École Polytechnique Fédérale de Lausanne
Distributed Electrical Systems Laboratory
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http://desl-pwrs.epfl.ch

Student project proposal

Project title
A Framework for Carbon Flow Tracing in Swiss Power Distribution Grids

Project type   ☒ MSc thesis   ☐ BA semester project   ☒ MSc semester project

Project responsible and e-mail
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Project description
This project aims to enhance an existing framework for estimating the carbon content of electricity in medium/low voltage (MV/LV). By merging public electricity market data with local factors, the framework provides accurate carbon footprint estimates. In this second iteration, the student will build upon the existing framework, refining and expanding its capabilities. This effort contributes to EPFL's sustainability goals and informed energy decision-making.

Tasks of the student

- Master the existing framework and the relevant literature:
  Get familiar with the existing framework, identify potential upgrades, etc. Understand the literature.
- Include the MV grid in the framework:
  The current framework allows for carbon flow tracing in LV grids, this has to be upgraded to study the carbon flows in MV grids.
- Include more generation technologies in the framework:
  The current framework models solar generation, the future framework will include the modelling of the generation from other technologies
- Framework Development and Testing:
  Design and validate the framework, analyze the results.

Requirements

- Familiarity with electricity generation methods, energy sources (renewable and non-renewable), energy markets (wholesale, ancillary services, …), grid operations and sustainability concepts.
- Proficiency in data analysis techniques, including data preprocessing, exploratory data analysis, and statistical methods for modelling and estimation.
- Proficiency in programming languages (ideally Python or Matlab), proficiency in code management using Git.

Literature
[1] Hofmann, F., Zerrahn, A., Gaete-Morales, C., "Techno-economic criteria to evaluate power flow allocation schemes", 2020.
[2] Baowei Li, Yongshua Song, and Zechun Hu, "Carbon Flow Tracing Method for Assessment of Demand Side Carbon Emissions Obligation." 2013.
[3] Bo Tranberg, Olivier Corradi, Bruno Lajoie, Thomas Gibon, Iain Staffell, and Gorm Bruun Andresen, "Real-Time Carbon Accounting Method for the European Electricity Markets." 2019.

[4] Fleschutz, Markus Bohlayer, Marco Braun, Gregor Henze, and Michael D. Murphy, "The Effect of Price-Based Demand Response on Carbon Emissions in European Electricity Markets: the Importance of Adequate Carbon Prices." 2021.

[5] Imran Khan, "Greenhouse Gas Emission Accounting Approaches in Electricity Generation Systems: A Review." 2019.

[6] Oneto, A.E., Gjorgiev, B., Tettamanti, F., Sansavini, G., "Large-Scale Inference of Geo-Referenced Power Distribution Grids Using Open Data", 2023.