

Location selection site 7 of 23

# Grønnevej 65, 69 ha

Varde municipality



**RAMBOLL**

Bright ideas.  
Sustainable change.





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# EXECUTIVE SUMMARY



01



# Denmark | Summary

## Market attractiveness

Denmark has a long-standing commitment to sustainable development, which has led to the country becoming a **global leader in renewable energy**. This provides a supportive regulatory environment and access to extensive knowledge and expertise in the green energy sector. The country has a high rank of 4 out of 175 in ease of doing business and a gross value added (GVA) by sector of 14% in energy and utilities. Denmark has a reliable supply of electricity, strong logistics performance, and a low corruption index score. Furthermore, Denmark's trade conditions, labour supply and political and legal stability make it an excellent destination for investments in or reliant on green energy infrastructure.

## Regulatory landscape

Denmark's green energy transition has been accelerated in response to the importance of energy independence in the EU due to Russia's invasion of Ukraine. **The Danish government has set ambitious targets for renewable energy production**, which are supported by a 7.2 bn. EUR green investment fund. These initiatives, combined with Denmark's political stability, low corruption and transparent legal system, make the country an attractive destination for investors.

The Danish economy is AAA-rated making it a safe and stable place to invest. Additionally, Denmark's commitment to reduce CO<sub>2</sub> emissions reinforces its position as a leader in the green energy transition.

## Labour market

**Denmark has a highly skilled workforce, including engineers, researchers and other professionals with expertise in the green energy sector.** Currently, there is a shortage of highly skilled labour in the private sector. Varde municipality proactively works with a recruitment program to attract foreign workers. The country has a strong tradition of unionisation, with 67% of employees in unions. Employment contracts and termination notice periods vary by length of service, but generally, there is a 3-month notice period for termination. Workers enjoy a standard 37-hour workweek and 25 days of holiday per year. Hiring foreign workers is possible but easier for EU/EEA/Switzerland citizens.

## Infrastructure & utilities

Denmark has a **well-developed infrastructure** with reliable highways, railways, industrial ports and international airports, all connected with different transportation modes. Likewise, Denmark has a developed utility network. The power grid is highly reliable and efficient, mostly powered by renewable energy sources. Furthermore, Denmark is part of a European hydrogen network connecting and developing new hydrogen pipelines across Europe. The hydrogen network is expected to cover most of Denmark, and it will be connected to Norway, Sweden and Germany, providing excellent opportunities for the transportation of hydrogen. Denmark is further deeply committed to promoting sustainable practices in the energy sector through large investments.

## Overview

<b>EU Membership</b>	Yes
<b>NATO Membership</b>	Yes
<b>Real GDP 2022</b>	402 b USD
<b>Real GDP growth 2022</b>	3.6%
<b>Population</b>	5,8 mill.
<b>Size</b>	43,000 km <sup>2</sup>
<b>Corporate tax</b>	22%
<b>Inflation rate 2022</b>	7.7%
<b>Interest rate 2023</b>	2.8%
<b>Human Development Index Rank (2021)</b>	No. 6 of 189 countries
<b>Ease of Doing Business (2019)</b>	No. 4 of 175 countries
<b># of top-ranked engineering universities in top 250</b>	4

# Varde | Summary

## Climate ambition

- Varde's ambition aligns with the Paris Agreement, focusing on reducing global greenhouse gas emissions and limiting the temperature increase to 1.5°C.
- Varde aims to **reduce greenhouse gas emissions by 70% by 2030** and to be completely climate-neutral by 2050.
- Varde prioritises renewable energy production, particularly solar, wind and biogas, alongside improving energy efficiency and infrastructure while enhancing green fuel infrastructure for reduced transport-related CO2 emissions.

## Utilities

- Varde collaborates with Energinet to establish a resilient power grid, with new transformer stations ensuring a reliable energy supply in the green energy sector.
- **The planned hydrogen backbone and existing biogas entities make it an attractive destination for Power-to-X facilities**, enabling large-scale production of green hydrogen.
- Varde's strategic location as a landing hub for subsea connections, combined with its cool climate and extensive fibre grid, positions it as an ideal destination for data centres and battery factories.

## Climate action plan

- Varde's energy sector plan involves **phasing out all oil and gas boilers by 2030 and transitioning to sustainable heat sources**, supporting fossil fuel-free district heating, and expanding renewable energy sources through solar panels, windmills, and attracting PtX and data centres to recover and utilise surplus heat.
- Varde aims to promote sustainable business growth through dialogues with companies in Green Network Varde.
- Varde aims to develop several Carbon capture and storage projects from waste incineration in collaboration with Energnist.

## Infrastructure

- Varde's excellent highway infrastructure connects it to major cities like Copenhagen and Hamburg (3 hours), facilitating easy access to a mobile labour force and attracting qualified workers.
- The well-developed railway network in Varde, connected to the Port of Esbjerg, makes the municipality an attractive destination for companies aligning with the EU's TEN-T strategy.
- The Port of Esbjerg is responsible **for shipping 80% of Europe's offshore wind capacity**, why it offers robust import and export capabilities.
- With Billund airport just 40 minutes away there is convenient access to the rest of the world.

## Green energy hub

- Varde's strategic location in the North Sea offers immense potential for investments in the renewable energy sector.
- The Esbjerg/Varde business region has become a thriving hub for the offshore wind industry, with ambitious goals of installing 260 GW of offshore wind power by 2050, creating significant investment opportunities in offshore wind farms.
- Esbjerg/Varde's successful transition from the fossil fuel industry to the wind power sector positions it as an attractive location for sustainable investments, aligned with the growing demand for renewable energy sources.
- The region's appeal extends to the data centre industry, with renewable-powered data centres and low electricity prices. The cold climate enables cost-effective data storage and processing while leveraging outside air for cooling.
- The rising demand for energy storage solutions, such as power-to-x facilities and battery factories, presents favourable investment opportunities.
- Plans for "energy islands" and carbon capture utilisation and storage (CCUS) projects emphasise the region's commitment to fast-track the green energy transition causing an attractive investment potential.

# Sector coupling | Summary

## Description and synergies of energy-intensive industries

### Description

### Synergies



Power-to-X

PtX technology can convert water into green hydrogen through electrolysis via renewable energy. The green hydrogen can either be used directly or synthesised into different forms (x).

PtX offers synergies across industries by providing surplus heat to the district heating network. PtX can further fertilise the agricultural sector and produce E-fuels to decarbonise transportation.



Data Centre

A data centre serves as a space for essential IT infrastructure, enabling the creation, operation and delivery of applications and services. It also handles data storage and management.

Data centres offer surplus heat to the district heating network or process heat to various industries. Data centres add renewable energy to the energy mix through PPAs.



CO<sub>2</sub> Industries

CO<sub>2</sub>-heavy industries can take various forms depending on the CO<sub>2</sub> origin. Green CO<sub>2</sub> originates from point sources burning biomass Black CO<sub>2</sub> originates from point sources burning fossil fuels.

There are strong synergies between CO<sub>2</sub>-heavy industries and PtX facilities. PtX is dependent on CO<sub>2</sub> as input in order to store and form the green hydrogen into different E-fuels or gasses. There are also excellent CCS possibilities due to the Bifrost project.



Battery Factories

A battery factory is a manufacturing facility that produces rechargeable lithium-ion batteries, primarily for electric vehicles. Additionally, the batteries can be used for portable electronics and renewable energy storage systems.

Battery factories generate renewable surplus heat, if they are powered by green electricity. Battery factories can also utilise surplus heat and regenerate water back to other resources.



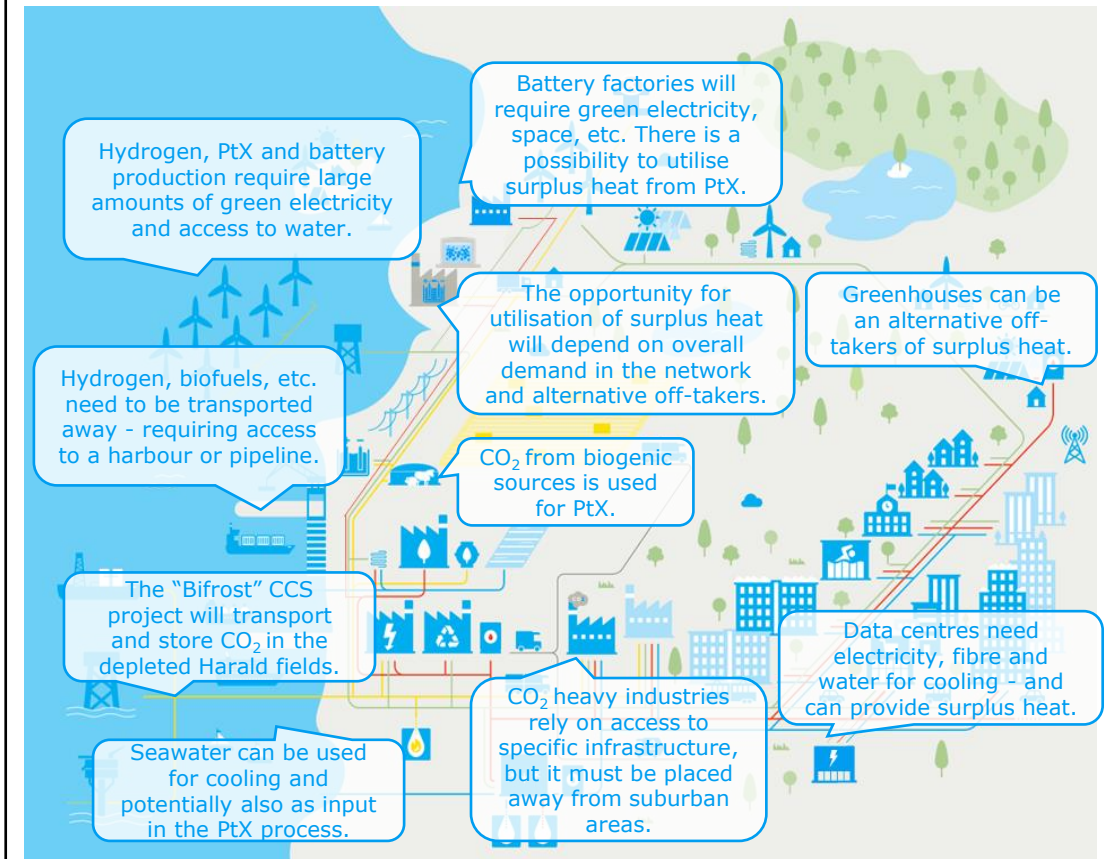
Greenhouse

Greenhouse farming cultivates crops in controlled structures, allowing farmers to regulate temperature, humidity and sunlight. It can produce various products like vegetables, fruits, plants and flowers.

Greenhouses provide an excellent solution for utilising the surplus heat generated by energy-intensive industries. Moreover, PtX facilities and greenhouses have synergistic benefits, as the ammonia produced by PtX can be used as fertiliser.

## Symbiotic effects

*Symbiotic effects have been considered when selecting site locations*



Red = Heat | Blue = Cooling | Yellow = CO<sub>2</sub> and gas | Green = Electricity



# Overview of 69 ha PtX/Industry/Battery, Grønnevej 65

## Site summary

### Utilities:

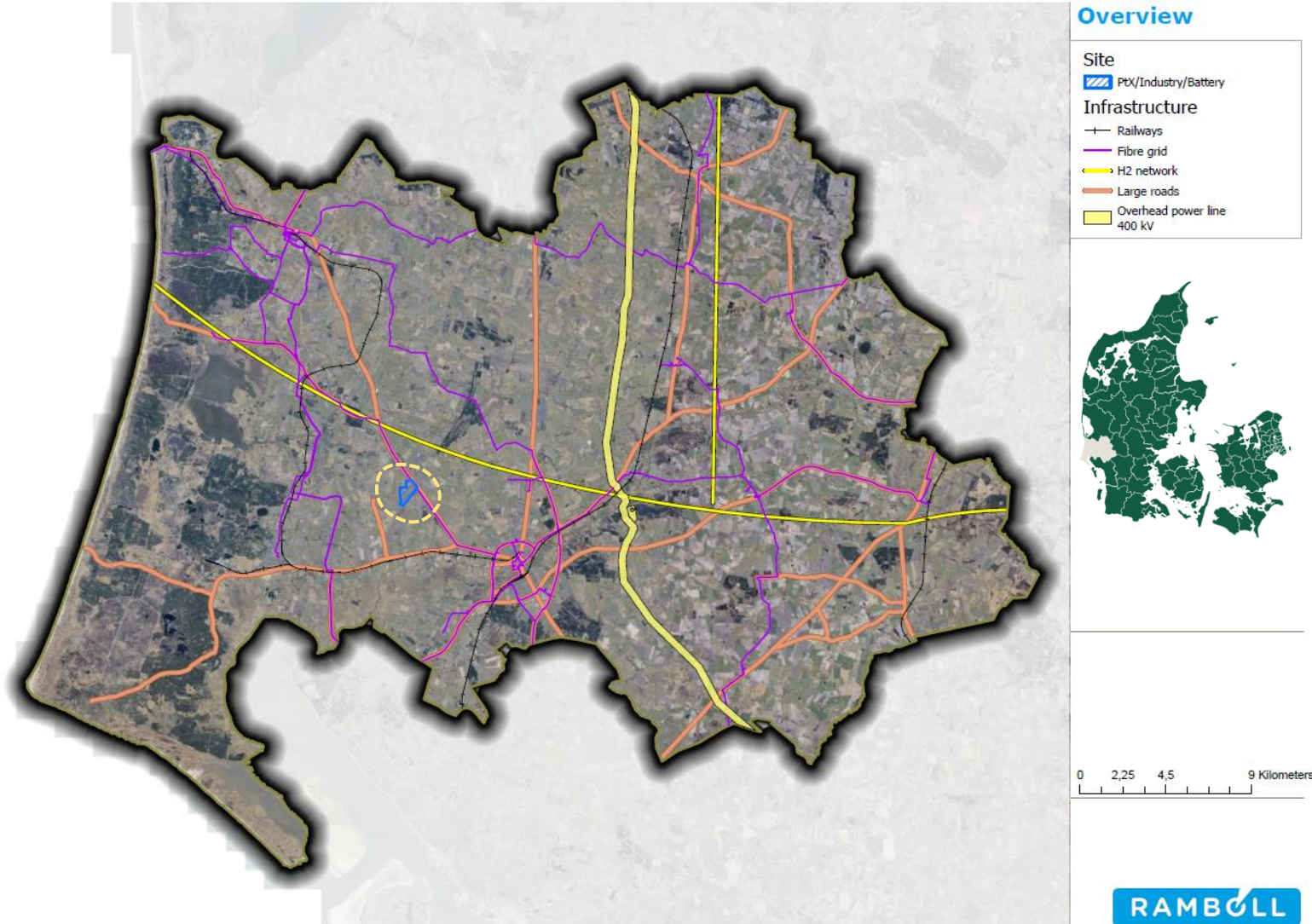
It is a highly promising site due to the presence of an H<sub>2</sub> and CO<sub>2</sub> backbone, which makes it particularly appealing for PtX facilities and CO<sub>2</sub>-reliant industries. To support the development of energy-intensive industries, Energinet and Varde municipality have strategic plans to potentially build a new transformer station in this area. The site offers convenient access to ultrapure and technical water from the Outrup water plant, which is needed for cooling and electrolysis. The site is also attractive for CO<sub>2</sub>-heavy industries due to the CO<sub>2</sub> backbone and the "Bifrost" CCS project. And lastly, it could also be relevant for battery factories due to the size of the site and surrounding utility network.

### Protected areas:

The chosen site does not overlap with any protected areas, making the entire site suitable for the placement of energy-intensive industries. To further enhance conservation efforts, clustering these industries is recommended, as it preserves the usage of natural protected areas that could otherwise be affected if the sites were scattered. However, it is important to note that the site does overlap with nitrate-sensitive extraction areas, as indicated by the groundwater map.

### Land ownership and suburban areas:

The identified land is far from neighbours and can be acquired at a low cost per square meter. There are ample non-residential areas within the site and expectedly low transaction costs for purchasing the site.





# DENMARK MARKET ASSESSMENT

02





# DENMARK GREEN FACTS



**#1 IN THE WORLD ON CLIMATE CHANGE ACTION**

*Environmental Performance Index, Yale University, 2022*

**PRODUCED RENEWABLE POWER BY 2022:**

**53%**  
WIND

**6%**  
SOLAR

**#2 GREEN FUTURE INDEX**

*MIT Technology Review, 2022*

**#2 IN ACHIEVING THE SDGS**

*SDG Index, 2022*



**66%**

**DANISH HOUSEHOLDS HEATED BY DISTRICT HEATING**

**SIX DANISH COMPANIES AMONG THE GLOBAL 100 MOST SUSTAINABLE COMPANIES**

# 2: VESTAS

# 18: CHR. HANSEN

# 13: ORSTED

# 23: NOVOZYMES

# 16: ROCKWOOL GROUP # 43: COLOPLAST

*Corporate Knights, 2023*

**#2 WORLD'S BEST ENERGY SYSTEM**

*World Energy Council, 2022*



**70%**

Reduction of CO<sub>2</sub> by 2030

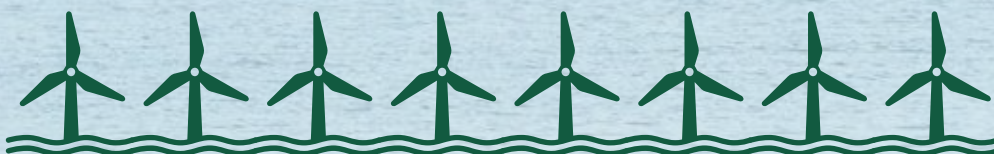
**DANISH GOVERNMENT CLIMATE ACT TARGET**

**100%**

**GREEN ELECTRICITY BY**

**2027**

**0%**  
GREENHOUSE GAS EMISSIONS BY  
**2045**



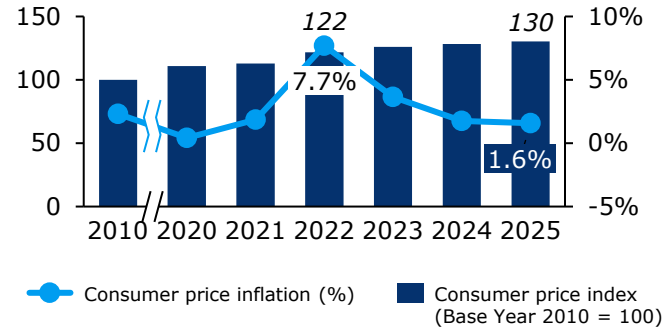
**DENMARK AIMS TO BE POWERED ENTIRELY BY RENEWABLE SOURCES BY 2045**



# Denmark | Macroeconomic factors

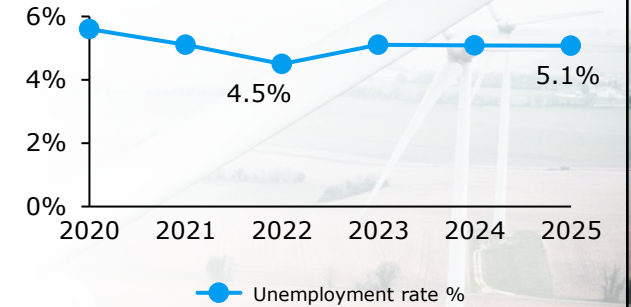
## Inflation

- Due to the volatile energy prices and war in Ukraine the inflation rate reached unprecedented highs in 2022 of 7.7%.
- The pace of the inflation rate is expected to decrease toward 2025 and reach a level close to the yearly target of 2%.



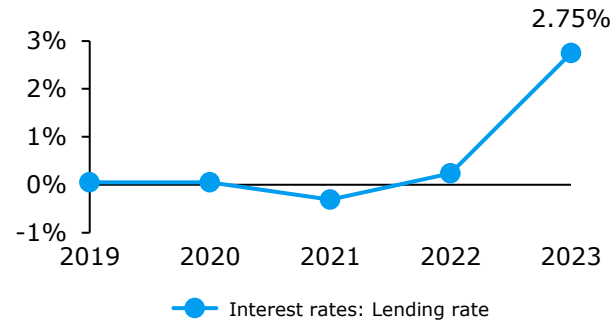
## Unemployment

- Denmark's unemployment has been decreasing over the past few years to record low level of 4.5%.
- Although high inflation may bring some uncertainty to the labour market, Denmark's economy is starting from a strong position and the consistent decrease in unemployment rates is a positive indicator for the future.



## Interest rate

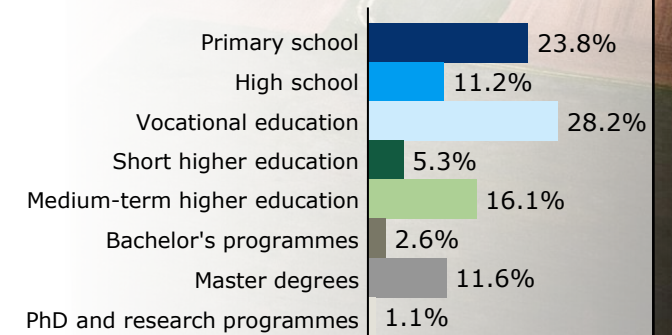
- Succeeding years of negative interest, the interest rate has increased significantly to 2.75%.
- This is due to the contractionary monetary policy from the European Central Bank trying to slow down the inflation.
- It is our hypothesis the interest rate will decrease as the inflation rate approaches the yearly target of 2%.



## Education

- Denmark's highly educated workforce includes 28.3% with vocational education degrees, 16.1% with medium-term higher education degrees and 11.6% with Master degrees.
- The country's focus on education and research is reflected in its low unemployment rate. Investors can safely rely on Denmark's skilled labour force to support their business ventures.

### Share of educated population (Highest completed education)





# Denmark | Overall assessment of market attractiveness

## Assessment

Denmark is a **highly attractive country for investing in green energy infrastructure, such as PtX facilities, Battery factories, Data centres and greenhouses**. The country has a high rank of 4 out of 175 in ease of doing business, a GVA by sector of 14% in energy and utilities, and a high ranking in enforcing contracts. Denmark's labour productivity is also high at \$66/h, and the unemployment rate is low at 4.5%. The country has a reliable supply of electricity, strong logistics performance, and a low corruption index score. Denmark's market attractiveness, trade conditions, labour supply and political and legal stability make it an excellent destination for green energy infrastructure investment.

Overall assessment	High
Market attractiveness	High
Labour supply	High
Trade conditions	High
Political and legal stability	High

Labour supply	High
Labour productivity (2021)	\$66/h
Human capital index (2020)	22/173
English Skills Index	5/111
Unemployment rate	4.5%

Market attractiveness	High
Ease of doing business	4/190
GVA <sup>1</sup> by sector (energy & utilities)	14%
Inward FDI stock per capita	\$26.5k
FDI inward stock	\$142.7b
Corporate tax rate	22%
Electricity price c€/February 2023	€30.3c

Trade conditions	High
Dealing with construction permits	High
Trading across borders	High
Reliability of electricity supply	High
Logistics performance	High

Political and legal stability	High
Enforcing contracts rank	14/189
Corruption index score rank	1/180
Political environment (political stability & government effectiveness)	32/194



# Denmark | Labour market

## Labour market landscape

- There is a current shortage in the Danish labour market with record high employment rates.
- The shortage is particularly evident in the private sector for highly skilled labour, such as engineers and IT specialists. Varde municipality proactively addresses this issue with a recruitment program to attract foreign workers.
- The high inflation caused by volatile energy prices and the war in Ukraine is bringing uncertainty to the Danish labour market, but Denmark has a robust starting point with a stable economy and low unemployment rate.

## Hiring and Termination

- An employment contract must state the parties, the type of work, the place of work and the work, and pay conditions with the remuneration components.
- Termination - notice period varies depending on the type of employment and length of service.
  - 0-6 months: 1 month
  - 6-36 months: 3 months
  - 36+ months of service: 5-6 months
- When terminating, the employer must state a reason which needs to be clear for the employee to understand why they are terminated.

## Labour mobility

- The amount of people who commute more than 100 km daily has increased 64% since 2002.
- The average commute to and back from work combined was in 2019 44 km.
- 67% commutes by car.
- In 2019 258,200 people commuted more than 100 km a day representing 9.4% of the Danish labour market.

## Contributions and entitlements

- In Denmark, pay and working conditions are typically laid down by collective agreements concluded between trade unions and employers' organisations. This system of labour market regulation is referred to as the Danish Model.
- As a general rule in Denmark, working hours are fixed in a collective agreement, and in the great majority of sectors, standard working hours are 37 hours.
- According to the Danish holiday rules, a worker is entitled to 25 days' holiday a year.

## Union participation

- Denmark has a high proportion of employees in unions of 67%.
- The trade unions have a collective bargaining coverage of 80%.
- There is a decreasing number of union members.
- The country's strong tradition of collective bargaining and social dialogue has played a significant role in fostering this culture of unionisation.

## Hiring foreign workers

- EU/EEA/Switzerland citizens and their relatives have the same rights as Danish citizens and do not need a work permit.
- Other foreigners can be hired if they have permission to work and a residence permit.
- Foreigners must apply for this permission before starting to work in Denmark.
- Specialised workers with long education can be hired through a fast track.
- It is difficult to hire non-EU workers if they are not specialised.

# Denmark | Regulatory landscape

## Political & Economic Environment



### #1 CORRUPTION PERCEPTION INDEX

Denmark's political stability, low corruption and transparent legal system make it an attractive destination for foreign investors looking to invest in green energy projects.



### THE DANISH ECONOMY IS AAA-RATED

Denmark has a high economic prosperity and is AAA-rated, which make a safe and stable place to invest.



### THE DANISH KRONE IS PEGGED TO THE EURO

Denmark has successfully pursued a fixed exchange rate policy since 1982 and DKK is pegged to the Euro since 1999. 1 EUR = 7.46 DKK.



### CORPORATE TAX RATE OF 22%

The Danish corporate tax rate of 22% is slightly above EU average of 18.5%.



### CLIMATE LAW WILL REDUCE CO2 EMISSIONS by 70% in 2030

In 2019, Denmark adopted a new climate law committing to reduce CO2 emissions by 70% in 2030 compared to the 1990 emission level.

## Denmark commits to renewable energy

- Russia's invasion of Ukraine has increased the importance of energy independence for the EU, leading Denmark to accelerate its green energy transition.
- The Danish government has launched initiatives to reduce reliance on fossil fuels and increase renewable energy production.
- A 7.2 bn. EUR new green investment fund will support the development of green energy infrastructure.
- Denmark has set ambitious goals to quadruple solar and land wind energy production and increase offshore wind power fivefold by 2030.
- The government plans to phase out gas heating in households and make all gas in the country green by 2030.
- These initiatives position Denmark as a global leader in the transition to sustainable energy, with a focus on reducing emissions and achieving energy independence.

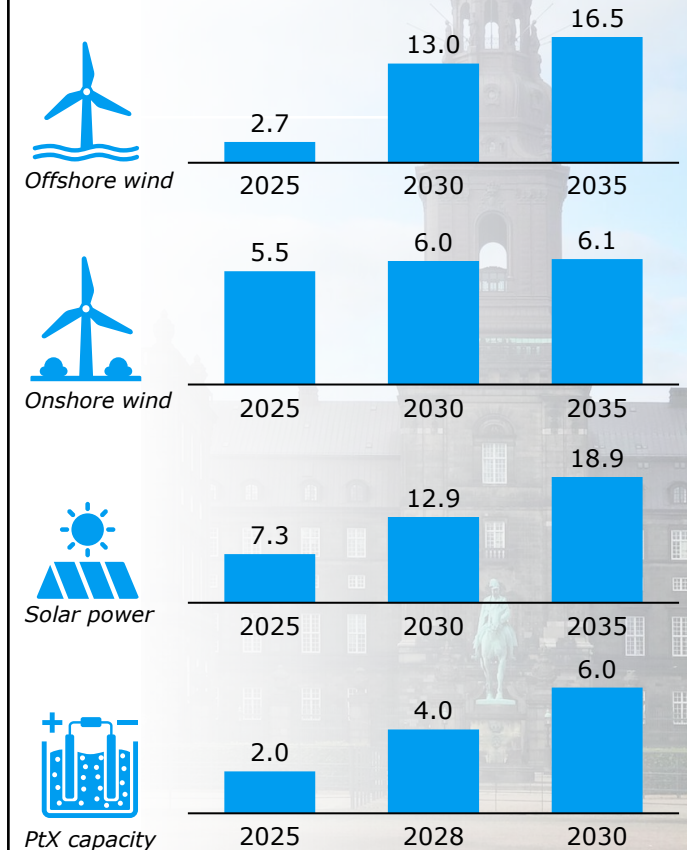


*"With these agreements, Denmark will become a green power hub for Europe, with an enormous expansion of our renewable energy sector."*

**Dan Jørgensen** - Minister of Climate, Energy and Utilities

## Green Energy Outlook

### Green energy market forecast (GW)





# Infrastructure

## Highways



- The Danish highway infrastructure is generally well-maintained and reliable, with a high level of stability and safety.
- The highway network is integrated with other modes of transportation, such as rail and sea transport, to provide efficient and environmentally friendly logistics solutions.

## Railways



- The Danish railway network is well-integrated with other modes of transportation, including sea and road transport.
- Denmark is committed to increase railway transport of industrial goods to implement the EU green deal and revised TEN-T strategy.

## Industrial ports



- Denmark has a long history as a maritime nation and a well-developed network of industrial ports that serves many industries and accelerates the green energy transition.
- The country's strategic location on the North Sea makes it an important hub for green energy development and transportation.

## International airports



- Denmark has a well-developed network of international airport infrastructure across the nation that is well connected to other modes of transport.
- The aviation industry has ambitious targets to reduce CO<sub>2</sub> emissions, why Denmark is investing to promote sustainable aviation fuels.



# Utilities

## Hydrogen network

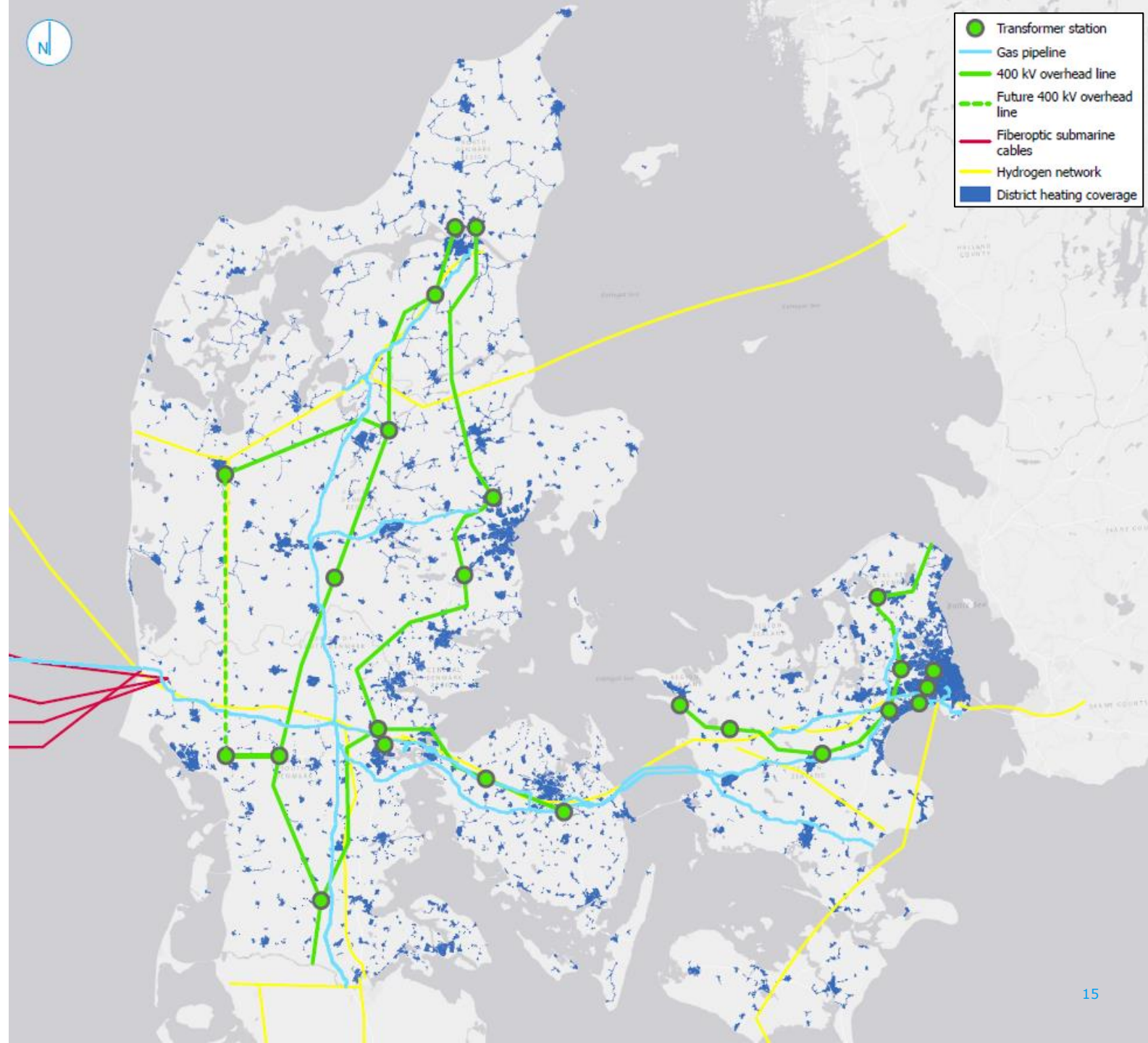
- Denmark's hydrogen network is a key part of the country's green energy transition as it will enable the production, storage and transport of green hydrogen.
- The network will also support the development of new industries, such as e-fuels, and facilitate the integration of renewable energy sources like offshore wind into the energy system.
- The hydrogen network covers most of Denmark and it is connected with export possibilities to Norway, Sweden and Germany.

## Power grid

- Denmark has a highly reliable and efficient power grid, where most of the energy supply consists of renewable energy sources.
- Denmark is an energy hub which expects to invest heavily in green energy infrastructure. The result is that there will be an increase in power stations and cables over the coming years.
- Several fiberoptic submarine cables are coming into Denmark from the west, which are ideal for data centres.

## District heating coverage

- 66% of Danish households are heated by district heating.
- District heating systems are highly efficient, with efficiencies up to 90%.
- District heating systems significantly reduce greenhouse gas emissions compared to individual heating systems by allowing the use of renewable energy sources.







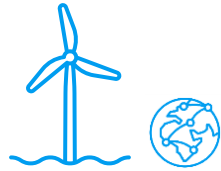
# VARDE IN-DEPTH REVIEW

# 03

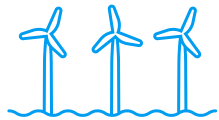




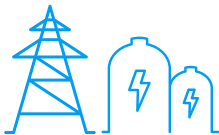
# Business region Esbjerg/Varde is a green energy hub



Business region Esbjerg/Varde is globally one of the most **advanced and promising destinations within the green energy transition** and is an integral partner in the World Energy Cities Partnerships.



**80% of the offshore wind capacity** installed in Europe was shipped from the port of Esbjerg. **In 2022 alone, 23.6 GW of offshore wind** was shipped out from the port. The vast amount of wind energy provides positive spillover effects toward developing the green energy infrastructure in the region.



Denmark was ranked as the **best country in the world to locate a data centre** by Investment Monitor in 2020. And in Denmark, business region Esbjerg/Varde is the most attractive location as the region is the **subsea cable landing hub for the US, UK/IRL and NL.**



The region possess a **highly skilled and experienced workforce within all aspects of the energy sector.** Furthermore, business region Esbjerg/Varde offers **excellent educational opportunities with 60 higher education programs** at six higher educational institutions. These programs include energy technology, engineering and business administration in energy management at university level.

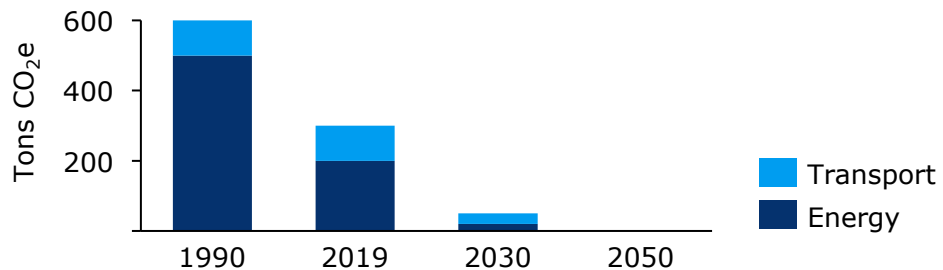


# Varde's ambitious climate action plan makes it an attractive destination for investors in green energy-intensive industries

## Varde climate ambitions

- Varde has an ambition to help redeem the goals of reducing global greenhouse gas emissions and limiting the global average temperature increase to 1.5°C, aligned with the Paris Agreement.
- Varde aims to reduce greenhouse gas emissions by 70 per cent by 2030 and to be utterly climate-neutral by 2050, which meets the ambitions of the Paris Agreement.
- Varde has set ambitious targets to reduce greenhouse gas emissions in the energy sector by 90% and in the transport sector by 70% by 2030 compared to 1990 levels.
- Varde aims to promote renewable energy production, focusing on solar, wind and biogas plant while improving energy efficiency and infrastructure.
- Varde aims to reduce transport-related CO<sub>2</sub> emissions by enhancing the green fuel infrastructure within the municipality.

**Varde's target for reducing greenhouse gas emissions**



## Varde climate action plan

In October 2022, Varde Municipality received the C40-certification as proof that its climate action plan is ambitious enough to help redeem the goals of reducing global greenhouse gas emissions.

In the energy sector, Varde's climate action plan includes the following:

- **Phasing out all oil and gas boilers:** Varde will phase out all oil and gas boilers and have these replaced with a sustainable heat source by 2030.
- **Fossil fuel-free district heating:** Varde will support the district heating companies in transitioning district heating to become 100 per cent sustainable. Varde further plans to identify new district heating areas that can be connected to the district heating network.
- **Expansion of renewable energy sources:** Varde plans to construct 200 ha solar panels (equal 0.1125 TWh) and 3-4 windmills (equal 0.069 TWh) annually until 2028. Furthermore, it wants to attract PtX companies to store renewable energy.
- **Carbon capture and storage:** Varde aims to develop several Carbon capture and storage projects from waste incineration in collaboration with Energist.
- **Sustainable business growth:** Varde will promote dialogue with companies on energy and resource consumption and improve the green fuel infrastructure. To enable the corporate green transition, Varde has established Green Network Varde.

# Varde is at the epicentre of Europe's new economic powerhouse

## The North Sea is at the center of European renewable energy

The business region Esbjerg/Varde, located strategically in the North Sea, holds immense potential for renewable energy generation, making it an enticing choice for investors interested in wind power projects. The North Sea region has become increasingly attractive to investors looking to invest in green energy infrastructure, thanks to the significant capacity for wind power that is being auctioned off and scheduled for development in the coming years.

The region has emerged as a thriving hub for the offshore wind industry, playing a vital role in assembling a majority of turbines in Europe's coastal regions. The region has set ambitious goals for itself, aiming to install 150 gigawatts (GW) of offshore wind power by 2050, and this target has recently been increased to 260 GW. Such ambitious goals create a wealth of investment opportunities in offshore wind farms.

What further adds to the appeal of the region is the successful transition it has made from serving the fossil fuel industry to becoming a key player in the wind power sector. This shift positions the region as an attractive location for investors seeking sustainable ventures and aligning their investments with the growing demand for renewable energy sources.

In addition to wind power, the region's attractiveness extends to the data centre industry. The development of a renewable-powered data centre and the laying of cables for international data traffic have further enhanced the region's appeal to investors in this sector. The region's low electricity prices and cold climate also make it cost-effective to store and process data while leveraging outside air for cooling data centres.

The demand for energy storage solutions is also on the rise. Power-to-x facilities that can convert excess wind energy into green hydrogen, ammonia or methanol are in high demand. These liquid e-fuels are essential for facilitating the green energy transition within the transport sector and play a vital role in achieving sustainable and eco-friendly transportation.

Furthermore, the potential of the North Sea region goes beyond energy production alone. Plans for "energy islands" are in the works, which would aggregate electricity from multiple sources and produce hydrogen and facilitate carbon capture and storage (CCS) projects. These ambitious plans present even more investment opportunities and emphasise the region's commitment to advancing green technologies and combating climate change.

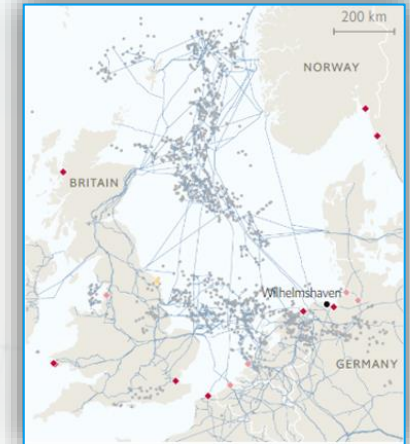
In conclusion, business region Esbjerg/Varde's strategic location in the North Sea, its thriving offshore wind industry, the transition to sustainable ventures, the development of renewable-powered data centres, and the overall potential for green energy production make it an attractive choice for investors. The region's commitment to technological advancements, falling costs and innovative energy solutions further enhance its appeal, positioning business region Esbjerg/Varde as a prime investment destination for those seeking opportunities in renewable energy and data centre industries.

## Energy Infrastructure development

### 'Old' North Sea energy infrastructure

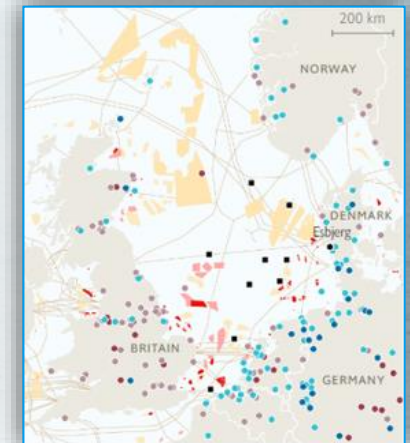
Oil and gas pipelines\* Oil- and gasfields  
LNG import terminals  
● Operating ● Under construction or planned  
● Speculative

\*Operating, under construction or planned  
†To host wind-farm repair staff, aggregate electricity and produce hydrogen in bulk  
Sources: Rystad Energy, SINTEF, TeleGeography



### 'New' North Sea energy infrastructure

Offshore wind farms  
■ Operating ■ In progress or application  
■ Concept or development/auction areas  
Hydrogen-electrolyser projects  
● Operating ● In progress or application  
Carbon-capture projects  
● Operating ● Under development or planned  
— Submarine cables\* ■ Energy islands† (planned)





# Varde has an efficient infrastructure to support the development of the green energy infrastructure

## Varde infrastructure

### Highways



The highway infrastructure is well connected with Copenhagen (3 hours), Hamburg (3 hours), and the rest of Europe. With a mobile labour force, it will not be an issue to attract qualified labour.

### Railways



There is a well-developed railway network in Varde which is connected to the Port of Esbjerg. Hence the municipality is an attractive for companies that wish to align with EU's TEN-T strategy.

### Industrial ports

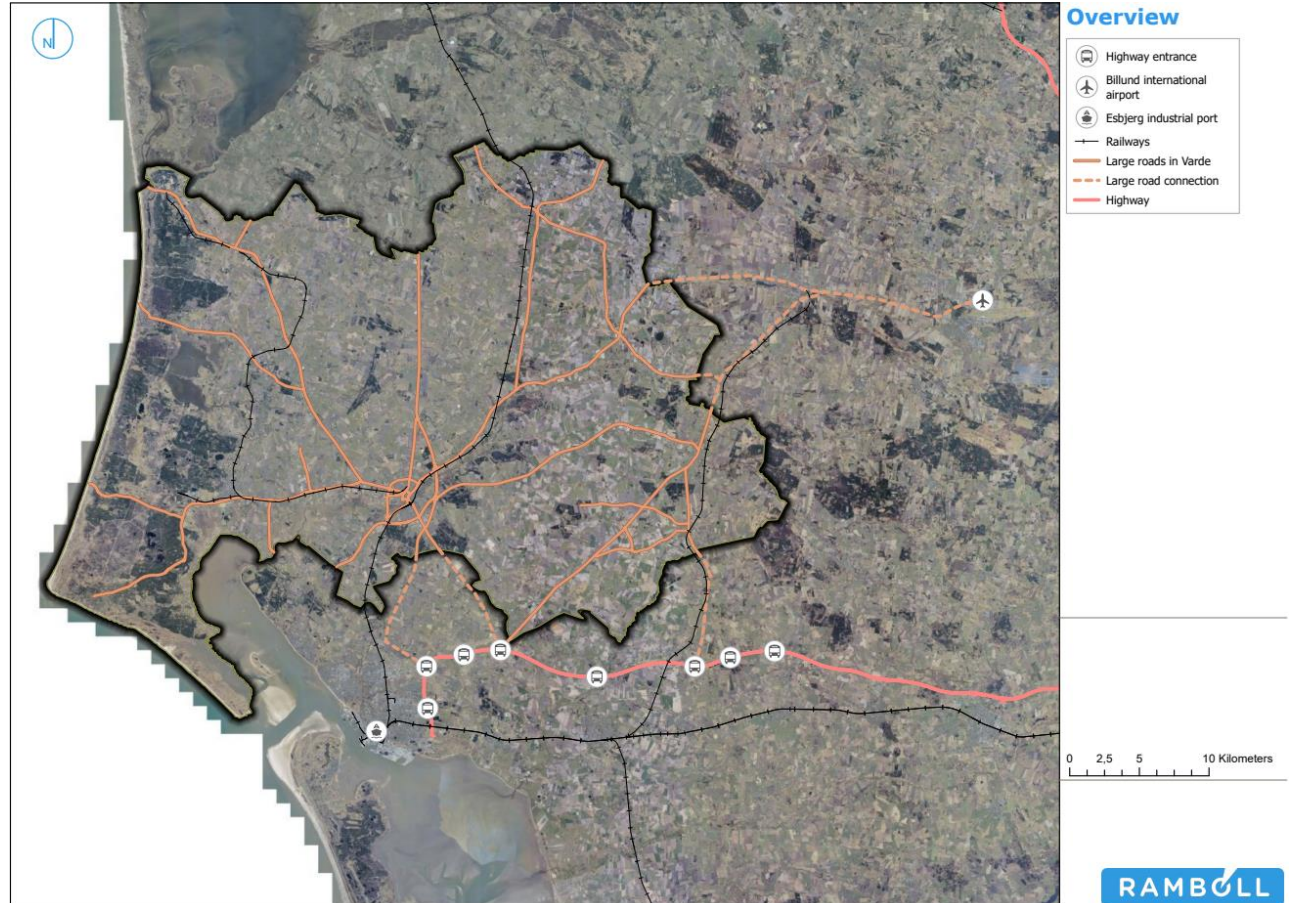


80% of the offshore wind capacity installed in Europe was shipped from the port of Esbjerg. Hence, the port is also fully capable port handle all necessary import and export.

### International airports



Billund international airport is only 40 minutes away, why living and working in Southern Denmark means having access to the rest of the world.



# Varde possess a best in class utility network to assist the green energy transition

## Varde utilities

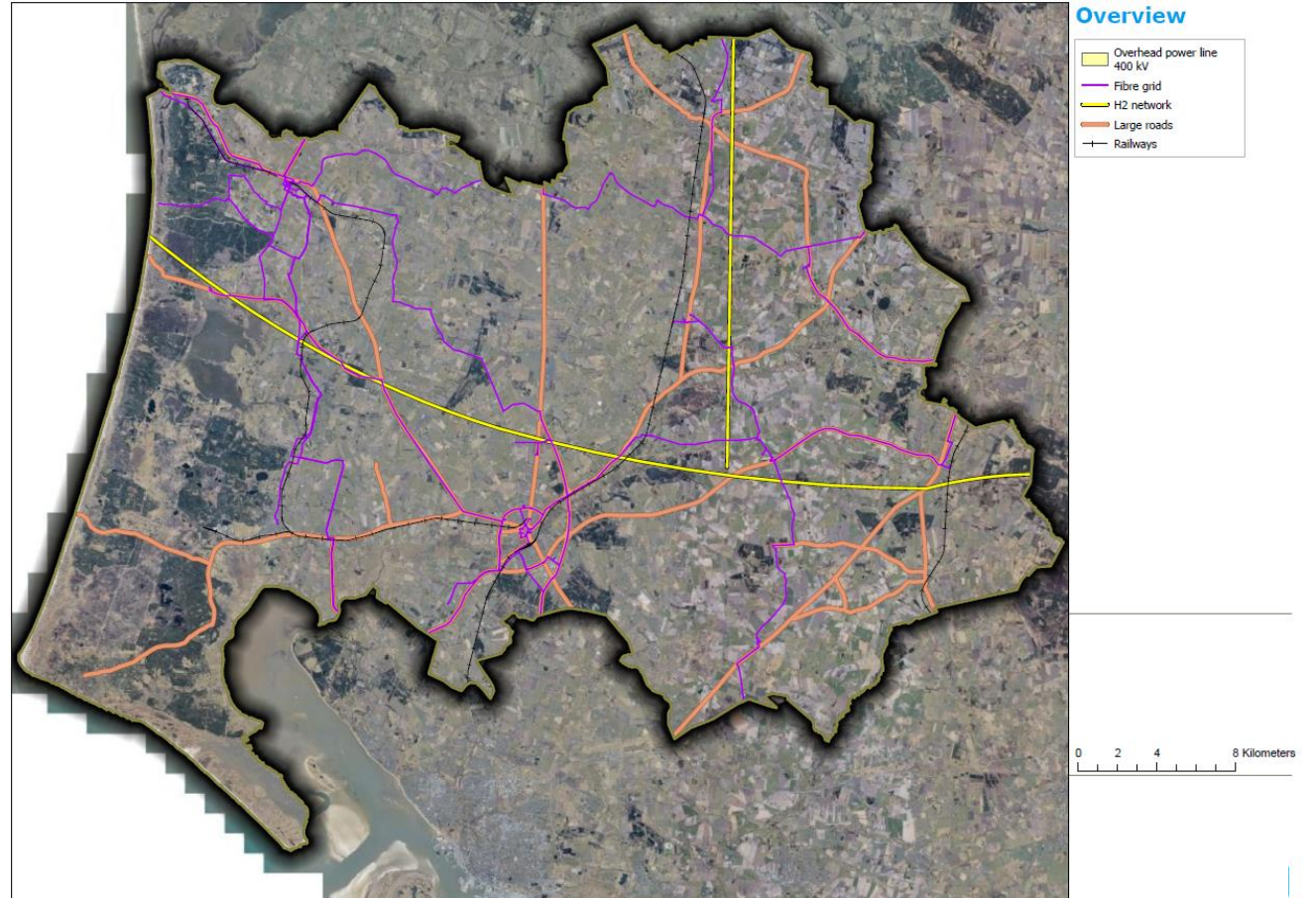
Varde offers an exceptional utility network and attractive investment opportunities for foreign investors seeking to capitalise on the green energy sector. The Danish Transmission System Operator (TSO), Energinet, has partnered with the business region Esbjerg to drive Denmark's green energy transition. As part of this commitment, Energinet is constructing new transformer stations in Varde, resulting in a resilient power grid with nearby stations that ensure a reliable energy supply.

A key advantage of investing in Varde is the planned hydrogen backbone that will span across the municipality. This infrastructure development positions Varde as an excellent destination for the Power-to-X industry, enabling the large-scale production of green hydrogen and facilitating the growth of innovative energy conversion facilities.

Furthermore, Varde is home to several biogas entities, which provide crucial support to the Power-to-X sector. These entities utilise organic waste for green energy production, contributing to a circular economy and enhancing the sustainability of the region's energy landscape.

Varde's unique advantages extend to the placement of data centres. The municipality serves as the landing hub for subsea connections to the UK, Ireland, and the US, providing an ideal gateway for international data connectivity. Moreover, Denmark's cool climate offers a natural advantage for data centres, as it allows for free air cooling, reducing energy consumption and operational costs.

In addition to its utility infrastructure, Varde boasts an extensive fibre grid, a prerequisite for the establishment of battery factories. This positions the municipality as an attractive destination for investors looking to capitalise on the growing demand for energy storage solutions.





An aerial photograph of a high-voltage power line tower situated in a lush green forest. The tower is a lattice structure, and several power lines extend from it across the scene. The shadows of the tower and lines are cast onto the grassy ground. The text 'GENERAL SECTOR COUPLING' is overlaid in white, bold, sans-serif font on the left side of the image.

# GENERAL SECTOR COUPLING

04

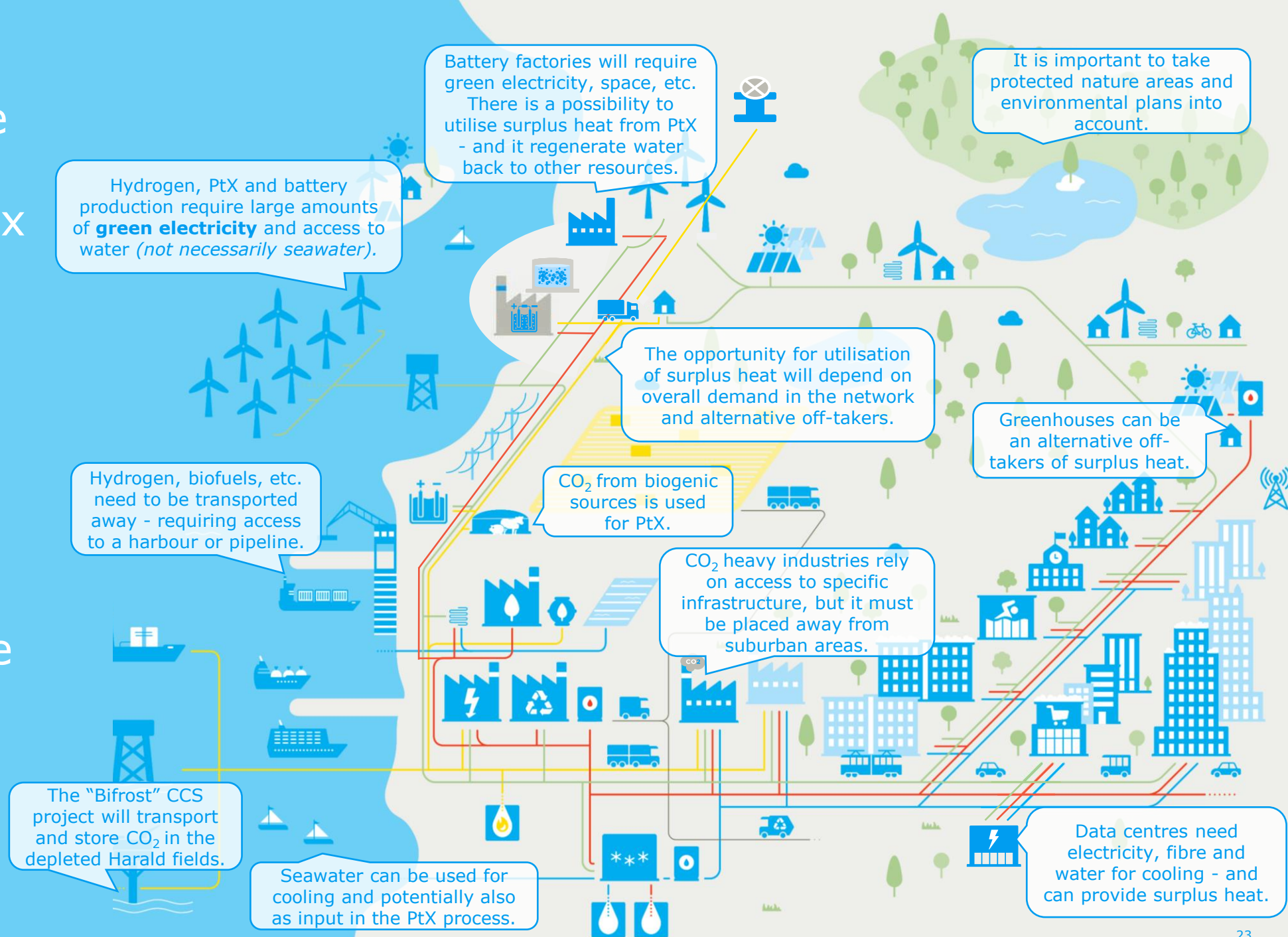


Energy-intensive companies are part of a complex system...

The symbiotic effects and limitations have been taken into account when selecting the site location

Red = Heat  
Blue = Cooling  
Yellow = CO<sub>2</sub> and gas  
Green = Electricity

Ramboll





# Several synergies can be utilised through sector coupling energy-intensive industries

## Power-to-X (PtX)

### Description & Output:

PtX technology converts water into oxygen and green hydrogen through electrolysis via renewable energy. The green hydrogen can either be used directly as a substitute for natural gas, or synthesised into different forms (x) through chemical processes. Common forms are methane, methanol and ammonia. PtX plays an instrumental part in decarbonising the production and consumption of energy.

### Synergies:

PtX offers synergies across industries by integrating with district heating networks and providing surplus heat. PtX supplies renewable process heat to industries. PtX serves as energy storage, enabling the use of E-fuels to decarbonise transportation. And PtX can fertilise the agricultural sector through CO<sub>2</sub> free ammonia. These synergies effectively reduce CO<sub>2</sub> emissions and enhance energy efficiency.



## Data centres

### Description & Output:

A data centre serves as a space for essential IT infrastructure, enabling the creation, operation and delivery of applications and services. It also handles data storage and management. A typical Hyperscale data centre specifically generates substantial computing power, storage capacity and network bandwidth to fulfil the rigorous demands of cloud computing and high-performance applications.

### Synergies:

Similar to PtX, data centres also offer synergies across industries, as they provide surplus heat to the district heating network or process heat to various industries. Data centres generally play a positive part in the green energy transition, as they add renewable energy to the energy mix through PPAs setting an example to follow for other industries.



## CO<sub>2</sub>-heavy industries

### Description & Output:

CO<sub>2</sub>-heavy industries can take various forms, where the CO<sub>2</sub> differentiates between green and black CO<sub>2</sub> depending on the origin. Green CO<sub>2</sub> originates from point sources burning biomass such as biogas upgrading plants, bio-ethanol plants, biomass power plants and waste-to-energy plants. Black CO<sub>2</sub> originates from point sources burning fossil fuels such as power plants, cement plants, or refineries.

### Synergies:

There are strong synergies between CO<sub>2</sub>-heavy industries and PtX facilities. PtX is dependent on CO<sub>2</sub> as input in order to store and form the green hydrogen into different E-fuels or gasses. Green CO<sub>2</sub> from biogenic sources is preferable, but the existing power plant at Nybro is an attractive point source for PtX facilities with accessible CO<sub>2</sub> within close proximity.



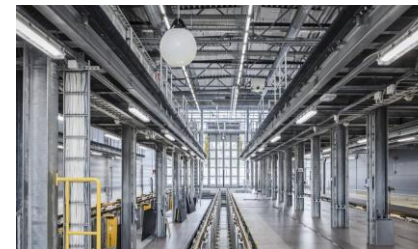
## Battery factories

### Description & Output:

A battery factory is a manufacturing facility that produces rechargeable lithium-ion batteries, primarily for electric vehicles. A modern battery has an estimated output of ~17,000 electric vehicles per year for every 1 GWh of production. In addition, the batteries can be used for portable electronics and renewable energy storage systems.

### Synergies:

A battery factory generates industrial synergies that contributes to the renewable energy systems. The production of batteries generates green surplus heat, given that the battery factory is powered by green electricity, that can be used in the district heating network. Battery factories can also utilise surplus heat and regenerate water back to other resources



## Greenhouse farming

### Description & Output:

Greenhouse farming cultivates crops in controlled structures, allowing farmers to regulate temperature, humidity and sunlight. It can produce various products like vegetables, fruits, plants and flowers. As the world's population increases, greenhouse farming will become instrumental for global food production.

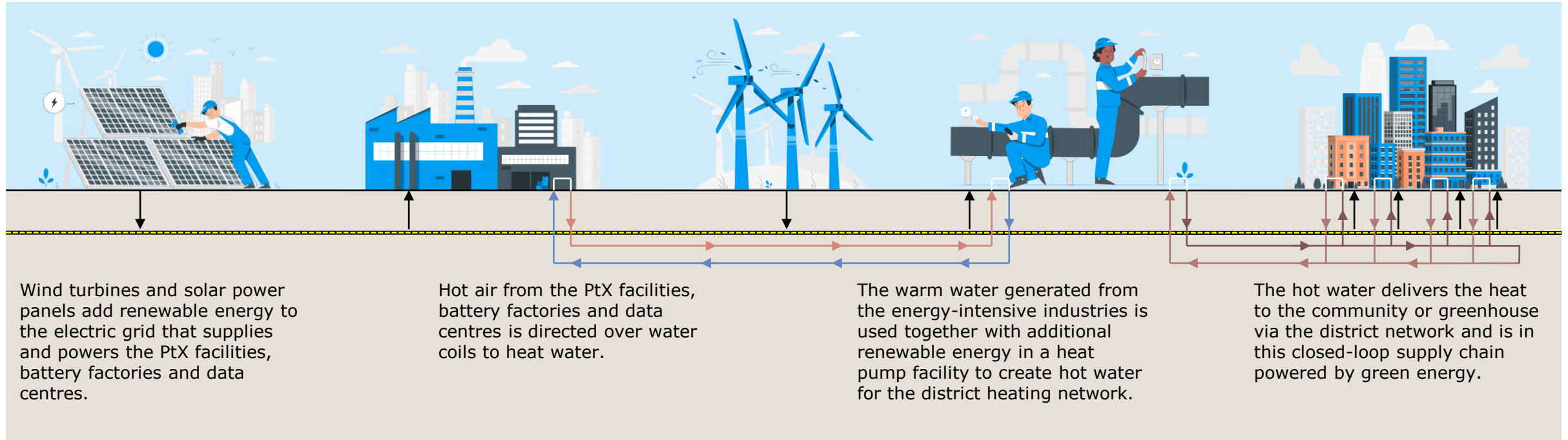
### Synergies:

Greenhouses provide an excellent solution for utilising the surplus heat generated by energy-intensive industries. Moreover, PtX facilities and greenhouses have synergistic benefits, as the ammonia produced by PtX can be conveniently used as fertiliser without requiring extensive transportation.



# Sector coupling the energy-intensive industries provides Varde with a unique surplus heat infrastructure

*Sector coupling, directly integrating energy-intensive industries with green energy sources, offers a remarkably climate-friendly solution for heating municipalities. In Varde, there will be abundant green energy and energy-intensive industries. This unique combination enables Varde to harness the surplus heat generated by green energy.*







**INDIVIDUAL SITE  
SELECTION & SECTOR  
COUPLING**

**05**



# Overview of selected sites

## Sector coupling of selected sites

The symbiotic effects between the various energy-intensive industries have been carefully considered when identifying the site locations. The chart to the right shows all the identified site locations for the respective industry types. Below are some key considerations highlighted for determining the site locations for the various industries.

### PtX:

The sites are ideally located close to the H<sub>2</sub> and CO<sub>2</sub> backbone. They should further be located close to the district heating network to utilise the generate surplus heat. And lastly, they should also be near a transformer station and water plant.

### Data Centres:

The sites must be located near the fibre grid. Similar to PtX, data centres should also be located near the district heating network and transformer stations.

### CO<sub>2</sub>-heavy industries:

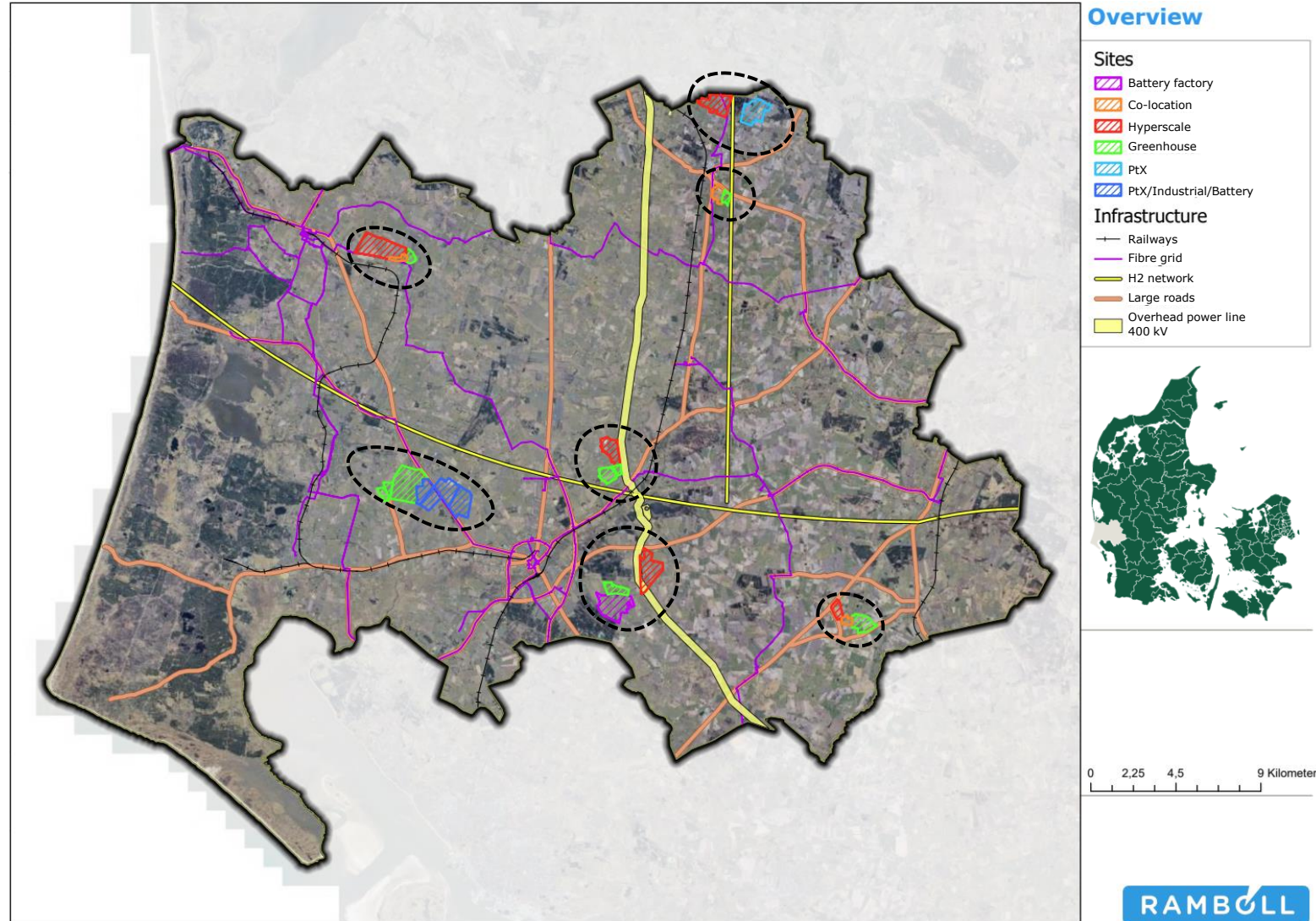
There are strong synergies between CO<sub>2</sub>-heavy industries and PtX facilities, which is why these should preferably be closely located. Furthermore, there are excellent CCS possibilities near Nybro due to the "Bifrost" project.

### Battery factories:

The sites must be located close to the district heating network. The sites require an efficient surrounding infrastructure. And they should have access to green energy.

### Greenhouses:

The sites should be located close to sites generating surplus heat. They must be located near the district heating network and have access to renewable energy.





# Overview of 69 ha PtX/Industry/Battery, Grønnevej 65

## Site summary

### Utilities:

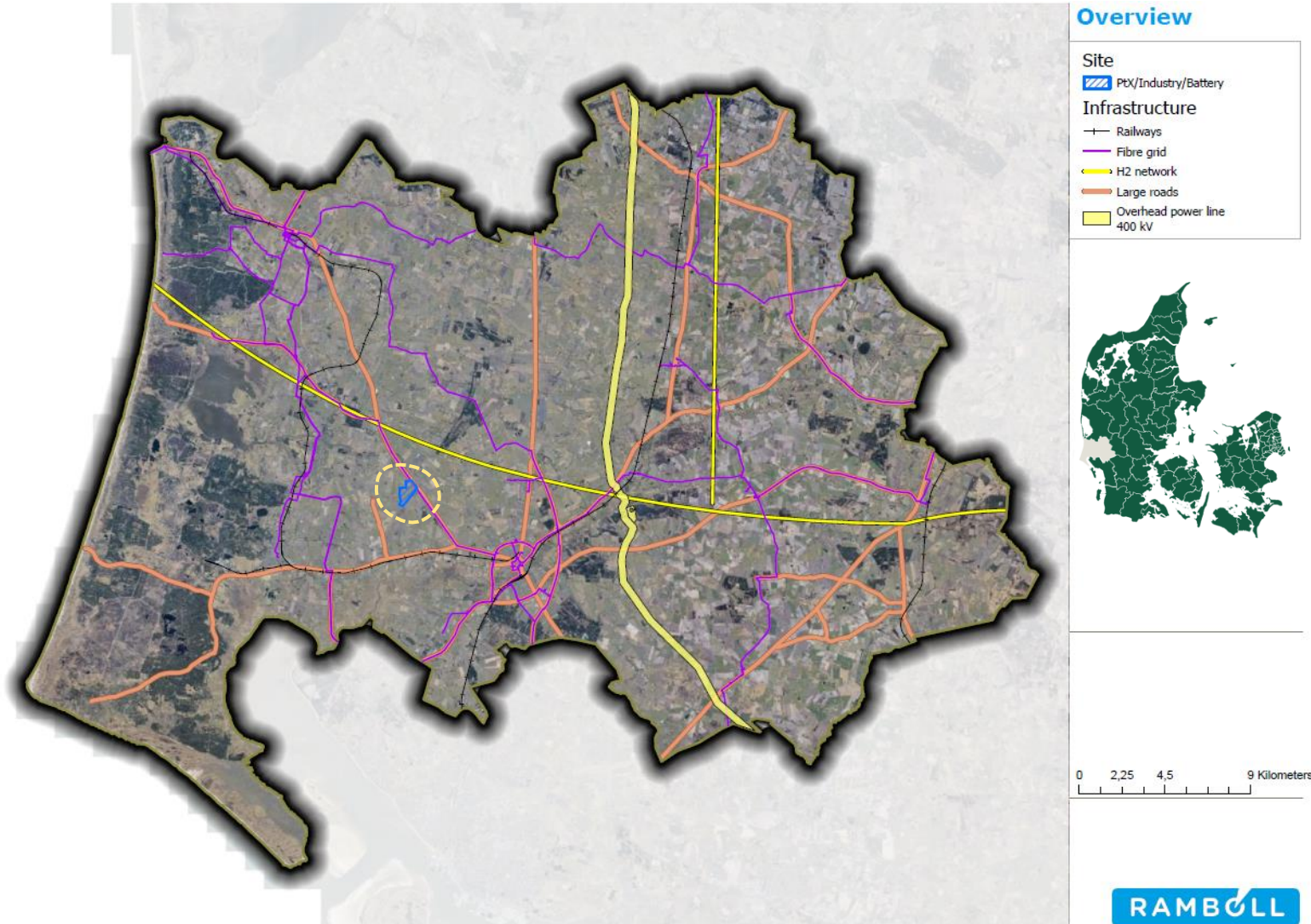
It is a highly promising site due to the presence of an H<sub>2</sub> and CO<sub>2</sub> backbone, which makes it particularly appealing for PtX facilities and CO<sub>2</sub>-reliant industries. To support the development of energy-intensive industries, Energinet and Varde municipality have strategic plans to potentially build a new transformer station in this area. The site offers convenient access to ultrapure and technical water from the Outrup water plant, which is needed for cooling and electrolysis. The site is also attractive for CO<sub>2</sub>-heavy industries due to the CO<sub>2</sub> backbone and the "Bifrost" CCS project. And lastly, it could also be relevant for battery factories due to the size of the site and surrounding utility network.

### Protected areas:

The chosen site does not overlap with any protected areas, making the entire site suitable for the placement of energy-intensive industries. To further enhance conservation efforts, clustering these industries is recommended, as it preserves the usage of natural protected areas that could otherwise be affected if the sites were scattered. However, it is important to note that the site does overlap with nitrate-sensitive extraction areas, as indicated by the groundwater map.

### Land ownership and suburban areas:

The identified land is far from neighbours and can be acquired at a low cost per square meter. There are ample non-residential areas within the site and expectedly low transaction costs for purchasing the site.





# Utilities

## Positive attributes

- This site is nationally highly attractive, especially for PtX facilities, due to the planned presence of an H<sub>2</sub> and CO<sub>2</sub> backbone.
- Energinet and Varde municipality plan to potentially build a new transformer station in this area to support the development of energy-intensive industries.
- The site's strategic location provides convenient access to ultrapure and technical water from the Outrup water plant, which can be utilised for cooling and electrolysis. Varde municipality has close collaboration with Din Forsyning, which has relevant experience building PtX facilities in Esbjerg municipality.
- The site holds promising possibilities for CCS and CCUS due to the "Bifrost" project.
- The power will be supplied by green energy from the energy islands.

## Additional attention points

- The existing transformer station is at full capacity so there will be some lead time before the new transformer station is in place.
- Even though there are planned surrounding greenhouses, the energy-intensive industries will generate more surplus heat than what is demanded in the area. Consequently, it can be costly to discard the surplus heat.





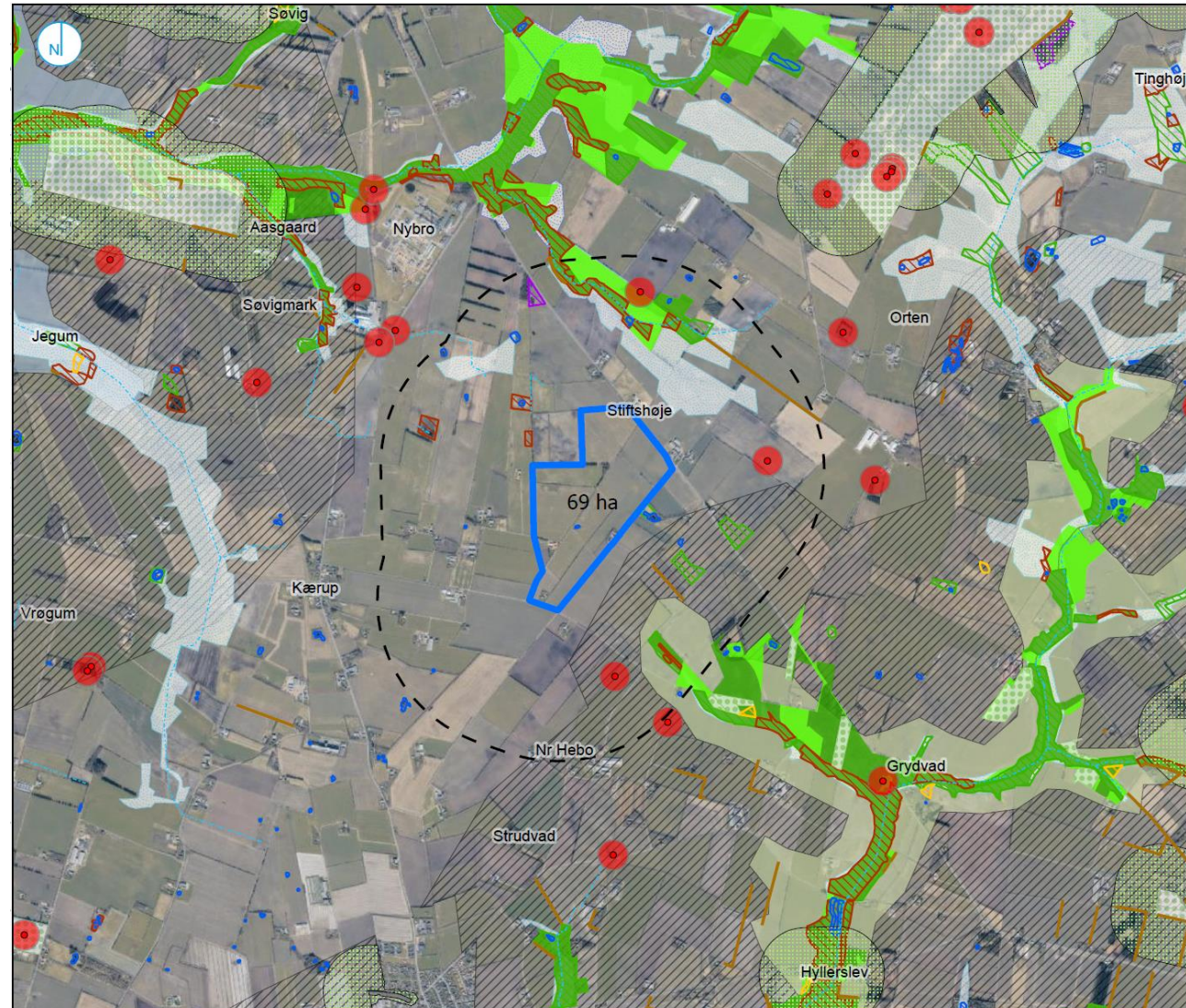
# Protected areas

## Positive attributes

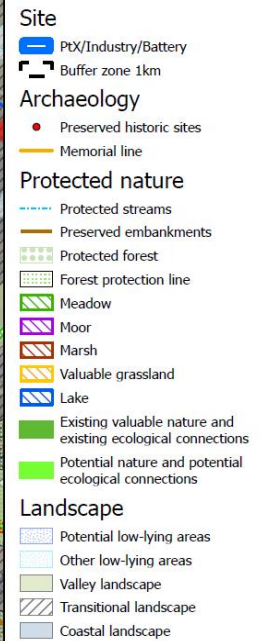
- Integrating protected nature areas in site selection for energy-intensive industries like PtX facilities, battery factories and CO<sub>2</sub>-dependent factories is crucial. It conserves biodiversity, preserves ecosystems, and promotes sustainable development, ensuring a harmonious coexistence between industry and nature.
- The located site does not overlap with any protected areas, which is why all of the site is relevant for the placement of energy-intensive industries.
- It will be beneficial to place these industries in a cluster to preserve the usage of natural protected areas, which could otherwise happen if the site locations were scattered.

## Additional attention points

- In this overview, there are no relevant attention points. However, as shown in the groundwater map, the site overlaps with Nitrate-sensitive extraction areas and drinking water extraction areas.



## Protected Areas



0 0,25 0,5 1 Kilometers



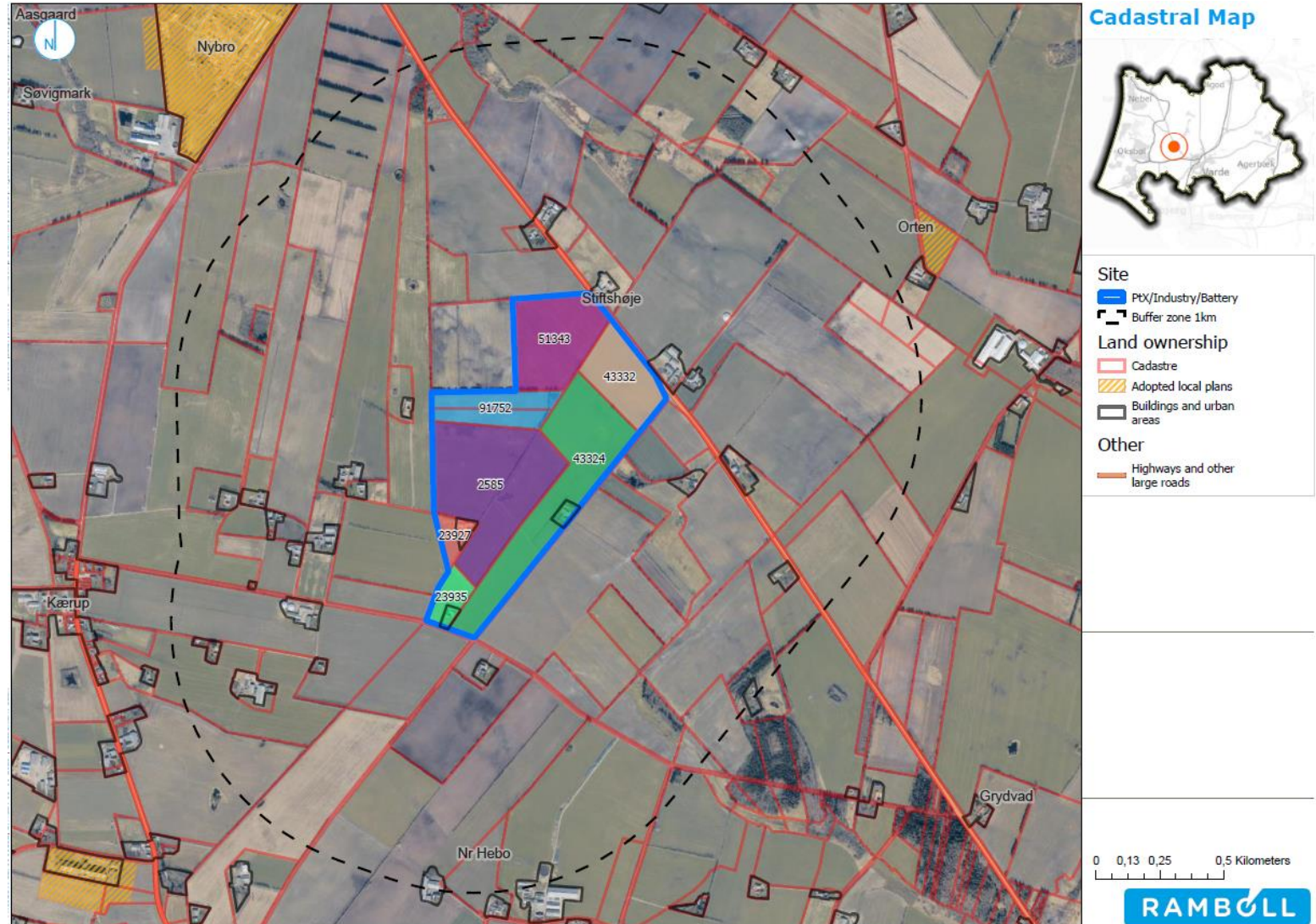
# Land ownership and suburban areas

## Positive attributes

- The identified site only has seven different landowners and three properties, so acquiring the site only entails a few transaction costs.
- The identified land is far from neighbours and can be acquired at a low cost per square meter.
- There are ample non-residential areas within the site and seven different landowners. Hence, there are expectedly low transaction costs for purchasing the site.

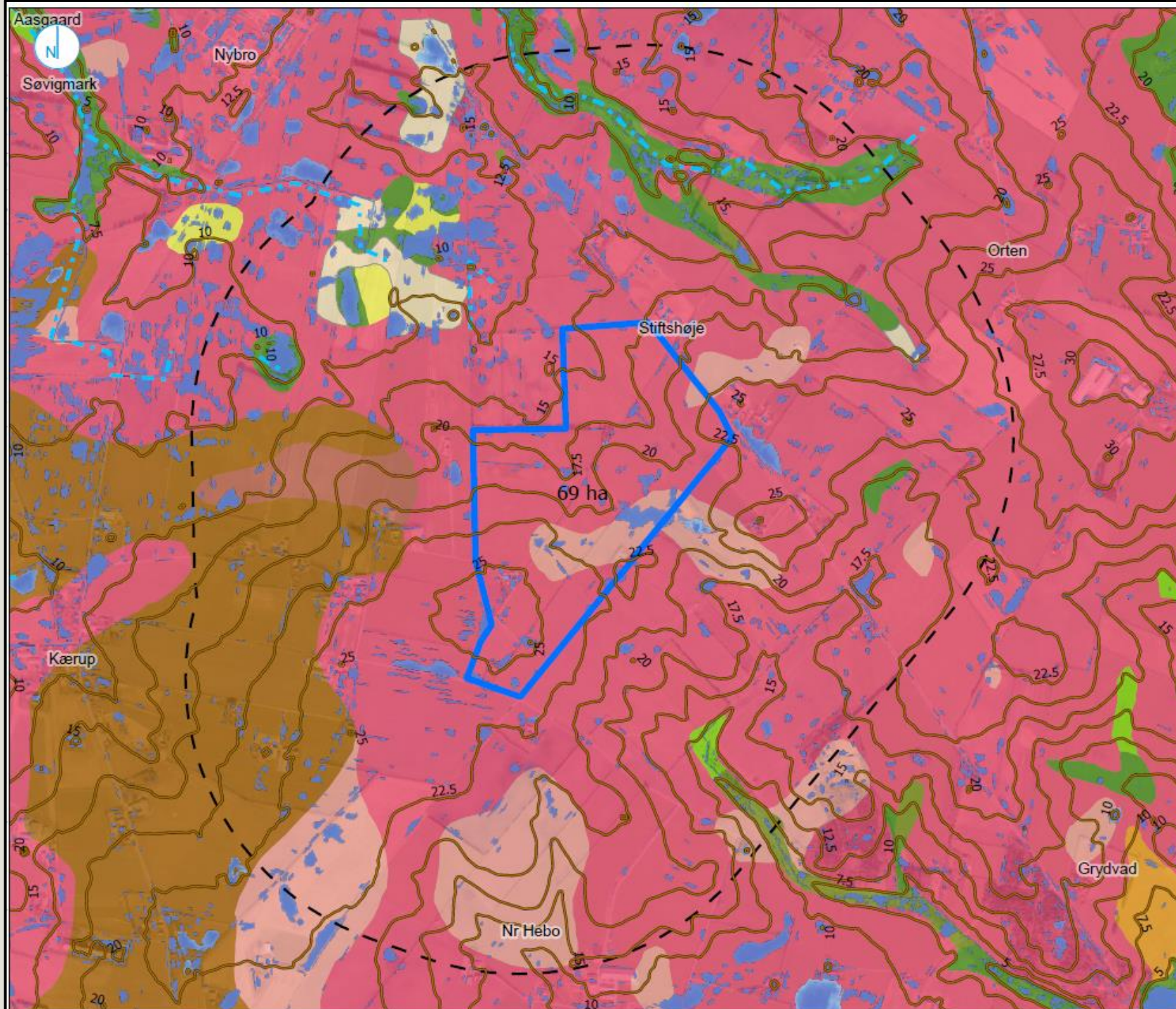
## Additional attention points

- The identified site is far away from the district heating network, why it can be costly to get rid of surplus heat.

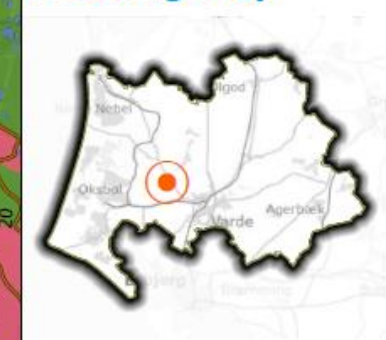




# FLOODING MAP



## Flooding map

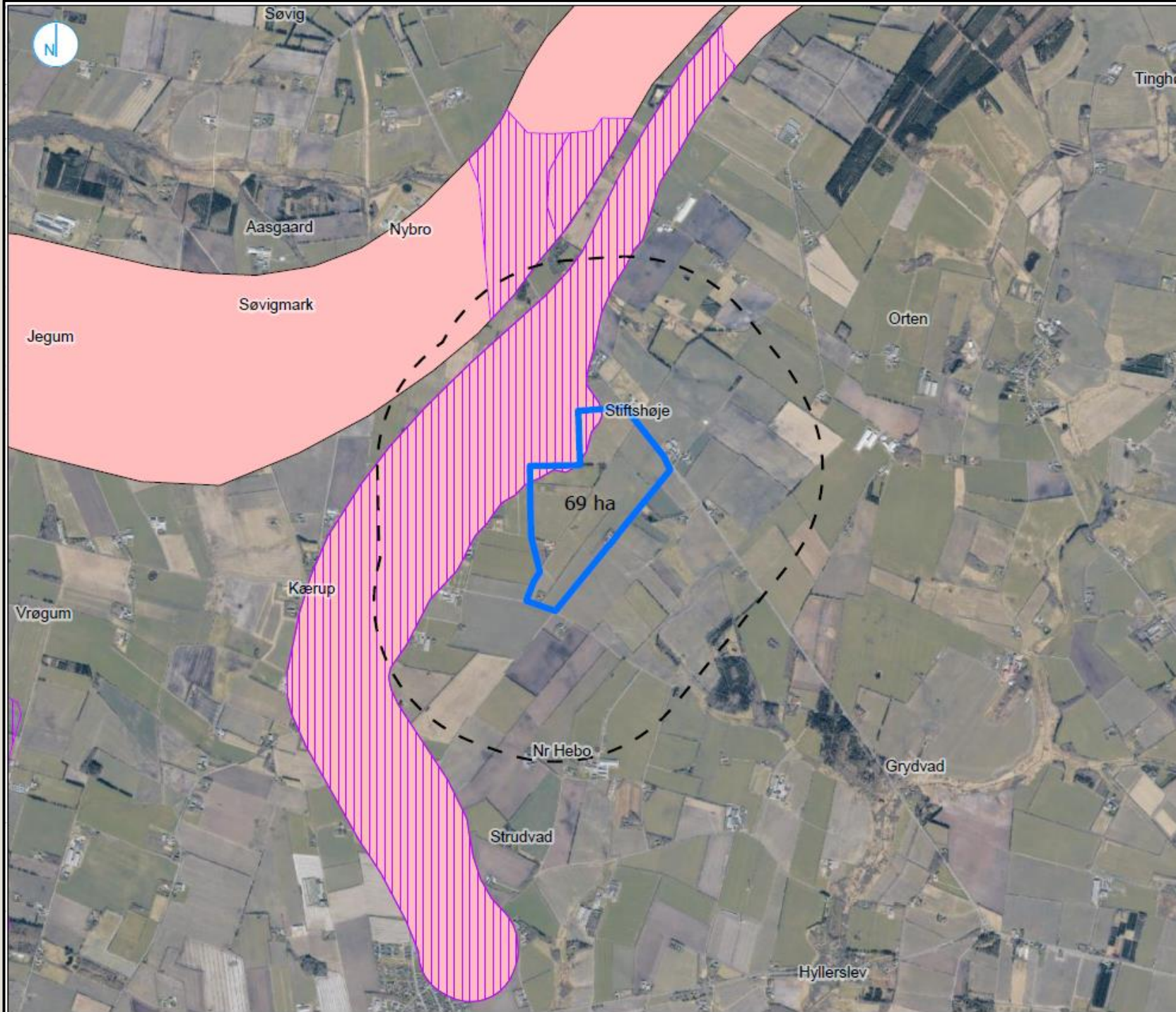


- Site**
  - PtX/Industry/Battery
  - Buffer zone 1km
- Water**
  - Streams
  - 100 year precipitation event
    - Low
    - High
- Topography**
  - Contour lines 2.5 m
- Types of soil**
  - Glaciofluvial clay
  - Glaciofluvial sand
  - Aeolian sand deposits
  - Fresh water pond
  - Fluvial sand deposits
  - Fresh water peat
  - Sandy till
  - Clay till
  - Sand
  - Fresh water
  - Glaciofluvial sand





# GROUNDWATER MAP



## Groundwater



### Sites

- PtX/Industry/Battery
- Buffer zone 1km

### Sensitive extraction areas

- Nitrate-sensitive extraction areas
- Drinking water extraction areas

0 0,25 0,5 1 Kilometers

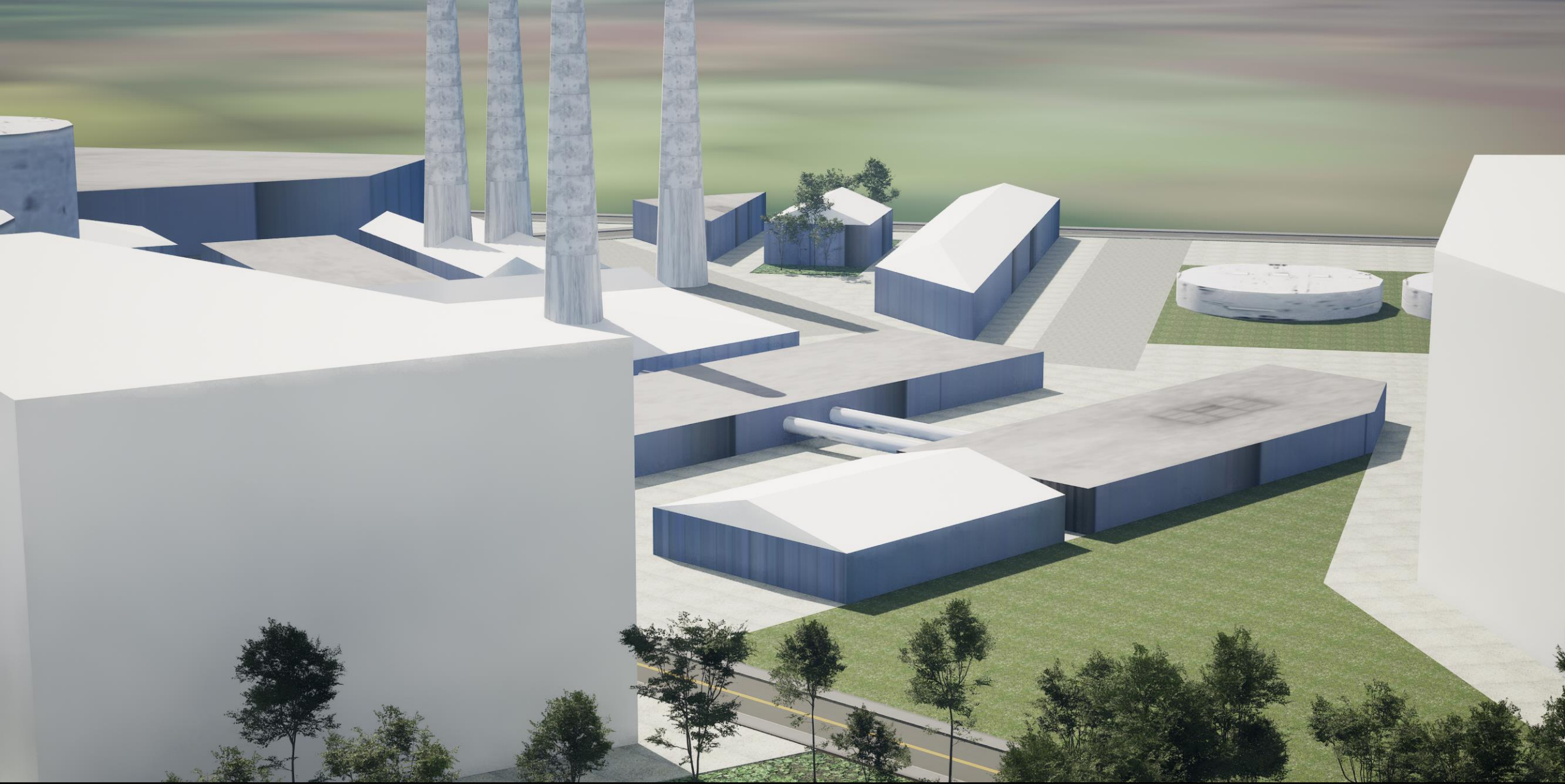






Illustrative example of the site in 3D





Close up example of the site in 3D