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Possibilities in Low-Carbon Logistics Systems in Finland

Part 4: Waterborne Transport

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Contents

1. Introduction

- Vessel- and log-floating transport play a significant role in timber transport, particularly in the Vuoksi water basin. Domestic timber is also transported by vessels in coastal and archipelago areas.
- The emissions and costs per transport performance unit of the timber waterborne transport chain are clearly lower than those of road transport.
  - Greenhouse gas emissions for the different transport chains are as follows: vessel-based transport chain 32.2 g CO_2e/tkm, log-floating transport chain 20.8 g CO_2e/tkm, and road transport 48.5 g CO_2e/tkm (Poikela and Strandström 2024).
  - Waterborne transport chain cost is 4.6 cent/m³km and road transport cost 9.6 cent/m³km (Strandström 2026).
- This study examines the low-carbon potential of timber waterborne transport from the following perspectives:
  - Propulsion systems for vessels, including low-carbon and renewable fuels
  - Fleet renewal and improvements in energy efficiency
  - Development of the loading and log-floating site network
  - The length of the navigation season
  - Emissions trading and taxation of waterborne transport.

Reduction Targets for Waterborne Transport

- In the International Maritime Organization (IMO, 2023) strategy to reduce greenhouse gas emissions from ships, the objective is zero-emission / climate-neutral shipping by 2050.
  - By 2030, greenhouse gas emissions from ships are to be reduced by 20%, and by 2040 by at least 70% (compared with 2008).
- The objective of the EU Sustainable and Smart Mobility Strategy (European Commission 2020) is to increase inland waterway transport and short sea shipping by 25% by 2030 and by 50% by 2050 (compared with 2015).
- Objective V5 of the Finland's National Alternative Fuel Distribution Infrastructure Programme (Ojala et al. 2024) is that inland waterway transport and its operating conditions develop, based on regional needs, into an efficient and low-emission mode of transport for log floating, vessel transport and waterborne tourism.

Regulation Reducing Emissions from Waterborne Transport

- The EU FuelEU Maritime Regulation entered into force in January 2025.
  - The objective of the regulation is to increase the use of low-carbon and renewable fuels in maritime transport.
  - A greenhouse gas intensity index value is calculated for ships based on the energy used by the vessel. The maximum permitted greenhouse gas intensity will be reduced gradually at five-year intervals.
  - The regulation also sets requirements for the use of shore-side electricity from 2030 onwards, depending on the port's TEN-T status.
  - The regulation currently applies to ships of 5,000 GT, and extending it to ships of 400 GT has also been discussed.
- At IMO level, binding regulation to reduce greenhouse gas emissions from maritime transport is under preparation (IMO Net-Zero Framework).
  - The regulation consists of a two-tier fuel standard and emissions charges resulting from exceeding the standards.
  - Final adoption of the regulation was postponed in October 2025 by at least one year.
  - IMO regulation would be more ambitious than FuelEU Maritime, as the objective is net-zero emissions around 2050.
  - The regulation would, according to current indications, apply to ships over 5,000 GT.
- Emissions trading and taxation are examined separately in the Chapter 3.

2. Low-Carbon Solutions
a) Alternative Fuels 1

- **Current situation**
- According to Ojala et al. (2024), in international maritime transport 22% of ships in the Finnish merchant fleet used alternative fuels (LNG, biofuels, shore-side electricity, grid-charged batteries, and wind and solar power).
  - With regard to timber transport, the only known use of alternative fuels is the use of an LNG-fuelled vessel in UPM-Kymmene's imported roundwood transport.
- In Finland, the biofuel oil blending obligation applies only to light fuel oil, which is used in part of waterborne transport.
- The AFIR alternative fuels infrastructure regulation requires TEN-T network seaports to provide shore-side electricity to ships by 2029 at the latest. For TEN-T inland ports, shore-side electricity must be provided on the core network by 2024 and on the comprehensive network by 2029.
  - The shore-side electricity supply obligations and investment plans for seaports concern vessel types other than those used in timber transport. Joensuu and Lappeenranta are comprehensive TEN-T network ports and already provide electricity supply, although it does not yet meet all the requirements of the regulation.
  - With regard to LNG, Finland already meets the requirements of the alternative fuels infrastructure regulation, as LNG can be bunkered to ships in almost all ports serving international traffic (Ojala et al. 2024).

Vessels with Different Propulsion Systems in Waterborne Transport

Propulsion system	Examples
LNG/LBG	UPM’s LNG-fuelled vessels for imported timber, Viking Line’s LNG+LBG:n fuel blend, Tallink MyStar and Megastar bio-LNG
HVO	Eckerö Linehas partially used HVO in its RoPax vessels
Hybrid	Wasaline’s RoPax vessel (natural and biogas, diesel and battery-electric), ESL Shipping’s bulk carries (diesel and battery-electric), Eckerö Line’s Finlandia passenger vessel (diesel and battery-electric), Finnlines’ Finnsirius cargo vessel (diesel, battery-electric), Meriaura has ordered two bio-oil-fuelled hybrid vessels
Electric	Yara Birkeland container vessel, Viking Line aims to order two RoPax vessels in the 2030s
(E-)methanol	Laura Maersk container vessel
Hydrogen	Fuel cell: Samskip’s container vessels planned in Norway for 2027 Liquid hydrogen fuel: Energy Observer cargo-vessel concept project under way in France
Carbon capture	Royal Caribbean Group is testing onboard carbon capture and hydrogen production, a Solvang vessel in Norway
Rotor sail	RoRo vessels under construction for Airbus, also using marine diesel and methanol, Norsepower rotor sails installed on 22 vessels
WASP (Wind Assisted Ship Propulsion)	Terntank’s tanker vessel in the Baltic Sea
(E-)ammonia	Wärtsilä ammonia engine to be delivered to Skarv Shipping Solutions’ new cargo vessel
Nuclear power	No cargo vessels built in recent years, but earlier examples exist. With the development of small modular reactors (SMRs), civial ship applications have begun to attract interest (e.g. Zodiac Maritime in South Korea)

Alternative Fuels 3

- **Targets**
  - In the National Alternative Fuel Distribution Infrastructure Programme (Ojala et al. 2024), targets are presented that may be relevant to domestic timber transport:
    - To reduce emissions from inland waterway freight transport, fleet renewal and the transition to alternative fuels are as central as in maritime transport.
    - Objective V1: In Finnish ports, safe distribution infrastructure for shore-side electricity and alternative sustainable fuels will be developed in accordance with EU regulation and on a market-driven basis.
    - Objective V4 (shore-side electricity, inland ports): In accordance with the Alternative Fuels Infrastructure Regulation, ports belonging to the comprehensive TEN-T network will provide sufficient shore-side electricity in relation to demand by 2030.
    - Objective V6 (liquefied methane, seaports and inland ports): In all ports belonging to the Finnish TEN-T core network, it will be possible to bunker liquefied natural gas or liquefied biogas by 2025 at the latest. Any LNG/LBG demand of vessels operating on the Saimaa deep-water fairways will be met by a mobile bunkering point or equivalent in Mustola, Lappeenranta, by 2030 at the latest.

Alternative Fuels 4

- **Development outlook**
  - According to expert interviews conducted by Schwartz (2024), the most important short-term emission reduction measures in vessel transport are LNG, biodiesel and biogas. Many vessels are equipped with multi-fuel engines.
  - The national Alternative Fuel Distribution Infrastructure Programme (Ojala et al. 2024) assesses the outlook for propulsion systems in vessel transport:
    - Near-term biofuels include liquefied biomethane (LBG), biomethanol and biodiesel, which can largely already be used in existing vessels. Biomethane production is expected to increase both in Finland and internationally. Methanol is further advanced than many other new propulsion options in terms of both technological and regulatory development. In Finland, there are several investment projects related to hydrogen and synthetic fuels. Challenges include fuel price levels and uncertainty regarding the timetable for fuel availability.
  - As elsewhere in Europe, Finland also has projects for renewable maritime fuel production plants (e.g. the P2X Solutions methanol plant in Joensuu).
  - Low-emission fuels required in international maritime transport are expensive and their availability is limited (Sweco 2025). In inland waterway transport, investment opportunities in new propulsion systems are more limited than in maritime transport (Ojala et al. 2024).
- **Impacts**
  - In a study on auxiliary vessels used in log floating (Ketoja 2024), renewable fuel oil was found to be the most cost-effective propulsion option, reducing emissions by 82% and increasing propulsion costs by EUR 6,600 per year, while keeping the vessel acquisition cost unchanged. Battery, fuel-cell and hybrid solutions currently increase costs significantly.
  - Kalliovalkama (2023) and Vanhanen et al. (2022) have compared the cost impacts of biofuel oil, LNG, methanol and ammonia in larger cargo vessels.

b) Fleet Renewal and Energy Efficiency

- **Current situation**
  - The average age of the fleet used in domestic timber waterborne transport is high. There is no consolidated information on the timing of engine replacements. Old diesel engines are inferior to modern engines in terms of emissions and energy efficiency.
- **Objectives**
  - The visions of the Logistics Vuoksi network are: “An environmentally friendly and versatile fleet serves inland waterway transport users year-round” and “Dockyard activity in the waterway region participates in new vessel construction.”
  - In Finland’s Distribution Infrastructure Programme (Ojala et al. 2024), fleet renewal has been identified as one of the emission reduction measures for inland waterway freight transport.
- **Development outlook**
  - New towing vessels for log floating are currently being designed. The first of these could enter operation towards the end of the 2020s (YLE 2025).
  - Other means to improve the energy efficiency of vessel transport include reducing empty runs, lowering speed, an energy-efficient hull form, technical upgrades during dockings, propeller efficiency and waste heat recovery (Schwartz 2024).
- **Impacts**
  - Cost and emission impacts have not been assessed in this study.

c) Port and Loading Site Network

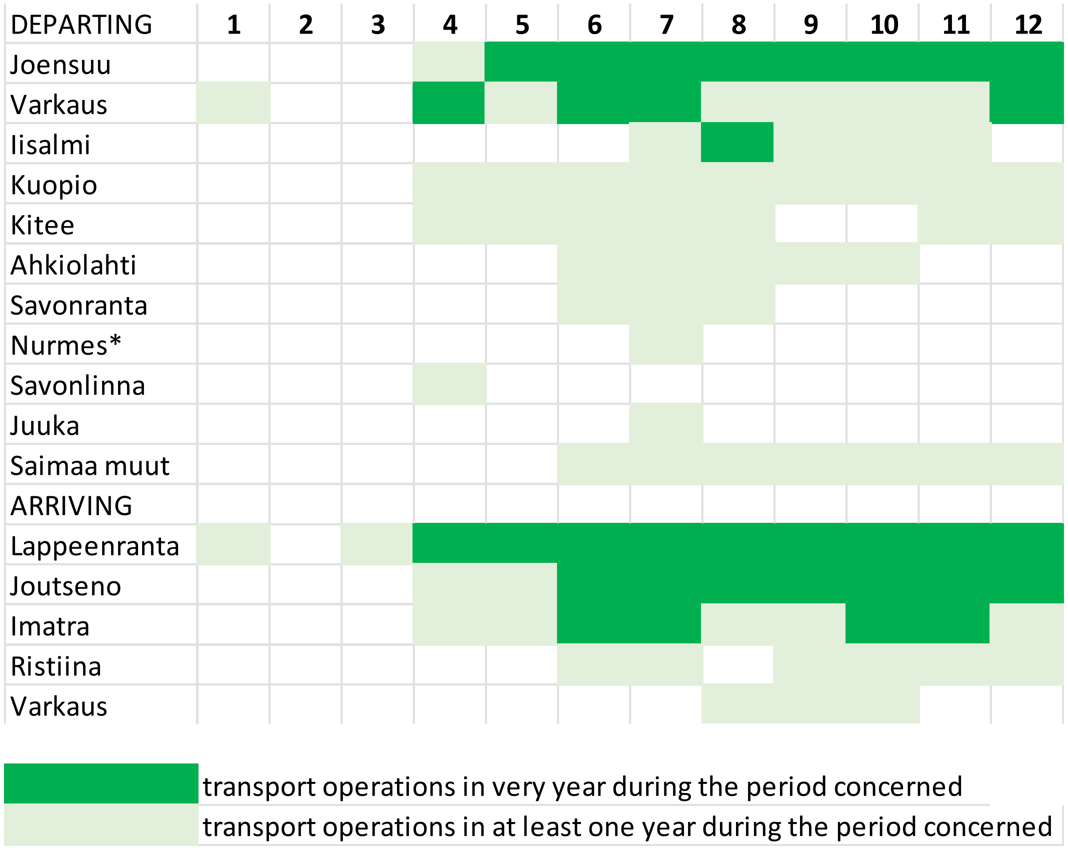
- **Current situation**
  - In the Vuoksi water system, there are around 10 active ports and loading sites and 16 log-floating sites used for inland waterway transport of timber.
- **Objectives**
  - There is no specific target for the network of loading and log-floating sites, but a Metsäteho study mapped the impacts of potential new sites and the reactivation of existing sites on emissions from vessel-based timber transport (Venäläinen et al. 2025).
- **Development outlook**
  - The Metsäteho study identified potential new loading and log-floating sites that could reduce transport emissions. The most significant development projects at existing sites are under way in Nurmes, Kitee, Joensuu and Peltoniemi.
- **Impacts**
  - According to the Metsäteho study (Venäläinen et al. 2025), the greatest emission reduction potential in timber transport would be at the Märäjälahti, Retulahti, Putikko and Yara loading sites and at the log-floating site of the Nurmes port.
    - The reference figure for emission reduction potential has been calculated based on harvesting potential and transport distance savings.
  - The impacts of ongoing development projects on the growth of vessel transport volumes and thus on emission savings were not assessed.

d) Extending the Shipping Season

- **Current situation**
  - At most, the shipping season of mill ports receiving timber is 9–11 months (see next slide). At departure ports, the shipping season is at most 9–10 months. In some ports, traffic is only occasional, so ice conditions limit year-round vessel operations only to some extent.
  - A couple of ice-strengthened vessels are used in inland waterway transport of timber.
  - Icebreaking services in the Vuoksi water system are provided by Mopro with two vessels. The independent icebreaking bow previously used in the Vuoksi water system remained on the coastal side after the closure of the Saimaa Canal.
- **Objectives**
  - The vision of the Logistics Vuoksi network developing inland waterway transport (2025) is that “an environmentally friendly and versatile fleet serves inland waterway transport users year-round”.
  - The Transport 12 Plan (Finnish Government … 2025) mentions a study on user needs for inland waterway transport, including the operational reliability, usability and length of the navigation season of fairways.
- **Development outlook**
  - Extension of the shipping season could be promoted by investments in new ice-strengthened vessels and by rising temperatures resulting from climate change.
- **Impacts**
  - Extending the shipping season would support an increase in waterborne transport volumes and improve cost-effectiveness, for example through higher utilisation rates of the fleet, and would generally improve the operating conditions for waterborne transport (e.g. improved utilisation and availability of personnel).

Length of the Shipping Season

Inland ports



Statistics Finland 2025

3. Taxation and Emissions Trading in Waterborne Transport

- Maritime emissions trading (ETS1)
  - launched in 2024 and fully implemented in 2026
  - applies to ships of at least 5,000 gross tonnage
    - The regulation does not apply to vessel sizes used in domestic timber transport or to inland waterway transport.
    - The EU Commission is expected to present a proposal during 2026 to extend emissions trading to smaller vessels (at least 400 gross tonnage).
  - In 2025, emissions trading covered CO_2 emissions, and from 2026 also methane and nitrous oxide emissions.
- A background study for the comprehensive reform of transport taxation and funding in Finland (VERA) has been completed (Ministry of Transport and Communications and Ministry of Finance 2026).
  - Fairway dues are charged on ships arriving in Finland and operating between coastal ports (i.e. not on inland waterway transport).
  - Fuel used in international commercial shipping and domestic commercial waterborne transport is exempt from excise duty.
  - Emissions trading for fossil fuel distribution (ETS2) will be extended nationally to fuels used by smaller vessels from 2028 onwards.
    - Operators that receive tax-exempt fuel through separate distribution are excluded from emissions trading. A refund scheme may possibly be introduced for operators entering the emissions trading system.
- The revision of the EU Energy Taxation Directive also includes proposals concerning the taxation of maritime fuels.

4. Conclusions and Further Research Needs

- Timber waterborne transport has lower emissions and costs per transport performance unit than road transport. However, the share of waterborne transport in total domestic timber transport is only a few per cent.
- The wider use of waterborne transport is hindered, among other factors, by interruptions to the shipping season in mid-winter, limited vessel capacity, and constraints in the infrastructure of production facilities for receiving waterborne timber.
- The fleet used in domestic timber waterborne transport is very old, so fleet renewal could not only reduce emissions but also improve ice-going capabilities.
- In recent years, the potential use of alternative propulsion systems for small-scale waterborne transport vessels has also been investigated. New research on the topic is due to be completed during 2026.
- A key challenge in fleet renewal is the small size of companies providing vessel transport services, meaning that new types of solutions are needed to finance investments.

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