

CIP\_fonden

# Newsletter

September 2023



# Extreme weather records remind us of the need for action

This newsletter from the CIP Foundation focusses on our upcoming and existing projects and how these are helping solve the climate crisis. The keyword is action. Because time is money.

The last few months have shown us the costs of not being able to act; whether due to lack of political decision-making, lack of approvals or lack of raw materials and capacity. This situation undermines the prerequisites for the active investment needed to ensure the necessary transformation, and this, in turn, undermines our possibilities for achieving national and global climate targets.

A summer of devastating forest fires, weather extremes and multiple climate change records across the globe is a reminder of the urgent need to take action if we're to build a resilient and sustainable society for future generations.

It's not that we haven't been warned! For a long time now, science has been telling us that we need to reduce our carbon emissions and replace fossil fuels with green energy. And we must do so in a way that allows an effective transition to go hand in hand with profitable investment.

The CIP Foundation takes an action-oriented approach to addressing unresolved structural problems in society, including the climate and energy crises, and we offer politicians, investors and the market ready-to-deploy plans. At our annual meeting on 30 May 2023, we presented our first signature project: a master plan for Denmark's future hydrogen infrastructure. This was the same day as a broad majority in the Danish Parliament agreed on a tendering round for 9 GW of offshore wind; Denmark's biggest ever tendering procedure for offshore wind.

The tendering procedure is an important step in the green transition, but it's not nearly enough to realise the potentials reflected in the renewable energy ambitions in the Esbjerg Declaration and the Marienborg Declaration. The ambitions in the hydrogen infrastructure proposed by the CIP Foundation require six-seven-times more offshore wind energy than the 9 GW in the tendering procedure announced this spring.

Action is also the keyword in the CIP Foundation's newly established Youth Advisory Board, which will serve to inspire CIP Foundation projects and guarantee a next-generation perspective on our work. The Youth Advisory Board just held its first actual working meeting, which resulted in ideas for new CIP Foundation projects. The Youth Advisory Board will discuss these ideas with the Board of the CIP Foundation at the start of 2024.

The Youth Advisory Board is a strong and diverse board. Its members have important skills, dedication and just the right amount of energy. This is promising! Niels Skovgaard, chairperson of LandboUngdom, an organisation for young farmers, has been elected to chair the Youth Advisory Board. He brings with him a proactive and forward-thinking mindset about the agricultural sector's role in solving the climate crisis. In future, the agricultural sector will have to produce high-quality food with low and less intensive impacts on the climate and nature, as well as energy products and sustainable raw materials for bio plastic, textiles and building materials, for example. The CIP Foundation believes this approach and mindset holds promising perspectives.

There are also promising perspectives in what Jens Kjærulf Petersen, a professor at DTU Aqua, has to tell about mussel and seaweed farming. In addition to positive impacts on the marine environment, mussels and seaweed can contribute to CO<sub>2</sub> emissions reductions. These 'blue proteins' do not have to pass through the stomachs of cows, pigs or other farm animals to become food for us to eat. The potentials are huge, but there's still some way to go and investment is required in both knowledge and technology.

**I hope you enjoy reading the newsletter!**



**Torben Møger Pedersen, Chair of the CIP Foundation**



**Charlotte Jepsen, Managing Partner**

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# The agricultural sector needs to deliver more than just food to feed the green transition

In the future, the agricultural sector will have to produce not just food but also energy products and sustainable raw materials for bioplastics, textiles and building materials, for example, says Niels Skovgaard, chairperson of LandboUngdom, an organisation for young people living in the countryside. He calls for better quality and more climate-friendly food products. He was recently appointed as chairperson of the CIP Foundation's Youth Advisory Board, which counts a broad range of young people.

If you refer to crops, cows and pigs to describe Danish agriculture, you can rest assured that Niels Skovgaard will be quick to add that Danish agriculture is much more than that. Not least in the context of the green transition.

-Agriculture, if anything, isn't something you can fit into one category, especially not when it comes to the green transition. Agriculture must produce the food products of the future and at the same time provide energy and bio-based products for which there'll be increasing demand, he says.

After completing vocational training to be a farmer, Niels Skovgaard worked in agriculture until embarking on political science studies at university in 2020. This is also when he was elected as the chairperson of LandboUngdom. In June, this year, he also became the chairperson of the newly founded Youth Advisory Board under the CIP Foundation.

The CIP Foundation's solution-oriented, cross-sectoral approach appeals to the young farmer and student.

-I like people who talk about climate solutions, but I really respect those who also act and, in fact, find solutions, says Niels Skovgaard.

Although not all the solutions have been realised, his argument that agriculture is key to solving the climate crisis demonstrates that he has a good general understanding of the situation as well as deep insight into the detail.

-Some argue that the agricultural sector should be downsized. I usually say that it should be up-sized. Not necessarily with regard to land area, but agriculture should contribute in more key areas, so that agriculture plays an even greater role in the economy and in society, he says.

## NO MORE BY-PRODUCTS

Bio-based products will be pivotal in a future sustainable society. We must produce more recyclable, biogenic products, and these must be biodegradable.

This is where agriculture can play a much greater role. Furthermore, it sets a new agenda for research and innovation in agriculture, according to Niels Skovgaard.

-Take wheat, for example. Focus within innovation has been on higher yields. Maybe we need to spend the next ten years developing wheat straw varieties, which can be used as building material or to make bioplastics to replace fossil-based plastics, he says.



Photo: John Christensen

-Grass also has potential, says Niels Skovgaard. You can make green protein from grass, and if you extract amino acids and the sap from grass, you get a product that resembles flax fibres. This can help replace climate-impacting textiles, argues the young farmer.

-Many more competences are required to pull this off, but we must move away from the idea of a main product and by-products and become much better at exploiting every resource. Luckily, there's no shortage of ideas. I talk to other young people almost every week with ideas for how to make insulation from straw, for example, or other sustainable building materials, or something completely different. I believe there's a huge potential for innovation in agriculture, says Niels Skovgaard.

### BETTER QUALITY AND BETTER FOR THE CLIMATE

He doesn't question whether agriculture needs to go through a transition. It's only a question of when and how to break down existing barriers.

An obvious focus area for Danish agriculture is to raise quality and at the same time produce food products with low climate and environmental impacts. Niels Skovgaard is convinced that this will be feasible in the long run.

He disagrees with others in the industry who say agriculture should stick to producing what consumers want.

-We should also provide what consumers will want tomorrow. But consumers also need to play ball; they must be willing to pay if we're

to improve biodiversity and the climate, says Niels Skovgaard.

However, he also acknowledges that we are facing an enormous challenge. Agriculture does not have billions to invest in product development; we will have to wait for the consumers.

-I'd love to be able to promise that agriculture can lead the way, like in the automotive industry, where some manufacturers were far-sighted and ready to deliver on a large scale when demand for electric cars boomed. But I can't make that promise. Because agriculture generally lacks investment to be able to develop products before there's a demand for them. We have to follow a more even development towards higher-quality and less climate-impacting food products, as well as towards more vegan products, in step with growing consumer demand, he says.

### TYPICAL DANISH OWNERSHIP STRUCTURE IS A STRENGTH, BUT ALSO A CHALLENGE

In many ways, the traditional Danish ownership structure, with freeholds and strong cooperative societies, is both a strength and a challenge.

The ownership structure has meant the path from research and innovation to farm field has been short and the industry has become more efficient for this reason. Niels Skovgaard admits that it may be possible to find a model for external financing to develop more sustainable food products. But this could create new dilemmas.

-This could feed new challenges. The farmers own their cooperative societies and farms. Therefore, focus has been on their return on investment. If external investment is obtained instead, very different considerations will come into play. And it won't be easy, he says.

On behalf of the industry, he warns everyone to be realistic. Danish agriculture operates in a global market, and even small price fluctuations can cause consumers to choose differently. The past six months, with increasing food prices, have already resulted in significantly lower sales of the more pricy, organic products, and this emphasises just how fast market sentiment can change.

### THE GREEN TRANSITION AS A REMEDY FOR DEPOPULATION

In the final analysis, however, Niels Skovgaard is in no doubt that Danish agriculture is heading towards a bright green future. Not pale green. But a bright green future, in which agriculture will be at the hub of the green transition.

At the same time, sustainability ambitions can also drive efforts for more social sustainability in regions under pressure socially, culturally and financially due to depopulation.

-It worries me when vast solar farms in the countryside lead to depopulation of the countryside as people move away. I think there is great value when we live in different places, with well-functioning workplaces, cultural life and civil societies. We mustn't forget this in our green transition, says Niels Skovgaard.

However, at best, the green transition can be a remedy for depopulation. Agriculture and energy production will give sustenance to new green industries in the parts of Denmark that have been under pressure for several decades. Let us hope all this will lead to more educational opportunities in more of the provincial towns under pressure.

Today, Niels Skovgaard can celebrate the fact that LandboUngdom has its highest membership numbers for more than 18 years. He believes this is an indication that many young



people in the countryside are actively choosing community.

Applications for agricultural colleges are also high, and the share of female applicants is increasing significantly.

-This reflects a general interest in the climate, nature and sustainability; topics that also have an important place on the curriculum. The responsibility of agricultural colleges cannot be underestimated. They educate the farmers who, in a few years from now, will be responsible for the production of climate-friendly food products and all the other products needed to propel the green transition, says Niels Skovgaard.

#### THOUGHT-PROVOKING NETWORKS

The young farmer and university student will be meeting ten other young people from various backgrounds in the CIP Foundation Youth Advisory Board. The board brings together young people from across start-ups, global corporations, the financial sector, trade unions and climate NGOs.

In other words, a mixed group of people from all parts of the political spectrum. However, this does not scare Niels Skovgaard.

-People talk so much about professional networks, I prefer thought-provoking networks. Interacting with people of other opinions and values than me makes me wiser. My background is in agriculture, but there's always something more for me to learn from talking with people who don't know about agriculture and ask critical questions. I hope they learn something from talking with me, too, he says.

The purpose of the CIP Foundation Youth Advisory Board is not to come up with fully-fledged projects.

So it is not a problem if the board cannot agree on specific issues.

-I'm sure that through debating and disagreeing we can actually take a number of topics to a higher level. We come to the table with different views and different educational and professional expertise. I see this as a strength. What brings us together is knowing that we need a green revolution of society, says Niels Skovgaard.

The eleven young board members arrive with competences and commitment, and they are all part of the generation who, in their lifetime, will have to live with the consequences of climate change and with the changing lifestyles and economy required to curb the climate crisis.

And perhaps they also have something else in common. They belong to a generation who feels no need to question the cause of climate change.

-There's hardly anyone in our generation who doesn't acknowledge that climate change is man-made, and that climate change is the absolute most important task ahead, says Niels Skovgaard.



# Port capacity must be large enough to accommodate the deployment of offshore wind and PtX

Offshore wind and PtX deployment makes new demands on port capacity at Danish ports. The CIP Foundation aims to identify these demands in a comprehensive analysis. Member of the Board Christina Grumstrup Sørensen says that a holistic approach is paramount.

The port capacity of Danish ports is instrumental in pulling off the ambitious plan for a twenty-fold increase in Danish offshore wind capacity. For this reason, the CIP Foundation will instigate a comprehensive analysis to identify existing port capacity and assess this against the needs and opportunities of Danish offshore renewable energy deployment.

-It goes without saying that port capacities are crucial for the logistics as we embark on our journey to expand the installed capacity in the North Sea and the Baltic Sea. Ports cannot become bottlenecks for the deployment of renewable energy at sea, and we have to ensure the greatest possible job and value creation for Denmark from growth in offshore wind power in the region. Efficient

ports and lucrative investments must go hand in hand, says Christina Grumstrup Sørensen, senior partner in CIP and member of the board of the CIP Foundation.

In April this year, Christina Grumstrup Sørensen was appointed chair of the government's partnership for the development of Danish ports with focus on green growth. The partnership is an inter-ministerial initiative between the Ministry of Industry, Business and Financial Affairs, the Ministry of Transport, and the Ministry of Climate, Energy and Utilities.

-I'm delighted to be able to chair this partnership. We'll be collecting input from all the players in the area and hearing about their needs. I'm also very pleased that the CIP Foundation will provide an important analysis of what is required of Danish ports in practice with regard to the green transition. This is the essence of the Foundation's purpose, says Christina Grumstrup Sørensen.

She explains further: The significance of Danish ports for the deployment of renewable energy is just one area of many that the partnership will be looking into. A holistic approach is paramount, so we must look at transitioning shipping as well as passenger and freight transport and fisheries. And there's also the latest requirements on ports in light of the current security situation.



## DIVISION OF RESPONSIBILITIES BETWEEN PORTS

Danish waters currently boast a total of 2.3 GW installed offshore wind power capacity. The ambition under the Esbjerg Declaration and the Marienborg Declaration is to boost offshore wind to 65 GW in the North Sea and 19.6 GW in the Baltic Sea by 2030.

These ambitious targets will require expansion of port capacities to accommodate shipping wind turbine components such as towers, blades, turbine houses, etc. Offshore wind

turbines have become ever larger. Today, only the ports in Esbjerg, Grenå, Odense and Rønne have capacity to deal with the largest components.

A key element in work by the partnership on ports is to come up with ideas for financing models. Expansion of port capacities is a long-term infrastructure investment with a long payback period. Attractive financing models are therefore crucial to attract the necessary capital.

The approach needs to be holistic, also in terms of geography, according to Christina Grumstrup Sørensen. Danish ports will be in competition with non-Danish ports for the role of shipping hub for offshore wind farms in both the North Sea and the Baltic Sea. Therefore, it will be far more constructive if, instead of having to compete, Danish ports agree on a division of responsibilities.

-Several of our most important ports already differ in what they can offer. When it comes to offshore wind deployment, it's not necessary for all ports to be able to accommodate all tasks. It will all require planning and coordination, says Christina Grumstrup Sørensen.

#### **WORKPLACES AND GROWTH IN PORT CITIES**

Esbjerg is a good example of how port-related activities from renewable energy deployment can have an enormous economic impact. From being a major fishing port, Esbjerg became the leading Danish offshore port, first with oil and gas in the 1970s and 1980s, and since then as a shipping and servicing hub for offshore wind farms, and much more.

-Port capacity expansion is a key element in the green transition, especially for offshore wind deployment, but also for PtX and subsurface carbon storage. Moreover port capacity expansion is an important economic engine to drive growth and employment in port cities and communities. Our goal is for our analyses to contribute to intelligent expansion of our ports, so that we can reap the best possible benefits for society, Christina Grumstrup Sørensen concludes.





# 'Blue proteins' can help clean coastal waters and they are a sustainable food source

Danish fjords and inlets offer favourable conditions for cultivating seaweed and mussels, says Professor Jens Kjerulf Petersen from the National Institute of Aquatic Resources at the Technical University of Denmark (DTU Aqua). Mussel production could be scaled up 20-30 times compared with today.

Almost all crops grown in Danish fields are not produced for human consumption but for animal feed. Putting the proteins we grow in crops through cows, pigs or other animals has a massive climate footprint.

But 'blue proteins' hold great potential. We can grow food in the sea, and send the proteins on a shorter, less climate-impacting route. For example, we can grow mussels and seaweed. Danish coastal waters are particularly well-suited for growing both of these. In this context, an unresolved environmental problem in agriculture and Denmark's many, effective wastewater treatment plants play an important role.

So says Professor Jens Kjerulf Petersen from DTU Aqua. He has helped start the Danish Shellfish Centre, now part of DTU Aqua. He has more than 30 years' experience in the field, and he is convinced that 'blue biomass', such as seaweed and mussels, has huge potential as a future sustainable food source.

-In Denmark, almost two-thirds of our land area is under cultivation. Nutrient pollution from agriculture has particularly serious implications for the marine environment. Moreover, we treat our wastewater to meet high quality standards. This gives us unique conditions for growing seaweed and mussels, which absorb nutrients and therefore have a positive impact on the marine environment. We already have good experience growing mussels in Limfjorden, and conditions are good in all our east-facing inlets, he says.

### THREE CRISES

According to Jens Kjerulf Petersen we are facing three crises at the same time. The first two are the climate crisis and the biodiversity crisis. And with a growing global population, the third crisis is a global food crisis, which has become all the more evident with the war in Ukraine. Farming so-called low trophic marine (LTM) species in the sea addresses all three of these crises.

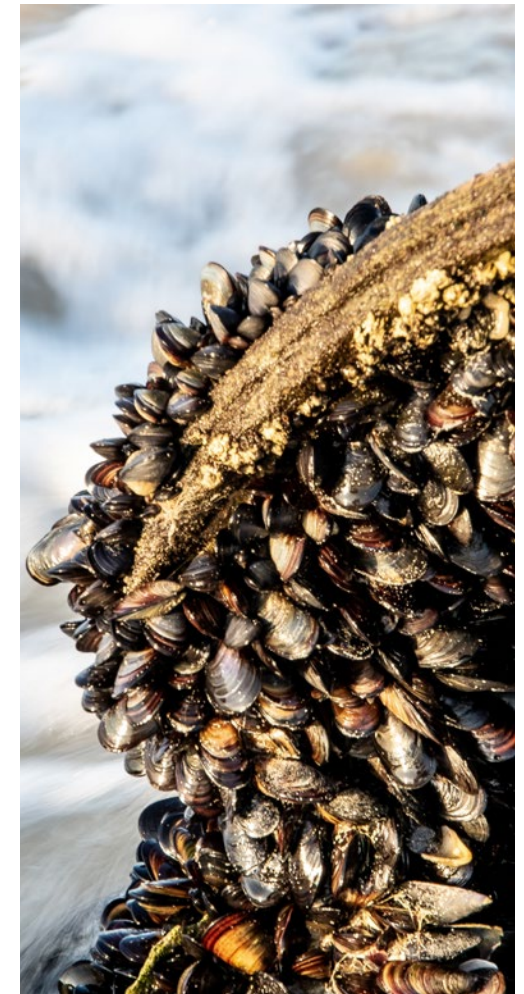
-We can't stop producing food on land, but terrestrial farming is causing several problems. For example, nutrient pollution of the sea and CO<sub>2</sub> emissions, with Danish agriculture accounting for around 30 percent of Denmark's climate footprint, depending on how you measure it, he says.

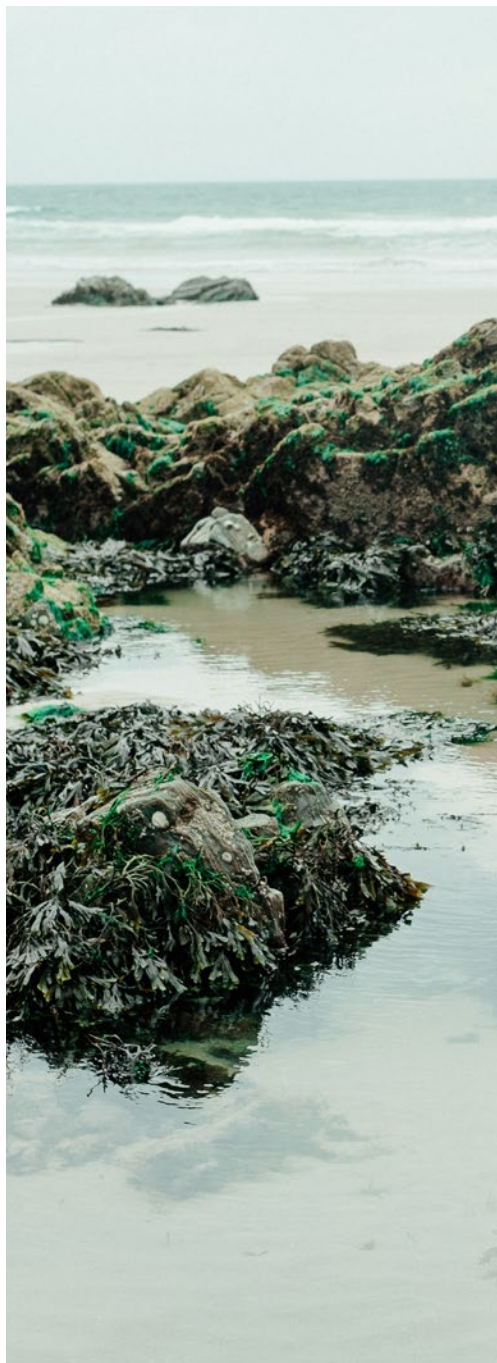
An obvious alternative would therefore be to focus on the opportunities offered at sea. Fish, for example, require less energy to farm than animals on land, because fish do not use energy to keep warm. But there are still issues with nutrient pollution.

Looking at wild fish populations and fisheries, we see that some species, for example cod, have migrated north because of rising sea temperatures, and stocks are dwindling. However, fishing of commercial fish stocks is generally at sustainable levels. The problem here is rather that Danes have picky eating habits, says Jens Kjerulf Petersen.

-Take the greater weever, for example. The greater weever is abundant in Danish waters, and it's actually an excellent food fish, but the greater weever just doesn't feature on Danish dinner plates, he says. And there is potential in other species as well, he says.

But first of all, we should focus on the species at the bottom of the food chain, the low





trophic species, because the benefits to be gained here are even greater, stresses Jens Kjerulf Petersen. If we focus on these species and on sourcing our food from the sea, we will also be able to offset the discharge of nutrients from agriculture.

### RIPE FOR DEVELOPMENT

Over the last 15-20 years, the Danish Shellfish Centre has been a driving force in accelerating mussel farming in Limfjorden. Production is now at 10,000 tonnes annually.

Jens Kjerulf Petersen assesses the total mussel production potential in Danish waters to be between 200,000 and 300,000 tonnes annually.

So far, Danish production of seaweed is rather modest, with only 10-20 tonnes annually. Production at European level is around 375 tonnes. Jens Kjerulf Petersen believes the seaweed potential is as high as 1 million tonnes.

We have only exploited a small part of the potential, because we are still at a low level of maturity with regard to knowledge and technology. This means we can achieve an exponential development.

-In some ways, we're at the same place as Danish Agriculture was 100 years ago. We still have extensive technological development ahead of us. We could be facing a steep development curve. Most mussel production in Denmark today is by small companies with only a single or a few owners. And mussel farming still requires relatively hard physical labour, says Jens Kjerulf Petersen.

With the company Blå Biomasse (blue biomass), owned by environmental services company Hedeselskabet, the first crucial step has been taken towards increased efficiency

and scale. Investments in Blå Biomasse are at another level than in the rest of the sector.

Much of the manual work has been replaced by mechanised work. It is expensive, but it allows for production at an entirely different scale.

-The best small-scale producers will still be able to contribute if they deliver high quality, but we need a far more industrial approach, and this requires investment, says Jens Kjerulf Petersen.

### POSITIVE BOTTOM LINE WITH REGARD TO NUTRIENTS

But it is not either big farms or small farms. Small mussel farms can still develop slowly and co-exist alongside large industrial farms. Furthermore, Jens Kjerulf Petersen has a list of areas where more knowledge is required.

The environment aspect is one such area that needs our attention. Large scale production requires concrete analyses of the individual farm location.

More detailed studies are needed, Jens Kjerulf Petersen stresses. At the same time, he corrects those who fear mussel farms will put pressure on the marine environment.

It is a question of simple household accounts, according to the DTU professor. If you farm mussels, they will absorb some of the nutrients in the sea, and although the mussels also poop, leaving mussel poop on the seabed, it all balances out. In the final analysis, mussel farms help absorb some of the nutrients that create problems for the marine environment.

-We don't add anything; we remove something. And at the same time, mussel production helps to filter the water and make it

cleaner. Plants and organisms will settle on the mussels. This will help improve biodiversity. So, the bottom line is positive, says Jens Kjerulf Petersen.

-Having said this, naturally, there'll be consequences from concentrating certain animals and plants at a density that doesn't occur in nature. For example, seabed conditions will be affected. We need to look at the total capacity of the ecosystem, and I'm sure this will differ from one bay to the other. This is something we need to have a closer look at, when the time comes, he elaborates.

### THE VIKINGS ATE SEAWEED

Another item on the to-do list is 'research into different species'. In addition to mussels, seaweeds hold great potential, and sweet tangle is being studied in particular.

In one new project, DTU Aqua is examining the potential of the seaweed species dulse. Whereas five to ten years ago, the paleo diet was all the rage, with this project, DTU Aqua is focusing on another historical era.

-Dulse is known from the Viking Age, when the Vikings gathered and dried dulse and took it with them on their raids, says Jens Kjerulf Petersen.

He recognises that there is still some way to go before seaweeds and mussels become regulars on Danish dinner tables. Today, most of the mussels produced in Denmark are exported to the Netherlands and Belgium.

-Low trophic species are good for the climate as well as for your health. Their climate impact is low, because producing them does not involve producing animal feed, and they have a high content of proteins and healthy omega-3 fats, says Jens Kjerulf Petersen.

The shells from the mussels can be used for horse arenas, and they are also suitable as insulation material. If they are used in foundations and walls, they become carbon sinks, stresses Jens Kjerulf Petersen.

### FOOD HABITS CAN BE CHANGED

He acknowledges that our meals are unlikely to be fully based on seaweeds in the future, but, in his experience, it is possible to change people's eating habits. He provides an example from his own childhood, growing up in the Greater Copenhagen area.

-An Italian restaurant opened in Fiolstræde - it was very exotic! Until then, not many of us knew what a pizza was. I also remember a fellow student from Lolland, who had never tasted curry before, says Jens Kjerulf Petersen.

Changing people's eating habits will require developments on several fronts. Not only is there a need to change what Danes put on their plates, there is also a need to develop different species. Because growth conditions vary from location to location.

-The types of mussel vary depending on local conditions. The same applies to seaweed. And there are many possible applications. Some seaweeds can be used directly as produce. Some can be used to enrich other products, and there are experiments with fermentation. Finally, some seaweed species could be suitable for animal feed, says the DTU researcher.

### CO-EXISTENCE WITH OFFSHORE WIND FARMS

While there are obvious potentials for growing blue proteins in Danish inlets, DTU Aqua is also looking at offshore projects. The department recently received funding for a new multi-use project, in which they will examine

the potential for mussel farms at offshore wind farms.

-We are already establishing wind turbine foundations on the seabed in many places, so why not use some of these areas to grow mussels? We can't grow mussels directly on the foundations, but perhaps we can use the area around the foundations, says Jens Kjerulf Petersen. But he also admits there is an obvious paradox.

Mussel farming usually requires calm wind conditions, so placing mussel farms near wind turbines might not be the obvious solution.

-There are benefits to moving the farms away from the coast, where they can be a nuisance to some, but currently this is not a feasible option, although it may be in five to six years, he says.



# The CIP Foundation shows the way to an inter-connected Danish hydrogen infrastructure

In March this year, Danish Minister for Climate, Energy and Utilities Lars Løkke Rasmussen and Vice Chancellor of Germany and German Federal Minister for Economic Affairs and Climate Robert Habeck made hydrogen history for the two countries when they signed a cooperation agreement to establish hydrogen interconnectors to transport Danish hydrogen to German consumers.

Energinet has since been tasked with establishing and operating the transmission infrastructure. However, work to plan and establish an interconnected hydrogen infrastructure is still ongoing.

This autumn, the political parties met to negotiate the framework conditions and financing for a future hydrogen infrastructure. The CIP Foundation has prepared a report as inspiration for the negotiations: [Roadmap for](#)

[a Danish hydrogen infrastructure for the future](#). The report contains concrete recommendations for deployment of an interconnected Danish infrastructure.

The recommendations outline a cost-effective phased deployment plan. The plan covers deployment of 1,300 km hydrogen pipelines up to 2045, as well as two dedicated hydrogen islands in the North Sea.

Green hydrogen produced from renewable energy will play a crucial role in the green transition of energy-intensive industries and the parts of agriculture and transport that cannot be electrified. Energy-intensive industries account for around 20% of total global emissions. Without hydrogen as the foundation for green fuels, the political targets for decarbonisation will not be achieved.

The report by the CIP Foundation stresses Denmark's opportunity to reap major benefits from investing in a hydrogen pipeline infrastructure with interconnectors. Favourable conditions for the production of renewable energy and green hydrogen, and a production potential far beyond Denmark's own hydrogen demand, mean there is a potential for exports of green hydrogen to neighbouring countries worth a total of around DKK 100 billion annually.

Realising this export potential requires a hydrogen infrastructure with interconnectors, initially to markets in Germany, the Netherlands and Belgium. This is a far-offshore venture, primarily in the North Sea, and it will require a total investment of DKK 130 billion over the next 15 to 20 years.

## DENMARK HAS UNIQUE COMPETITIVE ADVANTAGES

Denmark has favourable conditions for producing renewable energy at competitive prices, especially in the North Sea. There are vast areas with perfect conditions for offshore wind farms and energy islands: good wind conditions and shallow sea depths. This gives

Denmark a cost advantage of up to 10% when producing hydrogen at large scale on energy islands or dedicated hydrogen islands with interconnectors to other countries. Because Denmark will be self-sufficient in green energy by 2027, there is a basis for large-scale exports to neighbouring countries, and many of these already have strategies in place to import green hydrogen to fuel the transition of their energy-intensive sectors. This includes Germany, the Netherlands and Belgium.

In the long term, Denmark could produce more than 200 TWh of green hydrogen annually. After meeting domestic demand,



Denmark could export hydrogen valued at DKK 100 billion annually (fixed prices). This is slightly more than Denmark's current exports of green energy and environmental technologies. Furthermore, it exceeds net exports of oil in any year ever.

**A HYDROGEN INFRASTRUCTURE IS A NECESSARY GATEWAY TO THE MARKET**

We need an infrastructure of hydrogen pipelines to be able to reach our buyers. Because of the enormous export potential, it is crucial that we coordinate and secure interconnection of the Danish hydrogen infrastructure with the planned infrastructure of other countries in the North Sea, the Baltic Sea and onshore in Germany.

This will give us access to important buyers and will create economies of scale and lower costs. It is therefore paramount that Danish authorities and relevant players start collaboration with neighbouring countries as soon as possible, and in particular with our expected future primary export countries: Germany, the Netherlands and Belgium.

**DESIGN, TIMING AND SYNERGIES**

In its design of a hydrogen infrastructure, the CIP Foundation has been careful to consider flexibility in the total energy supply. This is to achieve the advantages of sector coupling and balancing between different energy sources.

As opposed to electricity, green hydrogen can be stored, and production can be increased or decreased depending on whether conditions are favourable for wind and solar power production. In other words, hydrogen production can help to balance the electricity grid and reduce the need to expand the grid to accommodate the large quantities of green electricity expected in the future. In fact, it is difficult

to imagine an electricity grid in Denmark and neighbouring countries that will be able to absorb the large quantities of green electricity pledged in the political plans already set for the North Sea and the Baltic Sea.

Hydrogen is therefore a necessary piece of the puzzle if we are to meet the political targets. Furthermore, exports are a necessary consequence because the targets far exceed Danish hydrogen demand.

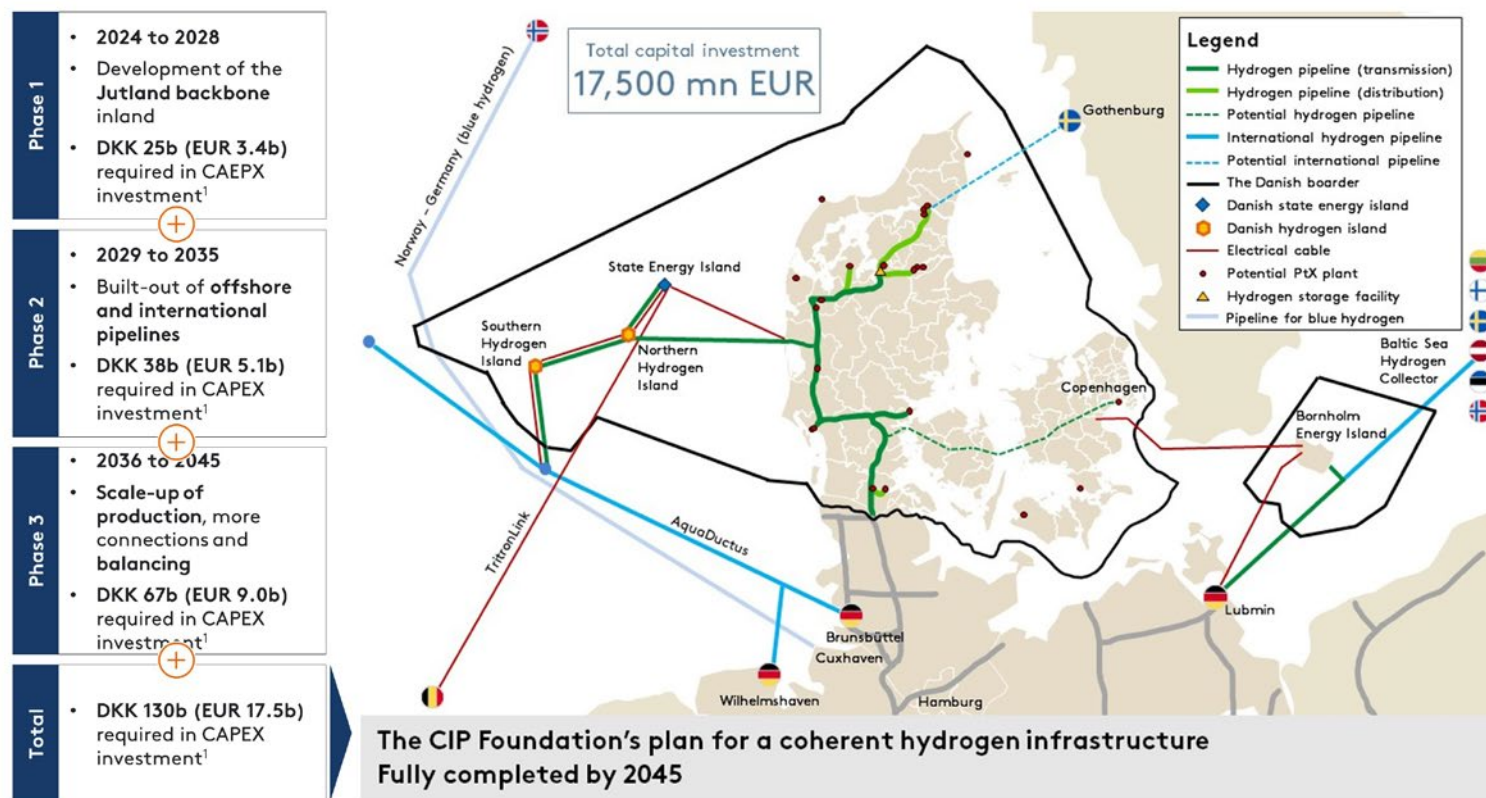
Hydrogen production relies on where and how much renewable energy is produced, and when it can be deployed. The CIP Foundation therefore recommends starting by estab-

lishing an onshore hydrogen infrastructure with interconnectors to Germany, followed by deployment of multiple offshore connections to create both synergies and improve security of supply.

Even though establishment of a hydrogen infrastructure in Jutland is the first part of the deployment plan, establishment of offshore infrastructure in the North Sea for exports is the key element in the overall plan. The phases in the deployment plan are designed so that they can stand alone and do not depend on future decisions. This adds security and robustness to the societal investment case.

In order to be able to realise the deployment plan, several key decisions have to be made within a short period of time. Among other things, the developers and the contractors who will be building the infrastructure have to be considered.

Most important is the crucial requirement that government tendering procedures for offshore wind power be completed so that there is sufficient renewable energy for both electrification and hydrogen production. The ambitions proposed by the CIP Foundation for the hydrogen infrastructure require six-seven-times more offshore wind energy than is included in the political agreement on the 9



GW tendering procedure that in the spring was called the largest offshore wind tendering procedure in the history of Denmark.

### DKK 130 BILLION INVESTMENT REQUIREMENT

The report from the CIP Foundation has calculated the investment requirement on the basis of the capital investments following directly from the recommended infrastructure, i.e. hydrogen pipes, compressors, hydrogen islands and the known, derived need for electricity reinforcements. Costs of already decided installations such as the government energy islands in the North Sea and on Bornholm have not been included.

Neither do the hydrogen infrastructure investments include investments in the deployment of renewable energy and electrolysis, as these investments are linked to the production side. Here, market and technological developments are likely to push prices downwards. Furthermore, there are the implications of new possibilities to site offshore turbines closer together.

The total investment amounts to around DKK 130 billion over a period of around 20 years, of which most will be around 2030-2040 in connection with the construction of hydrogen islands and offshore hydrogen infrastructure. If the CIP Foundation's proposed hydrogen infrastructure is realised, it will be the largest construction investment in Danish history. In comparison, the Fehmarnbelt link has a construction budget of DKK 55 billion (2015 prices).

### NEED FOR CLEAR FRAMEWORK

The market for green hydrogen is still immature and needs a framework that can help reduce risks for future market players. The market is also affected by the classic 'chicken-or-egg' dilemma with regard to decisions

on large, capital-intensive and irreversible investments at an early stage of market development.

The CIP Foundation's report points out that the government can play an active role in mitigating the risks entailed in establishing the hydrogen infrastructure. Firstly by taking on risks itself on behalf of the future users of the collective hydrogen infrastructure, which can then be paid back over time. Secondly by ensuring a relatively flexible and simple framework from the start to take into account that this is an emergent market and to meet the market's need to know the long-term framework conditions. A kind of 'regulatory sandbox' for a period, which can later be developed into specific regulations. This is also the principle in the regulation of the hydrogen market proposed by the EU.

Finally, the government also plays an important role by appointing the central planning authority and the coordinator, and by supporting clear and more predictable approval processes. For example, through binding deadlines for case processing and/or parallel processes in various authorities. Timing and the speed of decisions are also crucial for the role Denmark will play in future hydrogen production. And also for how much Denmark can support European energy and security, and for what climate reductions Denmark can contribute internationally.

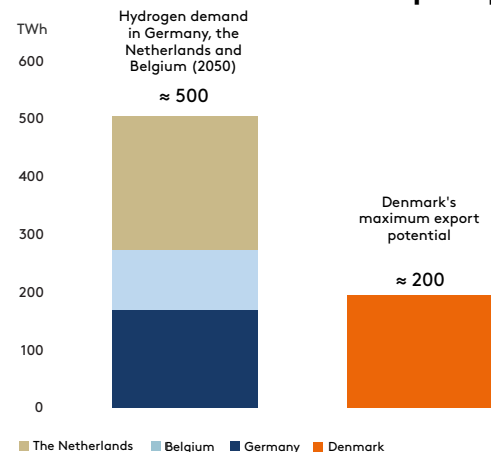
Read more about the report and analysis work by the CIP Foundation [here](#), as well as the report in its full length.



# Information and facts

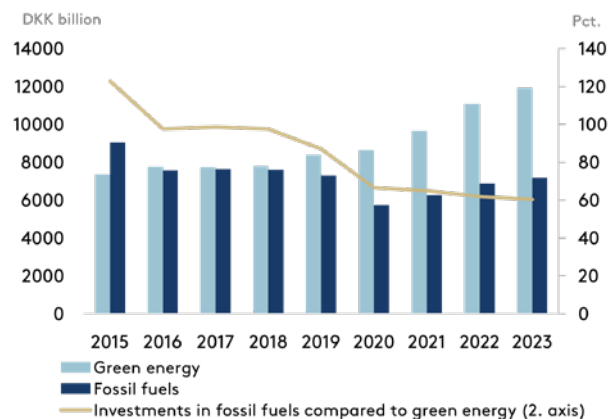
# Energy and infrastructure

## Northern European hydrogen demand exceeds maximum Danish export potential



Source: CIP Foundation's Market Assessment: Denmark's potential in a future hydrogen economy

## Increasing global investment in both renewable energy and fossil fuels



Note: 2023 figures are preliminary

Source: IEA, Global energy investment in clean energy and in fossil fuels, 2015-2023

## Facts about energy

### Renewable energy

**66%**

Share of renewables in total Danish energy production in the first half of 2023<sup>1</sup>.

### Investments in the electricity grid

**DKK 41 billion**

Amount Energinet will invest to expand the transmission grid over the next three years.<sup>2</sup>

### Exports

**DKK 63.1 billion**

Total value of Danish exports of green energy technology in 2022.<sup>3</sup>

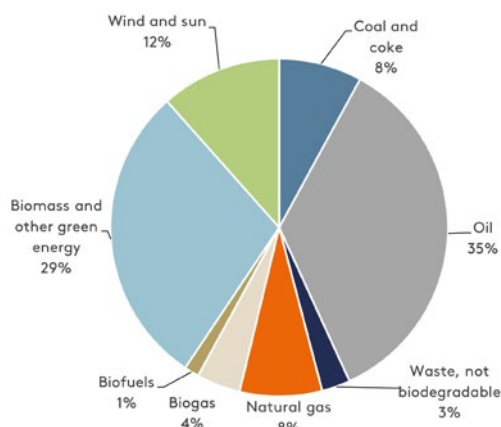
### Gas consumption

**23.4 %** ↓

Percentage by which Danish gas consumption was reduced from 2021 to 2022.<sup>4</sup>

Source: 1) Danish Energy Agency (2023) 2) Energiwatch (2023) 3) Confederation of Danish Industry (2023a) 4) Energinet's Annual Magazine 2023.

## Energy mix in total Danish energy consumption 2022



Source: Danish Energy Agency (2023): Denmark's Climate Status and Outlook 2023

## Recent and upcoming publications

- March 2023** Annual magazine 2023: Get up to speed on the green transition (Energinet) →
- May 2023** Roadmap for a Danish hydrogen infrastructure for the future (The CIP Foundation) →
- 14 June 2023** The green transition calls for a new approach to infrastructure decision-making (CONCI-TO; in Danish) →
- 22 June 2023** Feasibility study hydrogen transmission infrastructure in Jutland (Energinet) →
- October 2023** World Energy Outlook 2023 (IEA)

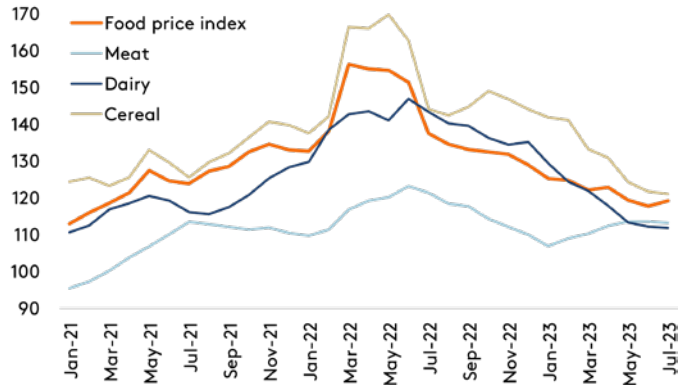
## Upcoming activities

- 26 - 27 September 2023** Green Gas Days 2023: Danish gas in green transition (Green Gas Denmark & Biogas Danmark) →
- 20 September 2023** Feature day: Possibilities within PtX 2023 (Green Power Denmark) →
- 3 - 5 October 2023** Technomania 2023 (Green Power Denmark & IDA) →
- 4 October 2023** Energy security: Energy policy conference 2023 (Green Power Denmark & DI Energy) →
- 30 November 2023** Wind Energy Denmark 2023 (Green Power Denmark, Energy Cluster Denmark, Danish Research Consortium for Wind Energy and Megavind) →



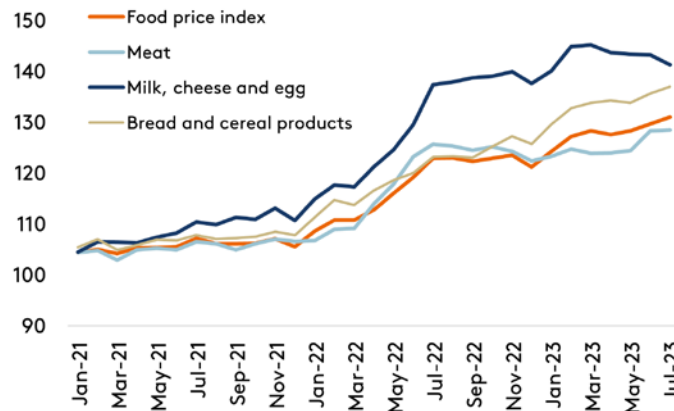
# Agriculture and food production

## Producers spot a reversal of the falling price trend in global food prices



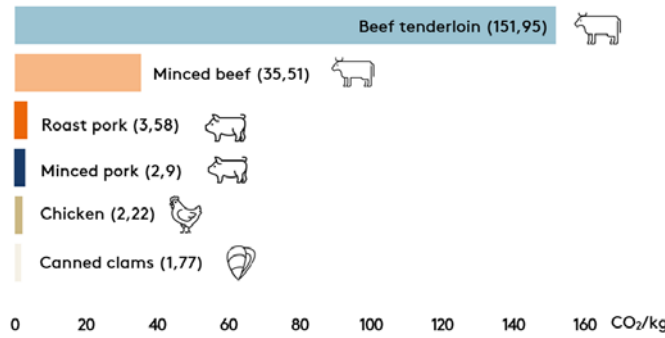
Source: FAO (2023), FFPI  
Note: Producer price index (2014-2016=100).

## Danish consumer food prices continue to rise



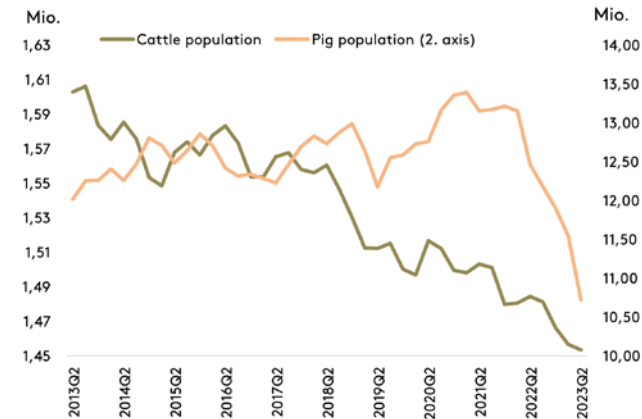
Source: Statistics Denmark, PRIS111  
Note: Consumer price index (2015 = 100).

## Climate footprint of various food products



Source: CONCITO (2021): The Big Climate Database, version 1

## Cattle and pig population is declining



Source: Statistics Denmark, KVAEG5 and SVIN

## Recent and upcoming publications

- April 2023** Climate tools for Danish agriculture (SEGES Innovation; in Danish) →
- June 2023** Mapping of biomass for biochar and CO<sub>2</sub> reduction potentials (NIRAS for the CIP Foundation; in Danish) →
- June 2023** The importance of biodiversity for future land use (CONCITO; in Danish) →
- September 2023** Analysis of the possibility to commercialise CO<sub>2</sub> storage in biochar (SEGES)
- Autumn 2023** CO<sub>2</sub> taxes for agriculture (Expert Panel for a Green Tax Reform)
- November 2023** Facts about the Danish food cluster (Danish Agriculture & Food Council)

## Upcoming activities

- 26 - 27 September 2023** Food & Bio Global Summit 2023 →
- 14 September 2023** DTU Conference: Plant-based foods →
- 4 October 2023** Danish Bio Economy Conference 2023 (Food & Bio Cluster) →
- 16 November 2023** Danish Bio Economy Conference 2023 (Food & Bio Cluster)

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