BIOGAS FOR MARITIME TRANSPORT IN BALTIC SEA, KATTEGAT- SKAGERAK-REGIONS

SAMSØ STATUS AND EXPERIENCES

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BioGas2020

Interreg Öresund-Kattegat-Skagerrak European Regional Development Fund

EUROPEAN UNION

SAMSØ KOMMUNE

ENERGI AKADEMIET

Interreg Baltic Sea Region Go LNG

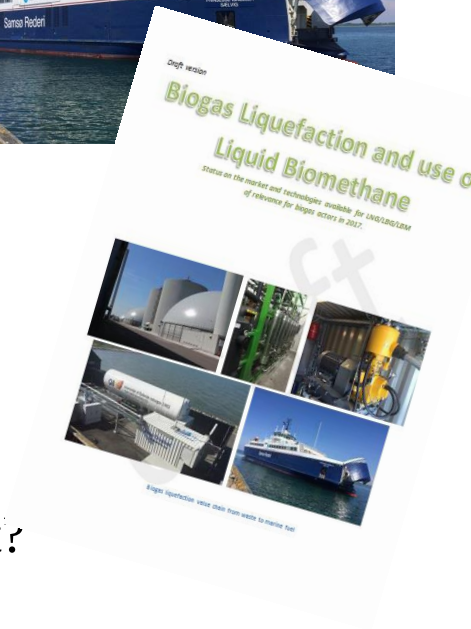
midt regionmidtjylland

Biogas2020

- Together we create a Scandinavian Biogas Platform

GoLNG



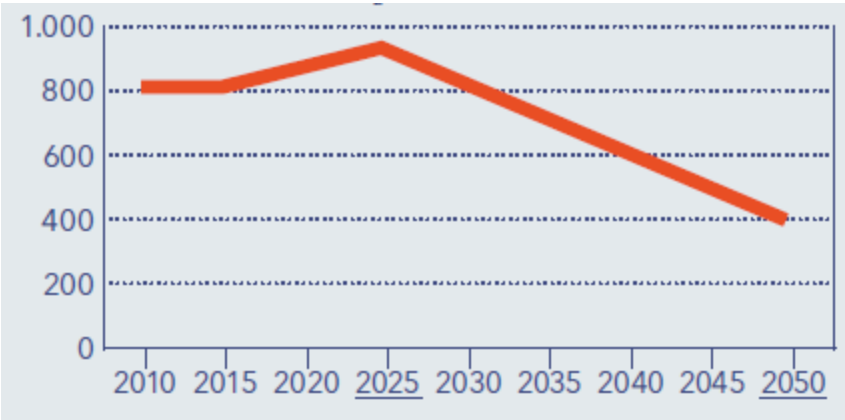



Content

- Intro
- Why do we want Liquefied BioMethane (LBM)?
  - The market now and in the future
- How to make LBM – the technologies
  - Biogas OsloFjord, DTU, companies
- The scale - economic aspects – Can we make a living of it?
- The Samsø Case
  - Status and perspectives

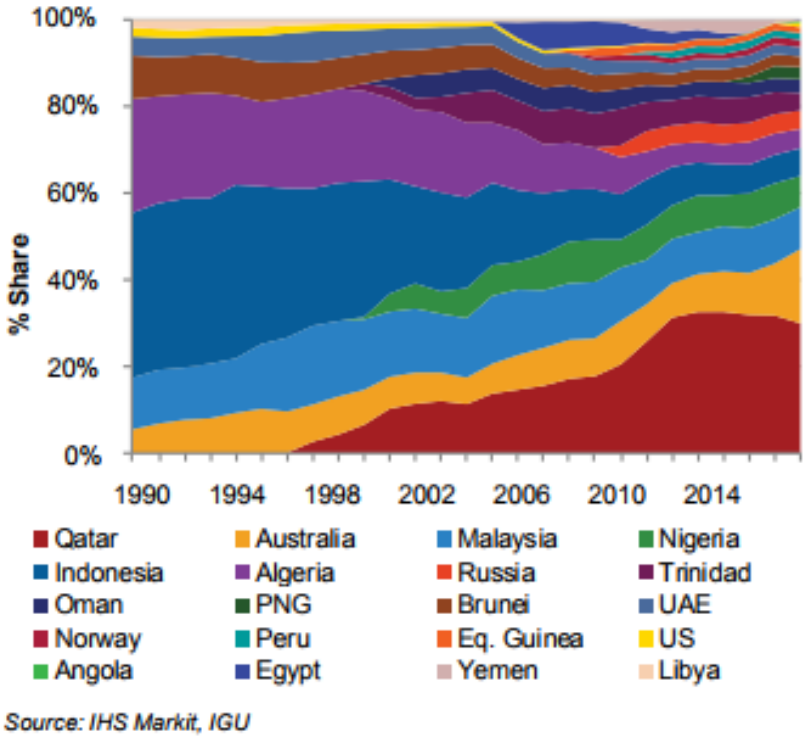
Why Liquefaction of Biogas?

- Biogas has negative GHG emission – if manure/waste based!
- Biogas (CNG/LNG) can solve energy needs for Heavy transport – virtual pipeline
- Traditional biogas arguments….
- It costs around 10% of energy to liquefy



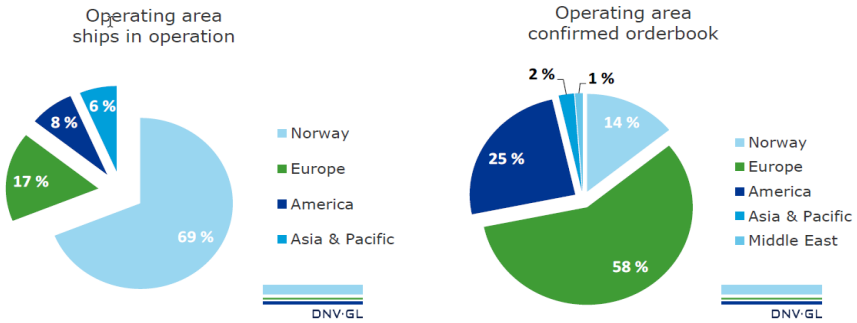
- Why marine sector? Energy density
- 2,5% of total global GHG emission
- Emission Control Areas
- Paris agreement
  - Reduce GHG emission by 50% in 2050
- RED biofuel blend incentives – new market

LNG global market



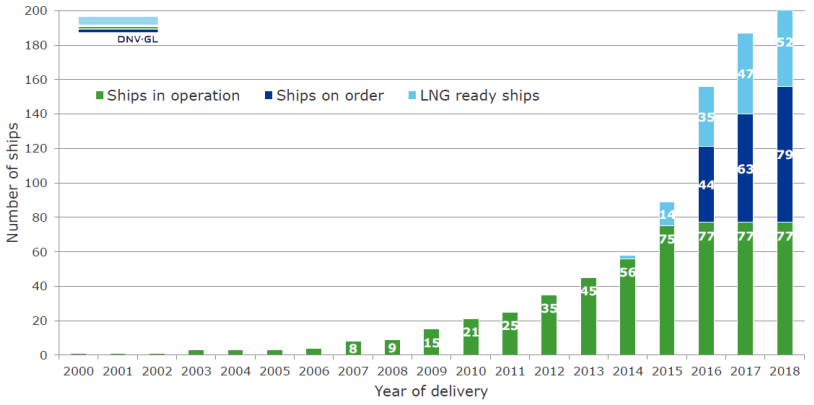
Source: IHS Markit, IGU

Figure 6. Share of global LNG exports by country 1990-2016- Source IGU World LNG Report — 2017 Edition



Updated 21 March 2016

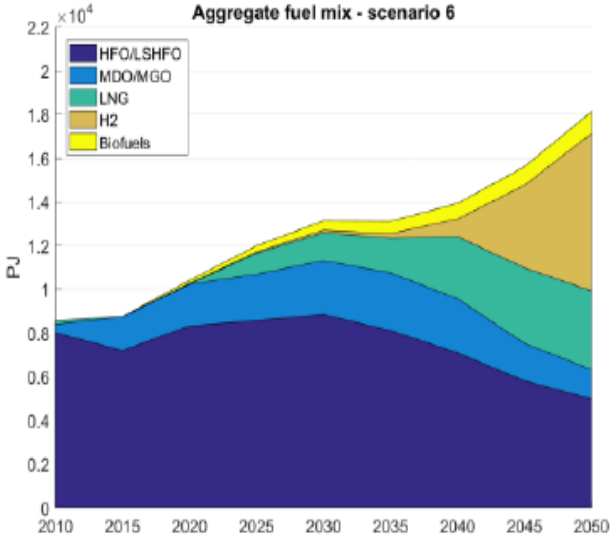
There are currently 162 confirmed LNG ship fuel projects

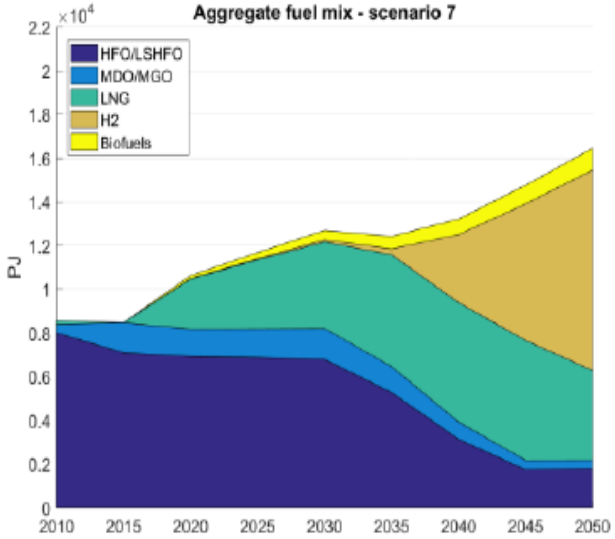


Additional orders beyond 2018 are confirmed

Updated 21 March 2016

Future Marine fuel scenarios

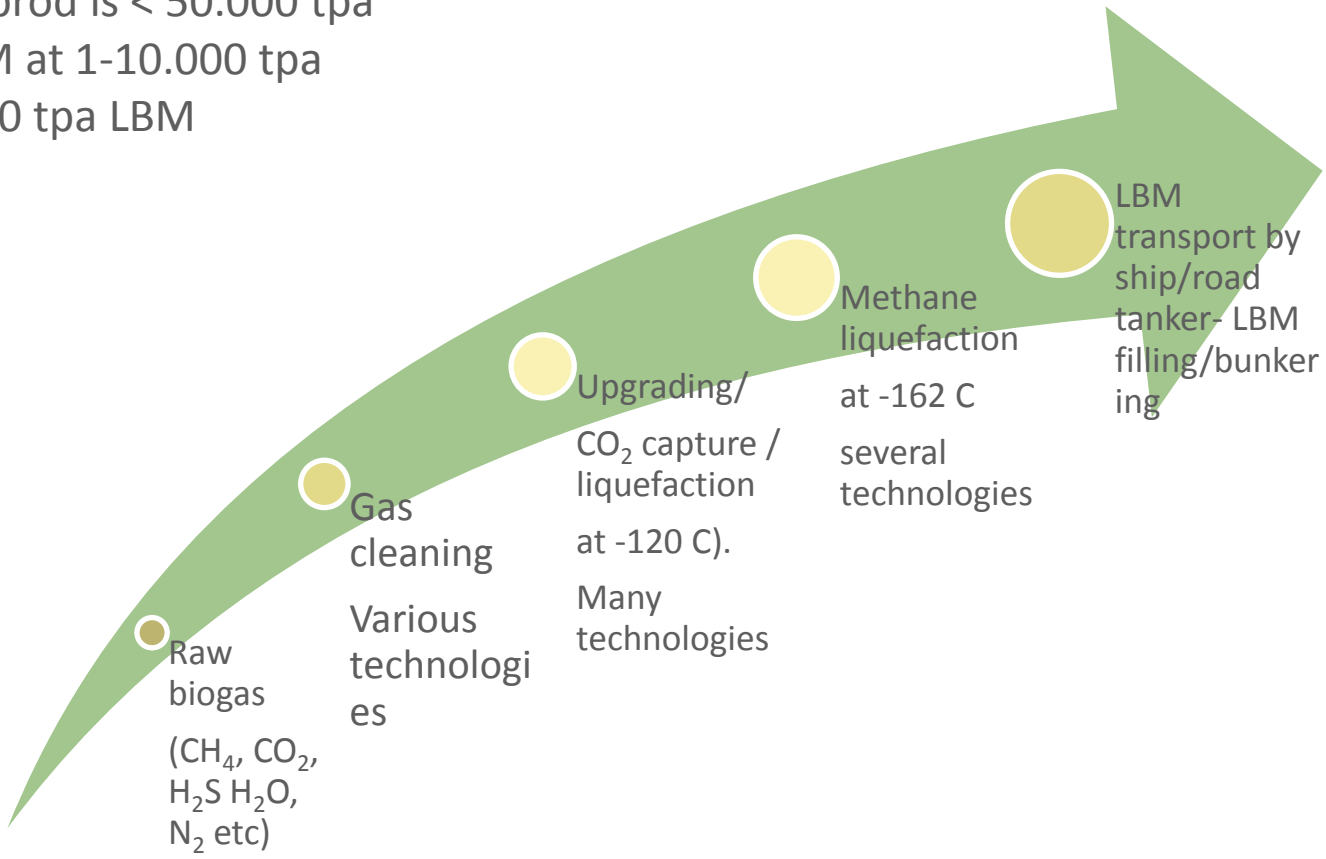




- Smith et al 2016 http://www.lowcarbonshipping.co.uk/files/ucl_admin/DSA_2016_Co2_emissions_in_shipping.pdf

Steps towards Liquefied Biomethane

The small scale is the major challenge
LNG at large scale > 1 mio tonnes annually
Global LBM prod is < 50.000 tpa
Biogas-> LBM at 1-10.000 tpa
Samsø < 3000 tpa LBM



Existing Biogas Liquefaction plants

Company/Technology	Country	Biomass source	Annual production of LBM (tonnes)
Hamworthy/Wärtsila Mixed refrigerant	Norway	waste	3,600
Hamworthy/Wärtsila Mixed refrigerant	Norway	waste	3,300
Air Liquide	Sweden	waste	4,900
Air Liquide	Italy	?	3,100
Gasrec, Mixed refrigerant	UK	landfill	6,000
Gasrec, Mixed refrigerant	UK	landfill	5,000
Linde, Single mixed refrigerant	US	landfill	7,200
Linde, Single mixed refrigerant	US	landfill	10,000
Total LBM production			**43,100**

The companies delivering

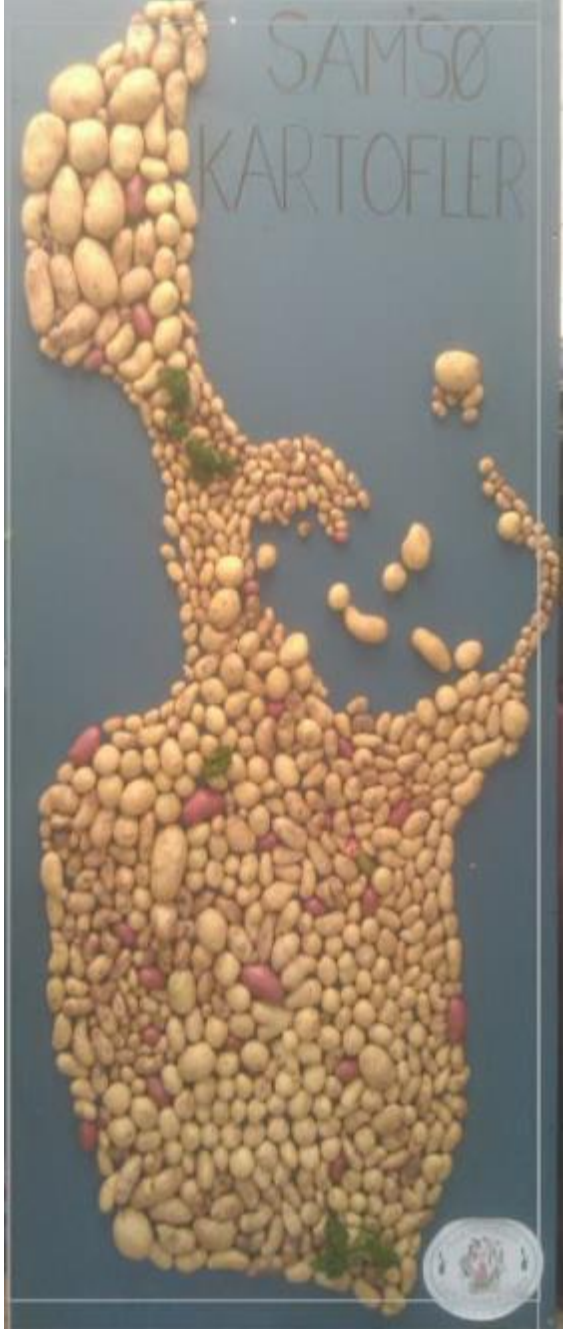
	Cryo Pur	Wärtsilä (Wärtsilä Puregas Solutions & Wärtsilä Gas Solutions)	Nærener… Da… …gies	Kosan Crisplant
Technology used (short description for non technical personnel)				
Production Capacity/range [day/year]				
Site requirements [m^2] (footprint of facility)				
(Range of) production cost pr. [SI uni… (kg./liter/ton/Nm^3)				
O&M Cost				
Methane slip (… describe how b… avoided)				
Advantages				
Disadvantages				
Number of facilities and production capacity installed world wide				

Several projects under way:
Kosan/Nature Energy, HMN, Samsø, SKOGN (Norge)

Scale is the challenge
– biotickets may become the solution

Samsø - The island of gathering

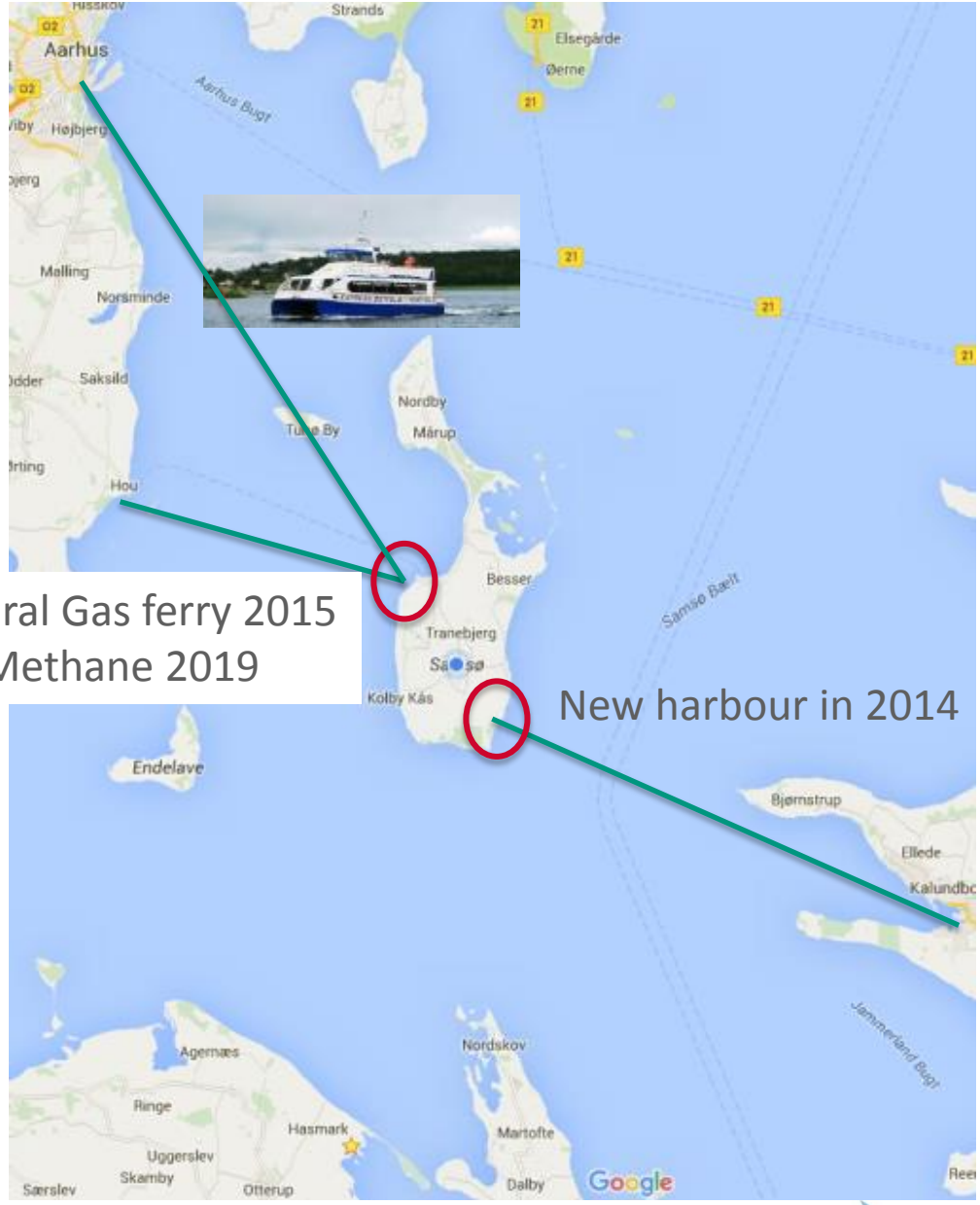
- 3700 inhabitants, 7x30 kms
- Independent municipality administratively
- Agriculture, grain, pigs and milk
- Vegetables – intensive cultures
  - potatoes, onions, cabbage
- Tourism, green energy, gastronomy



Connections and cooperation

Liquid Natural Gas ferry 2015
Liquid Bio Methane 2019

New harbour in 2014



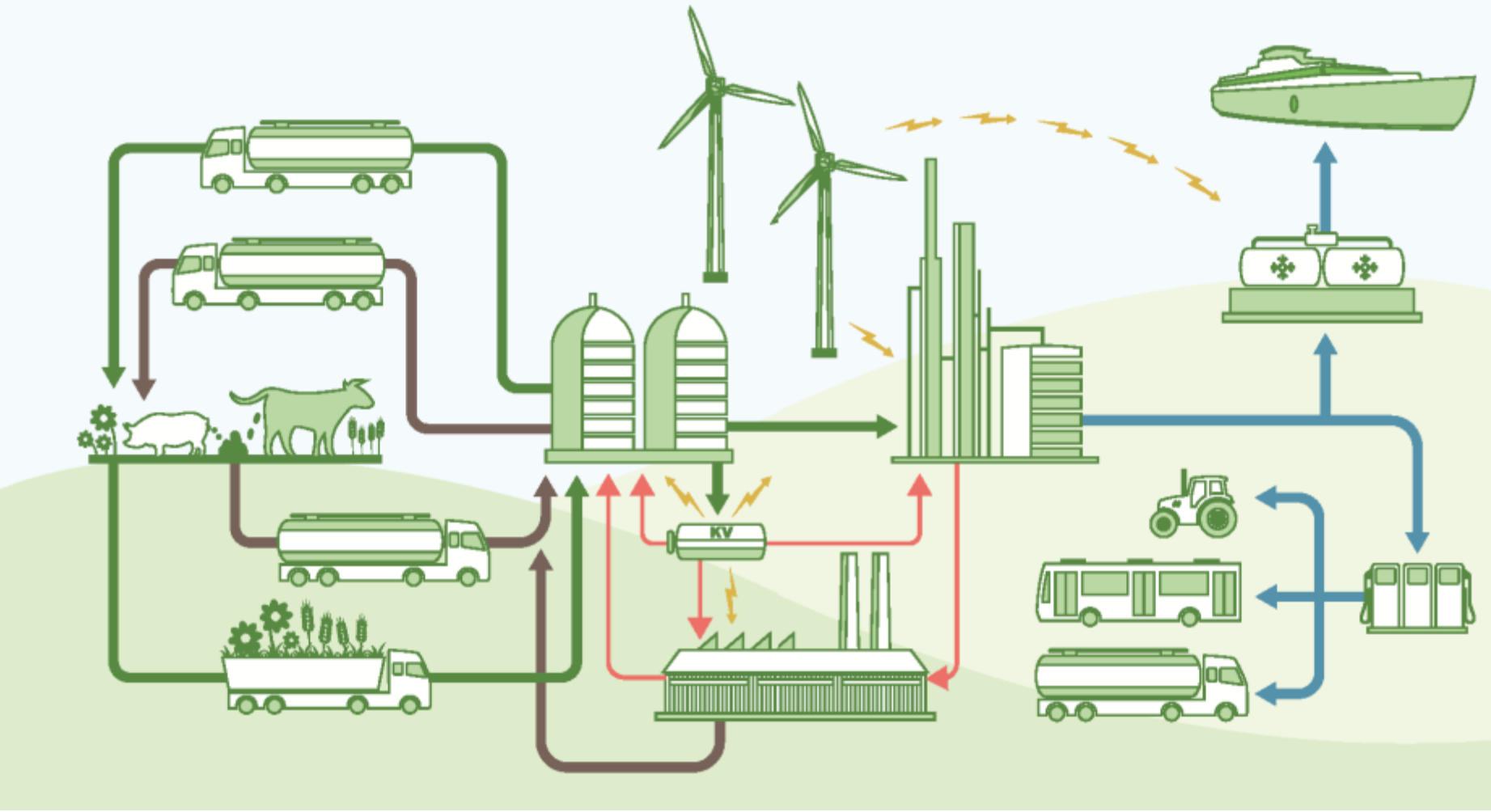
The Challenges for circular Samsø

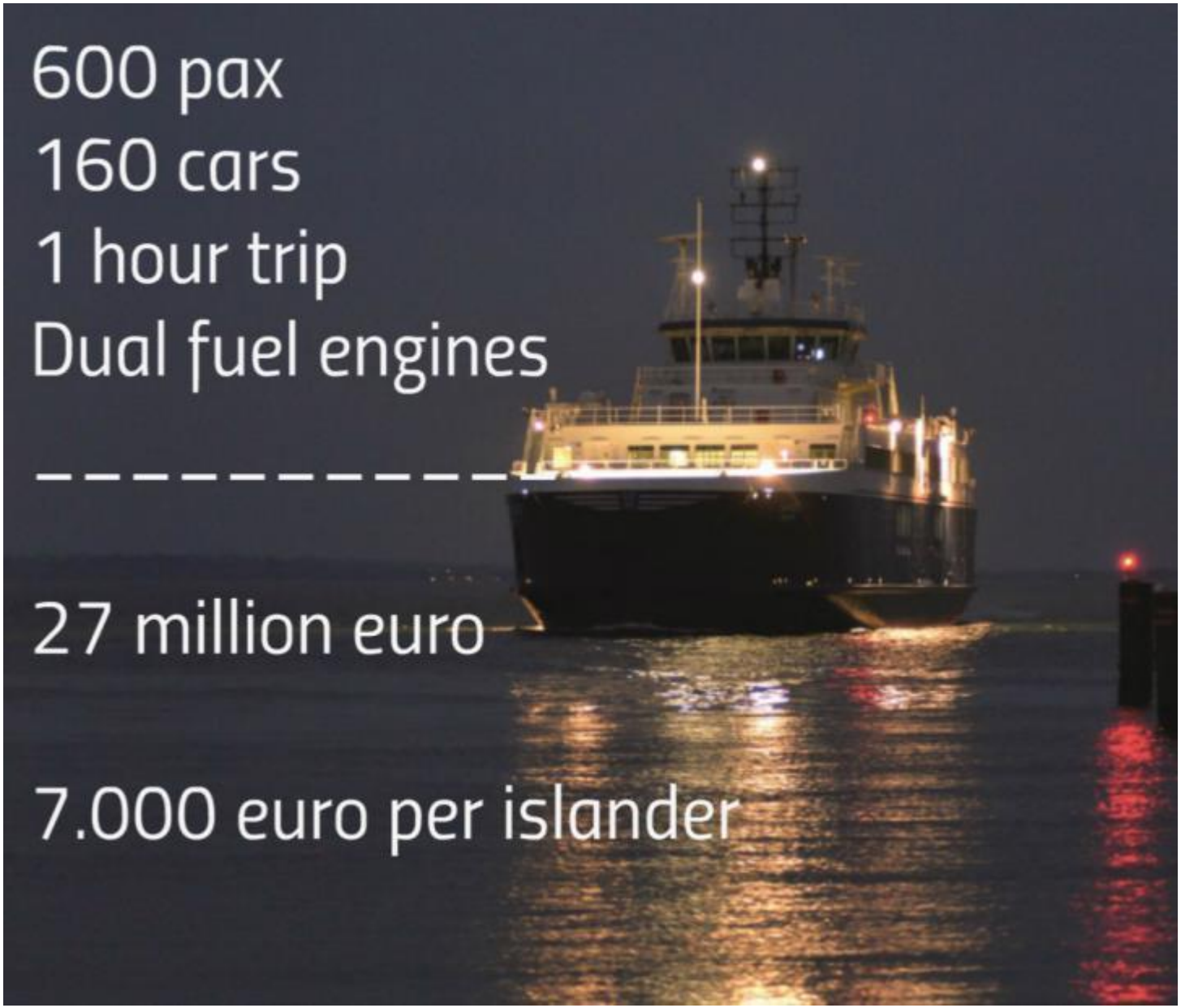
- Fossil energy for the ferries
  - To become free of fossil fuels
- Intense agricultural practices
  - Fertilizers, pesticides, water balance, nutrient losses, soil carbon
- Traditional renovation is not circular
  - Incineration of waste, 50% recycling is the demand
  - Alternatives are expensive
- Sewage water into the sea
  - While crops need nutrients and irrigation
- LNG is cheap – LBM in micro scale costly
  - Tricky business plan

Energiteknologisk Udviklings- og Demonstrationsprogram

EUDP Feasibility

BioGas2020




600 pax
160 cars
1 hour trip
Dual fuel engines
27 million euro
7.000 euro per islander


Q8
Leverandør af flydende naturgas (LNG)
Kosan Crisplant

Biogas as the engine towards circular economy

The challenges

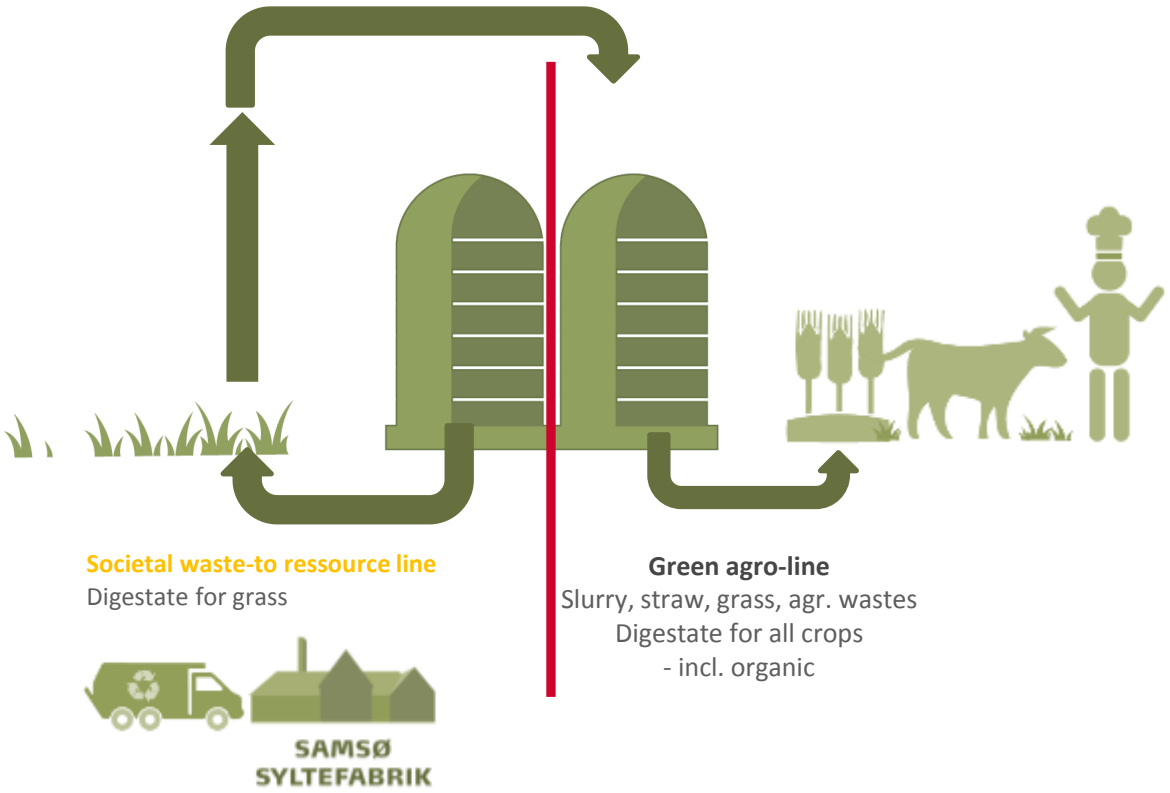
- Decreasing livestock
- Potatoes, cabbage, onions
- Bread wheat, milk
- Low precipitation
- Low % organic farmers

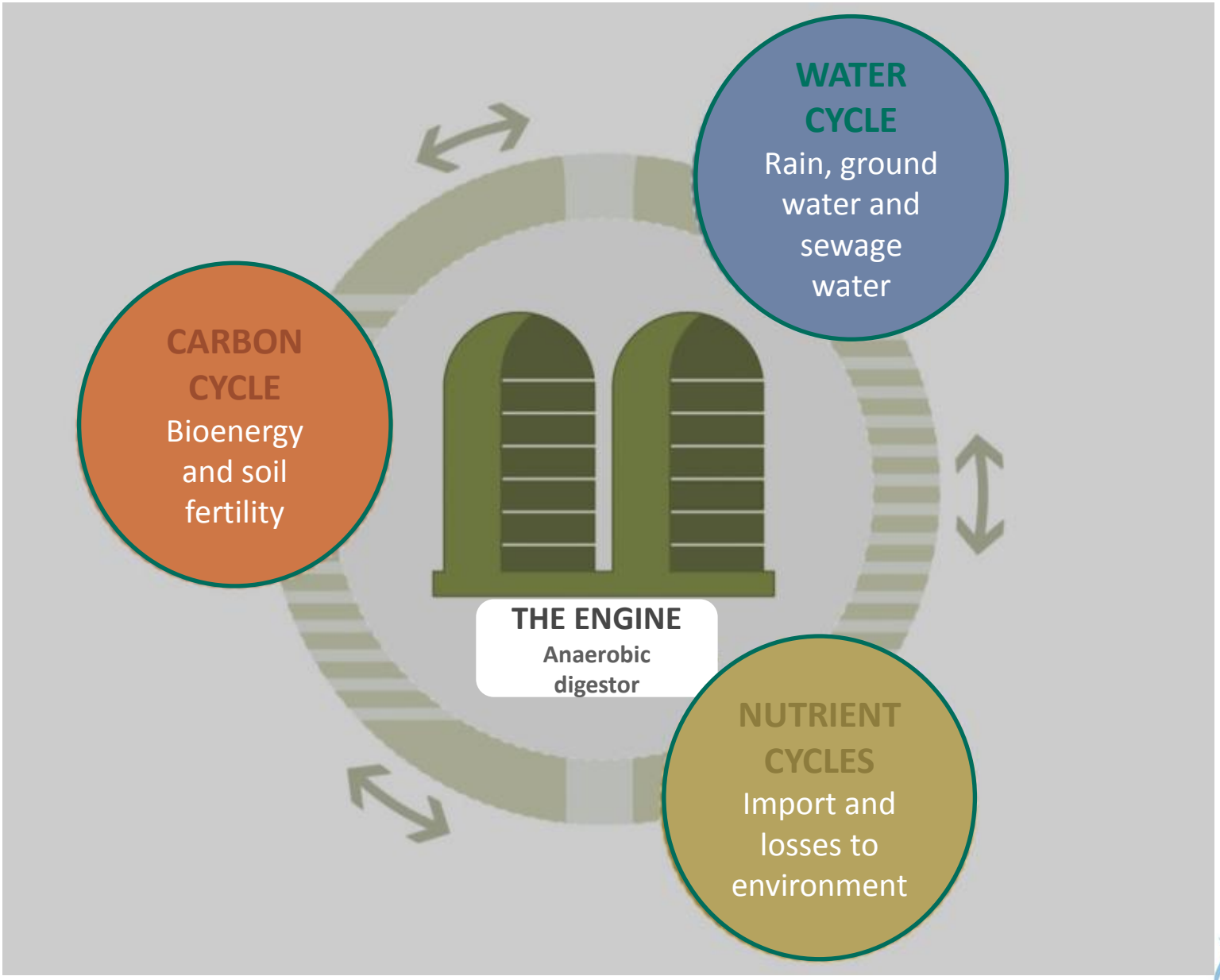
The Solution

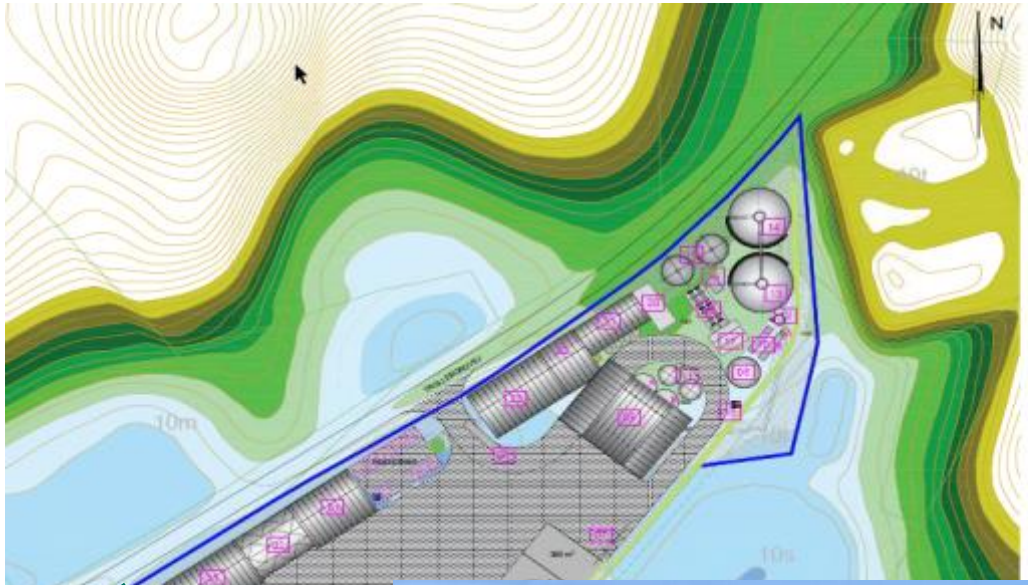
- Double loop nutrient cycling

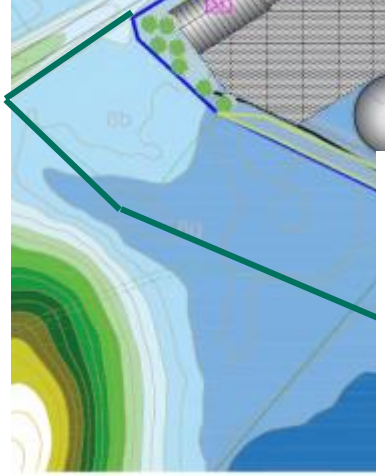
Input Samsø Biogas:

- 1/3 Slurry
- 1/3 food industry sludge
- 1/3 straw, deep litter, catchcrops etc




WATER CYCLE
Rain, ground water and sewage water
CARBON CYCLE
Bioenergy and soil fertility
THE ENGINE
Anaerobic digestor
NUTRIENT CYCLES
Import and losses to environment



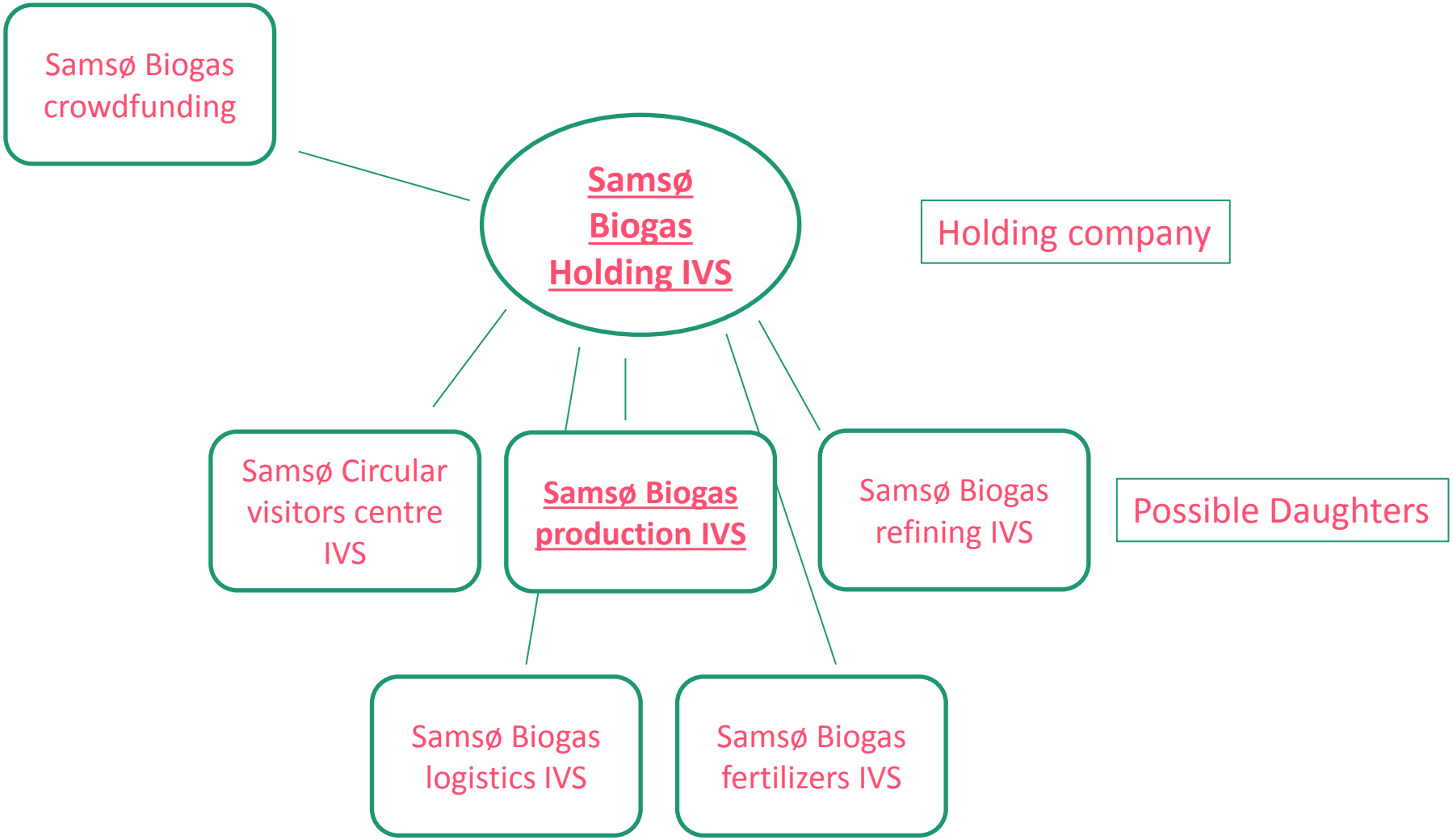


Environmental
Impact Assessment

Environmental permit
Ultimo 2017

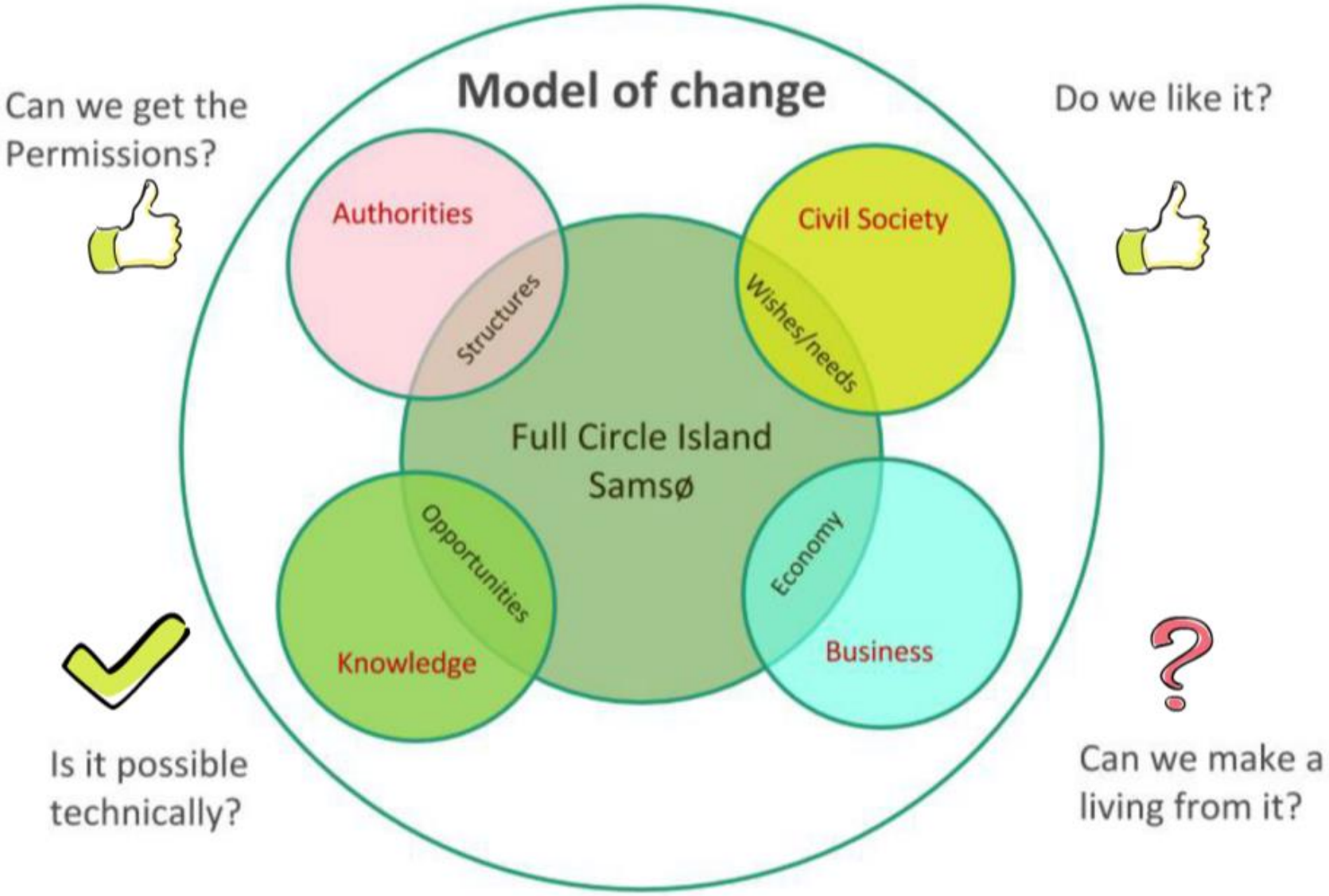
The Lean Business Model Canvas

Changed EU regulation might pave the way for the business
Draft RED: biofuel in marine transport


Samsø Biogas crowdfunding
Samsø Biogas Holding IVS
Holding company
Samsø Circular visitors centre IVS
Samsø Biogas production IVS
Samsø Biogas refining IVS
Possible Daughters
Samsø Biogas logistics IVS
Samsø Biogas fertilizers IVS

Sidebusinesses

- **Farmers business**
- **Samsø Fertilizers**
- **Samsø Slaugtherhouse**
- **Future Samsø Trout Farm – Aquaculture**
- **Samsø Gas –** Methanation or sale of liquid CO_2
- **Ferry business/** LBG, CBG, Hybrid
- **Samsø Ressource Water** – Water Symbiosis,
- **Circular economy visitor centre**
- **Tourism, more inhabitants**,


Model of change
Can we get the Permissions?
Do we like it?
Authorities
Civil Society
Structures
Wishes/needs
Full Circle Island Samsø
Opportunities
Economy
Knowledge
Business
Is it possible technically?
Can we make a living from it?

Thank you for your attention!

- And welcome to Samsoe! ☺
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