

<https://doi.org/10.7250/CONNECT.2026.032>

HIGH RESOLUTION ATTRIBUTION-BASED ACCOUNTING OF ELECTRICITY CONSUMPTION RELATED GHG EMISSIONS IN LATVIA

Maksims FEOFILOVS^{1*}, Pauls SONDORS², Agris KAMENDERS³, Francesco ROMAGNOLI⁴

^{1,3,4} *Institute of Energy Systems and Environment, Riga Technical University, Azenes iela 12/1, Riga, LV-1048, Latvia*

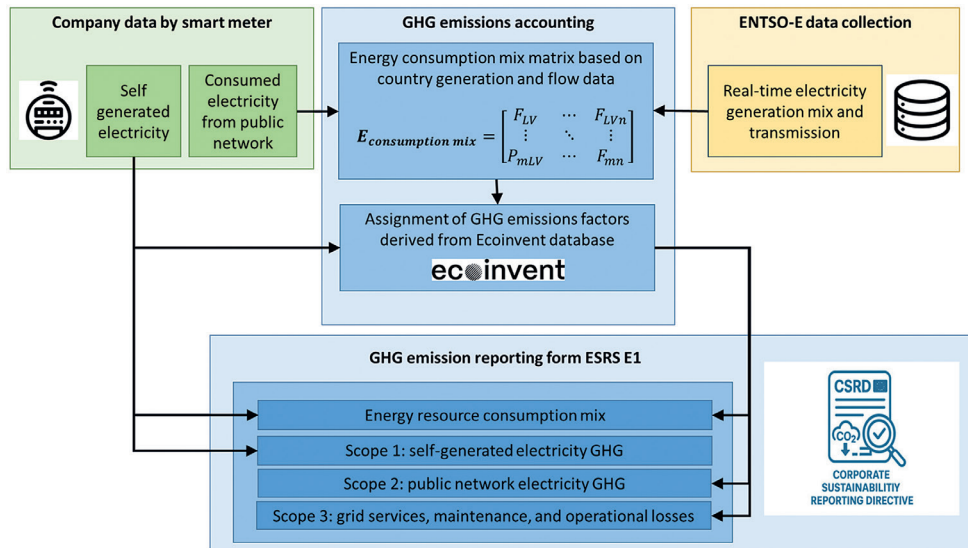
² *SIA AdvanGrid, Katlakalna iela 11, LV-1073, Riga, Latvia*

* **Corresponding author.** Email address: maksims.feofilovs@rtu.lv

Abstract – The implementation of the European Sustainability Reporting Standards (ESRS) for reporting under the Corporate Sustainability Reporting Directive (EU) 2022/2464 (CSRD) will substantially increase the demand for transparent, consistent, and methodologically robust greenhouse gas (GHG) accounting at the company level. It is expected that the upcoming ESRS E1 standard for climate disclosures will introduce detailed quantitative requirements related to energy consumption, including Scope 1, Scope 2 and Scope 3 emissions as referred in GHG protocol. Within the given frame of standards, electricity is one of the most widely consumed energy carriers across sectors and falls under Scope 2 emissions accounting and reporting. A tool for accounting electricity-related emissions under different market conditions for companies seeking to improve the accuracy of their climate reporting and perform better-informed carbon footprint management decisions. This study presents the development and application of a digital CO₂ emission accounting tool for electricity consumption within Latvia, designed to support companies in meeting the upcoming standard requirements for GHG emissions associated with purchased electricity. The methodological design of the developed tool combines corporate GHG accounting principles with electricity transmission system data and Scope 2 emissions data based on life cycle assessment (LCA) database Ecoinvent. The electricity generation emissions data are extracted from the Ecoinvent database for electricity generation types determined as significant for Latvia based on Nordpool market exchange and including Latvia, Lithuania, Estonia, Finland, Poland, Sweden, Norway and Denmark. The hourly cross-border physical flow data is further obtained from the ENTSO-E Transparency platform and processed using an attribution matrix, allowing the allocation of generated and transmitted electricity to geographical origins. Additionally, based on Ecoinvent data, the tool foresees Scope 1 emissions for onsite-generated electricity and Scope 3 emissions accounting for grid services, maintenance, and operational losses related to but not covered by Scope 2. The results demonstrate that the applied approach enables more precise estimation of electricity-related emissions than static national-average factors, particularly by tracking cross-border electricity trade. The separation of fossil and biogenic CO₂ flows, as well as the explicit treatment of CO₂ uptake. The tool provides real-time structured outputs aligned with ESRS E1 requirements and facilitates direct integration into sustainability reports. The study concludes that combining high-resolution electricity system data with LCA-based emission factors significantly enhances the accuracy and credibility of electricity emission data for corporate GHG accounting under ESRS. The proposed tool offers a practical solution for companies facing increasing reporting obligations, while also supporting internal decision-making related to energy sourcing and decarbonization

strategies. Further development should focus on consistent treatment of contractual instruments such as renewable energy certificates.

Keywords – Corporate sustainability; energy management; ESG; LCA; organisation carbon



Framework of the digital CO₂ emission accounting tool for electricity consumption

ACKNOWLEDGEMENT

This work has been supported by the European Union “NextGenerationEU fund” within the project “Development of a digital carbon footprint management and sustainability reporting tool” No. 2.2.1.3.i.0/1/24/A/CFLA/003.