

COASTAL Biogas

Cluster On Anaerobic digestion, environmental Services and NuTrients removal

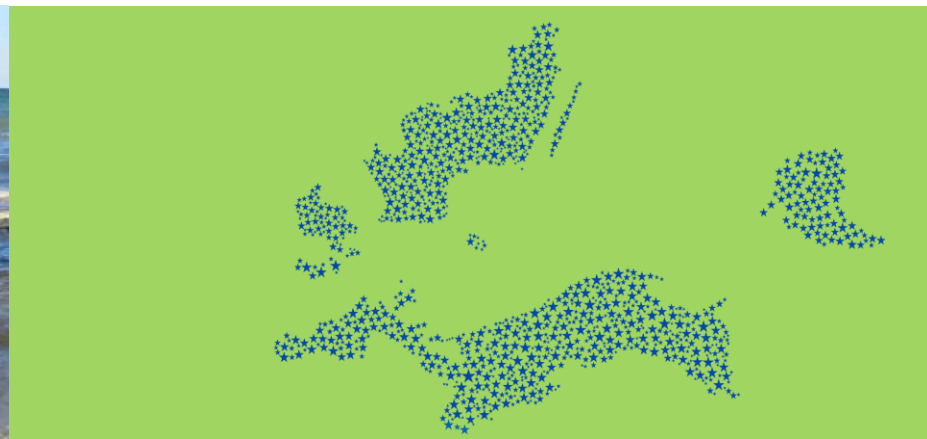
The final conference

9 December 2021

Industrial scale - Solrød Biogas

Tyge Kjær

Roskilde University



Partners



Universität
Rostock



Funded by



European
Regional
Development
Fund

The biogas facility

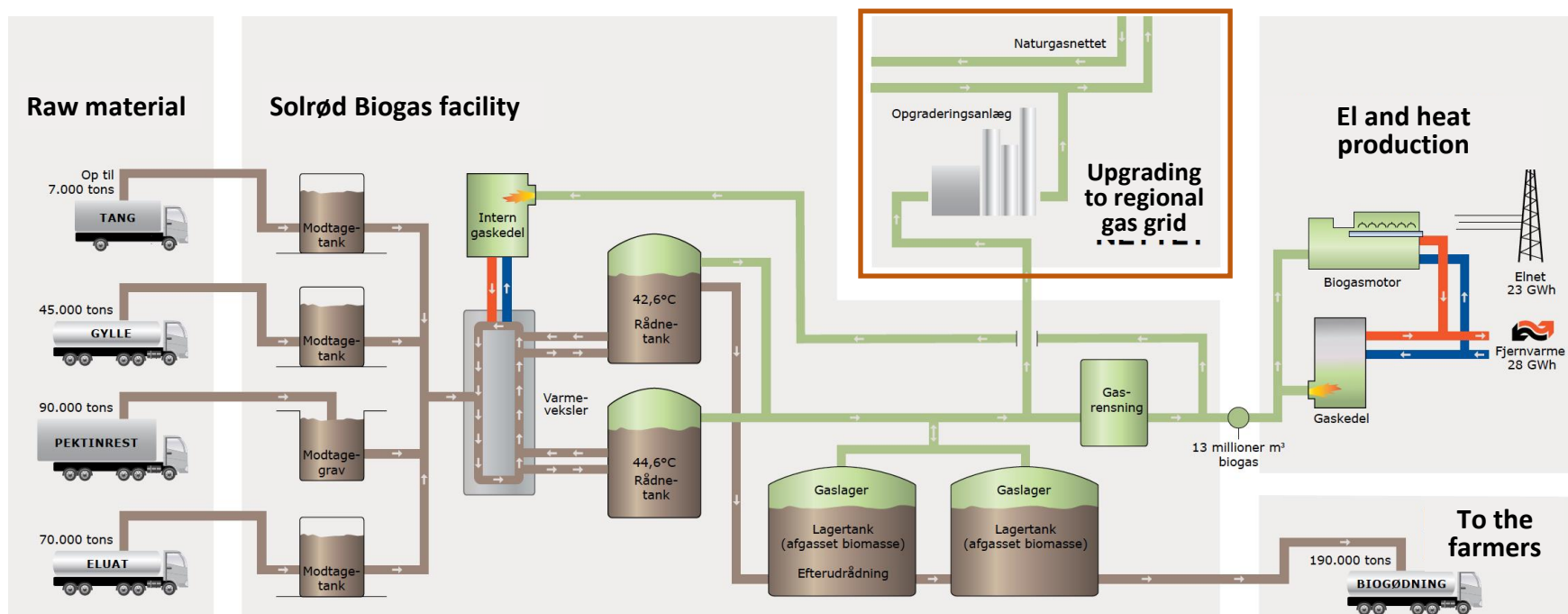
- Raw material use
- Production
- Eco-system services





Biogas • Start November 2015 • Raw materials

Designed for around 226,000 tons - has been expanded with a new gas upgrading facility



Biomass	Main contributors	Amount (tons)
Manure, seaweed, other	Gas production and process sludge	51,000
CPKelco: Pectin, carrageenan	Gas production 59.1%	95,000
Chr.Hansen: Eluat (BioTech)	Gas production 12.5% nutrients	60,000
Biopulp (organic waste)	Gas production 20.8% nutrients	20,000
Ialt		226,000

Suppliers • Raw materials

The basic materials for the gasproduction

Agricultural deliver slurry and receive degassed biomass from Solrød Biogas



CP Kelco deliver residual products of the pectin production to Solrød Biogas



Tests of raw materials

Test of different raw materials and combination of different raw materials

Henrik B. Møller, Foulum / Århus Universitet and Roskilde Universitet

A number of tests has been initiated. Operation assumption:

- 320 m³ of methane per tons of dry matter
- 30 m³ of methane per tons of raw material
- Seaweed - improved from 54 m²/tons VS to 120 m²

gas med alternativ biomasse til Solrød biogas

2013

gas forsøg med alternativ biomasse
solrød biogasanlæg – Fase 2

Henrik Bjarne Møller
Århus Universitet, Institut for ingeniørvidenskab

Rennemed

Biogas behandling af tang, pektinrestprodukter
og husdyrgødning

Henrik Bjarne Møller og Dhan Prasad Ghautam
Århus Universitet, Institut for ingeniørvidenskab

Yield in Praxis

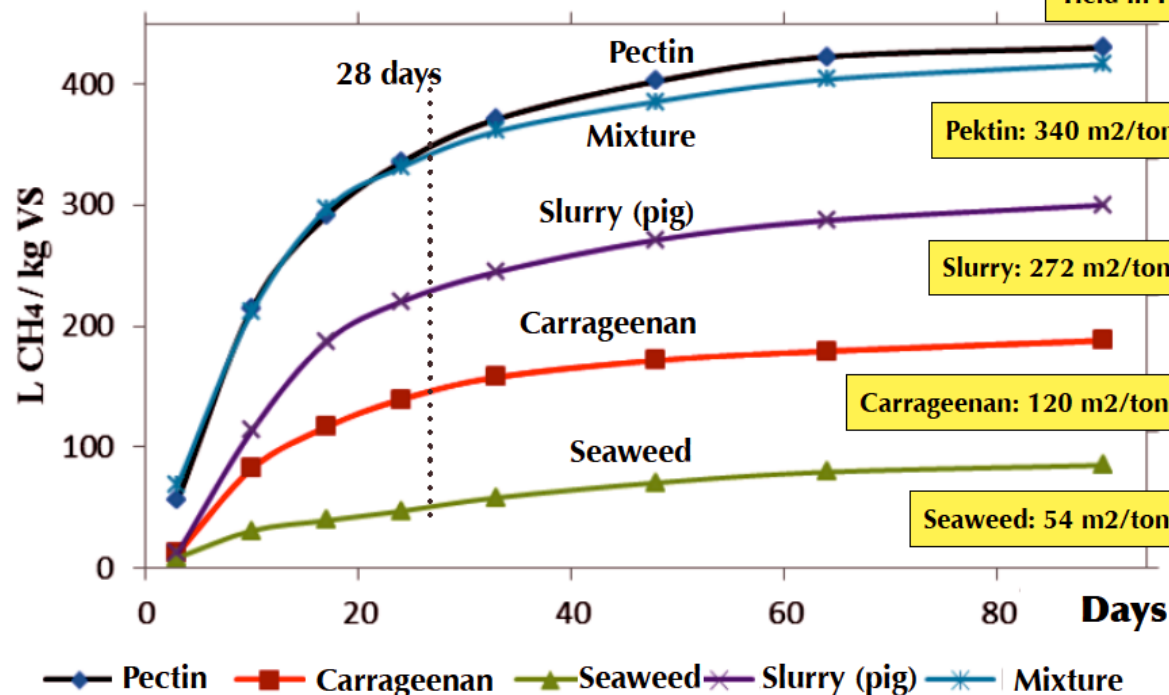
gas forsøg med den planlagte biomassesammensætning på
et med forsøget er at bestemme biogasudbytte og proces
massesammensætning på det kommende biogasanlæg i
le produkt herunder gødningsindhold. Første del af rapporten
appendiks med en mere fyldestgørende beskrivelse på

rt i 2 reaktorer med hhv. 3 og 15 liters aktivt volumen i
kort kontinuerligt og stabilt på svinegylle med ca. 5% tørstof
ler efter er forsøget startet op med den blandede biomasse
et løbende målinger af gasproduktion og procesparametre
dere er der udført metanudbytte målinger i batch af de

de fremgår af tabel 1.

ningen

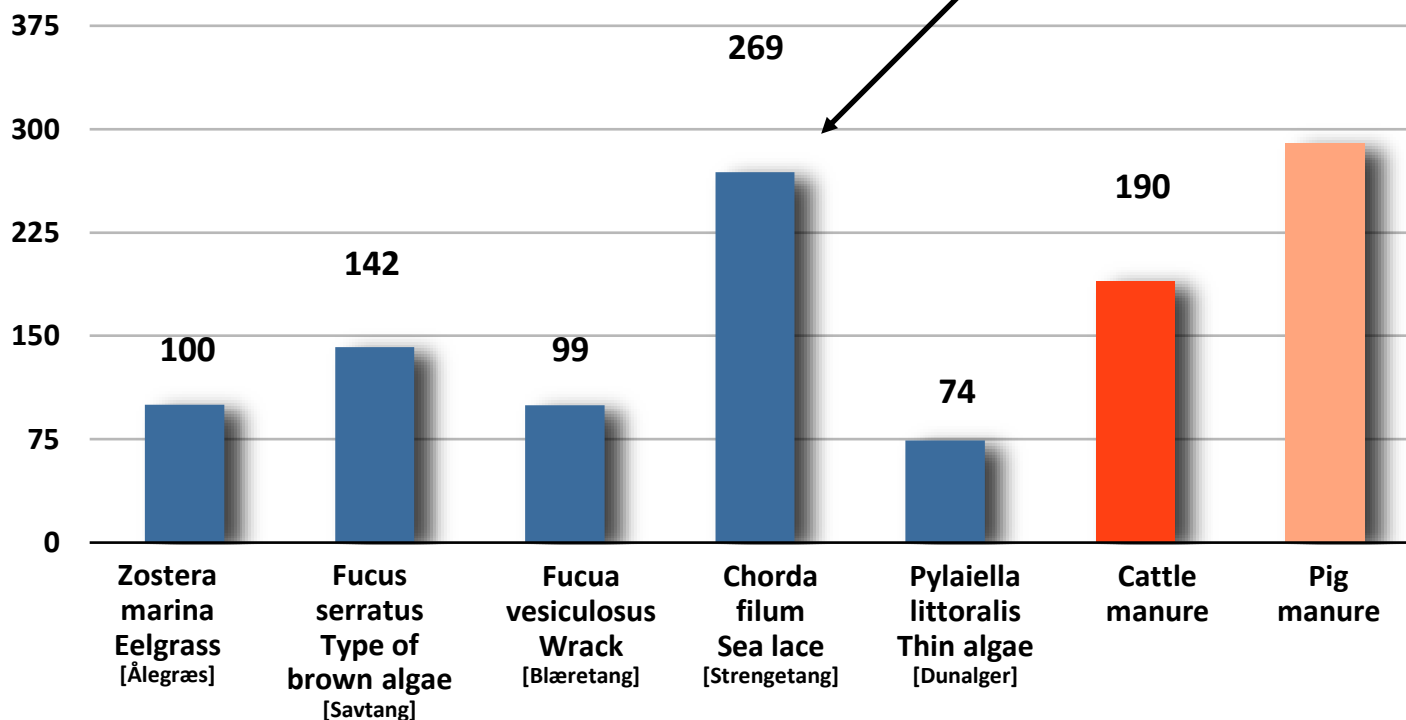
Indetab (VS), %	Andel i vægt
23,6±0,6	4
19,8±0,1	57
7,1±0,2	2
5,3±0,1	37
14,4	100



Big difference in gas yield from seaweed

- Fresh or not-fresh seaweed (methane loss already)
- Type of seaweed

Gas potential for seaweed (28 days)
Nml CH₄ / g VS

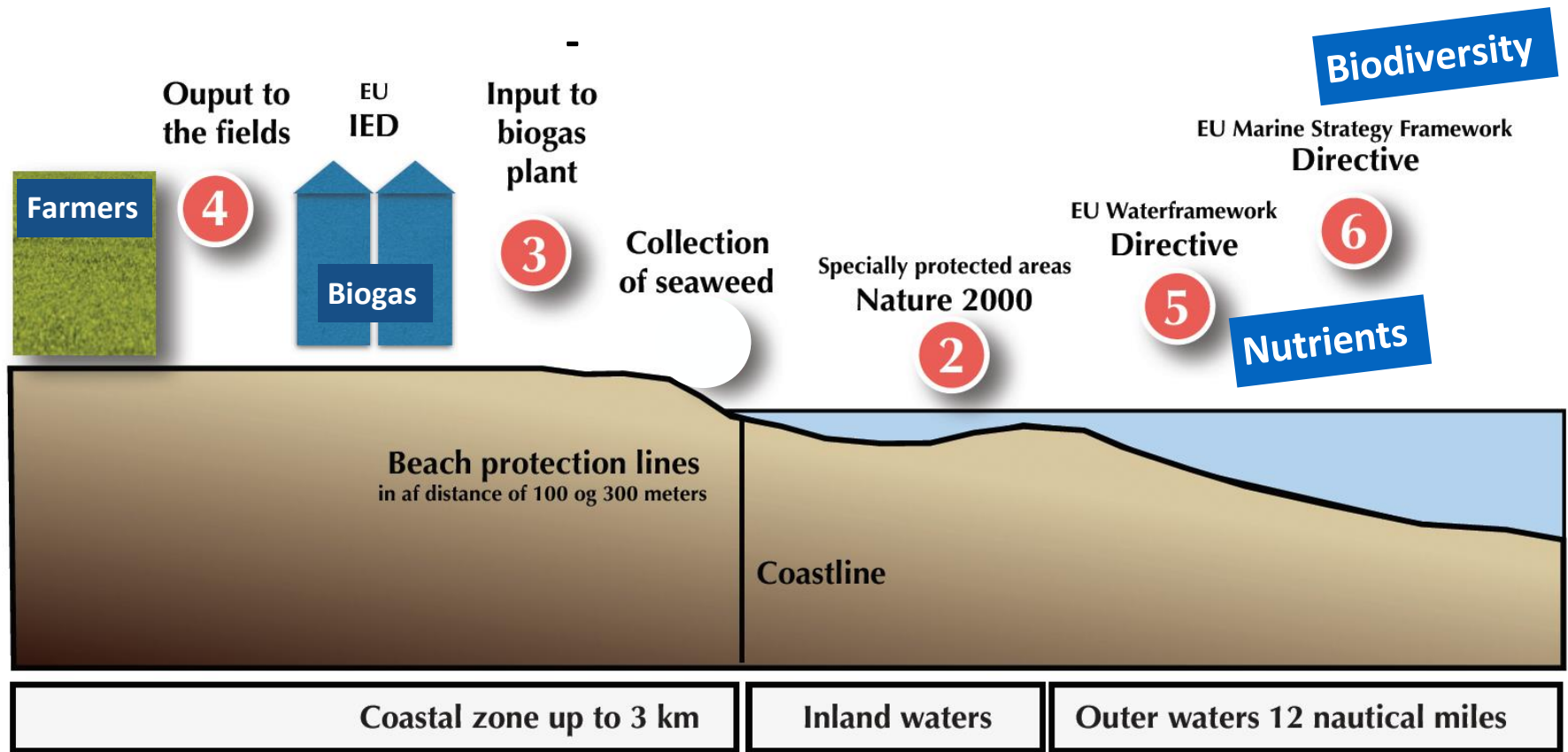


Chorda filum - sea lace - dead man's rope



Seaweed - Requirements in the coastal zone

- Six main regulations
- Seaweed is classified as **vegetable biomass** and not as waste (as energy crops)

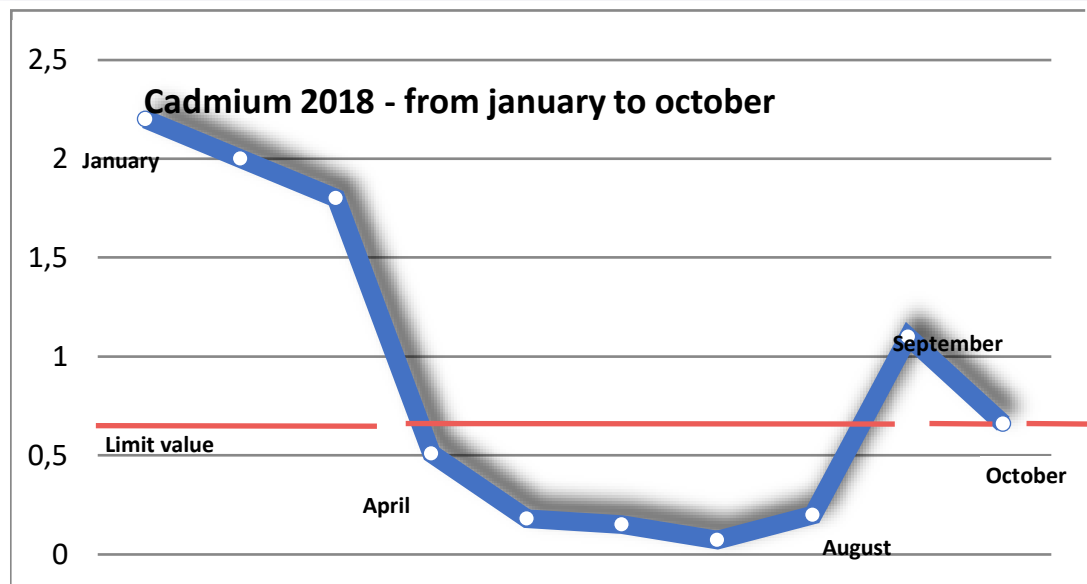


Seaweed - requirements

Supplier: Solrød Strand Beach Cleaning Laug

Delivery requirements:

- Cadmium and other below limit values
- No visible plastic, metal and big stone
- Sand maximum of 60% of dry matter



Measurement

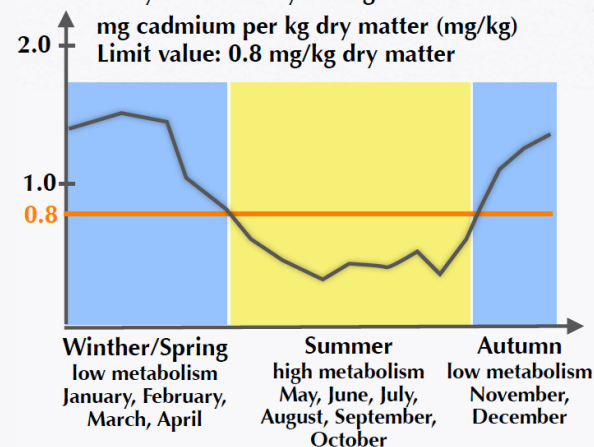
2009-2013 - mg/Kg dry matter

Parameters	Average	Limit value
Nitrogen, total	46,340	Non
Phosphor, total	732	Non
Lead (Pb)	<3.58	120
Cadmium (Cd)	0.52	0.80
Chromium	<2.40	100
Mercury (Hg)	<0.01	0.80
Nickel (Ni)	3.5	30
Zinc	38	4,000
DEHP	<0.50	50
Nonylphenol	0.64	10
PAH (sum of 9)	2.41	3
LAS	<50	1,300

Expected cadmium content

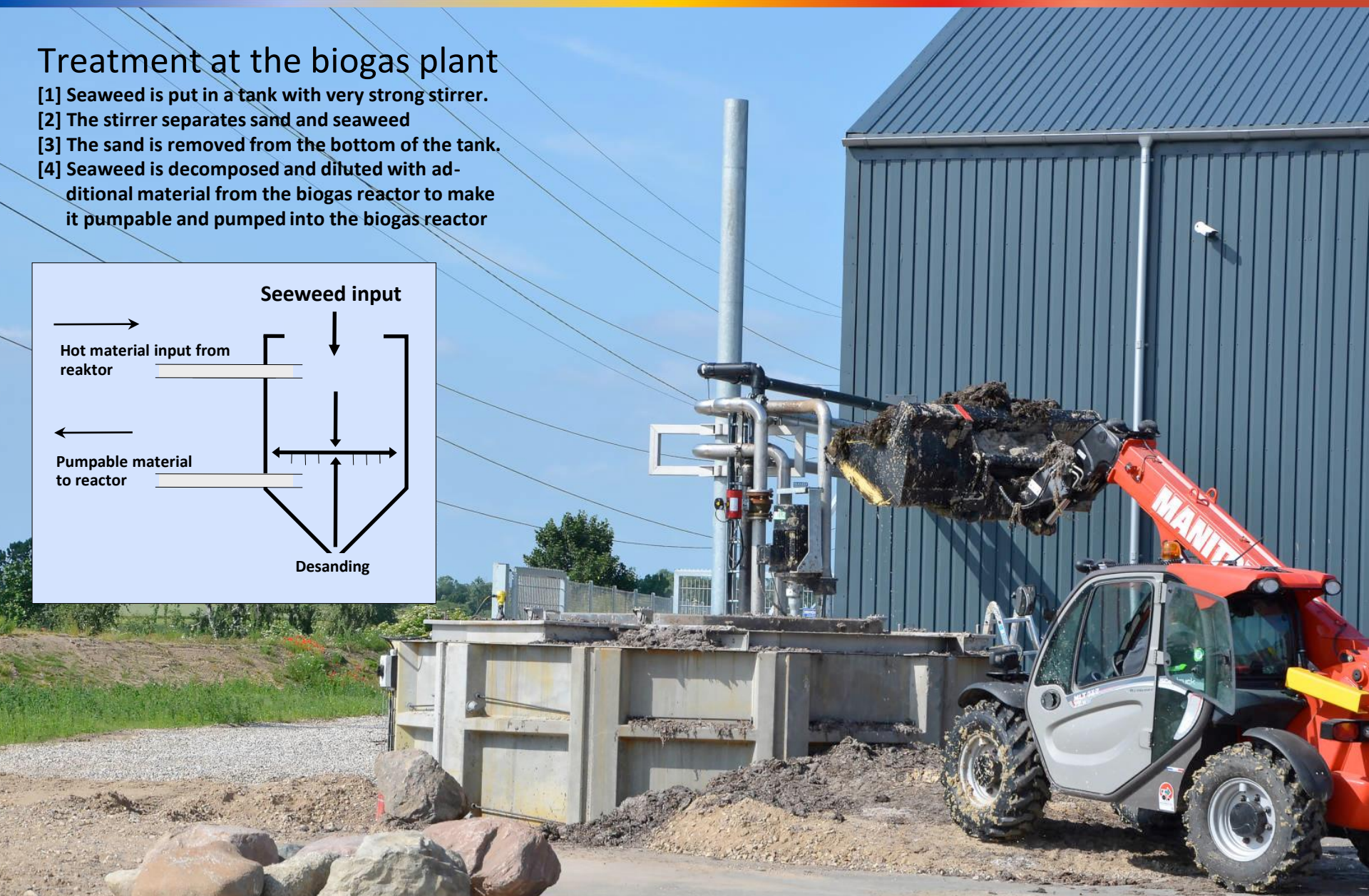
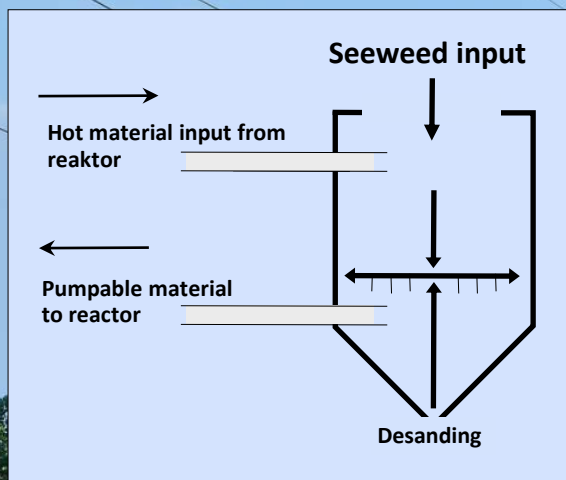
Study from the bay of Køge

mg cadmium per kg dry matter (mg/kg)
Limit value: 0.8 mg/kg dry matter

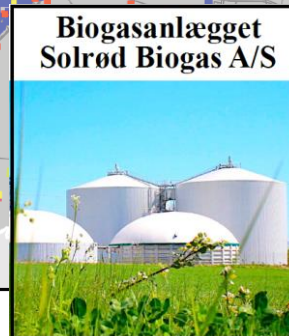
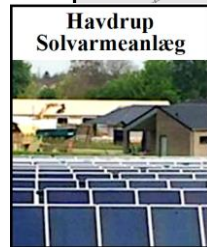


Treatment at the biogas plant

- [1] Seaweed is put in a tank with very strong stirrer.
- [2] The stirrer separates sand and seaweed
- [3] The sand is removed from the bottom of the tank.
- [4] Seaweed is decomposed and diluted with additional material from the biogas reactor to make it pumpable and pumped into the biogas reactor



Den grønne omstilling

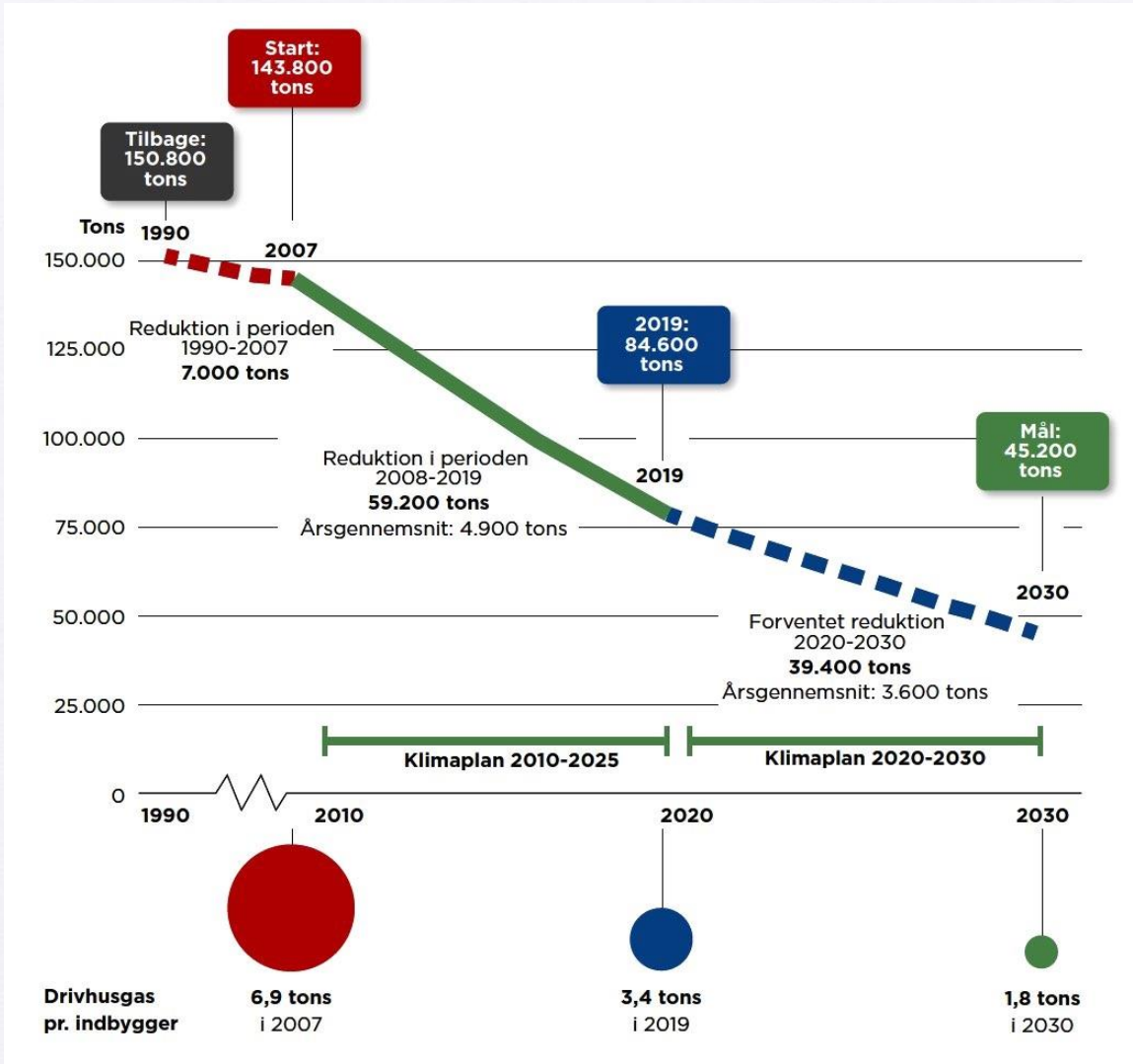


Vedvarende energianlæg
og den grønne omstilling

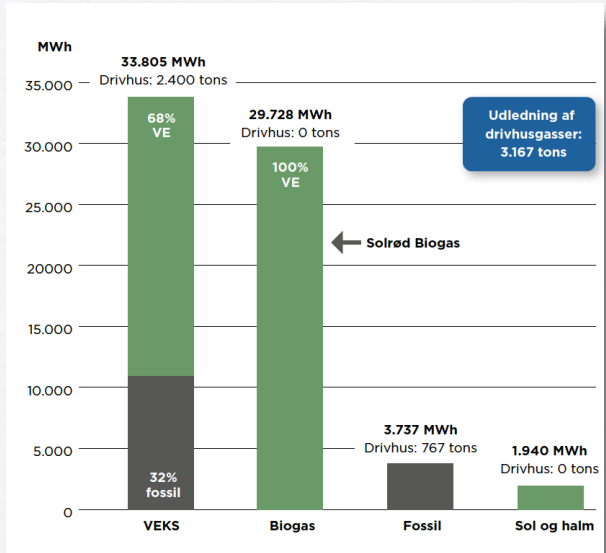
- Fjernvarme
- Naturgas
- Oliefyr
- Fast brændsel mv
- Elvarme
- Varmepumpe
- Andet, uspecifiseret

Greenhouse gas
2007: 143.823 tons
2019: 84.633 tons
Reduction: 59.190 tons
That is: 41,2%

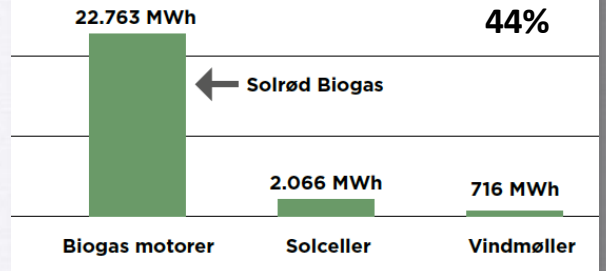
Solrød Municipality: From 2007-2019: ÷ 59.200 tons

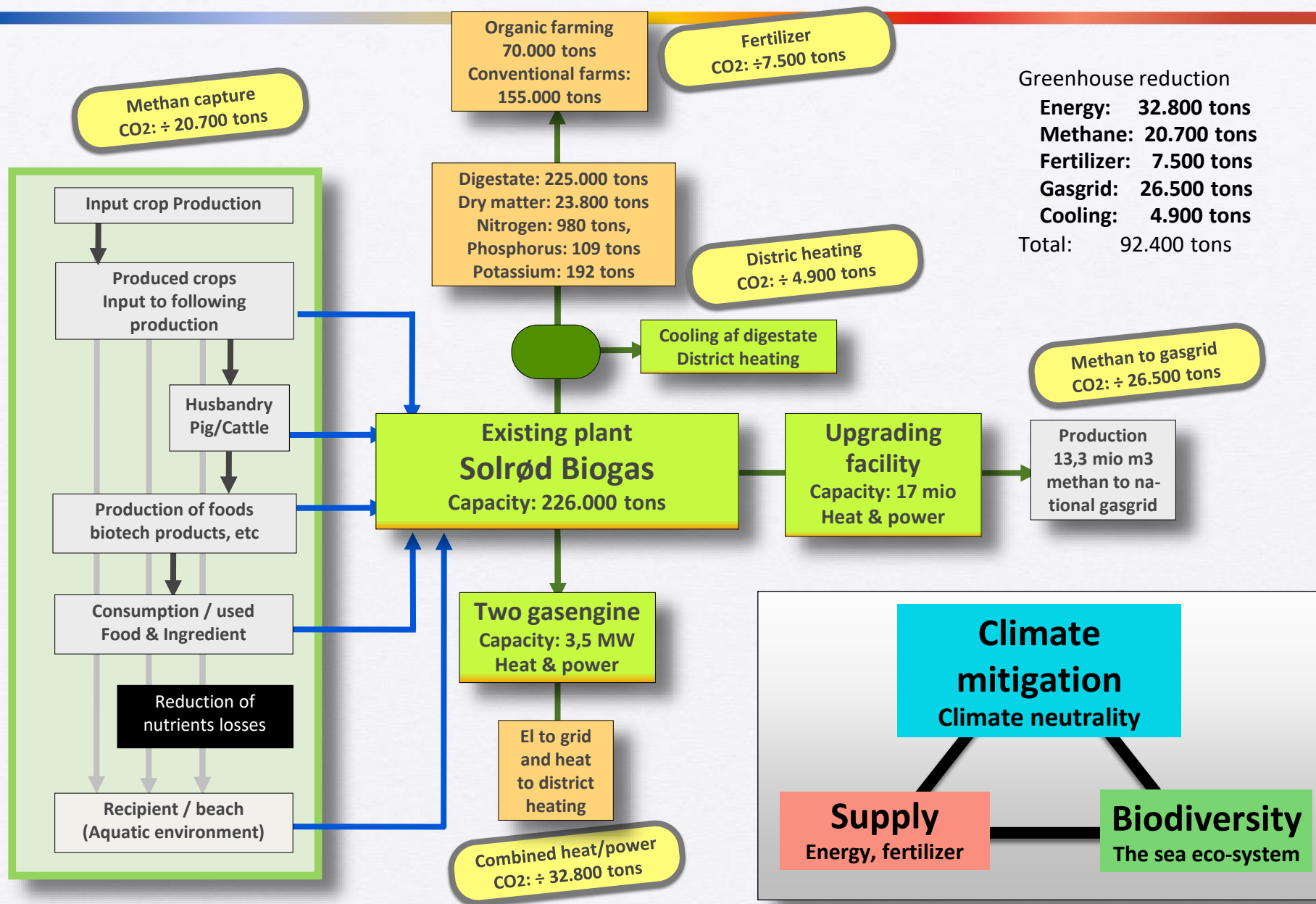


Main changeover in heat supply



More RE electricity production







Thank you for your attention