Kalundborg Symbiosis

Surplus from circular production

Agenda 9/9

9.30	**Presentation of Kalundborg Symbiosis** Welcome and introduction Bjarke Skaanning, Head of Administration & Per Møller, Senior Special Advisor
10.30	**Port of Kalundborg** Sustainability and synergies with industrial symbiosis Michael Larsen, Sales Manager, Port of Kalundborg
11.15	**The Meliora Bio Case** Per Møller, Senior Special Advisor, Kalundborg Symbiosis
11.35	**Symbiosis Tour to the Harbor Park**
12.00	**Lunch**
12.40	**Workshop on Symbiosis Streams and Ecosystems** Mette Wendel, Symbiosis Facilitator, Kalundborg Symbiosis
14.00	**Introduction to Kalundborg Utility** Hasse Milter, Head of Innovation, Kalundborg Utility
14.45	**Site visit at Kalundborg Utility**
16.00	**End of the Day in Kalundborg**


The Kalundborg Symbiosis Administration

Mission & Vision

Renew

Strengthening the partnership

Connect

Full resource utilization

Promote

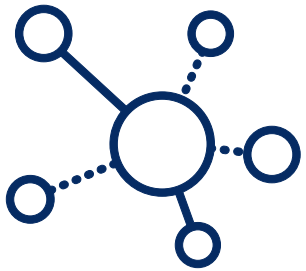
Sharing the symbiotic mindset

The worlds leading industrial symbiosis with a circular approach to production

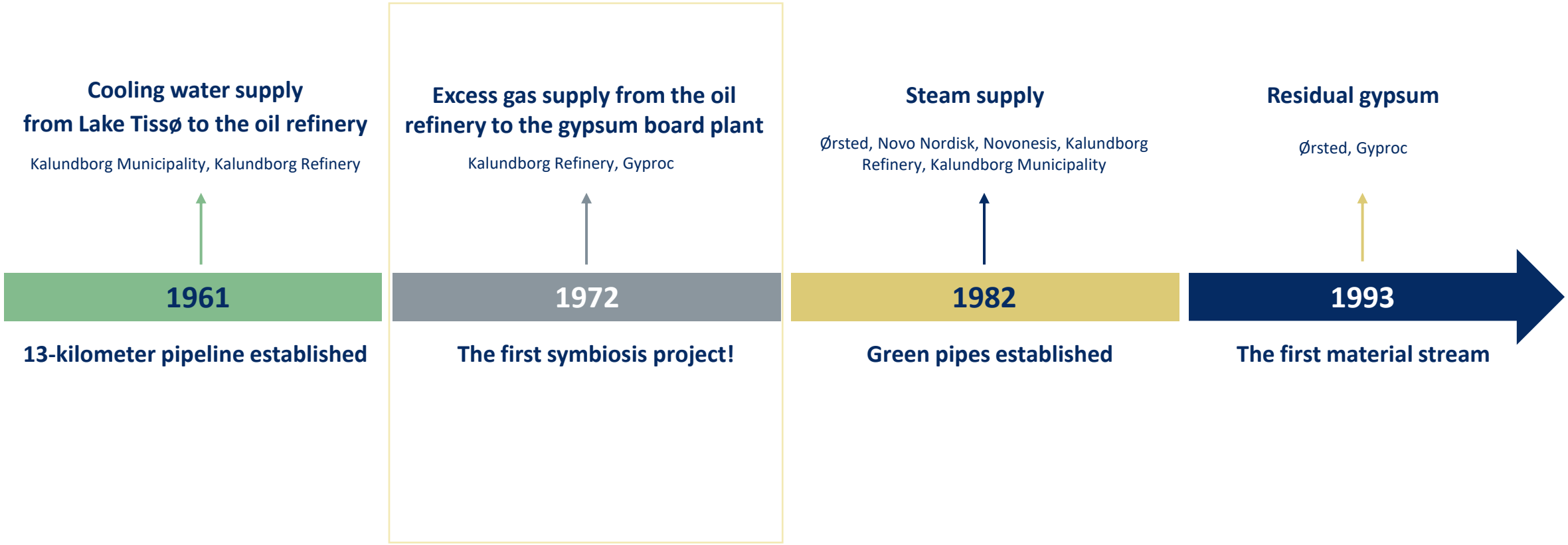
Kalundborg Symbiosis creates sustainable development in our companies through joint projects

International collaboration

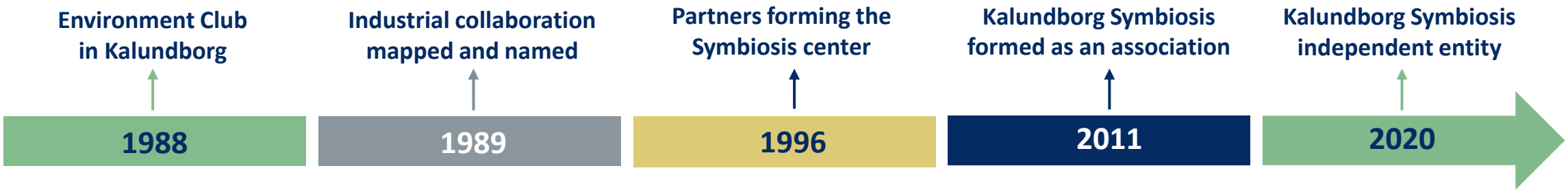
Governance structure



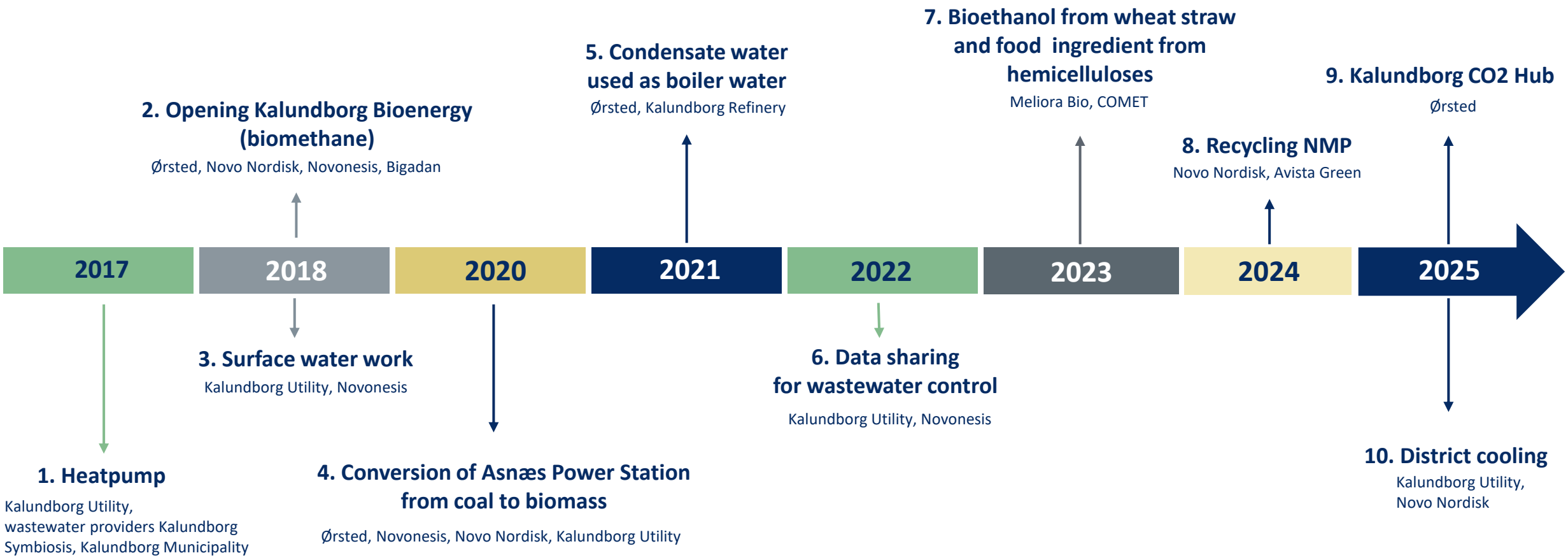
How it all started



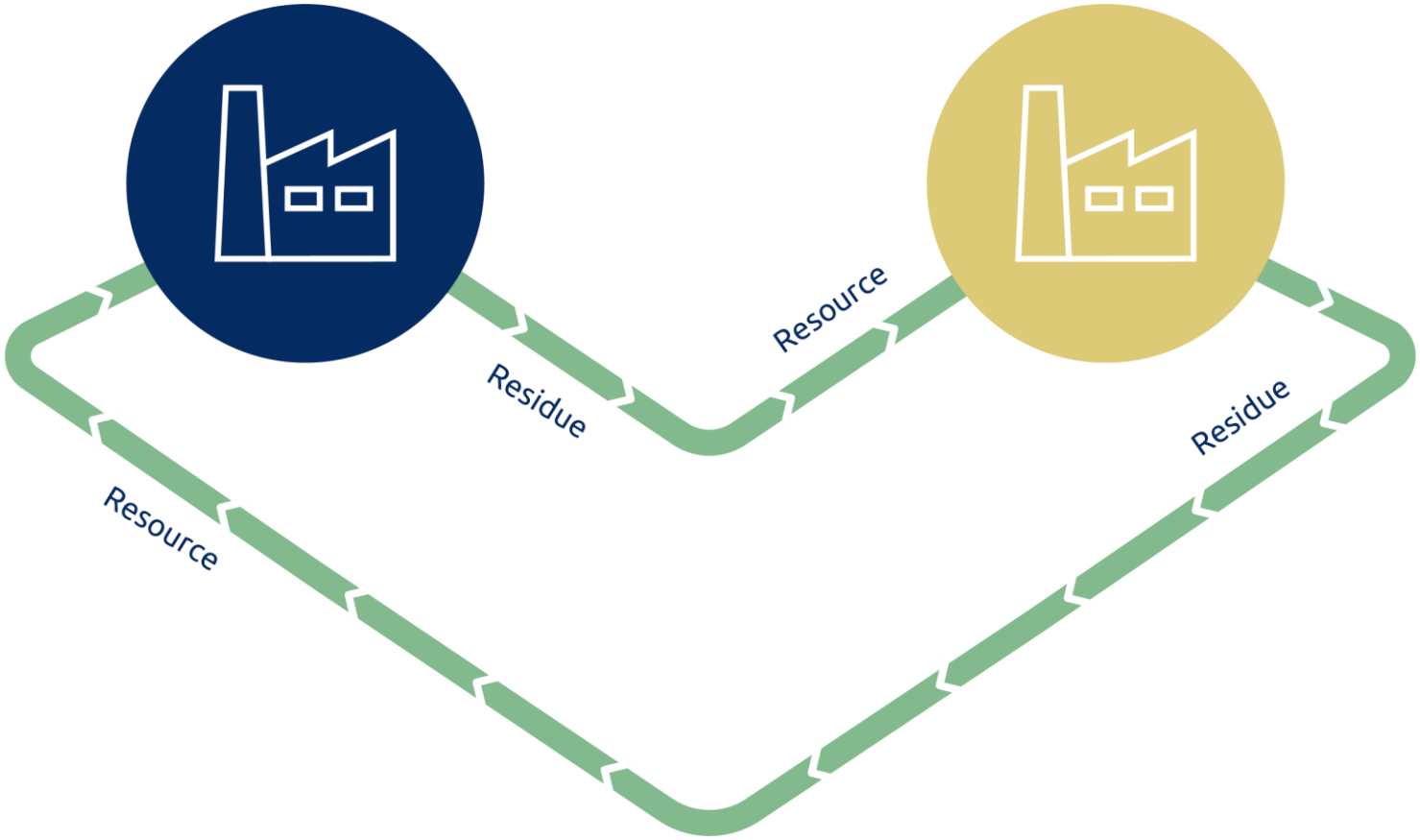
Organizational evolution



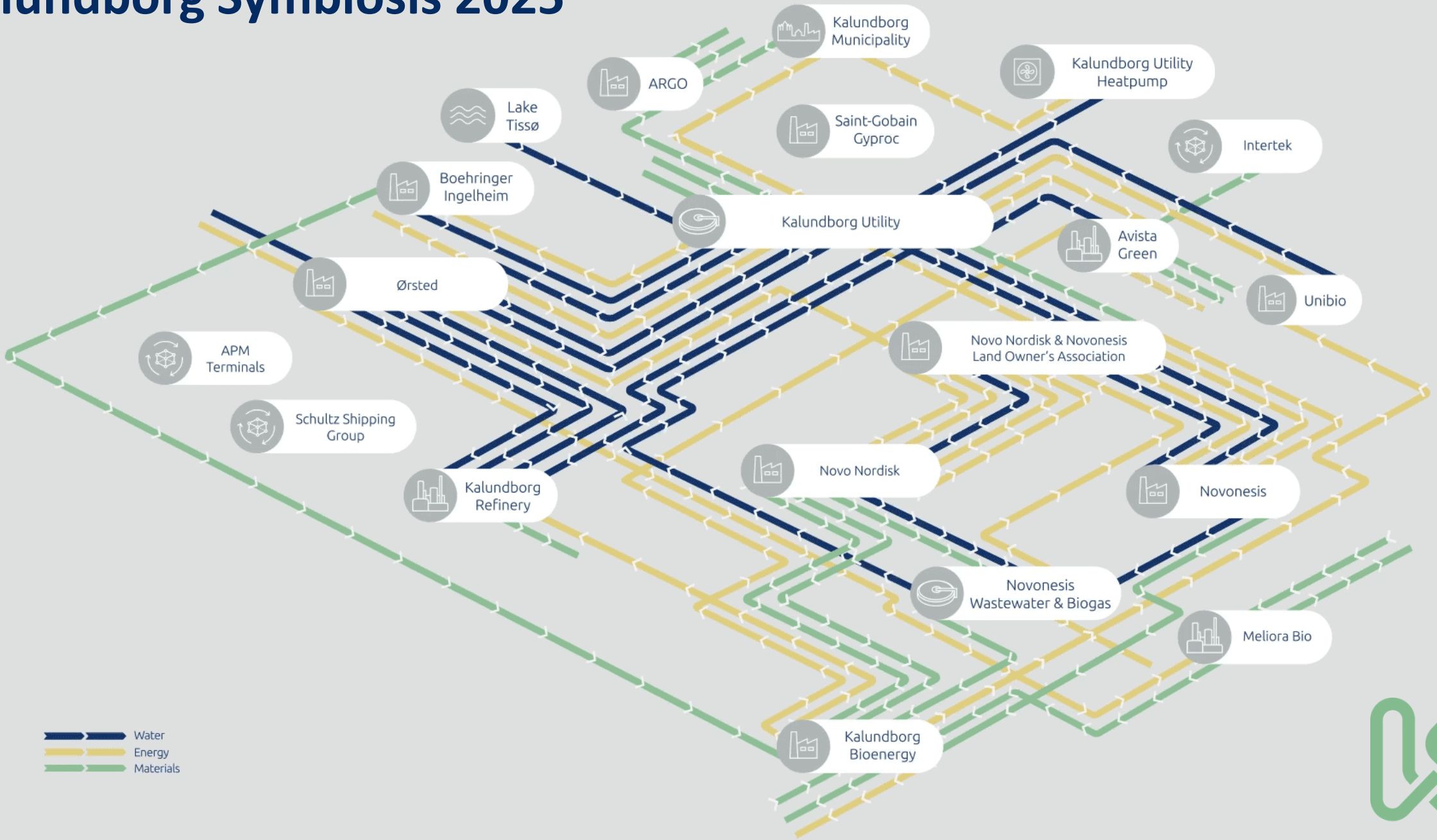
10 new streams by 2025



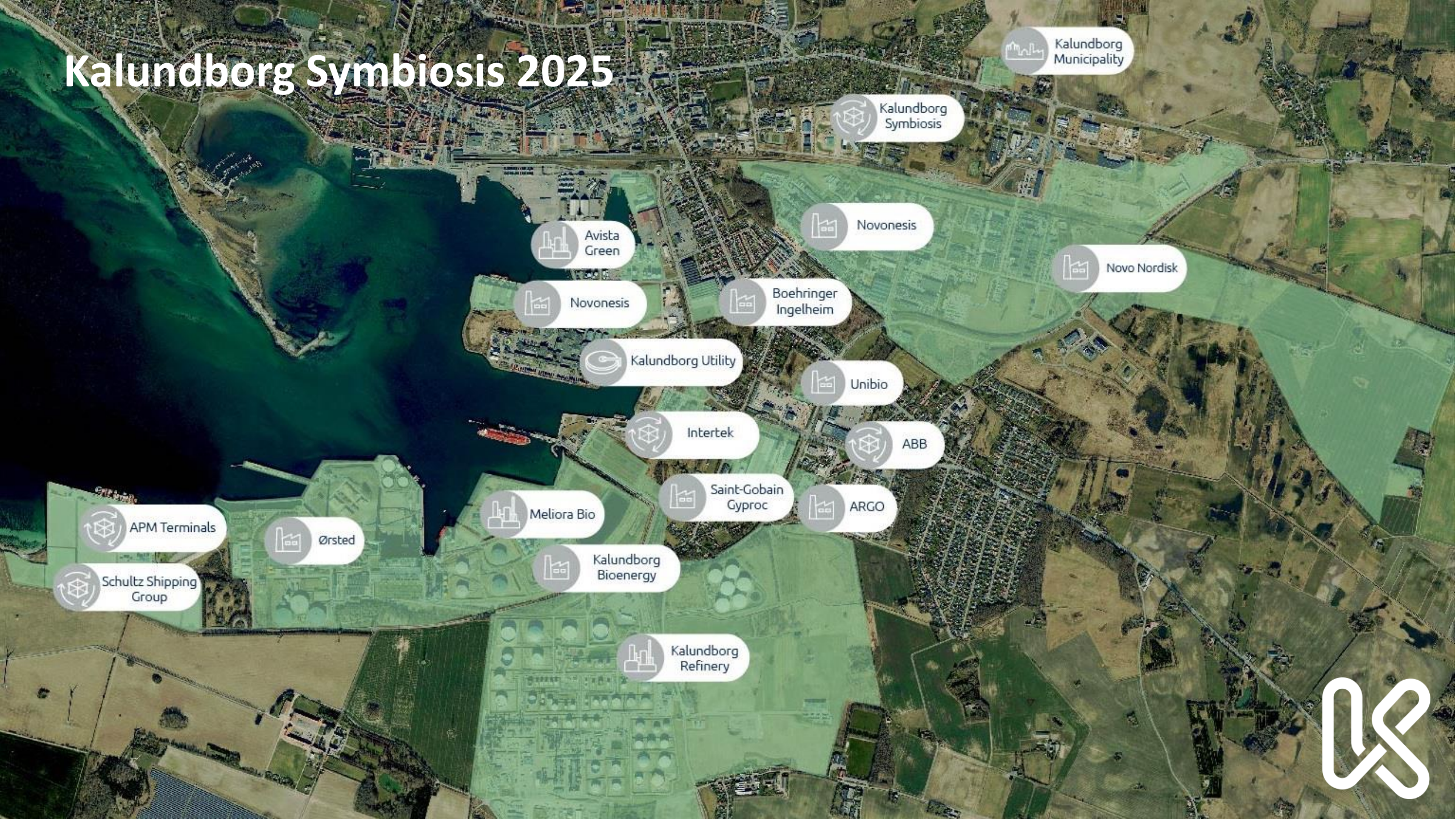
Industrial Symbiosis



Kalundborg Symbiosis 2025



Kalundborg Symbiosis 2025



Kalundborg Symbiosis 2025

ABB

APM TERMINALS
Lifting Global Trade

argo

AVISTA Green

Boehringer Ingelheim

Gyproc
SAINT-GOBAIN

intertek
Total Quality. Assured.

KALUNDBORG UTILITY

KALUNDBORG BIOENERGI

MUNICIPALITY OF KALUNDBORG

KALUNDBORG REFINERY

Meliora Bio

novonesis

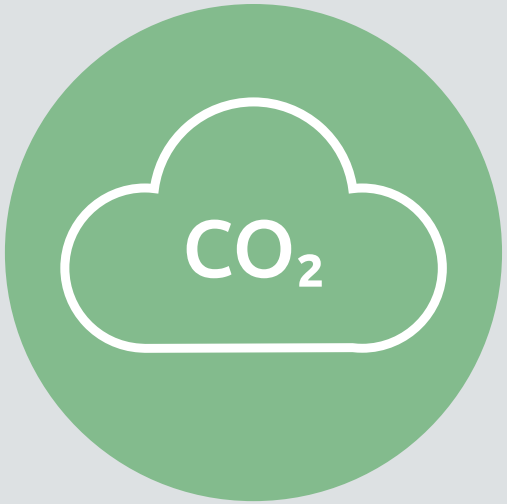
Schultz Shipping Group

unibio

novo nordisk®

Ørsted

Annual savings since 2015



586,000 tons CO_2
The local energy production is now CO_2 neutral

4 million m3
of groundwater

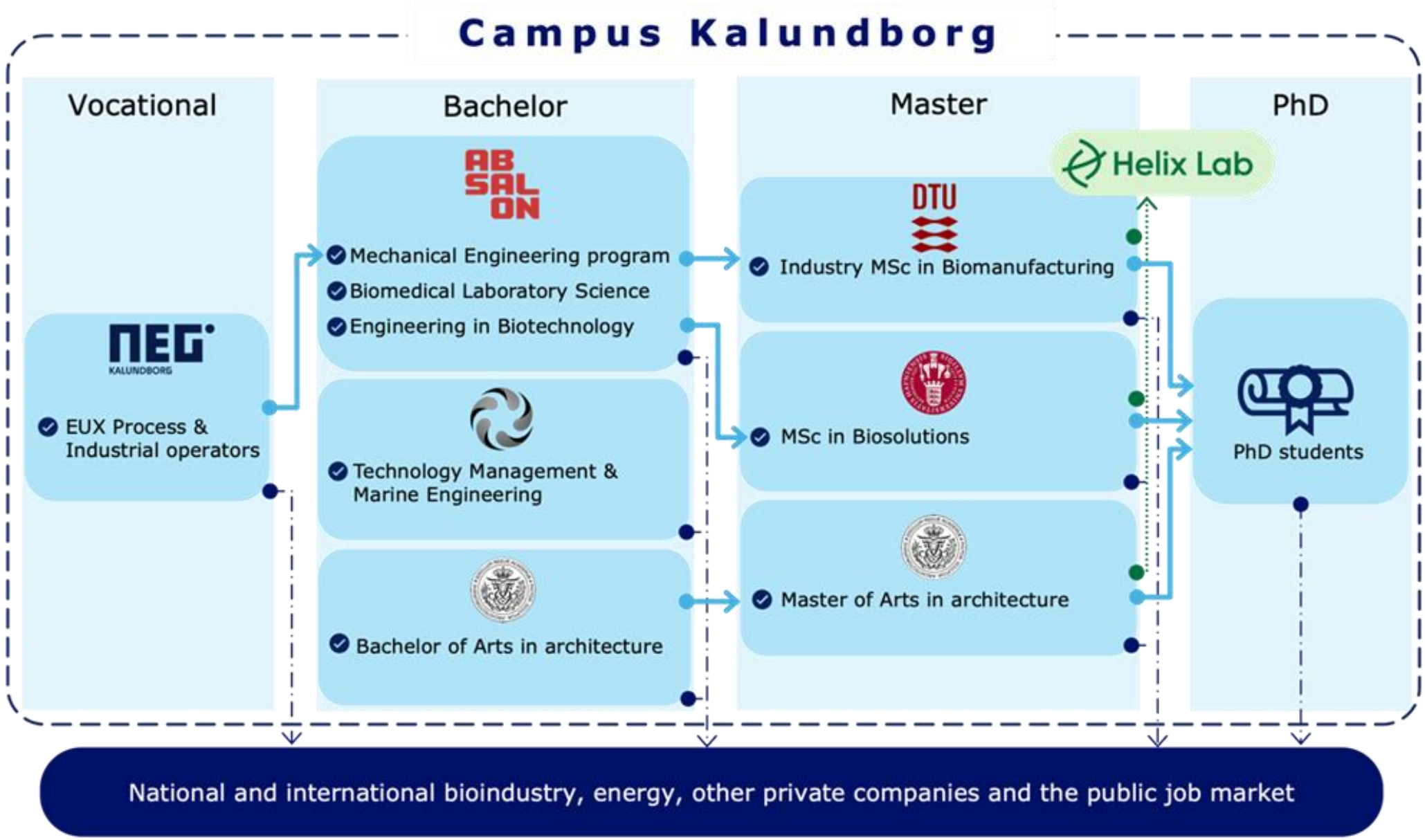
62,000 tons
of residual materials recycled

Examples of local growth

€10 bn
investment

The investments create
1,300+ new, permanent jobs

12 new educational programs
in Kalundborg


Campus Kalundborg
Vocational
Bachelor
Master
PhD
Helix Lab
EUX Process & Industrial operators
Mechanical Engineering program
Biomedical Laboratory Science
Engineering in Biotechnology
Technology Management & Marine Engineering
Bachelor of Arts in architecture
Industry MSc in Biomanufacturing
MSc in Biosolutions
Master of Arts in architecture
PhD students
National and international bioindustry, energy, other private companies and the public job market

New projects 2024-25

New production facilities & infrastructure

- District cooling and usage of excess heat
- Carbon Capture & Storage
- Co-management of Novonesis wastewater plant and Kalundborg Utility

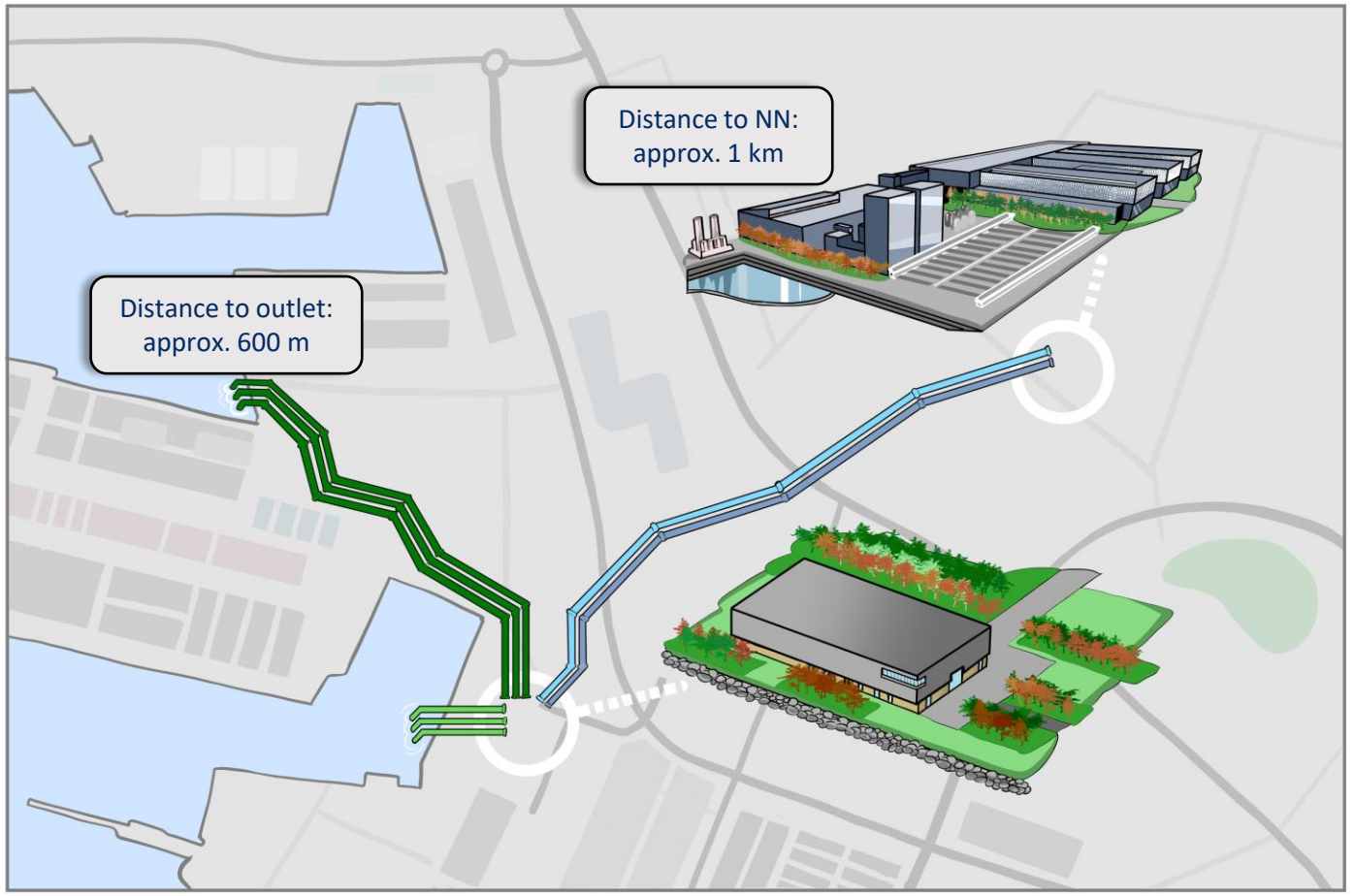
Site visit for the Board of Directors, April 2024

The biggest industrial combined cooling and heating central in Northern Europa

Saving water and chemicals, utilizing the potentials of excess heat

Key numbers behind the closed loop facility:

- Investments: 188 mil €
- Approx. 2 X 1 km underground pipes, Ø2 m
- Operating in 2025
- Capacity: 166 MW cooling
- Sea water intake: 18.000 m^3/h (max)
- Temperatures on the water flows:
  - Cooling for Novo Nordisk / Novonesis: 22,5^0 C
  - Heating from Novo Nordisk / Novonesis: 31,5^{0}C
- Back-up chillers: 10 MW

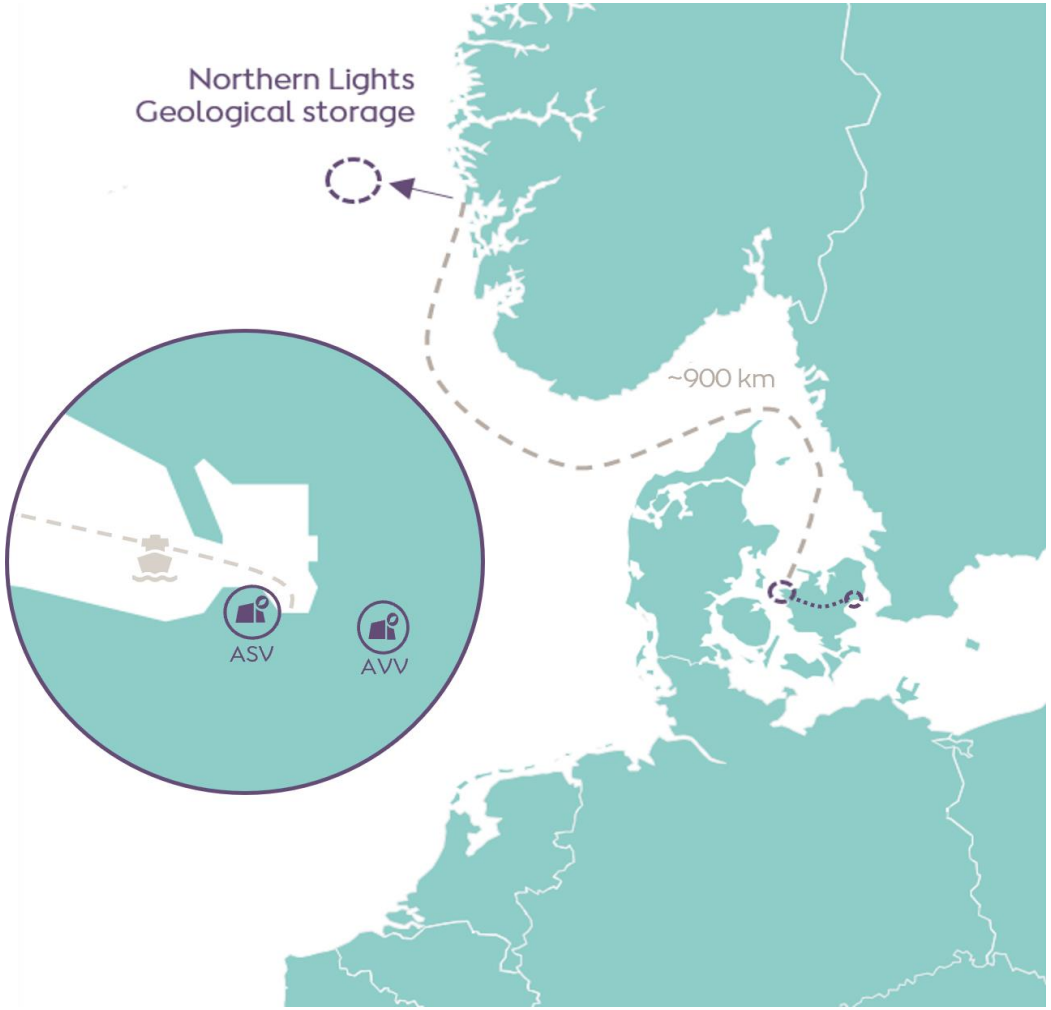


More info here: Nordeuropas største industrielle fjernkøl- og varmecentral | Kalundborg Forsyning (kalfor.dk)

The Ørsted Kalundborg CO2 Hub establishes a key starting point for CO2 infrastructure centrally in Denmark, capturing & storing 430,000 tonnes CO2 annually

Key numbers behind the CO2 infrastructure:

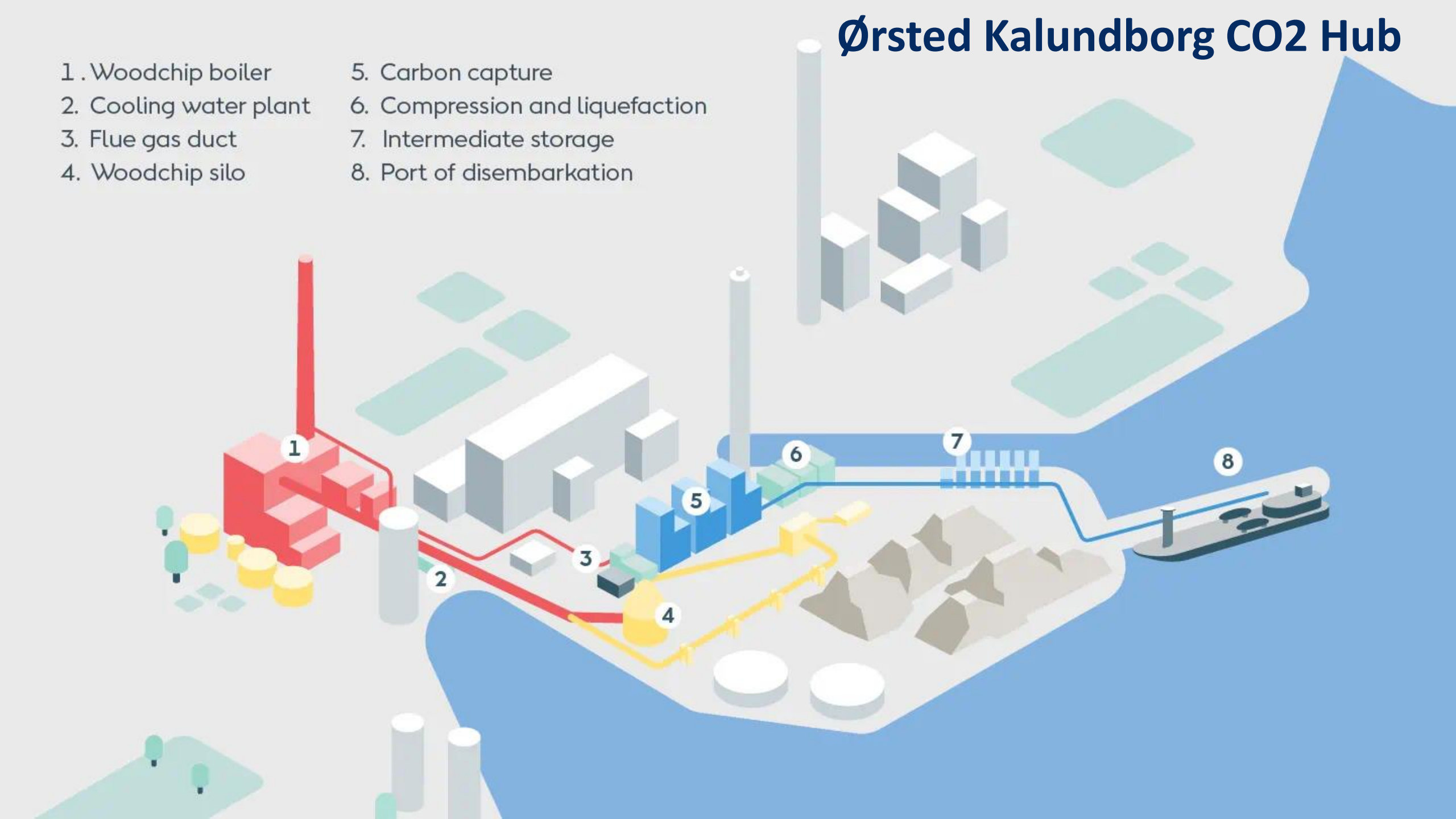
- Project is based on a portfolio of two-point sources to deliver the contracted CO_2 quantity of 430,000 tonnes annually:
  - Asnæs Power Station (ASV) with ~280,000 tonnes/annually
  - Avedøre Power Station (AVV) with ~150,000 tonnes/annually
- Commencement of operations end of 2025
- Total funding pool of ~8 bn DKK



More info here: Carbon Capture & Storage (CCS) | Ørsted (orsted.com)

Ørsted Kalundborg CO2 Hub

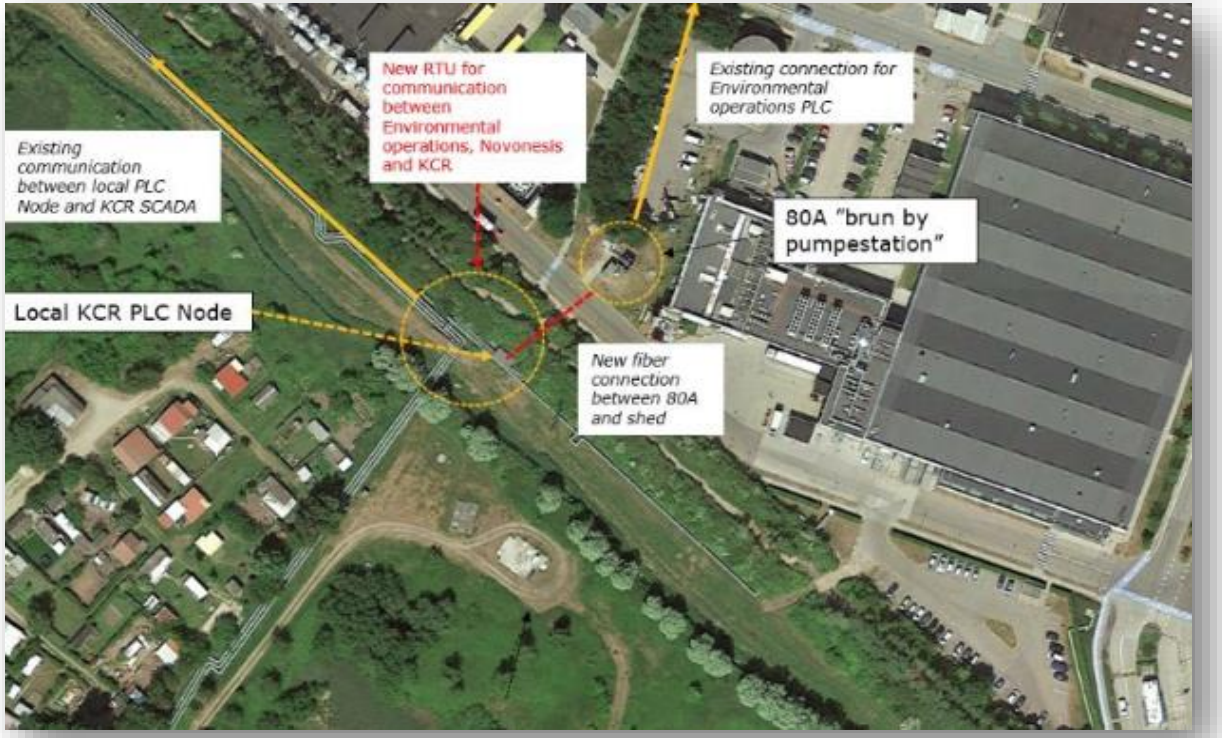
1 . Woodchip boiler
2. Cooling water plant
3. Flue gas duct
4. Woodchip silo
5. Carbon capture
6. Compression and liquefaction
7. Intermediate storage
8. Port of disembarkation



Co-management of Novonesis wastewater plant and Kalundborg Utility

Key objectives:

- Adapt to supply variations
- Guarantee quality for recipients
- Utilise spare capacity at Kalundborg Wastewater Treatment Plant
- Optimize aeration energy at varying oxygen needs
- Minimize chemical use for precipitation
- Implement ´early warning´ system for Kalundborg Utility



Next steps:

- Modelling calculations in SIMBA
- Installation of Biotector on the inlet to measure TN, TOC, TP

Case: Water sharing

Surface water

Case: Co-production of steam

Energy

Case: Biogas from fermentation sludge

Materials

Case: Bioethanol

Production in full scale

Case: Social Economy

The triple bottom-line

Case: Purified condensate water

Saving resources in scarcity

Case: Residue from service provider

Collecting residue from laboratories and use it as commodity

Case: From waste to raw material

Additional material to biogas production

Kalundborg Symbiosis

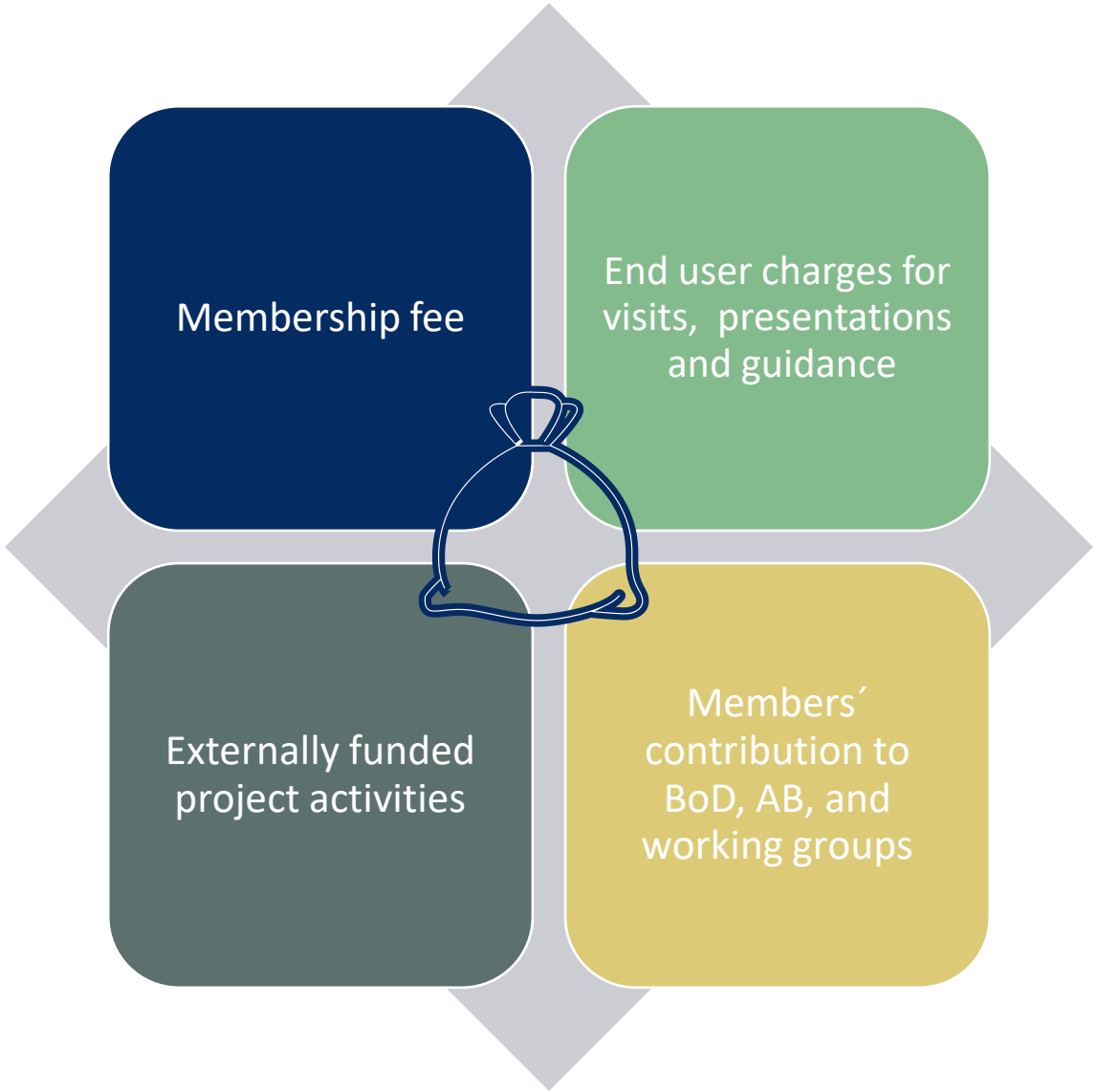
Surplus from circular production

For more information please contact:

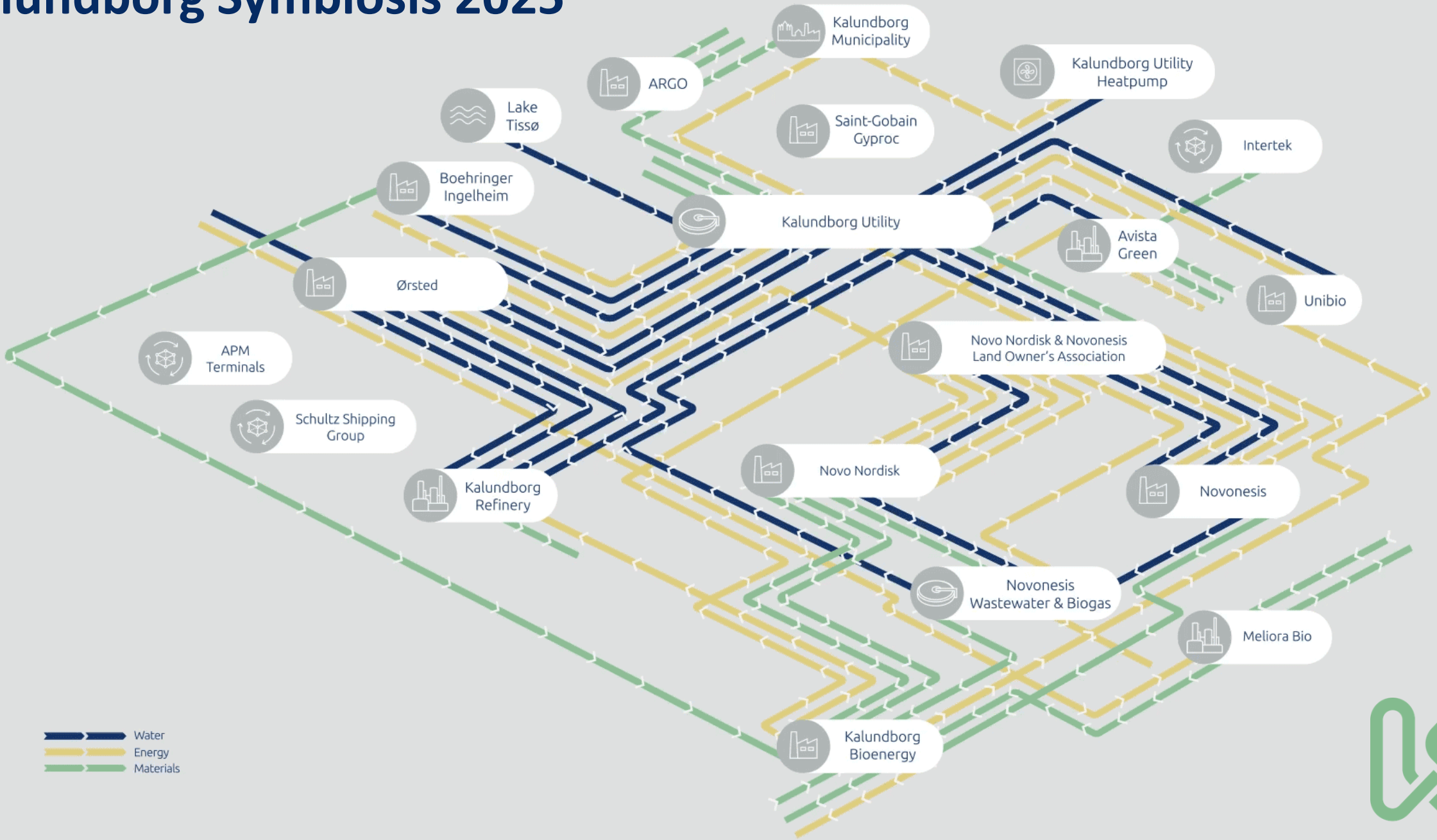
symbiosecenter@kalundborg.dk

Helix Lab

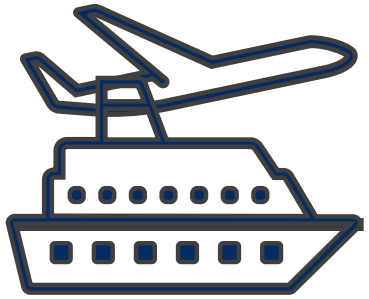
Funding


Membership fee
End user charges for visits, presentations and guidance
Externally funded project activities
Members´ contribution to BoD, AB, and working groups

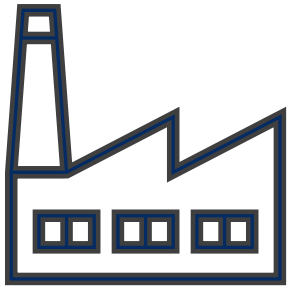
Kalundborg Symbiosis 2025



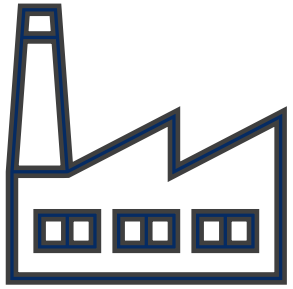
Symbiosis



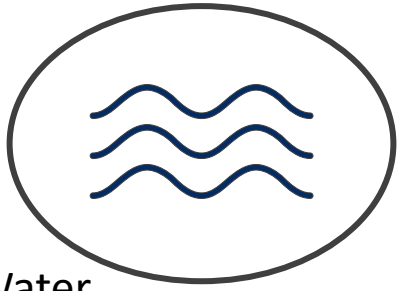
Company G
Harbor



Company A
Fermentation for
enzyme production

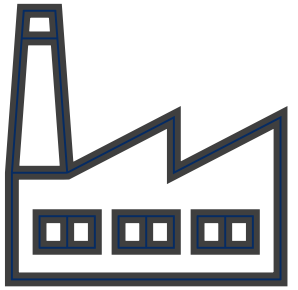


Company B
Power Plant



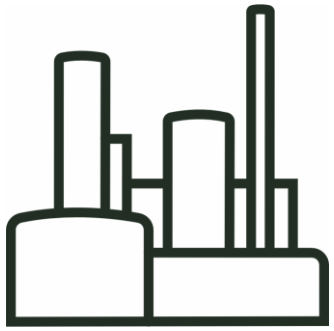
Water

Suface water or Desalinated water



Company C
Biogas production

Company D
Tomato production



Company E
Oil Refinery

Company F
Utility
Fresh water supply
Wastewater Treatment

Group Task (40 minutes)

Relocate into groups of 5 people

- Map connections (“streams”) between the companies.
- You may choose to approach this from either a **technical** perspective or a **business/governance** perspective.
- Illustrate your work on the posters provided.

Prepare a 4-minute pitch to present your work to the rest of the participants.

Company A

Material	Waste material/ residual resource to offer	Resource demand for production	Yearly amount
Wastewater	x		1 million m^3
Biomass	x		500.000 m^3
Clean water (not clean enough for pharma production)	x		1 million m^3
Drinking water		x	1 million m^3
Biogas/ Biomethane for product heating			250.000 m^3
Steam (for sterilization and product heating)		x	8 million KJ

Company B

Material	Waste material/ residual resource to offer	Resource demand for production	Yearly amount
Biomass (wood chips)		x	500.000 tonnes
Water (for steam production)		x	4 million m^3
Condensate water (from Chemnies)	x		6 million m^3

Company C

Material	Waste material/ residual resource to offer	Resource demand for production	Yearly amount
Biomass (for biogas production)		x	No limit
Water		x	50.000 m^3
Wastewater	x		20.000 m^3

Company D

Material	Waste material/ residual resource to offer	Resource demand for production	Yearly amount
Wastewater	x		1 million m^3
Clean water (not to damage the pipes and equipment)		x	75.000 m^3
Cooling water		x	1,5 million m^3
Biogas/ Biomethane for product heating			500.000 m^3
Steam (for sterilization and product heating)		x	6 million KJ

Company E

Material	Waste material/ residual resource to offer	Resource demand for production	Yearly amount
Waster for the crops		x	500.000 m^3
Biomass	x		20.000 tonnes
CO2		x	25.000 m^3
Biogas/ Biomethane for heating		x	50.000 m^3
Steam (for steril		x	10.000 KJ

Company F

Description of processes	Capacity
Wastewater treatment from idustry and citixens	6 million m^3
Water supply	
Groundwater	3 million m^3
Surface water from Lake Tissø – treated to drinking quality	4 million m^3
Surface water from Lake Tissø – only cleansed roughly	
Heatpump for district heating of the city	110 TJ

CompanyG

Material	Waste material/ residual resource to offer	Resource demand for production	Yearly amount
Waster for Cleansing		x	500.000 m^3
Coolling		x	1 million KJ
Heating		x	1 million KJ
Organic waste	x		20.000 tonnes
Green electricity	x		1 million kWh

Group Task (40 minutes)

Relocate into groups of 5 people

- Map connections (“streams”) between the companies.
- You may choose to approach this from either a **technical** perspective or a **business/governance** perspective.
- Illustrate your work on the posters provided.

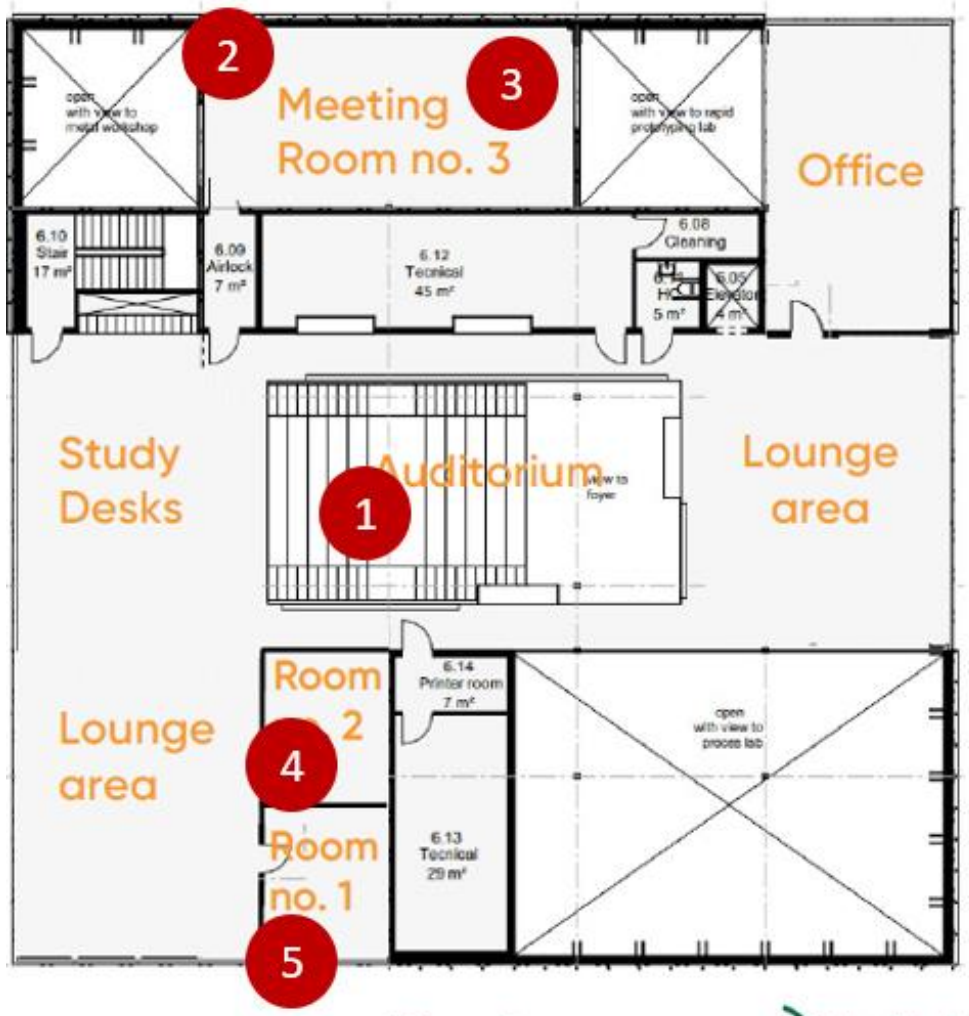
Prepare a 4-minute pitch to present your work to the rest of the participants.

Pitch Instructions (4 minutes per group)

In your pitch, please cover:

- What you achieved in drafting the ecosystem (the streams between the companies).
- How this work could progress in your own context.

- Your key learnings.
- The main points of discussion in your group.



1	Lisa Smith
1	Janice Zahn
1	Adam Lincoln
1	Eron Berg
1	Cassi Marshall
2	John Whitchurch
2	David Stuebe
2	Carly Michiels
2	Kirk Esmond
2	Sandy Kilroy
3	Erin Adams
3	Kyle Gitchell
3	Michael Steele
3	JC Baldwin
3	Alex Ybarra
4	Joel Hansen
4	Mike Chapman
4	Katharine Frazier
4	Nicholas Rohrbach
4	Jasmine Vasavada
5	Stephen McFadden
5	Justin Hopkins
5	Brandy Donaghy
5	John Flanagan
5	Rhys Roth