CRI technology and CCU project development in Norway

Benedikt Stefansson, Director of Business Development
Process21 and Innovation Norway workshop on CCU 2020-05-20
Carbon Recycling International (CRI): In a nutshell

New process technology utilizing green energy and waste

Launched 2006 in Iceland. Developed CO₂-to-methanol process. Built & operates 1st industrial scale plant 2012-

Covers full value-chain of renewable methanol. Selling certified e-fuel across EU market 2012 -

Turn-key technology provider developing and implementing CO₂-to-methanol projects in Europe and China.
CRI’s Emissions-to-Liquids technology

Energy & feedstocks

Capture

1.4 t CO₂

Synthesis

CO₂ + 3H₂ → CH₃OH

Electrolysis

0.2 t H₂

1.5 t O₂

11.5 MWh

2 t H₂O

Offtake

Methanol

Vulcanol®

1 t

11.5 MWh

CRI’s Emissions-to-Liquids technology

© Carbon Recycling International – CRI hf. all rights reserved

5/25/2020
CRI’s Emissions-to-Liquids plants 2012-

Svartsengi, Iceland 2012-
- Geothermal
- Electrolysis (Grid)
- 10 t/day (15 tCO₂)

Bergheim, Germany 2019
- Lignite coal power plant
- Electrolysis (Grid)
- Electrolysis (Wind)
- 1 t/day (1.5 tCO₂)

Luleå, Sweden 2020
- Blast furnace gas
- Blast furnace gas and electrolysis
- 1 t/day (1.5 tCO₂)

Henan, China 2022*
- Petrochemical processing
- Coke-oven gas
- 330 t/day (500 tCO₂)

*In project development
Commercial scale project development in Norway in partnership with Statkraft

Site: TBA
Energy source: Electricity from NO grid
CO₂ source: Metals industry
CO₂ conversion: 450 t/day
Methanol capacity: 300 t/day methanol
Investment: ~€150 million
Why Norway?

- Baseload electricity 100% from renewable sources
- Long-term power contracts and competitive pricing
- Strong infrastructure, workforce and industrial base
- Financial support for green industry projects
Project development based on internal mapping of CCU potential

Industrial emission sources*

> 150 ktCO₂/yr
8 Mt CO₂/yr

< 150 ktCO₂/yr
1.3 Mt CO₂/yr

* Excluding oil and natural gas processing

Ranking on two critical dimensions

- Hrs saling to ARA
- Power price

Capture €/tCO₂

Higher
- 20%

Lower
- 40%

Higher
- Lower

© Carbon Recycling International – CRI hf. all rights reserved
Why is the timing right to build a CCU industry?

Transport: Accelerate energy transition

Industry: Mobilize circular economy

Power: Intermittent energy penetration
Transport: Facilitate and accelerate energy transition

EEA 2030 target > biofuels + EVs

Green bunker fuel 2050 > total today

Source: EU RED II directive
Source: Smith et al. (2016), UMAS; CRI calculation
Industry: **mobilize cleaner circular economy**

**Linear economy**

**Circular economy**

CRI’s ETL process
**Power sector:** Increase penetration of intermittent renewable energy

<table>
<thead>
<tr>
<th>RES Power-to-X</th>
<th>Load balancing for grid</th>
<th>Valorise stranded energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseload</td>
<td>Load following</td>
<td>Intermittent operation</td>
</tr>
</tbody>
</table>

- Increasing utilisation of intermittent Renewable Energy Sources
- Decreasing cost of electricity for the ETL plant and reduced full load hours
What about cost and competing pathways?

Market pays for CO₂ abatement

Competitive CAPEX and OPEX

Cost drivers positive

Source: Ländalv, I et.al. (2017) EC

Source: Lazard (2019)
In 2024: First 100 kt power-to-methanol plant in Norway
Thank you

bs [at] cri.is
www.cri.is
@CarbonRecyclePR