European Commission

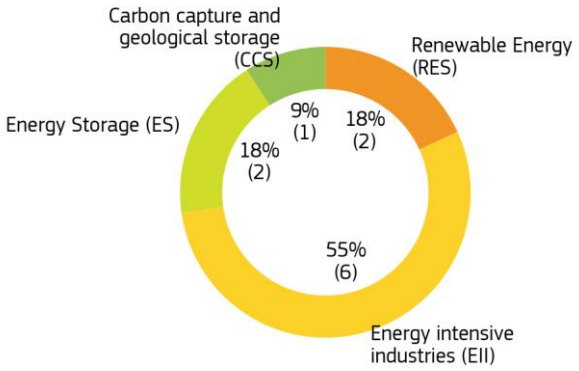
# Innovation Fund Programme

## Overview of ongoing projects in Sweden

Funded by the revenue of the EU Emissions Trading System, the Innovation Fund's goal is to help businesses investing in innovative low-carbon technologies with significant GHG emissions reduction potential.
The Innovation Fund currently supports **11 projects** located in Sweden, which will contribute to the decarbonisation of European industries with a total expected GHG emission reduction of **110.4 Mt $CO_2$ equivalent in the first 10 years of operation.**
The total **Innovation Fund grant in Sweden is of EUR 963.2 million**, out of the **total relevant costs of EUR 3.5 billion**, as defined in Art 5 of the Delegated Regulation 2019/856 on the Innovation Fund[1].

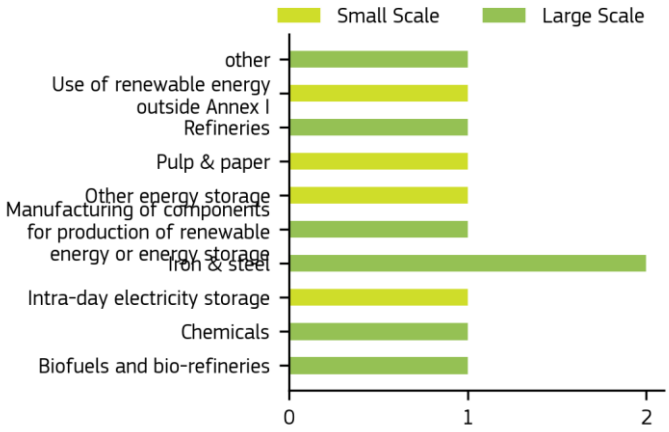
### Projects per category

*Number of projects and percentage of the total*



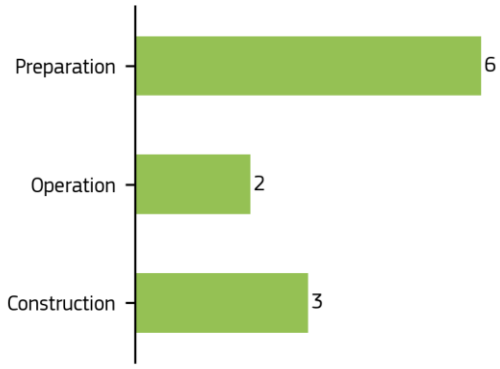

### Projects per sector

*Number of Small and Large-Scale projects*



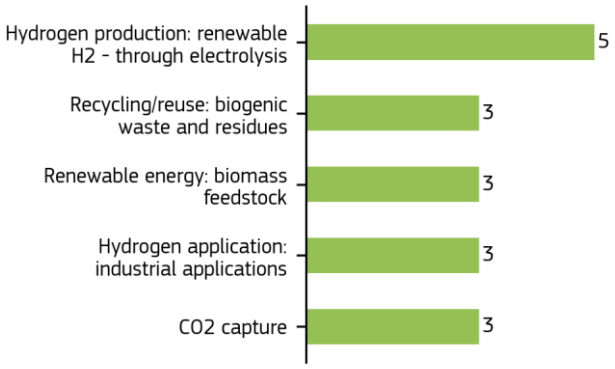

### Projects per phase[2]

*Number of projects*




### Top 5 technology pathways[3]

*Number of projects*




[1] *OJ L 140, 28.5.2019, p. 9.*
[2] *Preparation means the period before financial close is reached; construction means the period between financial close and entry into operation; operation means that the construction is finished and the project has already started production.*
[3] *Projects may employ several technological pathways, only the top 5 per country are kept in the graph.*
*State of play: 18/06/2024*

## List of ongoing Innovation Fund projects in Sweden

| Acronym | Title | Sector | Start date | Project phase | Beneficiaries | Innovation Fund grant (EUR million) | Expected GHG emission avoidance (t CO2eq) |
|---|---|---|---|---|---|---|---|
| **Large Scale** | | | | | | **949.1** | **72,344,108** |
| AIR | Production of sustainable methanol as raw material for chemical products by first-of-a-kind Carbon Capture and Utilization process integrated with world scale electrolysis unit | Chemicals | 01/01/2023 | Preparation | Perstorp Oxo AB \| FORTUM \| Uniper | 97.0 | 4,055,112 |
| Beccs Stockholm | Bio-Energy Carbon Capture and Storage (BECCS) at the existing Combined Heat and Power-plant KVV8 at Värtaverket, Stockholm, Sweden | other | 01/07/2021 | Preparation | Sthlm Exergi | 180.0 | 7,834,149 |
| BioOstrand | Biorefinery Östrand – The first commercial deployment of solid biomass-and-power-to- Sustainable Aviation Fuels technology line-up | Biofuels and bio-refineries | 01/01/2024 | Preparation | BioOstrand | 166.6 | 8,762,169 |
| DAWN | 200MW Production of thin-film solar by Sweden | Manufacturing of components for production of renewable energy or energy storage | 01/09/2023 | Construction | Midsummer | 32.3 | 1,073,343 |
| H2GS | H2 Green Steel | Iron & steel | 01/04/2023 | Construction | H2GS Boden | 250.0 | 33,594,396 |
| HYBRIT demonstration | Swedish large-scale steel value chain demonstration of Hydrogen Breakthrough Iron-making Technology | Iron & steel | 01/04/2022 | Preparation | LKAB \| HYBRIT \| SSAB EMEA AB | 143.0 | 14,296,430 |
| HySkies | HySkies: A partnership to develop Sustainable Aviation Fuel | Refineries | 01/01/2023 | Construction | LANZATECH BV \| LANZATECH INC \| SHELL NEDERLAND \| LANZATECH UK \| VATTENFALL AB | 80.2 | 2,728,509 |
| **Small Scale** | | | | | | **14.1** | **38,096,098** |
| Green Foil project | Low CO2 Footprint Battery Foil for Li-ion Battery Production for Energy Storage | Other energy storage | 01/04/2021 | Operation | Granges | 2.7 | 36,883,571 |
| NorthFlex | Decarbonising temporary power & flexible storage | Intra-day electricity storage | 01/04/2021 | Operation | BSAB \| NVP | 4.4 | 1,096,847 |
| TFFFTP | Towards a Fossil Fuel Free Tissue Production | Pulp & paper | 01/10/2021 | Preparation | Essity H/H AB | 4.2 | 70,865 |
| eMETHANOLxWSolution | Next Generation tanker vessel powered by e-methanol and wind assisted propulsion | Use of renewable energy outside Annex I | 01/10/2023 | Preparation | Terntank | 2.8 | 44,815 |

## Project overview

| Acronym | Title | Description |
|---|---|---|
| AIR | Production of sustainable methanol as raw material for chemical products by first-of-a-kind Carbon Capture and Utilization process integrated with world scale electrolysis unit | Project Air, coordinated by Perstorp Group and its partner Uniper, is a critical enabler for the European chemicals industry to become carbon neutral, with far-reaching effects throughout many industrial value chains, and contributes to ending Europe's dependence on imported fossil fuels. A combination of carbon capture and utilisation (CCU) process for converting CO2, residue streams, renewable hydrogen and biomethane is used to create the first-of-a-kind, large-scale production of sustainable methanol. The project is expected to lead to a relative decrease of 123% in greenhouse gas emissions avoidance in comparison with conventional methanol synthesis. |
| Beccs Stockholm | Bio-Energy Carbon Capture and Storage (BECCS) at the existing Combined Heat and Power-plant KVV8 at Värtaverket, Stockholm, Sweden | The Beccs Stockholm project will create a world-class, full-scale Bio-Energy Carbon Capture and Storage (BECCS) facility at its existing heat and power biomass plant in Stockholm. The project will combine CO2 capture with heat recovery, making the process much more energy-efficient than the process in a usual CCS plant. It will capture and permanently store large quantities of CO2 from biological sources, leading to carbon removals from the atmosphere, also called negative emissions. The Beccs Stockholm project has a potential to remove around 7.0 Mt CO2e over the first ten years of operation. Net carbon removals are seen as an increasingly important technology-based solution to climate mitigation, indispensable to reach climate neutrality in 2050. The project will also be a catalyst for paving the way for a new market of net carbon removals. Besides the actual negative emissions achieved, the project will also have a positive impact on the balance for renewable heat and electricity, resulting in additional around 0,8 Mt CO2e over the same period. |
| BioOstrand | Biorefinery Östrand – The first commercial deployment of solid biomass-and-power-to-Sustainable Aviation Fuels technology line-up | Biorefinery Östrand will contribute to the decarbonisation of the transport sector by creating a long-lasting solution for producing advanced biofuels and electro-fuels (e-fuels) from sustainable solid biomass and renewable electricity. The project will design, build and operate the world's first commercial scale biorefinery producing sustainable aviation fuel (SAF) and naphtha from solid forest residues. The project will deploy a breakthrough Anything-to-Liquid (XTL) pathway, solid biomass gasification and Fischer-Tropsch synthesis, with an electrolyser utilising renewable electricity. This will result in 100% relative greenhouse gas (GHG) emission avoidance compared to the reference scenario of fossil fuels.<br><br>The project is pioneering solid biomass-to-biofuels production at commercial scale. It goes beyond the state-of-the-art in utilising sustainable solid biomass as a feedstock in SAF production, and also delivers scale of operations, creating a major leap towards industrial production and leading the way for the future SAF industry. The technology set-up expands the feedstock base of SAF production to include solid forest industry residues – which helps to break the SAF industry's dependency on the limited pool of oleochemical feedstocks that are in use today. To increase the hydrocarbon yield, renewable hydrogen is added to the process, facilitating a more efficient use of the feedstock by turning more carbon into final product. The project showcases a cutting-edge integration of a biorefinery with a modern pulp mill, resulting in significant efficiency gains. This will lead to SAF and naphtha production, of which half are e-fuels half are advanced biofuels, with an accumulated GHG emission avoidance of 8.7 million tonnes of CO2 equivalent over the first ten years of operation. For reference, this is equivalent to twice the annual emissions from domestic aviation in Sweden.<br><br>Biorefinery Östrand will contribute to the climate-neutrality target under the European Green Deal by bringing renewable fuels and a commercial solution for decarbonising transport to the market, particularly the hard-to-abate aviation segment. Notably, the Biorefinery Östrand project contributes directly to achieving the SAF targets proposed in the ReFuelEU Aviation Initiative, as well as the renewable hydrogen and self-sufficiency targets outlined in the REPowerEU Action Plan and the EU Hydrogen Strategy.<br><br>The project contributes to the European value chain for advanced biofuels, starting with forest residues and locally produced renewable electricity and ending with filling the fuel tanks of the end-users with sustainable fuels. This provides both sustainability and robustness for the vital European transport economy – while simultaneously showcasing both a technology and a business model that can be replicated across Europe and beyond. The project is estimated to generate 60 direct and 660 indirect full-time equivalent per year of new green jobs which will also benefit the local economy. |
| DAWN | 200MW Production of thin-film solar by Sweden | The DAWN project will establish Europe's largest manufacturing plant for flexible and lightweight Copper, Indium, Gallium and Selenium (CIGS) thin-film photovoltaic (PV) cells and panels. The project utilises Midsummers resource efficient solar cell manufacturing equipment (Midsummer DUO) to produce a solar panel with a minimal carbon footprint and material use. The factory will manufacture the solar cell and the solar panel in the same facility. Production is set to start in 2026 and gradually ramp up to 200 megawatt (MW) annual production by 2028. The project involves the construction of a greenfield building of 10 000m2, which will be used to scale up the proven solar cell manufacturing technology and integration of panel processes into a fully automated production line.<br><br>The 200 MW production of flexible CIGS thin-film solar panels, represents a 100 times increase compared to the 2023 production capacity. The production will be energy and resource-efficient, resulting in a solar panel with an energy payback time that is less than one year. By using the DUO, complex and high melting materials can be efficiently deposited onto a stainless-steel substrate and in a single sequence, turn stainless steel into a fully functional solar cell. Solar cells are encapsulated between polymer sheets, thus becoming lightweight and flexible solar panels.<br><br>These thin-film solar panels are flexible and lightweight (~3 kg/m2) compared to traditional solar panels (~13-15 kg/m2) which use rigid glass and aluminium framing. The low weight |

| Acronym | Title | Description |
|---|---|---|
| | | makes it possible to apply Midsummers panels on buildings that have previously been inaccessible to solar installations, such as building with low load bearing roofs. Moreover, Midsummer solar cells can be recycled at a rate above 98% using recycling processes that are already commercially available. During a ten-year period, the electricity generated by the solar panels from the DAWN factory will have the potential to avoid 1.07 million tonnes CO2 equivalent of greenhouse gas emissions (GHG).<br><br>The establishment of the DAWN factory will help to restart European solar cell and panel production contributing towards the RePowerEU goals with respect to installed solar energy and manufacturing capacity.<br>Once fully operational, the DAWN factory will employ approximately 200 people, with 95% occupying direct operational roles. DAWN is also expected to generate around 400 indirect job opportunities. The factory will be able to serve as a blueprint for future manufacturing sites of European thin-film solar production through a copy-paste setup in empty facilities across Europe. |
| Green Foil project | Low CO2 Footprint Battery Foil for Li-ion Battery Production for Energy Storage | The market of EV sales has increased in the latest years and is forecasting to further increase within the coming years. Li-ion batteries demands will increase more than 20%+ from now till 2030 and beyond.<br><br>The battery foil market which is used as the cathode current collector will see the same increase in the coming years. Granges Finspang see a good opportunity to enter this market due to several reasons. First the market in Europe is under supplied, battery manufacturers are forced to source material from China; Second the high CO2 footprint for the material from China is not in line with the call of "Green Battery" in Europe; Third import material also posts a significant risk to the supply chain of EU battery production.<br><br>Granges Finspang has a vision to become the "sustainability leader" to the battery industry since the company's operation has a low CO2 footprint in comparison to European peer, and are constantly striving towards even further reductions on CO2 footprint. This supports Battery cell producers as well as OEMs future targets.<br><br>Battery foil as a new product is new to European aluminum mills. To produce battery foil in Europe, current producers must invest heavily in news kills and capabilities. In preparation for this project, Granges Finspang has made a solid technical, financial and commercial feasibility study for investing in new technologies for battery foil production in Finspang, Sweden with low CO2.<br><br>The project total absolute GHS avoidance is 36,883,571 tones, and the project cost efficiency ratio is 0.073.<br><br>The project will install an innovative surface treatment technology (corona treatment) and increase the use "end of life" aluminum scraps in production. |
| H2GS | H2 Green Steel | The H2 Green Steel (H2GS) project aims to build a greenfield integrated steel plant in Boden, northern Sweden, for the large-scale production of renewable hydrogen, green iron and green steel. Production is expected to start in 2025. The green steel produced will reduce greenhouse gas emissions by 33.4 million tonnes CO2 equivalent over the first ten years of operation, or by 87.3% (vs. relevant Emissions Trading System (ETS) benchmarks), and the volume produced would equal 5% of the total flat steel production in the EU.<br>Electrolysis will be an integrated part of the plant, using fossil-free electricity to produce the renewable hydrogen needed to bring 5 million tonnes of green high-quality steel to the market by 2030. The direct reduction reactorrefines iron ore into direct-reduced iron (DRI). This is done by exposing iron ore to hydrogen, which reacts with the oxygen in the ore, forming steam as a residual product. Using the renewable hydrogen for this process instead of coal, which is typically used in integrated steel plants, allows the project to reduce CO2 emissions from the reduction process by more than 95%. The majority of DRI is transported in its hot state, inside the plant to the Electric Arc Furnace, while the rest is briquetted into hot briquetted iron (HBI), for storage and later use. In the Electric Arc Furnace, fossil-free electricity will be used to heat a combination of DRI and steel scrap to a homogenous melt of liquid steel. Liquid steel is further refined via traditional ladle furnace and RH degasser and is turned into solid products in an integrated process called “continuous casting and rolling,” which enables a reduction of the energy consumption by 70% and replaces the natural gas that is typically used in the traditional process. Next, the product is further processed depending on customer requirements in our fully electrified downstream finishing lines, consisting of cold rolling, hot dig galvanizing line and batch annealing furnaces.<br><br>The H2GS project aims to respond to the increased climate ambitions of the revised EU ETS Directive and contribute to the EU’s overall climate ambitions. By contributing to the decarbonisation of the steel sector, the project is also perfectly aligned with the EU industrial strategy.<br><br>Sweden has excellent conditions for this type of industrial project, due to abundant renewable energy sources, a solid supply of raw materials, highly skilled technical competencies, and ample land availability for large scale projects. The H2 Green Steel project will generate up to 2 000 direct jobs in the region, and a total of 10 000 including the indirect jobs. The project will also be part of a green industrial cluster in Northern Sweden, significantly contributing to a growing cluster of digital companies in the region. |
| HYBRIT demonstration | Swedish large-scale steel value chain demonstration of Hydrogen Breakthrough Iron-making Technology | The HYBRIT (HYdrogen BReakthrough Ironmaking Technology) demonstration project aims to revolutionize the European iron and steel industry, by replacing fossil-based technologies with climate neutral alternatives. The project plans to replace the coal-based blast furnace technology with direct reduction based on fossil-free hydrogen. The project will produce approximately 1.2 Mt of crude steel annually, representing 25% of Sweden’s overall production, with the potential to avoid 14.3 Mt CO2e of greenhouse gas (GHG) emissions over the first ten years of operation. A new, first-of-a-kind hydrogen production facility in Gällivare will be established, using a 500 MW electrolyser capacity powered by fossil-free electricity. The use of hydrogen enables the conversion of iron ore into sponge iron. The project will also replace two blast furnaces in Oxelösund with an electric arc furnace, using the sponge iron as the feedstock to produce high-quality steel without fossil fuels. As access to renewable energy continues to increase, the project will lead the way to a full energy transition of the hard-to-abate, iron ore-based steel production across Europe. Iron ore-based steel will remain of strategic importance for the EU as it is the main approach to produce both high quality and high strength carbon steel; and not all steel can be produced via recycling and melting of scrap steel. The project will also support the local economy and help secure jobs that are otherwise at risk if the existing steel plants would have to be discontinued to enable Sweden's transition to a climate-neutral economy[1]. |

| Acronym | Title | Description |
|---|---|---|
| | | [1]Potential territorial impacts of the transition to a climate-neutral economy in Gotland, Norrbotten, and Västra Götaland. Project for DG GROW to support to the preparation of Territorial Just Transition Plans in Sweden, 2021. |
| HySkies | HySkies: A partnership to develop Sustainable Aviation Fuel | HySkies project contributes to the European and aviation industry's decarbonisation by building the first large-scale synthetic sustainable aviation fuel (SAF) production facility in Sweden. The plant will produce around 82 000 tonnes SAF and 9 000 tonnes of renewable diesel per year. Fossil-free hydrogen from a 200 MW electrolyser, biogenic CO2 captured from a waste-to-energy plant, and sustainable ethanol will be fed to a two-step process consisting of gas fermentation and alcohol-to-jet (AtJ). The project will result in the relative avoidance of 94% greenhouse gas emission avoidance compared to the reference scenario over the first ten years of operation. |
| NorthFlex | Decarbonising temporary power & flexible storage | The NorthFlex objective is to introduce the Voltpack Mobile System (VMS) to the market. The VMS is a Lithium-ion Battery Energy Storage System (BESS) which will close the gap between two separately developed markets: (i) temporary power generation, which is predominantly served by diesel generators and (ii) commercial / industrial scale energy storage relying on stationary, containerized BESS with a high cost of installation and low flexibility. The VMS? innovative features (mobility, plug and play, modularity, flexibility, sustainability, and digital connectivity) will make it competitive in both these markets. The project also introduces innovative battery pack technology and innovations in manufacturing setup. The VMS delivers a very strong degree of innovation as it represents a considerably changed, sustainable technology which will substitute carbon-intensive products and create new markets for BESS.<br><br>The VMS consists of two separable units: the Voltpack Mobile (Voltpack) and the Volthub Grid (Hub). The Voltpack is the individual self-contained, industrial-grade, high energy-density battery pack. The Hub is the central power hub, providing a 400V AC pluggable input and output. Up to five Voltpacks can be connected to a single Hub, ensuring scalability of the solution.<br><br>The VMS is at pilot demonstration stage (TRL7). Development to date has been enabled by leveraging Northvolt?s previous experience in the industrial and stationary BESS sectors. The scope of NorthFlex is to bring the VMS through industrial scale up (TRL9) and achieve mass production of the product. Fully ramped up, the VMS targets an annual capacity of 457 MWh placed on the market, and will during ten years after entry into operations achieve reduction of 1 165 949 tons of CO2 eq. At wider sector level, the VMS has the potential to contribute to material further GHG-emission reductions by accelerating the transition to electrified transport and decarbonisation of the stationary electricity grid. |
| TFFFTP | Towards a Fossil Fuel Free Tissue Production | The TFFFTP project replaces liquefied natural gas (LNG) used to dry the paper at a paper production facility with bio-syngas generated in a new on-site gasification plant using wood wastes. The direct connection of the bio-syngas production plant to paper production facilities is a first-of-a-kind integration. The project strongly contributes to the overall site's decarbonisation, covering the Paper Machines Air Systems heat needs for 69 000 tonnes of annual paper production.<br><br>The use of bio-syngas in the paper industry is innovative in several respects. Firstly, the setup whereby both a syngas production plant and a tissue paper production facility (that does not process the syngas) are operational on the same site makes it the first installation of its kind in the world to date. The Syngas burners have to be very flexible to ensure constant heat supply to the air system. Due to the expected variation in heat value a unique dynamic monitoring and air to gas ratio adjustment is essential for an efficient combustion. Using a Syngas combustion to heat up indirectly an air system which is in direct contact with the product for the customer is novel. Although the different parts are well known in the industry, the integration in Tissue is an absolute novelty.<br><br>The gasification plant substitute 51 400 MWh of the LNG used for hot air needed in the tissue paper production process. Using locally produced bio-syngas is expected to avoid 72% more of the GHG emissions associated with the current process. In line with circular economy principles, the feedstock used to produce the bio-syngas is sorted wood waste collected from local industries and municipalities. A number of alternative fuels and/or energy sources were explored. The option of replacing LNG with hydrogen was discarded because of its limited availability and high costs, as well as because of its embrittlement tendency at high temperature. Electric heaters were also discarded due to the temperature thresholds of electric hood systems (300°C max) and related fire risks. Lastly, the use of bio-oil was deemed unacceptable because of potential residues (i.e. ash) and impurities, which directly affected the final paper product.<br><br>The technology could be replicated at around 10 of the 40 production facilities of the company, particularly on sites with high local availability of biomass by-products, such as wood chips or forest residues. The bio-based gasification process could also be extended to other sources such as agricultural waste, industrial residues, animal residues, municipal solid bio-based waste, sewage, and even other non-edible low-value biomass sources such as straw, grass and algae. |
| eMETHANOLxWSolution | Next Generation tanker vessel powered by e-methanol and wind assisted propulsion | The objective of the eMETHANOLxWSolution project is to demonstrate an innovative combination of foldable suction sails and a dual-fuel engine uniquely designed to fit the new hybrid tanker, thus enabling the use of e-methanol as fuel and wind for increased energy efficiency. The project will have a 100 % relative greenhouse gas (GHG) emission avoidance, as the technology used will be able to replace the conventional technology that uses fossil fuels, contributing to the decarbonisation of the shipping industry and customer's zero-emission supply chains of renewable fuels in the Baltic Sea and the North Sea.<br><br>The project aims to produce one of the first coastal tankers in Europe that uses e-methanol as a main energy source in its operations. In addition, a wind assisted propulsion system (WPS) will be demonstrated for the first time in the newly built vessel, which will enable the best possible optimisation of the system. The project demonstrates the use of several technologies to push the emissions to zero in a novel stepwise combination and system integration in a real operational environment. Furthermore, the project promotes action towards improved energy efficiency in the maritime transport, especially with the WPS. In absolute terms, the combination of e-methanol and wind in a tanker will result in a larger annual emission avoidance compared to a state-of-the art newbuilt tanker.<br><br>By contributing to the decarbonisation of the maritime sector, the project supports the development and deployment of innovative low-emission solutions and reaching the climate targets set by the International Maritime Organisation and the European Union, for instance through the EU Emission Trading System and the new FuelEU Maritime regulation. The |

| Acronym | Title | Description |
|---|---|---|
| | | project will set an example and share acquired knowledge to other shipping companies about innovative emission reduction technologies.<br><br>Scaling these clean technologies to other vessels would further strengthen the available technologies for e-methanol and WPS as well as the e-methanol supply chains. The project will scale itself and convert the technologies to the other newly built and existing vessels in the future. Additionally, there is a high scalability potential to deploy both these clean technologies onboard different types of cargo ships. |