
CIP foundation
Newsletter
April 2024

The need for a green transition remains urgent

Recent years have introduced a new political reality that may affect the pace of the green transition in both Denmark and Europe. New competing needs for investments in military build-up and in new technologies are emerging. With Russia as an aggressor on the military front and extensive state subsidy programs in China for industries such as automotive and wind turbine production, massive investments are required if Europe is to maintain its global position.

In this context, it is crucial to be aware of the so-called tipping points that could lead to extremely rapid and irreversible climate changes, such as the collapse of the Greenland ice sheet or the Arctic sea ice. The main culprit is the increase in atmospheric CO_2 and other greenhouse gases, which continue to rise, pushing the planet towards these tipping points.

To meet the goals of the Paris Agreement and avoid crossing various tipping points, we need to both reduce CO_2 emissions and employ negative emission technologies that compensate for past sins and remove greenhouse gases from the atmosphere. This is reflected in our projects, which focus on transitioning the energy system and various forms of decarbonization.

In January, we launched the CIP Foundation's second signature project – how to establish a market CCS with biochar in Denmark – a negative emission technology that, once fully implemented, can store two million tonnes of CO_2 annually. Following this, we feature an interview with Professor Sebastian Mernild from the University of Southern Denmark (SDU), an expert in climate change and glaciology, who views negative emission technologies as essential. The message is clear: We cannot afford to choose between reducing CO_2 emissions and capturing and storing CO_2 with CCS or nature-based solutions like afforestation and biochar. We need to do it all, and at an unprecidented pace, as it is urgent to reduce greenhouse gas concentrations in the atmosphere to avoid passing critical tipping points, such as the collapse of the Greenland ice cap. Read more here.

Furthermore, as a prelude to our next project on creating flexibility in the electricity system through the demand side, we offer an article on the possibilities for balancing the power grid and ensuring power supply with digital energy data. The electrification of society imposes new demands on our electricity system, which must handle significantly increased demand while an ever-greater portion of our electricity comes from non-controllable sources like solar and wind.

This creates challenges on two levels:
1) Increasing electrification and the use of uncontrollable energy sources make it harder to balance production and consumption, and
2) the increasing electrification also places significant pressure on the power grid when transporting larger amounts of electricity, potentially creating bottlenecks. If unaddressed, this could lead to large and prolonged power outages in Denmark in the future.

The outages could become more frequent and last longer as we look further into the future. One solution is to ensure greater flexibility in electricity consumption, so that usage more closely aligns with production and the grid's capabilities. This approach can limit the need for expansion and ensure that we avoid building significant excess capacity outside of peak times. It can also result in lower and more stable prices for consumers and create new business opportunities. Read more here.

We hope you enjoy reading the newsletter!

Torben Möger Pedersen,
Chair of the CIP Foundation

Charlotte Jepsen,
Managing partner

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We need an upside-down hockey stick

Professor Sebastian Mernild from the University of Southern Denmark (SDU) has contributed to work in the UN Intergovernmental Panel on Climate Change (IPCC). We must both reduce carbon emissions and develop new technologies for carbon capture and storage, because rapid reduction in the atmospheric content of greenhouse gases is crucial, he stresses.

Sebastian Mernild's message is very clear. There's no either-or with respect to reducing carbon emissions or capturing and storing carbon with artificial or nature-based solutions such as afforestation and biochar.

"We need it all, and at a pace we've not yet seen. Because reducing concentrations of greenhouse gases in the atmosphere is urgent and critical," he stresses.

As a professor in glaciology and climate change, Sebastian Mernild is one of Denmark's most recognised climate researchers. He is the head of the SDU's Climate Cluster and author in the UN Intergovernmental Panel on Climate Change (IPCC), where he was the main author of the Sixth Assessment Report.

Sebastian Mernild

In the report, the SDU professor and his global researcher colleagues reviewed different scenarios to achieve the target to keep global warming below 1.5°C. In none of the scenarios is carbon capture and storage, CCS, enough to ensure that we meet the climate targets. Large reductions, particularly in the consumption of fossil fuels, are required. Furthermore, we also need to develop and exploit the potentials in CCS, according to the researchers' recommendation.

The IPCC applies a very large interval when estimating how much carbon can be captured and stored. In 2050, we will be able to store up to two to three gigatonnes of CO_2e, according to a prudent estimate in the report. This corresponds to around 6% of the total reductions required.

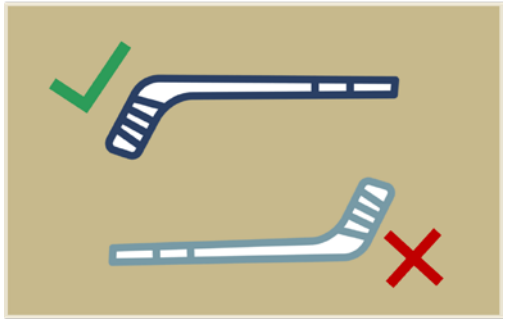
The report points to technical, economic, environmental and socio-cultural barriers. There is still only a relatively modest number of CCS projects. But in 2021 alone, the number of projects tripled. Therefore, the effect may prove to be higher.

Sebastian Mernild explains that emissions of CO_2, methane and other greenhouse gases have increased year by year, and so have temperatures. The global average temperature set a new record in 2023. Therefore, we must neither wait, nor write off specific technologies. Actual reductions in emissions from agriculture, construction, transport and the transition of the global energy sector to renewable energy sources are crucial instruments, but they cannot stand alone. We have to bring everything into play to reverse the growth in the atmospheric content of greenhouse gasses, as this is the only way we can curb temperature rises.

"We need a hockey stick - but it has to be turned around. It's crucial that we reduce the amount of greenhouse gases in the atmosphere. And we have to do something as soon as possible. We're approaching some of the critical tipping-points, and preferably we must never reach them. Therefore, we need to bring into use all the means we have available. New better and cheaper technologies may very well crop up along the way, but it can be very expensive to wait," says Sebastian Mernild.

Failure to act now will have economic, environmental and climate costs. And there will be the human costs of extreme weather, with flooding and permanent changes making agricultural land hard to cultivate, with consequential famine and refugees.

Hockey-stick shows the way for climate action, but must be turned upside down



TEMPERATURE RISES CAN BE SELF-REINFORCING

Since 2005, the IPCC has pointed to the need for CCS, which usually entails capturing CO_2 in the flue gas from energy production or industrial plants and compressing and storing it several kilometres under the ground in the stable layers. Besides this, there is also work to capture CO_2 directly from the air.

It has been estimated that, with the known stores, it is possible to store CO_2 in the subsurface corresponding to the current emissions up to the end of this century.

However, the debate on CCS often becomes polarized. In one corner, a number of the most climate-impacting industries and countries have been proponents of CCS.

And because CCS has appeared as - and perhaps also been meant as - an alternative to actual reductions in emissions of greenhouse gases, CCS has been seen as a diverting tactic. In the other corner are the advocates for first implementing full reductions of emissions in all places before moving on to storage. However, the one does not exclude the other. Carbon storage can supplement reductions. The debate has also run in Denmark, where CCS plays a crucial role in the government's plan to achieve the climate targets.

Just as getting into good physical shape demands strength training and aerobic training, there is no reason to write off initiatives to reduce the quantity of carbon in the atmosphere.

Some years ago, Sebastian Mernild and his colleagues identified one of the critical tipping points that we are approaching. A global temperature rise exceeding 1.6°C may have a significant impact on the ice sheet," he explains.

The surface of the ice sheet grows when it snows more than it melts. At the same time, the bottom melts, and icebergs calve out into the sea.

Temperature rises will shift this balance if surface melts faster than it grows when it snows, and this can cause increasing losses of ice and probably a self-reinforcing effect. Warmer temperatures will cause the ice sheet to shrink, so the top of the ice sheet lowers to where the temperature is higher, causing more ice to melt.

"This will cause ice losses to grow and grow. The ice sheet won't be able to restore itself.

Our studies indicate that this will happen if the global temperature rise gets to around 1.6°C. Several of the Earth's other major systems can approach critical tipping-points in the near future," he says.

HUGE POTENTIALS IN BIOCHAR

One of the technologies with great potential to store carbon in the short term is pyrolytic treatment of agricultural residues to biochar. Through the process, carbon is bound in biochar, which can then be spread on farm fields, and the carbon will remain bound in the biochar for several hundred years.

It is possible to produce biochar from of all types of biomass. Everything from straw and wood chips to residual fibres from biomass can be converted to biochar through the pyrolysis process, in which the biomass is heated to at least 500-600°C without oxygen. While biochar binds both carbon and nitrogen, phosphorus and potassium are released, so biochar could also contribute to soil improvement.

An action plan from the CIP Foundation in January 2024 shows that pyrolysis and biochar will be socio-economically advantageous compared with other types of CCS.

Anne Arhnung is a member of the board of directors of the CIP Foundation, and she explains that biochar could play the same role in the green transition of the agricultural sector as wind technology has done in the energy sector.

"The technology is mature and cheap, but framework conditions need to be in place as soon as possible, so that a market can be established in the area," says Anne Arhnung.

THE NORTH SEA CAN BE USED FOR CARBON STORAGE

The relatively slow development of CCS is partly because of the drastically falling prices of solar and wind energy. The price of PV solar modules has plunged since the turn of the millennium, and with a few small bumps in the curve, the same applies for onshore and offshore wind power. Economists have calculated that it is cheaper to save carbon emissions by replacing fossil power plants with wind and solar energy than to deploy CCS.

"With respect to security, there's no reason to fear release of the stored carbon. The carbon will be stored in the same soil layers as have stored oil for thousands of years. They're called impermeable clay layers, and greenhouse gases cannot penetrate them," says Sebastian Mernild, who stresses that this is not his research field, but knowledge from his colleagues.

Denmark is already well on the way. March 2023 saw the start of Project Greensand, which will exploit the subsurface under the North Sea for carbon storage. This turns history in full circle. From oil and gas production beginning in the 1970s, to storing unwanted by-products from fossil fuels 50 years later.

Credit: Project Greensand

Project Greensand is very exciting. But it is far from enough to meet the point at the top of Sebastian Mernild's wish list. In short: Scale.

"We have to scale-up for any sort of real effect. Pilot projects are all very well; but we need to get projects out of the research labs to have any impact. We have global annual net emissions of 19 gigatonnes of CO_2e, so it's urgent," he says.

THE CLIMATE FOLLOWS THE LAWS OF PHYSICS

There is a good probability that this relatively new technology could bring a technological leap similar to what we saw with solar and wind power, but it is important that the knowledge obtained through research and innovation is brought into play by companies and countries. Scaling CCS projects will contribute to further innovation. More projects will increase volume to gather more experience and improve efficiency.

"The emissions curve has only gone up and up. Turning the curve is vital. In reality, not only emissions are crucial. The concentration of greenhouse gases in the atmosphere determines the temperature changes. It's well known that the amount of greenhouse gases in the atmosphere, emissions and rising temperatures are closely linked. Time is the vital factor here. Therefore, I recommend an upside-down hockey stick," says Sebastian Mernild.

As a researcher, he keeps out of the political debate. And sometimes, political intrigue can shift focus from what's important, he points out.

The most recent temperature measurements indicate that we are very close to the 1.5-degree target in the Paris Agreement. However, it can be difficult to decide, because this is where politics quickly comes in. He needs an exact definition of how to calculate temperature rises.

"The climate doesn't care about politics and definitions, so it quickly becomes just talk. Sure, there's a lot of uncertainty. Both about the direct consequences for the climate, and about the consequences of extreme weather events, massive flows of refugees and other human disasters, but no matter whether we've exceeded 1.5 degrees or we're close to it, the climate doesn't care about definitions: For the climate, only physics matters," he says.

Politicians can't change the laws of physics. Therefore Sebastian Mernild once again stresses the importance of bringing all tools into play.

"We've pushed our climate system into an imbalance which may have insurmountable consequences. Therefore, we have to change gear. We have to act much faster, and we have to act across sectors. For example, we need more sustainable mobility and greener agriculture, construction and energy. We must remember to act internationally: the climate is indifferent to where the emissions come from. We also need technological solutions such as CCS, and we must change our behaviour: everything from our eating habits to our consumption is at stake," he says.

The CIP Foundation leads the way to efficient carbon storage with biochar

Biochar can underpin the green transition of Danish agriculture by storing carbon effectively and for a long time, providing a fertilizer product, and producing green energy during the process.

In socio-economic terms, the displacement costs of removing one tonne of CO_2 from the atmosphere with biochar is very competitive compared with other climate measures.

In January 2024, the CIP Foundation launched a number of reports on the use of biochar as a climate measure. The main report How to establish a market for CCS with biochar in Denmark shows how biochar can support the agricultural sector in the comprehensive and investment-intensive green transition, and at the same time generate energy for the rest of society as well as other benefits.

BIOCHAR FROM AGRICULTURAL RESIDUES

Biochar is made of biomass residues with no other significant economic utility value. Typically, residues at the bottom of a cascade use

of biomass. This could include biogas fibres, livestock manure, and straw residues that today are mulched on farmland, as well as other grass and plant residues. Or it could be residues such as sewage sludge and garden/park waste. In other words, side streams that can be reused, generate revenues and return important nutrients in cycle of uses, while potential substances of concern can be removed from the biomass.

Biochar is made by heating biomass residues in a pyrolytic oven, and this forms green energy in the form of pyrolysis gas (for heating and electricity), surplus heat (e.g. for district heating), and bio oil, which can be used in green fuels in sectors that would otherwise have difficulty transitioning. The solid residue is biochar, which can be used as fertilizer and to improve soil quality. It also has properties relevant for building materials for example. Furthermore, the biochar contains the carbon from the biomass in a solid and stable the form; i.e. carbon storage.

For more information about the process, see here.

BIOCHAR AS A CLIMATE MEASURE

It is relatively new in both Denmark and abroad to consider biochar as an effective climate measure. A negative emissions technology to capture and store CO_2.

1 tonne biochar ~ 2 tonnes stored CO_2e

The process also has other climate benefits: for example, treating biomass residues instead of spreading them directly on fields avoids emissions of potent greenhouse gases from the biomass. And the green energy from the process replaces fossil alternatives, thus displacing this type of emissions.

80 pct. of the carbon in biochar stays stored after 100 years and…

75 pct. stays stored after 1,000 years

This was demonstrated in a knowledge synthesis from Aarhus University in 2022. A number of other research papers have shown that the carbon storage is very long-term and stable.

It has been verified and documented that biochar stores carbon like other CCS technologies. This is new. In climate terms, biochar can help to "clean up" both after historical emissions, and after emissions which would otherwise be difficult to remove completely, for example emissions from soil and from livestock.

NEW CLIMATE MEASURE BASED ON WELL ESTABLISHED TECHNOLOGY

The actual use of biochar is nothing new. People in the Amazon region used biochar to enrich the soil more than 2,500 years ago. The soil in the rain forest is often sandy and infertile below the first thin, but fertile soil layer. Adding biochar made it possible to transform the soil and make it richer and more fertile to cultivate food.

In Europe and a number of other countries, biochar is today used to improve the soil on farms and as a fertilizer for gardens and parks. And in some places it is also mixed in concrete, asphalt and various other materials.

ENOUGH BIOMASS TO MEET POLITICAL TARGETS

NIRAS has examined the extent of relevant biomass residues in Denmark that can be used for biochar. Using five of the major sources (ungathered straw residues, digestate, deep litter, garden/park waste and sewage sludge), there are enough biomass residues to achieve the target in the Agriculture Agreement to store two million tonnes CO_2e annually from 2030[1]. And there is great potential for more biomass residuals from Danish agriculture, with up to 10 million tonnes of bioresources in 2030, see Nationale Bioøkonomiske Panel.

Biochar also provides good opportunities to reuse important nutrients such as phosp-

1 NIRAS (2023)

horus and potassium from the biomass and redistribute them between agricultural land. Phosphorus is crucial for plant growth, but it is also a scarce resource, which is extracted from mines, imported and spread on fields as artificial fertilizer. Biochar also has a liming effect on the soil.

BIOCHAR IS NOT JUST BIOCHAR …

The biggest benefits come when the biochar is used on agricultural land as fertilizer and to improve the water retention properties of the soil to help limit nitrogen run-off from the soil to wetlands.

However, it is not that easy to generalise the effects of using biochar. Biochar is not just biochar. The effects depend on a number of factors: the biomass biochar is made of, the treatment process it has been through, and the type of soil it is used on.

There is already a great deal of research about the effects of using biochar, including Danish studies. However, there is a need to ensure that the results are collated systematically and categorised, so that it is easier to see where best the biochar can be used, and what type.

CLIMATE CREDITS PAY FOR CARBON STORAGE

The CIP Foundation has examined the business case behind various types of biochar for the entire value chain, and has concluded that it is financially viable, provided there is a contribution to payment for the carbon storage. It's not free. Someone has to pay for the positive climate effects of biochar, if farmers and pyrolysis plants are to get anything out of it.

Today, payment can come from the market for purchases and sales of climate certificates, from higher prices of products in the value chain that benefit from the lower climate footprint, or from CCS aid.

A climate certificate is proof that one tonne of CO_2 has been removed from the atmosphere. When a certificate is traded, it is called a climate credit.

There are good prospects for co-financing carbon storage in biochar through the growing global market for climate credits, because the technology supplies reliable and long-term storage which can be localised. Furthermore, biochar has a number of spin-off benefits, which also affect willingness to pay.

Purchasers of a climate certificate can use it in their climate accounts. Prices for climate certificates are currently around EUR 130 per tonne CO_2e, however, the market for climate credits (carbon removals) is still in the start-up phase, and there is great uncertainty regarding future prices. For example, see the analysis of the market for climate credits prepared by SEGES Innovation for the CIP Foundation here (only available in Danish).

A European standard for certification of carbon removal and a common register are on the way from the EU, and these could strengthen the market for purchases and sales of climate certificates, with more transparency and credibility.

BIOCHAR AS A CLIMATE MEASURE MAKES GOOD SOCIO-ECONOMIC SENSE

Socio-economicslly, the cost of storing one tonne of CO_2 with biochar is competitive compared with other CCS technologies such as direct air capture (DACCS) and burning of biomass in heating plants (BECCS), where the carbon is subsequently captured at the chimney and stored in the subsoil. Among other things, this is because of several positive side-effects, e.g. the nutrients are recirculated instead of being burnt at a CHP plant, and lower production prices. See the EA Energy Analyses for the CIP Foundation here (only available in Danish).

Therefore giving biochar access to apply for CCS aid on equal terms with these technologies should be considered. This would also support development of an industry for biochar by reducing some of the risk.

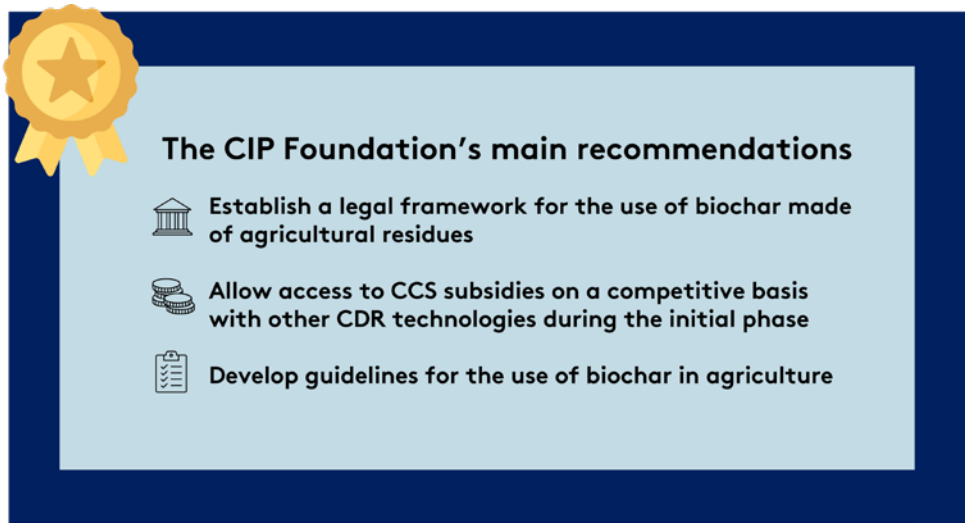
Biochar has climate potentials to contribute to Denmark's 2030 target, including the specific goals for agriculture. But it will take time to develop a new production infrastructure and achieve the climate impacts. And the more uncertainty, the more expensive it is to make a move.

NEED FOR A CLEAR FRAMEWORK

Technologically, Denmark is well on the way, with biochar production at 12 different locations in Denmark. With a good geographical spread and with variation in the size of the plants and in how and from what source the biochar is produced. And more plants are on the way.

At present the most important challenges associated with commercialisation of biochar are associated with the absence of direct regulation of biochar in Danish legislation. The longer this takes, the less biochar will be able to contribute to climate targets in the short term. However, the potential is great: and greater still after 2030, with later targets such as climate neutrality in 2045 and net negative status in 2050.

Read more and find the answers to your questions about biochar in the CIP Foundation's main report and additional information here.



Data can help balance an electricity grid with more wind and solar energy

Production and consumption in the electricity grid have to be held in balance, and this can be a challenge. With green energy sources, this balance will increasingly be maintained by adjusting the consumption side. This is only possible by systematically collecting and sharing data. data.

When we put a mobile phone in charge, or switch a light on, we expect the electric current to flow immediately. To the uninformed, electricity is an everyday utility we take for granted; a one-dimensional raw material. Electricity comes out of the socket and brings life to everything from lights to laptops.

However, if you look behind the socket and follow the cables back to the source, things are nowhere near that simple. At least not for those who are responsible. The electricity grid requires production and consumption to constantly remain equal to each other within a very narrow interval. Like a scales being held in balance. Otherwise there'll be black-outs and power failures.

More renewable energy sources, such as the sun and wind in electricity production, and consumers who sometimes act unpredictably, mean that balancing the electricity system has become considerably more complex.
In this context, data and data sharing are crucial tools to secure the electricity utility in an environment where high security of supply, a high share of green energy sources, efficiency and reasonable prices all have to fall into place. And much of this data has to come from the consumers themselves. Where it was previously possible to adjust production up and down to keep the system in balance, in the future it will also be necessary to adjust consumption as well.

"It's relatively easy to turn up production at traditional power plants, but this isn't possible with wind and solar energy. Instead, we can adjust consumption. This could be in large office landscapes, processes in the utilities sector, shops, industrial processes, homes, charging stations for electric cars or in other places. Whether you increase production or reduce consumption, the net effect is the same," says Flemming Silius Nielsen, Head of Flex Partner at Andel Energy.

The energy company is building experience via its so-called Flex Platform, which the company has developed with IBM. Initially, a number of very large electricity customers in the Andel group, including Salling Group, the City of Copenhagen and most recently the Birn iron foundry, as well as other major industrial and telecommunications companies, are in partnerships to provide the flexible consumption to maintain the balance.

LIKE A TETRIS GAME

Everything from refrigerators to keep food fresh in supermarkets, to heat pumps and ventilators to provide comfortable temperatures and fresh air in offices can be disconnected or turned on for short periods, without impairing either the food or comfort. By doing this, the partners can help secure balance in the electricity grid.

However, it's not quite that simple. The different units - assets as Flemming Silius Nielsen calls them - behave differently. In the Flex Platform, you have to know the capacity and the length of time you can shut down the refrigerator in a supermarket or the heating in an office building.

"We usually say this is like a Tetris game. We have a number of building blocks, i.e. the various elements that can be switched on or off. Some assets, such as batteries, can react very quickly, while this does not apply for heat pumps, for example. We need the building blocks to fit together, like in Tetris," he says.

So far, Andel only has large corporate customers on the Flex Platform. You need specific real-time data for the individual assets. In private homes, the challenge is to access relevant customers' assets, such as heat pumps, electric heating, car charging stations, PV solar modules and batteries etc. in a reasonably cost-effective way, and there must always be power for the router that ensures the internet connection. Furthermore, it must all run digitally and in real time.

"There are great potentials in private households, but it requires very different data solutions than we have today. Therefore, we've started with large corporate customers," says Flemming Silius Nielsen.

FLEXIBLE CONSUMPTION SUPPORTS THE GREEN ELECTRICITY GRID

He differentiates between what he calls private-economy optimisation on the one hand, i.e. that customers can choose to use electricity when the price is low, and flexible consumption on the other. Flexible consumption is an entirely new market in which customers are rewarded for enabling their electricity-consuming units to switch on and off when required to balance the electricity grid.

There are large economic and climate benefits. Much more renewable energy can be used in energy production, and there is much less need for thermal power plants, which burn coal, oil or biomass, as back-up to solar and wind.

The so-called frequency regulation, which is the market for services that can maintain balance in the electricity grid, is the final element in the enormous change that has occurred in the electricity system over the past 25 years.

Thirty years ago, local electricity companies supplied electricity and ran the local grids. Everyone paid on the basis of their consumption, typically every year or half-year.

With liberalisation of the market in Denmark around the turn of the millennium, first corporate customers and later private customers were released to choose their own electricity supplier. However, at first, for many years very few private customers exploited this possibility.

Things changed with the drastically increasing electricity and energy prices in the autumn of 2022, and it suddenly became popular for private consumers to optimise their energy consumption. Thousands of Danish households downloaded apps so they could monitor changes in electricity prices over the day. And everything from recharging electric cars to running dishwashers was moved to the night, when electricity was cheapest. At the peak, approximately 30% of electricity consumption was moved to times with cheap prices per kilowatt hour.

ACTIVE CUSTOMERS BRING NEW CHALLENGES

"It's good that we can even out electricity consumption over the day," stresses Professor Flemming Nielsen Silius. "Wind turbines can also produce electricity at night, and we better exploit both production capacity and investments in the transmission and distribution grids if consumption is spread more evenly over the day."

However, private-economy optimisation and increasingly price-conscious consumers have also brought new challenges to balancing the electricity grid.

Every day, players responsible for balancing the electricity sector and Energinet draw up detailed forecasts for future electricity consumption, in which the day is broken down into hourly and 15-minute intervals. On the basis of these forecasts, electricity producers adjust their production. But if, in the wake of the forecasts, consumers can check the time-based electricity prices, they will move their consumption. This disrupts the forecasts, because suddenly consumption is very different.

It's a bit like traffic. If you have a detailed forecast of when the rush hour and congestion are expected, many drivers will decide to leave earlier or later than the peak rush hour. And this will shift the rush hour.

On the roads, you need patience and live with congestion. In the electricity system, however, imbalances and lack of capacity in periods with calm winds and fog can potentially cause black-outs, or slightly less dramatic brown-outs, in which players responsible for the electricity supply deliberately turn off the power in specific areas for a shorter period to keep the electricity grid running without a major power cut.

DATA HAS TO FLOW FREELY

Data is both the key and one of the major challenges in the design of the electricity system of the future in which customers' flexible consumption helps to maintain balance in the grid.

Today, energy companies' knowledge stops at the main meter. Behind the meter, the calm of private life prevails. Or perhaps rather calm for the private suppliers.

Large modern buildings usually have a Building Management System (BMS) with data on heating, ventilation and so on. Flex Platform is designed to communicate with by far the majority of the larger BMSs. This provides access to the underlying assets.

Digital access to the underlying assets is more difficult in buildings without an updated BMS, special processes in industry, small industrial companies and at private customers, and it often requires specially designed IoT solutions.

"There will be a need for far more data, and this must flow freely. This applies for both the consumption side, and for the electricity system itself, which has to know the load on transformer stations because these can also be bottlenecks in the system," says Senior Research and Innovation Manager Lea Schick from the Alexandra Institute. Lea Schick has worked for several years on projects on data in the electricity sector.

With respect to electricity consumption, data has already been collected in Energinet's data hub. However, this is not the real-time data that will be required for a market for flexibility to work properly.

It will also be logical to collect data from other utilities. Production at CHP plants, and large pumps at wastewater treatment plants and in the water supply system can also be turned on and off, explains Lea Schick, who quickly adds that there are new challenges in this context too.

"There are very large amounts of data, but for obvious security reasons, we can't have it all on one server or in a large datapark. If the Russians or others with malevolent intention find out, it would be an obvious target. Therefore, it is crucial to store the data in decentralised locations," she says.

CONSUMERS ARE NOT RATIONAL

Lea Schick points to data spaces as the future solution. Both in terms of legislation and technically, there are still many challenges to resolve. Data spaces are basically a system that can provide relevant players with access to relevant data.

At the moment, a lot of work is going on in the EU to pave the way for an organisational and digital infrastructure in which it is easier to share data, while keeping it decentralised. The individual undertaking or consumer will still have to authorise data sharing. However, it should be easier, so you don't need separate agreements for all the power-consuming units connected to Andel's Flex Platform, for example, or similar initiatives.

"The EU is working on both legislation and technological development, and there are large subsidy funds to develop the basic structure for common European data spaces. There are very similar issues across sectors. There is a need for data spaces in the energy sector, in healthcare and in transport and mobility, just to mention some examples of the sector-specific data spaces being worked on at European level. It's a question of the technical set-up, security and the governance structure, and not least who is to have ownership of the data," says Lea Schick.

She points to several challenges. The technology and the amount of data need to be further developed to establish a more flexible electricity system. And there are challenges in conventional thinking. Both in those who make the systems and in the customers themselves.

"There's a huge potential in ordinary households. But getting customers to understand why they have to agree to help is a daunting task," says Lea Schick.

The change is in line with the radical changes brought about by the internet when it shifted from just being a tool reserved for researchers to being a communications motorway for the general public. We have understand customers more deeply.

"The energy system has been developed by what research calls "the rational resource man" - white, middle-aged men with an engineering background. The problem is that many don't behave with the same rationale as the developers require. It may well be that you can save money by washing clothes at night and hanging them out to dry in the morning. But if you have three children, and their football kit has to be clean for the next game, you'll run your washing and tumble dryer at other times," says Lea Schick.

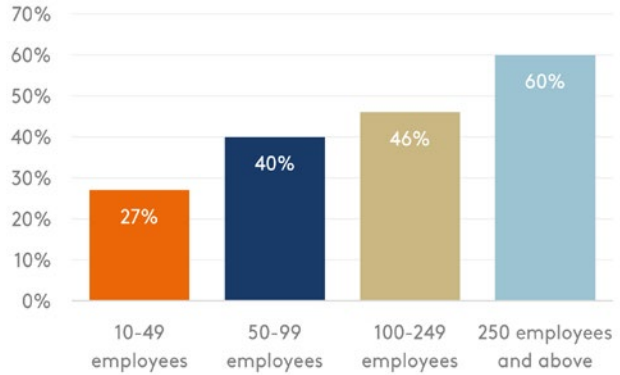
There are several changes to be addressed in the massive transition of energy systems, she points out.

"We have to develop new digital systems, and secure more, and more secure, exchange of data. This requires insight into consumers' habits in their use of energy, and not least fundamental acceptance from consumers. All these parameters must be in place if we are to exploit the full potential in flexible consumption," says Lea Schick.

Information and facts

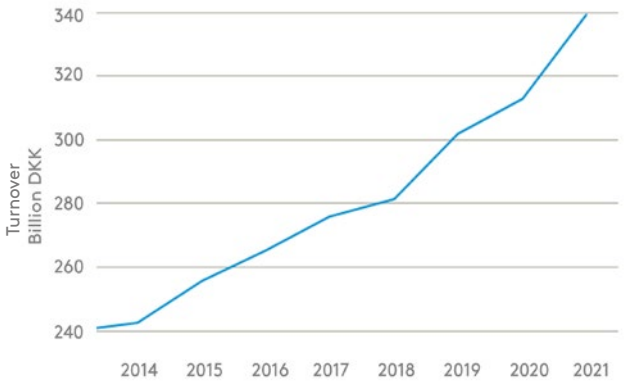
Data and digitalization

Particularly larger firms use digital devices or systems for surveillance/remote control via the internet (IoT)



Source: Statistics Denmark (2023), ITAV20.
Note: Companies' use of satellites and the Internet of Things (10+ employees) by industry (DB07), application, time, and company size

Continuous growth in the digital industries since 2014



Source: Statistics Denmark (GF01)

Facts about data and digitalization

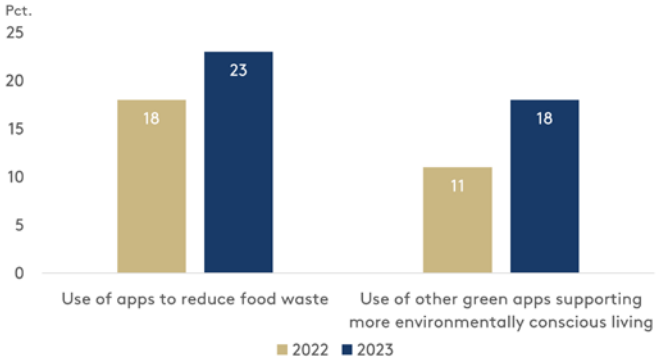
Only
15%
of the Danish population between the ages of 16-74 used 'smart-home' solutions in 2022 to manage energy consumption in the home.[1]

EU expects investments of
170 bn. EUR
in the digitization of the energy system up until 2030.[2]

Data traffic has
x2
during the last 5 years alone.[3]

Sources: 1) Statistics Denmark, IT-use in the population 2022, 2) IEA (2024), 3) Statistics Denmark (2023).

Increasing tendency in the use of green apps to reduce food waste and live more environmentally consciously



Source: Statistics Denmark, BEBRIT09.

Recent and upcoming publications

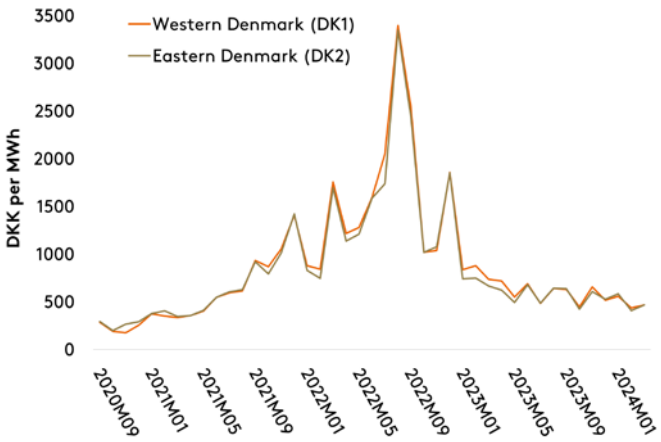
February 2024	Decoding the EU AI Act (KPMG) →
February 2024	Capturing the potential of AI and gen AI in tech, media and telecom (QuantumBlack, McKinsey & Co) →
March 2024	Industry analysis: Denmarks GenAI Paradox: From Lagging to Leading (Dansk Industri Digital) →
March 2024	The Municipalities' Technology-radar 2024 (Kommunernes Landsforening) →

Upcoming activities

24th of May 2024	DI Service Anniversary 2024 (DI Service) →
29th of April 2024	Supply Data 2024 - better access and increased liberation (DAFAGO & DI Digital) →
18th of June 2024	Green IT in the public sector (Kommunernes Landsforening) →

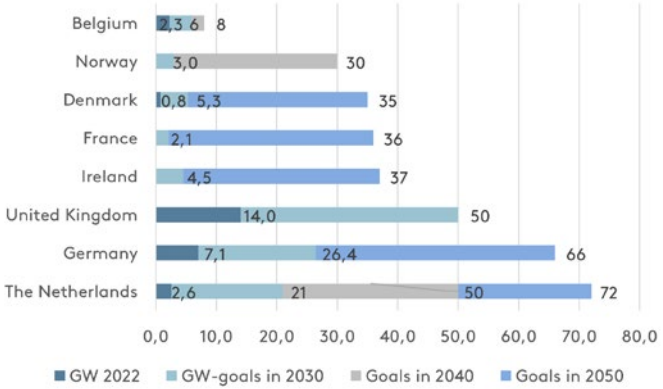
Energy and infrastructure

Danish electricity prices are stable



Source: Danish Energy Agency (2023) Prisdatabase_7.xlsx (live.com)

There is large variation in the North Sea countries' targets for offshore wind



Source: the CIP Foundation based on the Oostende-declaration and Royal HaskoningDHV (2023)

Facts about energy and infrastructure

RE-investments increased almost

50 pct.

globally in the period between 2019-2023, with an increase of roughly 10 pct. each year.

Energy-use in buildings

42 pct.

of all energy used in the EU in 2021, was used within buildings.

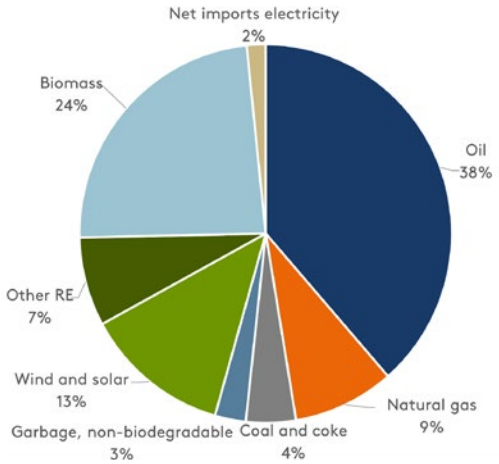
Modest improvements of

1 pct.

in global energy efficiency, which is x4 lower than the COP28-pledge of a doubling of energy-efficiency before the end of 2023.

Source: IEA (2024)

Resources covering the Danish energy-use 2023



Source: Danish Energy Agency (2023)
Note: Other RE covers biogas, water, geothermal and heat pumps. The statement is provisional.

Recent and upcoming publications

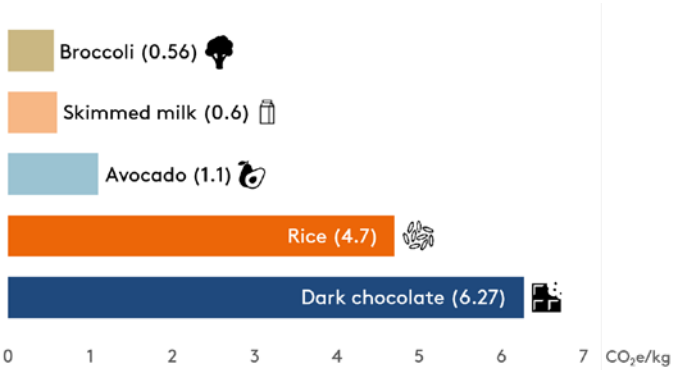
February 2024	Green electricity balance in the future (Green Power Denmark) →
March 2024	National mobility-strategy: Why, what and how?(CONCITO) →
March 2024	Value of green transition in Europe (estimate) (EA Energy Analyses) →
Spring 2024	Havne & havvind (CIP Foundation)

Upcoming activities

6th of May 2024	The European energy politics of the future (Danish Industry, CIP, Green Power Denmark & Think Tank Europa) →
7th of May 2024	Conference - Electricity in road transport (IDA) →
14th-16th May 2024	EL & TEKNIK '24 (VELTEK & Green Power Denmark) →
23rd of May 2024	Summit 2024 (Green Power Denmark) →

Agriculture and food production

Different food products' climate footprint (kg CO_2e per kg product)



Source: CONCITO (2024): "The Big Climate Database", version 1.1

Effects of a CO_2-tax (DKK 750)

Jobeffect

-8000 FTE in agriculture up until 2030.

Price increases of

2-4 pct. will milk and beef products experience.

Increases of

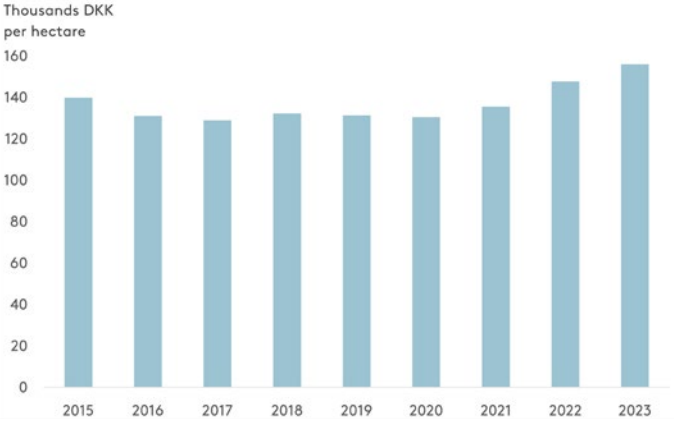
135 DKK/ year is the expected average increase in household expenditure on food with an unchanged consumption of milk, cheese, and beef.

Source: The Danish Ministry of Taxation: "Grøn skattereform - endelig afrapportering" (only in Danish)

Recent and upcoming publications

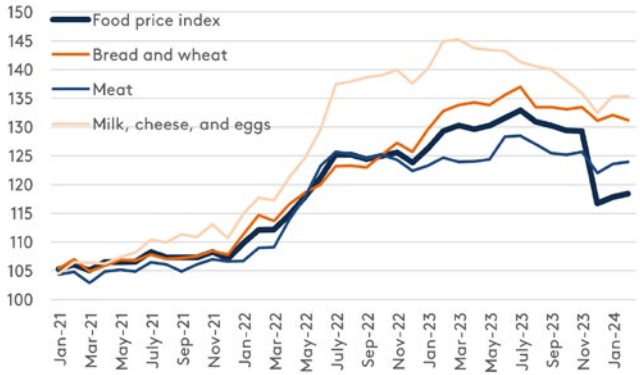
January 2024	How to market CCS with biochar in Denmark (The CIP Foundation) →
February 2024	CO_2-taxes in agriculture "Grøn skattereform - endelig afrapportering" (The Danish Ministry of Taxation) →
February 2024	Researchers at the University of Copenhagen use blue-green algae for "meat-like" proteins (KU FOOD) →
February 2024	Comparative EU analysis of current food legislation (CLEVERFOOD) →
February 2024	Status on agriculture's climare ambitions (Danish Agriculture & Food Council) →

Rising land prices after several years of stagnation since 2015



Source: Statistics Denmark (LPRIS37)
Note: Current prices. Data for 2022 and 2023 are provisional.

Food prices in Denmark are rising again, especially for animal products



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

Upcoming activities

2nd of May 2024	Conference: Food, Trends, & Sustainability 2024 (Food & Bio Cluster, SEGES, and others) →
22nd of May 2024	International synopsium on plant-based foods in Middelfart (Food & Bio Cluster) →
12th of July 2024	Organic field day 2024 (Agriculture & Food) →
21st of August 2024	Webinar: Market update on the organic grocery market Q2 2024 (Organic Denmark) →

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