

Towards carbon neutrality by 2035

Rasul Satymov and Christian Breyer
School of Energy Systems, LUT University

Finland's power sector already has low carbon intensity due to renewables and nuclear power. CO₂ emissions are falling with growing wind power and solar PV, and the addition of Olkiluoto 3. The power sector will likely be fully defossilised before 2035. The heat sector will benefit from this trend as well. Surplus wind and solar PV electricity can be used in district heating via electric boilers or heat pumps, which is highly efficient from a holistic systems perspective and leads to lower system costs. Support for continued development of heat storage solutions is essential. By coupling power and heat sectors alongside heat storage, district heating consumers will experience lower prices.

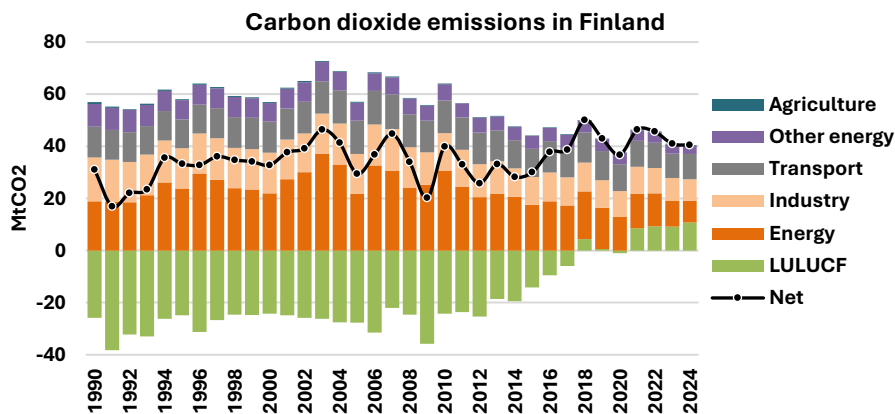


Figure 1. Carbon dioxide emissions in Finland [1].

The remaining areas of concern in terms of CO₂ emissions are the transport and industry sectors. The most reliable pathway to defossilisation in these sectors is through electrification, direct and indirect.

As of 2024, over 30% of new cars sold in Finland are already electric [2]. **Stronger incentives are needed to boost electric vehicle (EV) sales.** Annual vehicle taxes on EVs could be lowered further and **the use of fossil fuels disincentivised** by reversing the reduction in liquid fuel tax rates [3]. Import tax of used vehicles shall remain fully coupled to the CO₂ emissions to maintain a well working incentive for lower prices vehicles and broader accessibility for more people as an element of a just transition.

The electrification is already taking place in industry. This transition should be accelerated to reduce reliance on fossil fuels. Electrified industry also supports the integration of variable renewable electricity. **Maintain the financial support and incentives** [4] to continue this electrification.

Our study [5] estimates that CO₂ emissions of Finland can be reduced to 14.5 Mt by 2035, which is 26% below the 19.5 Mt projection by the Ministry of Economic Affairs and Employment [6]. Considering the uncertainty with LULUCF sink capacity, which is projected to be 21 Mt by 2035 [7], it is better to **overachieve CO₂ reductions**. Our Best Policy Scenario reaches 14.5 MtCO₂ by 2035 by electrifying 95% of all light and medium duty vehicles and 90% of buses (all fleet, not only newly added fleet) and quadrupling electricity consumption in industry (with direct electrification and indirect electrification with e-hydrogen in the steel industry). Best Policy Scenario requires **roughly 51 b€ cumulative investments** between 2025 and 2035, mostly in onshore wind power, solar PV and electrolyzers. Such enormous investments create many new jobs, build a resilient energy infrastructure, and enables new businesses, based on low-cost sustainable energy.

References

- [1] Statistics Finland, 'Greenhouse gas emissions in Finland, 1990-2024'. [Online]. Available: https://pxdata.stat.fi/PxWeb/pxweb/en/StatFin/StatFin__khki/statfin_khki_pxt_138v.px/
- [2] Teknologia Teollisuus, 'Sähköisen liikenteen tilannekatsaus – Q1/2025', Helsinki, Apr. 29, 2025. [Online]. Available: <https://teknologiateollisuus.fi/emobility/ajankohtaista/tilannekatsaukset-vuosittain/>
- [3] Vero, 'Tax rates on liquid fuels', vero.fi. [Online]. Available: <https://www.vero.fi/en/businesses-and-corporations/taxes-and-charges/excise-taxation/excise-duty-on-liquid-fuels/Tax-rates-on-liquid-fuels/>
- [4] Ministry of Economic Affairs and Employment, 'Finland's Integrated National Energy and Climate Plan Draft Update', Helsinki, June 2024. [Online]. Available: <https://julkaisut.valtioneuvosto.fi/handle/10024/165742>
- [5] R. Satymov, D. Bogdanov, T. Galimova, and C. Breyer, 'Energy and industry transition to carbon-neutrality in Nordic conditions via local renewable sources, electrification, sector coupling and Power-to-X', *Energy*, vol. 319, p. 134888, Feb. 2025, doi: 10.1016/j.energy.2025.134888.
- [6] Ministry of Economic Affairs and Employment, 'Carbon neutral Finland 2035 – national climate and energy strategy', Ministry of Economic Affairs and Employment of Finland, Helsinki, 2022:55, Sept. 2022. [Online]. Available: <https://julkaisut.valtioneuvosto.fi/handle/10024/164323>
- [7] Ministry of the Environment, 'Annual Climate Report 2022', Helsinki, 2023. [Online]. Available: <https://julkaisut.valtioneuvosto.fi/handle/10024/164809>