

KILPILAHTI

Forerunner in decarbonization



Niklas Koski, Patrik Laxell, Johan Wallin

September 2021

Posintra

synocus



Helsinki-Uusimaa
Regional Council

Project steering group:

- Fredrick von Schoultz, the City of Porvoo, Chairman
- Fredrik Pressler, Posintra, Vice-Chairman
- Jari Koivumäki, Borealis
- Mika Pirneskoski, Lamor
- Jori Sahlsten, Neste
- Ari Lainevuori, Helsinki-Uusimaa Regional Council

Layout: Kirsten Sainio, Synocus

Cover photograph: City of Porvoo

EXECUTIVE SUMMARY

Kilpilahti – forerunner in decarbonization

Kilpilahti aims to be a leading international decarbonization competence center by 2030. Achieving this, calls for the integration of three parallel development paths:

- *Establishing a cost-competitive renewable energy infrastructure in Finland,*
- *Neste and Borealis's progress towards carbon-neutral production by 2035, and*
- *Kilpilahti becoming an internationally recognized innovation hub focusing on the circular economy with plastic recycling as the first unifying development theme.*

Posintra, together with leading companies in Kilpilahti, have investigated how to support decarbonization and establish an attractive green innovation platform for companies with Synocus Group as the partner for the study. The project was conducted during April-September 2021 in close collaboration with a steering group consisting of representatives of Posintra, Neste, Borealis, Lamor, the City of Porvoo, and the Helsinki Uusimaa Regional Council. The project was co-funded by the Helsinki Uusimaa Regional Council (AKKE funding) and the City of Porvoo.

Kilpilahti's emergence as a decarbonization competence center would rely on four pillars: i) Green Hydrogen, ii) Carbon Capture Storage & Utilization, iii) Plastics Waste Solutions, and iv) Transformational Leadership. These pillars provide the foundation for an intensified collaboration between public and private actors. This will start from two sets of actions: establishing a regional decarbonization or transformation center and supporting the strategic agendas of the companies active in Kilpilahti through a joint decarbonization innovation project.

For more information, please contact:

Fredrik Pressler, Posintra Oy fredrik.pressler@posintra.fi

Patrik Laxell, Synocus Group patrik.laxell@synocus.com

TIIVISTELMÄ

Kilpilahti – ilmastotyön edelläkävijä

Kilpilahden tavoitteena on kehittyä johtavaksi kansainväliseksi ilmastotyön osaamiskeskukseksi vuoteen 2030 mennessä. Tavoitteen saavuttamiseksi kolmea rinnakkaista kehityspolkua on edistettävä samanaikaisesti:

- *Kustannuksiltaan kilpailukykyisen uudistuvan energian infrastruktuurin rakentaminen Suomeen*
- *Nesteen ja Borealixsen eteneminen kohti hiilineutraalia tuotantoa vuoteen 2035 mennessä, ja*
- *Kilpilahden kasvaminen kansainvälisesti tunnustetuksi kiertotalouden innovaatiokeskittymäksi, jonka ensimmäisenä yhdistävänä teemana on muovien kierrätys.*

Posintra, yhdessä Kilpilahden johtavien yritysten kanssa, on selvittänyt, miten tukea alueen ilmastotyötä ja rakentaa yrityksille vetovoimainen vihreä innovaatioalusta. Synocus Group toimi selvityksen kumppanina. Projekti toteutettiin huhti- ja syyskuun välisenä aikana 2021 tiiviissä yhteistyössä hankkeen ohjausryhmän kanssa, joka koostui Posintran, Nesteen, Borealixsen, Lamorin, Porvoon kaupungin ja Uudenmaan liiton edustajista. Projektin rahoittajina olivat Uudenmaan liitto (AKKE-rahoitus) ja Porvoon kaupunki.

Kilpilahden kasvu ilmastotyön osaamiskeskukseksi rakentuu neljälle pilarille: i) vihreä vety, ii) hiilen talteenotto, varastointi ja hyödyntäminen, iii) jätemuovisovellukset ja iv) muutosjohtaminen. Pilarit muodostavat perustan tehokkaalle julkisten ja yksityisten toimijoiden väliselle yhteistyölle. Työ käynnistetään kahdella toimenpidekokonaisuudella: alueellisen ilmastotyö- tai transformaatiokeskuksen perustaminen sekä Kilpilahdessa toimivien yritysten strategisten tavoitteiden tukeminen käynnistämällä yhteinen ilmastotyön innovaatiohanke.

Ota yhteyttä saadaksesi lisätietoja projektista:

Fredrik Pressler, Posintra Oy fredrik.pressler@posintra.fi

Patrik Laxell, Synocus Group patrik.laxell@synocus.com

SAMMANDRAG

Sköldvik – föregångare i dekarbonering

Sköldvik har ambitionen att vara ett ledande internationellt kompetenscentrum i dekarbonering fram till 2030. För att lyckas med detta, måste tre parallella utvecklingsvägar föras fram på ett integrerat vis:

- *Etablering av en kostnadseffektiv infrastruktur för förnyelsebar energi i Finland,*
- *Neste och Borealis framskrider mot en kolneutral produktion 2035, och*
- *Sköldvik blir ett internationellt erkänt innovationscenter med fokus på cirkulär ekonomi med återvinning av plast som första förenande tema.*

Posintra tillsammans med ledande Kilpilahti-företag har undersökt hur man kunde stöda dekarbonering och upprättandet av en attraktiv grön innovationsplattform för företag. Synocus Group var partner för studien. Projektet genomfördes under april-september 2021 i nära samarbete med en styrgrupp bestående av representanter från Posintra, Neste, Borealis, Lamor, Borgå stad och Nylands förbund. Projektet finansierades av Nylands förbund (AKKE-finansiering) och Borgå stad.

Att förverkliga ett kompetenscenter runt dekarbonering i Sköldvik grundar sig på fyra pelare: i) grönt väte, ii) koldioxidavskiljning, -lagring och -utnyttjande, iii) återvinning av plastavfall och iv) ledarskap för förändring. Dessa pelare formar grunden för ett intensifierat samarbete mellan offentliga och privata aktörer. Det fortsatta arbetet är förankrat i två: skapandet av ett regionalt dekarbonerings eller transformations center och stödande av Kilpilahti företagens strategiska agendor genom ett gemensamt innovationsprojekt med fokus på dekarbonering.

För tilläggsinformation vänligen kontakta

Fredrik Pressler, Posintra Oy fredrik.pressler@posintra.fi

Patrik Laxell, Synocus Group patrik.laxell@synocus.com

FOREWORD

The Helsinki-Uusimaa Region of the future aims to be cool, and the most vibrant region in Europe. In this vision for 2050, cool reflects, among other things, climate-awareness and vibrancy to technological business pioneers. The Kilpilahti area of Porvoo, in the Uusimaa region, is already one of Finland's most significant centers of expertise in the circular economy and known internationally.

Posintra Oy was granted co-financing for a preliminary study by the Helsinki-Uusimaa Regional Council (AKKE funding) and the City of Porvoo. The objectives of the project were to identify opportunities to raise the profile of the Kilpilahti area and to develop it into an EU-level exemplar of climate work. The aim was to collect, process, and analyze information that would allow the preparation of a larger project bringing together a wide range of actors.

The project was conducted during April-September 2021 with Synocus Group as the partner for the study and in close collaboration with a steering group consisting of representatives of Posintra, Neste, Borealis, Lamm, the City of Porvoo, and the Helsinki-Uusimaa Regional Council. I thank all those involved for their valuable contributions.

This publication sets out to review the results of the pre-study. I hope that it will provide necessary facts and serve as a useful starting point for a successful project preparation.

Arto Varis
Project Manager
Posintra Oy

TABLE OF CONTENTS

1 EXTERNAL FORCES INFLUENCING KILPILAHTI; DECARBONIZATION SCENARIOS	1
2 PILLARS FOR KILPILAHTI AS A DECARBONIZATION COMPETENCE CENTER.....	3
Green Hydrogen.....	3
Carbon Capture Storage & Utilization	4
Plastic Waste Solutions.....	4
Transformational Leadership	5
3 BUILDING THE TRANSFORMATIONAL AGENDA	7
European direction	7
National perspective	8
Regional engagement	8
4 ACTION PLAN - KILPILAHTI AS AN INTERNATIONAL FORERUNNER.....	10
The Baltic Sea regional hydrogen gigahub.....	10
Leader in carbon utilization technologies	11
Value from plastic waste ecosystem.....	11
Kilpilahti as transformation center.....	12
Conclusions.....	15
APPENDIX 1:.....	16
Description of conducted process	16
APPENDIX 2:.....	17
Four scenarios for 2030.....	17
APPENDIX 3:.....	22
Benchmark descriptions & energy reflections.....	22
APPENDIX 4:.....	24
Publicly funded relevant development initiatives	24

1 EXTERNAL FORCES INFLUENCING KILPILAHTI; DECARBONIZATION SCENARIOS

In 2019 the Finnish government announced that Finland will reach carbon neutrality in 2035, fifteen years earlier than the EU target. In July 2021 the European Commission published its *Fit for 55* program, which proposes that by 2035 all new cars registered in the European Union must be zero-emission. For Kilpilahti, which since the 1960s has been a successful oil refining and petrochemicals hub, decarbonization implies a huge transformation.

Kilpilahti must change its production processes from being the single largest carbon emitting industrial site in Finland towards becoming a carbon sink. This will require a complete overhaul of the production processes and the energy supply to Kilpilahti. In addition, the product portfolio of the two leading companies, Neste and Borealis, must be changed to reach carbon neutrality objectives leveraging upon the strong foundation already established by the companies in their own RDI-activities and in joint projects like Pobi. The circular economy offers opportunities to collaboratively reconfigure the whole plastics value chain.

This report provides an outline for how Kilpilahti can enter a development path through which the public and private sectors jointly will contribute to making Kilpilahti a successful transformation case and evolve into a leading European decarbonization competence center by 2030. The report is the result of a collective effort involving the key stakeholders engaged in Kilpilahti: the city of Porvoo, Posintra, Helsinki-Uusimaa Regional Council, and company representatives from Borealis, Lamor, Neste and Rosk'n Roll. Synocus was commissioned by Posintra to facilitate the pre-study resulting in this report. – A description of the conducted process is presented in Appendix 1.

As the future remains characterized by genuine uncertainty, four scenarios were crafted to allow for a more open and problematizing approach when defining the way forward for Kilpilahti as a decarbonization competence center. The main characteristics of respective scenarios are presented in the following table (the scenarios are presented in Appendix 2):

Scenario	Innovation communities (1)	Alliances rule (2)	Regional ecosystems (3)	Energizing missions (4)
Theme	Exploration	Determination	Negotiation	Policies
Focal actors	Ecosystems	Corporations	Cities and regions	Governments
Idealized worldview	Insightful citizenship	Purpose-driven business	Progressive cities	Sustainable statesmanship
Collaboration focus	Capability building	Technology development	Offering development	Global sustainability
Technology	Batteries	Hydrogen	Electrification	Diversity
Role of Finland	Global visionary	Niche player	Technology hubs	Prudent contributor
Role of Kilpilahti	Competence center	Orchestration hub	Innovation platform	Industrial symbiosis
Values	Engagement	Industrial transformation	Pragmatism	Societal responsibility
Main threat	Lack of critical mass	Non-Finnish priorities	Bureaucracy	Political disagreement

Common to the four scenarios is that they all contain deep collaboration between companies and the public sector and share the overarching ambition to achieve carbon neutrality in Finland by 2035. This pre-study has confirmed that there are strongly converging interests among the key Kilpilahti actors to jointly pursue collaboration towards making Kilpilahti an internationally recognized decarbonization competence center by 2030.

2 PILLARS FOR KILPILAHTI AS A DECARBONIZATION COMPETENCE CENTER

Based on the interviews and discussions carried out in this pre-study four themes have been identified as the pillars of Kilpilahti as a decarbonization competence center in 2030: Green Hydrogen, Carbon Capture Storage & Utilization, Plastics Waste Solutions, and Transformational Leadership. Each pillar will in the following be discussed.

GREEN HYDROGEN

Finland does not have a separate hydrogen strategy, but hydrogen is an integral part of the carbon neutral strategy. The hydrogen roadmap for Finland from 2020 recognized that Neste is the largest hydrogen producer and consumer in Finland. Whereas Kilpilahti will emerge as a leading user of green hydrogen, most of Finnish wind power is located in the north. Due to the long transmission distance and the shortage in north-to-south grid capacity there is a need to approach green hydrogen as a matter of national infrastructure. This implies collaboration, e.g. with the second biggest user of green hydrogen in Finland: the Raahe steel mill, which has the ambition to replace its blast furnaces with electric arc furnaces. This requires a significant amount of clean hydrogen production requiring billion-euro investments.

For Neste and Borealis green hydrogen is an imperative to achieve carbon neutrality. Neste is chairing the company-led Finnish hydrogen cluster, which aims to accelerate hydrogen exports and the hydrogen economy by opening up doors to European networks. The high level of Finnish hydrogen activity is illustrated by the intention to build Finland's first green hydrogen production plant with a capacity of 20 megawatts in Harjavalta. The Harjavalta process was initiated by Prizztech illustrating public-private collaboration. A state investment grant of €50 million has been applied for by P2X Solutions, a startup aiming to become a central actor in the rapidly evolving hydrogen business.

Vantaa Energy and Wärtsilä in turn are preparing the investment in Power-to-Gas facility at Vantaa Energy's waste-to-energy -plant. This facility would produce synthetic methane from captured carbon dioxide and hydrogen produced with renewable energy.

Kilpilahti could become a Baltic Sea region Gigahub for hydrogen. The key question is how Kilpilahti, and its leading companies, intends to position themselves in the ongoing race. The expected hydrogen capacity needed in Kilpilahti by 2035 is 1 GW (equivalent to the present capacity of the Loviisa nuclear power plant). This means that the Kilpilahti hydrogen development must be closely integrated with the work on how the national energy system transformation will support the 2035 carbon neutrality targets.

CARBON CAPTURE STORAGE & UTILIZATION

Whereas the green hydrogen development, due to its systemic integration with the national energy infrastructure, is highly dependent on national and EU-level energy policy decisions, the future of carbon capture storage & utilization (CCS/U) in Kilpilahti is more in the hands of the companies themselves. In June 2021 Neste announced that it was progressing on its projects for growth in renewable and circular solutions. The announcement stated as follows:

“The project for clean hydrogen and recovery of carbon aims at delivering fast and efficient reduction of greenhouse gas emissions through innovative transformation of the Porvoo refinery, where it introduces carbon capture and storage (CCS) and electrolysis solutions that allow decarbonization of production at the refinery. With the clean hydrogen and recovery of carbon project, Neste also aims to gather a network of leading European technology suppliers and R&D institutes and to lay the foundation for a world-class European hub for renewable hydrogen and CO₂ utilization.”

Neste has already submitted an application to the EU’s Innovation Fund. Based on its status as a Finnish Veturi company Neste also carries out groundbreaking research in how to use carbon dioxide either to produce electric fuels (Neste's own product development focus) or for other uses (industrial ecosystem partners are being sought, the research partners are Åbo Akademi University, and Aalto University). Neste also supports hydrogen and CCS/U development in Rotterdam, which actively develops green hydrogen production. In Rotterdam there is also a CO₂ capture and storage project named Porthos, which is scheduled to store an annual amount of 2.5 million tons of CO₂ from the industry in empty gas fields beneath the North Sea as from 2024 (for more information see Appendix 3).

PLASTIC WASTE SOLUTIONS

Neste produces globally over 3 million tons of renewable products from various bio-based raw materials annually at its renewables refineries and is working towards replacing crude oil use with over 2 million tons of alternative renewable and recycled raw materials at its traditional oil refineries by 2030. The aim is to have liquefied waste plastic to account for over 1 million tons of this annually. To achieve this Neste has established strategic partnerships and is orchestrating collaborations with sustainability-oriented industry forerunners to develop chemical recycling technologies and to build chemical recycling capacity.

Borealis announced in April 2021 that it will co-operate with Fortum Recycling and Waste in Sweden on a project involving the sourcing of plastic waste to its chemical recycling unit. Fortum will apply for public funding for a feasibility study to this end. The integration of waste management and processing directly into a steam cracker would be one of the first of its kind.

Lamor has taken the initiative to develop a “*Value from Waste center*” in Kilpilahti. The aim of Lamor is to scale up the activity and export the processes abroad. Rosk’n Roll has already a suitable area for this purpose.

Plastic waste solutions represent both an issue of highly relevant local importance, as well as an area with the potential to provide the basis for innovations that later could be scaled up and promoted internationally. Rosk’n Roll is in a key position regarding the local waste management infrastructure and has established KILKE as a waste management service point in Kilpilahti. Thanks to its 32 hectares of land the KILKE area offers opportunities for expanding the activities of Rosk’n Roll in Kilpilahti in pace with evolving customer demand. The local service operator is Revanssi Oy, a joint venture between Kuusakoski and Rosk’n Roll.

Plastic waste solutions will ask for both institutional undertakings to secure that Neste will have access to 1 million tons of waste plastic by 2030, and incubation efforts to fully support the efforts of Lamor and Rosk’n Roll to make Kilpilahti a circular economy role model.

TRANSFORMATIONAL LEADERSHIP

The ambition to establish an innovation hub based on environmental sustainability is nothing new. Arguably the first location where this happened was Kalundborg which has been characterized as an industrial symbiosis or an industrial ecosystem (see benchmark case in Appendix 3). Considering Kalundborg, its symbioses evolved gradually and without a grand design over more than 25 years, as the firms sought to make economic use of their by-products and to minimize the cost of compliance with new, ever-stricter environmental regulations.

In the case of Kilpilahti the urgency of reaching carbon neutrality by 2035 doesn’t allow the decision makers the luxury of allowing the process to evolve and hope for a positive outcome in decades to come. This means that there is a need for a proactive transformational leadership to nurture and speed up the innovation collaboration.

For Kilpilahti to emerge as a Baltic Region innovation hub it is important that there will be a core team of like-minded individuals that jointly take the responsible for bringing the resources together to make the envisaged development happen. One example of how such a development can start was when the new CEO of Nautor in 1998 teamed up with the chairman of the local chamber of commerce to strengthen the local collaboration with the ambition to strengthen the competitiveness of Nautor and its partners. This successful intervention resulted in the new Swan 45, which became a bestseller, and the order book of Nautor grew five-fold between 1998 and 2002.

Posintra could complement the companies in Kilpilahti in the same way as the local chamber of commerce complemented the boat building cluster in Ostrobothnia. Innovation collaboration implies that companies co-evolve capabilities around innovations in a continuous way to support new products and penetrate new market opportunities. The collaboration should

contribute both to the society and secure that there are also commercial benefits for participating enterprises. The focus should be on continuously updating the shared agenda and roadmap to pursue the efforts towards a carbon neutral Kilpilahti.

The characteristics of the transformational leadership should support the overall profiling of Kilpilahti to integrate the perspectives of green hydrogen, carbon utilization, plastic waste management into a vibrant innovation community making Kilpilahti an internationally recognized decarbonization competence center by 2030.

3 BUILDING THE TRANSFORMATIONAL AGENDA

The decarbonization efforts in Kilpilahti will be strongly influenced by the evolving legislation and the regulations that will form how both technical and commercial priorities should be set. As Kilpilahti and its stakeholders represent a significant knowledge based relating to the chemical industry, and its expertise in environmental technologies, it is evident that Kilpilahti also has the potential to influence how the future will unfold. In this section some observations about the potential to influence the agenda setting on European, national, and regional level will be presented.

EUROPEAN DIRECTION

The European Green Deal, and the further clarification through the *Fit for 55* -announcement in mid-July indicate that the EU aims to carry through a comprehensive and interconnected set of actions to address climate change. How the various measures will be undertaken in practice, and what will be the timing of individual missions and programs is still open but *Fit for 55* confirms that legislative tools will be used to accelerate decarbonization and force individual nations and companies to determinedly reduce carbon emissions.

An indication of the rapid changes is that *Fit for 55* shifted the attention from Zero- and Low-Emission Vehicles (ZLEV) into ZEVs (Zero-Emission Vehicles). As from 2035 all new cars should be ZEVs. It also proposes that sustainable aviation fuels (SAF) will become mandatory and airplanes departing from EU airports would be obliged to include more SAF into jet fuel: 2% by 2025, 5% by 2030, and by 2050 the requirement is 63%.

The funding of decarbonization will be increasingly based on the principle of combining EU level funding with Member State matching funds, which will strengthen the alignment between EU actions and those of individual Member States to spur innovation, economic growth, and investments in clean technologies. 37 % of the €724 billion Recovery and Resilience Facility (RRF) will be allocated to climate action.

An example of how different development efforts proceed in parallel is the hydrogen IPCEI. In December 2020, 23 EU countries also agreed on the IPCEI Hydrogen, and companies could apply with their projects. The hydrogen IPCEI mobilized 230 proposals in Germany, out of which 62 were nationally approved for EU consideration, representing a total budget of €33 billion. The governmental support would be €8 billion. In the Netherlands 24 projects were approved for the Dutch hydrogen IPCEI, which would add up to 2,2 GW of electrolysis capacity that could be in use by 2025, and another 4,6 GW of electrolyzers that could be operational between 2026 and 2030. 12 projects are located in Rotterdam, including the production of green hydrogen (by Shell, BP-Nobian, Uniper and Vattenfall-Air Liquide). The deadline for the Finnish IPCEI process was in the beginning of July

2021. The estimation is that the first round of decisions will be available Q1/2022, and the second round of decisions Q2-Q3/2022. Business Finland has indicated that the European Commission has informed that the first round of decision will include about 20 projects, and the second one about 50 projects. Finland has the opportunity to influence the European agenda through its active IPCEI engagement (for more detailed background see Appendix 4).

NATIONAL PERSPECTIVE

The Finnish Government is preparing legislation related to a subsidy for the electrification of energy-intensive industries. The subsidy will provide incentives for carbon-neutral production and the electrification of energy-intensive companies, taking cost competitiveness into account.

As of mid-August, the draft budget for 2022 of the Ministry of Economic Affairs and Employment does not yet include additional funding from the EU Recovery and Resilience Facility (RRF) for 2022. The allocation of funding will be decided later as the preparation of the Government's budget proposal advances. This allocation is of high importance for Kilpilahti, as Kilpilahti is a main area aiming to electrify energy-intensive production.

As the preparations of the national budget for 2022 are still open in respect of how to engage the RRF funding it illustrates the complex integration of EU-level, national and regional measures in the task of effectively addressing climate change. This also underlines the importance of the key actors engaged in the Kilpilahti transformation to contribute with relevant knowledge individually and collectively into the ongoing discussions to secure that Kilpilahti will attract the attention it is needing due to its potential to contribute to a significant step change in the decarbonization process in Finland.

The Finnish requirement of electrification of energy-dependent industry is another argument making Kilpilahti particularly relevant when Finland will decide on its next round of actions to meet its targets of carbon neutrality by 2035. Technically funding opportunities will soon open in the national RRF -program. There will also be funding opportunities for the public sector in ERDF and React-EU. For all these funds the Kilpilahti objectives fits well.

REGIONAL ENGAGEMENT

Kilpilahti will evolve to a leading competence center for decarbonization by integrating three development paths:

- *The establishing of a cost-competitive renewable energy infrastructure in Finland,*
- *Neste and Borealis proceeding towards carbon-neutral production by 2035, and*

- *Kilpilahti becoming an internationally recognized innovation hub focusing on the circular economy with plastic recycling as the first unifying development theme.*

The three development paths proceed in parallel, and the role of the key actors in Kilpilahti is to secure the best possible coordination across these three development paths to maximize the synergies. Each path has its own logic.

The energy system will be developed according to the national energy strategy, which will be updated this year. Kilpilahti must actively engage in the preparation of the strategy to make sure that its interests and potential are properly taken into consideration in the strategy.

Carbon neutral production in Kilpilahti is the result of the strategies of Neste, Borealis and their partners. Here it is important that the actors engaged in the Kilpilahti development properly will support and complement each other to have a forceful European impact.

Kilpilahti will become an internationally respected innovation hub based on concrete results from innovation collaboration starting with plastic waste solutions and carbon utilization. Developing and supporting innovation collaboration around circular economy topics is a key responsibility of the city of Porvoo and Posintra, supported by Helsinki Uusimaa Region.

4 ACTION PLAN - KILPILAHTI AS AN INTERNATIONAL FORERUNNER

Kilpilahti must pursue activities on several frontiers in parallel to become an international decarbonization competence center. The maturity of legislation and strategic commitment varies across the four identified pillars. Subsequently when proceeding the differences in maturity affect how to proceed. The recommendations below form the basis for a gradually strengthening Kilpilahti identity, that can guide the journey towards Kilpilahti as an internationally recognized innovation hub.

THE BALTIC SEA REGIONAL HYDROGEN GIGAHUB

The Sustainable Growth Programme for Finland published in May 2021 declares that achieving the carbon neutrality target by 2035 will require tens of billions in investments to transform the energy system. In the coming years several billions per year will be allocated to energy infrastructure investments. There is already €156 million reserved from the recovery funds for the period 2021-2026 for low carbon hydrogen and carbon capture and utilization, €60 million for electrification and decarbonization of industrial processes, and €110 million for circular economy investments. The IPCEI application of Neste will also influence the Finnish hydrogen roadmap and impact the decarbonization path of the Kilpilahti area.

The decarbonization of Kilpilahti will evolve through the interdependence of public sector engagement through recovery fund and IPCEI decisions, evaluations of the large companies regarding the role of Kilpilahti in their strategy, as well as the capacity of the regional actors to increase the attractiveness of Kilpilahti as a business development hub. In this respect the business landscape will evolve based upon the collaboration between all these parties.

The competitiveness of the Kilpilahti firms will be based on their competence in managing portfolios of development projects, products, and services through which they will both go through their own transformation, and simultaneously build the foundation for future growth. Here the Kilpilahti collaboration will support the way companies can flexibly test and evaluate new ideas and strengthen their transformational capability. Finding the optimal way to secure the needed amount of renewable electricity, primarily wind power, will form the foundation based upon the energy transition of Kilpilahti will take place.

The discussions about the Finnish energy strategy, and the way to solve the future demand for renewable electricity of leading industrial companies such as Neste and Borealis, will proceed very much driven by national interests. This will also impact the success of Finland to attract European level and funding for the needed investments.

For Kilpilahti the proceeding of these topics is dependent on legislative and policy decision making on European and national level. The Kilpilahti collaboration should ensure that the involved actors are keeping each other updated in these matters. If new joint actions may be needed to strengthen the Kilpilahti position in these issues, such support can be quickly and effectively mobilized. From the timetable perspective these matters can be integrated into the Kilpilahti roadmap once the present pending investment funding decisions have been made.

LEADER IN CARBON UTILIZATION TECHNOLOGIES

In its Veturi project Neste has announced its ambition to pursue research on conversion technologies for new carbon neutral fuels and chemicals from captured CO₂. This forms the basis for Kilpilahti as an innovation hub to attract new players with an interest and capacity to complement the production and innovation processes of Neste and Borealis related to the utilization of CO₂ as raw material for industrial production.

This area is still evolving. How the European Union will treat the capturing and utilization of CO₂ in different climate legislations is still work in process. However, the expectation is that the rules of this area will rather quickly be clarified. At that stage there will be possibilities to include this topic into the joint Kilpilahti road map with concrete enough objectives to be promoted as part of the overall Kilpilahti agenda.

What already now is indicated is that the upcoming legislation will increase the pressure to move towards carbon neutrality more quickly. As the proposed EU-legislation for road transport aims to allow only zero-emission new cars to be sold in Europe by 2035, it is expected that a similar quite firm stance will be visible in other areas as well.

VALUE FROM PLASTIC WASTE ECOSYSTEM

The success of Kilpilahti is dependent on its ability to combine institutional top-down innovation with entrepreneurial bottom-up innovation. The area most ripe for immediate entrepreneurial action is the treatment of plastic waste.

Rosk'n Roll and Lamor have already started investigations of various concepts relating to the circular economy in plastic waste treatment. There are also discussions relating to how the synergies between Rotterdam and Kilpilahti could be further leveraged upon, e.g. through new and innovative logistics solutions. As the amounts of plastic waste needed to satisfy the demand of Neste and Borealis by 2030 will require significant import of plastic waste the way to cost-effectively manage the material flows must be part of the systemic solution.

The Kilpilahti community offers the companies access to the networks of other participants, when there is a need to rapidly react upon new signals from the market. An enhanced image of Kilpilahti as a responsible and

innovative actor will strengthen the societal position of each individual community member. This should strengthen the plastic waste activities of Kilpilahti.

KILPILAHTI AS TRANSFORMATION CENTER

For Kilpilahti to succeed in becoming an international benchmark it needs to determinedly proceed on three frontiers simultaneously: European influence, national attractiveness, and collaboration effectiveness. The 2030 roadmap must integrate these three perspectives, and the first phase of development should both initiate key actions and at the same time continue the work of refining the roadmap to secure the best possible result by 2030. As the transformation of Kilpilahti will require the concentrated efforts of many different actors it is important to recognize the organization-specific ambitions of the key actors as the basis from which to build a shared agenda. The identified ambitions are as follows:

Neste has the intention to have its production carbon neutral by 2035 and to have 1 million tons of plastic waste as input to its production process by 2030. The potential to have synergies in the development of Kilpilahti and Naantali is also in the interest of Neste.

Borealis intends to have half of its electricity usage to come from renewable sources by 2030 and is also actively increasing the share of recycled raw materials in its production process.

Lamor has received growth engine status by Business Finland and is in that role building a circular economy global platform to support waste plastic solutions.

ABB has a production site in Porvoo for wiring accessories and installation products. This site as aims to be a forerunner in decarbonization and could also become a customer for recycled plastic and this way be an early showcase of decarbonization in the Porvoo region.

Fortum can contribute to increasing renewable electricity needed for Kilpilahti. In addition, Fortum is also engaged as a partner in the development of the Naantali Green Industry Park.

The City of Porvoo intends to become a carbon-neutral by 2030 and Porvoo also actively promotes the circular economy. Porvoo was the first city in Finland to introduce Neste MY renewable diesel, made entirely from waste and residues, in all its diesel vehicles in 2017.

Helsinki Uusimaa Region is preparing the Helsinki-Uusimaa Regional Program 2022-2025 focusing on technological development, population trends, regional development, and polarization. In respect of innovation collaboration Kilpilahti is on center stage.

As the organization specific objectives explain the development is very much driven by the various interests of the companies. Neste, for example, is a strong driver of both the new energy infrastructure of Kilpilahti and the circular economy solutions relating to the recycling of plastics. ABB in turn

brings extensive experience in upskilling of workforce and teams for digital transformation including their competency and capability development. In addition, the ABB Veturi initiative could find synergies with the Kilpilahti transformation of the electricity infrastructure. Both Fortum and ABB have a strong interest in the transformation of the whole Kilpilahti energy infrastructure, ABB as a system provider to the energy and process management systems in Kilpilahti, and Fortum as an energy provider.

The commitment from all above organizations to continue efforts towards jointly contributing to making Kilpilahti a decarbonization competence center provides synergy benefits to the organizations on European, national and regional level:

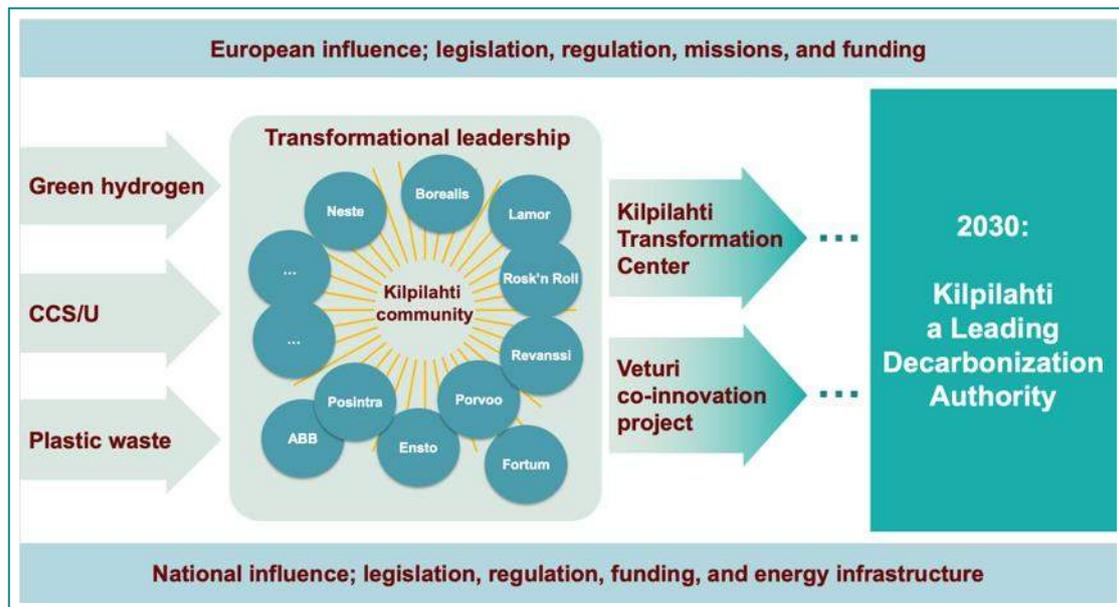
- *On European level the Kilpilahti actors and their partners must be successful in attracting European level funding for their development efforts in Kilpilahti. There is also a need for lobbying related to the detailed regulations for the future transport fuels for aviation, sea transport, and land transport.*
- *Nationally the decisions on the energy infrastructure and the circular economy should make the national landscape attractive from the outside. The contribution of Kilpilahti is here important. As e.g. the Finnish government uses the IPCEI process to strengthen Finland internationally in the hydrogen and carbon capture areas, it benefits from Kilpilahti being a leading site for industrial transformation.*
- *Regionally the waste plastic solutions are already under development through the collaboration among the Kilpilahti companies. Neste, Borealis, Lamor and Rosk'n Roll have concrete discussions about the next phase of this collaboration.*

The city of Porvoo and Posintra want to secure that there will be smooth coordination with the development going on in the Turku region, as Neste and Fortum also are strongly engaged in the activities around the Naantali Green Industry Park.

The next phase of development is here recommended to proceed in two parallel paths:

- **Co-innovation project:** *company-led collaboration integrating efforts through the ongoing Veturi projects by Neste, ABB and Fortum and looking for possibilities to develop a new co-innovation project supporting the Veturi objectives.*
- **Innovation platform:** *Posintra-led joint efforts among the key Kilpilahti actors to form the "Kilpilahti Transformation Center" (tentative name), securing that the strong interest in collaboratively driving the future Kilpilahti agenda will be maintained.*

These two development paths support each other and contribute to a very active sharing of information among the key Kilpilahti actors. This integrates the Kilpilahti agenda and roadmap with the individual agendas of the key partners. The pre-study has identified there is a strong interest among the parties involved in the pre-study in making Kilpilahti a success story.



The co-innovation project must be anchored in the detailed project plans of the three Veturi companies Neste, ABB, and Fortum. These discussions will continue during autumn, based on the initial probing done during the pre-study.

Institutionalizing the innovation platform into a formal organization, possibly a separate company, has been supported by the steering group. The argument for having this type of formalization at this stage is the change in magnitude of collective efforts needed due to the Kilpilahti decarbonization agenda outlined in this report. Another factor supporting such an arrangement is the formation of the Naantali Green Industry Park with Neste and Fortum as founders. Because Naantali and Kilpilahti both influence the future of the chemical industry in Finland, it would be natural to have a similar organizational arrangement around Kilpilahti as the one already agreed upon for Naantali.

CONCLUSIONS

The high-level target for Kilpilahti is very clear: carbon neutrality by 2035. This provides a strong common purpose for intensifying and speeding up the joint decarbonization work in and around Kilpilahti. There are different clock speeds and maturities in respect of how concrete decarbonization projects can be started in Kilpilahti. For example, the hydrogen IPCEI process will have a great influence on how the decarbonization of Kilpilahti will proceed, and this will be known in 2022. Hydrogen development will also require additional areas for collaboration e.g. relating to logistics and urban mobility and strengthening the integration of Kilpilahti with the capital region in terms of competence building and talent mobility.

The local dimension of an innovation community also includes the living conditions for the professionals that will contribute to the Kilpilahti development. Here it is likely that an increasing part of the professionals will be foreigners, which raises issues such as how to provide English services for international specialists by the city of Porvoo (including schools).

For the city the question of new industrial activities in and around Kilpilahti (e.g. Nyby/Kulloo) is another input in the discussion about the profiling of Kilpilahti as an innovation hub. Land use and city planning are tools by which the city can contribute to the attractiveness of Kilpilahti. Here as well these efforts should be strongly integrated with the agendas of the leading companies in Kilpilahti. Public-private projects can be additional tools to support the development of the decarbonization competence center, the proposed Kilpilahti Transformation Center.

APPENDIX 1:

DESCRIPTION OF CONDUCTED PROCESS

		3/2021	4/2021	5/2021	6/2021	8/2021	9/2021
		Background	Identifying potential		Developing measures		
WP I	Kilpilahti as a demonstration site for low-carbon mobility		Surveying interest of City of Porvoo and actors active in region		Coordinating low-carbon demonstration concepts		Refining measures for selected demonstrations
WP II	Kilpilahti as a forerunner participatory city planning		Collecting visions from leading experts	Strengthening foresight; EU mission, project concepts		Profiling benchmarks	
WP III	Kilpilahti as an international innovation hub			Initial tests of identified potential	Following through on international-scale potential		Identifying measures
WP IV	Kilpilahti as a global climate success story in 2030		Workshop preparation/debriefing	Commencing process	Workshop preparation/debriefing	Scenario workshop	Workshop preparation/debriefing
WP V	Foundations of a European network project and project management	Identifying opportunities for funding				Reporting; visualizing scenarios	Concluding seminar
		PG	SG	PG	PG	SG	PG
					Intern report	Final report; action plan for scenarios	

Key input in process:

- Steering group interviews:
 - Neste 19.4.
 - Borealis 20.4.
 - Lamor 22.4.
 - City of Porvoo 28.4.
 - Helsinki Region 29.4.
- Complementary expert interview: Rosk'n Roll 16.8.
- Steering group meetings: 10.5., 23.6. and 1.9.
- Project group meetings: 18.3., 25.3, 27.4., 20.5. and 17.8.

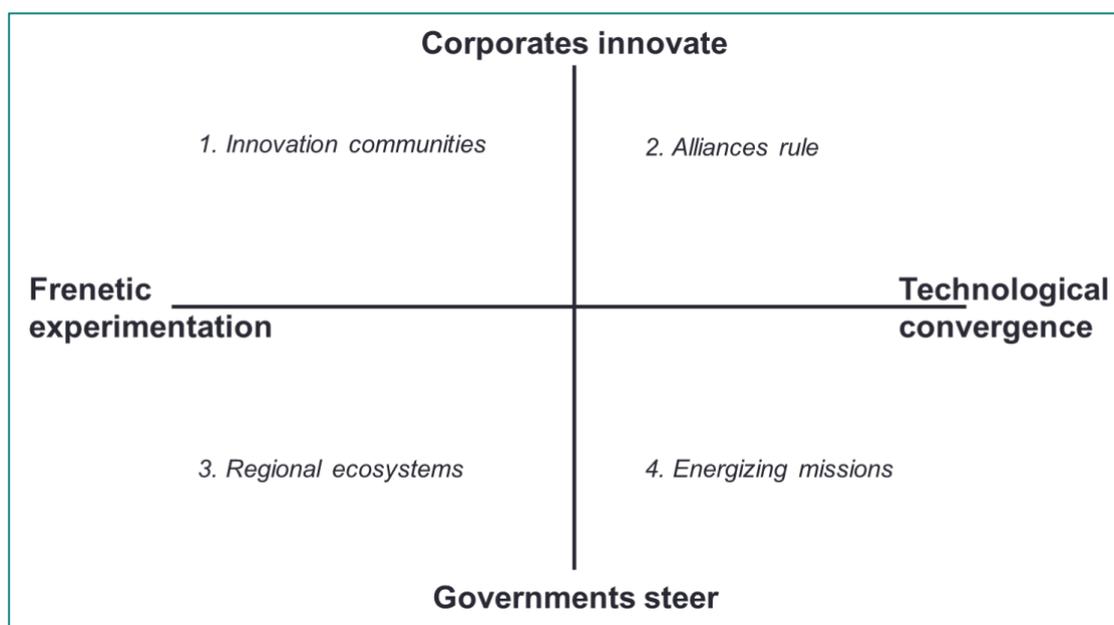
Additional insight/synergies derived from:

- Synocus project Empowering Low Carbon Cities
 - EU CoR VP, Markku Markkula 7.5.
 - Neste, Lars Peter Lindfors 22.6.
 - Neste, Outi Ervasti 5.8.
 - Neste, Outi Teräs 26.8.
- Synocus customer event 30.6.

APPENDIX 2:

FOUR SCENARIOS FOR 2030

The scenarios developed for this report were developed as a means to demonstrate the key uncertainties facing Kilpilahti and its companies when moving forward. Two dimensions were selected to develop a two-by-two matrix: innovation vanguard (private or public) and technology maturity (converging or experimenting). Based on these dimensions four scenarios were outlined in accordance with the following figure:



FINANCIAL TIMES

EUROPE MONDAY JUNE 23, 2031

BRIEFING

From Platforms to Engagement

Alphabet CTO Demis Hassabis outlines the ongoing migration of the Google business model; based on applying ethical AI and the wealth of data on our networks. **Page 5**

Countries in capability building competition

We have discussed with leading investment banker how capability building competition formed the '20's leading theme for national value creation. **Page 7**

Highlight: Kilpilahti Decarbonization Competence Centre

Kilpilahti seems to succeed at every stage in expanding its sphere of influence in the transformed field of liquid fuels and bioplastics. Read why **Page 8**

Insightful individual of the decade

The 2020's key individual was Greta Thunberg; who in hindsight showed us that an individual with a clear ownership of her future can have a gigantic impact. We will look back and review flagbearers for the 2030's. **Page 12**



Exploration of new innovation territory

Swedish ecosystems for sustainability

By Caroline Daniel and Kevin Morrison in Stockholm

When the Nordics soared past Silicon Valley as the leading region for the new decacorns in 2027; it was not by simple chance.

The long-term focus on addressing sustainability systematically, combined with the strong industrial actors and vivid start-up ecosystems provides for the excellent combination needed for a sustainability-first world.

Many other regions globally have lacked the trust needed when moving frenetically from early start-up and research exploration to later collaborative ecosystems.

Sweden has, by a clear margin, been the leader in the Nordics. The leader of the Wallenberg sphere Markus Wallenberg (Chairman of the board of ABB) gives credit to the mix of idealism and pragmatism in Sweden.

“Firms have been able to develop world-leadership and collaboration in their respective fields; with a good mix of idealistic policy and a good dialogue between sectors”. “Future-minded individuals and responsible consumers not to be forgotten”, he adds.

Traditionally, the shadow on the wall has been whether any of the promising innovative firms will reach critical mass. Early experiments and the evolution of the global market can be very far between.

Markus Wallenberg states that the Paris Agreement, EU Green Deal and the first 100 days of the Biden presidency were the basis for a change. “The time spans grew shorter for a new innovation to go from idea to a commercial product”. This called for new behaviour from firms—focusing more on learning or innovation communities.

Now, critical mass is more a question of the variety of different alternatives available in parallel. Here, the ecosystem-level can keep several balls in the air unlike a single company; and collaborate on the winning alternative.

The Wallenberg-sphere's transition into a leading developer of the broader Swedish innovation community is a showcase of this.

Actors of tomorrow, **Page 8**

Solid-state Batteries

By Mike Scott in Shenzhen

The record-breaking year-to-year growth of the battery industry takes new speed, as solid-state batteries make the breakthrough. Also new mines and processing plant expansion changes the price competitiveness of the sector.

This creates an opportunity to take full-on the competition in previously hydrogen-led territories. We will present key insights on new heavy equipment manufacturing.

China leads the field, in cutting-edge research and the largest market and, consequently, also in leading firms. We will investigate how Chinese policy could evolve during the 2030's.

Our report will also look more closely at CATL—the leading firm of the sector and stock-exchange darling; assessing how partnerships with innovation leaders, such as Apple and Tesla, have taken it to its current position and how its CEO Robin Zeng is developing its capabilities to address new sectors of growth.

Technologies report

FINANCIAL TIMES

EUROPE MONDAY JUNE 23, 2031

BRIEFING

Technologies drive industrial transformation

Mobility and energy industries at core of massive transformation in industry enables by rise in sustainable technologies. **Page 5**

Alliances strengthen technology development

A new study on the rise of sustainable technologies in the '20s puts technological alliances at the heart of the revolutionary developments. Read how collaborative alliances guided the development. **Page 7**

Highlight: Kilpilahti Decarbonization Orchestration Hub

The Kilpilahti region has become home to a world-leading hub of networked knowledge on sustainable transformation. Read how. **Page 8**

Purpose-driven business accelerating transformation

A key to the accelerated pace of technological innovation in the 2020's was the shift away from profit-driven business and the embrace of purpose as the defining element among businesses. **Page 12**



Major corporations hold reins in sustainable tech

By Caroline Daniel and Kevin Morrison in Berlin

With the world's governments seemingly stalling in their commitment to speeding up the move to decarbonization in the early years of the 2020's, corporations move to take up the reins in the development of technologies and services necessary to keep global warming below 1.5 C.

With sustainability now the primary priority in these emission-heavy industries, businesses quickly aligned themselves in reforming their portfolios in accordance with the prevailing understanding on the actions necessary to avert climate catastrophe.

This renewed engagement in turn saw the world's major corporations shoot past the early market incumbents that had, in the decade's first half, pioneered many of the technologies that would become market leaders and world changers in its latter half.

With this, the major corporations headquartered in major markets came to dominate the market and drive the innovators in countries like Finland out of the limelight they had held.

From 2026 on, the technologies produced by these major corporations became industry standard as the experimentation of the previous decade and a half came to an end with an increasing technological convergence.

The CEO Alliance for Europe's Recovery, Reform and Resilience, formed in 2020, is a case in point. It has dictated the development in several fields of cross-sector climate innovation, leveraging the power of its core corporate members.

Smaller countries—once darlings of the technology world as the start-ups and SMEs headquartered in them drove early development—found themselves falling behind in the global competition.

Now smaller nations like Finland are looking to strengthen their competitive footholds as well as their position at the global political table by increasing governmental efforts to support local industries.

Threats to small nations, **Page 8**

Technologies: Hydrogen

By Mike Scott in Tokyo

Hydrogen rose to become a crucial driver for the economy over the 2020s as Japanese corporations and European alliances invested heavily in the development at an early stage, making them leaders in the field as it matured throughout the decade.

The rise of clean hydrogen was spurred by the European Union's strong support of the field as well as the Japanese government's last-ditch bid to reform its oil-dependent economy into one powered by clean hydrogen.

These twinned impetuses served to unseat the perceived leaders of the post-fossil-fuel future, previously thought to have resided largely in China and its burgeoning electric vehicle and battery industries.

In our report we also will look closer at the role played by major oil companies like Shell and BP in the rise of clean hydrogen as they focused on finding a future in the twilight days of their industry.

Technologies report

FINANCIAL TIMES

EUROPE MONDAY JUNE 23, 2031

BRIEFING

In demand: pragmatic problem solvers

FT speaks at length about the skill shortage for effective integration and implementation of the new economic model. Read the full interview on Kate Raworth. **Page 5**

Empathic leadership is driving mobility offerings

Collaboration and empathic leadership, translated systematically into engaging models for experimentation, produce new types of mobility offerings at Daimler. **Page 7**

Industrial innovation platforms support spin-offs and scale-ups

Regional industrial parks prove to be a high potential for growth. We will review some successful examples in the ongoing conversion of oil and gas to bio-circular industries. **Page 8**

These previously polluting industries are becoming carbon neutral

2030 was the deadline for many industries to reach their first climate goals, yet some front-running industries have gone further and achieved carbon neutrality. Learn more about them on **Page 12**



Negotiation practices push regional development

Dynamic European cities are models for climate transformation

By Caroline Daniel and Kevin Morrison in Stockholm

The Belgian City of Leuven has long been one of Europe's Labs of the Future through a mission-oriented model that facilitates collaborative innovation. Different groups of stakeholders come together, with the common purpose of innovating around complex challenges from climate change and the shift to a circular economy to ensuring high-quality education and care.

Leuven not only provides its citizens increased opportunities for innovating, but also actively involves them in testing their ideas in the city. Since being awarded European Capital of Innovation in 2020, Leuven has followed up their collaborative roadmap for carbon neutrality and, thanks to its long tradition of citizen participation in critical decision-making processes, continued to improve quality of life in the region.

Lahti, the first Finnish City to reach Carbon neutrality in 2025 is similarly growing their reputation as a regional competence centre for climate transformation innovations.

Lahti began its journey in 2019 with carbon trading for individuals, now a staple in each loyalty and city card scheme. The experiences in tweaking sustainability behaviour by rewarding individuals continues to be a key research topic into the next decade.

What we can learn from these cities as the actors of tomorrow is that they have managed to avoid the bureaucratic processes by taking an action learning approach and leveraged a variety of other competence holders in resolving the climate transformation in innovative ways. Co-created pilot solutions are then strengthened further through the city's usual processes.

Actors of tomorrow, Page 8

Technologies: Electrification

By Mike Scott in Helsinki

Ecosystem models for smart energy is the theme of today's Low Carbon Cities conference in Helsinki. The biannual conference is co-organized by Europe's largest pure-energy player, Fortum.

The conference's highlight is a look back at the results of the Helsinki Energy Challenge competition; where the ambition in 2021 was to resolve the climate neutrality challenges of Helsinki. The learnings will be presented by Juhana Vartiainen, ex-mayor of Helsinki.

Another highlight is the energy transformation of the Aland Islands. The consortium behind the 100% renewable energy system provides workshops with insights into the innovative sector coupling and storages solutions.

The Financial Times will offer detailed reporting on these developments and emerging new technologies supporting electrification.

Technologies report

FINANCIAL TIMES

EUROPE MONDAY JUNE 23, 2031

BRIEFING

Chinese big Tech highlights societal responsibility

CEOs of leading Chinese firm have jointly expressed their societal responsibility in the mission for sustainability. **Page 5**

Global sustainability drives collaboration

Recent research shows how sustainability and green transition have transformed, in total, how companies and public organizations collaborate. **Page 7**

Industrial symbiosis reinvented

Kalundborg an earlier hothouse of symbiosis has transformed industrial symbiosis by reaching out not only to proximity but also larger region. Read how. **Page 8**

Scenario report 2040 – sustainable statesmanship

According to over 1000 interviews with decision makers from both public and private sectors, sustainable statesmanship will be the worldview of the decade. **Page 12**



EU and national governments for sustainability

By Caroline Daniel and Kevin Morrison in Rome

The prime ministers of EU member countries have gathered in Rome to celebrate the union's exceptional achievements regarding sustainability.

A decade ago, the EU presented a plan to reduce its greenhouse gas emissions by at least 55% by 2030. The target was significantly surpassed for a 75% reduction in emissions.

The original European Green Deal was a set of policy initiatives with the overarching aim of making Europe climate neutral in 2050. However, due to the faster achievement of the target, technological development, and active governments, the target year of climate neutrality has been reconsidered. The new ambitious aim has been set to 2045, making Europe the earliest carbon neutral continent in the world.

In support, the EU has introduced the third version of the European Green Deal program that includes measures to significantly reduce greenhouse gas emissions, invest in cutting-edge research and innovation and preserve Europe's natural environment.

The government of the member countries have shown a green flag for the commission's new targets and plans. However, the Finnish government has expressed some conflicting opinions. The recently elected Finnish government, consisting of the EU negative Finns and Central parties, might even stop the proposal.

Read more about the EU plan and how we see the influence of the Finnish government's conflicting opinions.

Actors of tomorrow, **Page 8**

Technologies: Diversity

By Mike Scott in Brussels

A decade ago, the future was expected to be driven by batteries and electrification. However, the result as of today is very different as governments have set policies to support a variety of technological solutions.

China, the largest market in the world, is the leading player in the field of batteries both in cutting-edge research and leading firms.

Thanks to the IPCEI projects and Union-level policies, Europe has become the dominant player in the field of hydrogen solutions.

In the US, the government has allowed market forces to compete without greater political guidance. However, President, Donald Trump Jr., has even discussed subsidies for fossil fuels.

In our report, we will look at the major actors and give our view of how this sector will develop over the next ten years.

Technologies report

APPENDIX 3:

BENCHMARK DESCRIPTIONS & ENERGY REFLECTIONS

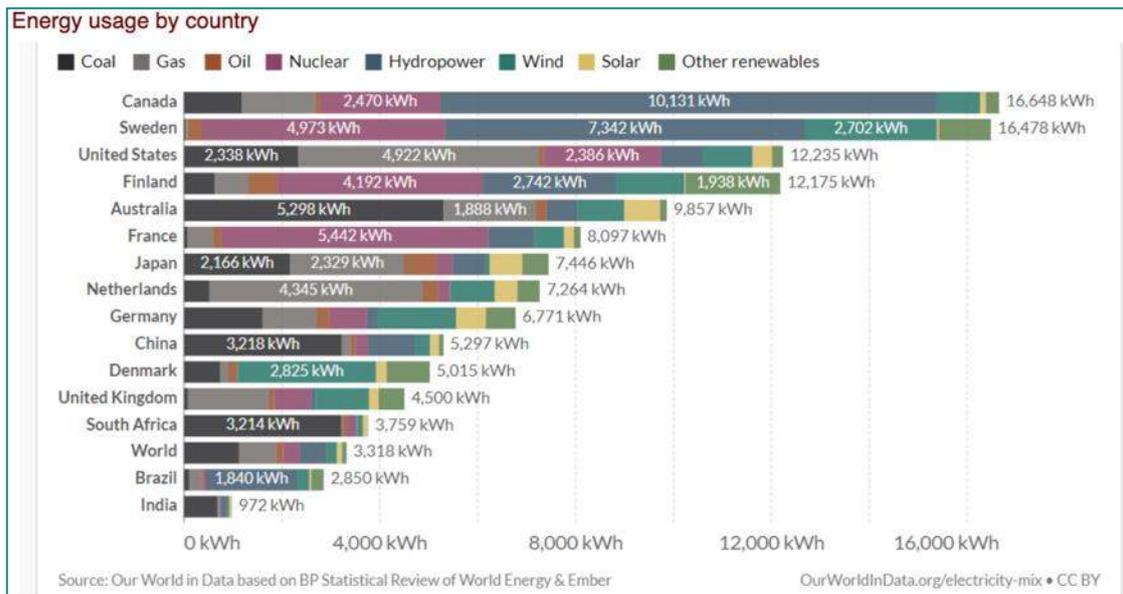
The study has included review of both national and international benchmark cases, and the most interesting complementary benchmarks for Kilpilahti have been selected:

1. *Rotterdam, the Port of Rotterdam*
2. *Kalundborg, Industrial Symbiosis*
3. *Turku, Smart Chemistry Park*

More detailed case descriptions of the three selected benchmarks have been made, the conclusions of which are described in the following table.

	Industrial logic	Capabilities focus	Leveraging external resources	Direct benchmark opportunity	Collaboration opportunity
1. Rotterdam	Environmentally driven industrial cluster with a supportive infrastructure based on a plug-and-play logic.	How to integrate a synergetic corporate and long-term governmental support for international positioning; e.g. in CCUS and hydrogen.	Very active advocate in the EU (and mobilizer of additional support) for its role as a global chemical hub.	How to mobilize funding and global promotion of a (petro)chemicals cluster in transformation.	By jointly leveraging Neste's position in Rotterdam there is a possibility to collectively identify how to collaborate between Kilpilahti and Rotterdam.
2. Kalundborg	Privately lead multi-actor partnership, with both strong industrial actors, public actors, and central functions.	Is based on symbiotic exchanges between more diverse actors; including construction materials, biochemicals. This provides insights into opportunities and challenges in expanding Kilpilahti scope.	Uses international (multi-actor) projects extensively to investigate new synergies or speed up the renewal of the symbiosis; which has yet to be leveraged by Kilpilahti.	Insight on how to lead: <ul style="list-style-type: none"> • Public-private collaboration in promoting attractiveness • Strategic added value defined in: renewal, connect and promote • Governance logic 	Project opportunities at least through Nordic policy and innovation collaboration.
3. Turku	Expanding collaboration platform starting from research strengths of universities in Turku and then integrated with Raisio corporation to further support battery technology in Harjavalta and latest also reinvigorating Naantali.	Organized as an incubator with a high degree of flexibility as the individual SME's are independent. This can provide insights into how Kilpilahti may also establish an incubation element into its next phase of development.	Green industry park in Naantali means there is an opportunity to connect with the Turku region to agree upon common priorities and some preliminary complementary roles to maximize national integration.	As hosted by Turku business region it suggests that Posintra could take a similar incubator hosting role in Kilpilahti, providing that there will be supports from anchor companies and institutionally from the region.	Immediate actions to be taken due to the role of Neste and Fortum as founders of green industry park in Naantali and the strong role of Åbo Akademi as a research partner of Neste.

When comparing the benchmarks, it is important to consider their energy context. The starting point is electricity production. The figure below presents how the different countries are positioned in respect of their electricity production.



Finland (like Sweden) has a much higher electricity production per capita compared to Denmark and Netherlands. What also is important is that in respect of wind energy the absolute wind energy production per capita in Denmark is more or less the same as wind energy production in Sweden and about twice the one of Finland. This suggests that there is a significant potential to expand wind energy in Finland.

In the Netherlands two thirds of 2020 electricity production (7,264 kWh/capita) was based on coal and gas, and in Denmark 18 % of electricity production (5,015 kWh/h) was carbon-based. The 2020 Finnish electricity production (12,175 kWh/capita) had only 11 % based on coal and gas. Due to the high degree of energy-intensive industry in Finland we produced almost 2,5 times the electricity per capita compared to Denmark.

Electricity forms only part of the total energy consumption. For 2020 Motiva has calculated that the total energy consumption in Finland was 355 TWh or 64,100 kWh per capita. As the pulp and paper industry has a significant share and reuses energy in the process, bio-based energy is the biggest individual share of Finnish energy production, representing 28 % in 2020, oil is the second biggest energy source, 21 %, which primarily represents the transport sector. Hydro and wind energy together represented 7 % of the total Finnish energy production in 2020.

APPENDIX 4:

PUBLICLY FUNDED RELEVANT DEVELOPMENT INITIATIVES

The Ministry of Economic Affairs and Employment published in March the following list of project proposals that have applied for funding relating to energy technology. The decision is expected by the end of 2021.

10.3.2021

Työ- ja elinkeinoministeriöön toimitetut uudet tukihakemukset uuden energiateknologian ja suurten demonstraatioiden hankkeiden investointeihin 2021

Hakijan nimi	Hankkeen nimi	Haettu tuki, €
Ab Ekorosk Oy	Biokaasulaitos Ekorosk Oy	6 776 440
Bioenergo Oy	BioEnergo biokonversiolaitos	39 708 069
EPV Energia Oy	H-FLEX-E Skaalautuvan aurinko- ja tuulisähkön varastointi ja käyttö	12 652 000
Fortum Power and Heat Oy	Inkoon vanhan hiilivoimala- ja turvetuotantoalueen muuntaminen aurinkovoimatuotantoon ja sähkön varastointiin	11 376 000
Gasum Oy	Haapaveden biokaasun jalostus- ja nesteytyslaitos	7 281 300
Joensuun Biohiili Oy	TORREFINE	3 818 000
Karhubetoni Oy	Nurmeksen Biokaasulaitos	2 673 133
Kiinteistö Oy DC Seinäjoki	Seinäjoen Datakeskus	5 677 788
Kiinteistö Oy Myllykoski	Myllykosken bioetanolitehdas	30 000 000
Kuopion Energia Oy	Haapaniemen lämpöpumppu	12 000 000
Lakkikeidas PV Oy	Lakkikeitaan aurinkovoimala	6 046 980
Metsä Fibre Oy	MF Rauman meesauunin polttoaine	8 038 200
Neste Oyj	Porvoon jalostamon uusiutuvan vedyn hanke	43 400 000
Oulun Energia Oy	Oulun Biojalostamo	36 000 000
P2X Solutions Oy	P2X - Vihreän vedyn tuotantolaitos	25 600 000
Pohjolan Voima Oyj	Vesivoiman ja järjestelmäsuojan akkuhybridi	3 800 000
Solarigo Oy	Solarigon hybridaurinkovoimalahanke	2 613 000
Tampereen Sähkölaitos Oy	Voimalaitoksen lämmön talteenotto lämpöpumpuilla	6 800 000
Tampereen Sähkölaitos Oy	Geolämpö yhteishanke Tampereella	2 146 771
Tervakoski Oy	Prosessihöyryä hukkalämmöstä	2 407 770
Vantaan Energia Oy	Fossiiliton Vantaa 2026: Uusiutuva sähkö liikennepolttoaineeksi ja lämmöntuotannon huippu-uormiin Power-to-Gas -menetelmällä (PtG)	20 000 000
Vantaan Energia Oy	Fossiiliton Vantaa 2026: Lämmön kausivarasto mahdollistavana teknologiana	8 025 000
Yhteensä		296 840 451

Työ- ja elinkeinoministeriön alustavan arvion mukaan päätökset tuettavista hankkeista tehdään syksyllä 2021.

In June 2021 Neste announced that two project proposals applying for funding by the European Innovation fund were among the 70 proposals (among 311 applications) accepted for the second stage. If realized, both projects would strongly contribute to reaching both Finland's and the EU's climate targets. Here the decision is also expected by the end of 2021. The second stage remains very competitive as the projects may request up to EUR 7 billion of grants, based on the information provided in their applications for the first stage.

For Kilpilahti and its partners it may be relevant to also consider possible project proposals for the next funding round of the Innovaiton Fund:

Innovation Fund: Commission announces planning of the next calls for proposals



08/07/2021

Preparations for the next calls for proposals under the Innovation Fund are well underway. As announced at the Innovation Fund Expert Group meeting on 6 July, the Commission plans to launch the second call for large-scale projects on 26 October, while the second call for small-scale projects is expected to be launched in

March 2022.

Finland is also actively engaged in the hydrogen IPCEI process. Here Finland has not yet publicly announced its own targets, but Germany and the Netherlands have already made announcements about their own ambitions. Their project proposals are presented below.



Naam initiatiefnemer	Naam project
Air Liquide B.V.	HyTrucks
Air Liquide Industrie B.V.	ELYgator
Air Products	Pink Camel, "Low carbon energy import (NH3) and distribution (NH3/H2) for Mobility, with kickstart aid for Buses and HDV uses"
Bosch Transmission Technology B.V.	"Electrolyser Stack_project_proposition"
Chemgas Shipping B.V.	H2 Danube-Main-Rhine
DAF Trucks N.V.	Hydrogen Powered Trucks - HyPoTs
ENGIE Energie Nederland N.V.	HyNetherlands
Havenbedrijf Rotterdam N.V.	H2Sines.RDAM – a European shipping corridor for Green Hydrogen
Havenbedrijf Rotterdam N.V.	H2-Fifty
Havenbedrijf Rotterdam N.V.	Hydrogen conversionpark Rotterdam
Havenbedrijf Rotterdam N.V.	Open-access hydrogen infrastructure Rotterdam-Germany Phase A1: Maasvlakte-Pernis
Hydron Energy B.V.	Enabling breakthrough cost reduction of PEM electrolyser technology
Lukoil and TotalEnergies	H2ero – Green Hydrogen
N.V. Nederlandse Gasunie	Dutch Hydrogen Backbone
N.V. Nederlandse Gasunie	Hydrogen storage; HyStock
NedStack fuel cell technology B.V.	Fuel Cell Giga Factory
Nouryon Industrial Chemicals B.V.	H2ermes
Provincie Zuid-Holland	RH2INE
SHELL Nederland B.V.	An integrated green hydrogen supply chain from production to use Netherlands
Uniper Benelux N.V.	Hydrogen to Maasvlakte (Rotterdam, The Netherlands)
Vattenfall N.V.	Curthyl, 'renewable hydrogen'
VDL Nederland B.V.	Energy Systems for mobile and stationary applications
Vopak Europa & Africa B.V.	Green H 2 Imports in Europe
Yara Sluiskil B.V.	Haddock