EUROPEAN ENERGY

Power-to-X

The Path towards a Sustainable Future

Brønderslev PtX

Integrated VE and e-methanol facility

Denmark

Program

1. Kort introduktion til European Energy
2. Hvad er Power-to-X og hvorfor er det en vigtig teknologi
3. Eksempel på et PtX projekt European Energy er ved at bygge
4. Hvad er det mere konkret European Energy arbejder på i Brønderslev

01
Lidt om European Energy

02
Hvad er Power-to-X

03
Eksempel på PtX projekt under opførelse

04
Brønderslev Energipark og PtX

About European Energy

Svindbæk
32 MW
Denmark

European Energy is built on four pillars

Solar power

Onshore wind

Offshore wind

Downstream technologies

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The European Energy Business Model

Screening

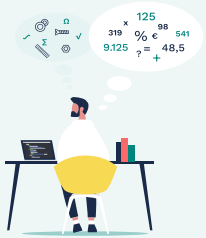
We screen our markets for relevant locations for solar, wind and Power-to-X-facilities, using our bespoke GIS-based IT-tools as well as our local knowledge and network. Based on a careful screening of environmental and technical concerns as well as a mapping of key stakeholders, we enter into a cooperation with the landowners to secure the land for development.

Development

During development we secure the grid and work to obtain the necessary permits. We conduct environmental studies and discuss mitigation measures with key stakeholders. Technical specifications may be adjusted, and hybrid and storage solutions are considered as part of the optimisation of the project. When land, grid and all necessary permits are secured, the project is ready-to-build..

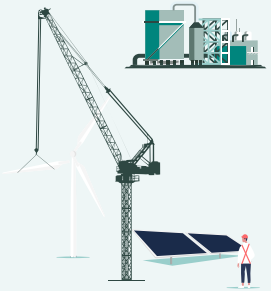
Engineering & procurement

Our design and engineering expertise ensures the strong operational performance of our projects. Our procurement team selects suppliers on the basis of thorough evaluation and closely monitors their delivery. We perform quality management of all our engineering and procurement processes



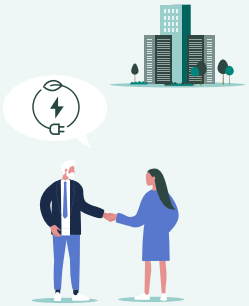
Construction

With rights and permits secured, we continue with procurement, power offtake and financing, before we initiate construction of a project. We have a strong track record for managing contractors and suppliers on-site and, as the final construction step, connect the projects to the grid and produce Power-to-X solutions.



Power Purchase Agreements

Power Purchase Agreements are long-term, fixed-price energy supply contracts. These agreements ensure that we have offtakers for our renewable energy projects. The agreements are often made prior to the construction of a project.



Financing

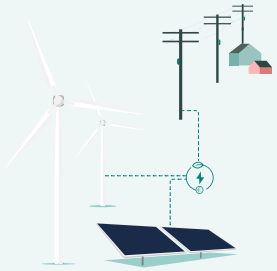
Funding is raised at both parent company and project level. We have a treasury and project financing team that designs and optimises the Group's capital structure, parent funding, liquidity and financial risk management.

Project sales

We assess each project individually and take risk-and-reward profiles into consideration. In some cases, we divest the projects to long-term investors. In these cases, we often continue to manage the assets for the investors, to optimise production output and minimise operating costs.

Power sales

In some cases, it is advantageous for us to retain ownership of a project for a period of time, and sell the renewable power as an independent power producer, or to use the power for production of Power-to-X solutions.



Asset management & operations

We have in-house expertise in the technical, commercial and financial aspects of managing our projects. We also deliver operational services for solar plants, including scheduled preventive maintenance, corrective maintenance, technical support and plant monitoring.

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Facts about European Energy

18

We have offices in 18 different countries

29

We have development activities in 29 countries

635

We are more than 635 employees working at European Energy

10

We have developed operational wind parks in 10 different countries

10

We have developed operational solar parks in 10 different countries

2

We are constructing two Power-to-X plant in Denmark

Growth across the world

We are screening for projects in 29 countries and we have actual development activities in 19 out of the 29 countries. In 2022, we opened 8 new offices, and now have a total of 23 offices across 18 countries.

Home market	Development solar/wind	Construction solar/wind	Operational wind activities	Operational solar activities	Offices
Denmark	■	■	■	■	■
Northern Europe					
Finland	■				
Sweden	■	■	■	■	■
Latvia	■				■
Lithuania	■	■			■
UK	■	■	■	■	■
Estonia					■
Central Europe					
Germany	■	■	■	■	■
Poland	■	■	■		■
Romania	■				■
France	■				
Netherlands	■	■	■		■
Southern Europe					
Italy	■	■	■	■	■
Spain	■			■	■
Greece	■				■
Bulgaria	■		■		■
Croatia					■
Montenegro	■				
Rest of the world					
Brazil	■	■		■	■
Australia	■				■
US	■				□

*Operational activities include power generation and asset management.
We only undertake asset management in markets where we generate power.

Power-to-X

European Energy's value chain approach

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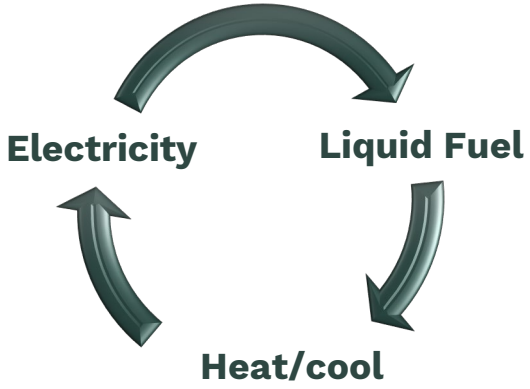
The Future Energy System

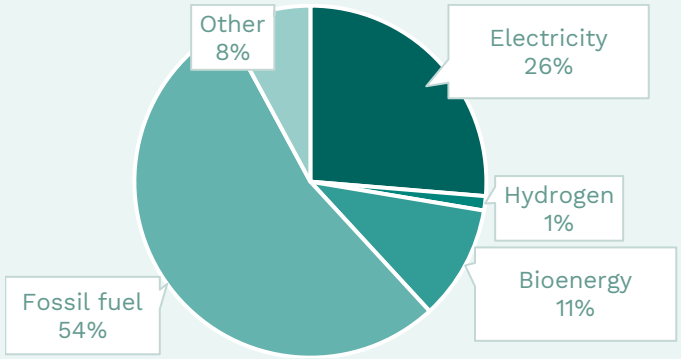
Energy conversion and storage



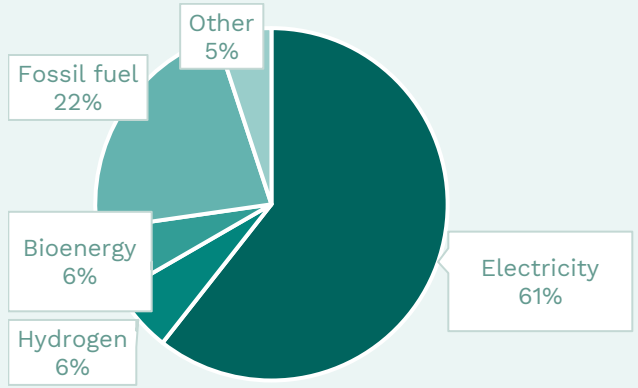
What is Power-to-X and why do we need it?

We need to decarbonize our energy use through both direct and indirect electrification

Total energy consumption in 2020 of 380 mTJ



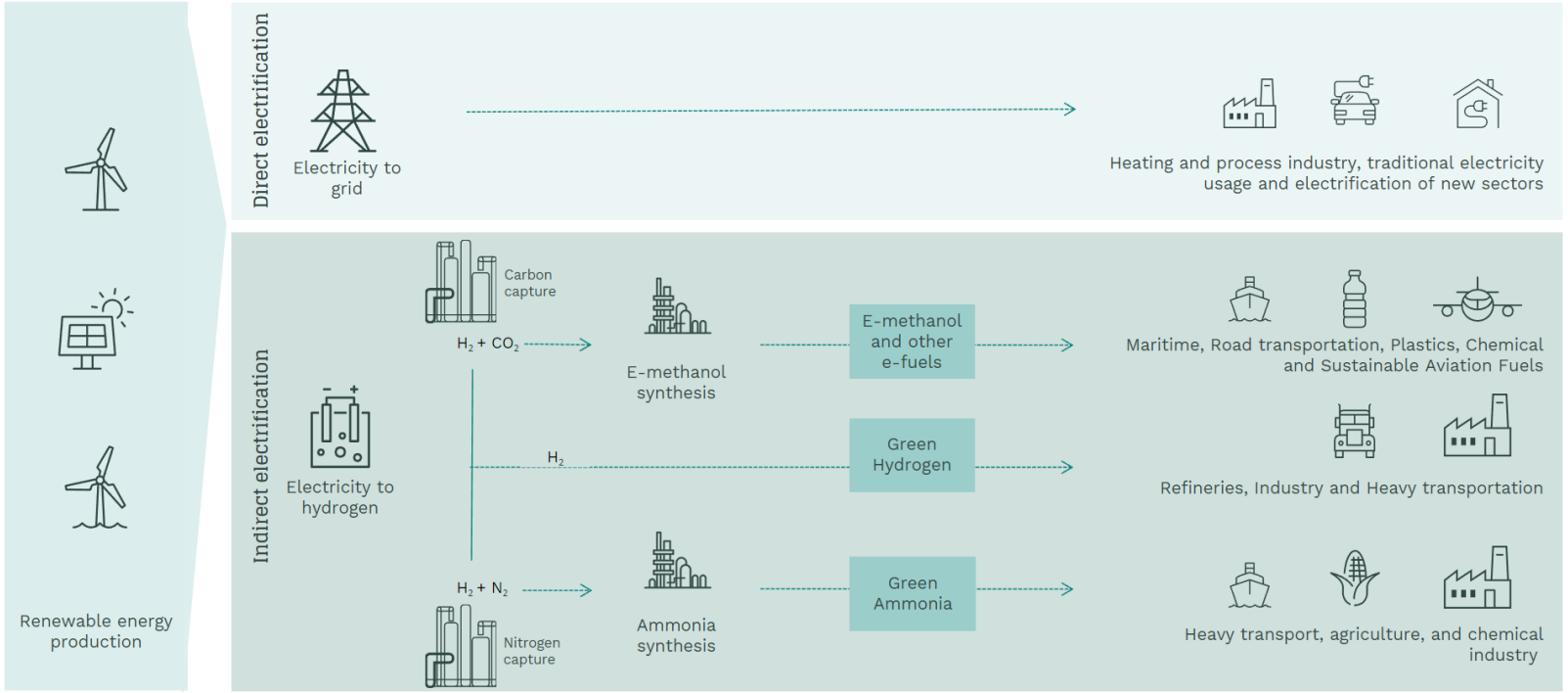
Total energy consumption in 2050 of 495 mTJ



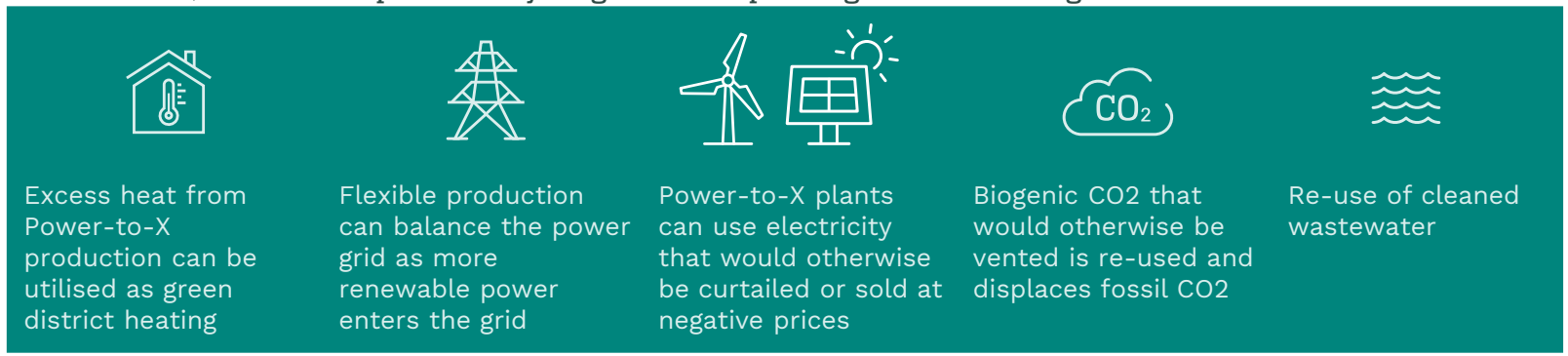
- Global energy consumption expected to grow by ~ **30 %** in 2050
- Share of renewables is expected to reach **~80-90%** in 2050
- This to be driven by doubling electrification and uptake of hydrogen to suppress fossil energy sources by **40%** in 2050

Source: McKinsey, Energy Insight Global Energy Perspective 2022

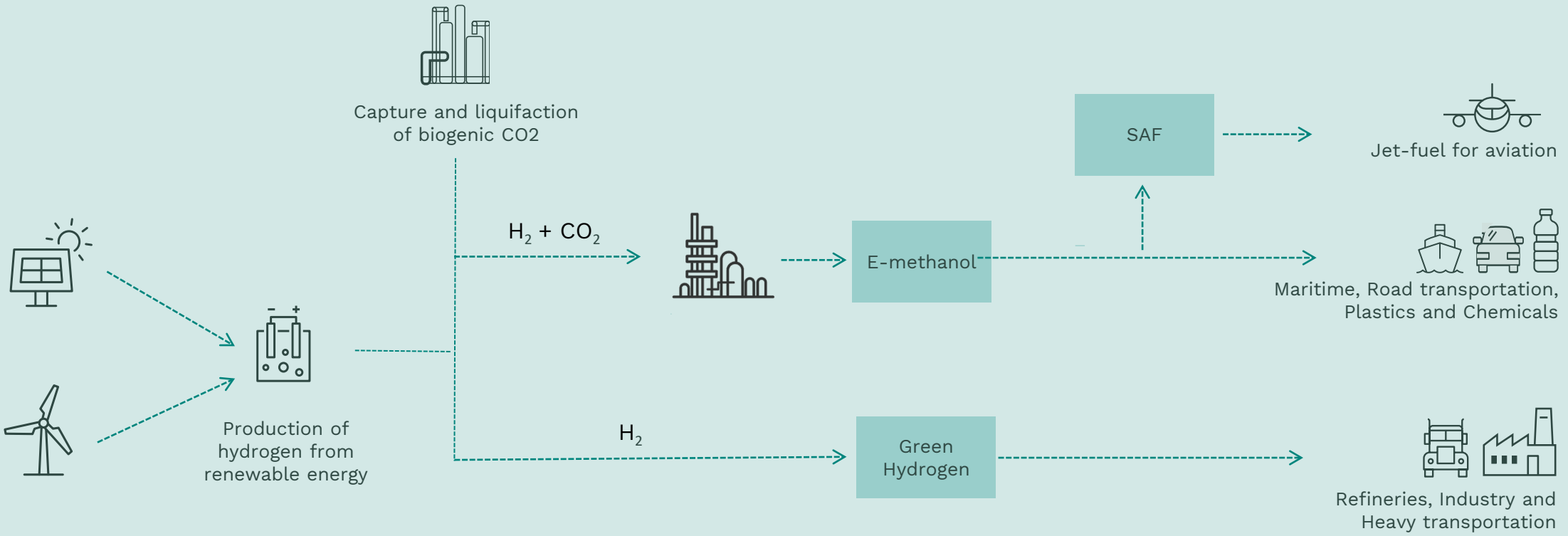
Indirect electrification through Power-to-X allows decarbonization of “hard-to-abate sectors” where direct electrification is not possible



Furthermore, Power-to-X provides synergies to the power grid and heating sector



Power-to-X in European Energy includes the entire value chain from power generation to end-product



Pipeline of + 30 GW worldwide

Different electrolyzer technologies tested at our sites

Our group company Ammongas supplies CO2-capture equipment

We are constructing worlds largest e-methanol plant – see p. 17

We are constructing a hydrogen plant in Denmark – see p. 20

EE will prototype-test methanol-to-SAF production in 2024/25

Significant depth in each part of the value chain

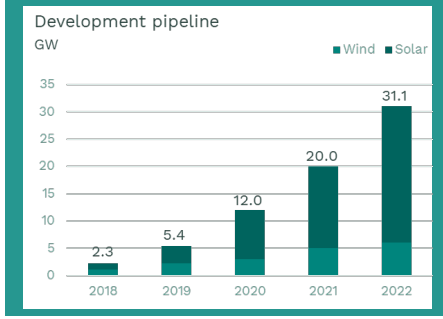
Access to renewable energy

Expert technical knowledge

Practical experience

Wind & Solar power

- Since 2004, European Energy has installed purchased more than 3 GW of wind and solar plants
- In 2023 alone, European Energy has received permits to construct +1.5GW renewable enery
- Pipeline of more than 30GW renewable energy plants in development



Development

- In-house project development and management of project pipeline, economic optimization and prioritization of projects. This includes
  - Evaluation of sites
  - Securing feedstock
  - Stakeholder engagement
  - Public funding
  - Permitting
  - Grid connection
  - Offtake agreements
- Currently, the PtX-pipeline include projects in +10 countries.

Technology

- In-house team of process engineers prepares basic for all plants
- Strategic acquisitions to acquire key competencies within methanol and CO2, e.g.
  - Reintegrate in 2021 (methanol synthesis)
  - Ammongas in 2022 (carbon capture and cleaning technology)

REintegrate

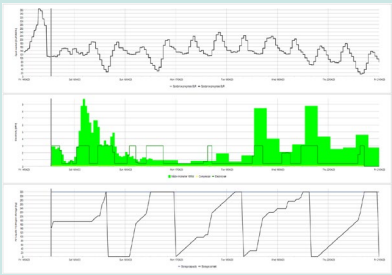
Ammongas

EPC

- Hands-on experience in engineering, procure-ment and construction of Power-to-X plants
  - Contruction of world's largest e-methanol plant in Kassø with COD 2024
  - Construction of green hydrogen plant in Måde with COD 2023

O&M

- In-house operation and maintenance organization to run plants in operation
- In-house developed production scheduler for minimizing production costs and maximizing total plant revenue



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Projects & Pipeline

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Our Danish e-methanol plant

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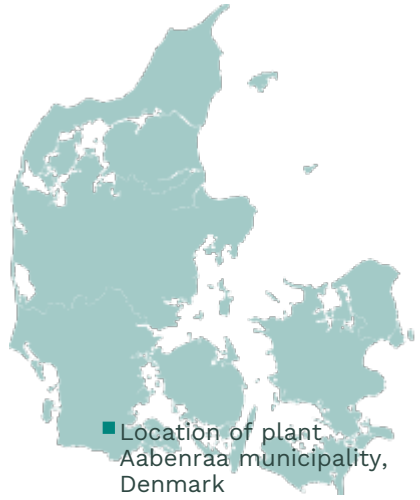
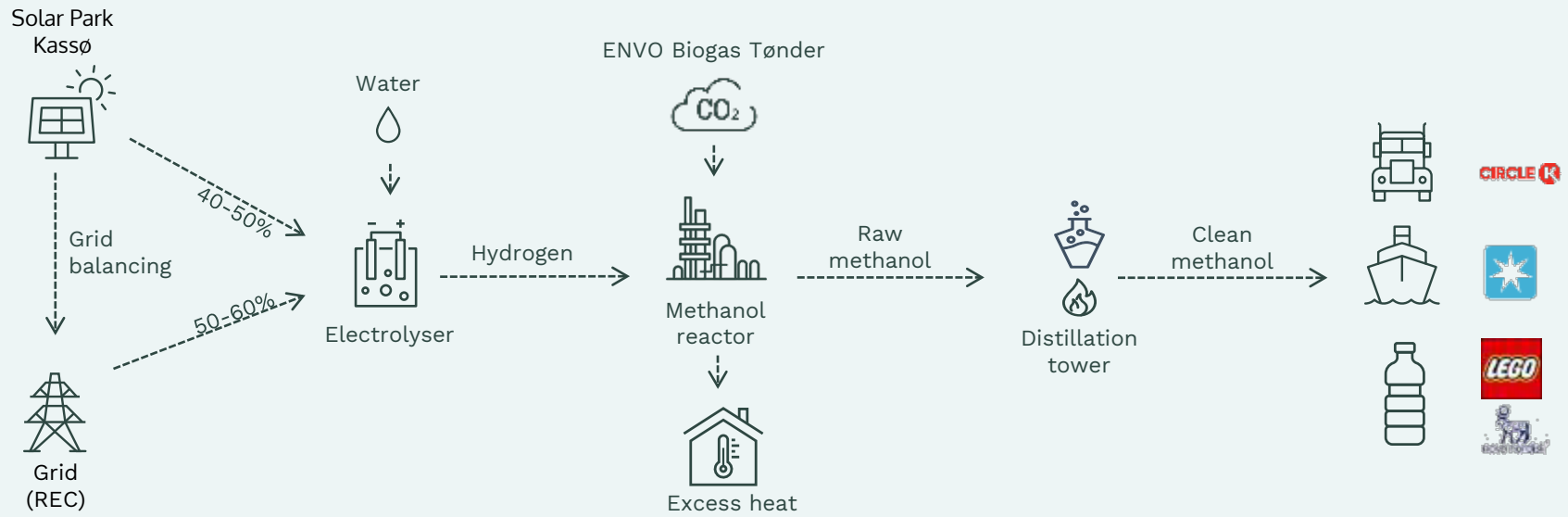
Our e-methanol plant in Kassø, Denmark

Input (consumption)	
Water	~90.000 tons
Electricity	~360-380 GWh
Biogenic CO_2	~45.000 tons

Output (production)	
Hydrogen	~6000 tons
Raw methanol	~50.000 tons
Clean methanol	~32.000 tons (nom. cap. 42.000)
Excess heat	~50 GWh



How we produce e-methanol in Kassø



Sector coupling

Power supply

Power sourced from own 304MW solar farm and from the grid → robust and cost-optimal power supply

Grid Balancing

52 MW PEM electrolyser from Siemens Energy capable of fast ramp times → flexible operation with the ability to provide grid balancing services

Excess heat

Excess heat produced from production process delivered to the district heating grid to supply approx. 2500 households

Utilization

E-methanol from the plant Is shipped out from Port of Ensted to be used across three different sector for the benefit of the green transition

Milestones

- ✓ Final Investment Decision
- ✓ All permits secured
- ✓ Offtake agreements signed for e-methanol
- ✓ Methanol plant detailed design completed
- ✓ Construction initiated and on-track
- ❑ First methanol, COD 2024

Kassø PTX – Progress on a daily basis

January 2023

August 2023

CO2-storage tanks

1st electrolyzer (out of 3)

Kassø PtX construction in progress

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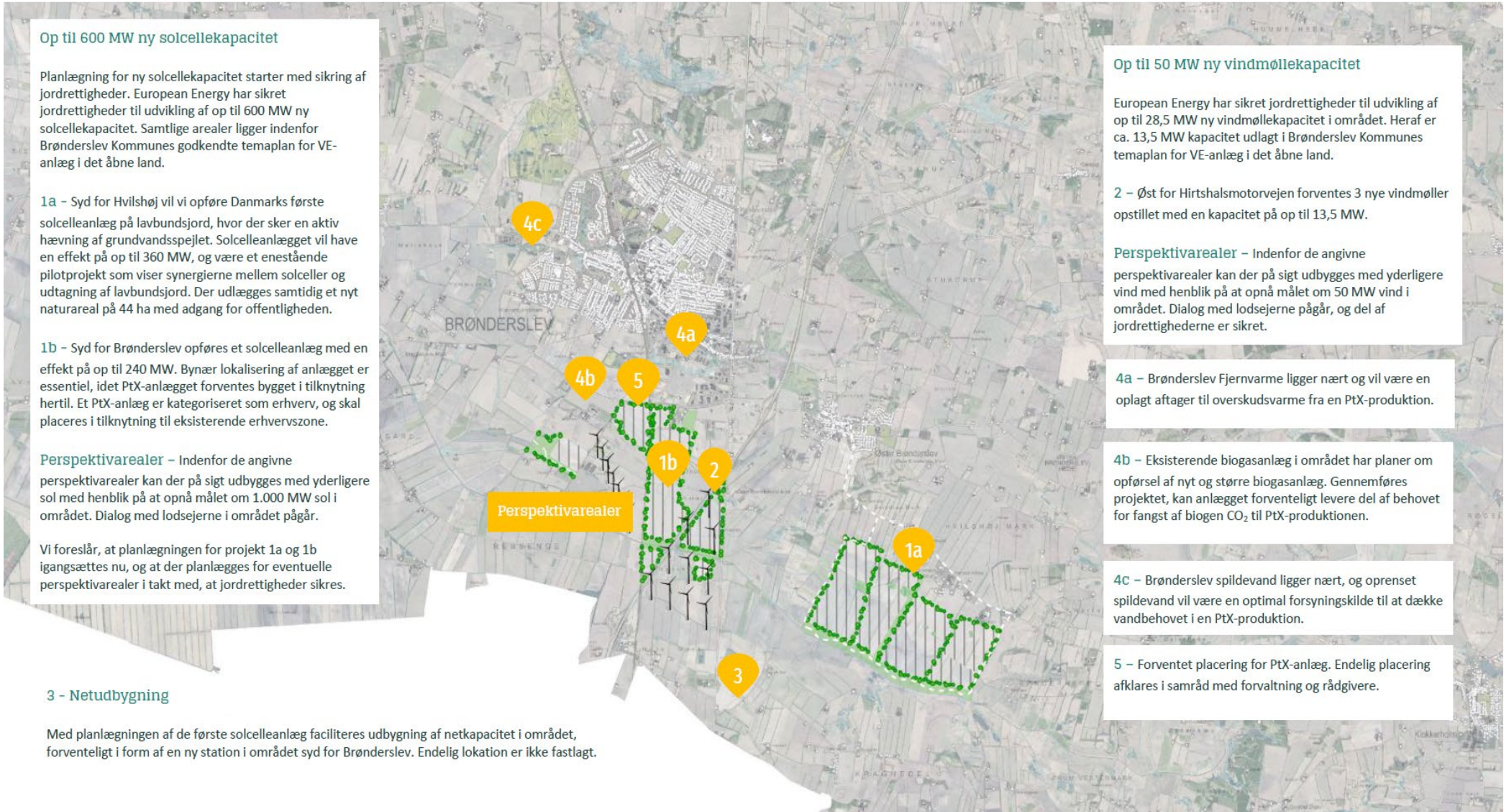
Vejen til Power-to-X syd for Brønderslev



Op til 600 MW ny solcellekapacitet

Planlægning for ny solcellekapacitet starter med sikring af jordrettigheder. European Energy har sikret jordrettigheder til udvikling af op til 600 MW ny solcellekapacitet. Samtlige arealer ligger indenfor Brønderslev Kommunes godkendte temaplan for VE-anlæg i det åbne land.

1a – Syd for Hvilshøj vil vi opføre Danmarks første solcelleanlæg på lavbundsjord, hvor der sker en aktiv hævning af grundvandsspejlet. Solcelleanlægget vil have en effekt på op til 360 MW, og være et enestående pilotprojekt som viser synergierne mellem solceller og udtagning af lavbundsjord. Der udlægges samtidig et nyt naturareal på 44 ha med adgang for offentligheden.

1b – Syd for Brønderslev opføres et solcelleanlæg med en effekt på op til 240 MW. Bynær lokalisering af anlægget er essentiel, idet PtX-anlægget forventes bygget i tilknytning hertil. Et PtX-anlæg er kategoriseret som erhverv, og skal placeres i tilknytning til eksisterende erhvervszone.

Perspektivarealer – Indenfor de angivne perspektivarealer kan der på sigt udbygges med yderligere sol med henblik på at opnå målet om 1.000 MW sol i området. Dialog med lodsejerne i området pågår.

Vi foreslår, at planlægningen for projekt 1a og 1b igangsættes nu, og at der planlægges for eventuelle perspektivarealer i takt med, at jordrettigheder sikres.

3 - Netudbygning

Med planlægningen af de første solcelleanlæg faciliteres udbygning af netkapacitet i området, forventeligt i form af en ny station i området syd for Brønderslev. Endelig lokation er ikke fastlagt.

Op til 50 MW ny vindmøllekapacitet

European Energy har sikret jordrettigheder til udvikling af op til 28,5 MW ny vindmøllekapacitet i området. Heraf er ca. 13,5 MW kapacitet udlagt i Brønderslev Kommunes temaplan for VE-anlæg i det åbne land.

2 – Øst for Hirtshalsmotorvejen forventes 3 nye vindmøller opstillet med en kapacitet på op til 13,5 MW.

Perspektivarealer – Indenfor de angivne perspektivarealer kan der på sigt udbygges med yderligere vind med henblik på at opnå målet om 50 MW vind i området. Dialog med lodsejerne pågår, og del af jordrettighederne er sikret.

4a – Brønderslev Fjernvarme ligger nært og vil være en oplagt aftager til overskudsvarme fra en PtX-produktion.

4b – Eksisterende biogasanlæg i området har planer om opførsel af nyt og større biogasanlæg. Gennemføres projektet, kan anlægget forventeligt levere del af behovet for fangst af biogen CO_2 til PtX-produktionen.

4c – Brønderslev spildevand ligger nært, og oprenset spildevand vil være en optimal forsyningskilde til at dække vandbehovet i en PtX-produktion.

5 – Forventet placering for PtX-anlæg. Endelig placering afklares i samråd med forvaltning og rådgivere.

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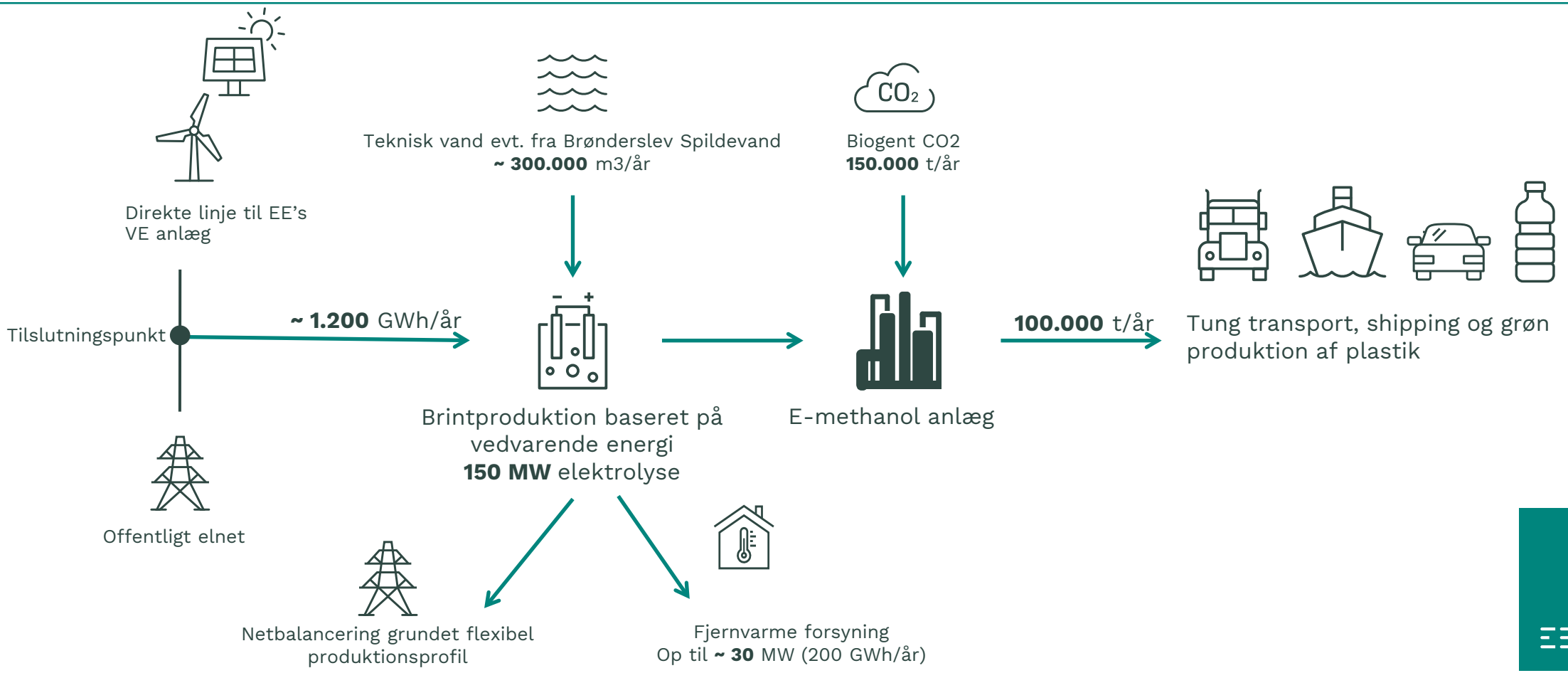
PtX-forudsætninger og muligheder

- Metanolproduktion kræver store anlæg for at være rentable og konkurrencedygtige internationalt, ~100.000 tons/år (180 MW)
- Forudsætninger
  - Tilstrækkeligt lokal VE (sol og vind)
  - CO2 (biogas, affaldsforbrænding, biomasseanlæg)
  - Vandforsyning
  - Placering der opfylder alle myndighedskrav
- Resultater
  - Et markant fyrtårnsprojekt
  - Omkostningseffektiv grøn fjernvarme
  - Lokale aktiviteter og arbejdspladser
  - Følgeaktiviteter med nye virksomheder i værdikæden

Power-to-X i Brønderslev

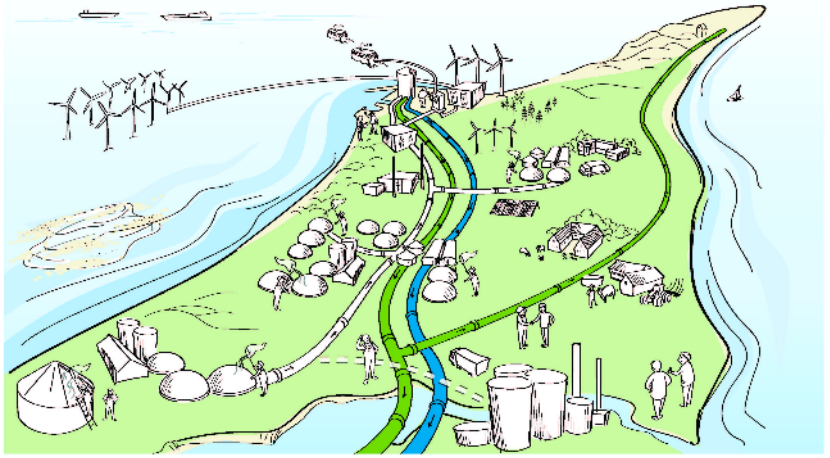


Biogent CO2

Til at producere 100.000 tons metanol/år kræves 150.000 tons (biogent) CO2/år.

Hvor kan vi få det fra?

- Biogasanlæg i Nordjylland, affaldsforbrænding, flis-/halmfyrede varmeværker
- CO2 (og brint) infrastruktur i Nordjylland (2030+)



Overskudsvarme

Et metanolanlæg på 100.000 ton/år kan levere op til 30 MW varme og 200 GWh årligt.

- Det svarer til varmeforbruget i 11.000 husstande.
- Varmen kan leveres ved omkring 75 grader
- Sæsonvariation i overskudsvarme afklares i projektudviklingen

Vand

Årlig vandbehov 300.000 m3/år

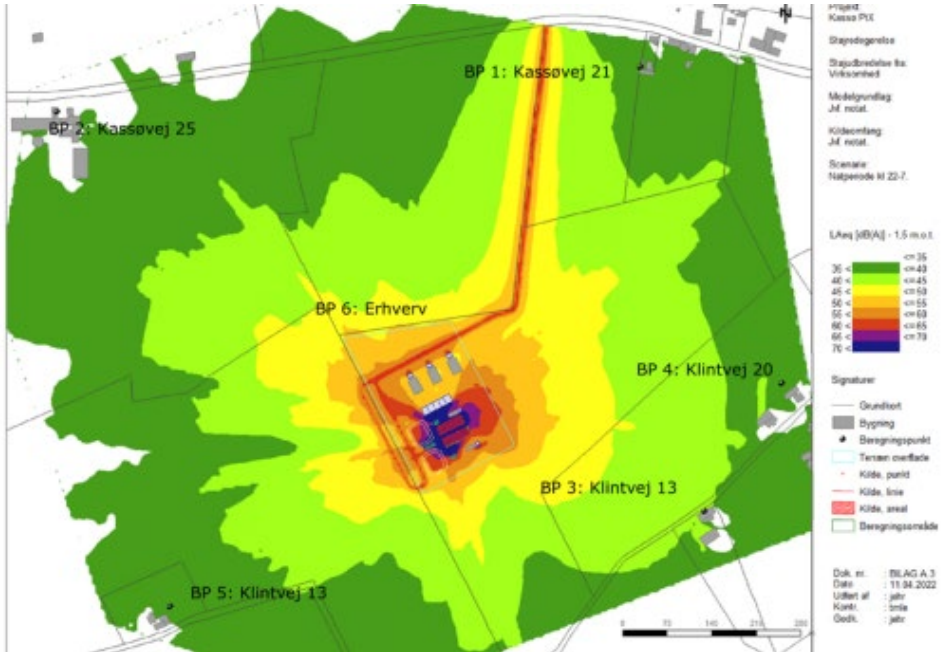
- Oprenset spildevand
- Ny boring eller genåbning af lukket boring

Der er begrænset miljøpåvirkning fra PtX - eksempel fra Kassø

Eksempel på støj

Støjgrænseværdierne overholdes 24/7

Støjkilder på anlægget:
- Luftkølere
- Elektrolyseanlæg
- Pumper, kompressorer og transformatorer
- Intern transport



Eksempel på risikovurdering

- Beregning af den maksimale konsekvens afstand når max. ca. **40** m ud fra produktionssitet
- *"...Forsvindende lille og acceptabel samfundsrisiko efter de sædvanlige accept-kriterier i Risikohåndbogen"*
- *"...Samlet set vurderes det, at planforslagenes påvirkning med menneskeskabte katastroferisici og ulykker er lille.."*

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Nye lokale arbejdspladser i forbindelse med etablering af PtX

30-40
direkte arbejdspladser knyttet til anlægget

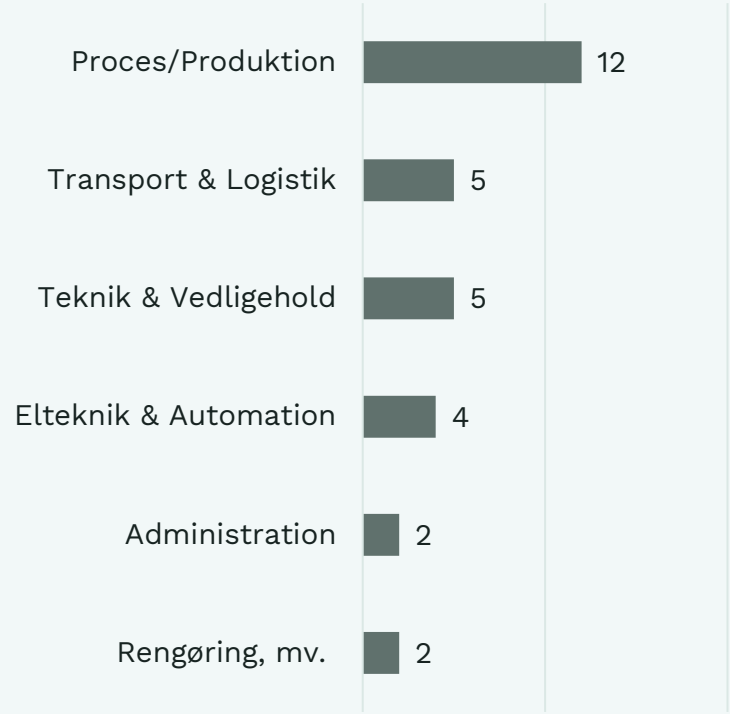
Lokale arbejdspladser

Fortrinsvis rekrutteret fra nærområdet

Lokal oplæring og træning

i drift og vedligehold af E-methanol anlæg

Faggrupper



PtX projektet i Brønderslev forventes at skabe 30-40 arbejdspladser, primært relateret til overvågning, styring og vedligehold af procesanlæg. Yderligere arbejdspladser knytter sig til transport & logistik, el & automation samt forskellige lokale service ydelser.

Procesanlægget er højt automatiseret med styring fra et centralt kontrolrum af hensyn til sikkerhed, effektiv drift og godt arbejdsmiljø.

Thank you for listening!

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