

ROADMAP TO DECARBONISE THE FOOD PROCESSING & PACKAGING SECTOR BY 2050

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This roadmap explores how the food processing sector can decarbonize and assesses the feasibility of achieving a near-zero-carbon cold storage sector by 2050. It selects the best technologies/ strategies with a high technology readiness level (TRL) that have the potential to reduce carbon emissions in meat processing, fish processing, dairy processing, and secondary processing in the food industry. Analysis includes emissions from refrigerant leakage and direct fuel use (Scope 1), as well as indirect emissions from the electrical grid (Scope 2).



Modelling of impacts from 2020 through to 2050

The modelling covers key segments (meat, fish, dairy, prepared foods), assessing the combined effect of state-of-the-art emissions-reducing technologies:

- Efficient refrigeration, high-temperature heat pumps, heat recovery, optimised equipment (e.g. VFDs), renewable energy (PV, biogas), natural refrigerants, advanced process controls, and improved building envelopes.
- The largest effect derives from thermal electrification and grid decarbonisation, complemented by heat recovery solutions and the transition to best-available, high-efficiency process equipment.
- Gradual adoption scenarios are used, reflecting technology maturity and suitability for each sector and country.

The results show that in all analyzed sectors, considerable GHG reduction potential by 2025

- For the meat, dairy, and fish processing sectors, if all measures are deployed and the electricity grid is fully decarbonized, it was possible to reduce emissions by almost 100%
- For the prepared meals studied, e.g., breaded fish, cooked beef (secondary processing), possible emissions reductions were by up to 91%.

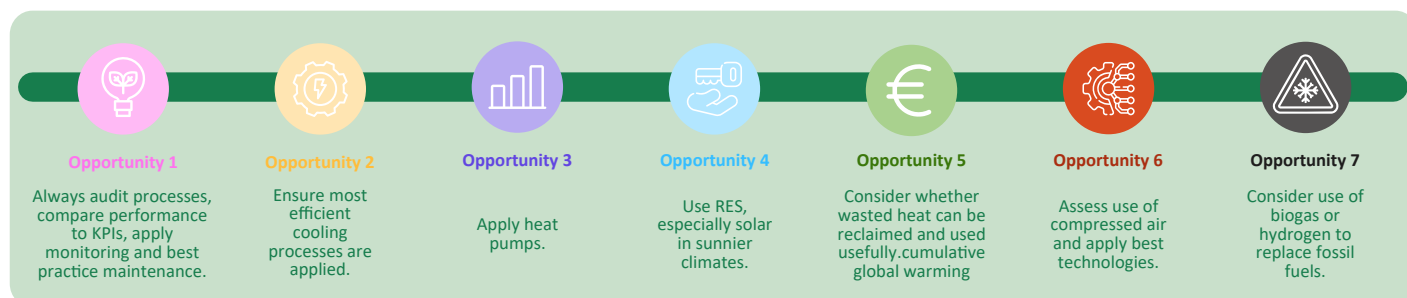
Other actions needed to achieve almost net-zero in 2050 :

- Boosting energy efficiency (heat recovery, VFDs, insulation, pressure optimization);
- Substituting fossil boilers with high-temperature heat pumps and/or advanced biomass boilers;
- Common use of natural refrigerants (CO₂, ammonia)
- Expanding renewable energy inputs (solar PV, biogas)
- Ongoing optimization through energy audits, maintenance, advanced controls, and dynamic process management

The anticipated benefit varies with each country's electricity grid carbon intensity: rapid gains are possible in countries like France and Norway, while Poland, for example, faces greater challenges due to its electricity mix.

Roadmap

From the work, this roadmap recommends 6 major opportunities to reduce carbon in cold stores.



The food processing sector could approach net zero emissions, provided best-available solutions are rapidly adopted and the national energy mix shifts as planned. Immediate action, targeted energy audits, diligent maintenance, and technology tailored to each sub-sector are key levers to maximise impact while preserving the competitiveness of Europe's food industry.

Find out more about this work: <https://enough-emissions.eu/publications/>



ENOUGH webpage: <https://enough-emissions.eu/>



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