

Cleantech  
*for Nordics*

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# Unlocking growth in Nordic Cleantech

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# ACKNOWLEDGEMENTS

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This report was researched and written by Cleantech Scandinavia

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**Cleantech for Nordics** is a coalition of investors and others seeking to closely engage with policymakers to ensure that the Nordic region becomes a global hotbed for cleantech innovation, jobs and economic growth. Our objective is to remove costly barriers and uncover new opportunities that can develop and grow the cleantech sector. We want to help pioneer globally competitive industries that can slash carbon emissions all while increasing energy security across the Nordics and even Europe more broadly.

The Nordic countries – Denmark, Finland, Iceland, Norway and Sweden – have for decades been at the forefront of climate action. They have impressive track records of citizen engagement, ambitious legislation and open and collaborative cleantech business environments.

The region also boasts a strong innovation system. In the 2022 European Innovation Scorecard, Sweden, Finland and Denmark were ranked Nos. 1–3. The “Nordic unicorn factory” has produced international tech companies the likes of Skype, Spotify, Klarna, and Supercell.

Now, a new generation of Nordic cleantech companies are on the cusp of going global. These companies not only benefit from the Nordics’ existing business and innovation ecosystems; they also inherit its hard-won experience and its cutting-edge infrastructure.

This places the entire Nordic region in an enviable position. It is poised to lead Europe’s cleantech industry as it scales up innovative climate solutions – this decade – that can help create jobs, strengthen economic resilience, increase energy security and reach net-zero goals.

It is nothing short of a re-industrialization in the making.

In this executive summary we provide a snapshot of the Nordic cleantech landscape utilizing investment data, policy analysis and interviews with 30 Nordic cleantech companies and investors. The aim is to provide a common knowledge base and a starting point for policy recommendations that can further improve the ecosystem – **Unlocking Growth in Nordic cleantech**.

# From low-carbon food production to energy storage, big potential in diverse sectors

The breadth of recent investments in Nordic cleantech companies underscores the potential for the region to lead in multiple sectors globally. Among companies that attracted big investments in 2021 (+50 M€) were companies looking to:

- Decarbonize the manufacturing process for steel (H2 Green Steel)
- Large scale battery production (Northvolt, Freyr, Nilar)
- Long term energy storage including heat (Azelio)
- Developing and building large scale wind and solar farms (OX2 and Ilmatar)
- Electric, autonomous and digital transport (Einride)
- Technology for large-scale production of green hydrogen (Permascand)
- Design and manufacturing of electric motorbikes (Cake Bikes)

Projects and investments like these are part of what essentially is a remaking of the world's entire physical economy in order to reach net-zero and stave off the worst effects of climate change. An example is the steelmaking industry, not traditionally known for its new initiatives and innovation despite 6% of the world's GHG emissions coming from iron and steel according to Rhodium Group. Initiatives like Swedish Hybrit has industry giants SSAB, LKAB and Vattenfall working together to develop the first fossil-free steel. Meanwhile, H2 Green Steel announced Oct 2022 it had secured 260 M€ in funding from Hitachi Energy, Kobe Steel and Kinnevik to develop their production process, using digitalization, electricity from fossil-free sources and green hydrogen instead of coal to produce green steel.

Finland sees the circular economy as a key to a future-secured competitive economy and was the first country in the world to prepare a national road map

to a circular economy in 2016. Now, Finnish Swappie, which sells refurbished iPhones online, is at the top of the Financial Times' list of Europe's fastest-growing companies. Between 2017 and 2020, Swappie had a compound annual growth rate of almost 500%. Other fast-growing circular economy companies in Finland include ResQ, saving restaurant meals from going to waste, while Karma in Sweden and ToGoodToGo in Denmark also active in the same field making it almost a Nordic specialty. Other examples include Nasdaq First North-listed Renewcell out of Sweden, which is building a factory to recycle fabric from textile waste and is already getting orders in from big fashion brands H&M and Levi's.

Another strong pipeline of Nordic companies are involved with electrification. Sweden's fast-growing electric transport industry alone boasts: bike manufacturer Cake, electric autonomous truck company Einride, electric boat companies X-shore and Candela, and electric airplane manufacturer Heart Aerospace. Another Nordic growth industry is electric charging. Examples include Charge Amps (Sweden), Virta (Finland), Monta (Denmark) and Zaptech (Norway).

In **storage**, Northvolt of Sweden is building battery factories in Sweden, Germany and Poland, securing some 55 Bn€ in orders from customers including BMW, Fluence, Scania, Volvo Cars, and Volkswagen Group and attracting 2.3 Bn€ in funding in 2021 alone. Freyr (Finland) also attracted large funding in 2021, and Fortum is a legacy energy company building a new battery material recycling facility in its home market Finland. On top of that there is a number of emerging battery players in the Nordics, with innovations that can drastically reduce the negative environmental impact of batteries such as Swedish Altris producing a sodium-ion cathode material.

**Solar** research in the Nordics is strong, as is the growth of innovative solar technologies as well as installation companies who now increasingly include grid battery storage and energy efficiency software in their offerings. REC and Scatec Solar (both from Norway) are early success stories in terms of manufacturing and installing solar, and growing companies are now emerging across the solar value chain. Exeger (Sweden) builds flexible thin solar cells that can be integrated into devices such as headphones, speakers, and remote controls. Recent customers include Adidas and Omni remotes. Epishine (Sweden) has launched printable thin film solar for indoor light energy harvesting and now has pioneering customers building products using them. Peafowl (Sweden) develops transparent panels, while other fast-growing Nordic solar companies include Alight (Sweden) and Svea Solar (Sweden), the latter recently passed 100 M€ in revenues.

Venture capital investment in the **agriculture** sector (including low-carbon food production) has changed dramatically over the last five years. In 2021, the sector attracted five times more VC investments than in 2017. Investments were made in everything from airborne forestry to foodtech. The top 10 investments include:

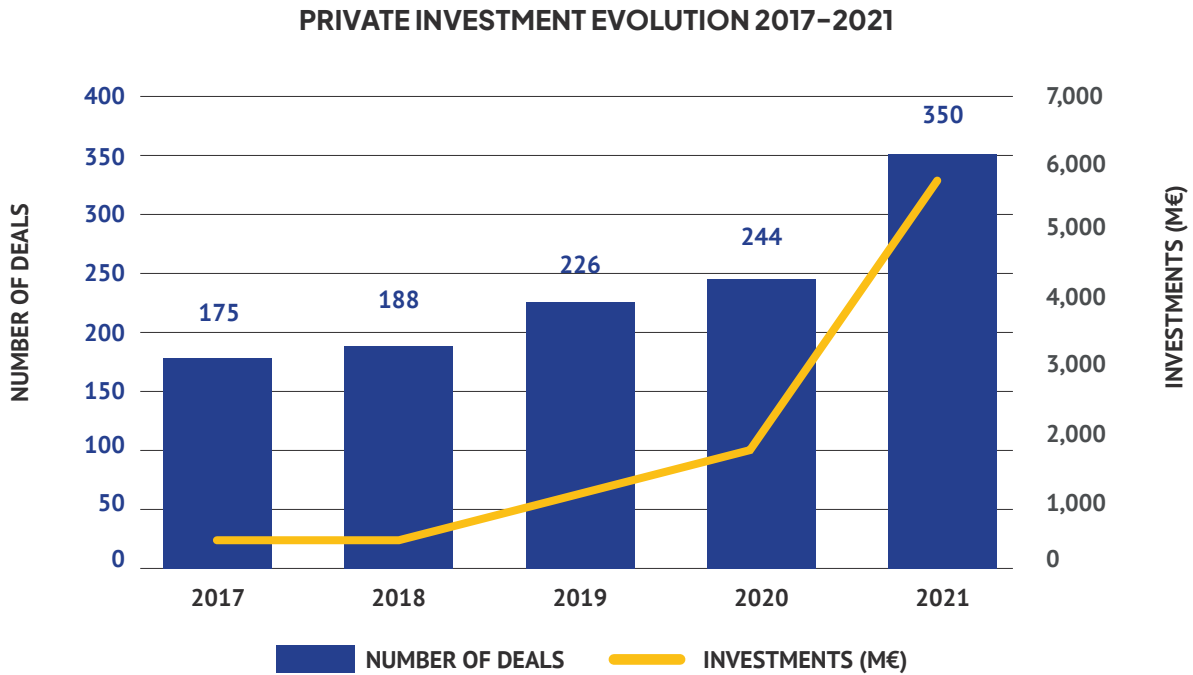
- Making plant-based food alternatives to dairy (Oatly, Stockeld Dreamery, Oddlygood)
- Ocean growing and harvesting to provide plant-based food (Alginor)
- Turn degraded land and sand to fertile soil (Desert control)
- Vertical Indoor farming (Onna Farming)
- Protein alternatives to animal based (Solar foods)

These are far from the only areas where fast growing companies are emerging and to be very clear: Fast growing Nordic cleantech companies are emerging across a very wide spectra of sectors.

# The ecosystem

From 2017 to 2021, there has been impressive growth in both the number of deals and the amounts invested into growth companies. In 2021, there were 350 cleantech venture capital deals in the Nordics, totaling 5.8 Bn €. This doubled the previous year and was 12 times more than in 2017, when just 471 M€ was invested:

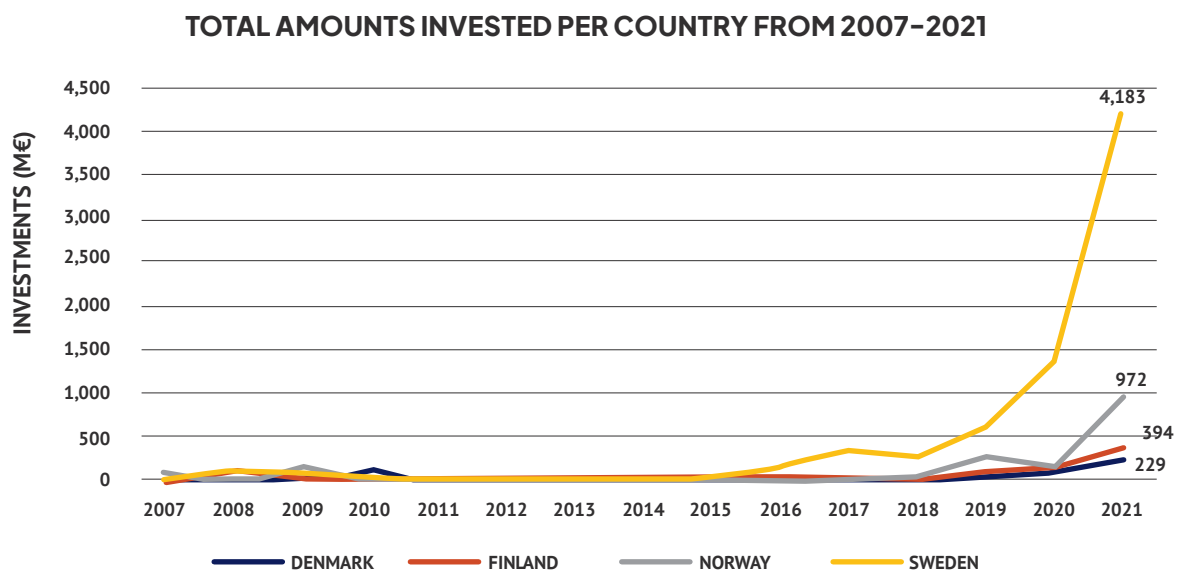
- 2017 – 471 M€
- 2018 – 454 M€ (- 3.5% from 2017)
- 2019 – 1.1 Bn€ (+139% from 2018)
- 2020 – 1.8 Bn€ (+70% from 2019)
- 2021 – 5.8 Bn€ (+212 % from 2020)





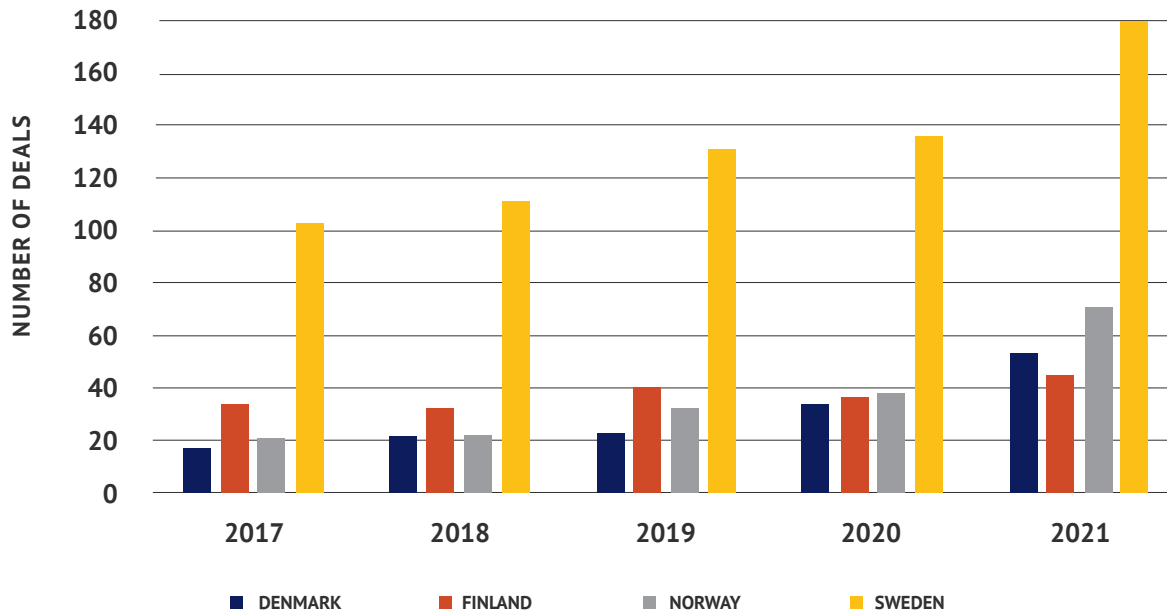
Looking at the total amount invested since 2007, there was little difference between the Nordic countries up until 2016 when Sweden started to stand out. Since then, **Sweden has been well ahead of its neighbors.**

However, while Norway seemed to be following the paths of Finland and Denmark, 2021 broke that trend. Norway now appears to be following the lead of Sweden, not only in terms of the deal volume it attracted in 2021 but also by attracting some larger later-stage deals.

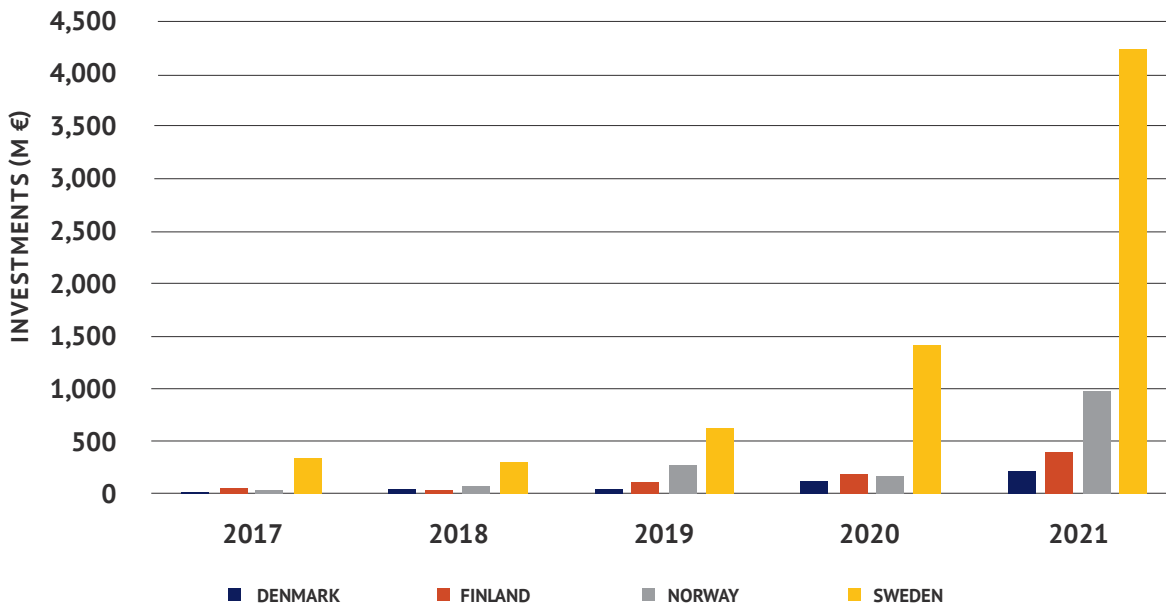


The two following graphs summarize the number of deals and amount invested per country over the last five years. The number of deals across countries has remained quite stagnant for Denmark, Finland and Norway until 2020, which marked a rupture. In 2021, these three countries passed the threshold of 40 deals each, which is twice as many as in 2017 for Finland and Denmark. Sweden, which has had a much larger number of deals than the other countries since 2017, has experienced steady growth since then. In Sweden, the amounts invested have increased dramatically.

### NUMBER OF DEALS PER COUNTRY 2017-2021



### TOTAL AMOUNT INVESTED PER COUNTRY 2017-2021



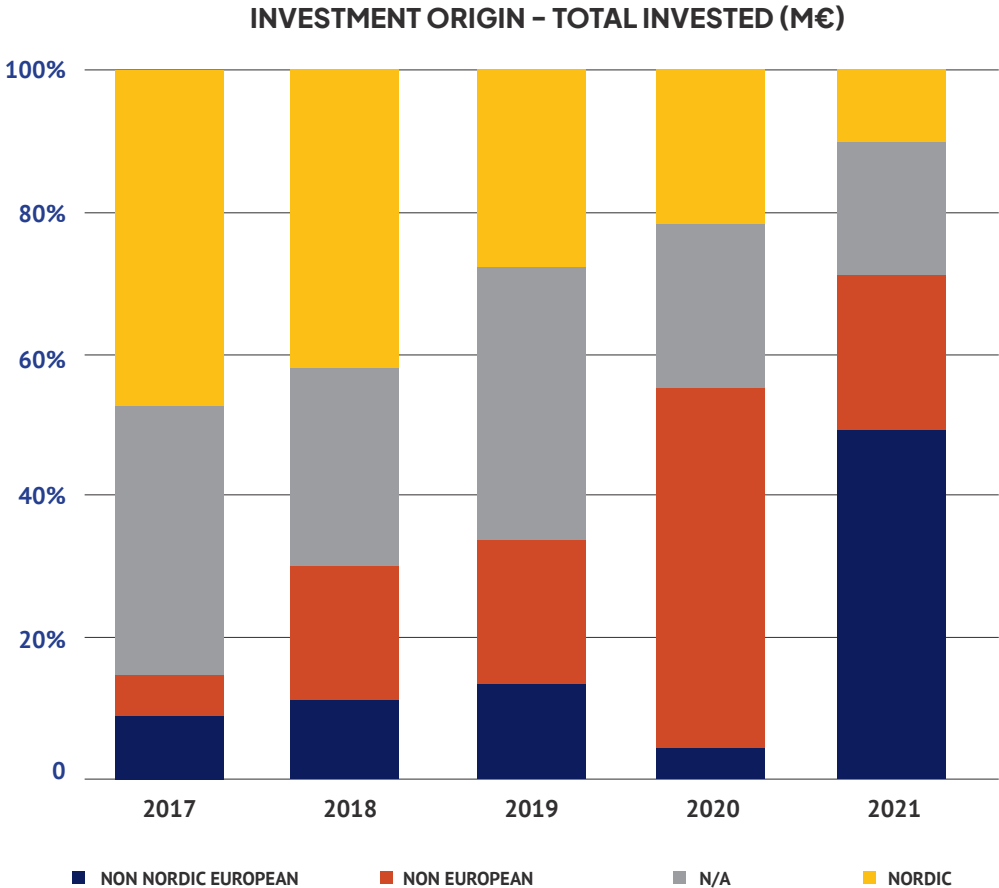
Another difference over the years is that **international capital is increasingly finding the Nordic cleantech sector**. We classified investment rounds following the headquarter location of the top five investors involved in each deal, making the following distinctions:

**Nordic:** Investment rounds where only Nordic investors were involved.

**Non-Nordic European:** Investment rounds that included European investors.

**Non-European:** Investment rounds that included non-European investors.

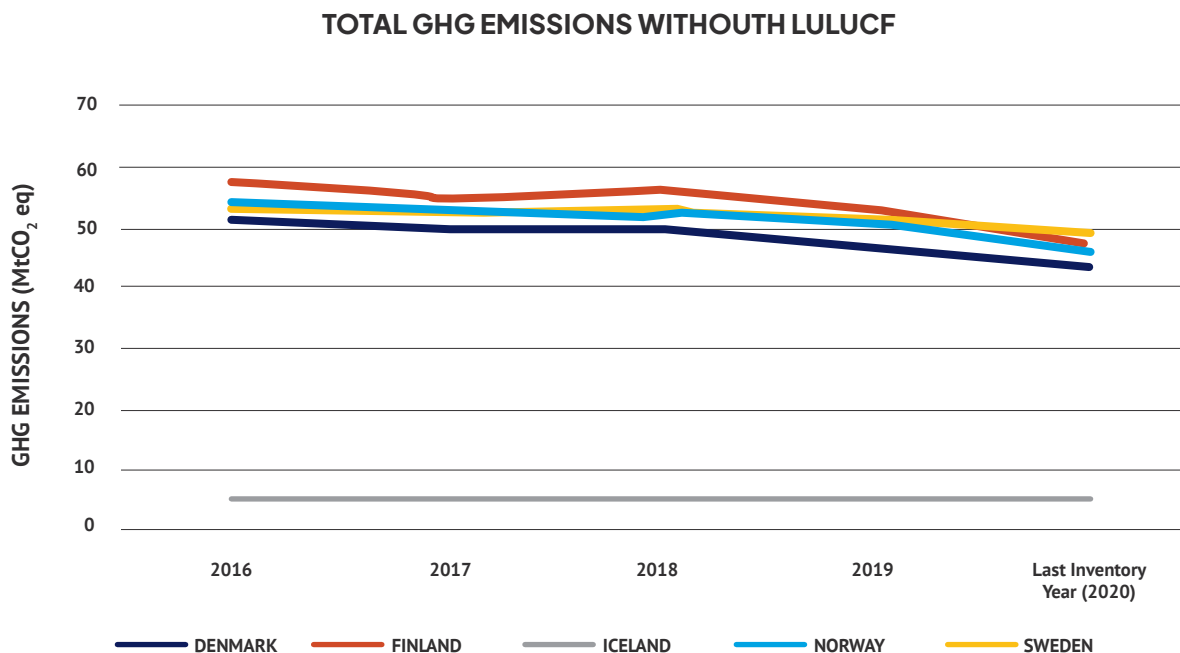
What stands out is that non-Nordic capital is becoming a main source of capital for later-stage Nordic cleantech companies. Deals where non-Nordic investors were involved has boomed. In 2021, 70% of the capital came from deals where non-Nordic investors were involved, compared to 15% in 2017. Investors from the United States are the most active among non-European investors.



# Carbon related policies and emissions

The Nordic countries all have ambitious goals to cut emissions and reach net zero.

The way power is produced in the Nordics is the major contributor to our low carbon emissions from energy production, which in turn also favorably impacts our total per capita carbon footprint. Based on statistics from 2020, total territorial emissions from the Nordic countries are close to 190 MtCO<sub>2</sub>e. That is a reduction of some 25% compared to 1990 and close to 14% compared to 2016.



On a global level all the Nordic countries stand out with a low carbon footprint compared to the level of economic output, but also compared to many other countries with substantially lower economic outputs.

Ambitious politics and policymaking contribute and have had their share in forming the Nordic power production of today. The Nordic region meets more than three quarters of its electricity needs with renewables, relative to the one third share of the EU-28. Norway even produces more renewable electricity than it consumes, and Iceland's electricity mix is also in practice fully renewable.

And that, in turn has a lot to do with fast running water. Half of the electricity produced in the Nordics combined is generated from hydropower. In Norway the vast majority at approximately 90% and in Sweden it is 42%.

	NORDICS		EU 28	
	2005	2019	2005	2019
Renewable energy share (RES %)	37,7%	54%	9,1%	19%
Renewable electricity share (RES-E %)	58,1%	77,6%	14,8%	34,2%
Renewable heating share (REC-H&C %)	39,4%	57%	11,1%	21%
Renewable transport share (RES-T %)	3,3%	22,5%	1,8%	9%

Table: Renewable energy in the Nordics 2021, prepared by Nordic Energy Research

Analyzing the policy initiatives in each country shows that the Nordic countries share strong support for cleantech and climate-related R&D, as well as efforts to catalyze industrial sector innovation by decreasing risk when new technologies are tested (this is typically done via state grants being matched by similar amounts from industry).

Having a collaborative approach is also strong in all the Nordics. For example, the government initiative Fossil Free Sweden works with 22 business sectors that have made net-zero roadmaps. In Finland, low-carbon roadmaps have been put in place by 13 sectors. Export credits is another shared tool used in several countries to boost sales for green technology companies, where the state can typically offer financing to the buyer and guarantees of payment to the exporter.

There are also some differences between the Nordic countries. Denmark stands out in focusing on a few specific technology areas like Power-to-X and Carbon Capture. By comparison, Sweden has a more general, technology-neutral approach (one stand-out is an ambitious electrification strategy).

Denmark is building the world's first energy islands. The islands will serve as hubs that can facilitate better connections between energy generated from offshore wind and regional onshore energy systems. With its significant wind power generation, Denmark is showing the world what an energy system that at times is wholly dependent on renewables looks like.

Norway stands out as a large oil exporter that seeks to be a global leader in electrification, first in EVs and now by supporting electrification of its shipping industry.



# Recommendations: How to unlock cleantech growth in the Nordics?

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The authors of this report conducted 30 interviews with Nordic cleantech entrepreneurs and investors. Topics discussed included growth potential, investments and the policy landscape. These insights from professionals at the edge of the burgeoning Nordic cleantech industry were then combined with the industry data we have compiled. Based on the anecdotal and empirical evidence gathered, we then formulated high-level recommendations that can be refined and ultimately implemented to help fuel the crucial next stage of Nordic cleantech growth.

## **1: Address the shortage of skilled personnel in the cleantech sector**

The market potential of reorientating global industry to align with net-zero goals is attracting more entrepreneurs to the cleantech space. Unfortunately, many of the fast-growing companies they found soon lack enough skilled workers to take their growth to the next level. This includes workers who assist in large-scale production at factories, deploy artificial intelligence or manage internationalization. To address this skilled worker shortfall may include: Enhancing the education systems and possibilities for work force import of skilled workers to the sector.

*“We need experienced start-up founders to bring their experience, say from web and general tech sectors and leverage those learnings into a green transition. That could potentially accelerate the development – and the money will flow to the exceptional start-ups”.*

**Terhi Vapola** at Helen Ventures, Finland

## 2: Increase cooperation between Nordic countries

For cleantech companies, the Nordics offer an incredibly supportive and globally unique environment for growth. The region combines demanding customers, supportive regulatory frameworks and widespread availability of clean, renewable energy. In addition, the Nordics have a strong R&D tradition, predictable business environments and good early-stage funding and investment opportunities. Despite these favorable conditions, the interviewees highlighted increased potential by improving cooperation across Nordic countries, sharing best practices, collaborating on outreach and coordinating the energy system.

From a Nordic perspective there were also policy areas mentioned where we might be ahead as a region and where one country may have something that works and could be shared, an example mentioned was the Danish tax deduction for research and development expenditures.

*“Being in the Nordics gives us an excellent launching pad.”*

**Samantha Jane Phillips**, Dynelectro (Tech to reduce the cost of green hydrogen)

*“Sweden is good also because of its basically carbon free electricity production.”*

**Mattias Josephson**, Epishine (Indoor light energy harvesting)

*“Wave farms along the Norwegian coastline could make a significant help in balancing future Nordic power system. We need more studies that look at the whole system, to reach zero-carbon electricity at the lowest cost. The interconnected system needs balancing, not individual regions or countries...”*

**Patrik Möller**, CEO CorPower Ocean

*“There is a need for less working in silos and more joint efforts to support the whole Nordic region”*

**Stefan Söderling**, CEO ALMI Invest Greentech, Sweden



### **3: Investing more Nordic capital in later-stage funding rounds would fill a gap and act as a bridge for international capital**

Interviewees pointed to an increasing need for investments that can support capital-intensive projects like building out new factories in the Nordics or scaling up to meet the growing global market demand for deeptech hardware. This kind of funding requires more specialized investors and networks who understand specific sectors, regions and technologies. Combining these requisites – late-stage funding, specific knowledge sets and networks – into a new, late-stage Nordic cleantech fund could fill a critical role in the market.

*“The biggest challenge, at least within the energy sector, is the long investment cycles and (understandably) conservative approach to deployment of new technologies in critical infrastructure. The majority of innovative cleantech solutions include hardware components, which makes it a bit more difficult for start-ups to raise capital”*

**Jussi Teijonsalo**, Grid.vc, Finland

### **4. Nordic cleantech community sees major potential to improve EU policy design**

In business, policy matters. That is perhaps even more so in the cleantech space, as the scale of the challenge of reaching net-zero across regions, continents and the globe requires unprecedented collaboration between the private and public sectors.

Most companies focus on the one or two specific policies most germane to their business. For example, EU food regulation and GMO-related regulation directly affects an alternative protein company, while hardly mattering to most other companies in Europe. EU-wide policies like Fit for 55 can have broader impacts as they matter to many companies' target markets. The Renewable Energy Directive has been mentioned several times as important to growth, but the taxonomy, traceability requirements, ESG reporting, the food waste law and battery regulations were all also highlighted as policies that can enhance market certainty and growth for cleantech businesses in the Nordics and elsewhere.

Based on the interviews, three important aspects of EU policy emerged and all warrant further attention:

1. “Synchronization of regulatory framework so that market entry to different European markets would be faster – so that we could potentially also be able to offer a large home market for our start-ups, in line with the US market” (citation: Terhi Vapola, Helen Ventures, but goes for several interviewees).
2. The pace and transparency in implementing EU policies into national policy frameworks could be better and create less confusion.
3. Stricter import related policies to drive away, for example materials with negative impact from the EU market and support solutions with positive impact.

***“All initiatives going towards fossil free energy have created the market pressure we now act on”***

**Mattias Josephson, Epishine**

## **5. Make the Nordics a powerhouse for cleantech innovation and growth, increase exports and avoid emissions globally**

The Nordics have a unique opportunity right now to become a powerhouse for global cleantech innovation and growth. International growth may be where both the big room for improvement lies, but also where the most impact can be created.

Nordic cleantech companies differ greatly in their sales and marketing abilities, especially related to becoming globally successful. Role-models that have excelled at this from the get-go, such as Northvolt, Cake, Swappie, are plenty but so are the examples that have little understanding and/or capabilities in this regard.

To achieve the potential of many of our cleantech innovations we need to improve global deployment of them. Part of this challenge is related to the workforce, in particular attracting skilled sales and marketing people as well as seasoned entrepreneurs with internationalization experience.

If we increase our focus on this, we will find more ways to accelerate global growth. It may involve providing infrastructure type of financing that turns products into services. It may involve board level attention and capabilities to direct strategy and managerial efforts in this direction, it may be to help with international visibility and connections, working with success stories in other fields to learn from them and it may involve helping companies remove the barriers that they, themselves, see as the ones stopping them from making it on the international scene.

# History shows us that it can be done

Two Nordics stories, EVs in Norway and wind power in Denmark provide blue-prints of low-carbon technology deployment.

**Norway began offering incentives for electric cars as far back as 1990**, the most important being an exemption from the vehicle purchase tax, which otherwise is 25%.

They added additional incentives such as the right to park EVs for free in municipal car parks, drive in bus lanes, take ferries without a ticket and drive toll-free. Finally, EVs were also freed of road tax, and company electric cars were taxed at a lower rate than petrol or diesel vehicles.

Co-aligned with technology and market development in the field, led by US automaker Tesla, and a perfect storm was created for Norwegian consumers. The rise of EVs has been seen in many other countries but none matches the speed of penetration that has been achieved in Norway.

The Norwegian government has continued to address obstacles and bottlenecks along the way. As an example, availability of charging points has rapidly increased since 2015, when the government set the goal of having at least one fast charging station every 50 km on major highways, offering subsidies to accelerate installations. By mid-2017, there were more than 1,500 stations along these key routes, up from 300 in 2014.



**85%** of cars sold in May 2022 were cars you can plug into a socket (EV, PHEV)

**In Denmark, as early as 1918, 120 wind-powered electricity** plants delivered 3% of total Danish electricity use. Wind was then outcompeted until World War II made other energy resources scarce and a few years later, the mother of future wind energy design, the Gedser turbine, was erected in Denmark. The largest in the world at that time, it was in operation for 11 years reportedly without maintenance.

This was not enough for wind to become dominant as the price of electricity from oil and coal again outcompeted it in the 60s (electricity from the Gedser turbine was then double the price of electricity from oil). More than 90% of Danish fuels were imported from the Middle East when the oil crisis hit in the 70's, and set off a new wave of wind policies with a feed-in tariff, support for wind power research, and a 30% subsidy.

Wind turbines gradually increased in size and efficiency and as the industry started gaining real momentum, in 1979, a small Danish company called Vestas started mass producing them.

Wind power in the grid increased and technologies for wind power generation at sea started taking form. In the 90s, a plan for GHG reductions, with several initiatives benefitting the Danish wind industry was introduced and in the early 90's Denmark had a global market share of about 50%.

By the late 1990s, small or large wind farm cooperatives and individuals still owned most of the now 6,300 wind turbines in Denmark. As the efficiency of wind power technologies improved, public utilities also started investing in them. In 2000, approximately 13% of the total electricity consumption in Denmark was wind. With a production capacity of approximately 2 MW, the total height of the newest onshore wind turbines now exceeded 100 m at the tips of the wings.

At the turn of the century incentives supportive of renewables were cut back, and the now liberalized electricity market fluctuated. The bottom-up wind farm cooperative movement from the early days of wind power had lost its importance and support for local wind farm projects could not be taken for granted.

2008 a broad political coalition negotiated a future low-carbon energy transition in the Renewable Energy Act gathering all renewable energy technology-related legislation into one framework. For example, future wind farm neighbours would be offered the opportunity to invest in wind farm shares (minimum 20% of the wind farm project) according to predefined criteria. Compensation for potential reduction in property value due to wind farm proximity could also be granted.

In 2019, wind power accounted for almost 50% of the total national electricity consumption in Denmark. The country currently produces the highest amounts of wind power per capita in the world, and approximately 2.3% of its private-sector jobs are within the wind power industry and supply chain and Vestas is currently the world's largest manufacturer of wind turbines.

**These examples show us a few things:**

**▲ MOST IMPORTANTLY: IT CAN BE DONE.** Denmark and Norway are on the world map with regards to uptake of wind and EVs. They differ greatly but both are success stories in the deployment of low carbon solutions in their own right.

**▲ YOU CAN COMBINE GROWTH OF A HOME MARKET EXTREMELY WELL WITH THE GROWTH OF GLOBAL EXPORT IN THAT VERY FIELD.**

Consciously or not, Vestas growth matched the take-off of wind power in Denmark and the company has since been able to meet a strong growing global demand by constantly improving its offering. Norway has not seen the same giant export effect in the EV space. Interestingly enough, Norway was actually home to one of the very first EVs in the company THINK, building 10 prototypes already in time for the 92 Olympics but it never made it to volume production and went bust before EVs really took off. It should be said that several companies strongly related to electrification and charging has sprung out of the end-user needs and are now growing in Norway.

**▲ MARKET ADOPTION IS NOT ALWAYS A STRAIGHT LINE.** The Danish example shows clearly the ups and downs in the journey, where wind more or less died on the market twice and slowed down considerably a third time. Meanwhile, the cost curve kept improving and over time started beating competition.

A new wave of Nordic cleantech companies are now scaling up. Coming from a domestic market ahead of other markets they are now going for global markets with strong and proven technologies. The Nordic potential to create a number of new success stories has, in our view, never been greater.

## **ABOUT BREAKTHROUGH ENERGY**

Breakthrough Energy was founded by Bill Gates in 2015 to accelerate the clean energy transition and help the world reach net-zero emissions by 2050. Through investment vehicles, philanthropic programs, policy advocacy and other activities, Breakthrough Energy is committed to scaling the technologies the world needs to meet its climate goals.

## **ABOUT CLEANTECH FOR EUROPE**

Launched in 2021, Cleantech for Europe represents the trailblazers developing, deploying and investing in clean technologies across the EU. Our mission is to make cleantech a strategic priority in the EU, by bridging the gap between cleantech and policy leaders. The initiative equips policymakers with insights about cleantech and builds coalitions to chart a new path for the continent.

## **ABOUT CLEANTECH SCANDINAVIA**

For 15 years Cleantech Scandinavia has been a trusted source of cleantech-related investment opportunities, business intelligence and investment statistics in the Nordics. Our exclusive platform of Nordic and Baltic cleantech companies offers a unique opportunity for our international community network of investors, industrials, real estate companies, cities, service providers and the public sector.

# Cleantech *for* Nordics

