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# Carbon Capture and bio-LNG Projects evolution

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*First Decarbonization Seminar*

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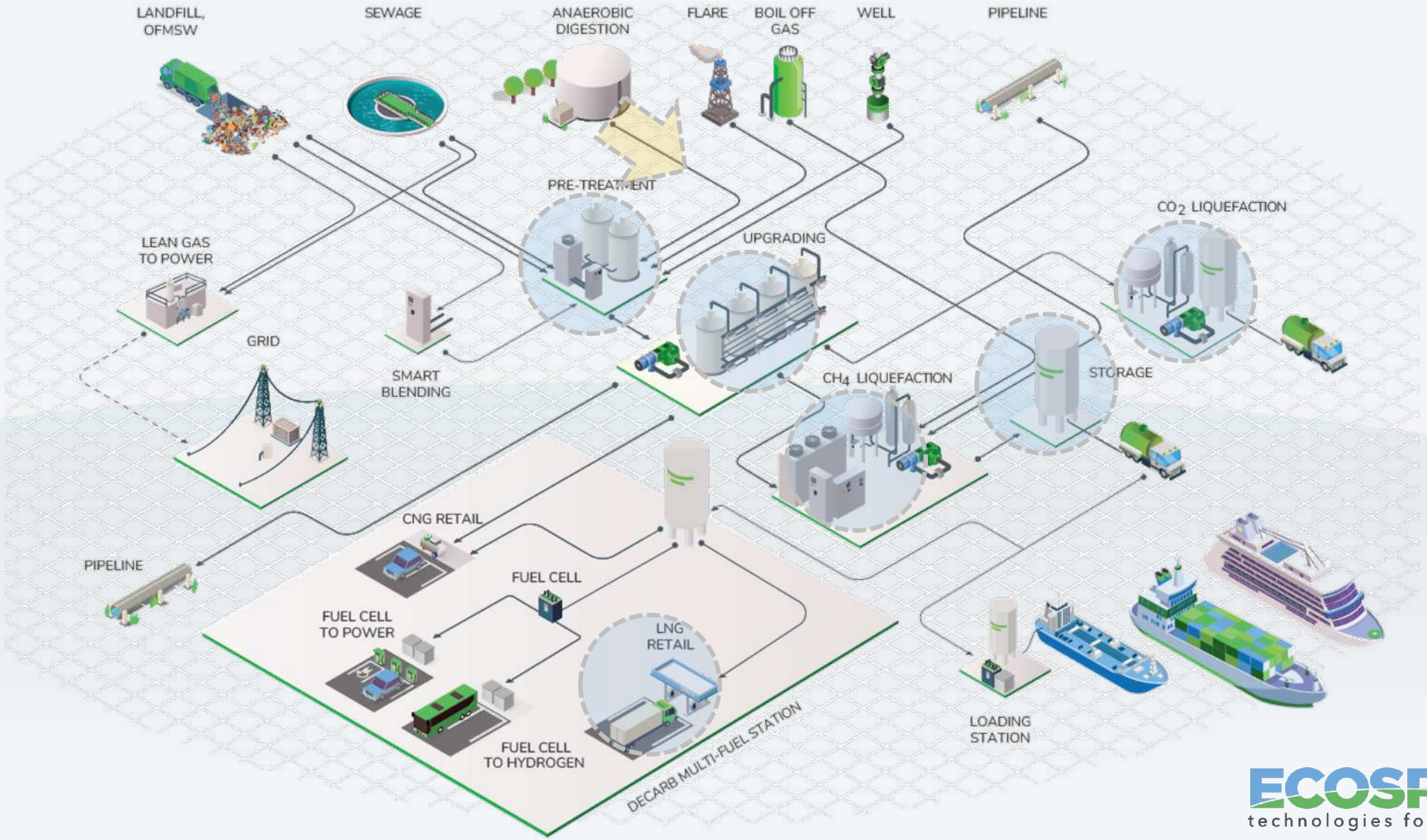
# **Clean Fuels:** bio-LNG and LNG solutions

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# **Clean Fuels:** bio-LNG and LNG solutions

**Ruhe Agrar Group**, a German company, one of the most important agricultural firm with 5 farming locations in Lower Saxony, Brandenburg and Mecklenburg-Western Pomerania.

In 2021 Ecospray and Ruhe signed a partnership agreement for the German market, first plant just completed in Darchau (MV).

In Italy Ecospray started 3 projects on farming facilities operated by a major European producer of renewable energies. The plants will be delivered in 2023.

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# Capture the future: technologies for decarbonization.

*First Decarbonization Seminar*

| Lower Saxony | LNG | $LCO_2$ |
|---|---|---|
| Capacity | 9 tpd | - |
| Delivery | Aug-23 | - |
| Production | Nov-23 | - |

| Mecklenburg-West Pomerania | LNG | $LCO_2$ |
|---|---|---|
| Capacity | 3 tpd | 6 tpd |
| Delivery | Jul-22 | Jan-23 |
| Production | Oct-22 | May-23 |

| Bavaria | LNG | $LCO_2$ |
|---|---|---|
| Capacity | 9 tpd | - |
| Delivery | Aug-23 | - |
| Production | Nov-23 | - |

| Mecklenburg- West Pomerania | LNG | $LCO_2$ |
|---|---|---|
| Capacity | 7.5 tpd | - |
| Delivery | Aug-23 | - |
| Production | Nov-23 | - |

| Brandenburg | LNG | $LCO_2$ |
|---|---|---|
| Capacity | 9 tpd | 18 tpd |
| Delivery | Dec-22 | Apr-23 |
| Production | Apr-23 | Aug-23 |

| Mecklenburg- West Pomerania | LNG | $LCO_2$ |
|---|---|---|
| Capacity | 3 tpd | 6 tpd |
| Delivery | Mar-23 | Apr-23 |
| Production | Jul-23 | Aug-23 |

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| Rivarolo del Re (CR) | LNG | $LCO_2$ |
|---|---|---|
| Capacity | 6 tpd | - |
| Delivery | Feb-23 | - |
| Production | Apr-23 | - |

| Serre (SA) | LNG | $LCO_2$ |
|---|---|---|
| Capacity | 9 tpd | - |
| Delivery | Feb-23 | - |
| Production | Apr-23 | - |

| Albanella (SA) | LNG | $LCO_2$ |
|---|---|---|
| Capacity | 9 tpd | - |
| Delivery | Feb-23 | - |
| Production | Apr-23 | - |

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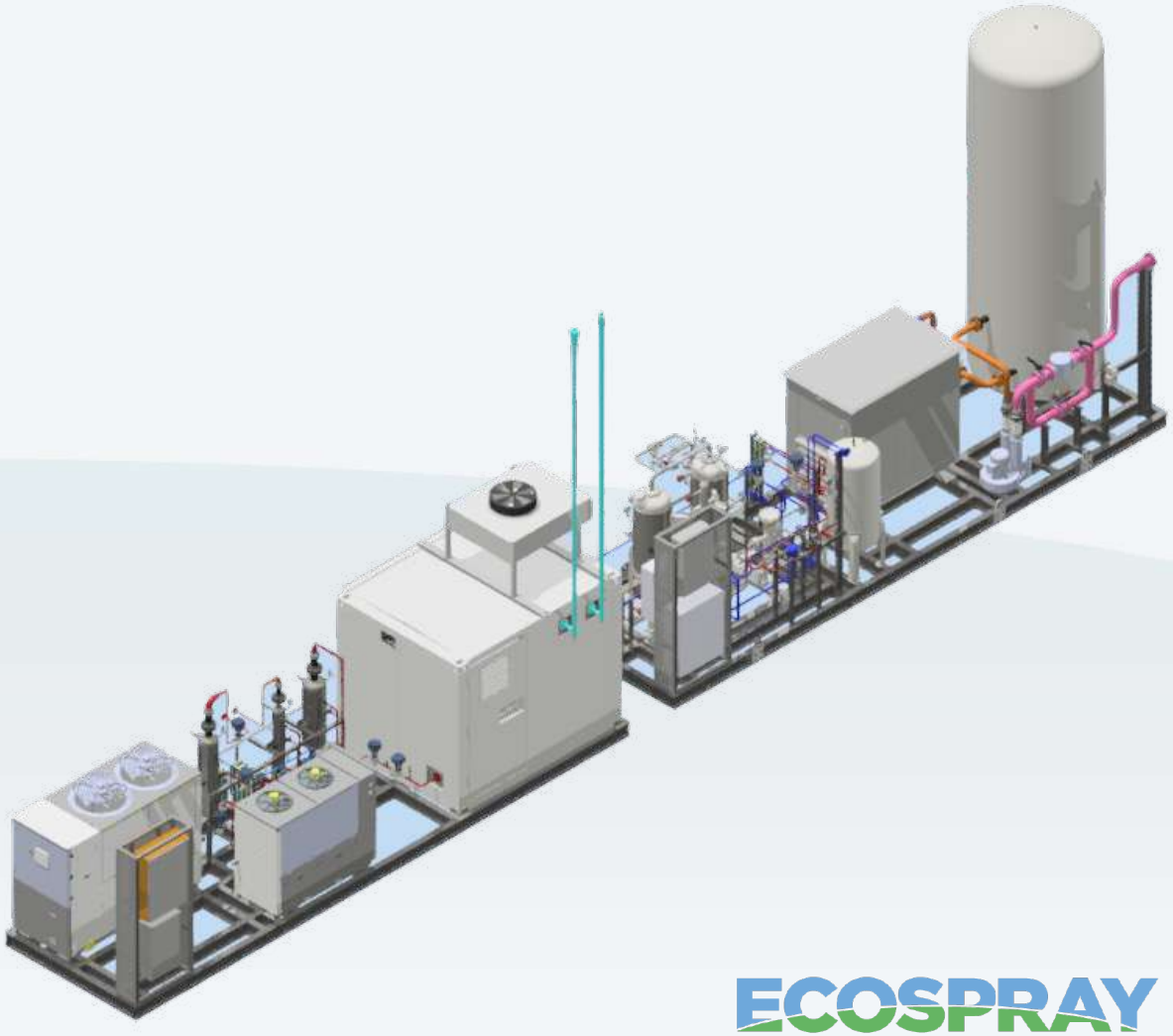
# **Clean Fuels:** $CO_2$ separation & liquefaction

As a part of the implementation of the European **Renewable Energy Directive (RED II)**, the German legislation already promotes the production of "advanced biofuels", with additional incentives for the **separation and liquefaction of $CO_2$ from biogas**.

Ecospray developed a proprietary technology in order to separate, purify and liquefy $CO_2$, wich is together with methane the main component of biogas (approx. volume share is in the range of 50% each of the total biogas). This will allow the production of **"Super-bio-LNG", i.e., renewable and carbon-negative LNG**.

The first additional $LCO_2$ stage will be delivered in Q1-2022 and will be producing **industrial grade** $CO_2$ (99.5% purity). An additional cleaning stage for reaching **food grade** purity (99.9%) and analysis/certification is already under development.



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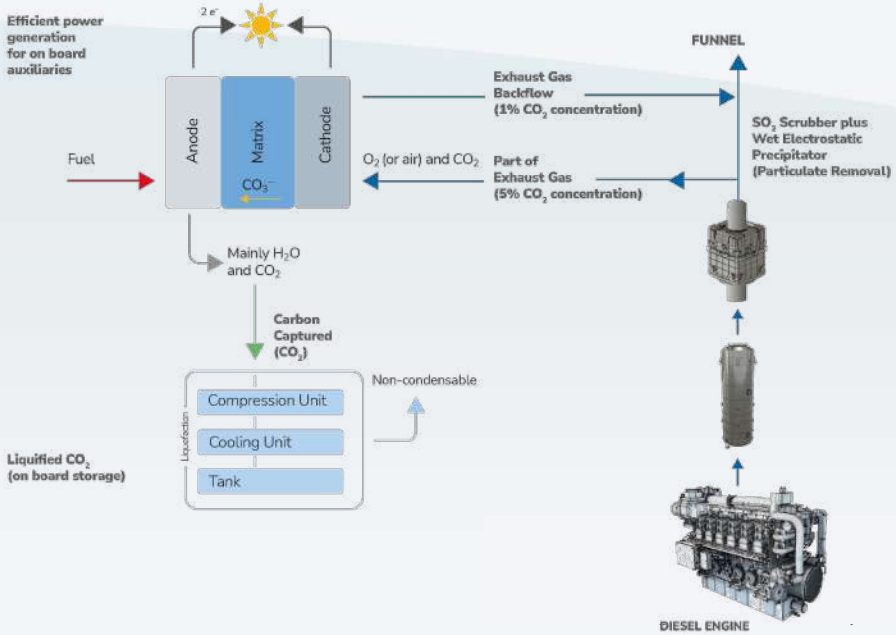
# MCFC & Super bio-LNG: ongoing studies

| Internal combustion engine | | |
|---|---|---|
| 100% MCR Power | **16.667** | kW |
| Load % | 60 | % |
| 60% MCR Power | **10.000** | kW |
| Estimated exhaust gas flow at 60% load | 83.069 | kg/h |
| Engine $CO_2$ emissions at 60% | **6.230** | kg/h |
| **bio-LNG production** | | |
| $CO_2$ | **50** | % |
| $CH_4$ | **50** | % |
| $CO_2$ capture efficiency | **90** | % |
| **MCFC** | | |
| MCFC output | **515** | kW |
| Power for liquefaction | **228** | kW |
| Net MCFC output | **287** | kW |
| **$CO_2$ balance** | | |
| Engine Power minus MCFC net output | 9.713 | kW |
| Corresponding exhaust gas flow | 81.157 | kg/h |
| Corresponding engine $CO_2$ emissions | 6.087 | kg/h |
| Reduction for $CO_2$ captured in the BIOLNG production | 337 | kg/h |
| Reduction for $CO_2$ from reformer and burner using BIOLNG | 374 | kg/h |
| Reduction for net $CO_2$ captured by MCFC | 386 | kg/h |
| Total $CO_2$ emissions | **4.990** | kg/h |
| **% $CO_2$ reduction** | **20** | % |

The potential application of **MCFCs fueled with Super bio-LNG** on a traditional vessel fitted with a **16.6 MW diesel engine** is ongoing, with the support and certification from **RINA**. The following step will be an application for **Approval in Principle**.

The studies performed so far showed very interesting results for this application, reaching a **net 20% $CO_2$ reduction** at 60% MCR with the installation of a **very small, 515 kW installed power, MCFC module**.



# bio-LNG for shipping: our thoughts

Source: The Maritime Executive 2021

Source: INDanube – PitPoint.LNG

- **LNG as a maritime fuel is already a reality**, particularly for passenger vessels, container vessels and, of course, LNG carriers
- The **trend for LNG-capable vessels will be further increasing** in the next years
- The **IMO decarbonization targets** will require both new technologies (e.g. carbon capture) and **carbon neutral/negative fuels**
- **Carbon taxes in the maritime industry will most probably speed up those trends**
- **Bio-LNG and bio-fuels in general will play a key role** in the decarbonization effort of the global maritime industry
- **New bunkering vessels and shoreside facilities** will further expand the market in the next years

**Join the (R)evolution**

**Questions?**

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