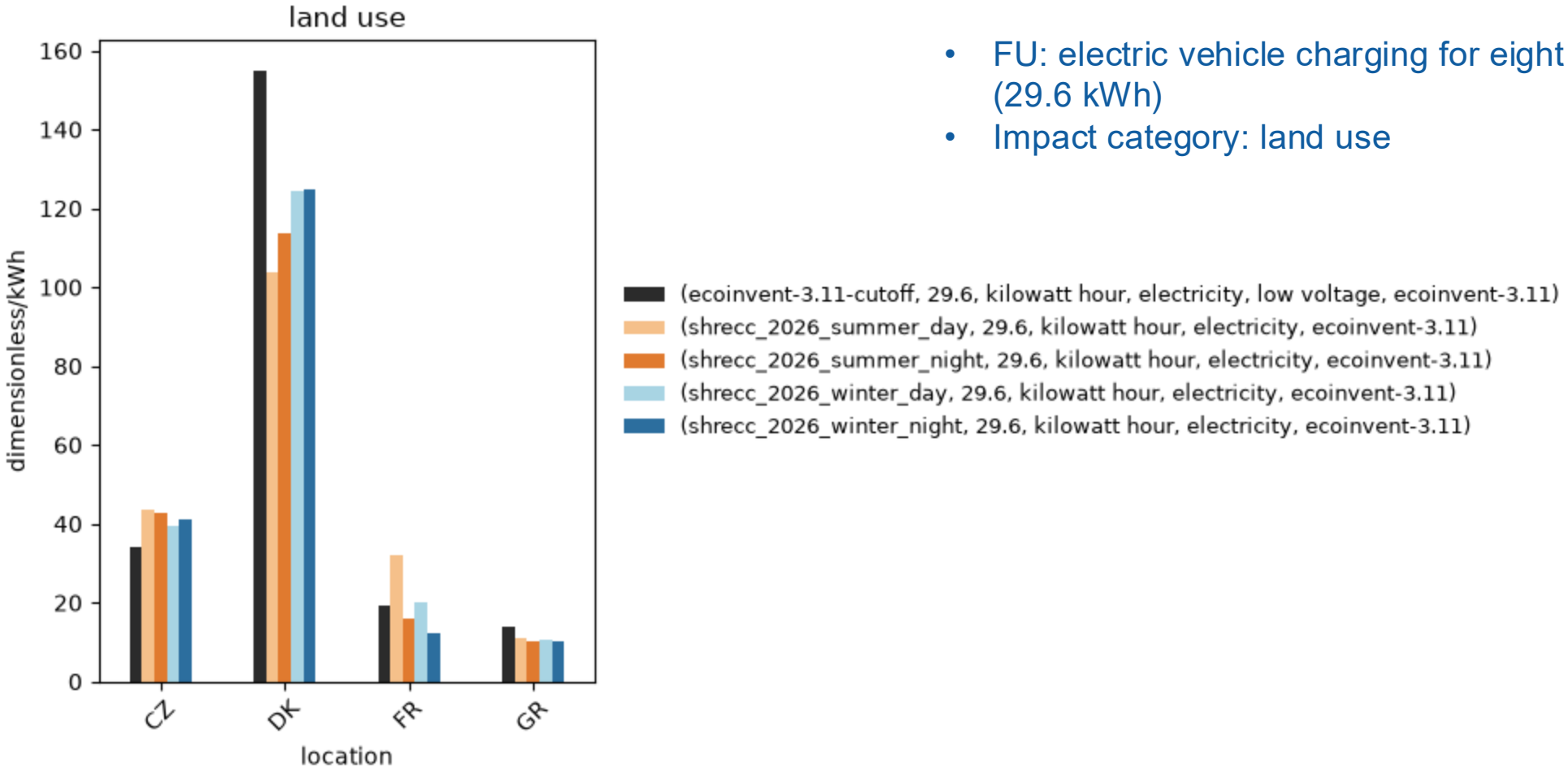
Small case study: EV charging (retrospective data)



- FU: electric vehicle charging for eight hours at 3.7 kW (29.6 kWh)
- Impact category: global warming potential

04 | IN PRACTICE

Small case study: EV charging (retrospective data)

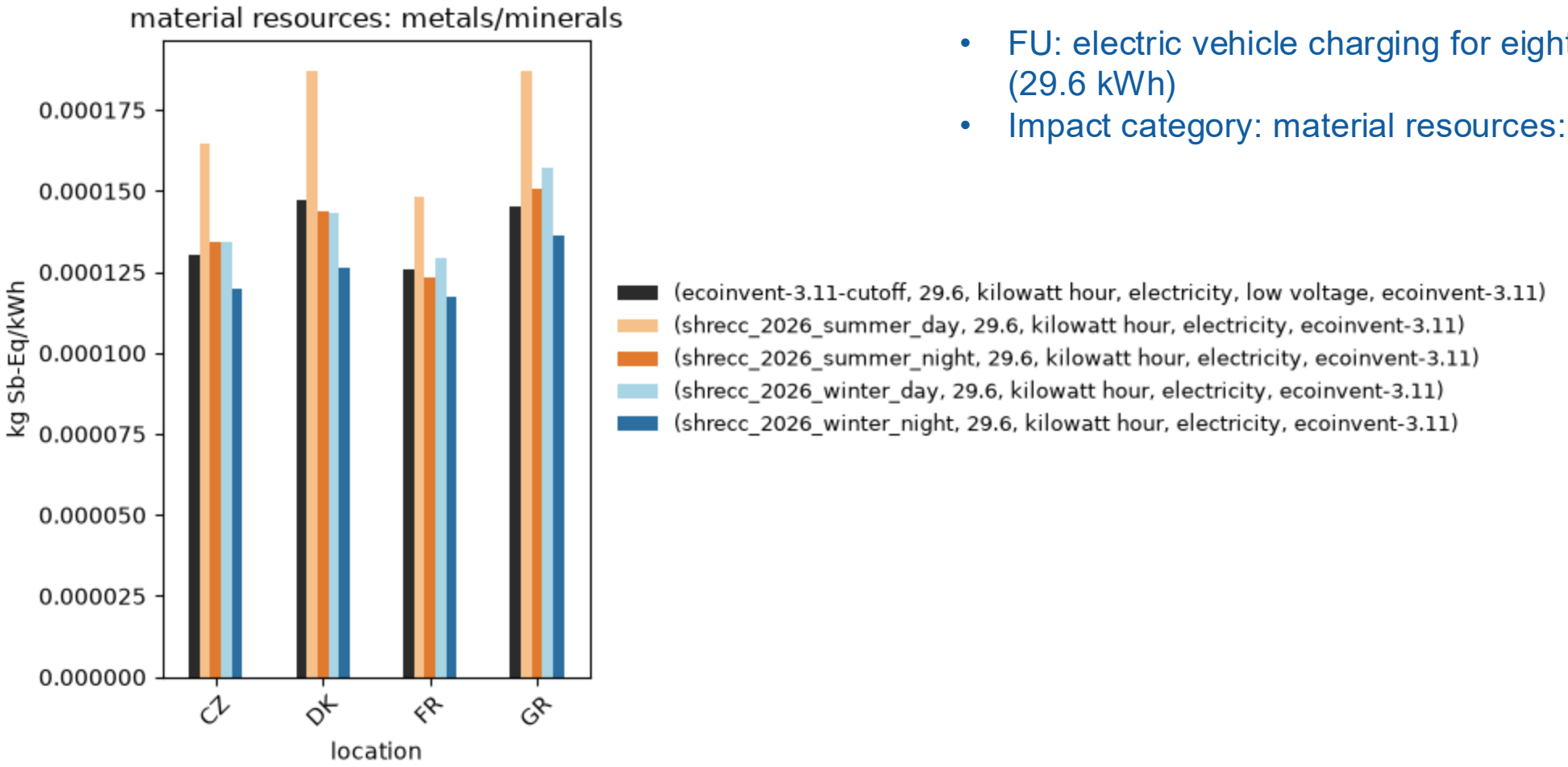


- FU: electric vehicle charging for eight hours at 3.7 kW (29.6 kWh)
- Impact category: land use

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04 | IN PRACTICE

Small case study: EV charging (retrospective data)



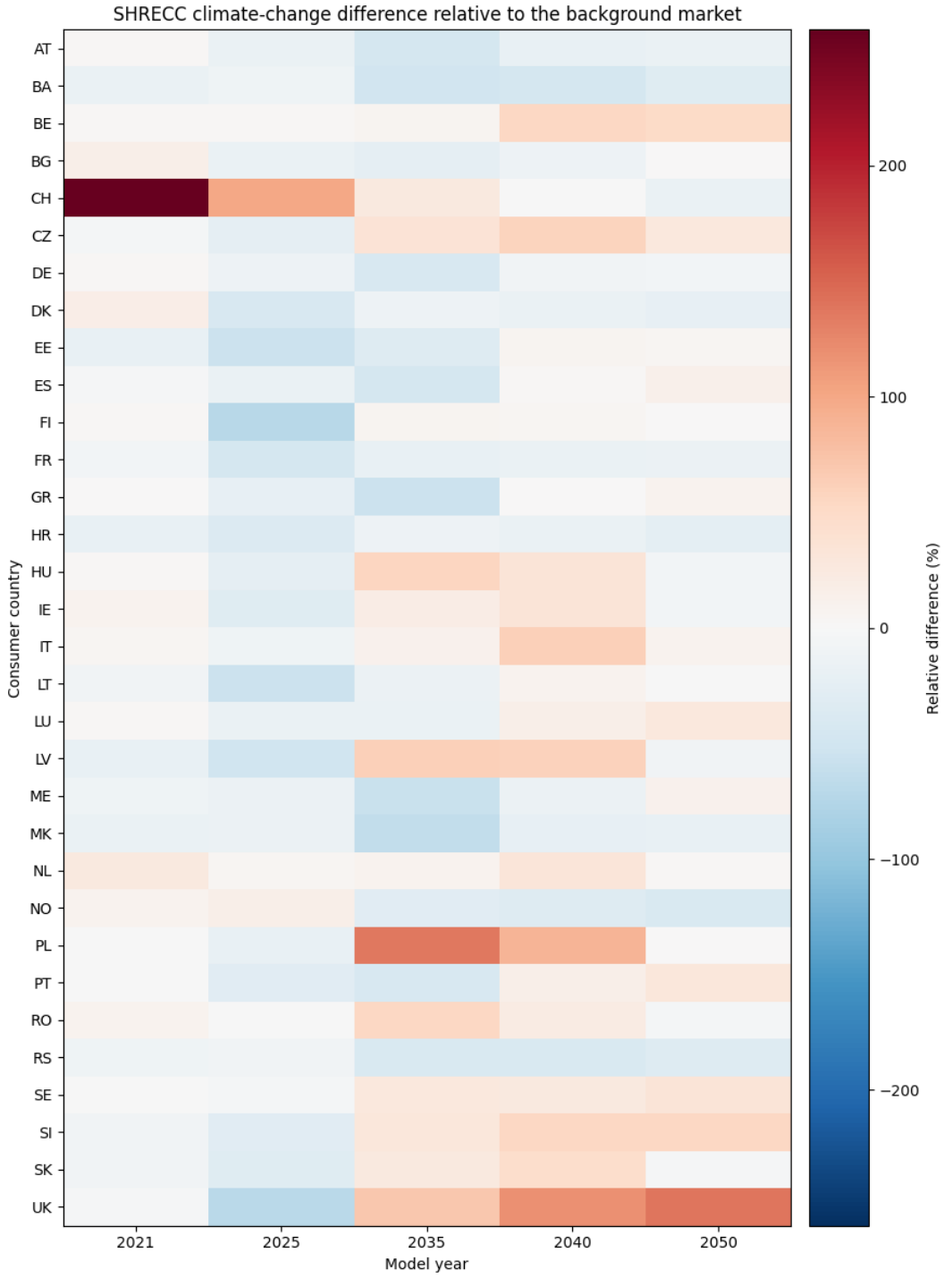
- FU: electric vehicle charging for eight hours at 3.7 kW (29.6 kWh)
- Impact category: material resources: metals/minerals

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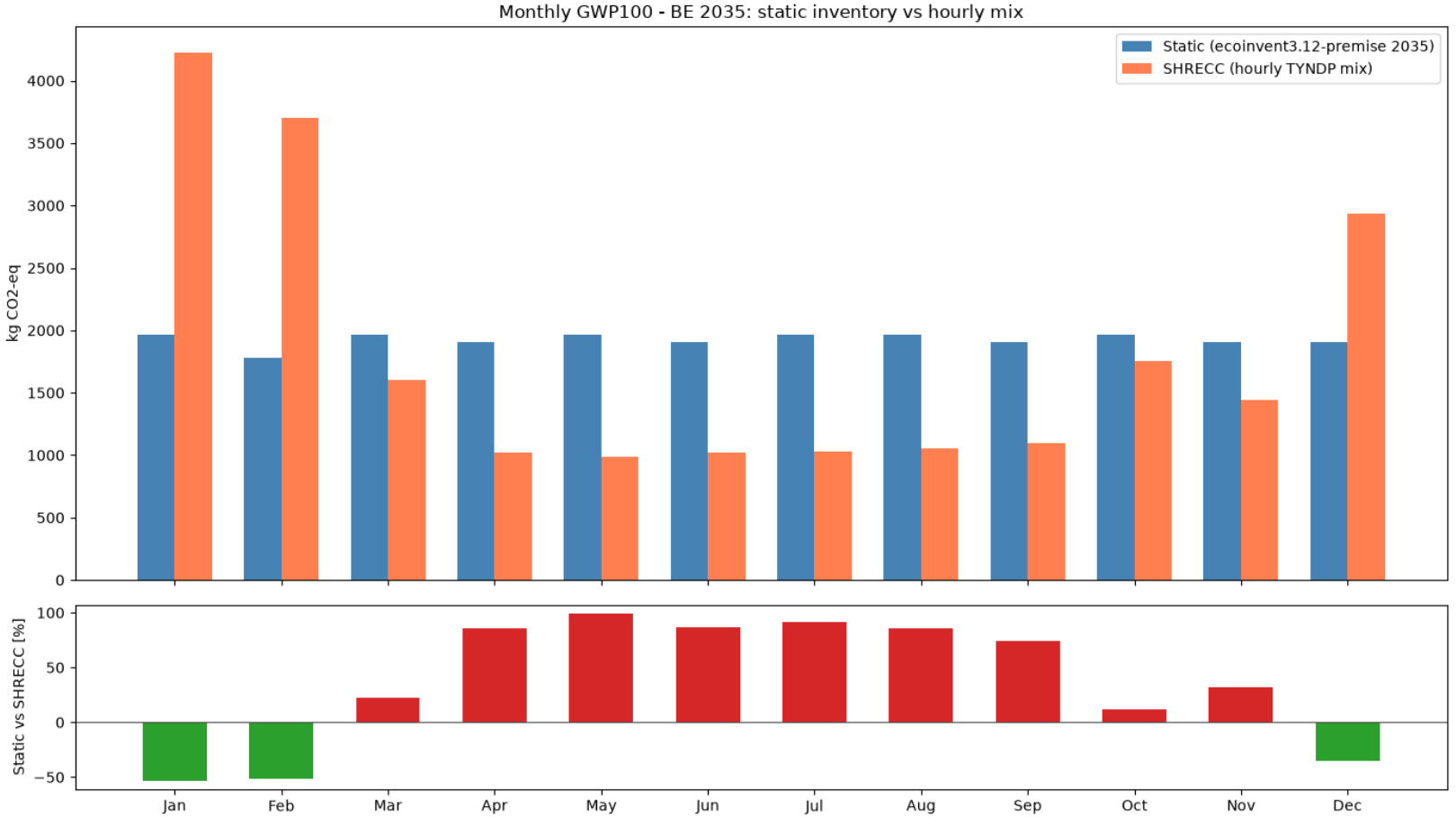
Benchmark

- From a GHG footprint perspective (g CO2 eq./kWh), historical data broadly agrees with ecoinvent 3.11 for 2021, except for Switzerland (+260%), the Netherlands (+26%), Croatia (-19%), Latvia (-19%), Estonia (-19%), North Macedonia (-17%), Bulgaria (+16%), Denmark (+16%)



04 | IN PRACTICE

Small case study: modelled hourly electricity demand of one building block in Antwerp, Belgium (future data)



05 | PUBLICATIONS

https://git.list.lu/shrecc_project/

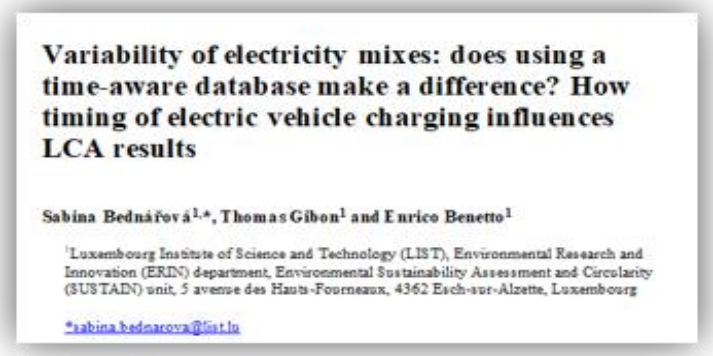
shrecc (the code)

- Can re-calculate for any given year and countries available

shrecc_data

- Easy data download
- Can go directly to database creation for years 2021-2024

https://pypi.org/project/shrecc/

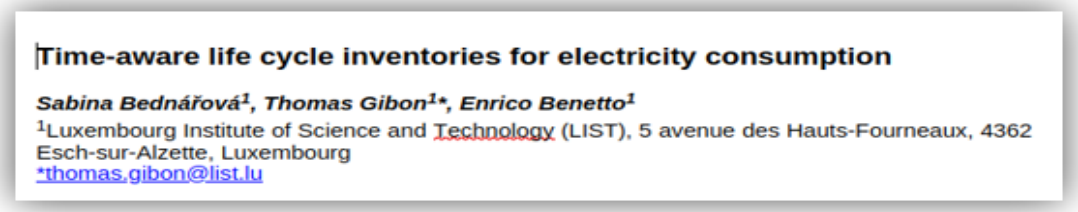

Variability of electricity mixes: does using a time-aware database make a difference? How timing of electric vehicle charging influences LCA results

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Bednářová, S., Gibon, T., Benetto, E. (2026). Variability of Electricity Mixes: Does Using a Time-Aware Database Make a Difference? How Timing of Electric Vehicle Charging Influences LCA Results. In: Traverso, M., Mankaa, R.N., Bonaffini, D., Covais, A. (eds) Life Cycle Management from Global to Local . Springer, Cham. https://doi-org.proxy.bnl.lu/10.1007/978-3-032-17987-6_4


Time-aware life cycle inventories for electricity consumption

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Bednářová, S., Gibon, T., & Benetto, E. (2025). Time-aware life cycle inventories for electricity consumption. SoftwareX, 32, 102362. https://doi.org/10.1016/j.softx.2025.102362

06 | SHRECC: CONCLUSIONS

- ✓ Directly compatible with brightway2 and brightway2.5
- ✓ Dynamic temporal representation
- ✓ All impact categories
- ✓ Ecoinvent matching
- ✓ Retrospective and future data

- ✗ Only compatible with brightway and activity browser
- ✗ No low/medium/high voltage distinction
- ✗ Only ecoinvent/premise matching

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