Green LNG
Liquefied Bio Natural Gas in Hirtshals
Value Chain in Small Scale LNG and Business ideas’ for the Industry

HMN Naturgas A/S
Agenda

1. Presentation of HMN and Partners
2. Business Idea
3. Balancing and integration
4. Carbon reductions
5. The Project
HMN Group

HMN Naturgas I/S
owned by 57 Municipalities
Revenue: 3,805 mill. DKK
Net profit: 266 mill. DKK
365 employees

Distribution
+ 250,000 connected customers
Distributed volume; 1,498 mill. m3

Sales
+ 220,000 customers
Volume; 1,121 mill. m3
Net profit; 166 mill. DKK

Green LNG A/S
(During formation)

CNG

Key figures 2016

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Green LNG A/S
(During formation)
### Liquefaction plant – Business case Light

_Disclaiming of all the mentioned statement_

<table>
<thead>
<tr>
<th><strong>Liquefaction close to consumption</strong></th>
<th><strong>Liquefaction - imported</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas price: TTF + 1 euro/mwh</td>
<td>Gas price: TTF + 2 to 5 Euro/Mwh</td>
</tr>
<tr>
<td>CAPEX: 10 Euro/Mwh</td>
<td>CAPEX: 5 Euro/Mwh</td>
</tr>
<tr>
<td>OPEX: 5 Euro/Mwh</td>
<td>OPEX: 10 Euro/Mwh</td>
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</tbody>
</table>

**Pros and cons**
- Security of supply!
- Use of Biogas (a business case in its own)
- Balancing of the gas and power grid and integration (a business case in its own)
- LNG price TTF indexed!

High fixed cost

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<th><strong>Pros and cons</strong></th>
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<td>Transportation in the weekends?</td>
<td>Will the LNG price rise or fall?</td>
</tr>
<tr>
<td>Take or Pay?</td>
<td>LNG price TTF indexed or Oil indexed?</td>
</tr>
</tbody>
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Low fixed cost
Danish Gas System

In 2017 will biogas production in Northern Jutland exceed consumption in summertime.

In 2020 is biogas production expected to exceed consumption.

Balancing services to save “Back-Compressions costs”
Danish Power System

Consumption in DK = 3.710 MW
Windpower + Solar = 4.000 MW
(snapshot 20.04.2017, 16:32)

Windpower and Solar are increasing

Screaming for balancing services
Balancing & Integration

• A liquefier can

  • Secure gas consumption in the gas grid in (summer) nights and weekends
    • And hereby reduce cost to back-compression in the gas grid

  • Reduce power consumption (to zero), in night times without windpower
    • And hereby be a part of the power regulation regime
    • And/or optimize power costs according to LNG production

• In both cases it will depend on a calculations which takes into account the storage capacity and supply of customers.
Biogas and Carbon reduction

Calculation of carbon reductions can be done in 2 ways;

• The REDcert way;
  • In the process alone
  • Typical carbon reduction based on manure, straw and waste
  • GHG-savings at 85 – 90 % ~ 8 – 12 g CO2 eq per MJ

• Including derivate effects, as reduction of methane emissions at fields
  • GHG-savings up to 160 %

• LBG certificate
  • GHG-savings at 83 – 88 % ~ 8,1 – 12,2 g CO2 eq per MJ
  • @ liquiefier efficiency at 98 %, can be improved by windpower
Biogas Markets and customers

- Land based customers
  - Trucks at EU’s Blue Corridor
  - Off-Grid customers who wants greener image
  - And/or driven by environmental/economical attraction (higher value for customers customer)

- See based customers
  - Ferry in national services (local demands)
  - Local Ships like Tug Boats and supply Ships for Oilfields or Windfarms
  - Long terms; Ship Fleets in international services who wants to reduce the total emission.

- LNG Terminals near Hirtshals, who want to provide customers with a green alternative

- Price for LBG ? As LNG + biogas fee
  - Driven by demand and the value of the exact GHG-savings on the specific biomass.
Green LNG A/S (during formation)

Project Partners

Fjord Line
Secure basic consumption

Skangas
Knowledge in LNG Markets & handling & transport & bunkering

HMN Naturgas
Knowledge in Energy Markets & hedging & gas- & biogas-supply
The Project

Capacity: 160 ton/day
Storage capacity: 750 – 2.500 tons
Area needs: 15.000 m2
Power capacity: 4 MW

Produced capacity:
~ 56.000 ton = 70,0 mill. m3* (per year)

Price estimate: 50,0 mio. Euro

Construction time: 24 – 30 months

First delivery: Q1 - 2020

* 1 ton LNG = ~ 1.250 Mn3 (Danish grid quality)
The Project

- EIA application
  - Expected approved January 2018

- CEF application for Grants
  - In process
  - By July 2017
  - Approved by end of 2017

- Contract signing by end of 2017
  - Depending on Grants
Thanks for your attention

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