From Field to Ferry
Liquid Biogas as a marine fuel of the future
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Samsø
Fossile Free Island

Building a local supply chain from "Field to Ferry"  
Fossil free test bed demonstration  
Local vessel development
Building a local supply chain from "Field to Ferry"

From imported fossil fuel dependency to

Local resilient development
The Island of Samsø:
3.712 inhabitants
114 square km
28 km N to S

1 Hour trip

1 Hour, 15 minutes trip
Farming community
Summer Tourism
District heating homes and businesses - with biomass and sun
Using waste straw and wood chips
Powering electricity with wind
As you can see, there's plenty going on!
Now we have lots of wind turbines.
Down there is Samsø's brand-new learning center, the Energy Academy, where kids and grownups from all over the world come to learn about what we've achieved, and to talk about new ideas for creating, sharing, and saving energy.
Local ownership ... literary!
WE ARE IN THE CENTER
OF OUR OWN LIFE

HERE WE CAN DO
SOMETHING!

Søren Hermansen

Bigger Picture
Stine Arensbad

Alt med en s
Søren

Municipality

Fossil Free Island

Being on the cutting edge!

Potatoe ferry!

Many passionate people!
Samsø Fossile Free Island
Why we choose LNG?

LNG operating costs compared to MGO?
2012: Decision to bid on our own tender on the west route
2013: Tender won - build 1 ferry - ASAP
Forecast marine fuel price paths

Price [$/mmBtu]

2011 2015 2020 2025 2030 2035

LNG fuel
HFO
MDO
World LNG Trade (2015)

Total Sales = 337mt
(13% of global gas consumption)

NB. All figures are rounded million tonnes of physical deliveries in CY2015. Excludes amounts <1mtpa.

Source: IEC modeling
Methane emissions per animal/human per year

120kg Western cattle
60kg Non-western cattle
8kg Sheep
1.5kg Pig
0.12kg Human

Source: NASA's Goddard Institute for Space Science
LNG operating costs compared to MGO?
LNG powered Ferry

- 600 pax
- 160 cars
- 1 hour trip
- Dual fuel engines

- 27 million euro
- 7,000 euro per islander

Is there an alternative to the established supply chain of LNG?
600 pax
160 cars
1 hour trip
Dual fuel engines

27 million euro

7.000 euro per islander
LNG "Pit-stop" - Formular 1 racing equivalent
Refueled in 15 minutes!
New LNG trailer delivered every 3 to 5 days - depending on consumption
Daily consumption app. 10 m³
Added price for LNG vessel and bunkering system – 5%-10%
Is there an alternative to the established supply chain of LNG?
Local Liquid Biogas Supply chain
Biogaskæden
Methane yield from biomass resources on Samsø
There is enough biomass on the Island!
### Ægnetank

**Stålkonstruktion**
- Diameter: 22,5 m
- Højde: 21 m
- Effektiv volumen: 4800 m³/tank

### Lagertank

**Beton**
- Diameter: 22 m
- Højde: 5 m
- Effektiv volumen: 1500 m³

- **EN**
- **RT**
- **BI**
- **MT**
- **BL**
- **M**
- **LT**
- **GL**
Biogas Composition (Approximate)

- Methane Gas (60%)
- Carbon Dioxide (39%)
- Other Gases (1%)
Nano scale liquefaction

Full scale
- Capacity 300 m³/hr for raw biogas (H₂S, CO₂, NH₃, H₂, CH₄)
- < 30°C at top of HRU
- Total power consumption < 1.2 kWh/kg

Cryofuel

GAUDEO Cryobox references
More than 25 plants put into operation worldwide over last 4 years

Raw biogas pre treatment
Cooling techniques varies
OPEX => Power consumption
Nano scale liquefaction
Full scale

Capacity: 530 Nm³/h raw biogas (55% CH₄ / 44% CO₂ / 1% N₂/O₂
+/- 5 T / day Bio-LNG
Total power consumption +/-. 1,2 kw / kg
GALILEO Cryobox references

More than 25 plants put into operation worldwide over last 4 years
Typical Plant Layout

1. Gas pretreatment
2. Liquefaction
3. LNG storage
4. Electrical and control system
5. Truck loading

10m
Raw biogas pre treatment

Cooling techniques varies

OPEX => Power consumption
Dynamo for rural development
**Figur 1:** Principdiagram i anlægget med to linjer for at recirkulere øens reststrømme til landbruget

- **Affald-tillressource-linje**
  - Biorest til græs

- **Grøn linje**
  - Gylle, halm, græs, rester
  - Biorest til alle afgrøder
Technically possible?

Building a local LBG supply chain from field to Ferry

YES
Technically possible?

Building a local LBG supply chain from field to Ferry

YES
YES
Financially feasible?

TOTAL: 10 mill euro

With the current energy prices - NO
Renewable energy directive - Maybe!
LBG marine fuel of the future?

CO2 neutral
Local job creation
Resilient communities
Circular economy

Will we be brave enough to do it?
LBG marine fuel of the future?

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