Q Power lead the change delivering Finland's first industrial-scale synthetic methane plant

Q POWER

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Anni Alitalo, PhD

R&D Director Q Power

I have a long experience in research. Before joining in business world I have worked in a Research Institute where, together with the team, I developed several novel processes from the ground up.

My approach is integrating various scientific disciplines for sustainable solutions. In Q Power my focus have been launching innovative technologies. I embrace continuous learning in collaborative environments.

Q Power – a Power-to-Methane technology company, offering the most efficient methanation technology on the market

- Q Power is a Finnish renewable energy technology company
- Q Power was founded in 2019 to provide concrete solutions for fighting climate change.
- The core business of the company is designing, implementing, and operating methanation plants.
- CO_2 and green hydrogen are utilized as feedstocks to produce green methane, a versatile and carbon-neutral drop-in fuel.
- The technology has been piloted and validated in industrial contexts and is now scaled to the first industrial deployments.
- The company is growing strongly.

WHY

37,12
Global CO2 emissions 2021 (mrd. t)

1,01 °C
Global temperature rise

WHAT

We re-use our customers CO_2 streams and help them to substitute fossil fuels with renewable e-methane.

HOW

By implementing the most efficient state-of-the-art technologies and processes to decarbonize value chains also in the sectors that are most difficult to decarbonize.

Q Power – an innovative company developing concrete solutions for fighting climate change

Modularly scalable microbiological solid-state reactor.

10 +
Yrs R&D

68
Patents

Q Power holds 68 active patents around solid-state fermentation technology

- Innovative bioreactor technology enables the production of gases, liquids, or solids from gaseous or gaseous and liquid starting materials through fermentation.
- Q Powers' invention enables, **sparingly soluble gases to be efficiently utilized** by microbes without the need for pressure or mixing, resulting in high production efficiency.
- The patented technology is **suitable for producing a wide range** of products, including alcohols, enzymes, and cells to name just a few.
- Additionally, it provides **unprecedented opportunities for discovering and utilizing new, previously unexplored microbiological properties** by offering unique culturing conditions and transformation opportunities.

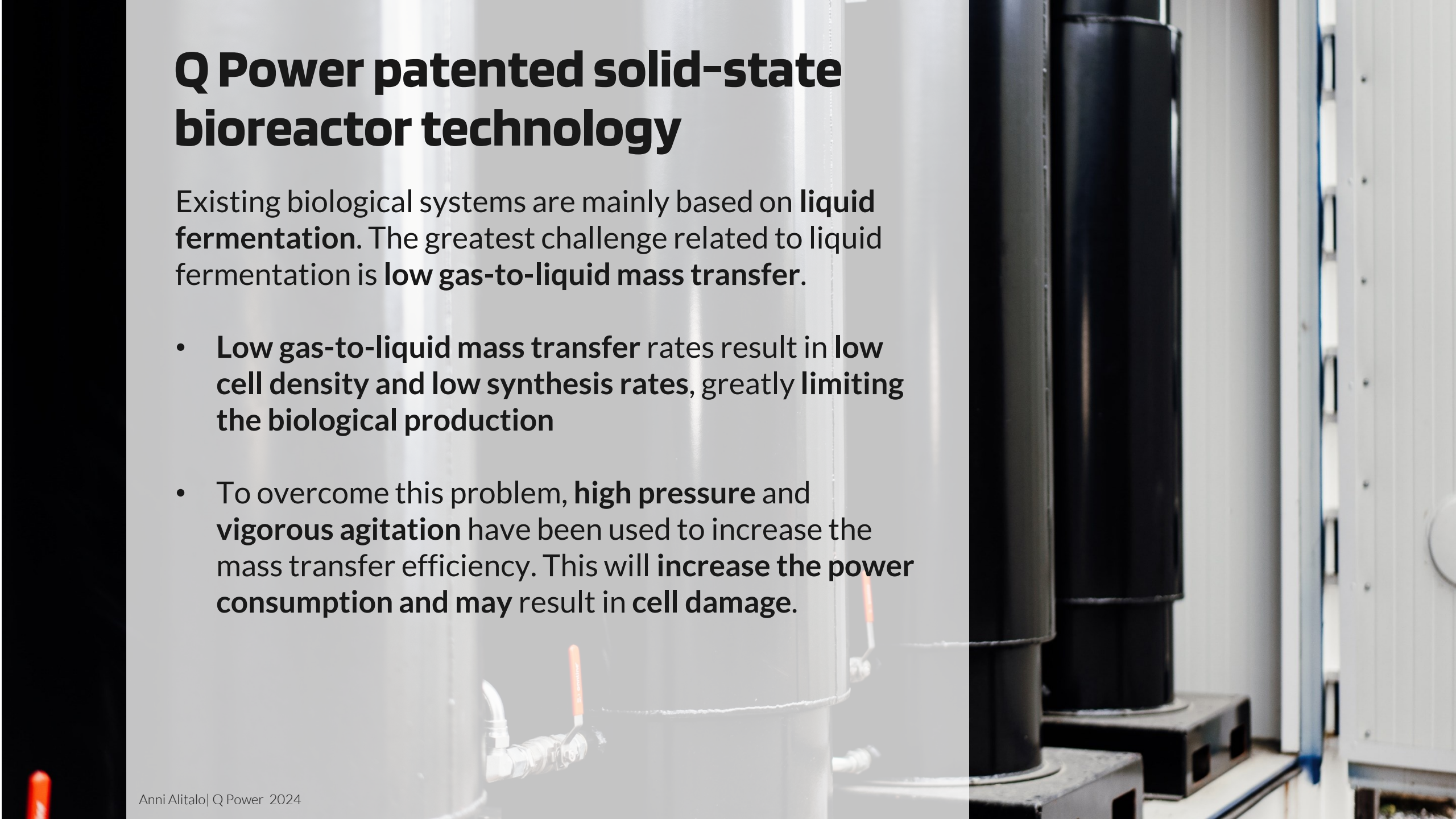
Q Power technology

Q Power patented solid-state bioreactor technology

Existing biological systems are mainly based on **liquid fermentation**. The greatest challenge related to liquid fermentation is **low gas-to-liquid mass transfer**.

- **Low gas-to-liquid mass transfer** rates result in **low cell density and low synthesis rates**, greatly **limiting the biological production**

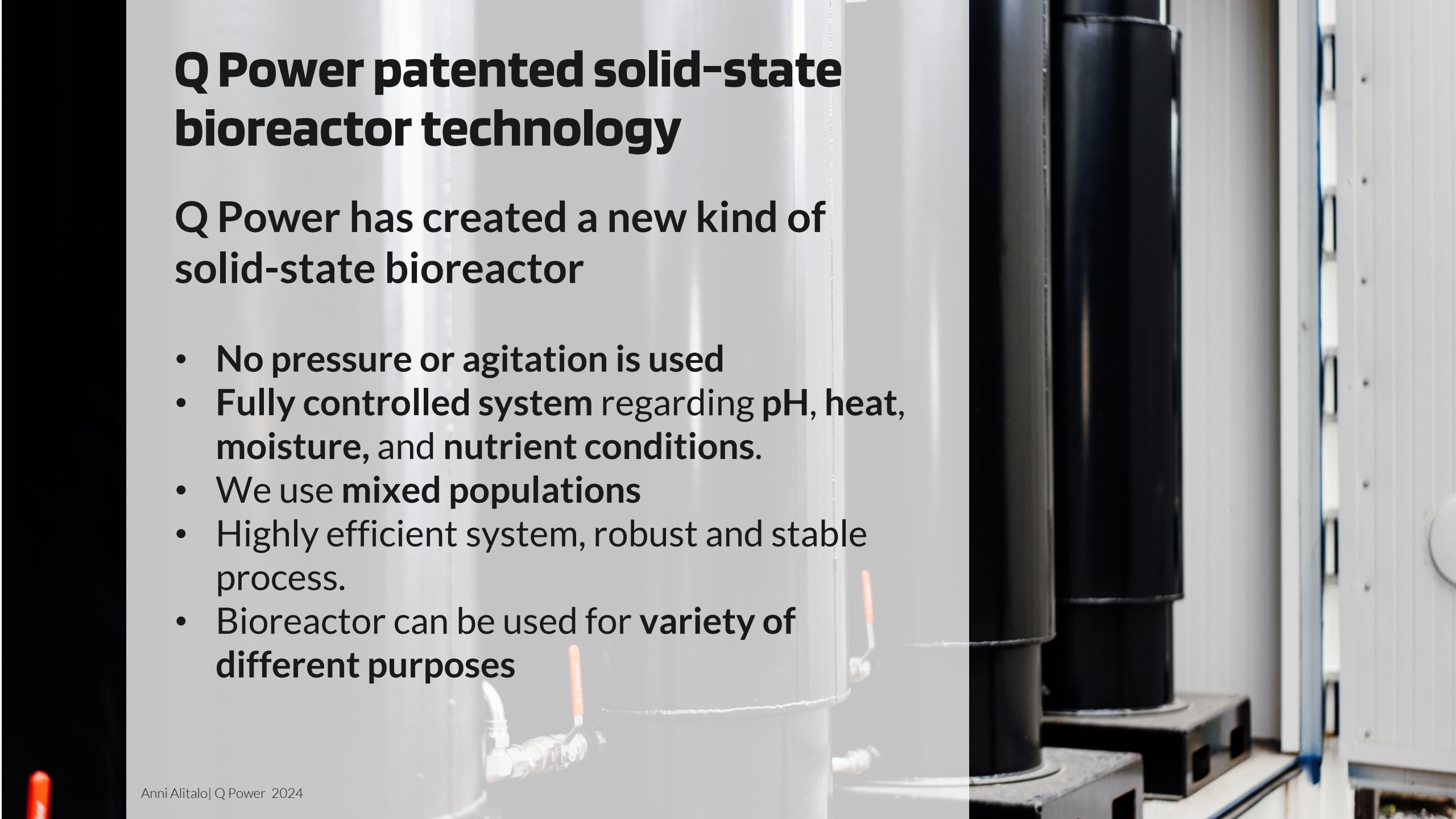
- To overcome this problem, **high pressure** and **vigorous agitation** have been used to increase the mass transfer efficiency. This will **increase the power consumption and may** result in **cell damage**.



Q Power patented solid-state bioreactor technology

Q Power has created a new kind of solid-state bioreactor

- **No pressure or agitation is used**
- **Fully controlled system** regarding **pH**, **heat**, **moisture,** and **nutrient conditions.**
- We use **mixed populations**
- Highly efficient system, robust and stable process.
- Bioreactor can be used for **variety of different purposes**

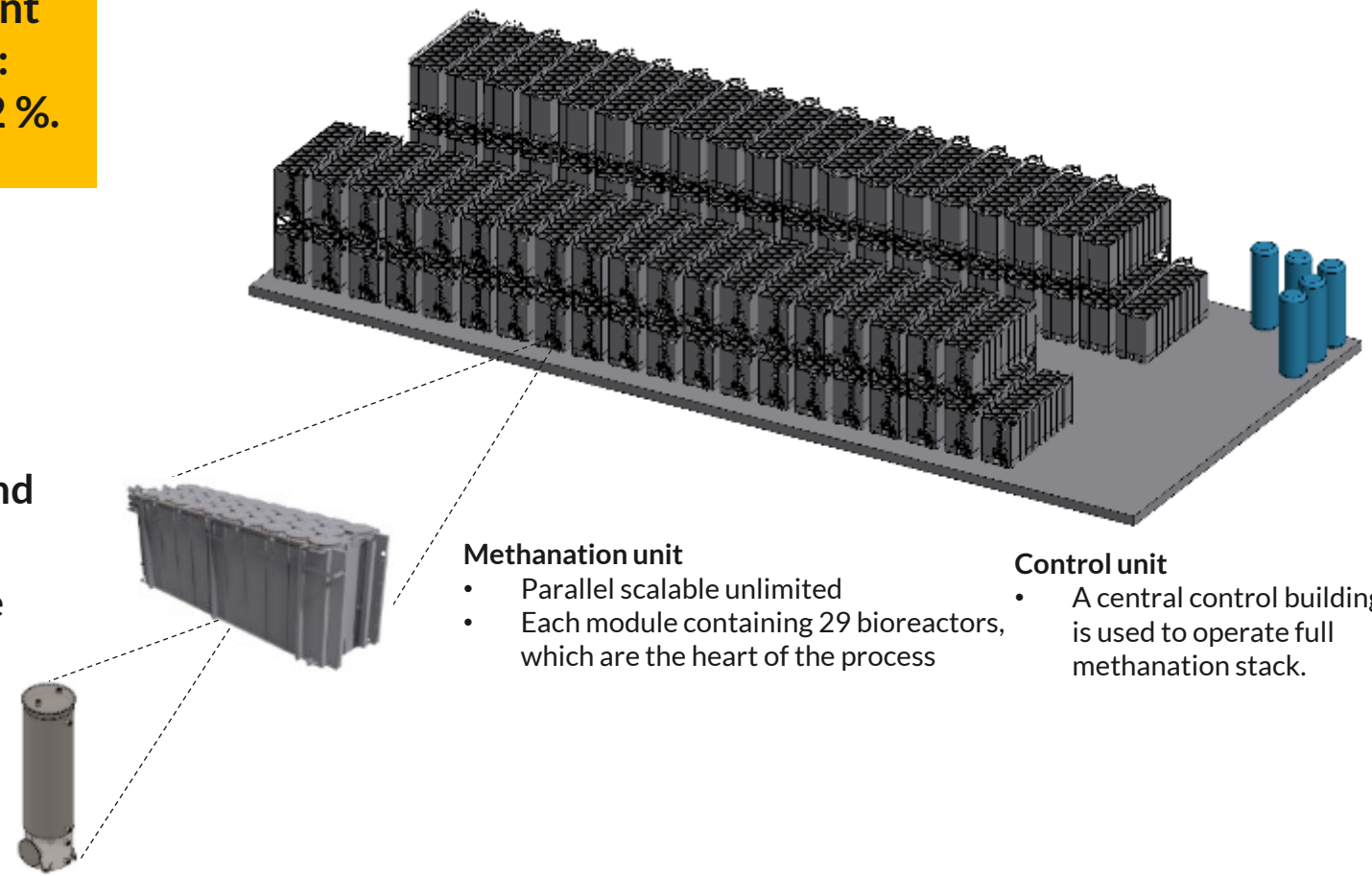


Modularly scalable and highly efficient

Q Power technology is the most efficient methanation technology in the market: process efficiency of methanation is 82 %.

Large scale microbiological methanation

- Modular scalability by stacking the methanation units to industrial scale
  - Indoor and outdoor installations
  - **Capacity from 5 MW to 100 MW and beyond**
- Centralized control building to operate whole system, aligned with customer control room



Methanation unit
- Parallel scalable unlimited
- Each module containing 29 bioreactors, which are the heart of the process

Control unit
- A central control building is used to operate full methanation stack.

The benefits on Q Power biocatalytic methanation

The heart of the Q Power process is the patented bioreactors. Unique structure and process enable the best process efficiency in the market, leading to low lifecycle costs. Due to the efficiency of the Q Power process, **the estimated annual electricity savings are significant** compared to other solutions.

Unique biological process.
Low energy losses and high plant efficiency 81%.

Robustness.
Methanation is tolerant to impurities, enabling multiple input feeds.

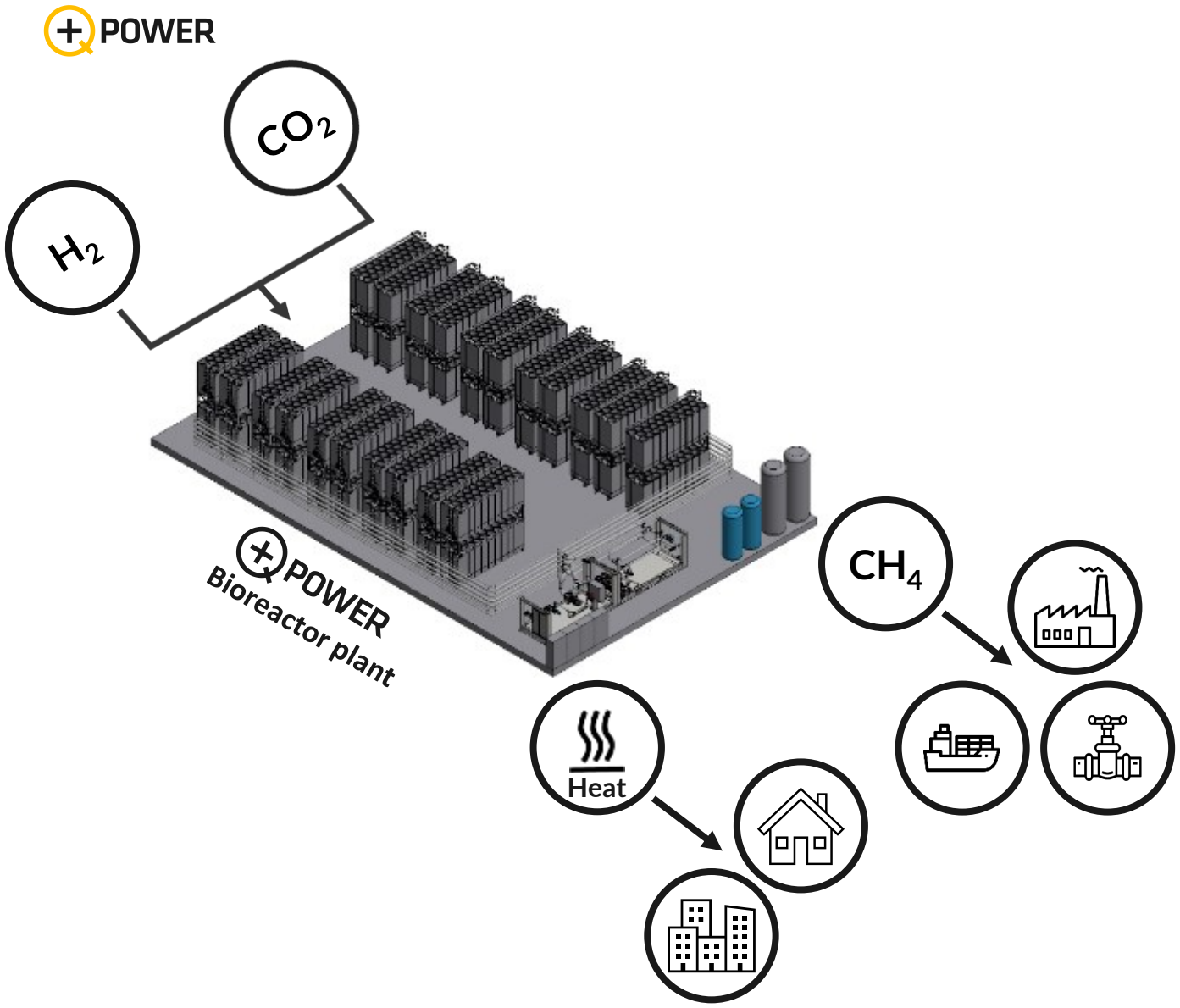
Scalability.
The modular design allows redundancy and easy capacity increase.

Easy to operate.
Process stability and a high level of automation ensure easy operation.

Low operational costs
Minimized need for lifecycle maintenance due streamlined technical solution.

Efficiency has a particularly significant impact on operating expenses of synthetic fuels because the cost of energy makes up a large portion of the price of the synthetic fuel produced.

Our products and services

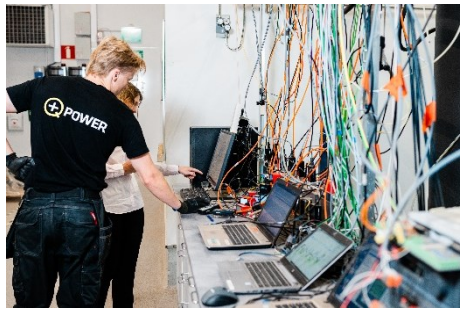


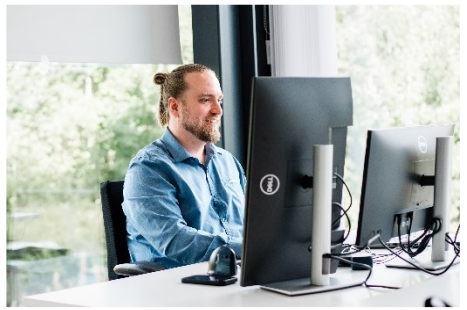
Q Power is a system integrator

We enable our customers to work towards a sustainable future. We turn emissions into valuable fuels and reduce fossil fuel consumption.

We offer full life-cycle turnkey solutions from expert services to plant design, implementation and operation to create a next-generation energy system based on eFuels.

Our biocatalytic methanation process utilizes microbes originally isolated from a Finnish marshland.





Services

Power to X deliveries based on own and partners' technology

Turnkey deliveries including manufacturing, installation and commissioning

- Methanation technology
- Carbon capture technology
- Hydrogen production technology
- Post-treatment of methane to the agreed quality

Methanation solutions based on our own technology

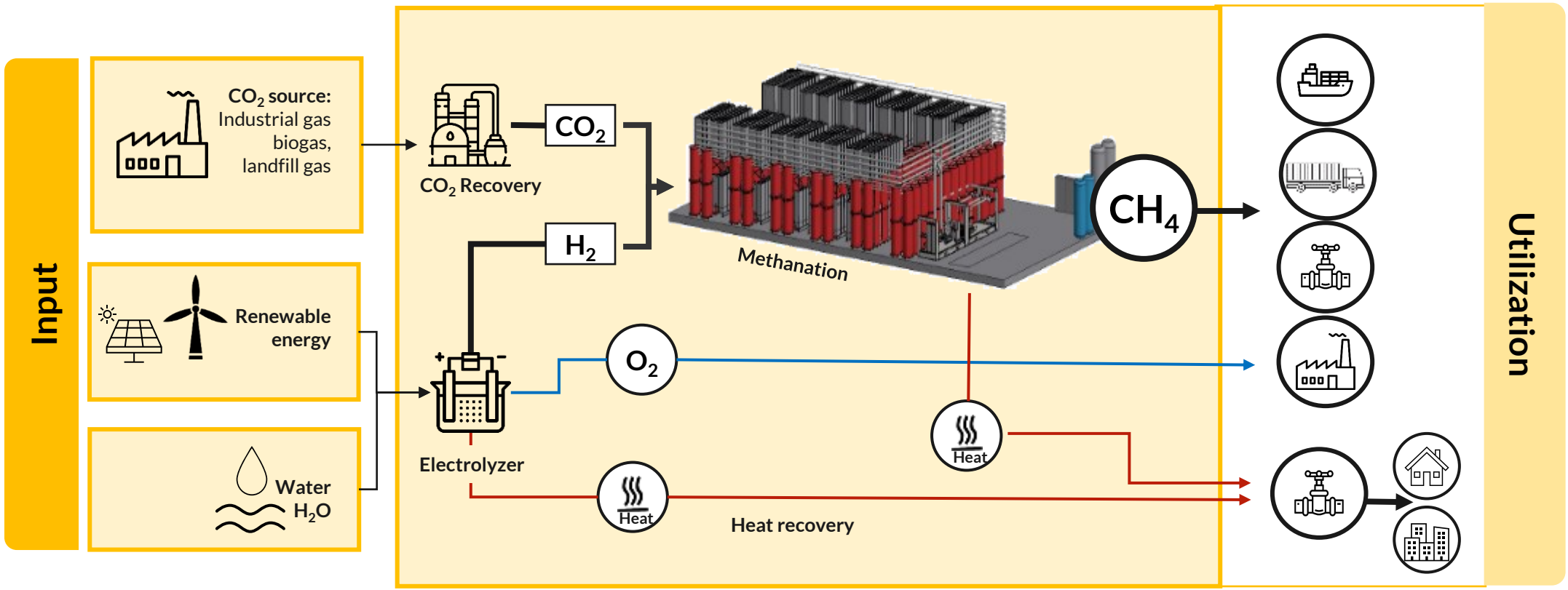
Turnkey deliveries including manufacturing, installation and commissioning

- Pretreatment of carbon dioxide as agreed
- Methanation technology
- Post-treatment of methane to the agreed quality

Expert services and pilot projects

- Power to X consulting
- Preliminary studies and profitability calculations
- Testing and analysis
- Piloting services from carbon dioxide flow to methane

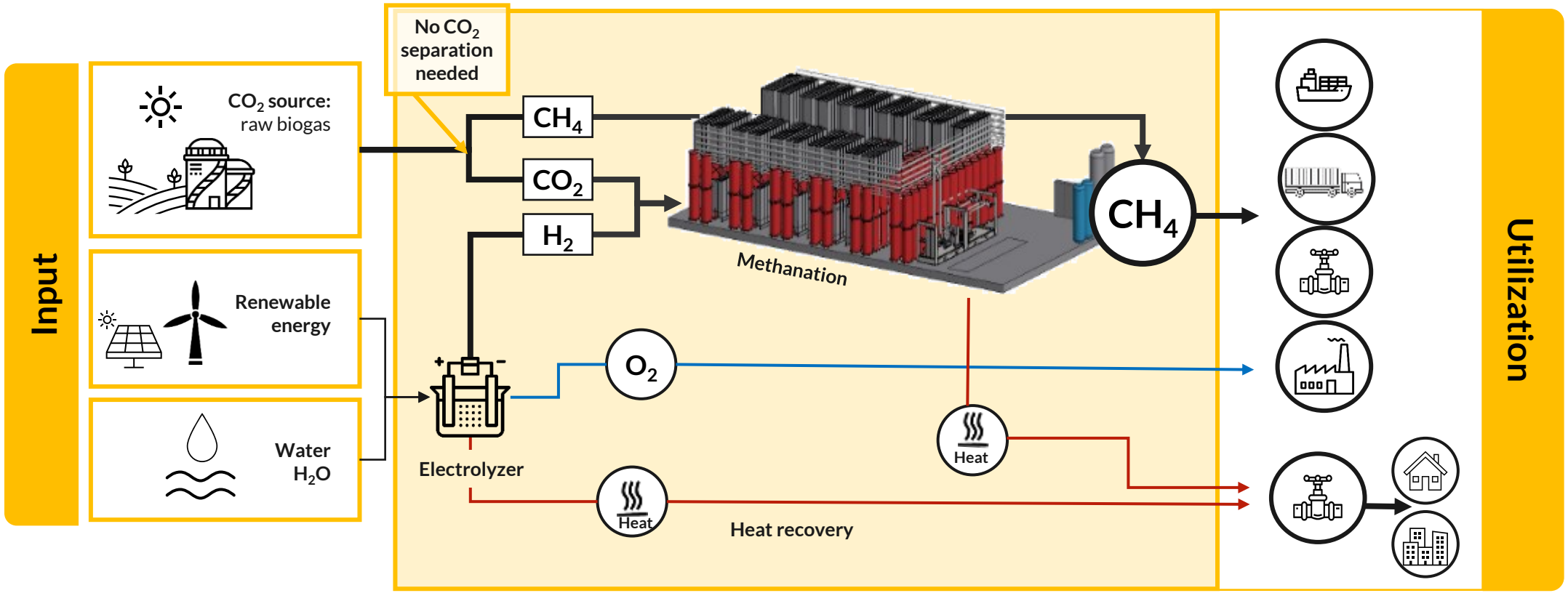
Q Power-to-X



Raw materials: Carbon dioxide, energy production, renewable electricity and water

End product: Renewable methane, green hydrogen, heat and oxygen

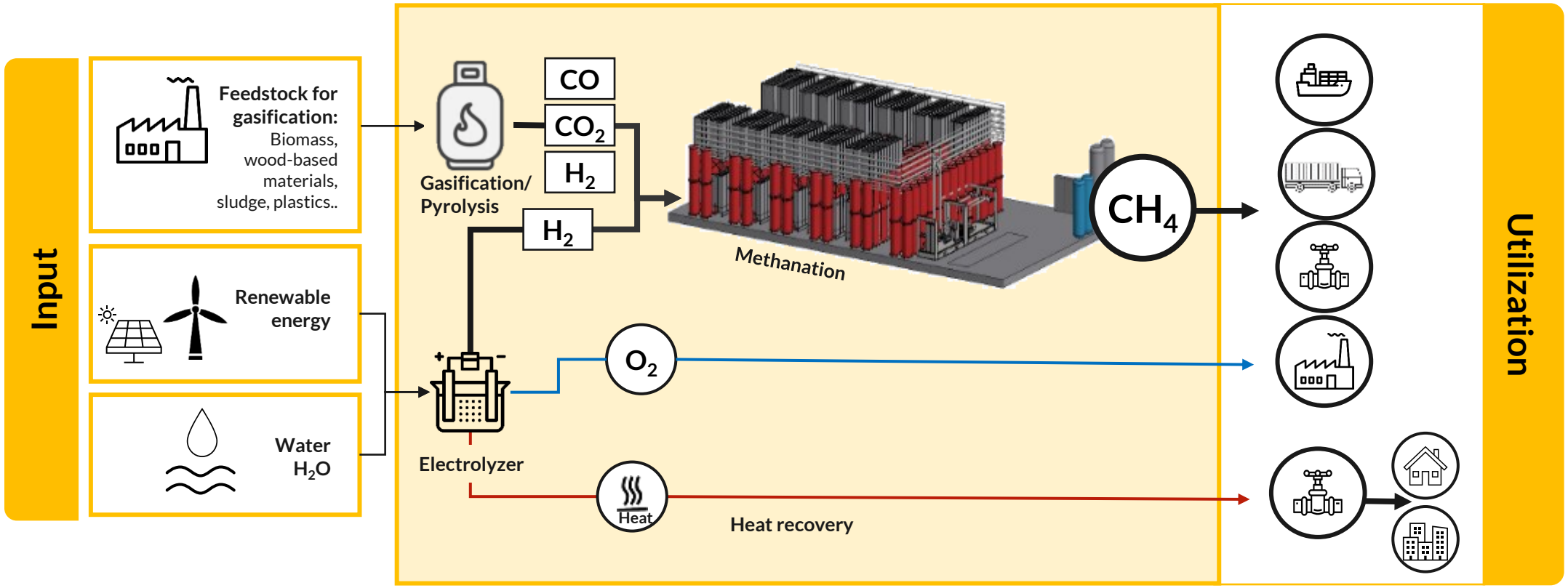
Q Power-to-X with biogas



Raw materials: Raw biogas or separated CO_2, renewable electricity and water

End product: Synthetic methane, heat, and oxygen + biomethane from biogas

Q Power-to-X with syngas



Raw materials: Synthesis gas (from sludge/wood/biomass/plastics etc), renewable energy, water

End product: Renewable methane, heat, oxygen + biomethane from syngas

eMethane in Hydrogen Economy Value Chain

Power-to-X projects and renewable energy projects support the energy market.

eMethane is a drop-in substitute for natural gas and LNG

weather-dependent energy production increases.

Carbon Capture & Utilization (CCU) reduces the need for new fossil fuels.

RFNBO fuel part of distribution obligation; increases the valuation of end-product

From piloting to industrial-scale synthetic methane production

10+ years of methanation journey to industrial scale

The journey begins
- research and collection of the first microbes

2007

ST1 methanating CO_2 side stream **from bio-ethanol** production

2019

A successful pilot in which **low-quality landfill gas** was methanized in Salo

2020

Strategic **Power-to-Methane** cooperation begins with Kerava Energy

2021

Waste-to-Energy pilot at **Fortum's** Riihimäki waste incineration plant.

2022

P2X Solutions and Q Power agree on the **first industrial-scale (3MW)** e-methane production facility

2022–

Research, development and piloting → **Commercializing** → **International**

10+

YEARS OF R&D

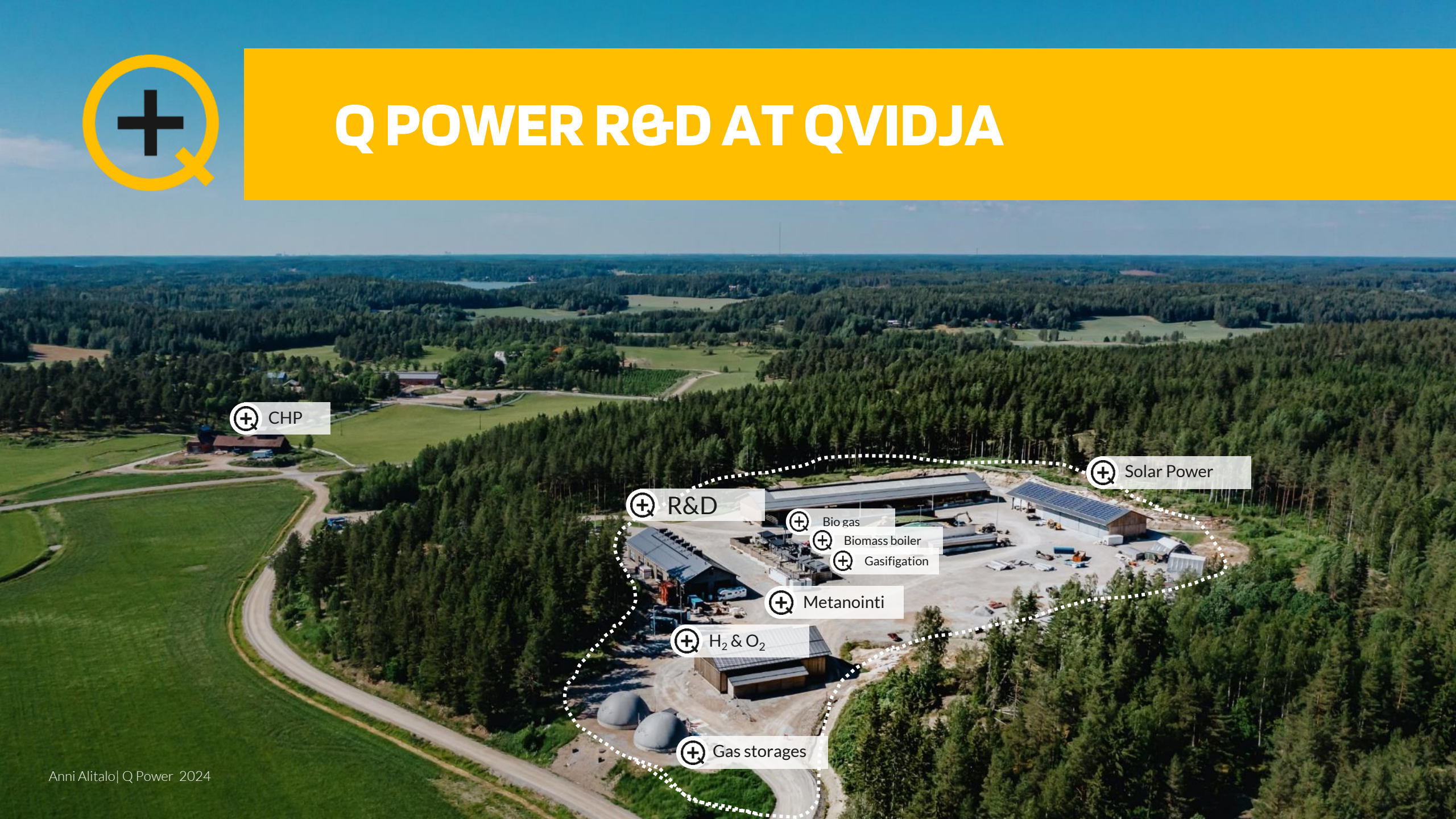
50+

PATENTS IN MAJOR MARKETS

81 %

METHANATION PLANT EFFICIENCY

Q POWER R&D AT QVIDJA



Production scale demonstration site

Qvidja R&D facilities include:

- Fully equipped **R&D laboratory** and **workshop**
- **Methanation facility**
- **Hydrogen production**
- **Oxygen production**
- **Solar power plant**
- **Oxygen gasifier**
- **Biogas plant and biogas boiler**
- **Gas storage & distribution**

At Q Power we are creative and always develop, test and build new things

We have experience on **selecting microbial communities** for desired purposes, **bioreactor development skills** and **microbiological process expertise**, good knowledge on **bioprocess development** (process control, fine-tuning and optimization), experience on **system automatization**, **scale-up** and **production-scale development**.

If you interested in collaboration, please contact us!

Q Power pilot unit – fully automated mobile unit for studying and demonstration purposes

We can demonstrate methanation on-site with customers' stream and verify its suitability for producing eMethane.

A pilot project can be part of or lead to a more comprehensive feasibility study of the operating environment on a detailed technical and economical
Q Power's mobile 12kW pilot unit implements methanation on a small scale

➔ Verifying the process for certain gas
➔ Uses bottled hydrogen
➔ Reduce overall risks
➔ Full analysis report and recommendations

References

Bioethanol CO_2 sidestream methanation pilot, Vantaa, Finland

In 2019, Q Power and Nordic energy company ST1 conducted a successful pilot methanating the CO_2 side stream from a bioethanol production process. Findings:

- Methanation process is operational and efficient in an industrial environment.
- High-concentration CO_2 side streams can be utilized as such.
- Residual concentrations of ethanol in the gas stream are not a problem.

Biopower plant flue gas methanation, Kerava, Finland

The pilot scale production of synthetic methane has been completed Dec 2021, designed to validate the methanation process with the specific flue gas composition. Q Power delivers, commissions, and operates the whole technology chain from the flue gas CO_2 capture to synthetic methane utilizable as traffic fuel.

Qvidja R&D center, Parainen, Finland

Q Power, together with our parent company Qvidja Kraft, has designed and implemented a versatile R&D environment at the Qvidja Manor in Parainen, Finland. The site includes a methanation plant, gasification plant, biogas plant, gas storages, solar power plant, biogas filling station, and a syngas powered micro-CHP plant. Q Power can utilize the site in developing various novel solutions for customers.

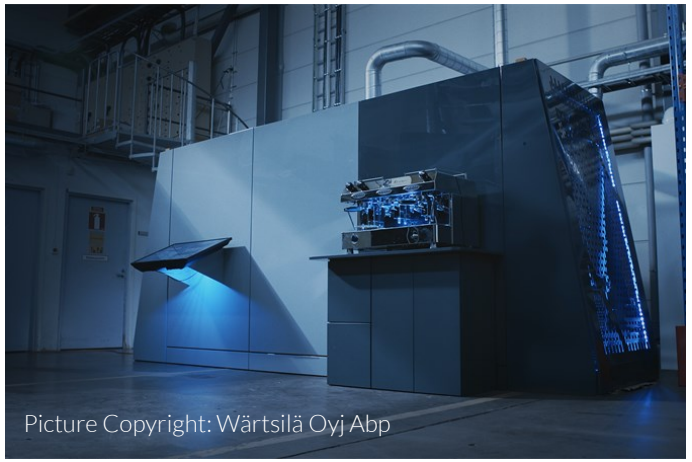
References


Picture Copyright: Fortum

Waste to energy plant flue gas methanation, Riihimäki, Finland

Q Power microbiological methanation enables Fortum's groundbreaking pilot. The aim is to recycle waste to energy plant CO_2 emissions into new materials.

Fortum together with Q Power conducted a pilot at Riihimäki waste-to-energy plant. Its aim is to capture carbon dioxide from flue gas and with added hydrogen, produced with renewable energy, the microbiological process will produce renewable synthetic methane. The produced methane can then be used as raw material for producing new, high-quality materials like plastics


Picture Copyright: Wärtsilä Oyj Abp

Wärtsilä Dubai EXPO unit –the smallest methanation plant

Q Power together with Wärtsilä and Soletair Power Oy demonstrated on a small scale how carbon capture and methanation works in practice. Produced methane was used to operate the espresso machine.

The demo plant produced synthetic methane from electrolysis hydrogen and carbon dioxide capture from indoor air. Q Power has designed and implemented an automated and remote-controlled biomethanation unit for the demonstration, while Soletair Power has completed the carbon capturing technology.

Landfill gas methanation pilot, Salo, Finland

In 2020, Q Power, Lounais-Suomen Jätehuolto and Lounavoima conducted a successful pilot methanating the raw landfill gas from the Korvenmäki waste management site. Findings:

- Even low-quality landfill gas is suitable for methanation in the Q Power process
- The methanation process is highly resilient to feed gas impurities
- Impurities (hydrogen sulfides and siloxanes) can be microbiologically metabolized to purify bio and landfill gas for end use

Harjavalta project

Harjavalta project

The Harjavalta plant will be **the first** industrial-scale green hydrogen and synthetic methane production plant **in Finland.**

The plant will be located in an industry park in North-East Finland.

The heat and oxygen generated as by-products of the process **can be utilized in industrial processes.**

Harjavalta project

CAPACITY:
Hydrogen plant 20 MW
Methanation plant 3MW.

The facility will **reduce Finland's carbon dioxide emissions by 40,000 metric tonnes per year.**

Green hydrogen and its downstream products promote the **green transition** in transport and industry, contributing to countries' **energy self-sufficiency.**

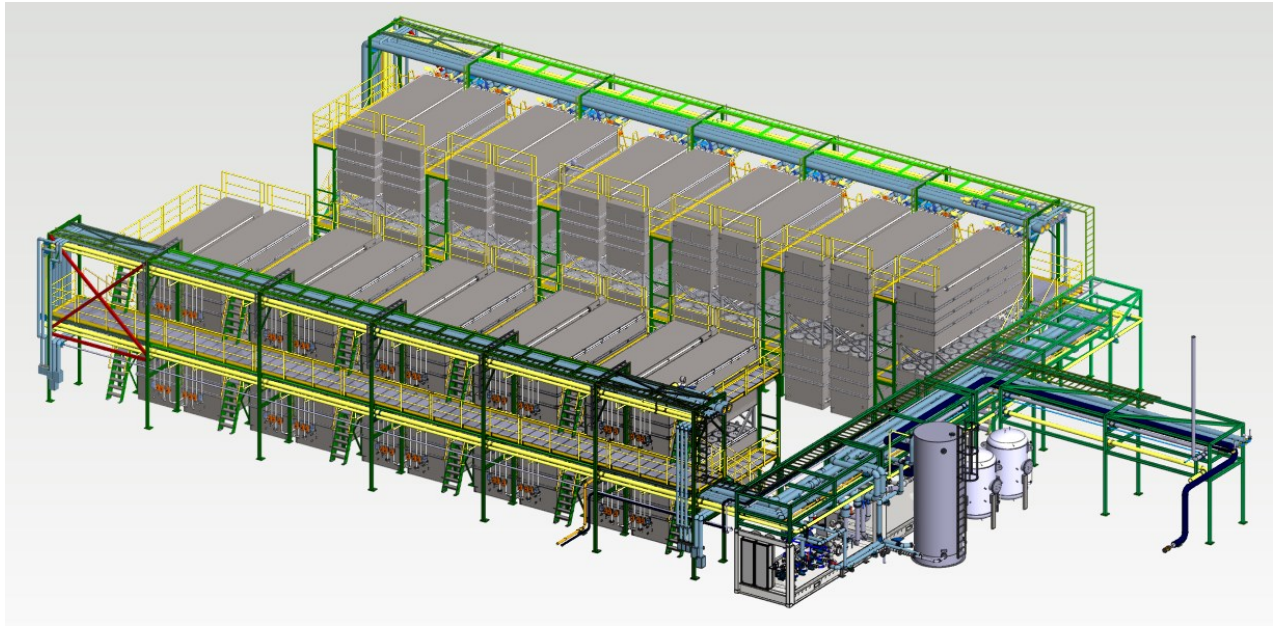
Green hydrogen production

- The electrolysis technology for producing the green hydrogen will be manufactured and delivered by Sunfire – one of the world's leading electrolysis companies.
- The pressurized alkaline electrolyzer will have a capacity of 20 MW and as by-products it generates oxygen and thermal energy needed by industries.
- When commissioned, the facility will produce green hydrogen for e.g. industrial needs by using electricity produced from renewable energy sources.
- There is market demand for example for green steel, in the production of which hydrogen plays an important role.
- Part of the sustainably produced hydrogen is processed into synthetic methane in the commissioned methanation plant.

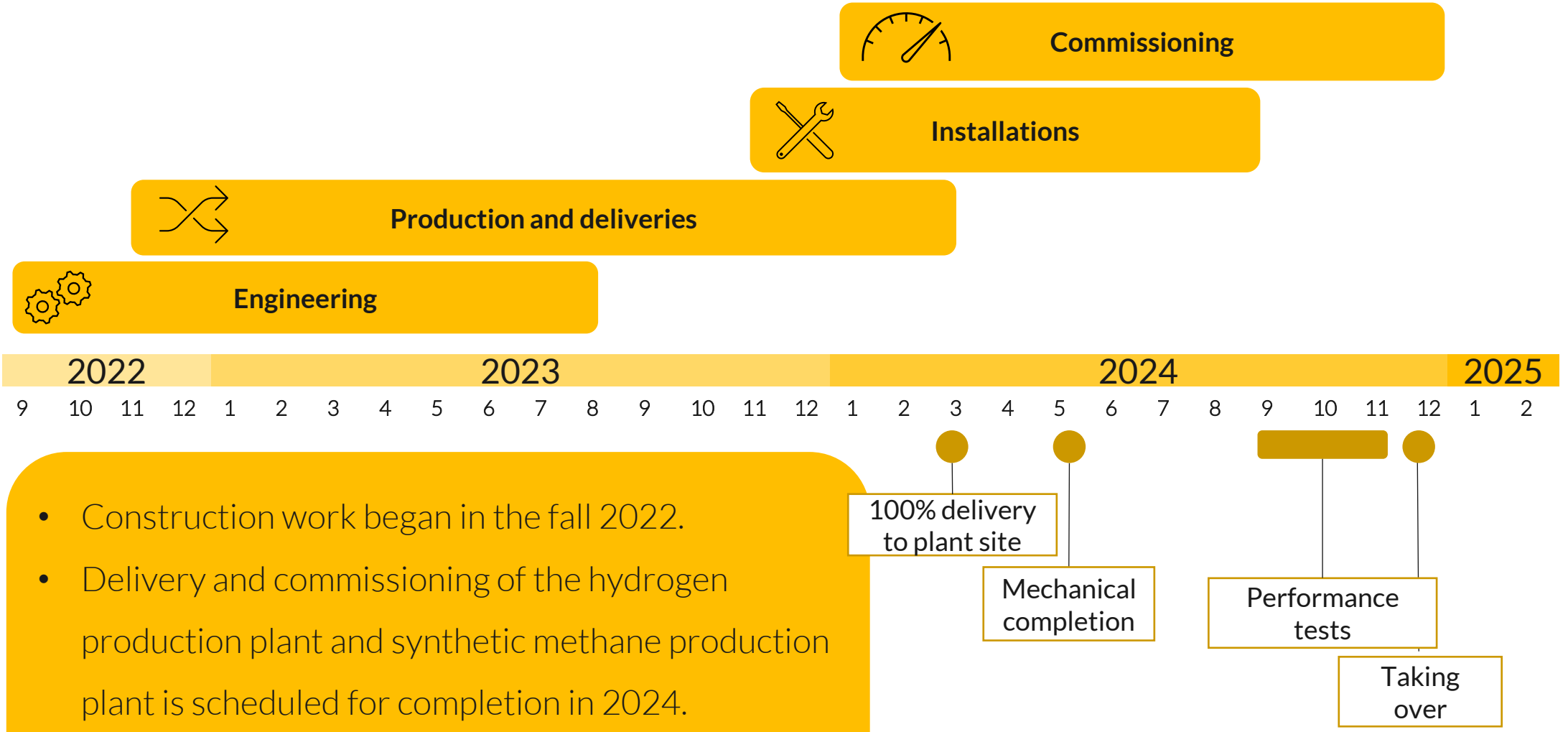
Methanation

Turnkey plant deliveries

- Design and manufacturing of the Equipment
- Full system automation and electrification
- Installation and commissioning
- Full documentation and certification
- Project management
- Training of Client's operation and maintenance personnel
- Expert services available during plant lifetime operation



Schedule



- Construction work began in the fall 2022.
- Delivery and commissioning of the hydrogen production plant and synthetic methane production plant is scheduled for completion in 2024.
- Commercial operation 2025.

Concrete solutions for fighting climate change

Thank you

Anni Alitalo
R&D Director