TOWARDS A COMPETITIVE AND FOSSIL-FREE INDUSTRY: FINLAND'S STRENGTHS IN THE TRANSITION OF THE CHEMICAL INDUSTRY

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GROWTH FROM FOSSIL-FREE CHEMISTRY

The phase-out of fossil fuels and raw materials in the chemical industry represents a significant economic and societal opportunity for Finland. Finland can harness the domestically available biogenic carbon dioxide and renewable electricity required for this transition as sources of economic growth and welfare. In Europe, only Sweden has comparable conditions alongside Finland, making this a unique opportunity. Seizing this opportunity requires national commitment and active influence on European Union regulation, so that the chemical industry has the conditions necessary for the transition and Finland has the ability to attract investments and high value-added production.

This report provides an overview of the prerequisites and challenges facing Finland's chemical industry in transitioning to a fossil-free future. For the report, representatives of five chemical companies operating in Finland and active in the Power-to-X Economy were interviewed. In addition, demand forecasts for e-methanol, that is strongly linked to a fossil-free chemical industry, were assessed using European Union regulations and the strategies of international transport organizations. The report highlights the opportunities and challenges of the Finnish chemical industry's ability to phase out fossil resources and offers recommendations to promote this transition.

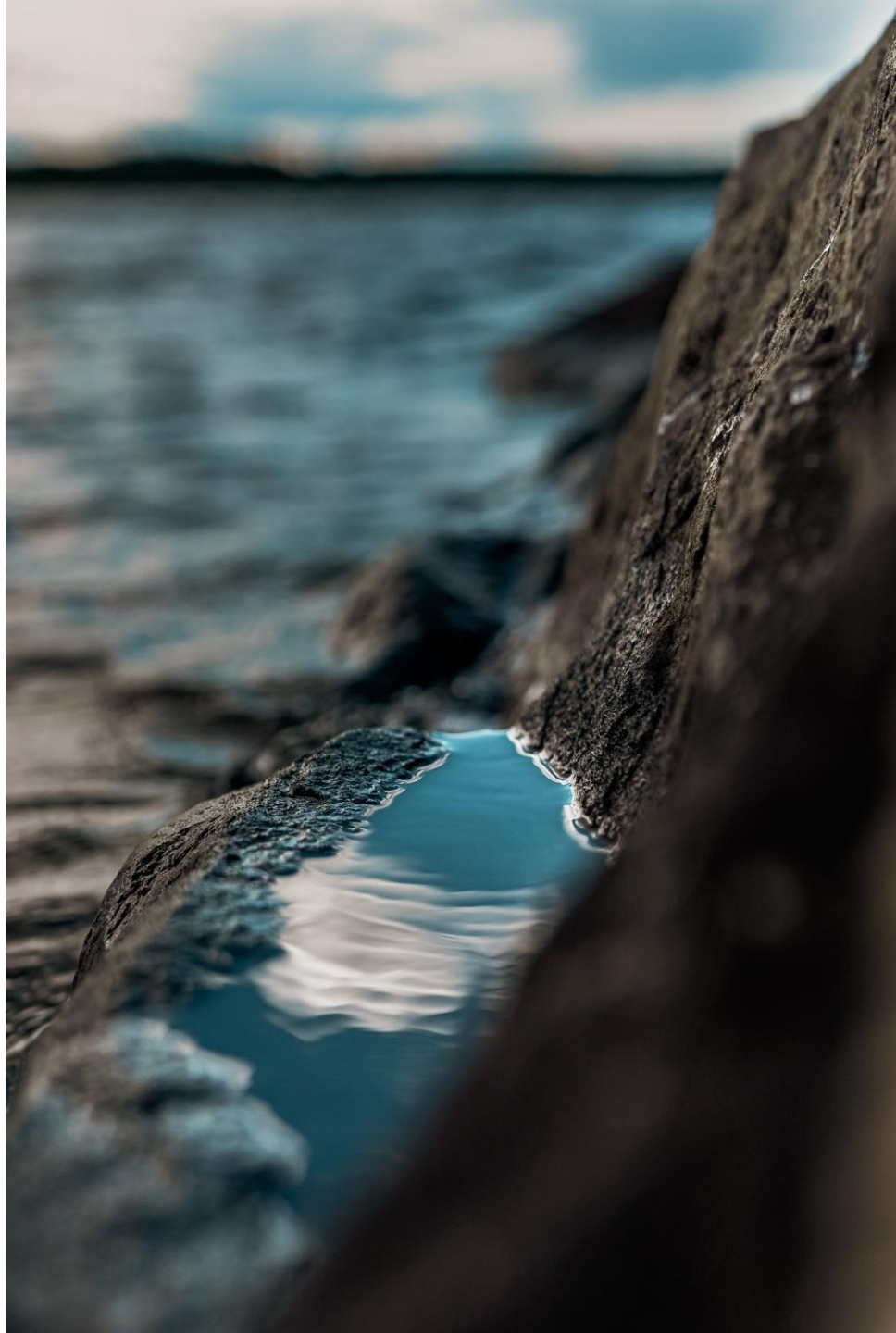
The key message from the chemical industry was that the sector is not currently transitioning towards fossil-free production. The most important measures for advancing the transition are the development of demand and competitiveness for fossil-free products. Opportunities for the utilization of carbon dioxide must also be expanded, and the availability of renewable energy must be improved.

THE KEY RECOMMENDATIONS ARE:

1. Ensuring the sufficiency and utilization of carbon dioxide and renewable electricity

2. Strengthening demand for fossil-free products of the chemical industry through EU regulation

3. Equalizing the production costs of fossil-free products in comparison to fossil-based alternatives



INTRODUCTION: ECONOMIC SIGNIFICANCE OF THE CHEMICAL INDUSTRY

THE ROLE OF THE CHEMICAL INDUSTRY IN FINLAND AND EUROPE

The chemical industry is one of the cornerstones of the European Union (EU) economy. The EU is the world's largest exporter of chemicals and the second-largest producer of chemicals globally. The chemical industry accounts for approximately 20% of EU exports and is the EU's second-largest export sector. However, the EU's share of the global chemicals market has halved over the past 20 years, while China has significantly increased its market share. The chemical industry is also the second-largest industrial source of carbon dioxide emissions in Europe.

In Finland, the chemical industry is the largest export sector, accounting for around 20% of the country's exports. Chemical companies are also among the largest in Finland in terms of turnover. In addition, the chemical industry produces approximately 9% of Finland's carbon dioxide emissions, making it one of the most significant sources of emissions in the country.

> The production of e-methanol benefits the Finnish economy, increases employment, and offers growth opportunities. It also create a brand image of Finland as a frontrunner in the industry.

The production of chemical products and fuels is subject to several EU-level regulatory mechanisms. Aviation and maritime transport are governed by the ReFuelEU Aviation and FuelEU Maritime regulations. The most comprehensive mechanism is the EU Emissions Trading System (EU ETS), which covers emissions from industry as well as from aviation and maritime transport. Until 2025, industrial companies covered by emissions trading have received emission allowances free of charge, but this free allocation will be gradually phased out by 2034. During the phase-out of free allocation, the Carbon Border Adjustment Mechanism (CBAM) will be introduced in stages to ensure that a carbon price is paid on fossil-based products imported into the EU. The aim of the mechanism is to prevent the relocation of industrial emissions outside the EU.

As a result of the free emission allowance phase-out, industrial emission costs will rise significantly. At the same time, CBAM enables fossil-free products to be imported into the EU without a carbon charge. These factors may pose a threat to Europe's competitiveness if European industry does not abandon the use of fossil fuels as sources of energy and raw materials. The report found that, for example, China has favorable conditions to export fossil-free products to the EU market in compliance with CBAM.

Societal benefits of a fossil-free chemical industry:

1. **Independence of fossil fuels** – Biogenic carbon dioxide emissions from the forest and energy industries can be converted into valuable raw materials for the chemical industry. The production of fossil-free chemicals and fuels helps avoid fossil carbon dioxide emissions and the resulting emissions-related costs.
2. **Economic growth** – The chemical and technology industries have significant potential to increase exports. In addition, new investments create new companies, jobs, and business opportunities.
3. **Resilience** – The sustainable production of chemicals and fuels from domestic raw materials using renewable energy strengthens Finland's security of supply and energy security. Phasing out fossil fuels and their import reduces international dependencies and lowers geopolitical risks.

OVERVIEW: E-METHANOL AND RAW MATERIAL DEMAND ESTIMATES IN EUROPE

e-METHANOL AND RAW MATERIAL DEMAND ESTIMATES IN EUROPE

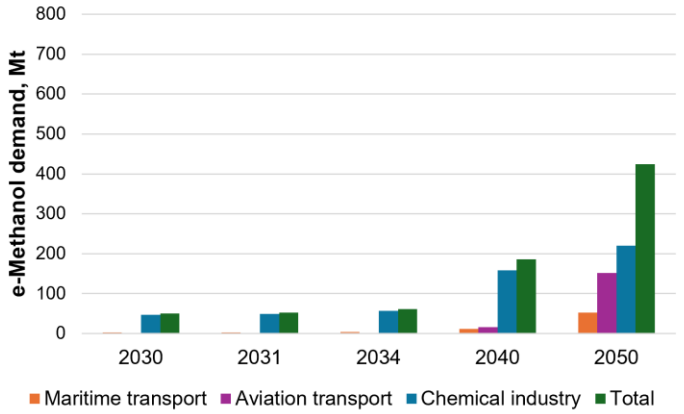
e-Methanol is expected to become one of the most important platform chemicals in the fossil-free chemical industry. Demand for e-methanol in Europe's chemical industry as well as in aviation and maritime transport was assessed using EU regulations and the strategies of transport organizations. Demand for e-methanol in the chemical industry arises from regulation related to emission reduction. Demand from aviation and maritime transport is linked to the ReFuelEU Aviation and FuelEU Maritime regulations. The requirements for biogenic carbon dioxide and renewable electricity needed to produce e-methanol were estimated using modeling conducted for this report.

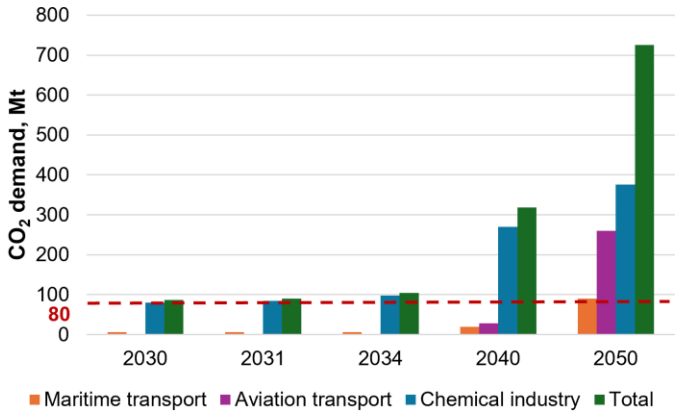
The chemical industry will initially account for the majority of e-methanol demand. In the transport sector, demand is expected to begin to rise in the 2040s and 2050s. By 2030, demand for e-methanol is already nearly five times higher than Europe's current demand for fossil-based methanol.

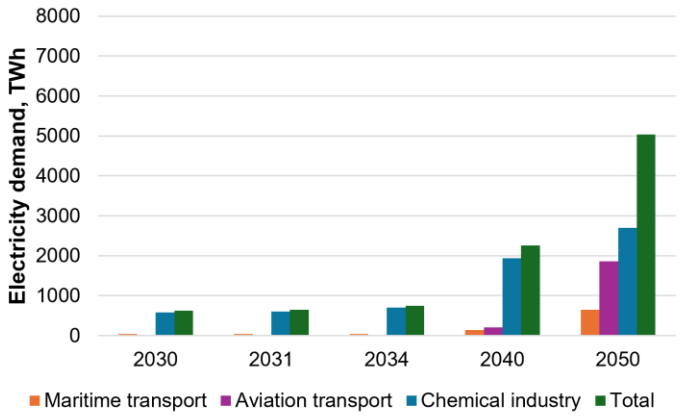
Demand for e-methanol is expected to grow explosively. However, sources of biogenic carbon dioxide will not be sufficient to meet this demand. Europe's renewable electricity generation will also need to be quadrupled to meet demand.

Carbon dioxide derived from biomass is currently the only category of carbon dioxide permitted under the EU's Renewable Energy Directive (RED III) to produce carbon-based products after 2040. Biogenic carbon dioxide is primarily sourced from the pulp and paper industry as well as from biomass-fueled thermal power plants. Annual carbon dioxide emissions from the EU's pulp and paper industry amount to approximately 80 million tonnes, of which Finland accounts for 24% and Sweden for 30%. Modeling conducted for the report found that, even if fully utilized, emissions from the EU's pulp and paper industry would be sufficient to meet the demand only in 2030.

In 2024, the EU produced 1,300 terawatt-hours of renewable electricity. Based on the report's modeling, meeting demand for e-methanol would require renewable electricity generation capacity to be quadrupled by 2050. Finland has excellent potential to expand onshore wind power in particular. Estimates suggest that Finland's onshore wind power capacity could be increased by more than 1,600 terawatt-hours, while Finland's current annual electricity consumption is approximately 80 terawatt-hours. Converting Finland's biogenic carbon dioxide emissions into e-methanol would require approximately 170 terawatt-hours of renewable electricity, which would in turn require tripling Finland's current total electricity consumption.







OVERVIEW: FOSSIL-FREE CHEMICAL INDUSTRY IN FINLAND

FOSSIL-FREE CHEMICAL INDUSTRY IN FINLAND

The report's key finding was that no major investments aimed at advancing fossil-free chemicals production are expected in Finland. Companies felt that current EU regulation does not provide sufficiently strong incentives to implement the transition, even though the phase-out of the free allocation of emission allowances is known in advance. EU-level regulation was seen as an essential factor in promoting the phase-out of fossil fuels and in creating demand for fossil-free products, but in the case of the chemical industry this regulation was considered inadequate. As a point of comparison, the EU regulation applied to aviation transport was cited, as it is seen to create demand for fossil-free aviation fuels.

Company representatives emphasized that Power-to-X (PtX) technologies will play a significant role in a fossil-free chemical industry. However, challenges related to the use of PtX technologies include limited experience at industrial scale and the weak competitiveness of PtX products compared with cheaper fossil-based alternatives. Significant uncertainty was also associated with demand for e-methanol, as the market is still in an early stage of development.

The report also strongly highlighted that individual companies are not able to implement the transition on their own. Building a PtX value chain requires broad-based synergy among companies within the value chain in order to share expertise as well as technology and market risks.

Despite the challenges associated with achieving fossil-free production in the chemical industry, companies in the sector identified Finland's competitive advantages, biogenic carbon dioxide and renewable electricity, in international markets. The interviewees emphasized the importance of domestic processing of fossil-free raw materials to ensure that the value added from higher-value products, such as chemicals and fuels, remains in Finland.

1. The transition of the chemical industry has not yet begun.
2. EU-level regulation can play a crucial role in promoting the phase-out of fossil fuels.
3. A fossil-free chemical industry offers significant growth opportunities, and Finland has excellent potential to act as a frontrunner.

Power-to-X (PtX) = technologies utilizing renewable electricity and fossil-free raw materials to produce electricity-based products, such as e-hydrogen, e-fuels, and e-chemicals.

OVERVIEW: PROPOSED ACTIONS

PROPOSED ACTIONS

EU-level actions

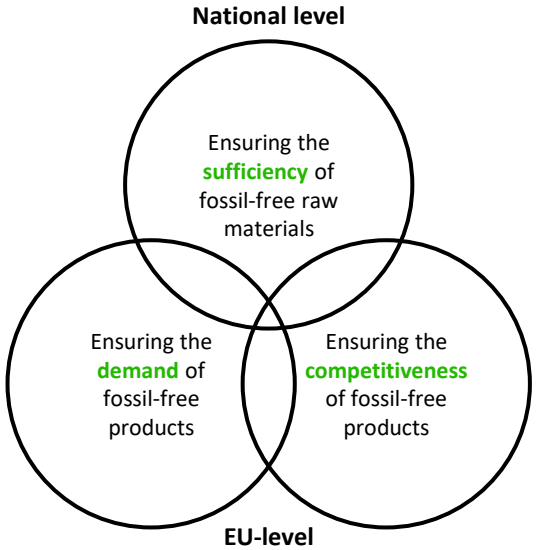
Sources of biogenic carbon dioxide are limited within the EU and are largely concentrated in Finland and Sweden. Other point sources of carbon dioxide should be considered for approval alongside biogenic carbon dioxide. Hard-to-abate emission sources, such as waste incineration and cement production, offer potential sources of carbon dioxide, as their utilization would reduce the need for fossil fuel use.

The interviewed companies emphasized the importance of EU-level regulation, particularly in creating demand and markets for fossil-free products of the chemical industry. Blending mandates included in regulatory frameworks have been shown to create and secure markets for fossil-free products in cases where they would otherwise not be competitive with fossil-based alternatives.

Fossil-free products of the chemical industry are initially more expensive than fossil-based alternatives, as they must cover the costs associated with avoiding the use of fossil fuels. The transition of the chemical industry to fossil-free production requires narrowing this price gap, for example by reducing subsidies for fossil-based products and introducing potential additional charges.

National actions

Finland has excellent conditions for the utilization of biogenic carbon dioxide. Processing requires carbon capture and utilization projects as well as a substantial expansion of renewable electricity generation capacity. Finland's Ministry of Economic Affairs and Employment should develop a national strategy for the industrial utilization of carbon dioxide to initiate such projects. Finland can influence the development of EU regulation, particularly in creating demand, through implementation dialogues, reality checks, and feedback to Commission calls for evidence and facts. In these contexts, Finland can highlight the specific characteristics related to the transformation of its chemical industry.



Economic impacts in Finland and Europe if the phase-out of fossil fuels in the chemical industry is not realized:

1. **Rising emissions costs** – The phase-out of the free allocation of emission allowances in 2034 will impose annual costs of up to hundreds of millions of euros on producers of fossil carbon dioxide emissions.
2. **Finland's economic growth remains subdued** – The positive economic impacts of the chemical industry's transition in Finland will fail to materialize if Finland's biogenic carbon dioxide and renewable electricity are not utilized in the transition.
3. **The European chemical industry declines** – The EU's share of global chemical markets continues to decrease. The full entry into force of the Carbon Border Adjustment Mechanism in 2034 will allow fossil-free chemicals to be imported into the EU without carbon charges. Exporting countries may meet the EU's demand for fossil-free products instead of these products being manufactured within the EU.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