



Clean fuel solutions

Decarbonising freight transport
along the Scandria[®]Corridor

scandria-alliance.eu

Content

Introduction

1

Decarbonising freight transports
along the Scandria®Corridor

2

European strategies and instruments
fostering climate-smart transport

3

Scandria®Corridor and
European Transport Corridors

4

Corridor Map

6

**Clean fuels in ports, terminals
and city logistics**

H2 retail

7

Cityporto Padua

Elektra

8

CPL

Four Ports & Blue Supply Chains

9

Ship-aH2oy

10

**Clean fuels in long distance
heavy-duty transport**

Clean Alps crossing

11

GREATER4H & HyTruck

e-Roads

12

Fully electric

Green Energy Stations

13

REEL

Conclusions

14

Driving decarbonisation
of freight transport

16

Ambitious policy
framework expected

Decarbonising freight transports along the Scandria®Corridor

Supporting the decarbonisation of transports through cooperation is one of the core objectives of the Scandria®Alliance. While other sectors have achieved significant reductions of greenhouse gas (GHG) emissions during recent decades, the transport sector has shown an opposite trend. Between 1990 and 2021, GHG emissions from road transport have increased by 21 % within the European Union (EU), those from heavy-duty trucks and busses even by 28 %. And freight transport volumes in the EU are expected to show further growth: by around 25 % until 2030 and by 50 % until 2050.

+21 %

increase of the transport sector's greenhouse gas emissions in the European Union between 1990 and 2021. Source: Eurostat (EUA)

+56 %

projected growth of freight transport activity within the European Union by 2050. Source: European Commission (COM(2020) 789 final)

-90 %

reduction target for the transport sector's greenhouse gas emissions by 2050 compared to the 1990 level as defined in the European Green Deal

These figures show that decisive measures are needed to reach the policy goals defined by the European Green Deal: a reduction of the transport sector's GHG emissions by 90 % until 2050 and 55 % until 2030 compared to the 1990 level.

Compared to passenger transport, decarbonisation of freight transport is still in an initial phase where

different technological concepts are being explored. Organised by private stakeholders and international by nature, stakeholders need to be in constant dialogue with each other across sectors and borders to make progress. By setting right framework conditions, also cities and regions can indirectly influence the decarbonisation pathway in freight transport. Incentivising the use of clean fuels and disincentivising the use of fossil fuels is one example for this.

With this brochure, we want to highlight some already applied solutions for decarbonising freight transports along the Scandria®Corridor – be it in long-distance transports or on the last mile within urban nodes.

A special focus is on the following three areas:

- **port handling,**
- **city logistics,**
- **long distance heavy-duty transport.**

This brochure is the result of the work of the Scandria®Alliance task force on clean fuels. This task force acts as platform bringing together clean fuel deployment projects along the ScanMed corridor. It promotes a multi-fuel approach and has dealt with battery-electric, hydrogen, liquid biogas (LBG) / compressed biogas (CBG) from renewable sources as possible propulsion technologies.

Being aware of the complexity of clean fuels development in the freight transport sector and not claiming to be exhaustive, this brochure shall inspire by sharing the knowledge about existing solutions across borders. The Scandria®Alliance's members are convinced that we need more collaboration across borders to make climate-smart freight transports along the Scandria®Corridor a reality!

European strategies and instruments fostering climate-smart transport

The European Green Deal strives for climate neutrality by 2050. To accelerate its implementation, the EU adopted the Fit-for-55 package, aiming at a reduction of GHG emissions by 55 % until 2030. For the transport sector, GHG emissions need to be reduced by 55 % for passenger cars and 50 % for heavy-duty vehicles until 2030 compared with 1990 levels.

The package contains a set of legislative proposals, addressing emissions trading, CO₂ emissions standards for heavy-duty vehicles, alternative fuels infrastructure or sustainable aviation. Specifically, the Alternative Fuel Infrastructure Regulation (AFIR) requires member states to provide sufficient recharging or refuelling infrastructure.

The goals of the European Green Deal are also reflected in the EU's trans-European transport network (TEN-T) policy. The European Commission's proposal for a revised TEN-T regulation clearly emphasizes cleaner and smarter mobility. Beyond fostering modal shift, it requires new TEN-T infrastructure to comply with the provisions of the AFIR. The proposal seeks to strengthen the concept of urban nodes and requires member states to focus more on multimodal freight terminals and ports, e.g. related to the provision of onshore power supply or LNG refuelling points.

TEN-T policy is an important cornerstone of the New EU Urban Mobility Framework. In line with 21st century challenges of climate protection and social inclusion, the framework shifts focus from an approach based on traffic flows to an approach based on moving people and goods more sustainably, including efficient zero-emission urban logistics and last mile deliveries.

In the current Multiannual Financial Framework 2021–2027, the Commission supports climate friendly transport by several instruments. The Connecting Europe Facility (CEF) provides nearly € 26 billion for transport, including decarbonisation measures. The Horizon Europe research and innovation programme dedicates € 15 billion to address global challenges and European industrial competitiveness in the climate, energy and mobility sectors. € 800 million have been allocated to the transnational Interreg Programmes Baltic Sea Region, Central Europe, Danube and Alpine Space, providing the opportunity to strengthen competence of public stakeholders to manage the transition to climate-neutral societies.

Scandria® Corridor and European Transport Corridors



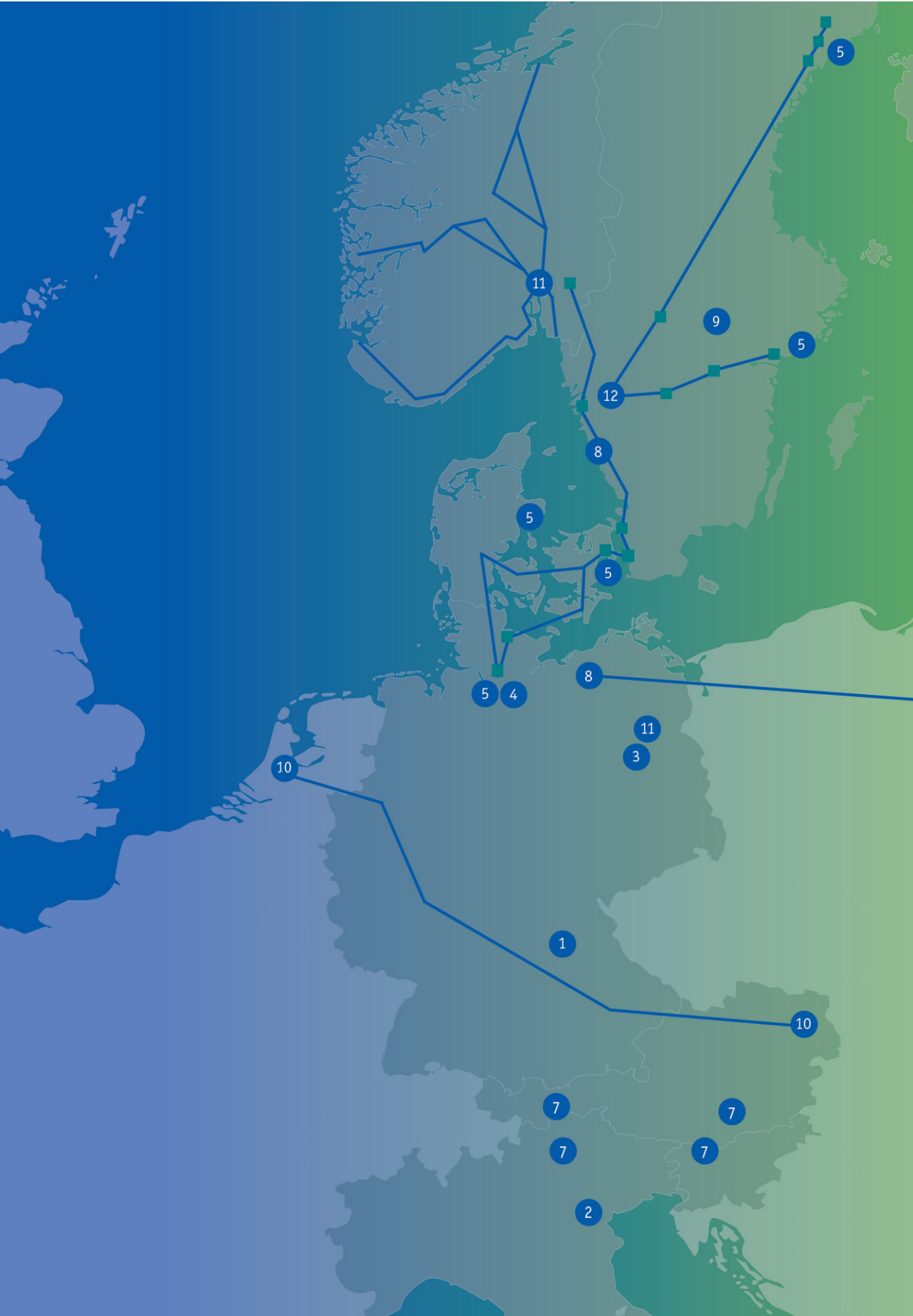
To coordinate the development of the trans-European Transport Network, the European Transport Corridors (ETC) have been introduced as governance mechanism. Facilitated by a European Coordinator, a Corridor Forum involves relevant stakeholders in the corridor development.

The Scandria®Corridor complies to a great extent with the Scandinavian-Mediterranean (Scan-Med) corridor and includes Northern parts of the ETC Orient / East – Med and southern parts of the ETC Baltic – Adriatic, connecting Scandinavia to the Adriatic Space. Currently, the members of the Scandria®Alliance represent cities and regions along the Scandria® Corridor with more than 20 million inhabitants from Finland, Sweden, Norway, Germany, and Italy.

Its members are united by a common vision: to connect regions, communities, and economies through clean and smart transportation.

The projects and initiatives presented in the following sections of this brochure focus on the Scandria® Corridor geography. They aim to represent forerunners and sources of inspiration for other actors and regions along the corridor.

Decarbonising freight transport



along the Scandria® Corridor



12 forerunners at a glimpse

- 1 H₂ retail H₂
- 2 Cityporto Padua BG
- 3 Elektra H₂ BE
- 4 CPL H₂
- 5 Four Ports & Blue Supply Chains BE OPS
- 6 Ship-aH2oy H₂
- 7 Clean Alps crossing H₂
- 8 GREATER4H & HyTruck H₂
- 9 e-Roads BE
- 10 Fully electric BE
- 11 Green Energy Stations H₂ BE BG
- 12 REEL H₂ BE

Alternative and renewable fuels

- H₂ Hydrogen / Fuel Cell
- BE Battery Electric
- BG Biogas
- OPS Onshore Power Supply

Clean fuels in ports, terminals and city logistics

As crucial elements of the logistic chain linking intercontinental transport, long distance transport and last mile delivery, ports and terminals fulfil an important function in decarbonising freight transport.

Beyond enabling multimodal transport, they also represent hubs in terms of clean energy supply. Concentrating logistics services, they are ideal for refuelling, charging, producing, and storing renewable energy.

The projects presented below provide a broad portfolio from the Scandria®Corridor demonstrating how multimodal logistics can get decarbonised.

1 H₂ retail H₂ Hydrogen city logistics



By purchasing four Hyundai hydrogen fuel cell-powered trucks to transport goods from the Nuremberg port to local dm stores, freight forwarder AMM Spedition, retailer dm and logistics integrator DSV aim at reducing the carbon footprint of urban logistics operations. The trucks have a range of up to 400 km on a single tankful of hydrogen. All four dm stores in Nuremberg will be served by the fuel-cell powered trucks.

The project is limited to four years, during which relevant experience shall be gathered and evaluated. The trucks are leased from hylane and will be fuelled at the H2-Mobility hydrogen refuelling station in neighbouring Erlangen at a pressure of 350 bar. The project gets support from the German Federal Ministry of Transport and Digital Infrastructure.

bit.ly/dm-hydrogen-retail
(German)

2 Cityporto Padua ^{BG}

Clean urban freight distribution

Padua banned most freight transport from the historic inner city. To ensure the supply of goods to retailers, restaurants and hotels, Cityporto offers an alternative by consolidating goods flows and thus reducing the number of vehicles in the city centre. Cityporto is committed to using clean fuels and new technologies to achieve

this goal. So far, the fleet operates with 11 vehicles powered by compressed natural gas (CNG), but the company is starting to consider testing and introducing electric vehicles in the future.

www.interportopd.it/cityporto
(Italian)

3 Elektra ^{H₂} ^{BE}

Hybrid-electric inland push boat

Berlin's inland ports' operator BEHALA initiated several projects that shall pave the way towards carbon-free and competitive transport on inland waterways in northern Germany.

Together with research and industry partners, BEHALA developed the "ELEKTRA", the world's first emission-free canal push boat, powered by electric motors and fuel cells.

With a capacity of 750 kg hydrogen compressed at 500 bar, the push boat is able to travel distances up to 400 km. The project totalling to € 14.6 million was supported with € 9.1 million by the German Federal Ministry for Transport and Digital and Transport. Officially taken into operation in May 2022, ELEKTRA is being tested in real life application at inland waterways in Berlin and between Berlin and Hamburg.

The A-SWARM project is about developing an autonomous and flexible transportation system for deliveries from Berlin's inland ports to inner city distribution hubs.



Together with the Schiffbau-Versuchsanstalt Potsdam GmbH and further scientific and business partners, BEHALA aims to demonstrate the technological feasibility of a small electric watercraft concept for the metropolis. A-SWARM was supported with € 4 million by the German Federal Ministry for Economic Affairs and Climate Action.

Elektra
bit.ly/elektra-behala

A-SWARM Berlin
bit.ly/a-swarm_berlin

4 CPL H₂

Clean Port & Logistics in Hamburg



Hamburger Hafen und Logistik AG (HHLA), operating port of Hamburg container terminals, initiated the project Clean Port & Logistics (CPL). Supported by the German Federal Ministry of Transport and Digital Infrastructure, CPL is an innovation cluster for real-life testing of hydrogen-powered equipment in port logistics.

Supporting and accelerating the achievement of market maturity and integration into regular port operations, CPL brings together equipment manufacturers, port and logistics companies, academic partners, producers of renewable hydrogen, software companies, and operators and manufacturers of storage tank locations.

The test field is located at the container terminal Tollerort in the port of Hamburg including 1 kilometre quayside, 57 Van Carrier special vehicles, 14 container bridges and four mooring berths. Being operational since early 2023, tests will be performed 2023/2024. In 2025, results will get evaluated and conclusions on further implementation of the approach will be met.

hydrogenports.org/en

5 Four Ports & Blue Supply Chains BE OPS

Greening sea-borne transport in the Baltic Sea

Reducing CO₂ emissions in shipping is an important step towards a cleaner and greener European transport system. Providing clean onshore power for ships in ports as well as greening port operations are important building blocks for any clean shipping system. The Four Ports project is an initiative to provide onshore power in Baltic seaports of Aarhus, Copenhagen, Stockholm and Helsinki. Totalling to € 76 million, the project receives support from the Connecting Europe Facility of € 15 million. Until 2024, the ports will provide onshore power supply for cruise ships and RoPax vessels.

In the Interreg Baltic Sea Region project Blue Supply Chains lead by Port of Hamburg Marketing, 20 European partners evaluate and pilot measures for the further electrification of handling equipment, strategies for the provision, handling and storage of clean fuels, and promotion of more environmentally friendly hinterland transport. The project is implemented between 2023 and 2025 and supported by the European Regional Development Fund with € 3.6 million.

Four Ports
four-ports.eu

Blue Supply Chains
interreg-baltic.eu/project/bluesupplychains

6 Ship-aH2oy H₂

Hydrogen-based power and heat generation onboard ships

In the project Ship-aH2oy, a consortium of 17 partners is developing and demonstrating a zero-emission propulsion technology onboard ships.

This technology is based on the combined use of hydrogen Solid Oxide Fuel Cells (SOFC) and liquid organic hydrogen carrier (LOHC) on a megawatt scale with efficient heat integration, resulting in a much higher efficiency for the production of electricity and on-board power.

The project is supported by the European Union with € 15 million through Horizon Europe and coordinated by VTT Technical Research Centre of Finland. The offshore service operation vessel operator Edda Wind will equip one of its vessels with



a 1 MW hydrogen power system. The project that is to be realised until December 2027 represents an important step towards a greener future for commercial transport in Europe.

shipah2oy.eu

Clean fuels in long distance heavy-duty transport

Lorries, buses and coaches are responsible for more than a quarter of GHG emissions from road transport in the EU, and for over 6 % of total EU GHG emissions. Given the juvenility of technologic solutions, specific requirements of long distance heavy-duty vehicle transport and the private domain, public authorities need to prepare well for upscaling zero emission heavy-duty vehicle transport in close collaboration with vehicle manufacturers, hauliers and energy providers.

On the Scandria®Corridor, there is a large number of approaches based on different technologies. Fuel cell, electric road systems, liquid biogas or battery electric vehicles are some examples applied by the running projects from Scandinavia to Italy. All these technologies are faced with the “chicken-and-egg problem”, i.e. the challenge to develop infrastructure and vehicle markets simultaneously.

7 Clean Alps crossing H₂

Forerunners in decarbonising freight transport

Greening transport across the Alps has been an important aim of Austrian and Italian regions. Italy's first hydrogen refuelling station in Bolzano was opened in 2014. The station can supply about 15 hydrogen buses or up to 700 passenger cars daily. In 2021, the Euroregion Tyrol / South Tyrol / Trentino adopted Europe's first cross-border hydrogen master-plan, a precursor to future projects fostering the establishment of clean fuels along the Brenner highway.

Currently different projects are being realised. The project Zero Emission Services for a Decarbonised Alpine Economy (LifeAlps) aims to develop South Tyrol into a model region for zero-emission mobility by 2027.

This will include infrastructure for zero-emission freight transport, with several hydrogen refuelling stations within the territory and a new one in Verona. The project totaling to € 20 million is supported by the EU within the Life+ programme.

The project H2Alpin, coordinated by the Standortagentur Tirol GmbH, will test fuel cell powered busses

and heavy-duty vehicles under alpine conditions, develop business models for purchasing fuel cell powered vehicles and simulate energy demand for green hydrogen production.

The project H2MA, supported by the Interreg Alpine Space Programme, accelerates the transnational roll-out of green hydrogen infrastructure for transport and mobility in the Alpine region. Between 2022 and 2025, H2MA will increase the capacities of territorial public authorities and stakeholders to overcome existing barriers and collaboratively plan and pilot trans-alpine zero-emission hydrogen routes.

H2-South Tyrol Hydrogen Centre
h2-suedtiroel.com/en

LIFE Alps
life-alps.eu/it

H2Alpin
bit.ly/H2Alpin

H2MA
alpine-space.eu/project/h2ma

8 GREATER4H & HyTruck ^{H₂}

Hydrogen refuelling stations in the Baltic Sea Region



The common objective of the projects HyTruck and GREATER4H is to solve the “chicken-and-egg problem” in establishing a hydrogen refuelling network. In the project GREATER4H, three industry partners will build a cross-border network of 14 hydrogen refuelling stations in Germany, Denmark, Sweden and Norway along the Scan-Med Corridor. By 2025,

the hydrogen refuelling stations shall provide hydrogen at pressure levels of 350 and 700 bar. The investments are co-financed by the Connecting Europe Facility with € 12.4 million.

Until 2025, the Interreg Baltic Sea Region project HyTruck, led by the Ministry of Economics, Infrastructure, Tourism and Labour Mecklenburg-Vorpommern, designs a network of hydrogen refuelling stations for large trucks along the North Sea – Baltic European Transport Corridor. The European Union has granted € 2.6 million to the project.

Greater4H
greater4h.com

HyTruck
interreg-baltic.eu/project/hytruck

9 e-Roads ^{BE}

Electric road projects in Sweden and Germany

The Electric Road E20 Hallsberg-Örebro is Sweden’s first permanent electric road project. Being part of the Swedish Transport Administration’s electrification programme, the purpose of the pilot is to verify and demonstrate the technology by installing and testing a complete electric road system. The project will be constructed on a 20-kilometre section of the E20 European motorway.

The choice of route was based on a number of criteria such as road type, traffic volumes, transport arrangements, the natural and cultural environment, the available power supply and national defence interests.

The Swedish Transport Administration stopped the procurement process in autumn 2023 due to considerably higher costs than expected, but expects to continue the work on the project in 2024 by analysing how costs for the design and construction

of the electric road can be reduced.

In Germany, several test tracks for electric highways (eHighway) have been piloted in Schleswig-Holstein, Hesse and Baden-Württemberg.

In the project ELISA - Electric heavy goods traffic on Autobahnen/Highways, a public-private consortium is testing overhead contact line trucks on the highway A5 between Frankfurt and Darmstadt. After more than 500,000 vehicle kilometers have been evaluated, the research consortium concludes that the eHighway proved its technical and operational feasibility and can deliver a significant contribution to decarbonising heavy duty vehicle transport.

Electric Road E20
bit.ly/electric-road-e20 (Swedish)

ELISA
www.autobahn.de/ehighway-elisa
(German)

10 Fully electric BE

Flower delivery from the Netherlands to Vienna

On September 30, 2019, the very first fully electric intermodal delivery of flowers near Venlo in the Netherlands was received at the Port of Vienna. The transport was actively supported by the Embassy of the Kingdom of the Netherlands, Oldenburger Transport, Westerman Multimodal Logistics, THT New Cool, Tinie Manders Transport, Hytruck Consult, Emodz New Mobility, the Port of Vienna, WienCont Container Terminal GmbH and thinkport VIENNA. One of the partners, Oldenburger Transport, has transported flowers from the Netherlands to Austria since 1997. One of 25 weekly truckloads of plants was replaced by an electric

intermodal rail-road transport. A refrigerated trailer operated with an electrically driven cooling unit was transported from Venlo with an electrically driven tractor to a container terminal in Herne and loaded onto the train. From there, it continued on an electrically driven freight train to the Port of Vienna. There, the refrigerated trailer was reloaded onto an electrically driven tractor unit in the container terminal of WienCont. By the demonstration project the partners aim to show that a fully electric supply chain is possible and to improve their knowledge on how to organise such transport.

thinkportvienna.at

11 Green Energy Stations H₂ BE BG

Advancing Sustainable Transportation in Eastern Norway

In 2022, the Oslo Region and the Eastern Norway County Network jointly initiated the "Energy Stations for Green Commercial Transport" project (Energistasjoner for grønn næringstransport). The Greater Oslo Region serves as the primary recipient of 70 % of all goods transported into Norway, while heavy-duty vehicles contribute to 34 % of road traffic emissions in this region. However, the transition to environmentally friendly commercial transport faces a significant challenge due to the limited availability of infrastructure for electricity, hydrogen, and biogas. Considering these challenges, the project's primary objective is to strategically coordinate and plan the placement of refueling stations across Eastern Norway. The project encompasses a comprehensive examination of various fuel options, including hydrogen, liquified biogas, and electricity. Furthermore, the



project aims to address issues related to extended fueling times with alternative fuels and the constrained availability of space for necessary infrastructure. With a total budget of 3 million Norwegian Kroner (approx. € 250,000 EUR), the project has received support through grants from the Norwegian Climate programme. Anticipated results from the project are expected to be available in the second half of 2024.

energistasjoner.org
(Norwegian)

12 REEL H₂ BE

Transition to green commercial transport in Sweden

REEL is a national initiative in Sweden aimed at accelerating the transition to electrified, emission-free heavy transport on the country's roads. Within the venture running from 2021–2024, 70 different regional logistics cases with electric trucks provided by Volvo and Scania are tested and evaluated. The project brings together leading actors from various sectors, including transport buyers, forwarders and distributors, haulage companies, terminal operators, charging point operators, electricity grid companies, and suppliers of trucks, charging equipment, and management systems. In addition, regions, national authorities, and universities participate in the initiative. Beyond testing the trucks, the project consortium investigates charging solutions, business and financing models, work culture



and skills, policy framework as well as system architecture. Covering a total volume of 189 million SEK (approx. € 16 million), the project receives co-financing from the Swedish "Strategic vehicle research and innovation (FFI) programme through Sweden's innovation agency "Vinnova", the Swedish Energy Agency and the Swedish Transport administration.

closer.lindholmen.se/en/project/reel

Driving decarbonisation of freight transport

Building on the examples identified, Scandria®Alliance organised a clean fuel seminar on 30 August 2023 in Hamburg. Public and private stakeholders presented their experiences in decarbonising freight transport and discussed challenges as well as needs for further action.

Technology is available

Currently, decarbonisation of freight transport is transferred from the laboratory and put into practice.

More and more public and private stakeholders are deploying clean fuel solutions in freight transport.

Yet, real-life applications are still in a pre-mature phase and have not been rolled out on a larger scale.

The lack of economies of scale makes clean fuels in freight transport costly and risky.

European Policy Efforts paving the way

Current regulatory efforts at the European level, such as the European Commission's proposal on CO₂ emission performance standards for new heavy-duty vehicles or the new regulation for the deployment of alternative fuels infrastructure (AFIR) are important steps forward.

However, to fully unfold their potential, these policies need to be accompanied by consistent action at national, regional and local levels.

Multi-fuel approach

In deploying clean fuel solutions, there will not be a one-size-fits-all solution. Several factors, such as operational parameters, availability of clean fuels, business models of market actors and their adaptability determine the optimum use of clean fuel technologies. There will be different solutions for port and terminal handling, last mile logistics or long-distance heavy-duty transport.

Whereas battery electric is expected to be chosen in light duty vehicles and last mile operations, hydrogen and biogas currently seem to be more promising for solutions that require long range or high energy consumption. However, currently there is no mature market for hydrogen due to the high costs to provide green hydrogen.

Overcoming the "chicken-and-egg problem"

To overcome the "chicken-and-egg problem", the three dimensions of the clean fuels ecosystem - availability of zero-emission vehicles, refuelling / recharging infrastructure and clean fuels - need to be addressed at the same time. From a broader perspective, there is still a lack of integrated approaches - partly because of too sector-oriented support and financing schemes.

Learning by doing

The complexity of challenges and the urgent need for action means that there is no time to develop “perfect solutions”. The deployment of clean fuels will only be successful if technological solutions are transferred from the lab to the road. This includes a risk of failure, which public support schemes need to mitigate.

Policy support needed

Policy makers should provide support for the market roll-out of clean fuel technologies until new markets have formed and consolidated. The framework conditions should be in favour of clean fuel technologies and disincentivise fossil fuels along the whole value chain – from production via distribution to the end consumer. As technology and market development is expected to be dynamic, policy makers shouldn't make any pre-mature decisions without closely following technology development pathways.

Holistic perspective

When discussing clean fuels in freight transport, all stakeholders need to broaden their perspective and look at the close interconnections between the transport and the energy systems. Availability of clean fuels at competitive prices will be one key factor to upscale available technological solutions in the market. Shortcomings in renewable energy production, grid capacity and land availability may strongly impede the roll-out of clean fuels.

Collaboration and coordination

To create a business case, stakeholders need to collaborate: clean fuel infrastructure providers, anchor customers like heavy-duty vehicle fleet operators, clean fuel providers, car manufacturers as well as public authorities. Public authorities can be catalysts for clean fuel deployment if they closely collaborate with relevant stakeholders in their region and exchange experiences horizontally with other regions and vertically with the national and European level.

Ambitious policy framework expected

Policy makers at national and European level

should create favourable conditions for clean fuel deployment in the freight transport sector.

This should include support for researching, testing and upscaling alternative fuel solutions as well as bonus and malus systems, that incentivise the use of clean fuel technologies and disincentivise the use of fossil fuels. Furthermore, technical planning guidelines are needed to simplify permission procedures.

Support schemes addressing roll-out of alternative fuel ecosystems should enable to address all three dimensions of the ecosystem: vehicles, refuelling infrastructure as well as energy supply. They should allow for necessary coordination and planning measures.

Especially the production of alternative fuels, like green hydrogen in sufficient quantity and quality requires further support.

Regional policy makers

should support efforts to coordinate stakeholders within their regions to deploy clean fuel ecosystems in freight transport. This support should involve substantiated analysis of regional conditions and regional clean fuel deployment planning instruments aiming to provide relevant information, simplify permission processes and solve land use conflicts.

Regions should coordinate with neighbouring regions as well as at European level. Collaboration along European Corridors can largely facilitate knowledge exchange. They should translate European and national policies to regional and local levels and contribute to the discussion with their own experiences in implementing clean fuel deployment. National governments and the EU should support regional efforts to boost regional clean fuel ecosystems in freight transport.

With clear ambitions, cities and regions can act as forerunners, for instance by consequently decarbonising public vehicle fleets. This will stimulate market development.

An ambitious and coherent European policy framework implemented by member states combined with action at regional and local level can path the way towards decarbonisation of freight transport. The policy framework must be responsive to learnings from its implementation at regional and local level. This requires effective communication and decision-making procedures in a multi-level governance approach.

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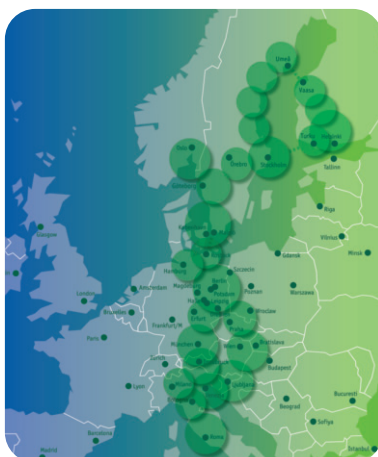
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Scandria® Alliance



The Scandria®Alliance is an arena for cities and regions to collaborate on climate-smart multimodal transport connectivity at the interface to sustainable regional development between Scandinavia and the Adriatic Sea.

Our common vision is to connect regions, communities, and economies through clean and smart transportation.

Full members



Associated members



scandria-alliance.eu

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