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COASTAL BIOGAS

Experiences from Solrød Biogas A/S

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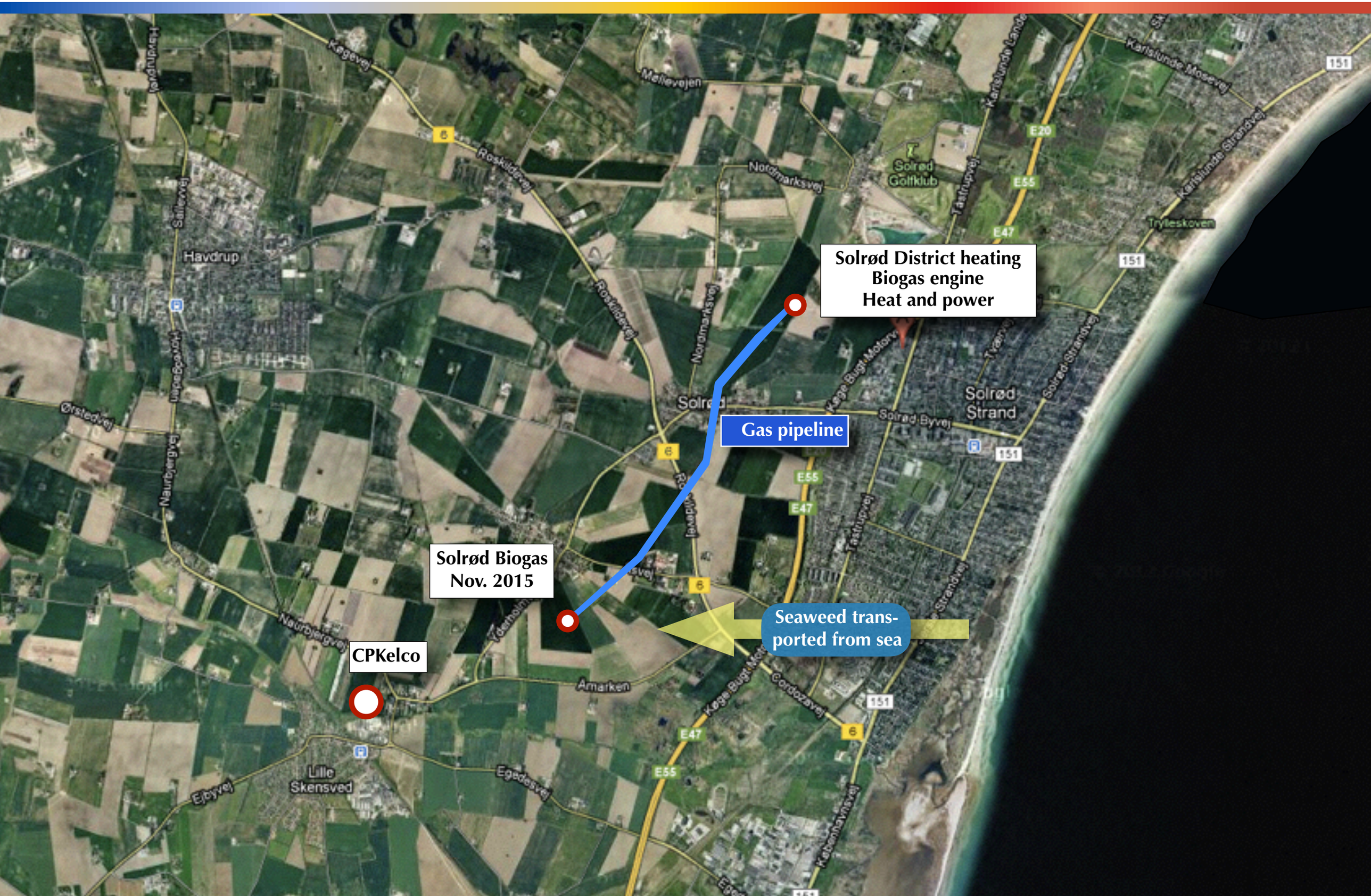

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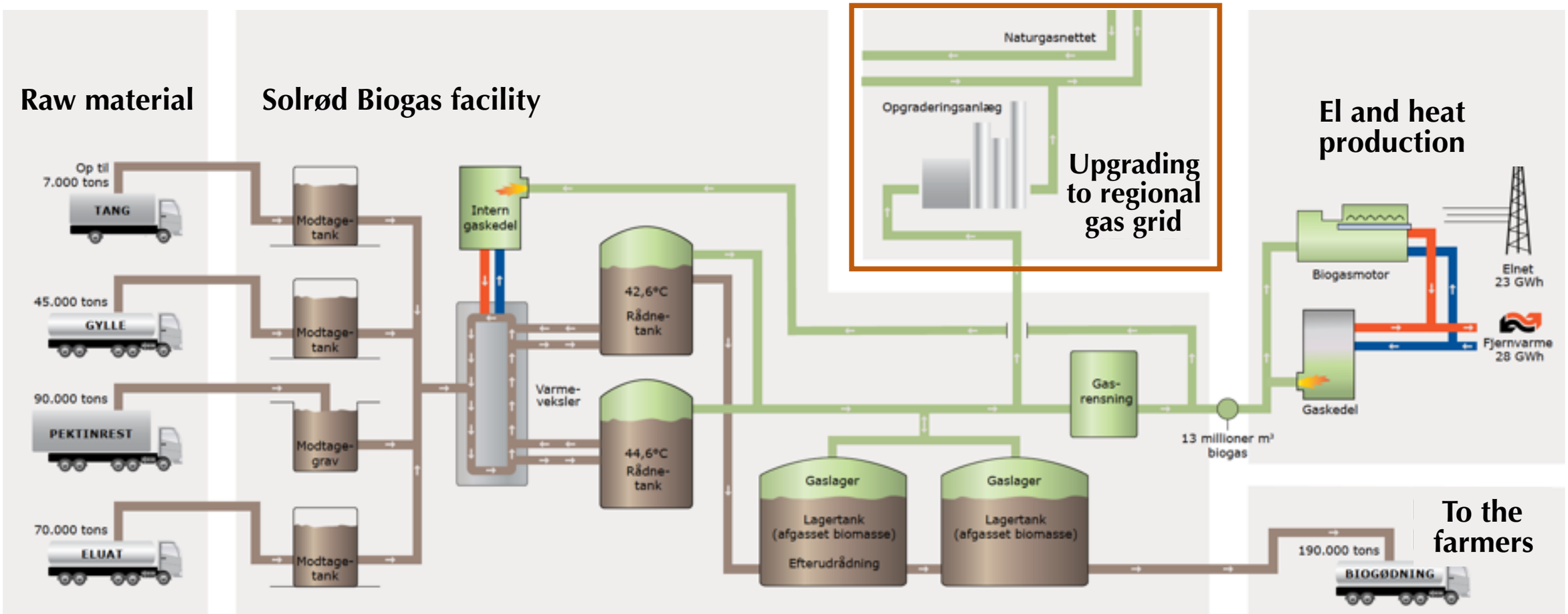
Biogas • Start November 2015 • Raw materials

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



Biomass	Amount (tons)	Biogas	Main contribution
Manure, seaweed, other	51,000	6.0%	Gas production and process stability
CPKelco: Pectin, carrageenan	95,000	59.1%	Gas production
Chr.Hansen: Eluat (BioTech)	60,000	12.6%	Gas production and nutrients
Biopulp (organic waste)	20,000	22,3%	Gas production and nutrients
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

Solrød Kommune · CP Kelco · Chr. Hansen · VEKS · Landbruget

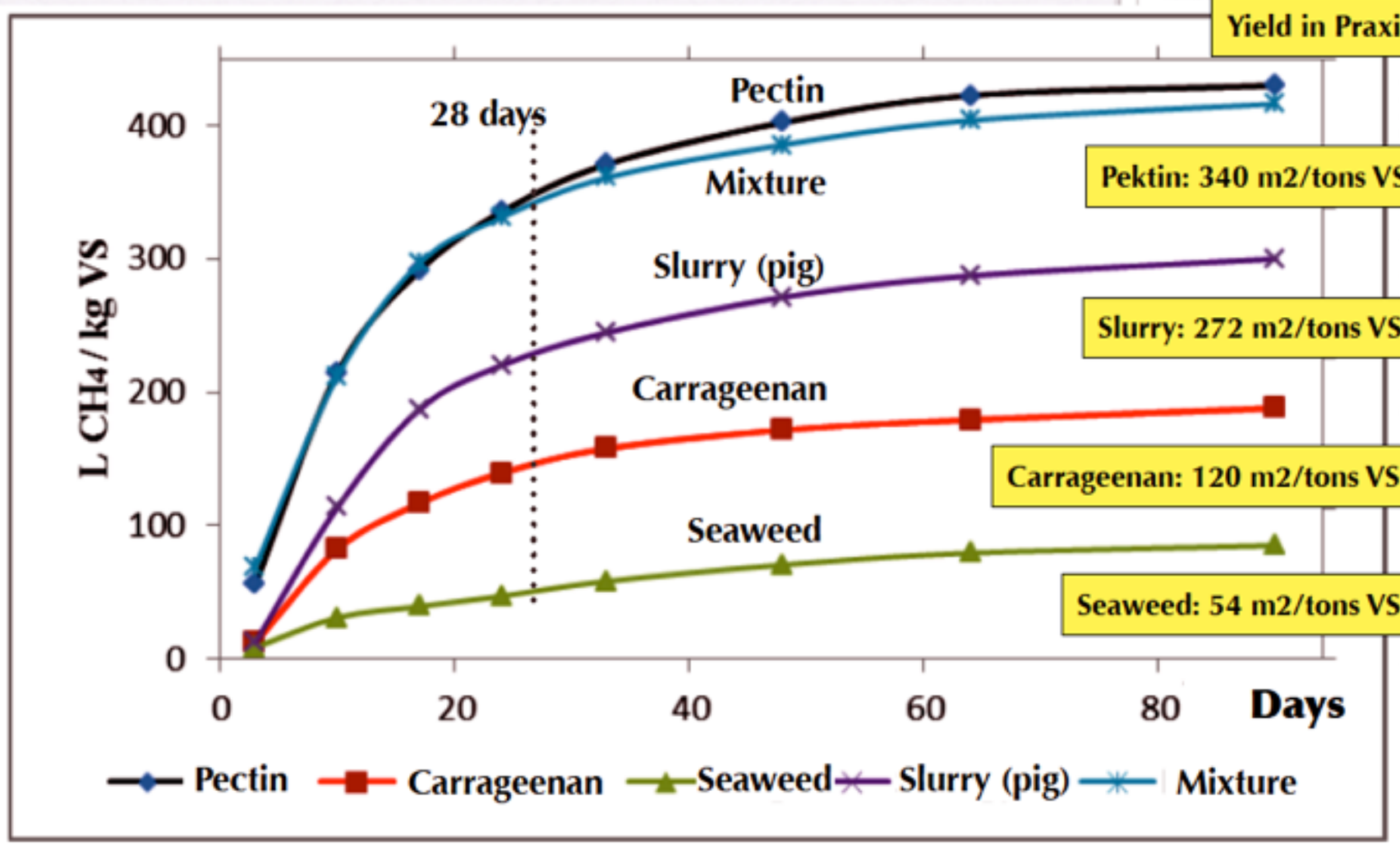
Tests of raw materials

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
- or 1,060 m3 of biogas per hour



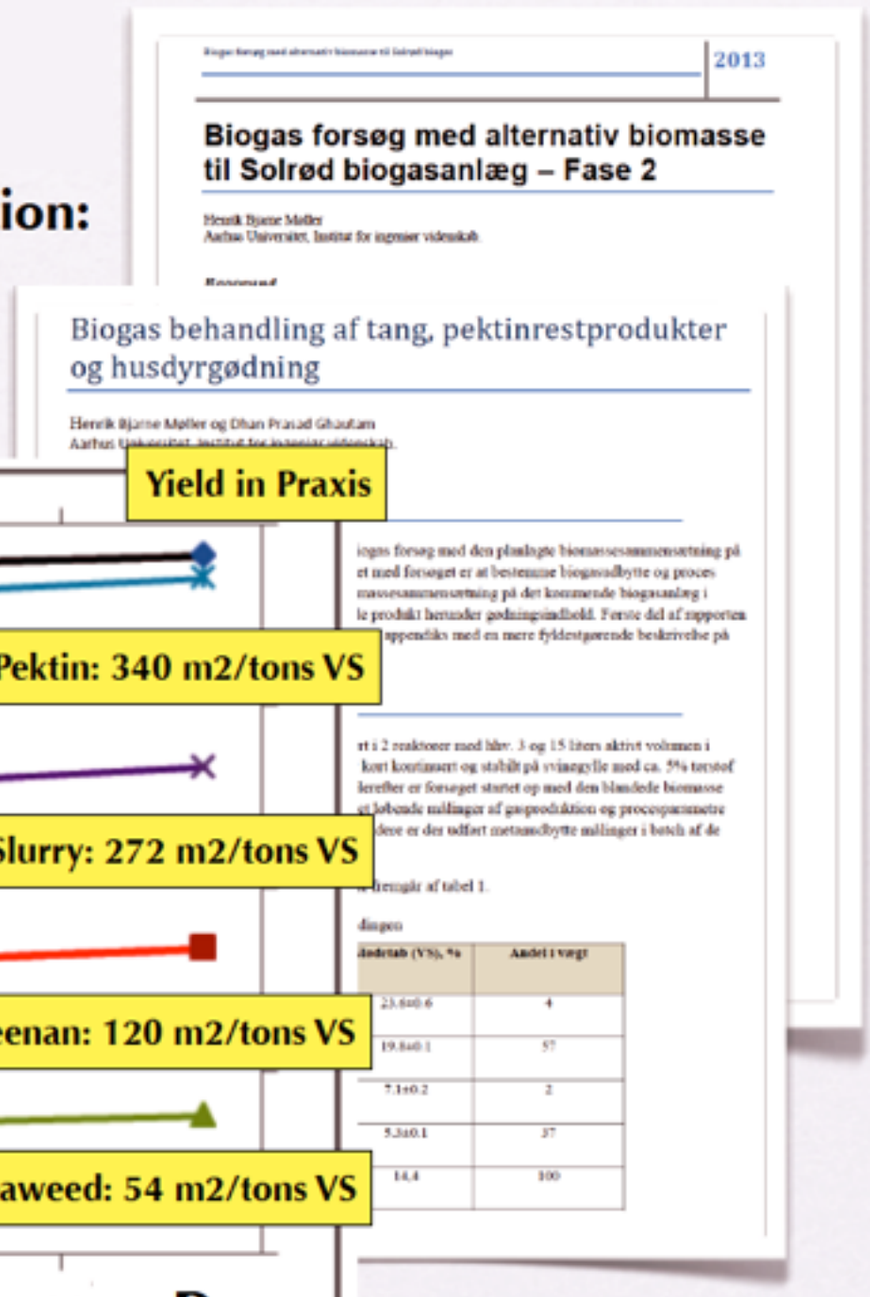
Yield in Praxis

Pektin: 340 m2/tons VS

Slurry: 272 m2/tons VS

Carrageenan: 120 m2/tons VS

Seaweed: 54 m2/tons VS


2013

Biogas forsøg med alternativ biomasse til Solrød biogasanlæg – Fase 2

Henrik Bjarne Møller
Aarhus Universitet, Institut for ingeniør videnskab

Biogas behandling af tang, pektinrestprodukter og husdyrgødning

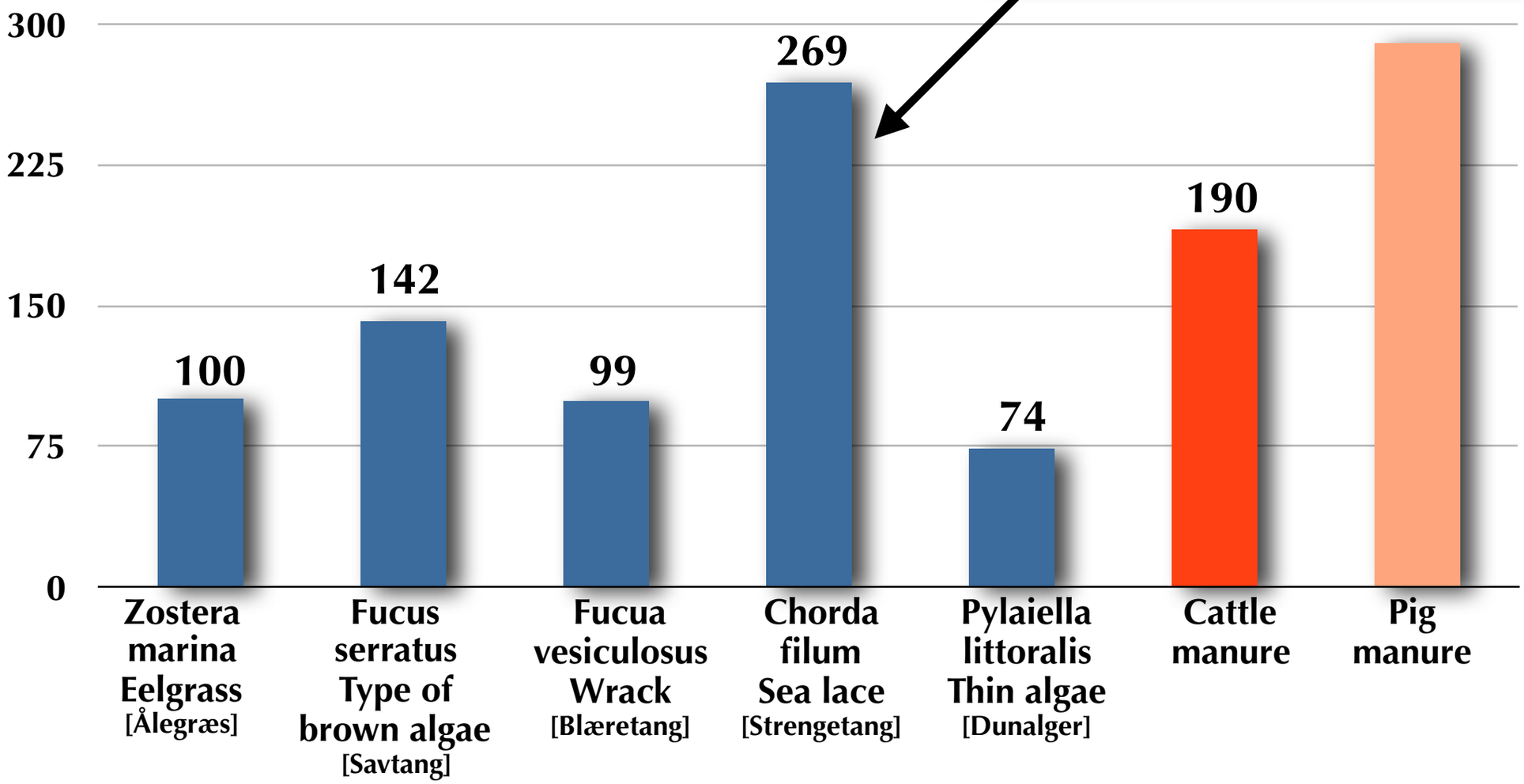
Henrik Bjarne Møller og Dhan Prasad Ghaudam

Big difference in gas yield from seaweed

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

Chorda filum - sea lace - dead man's rope

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



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Collection of Seaweed

Seaweed after storm and offshore winds

Main Issue

- Minimum amount of sand
- Separation of plastic, metal, etc.
- As fresh as possible

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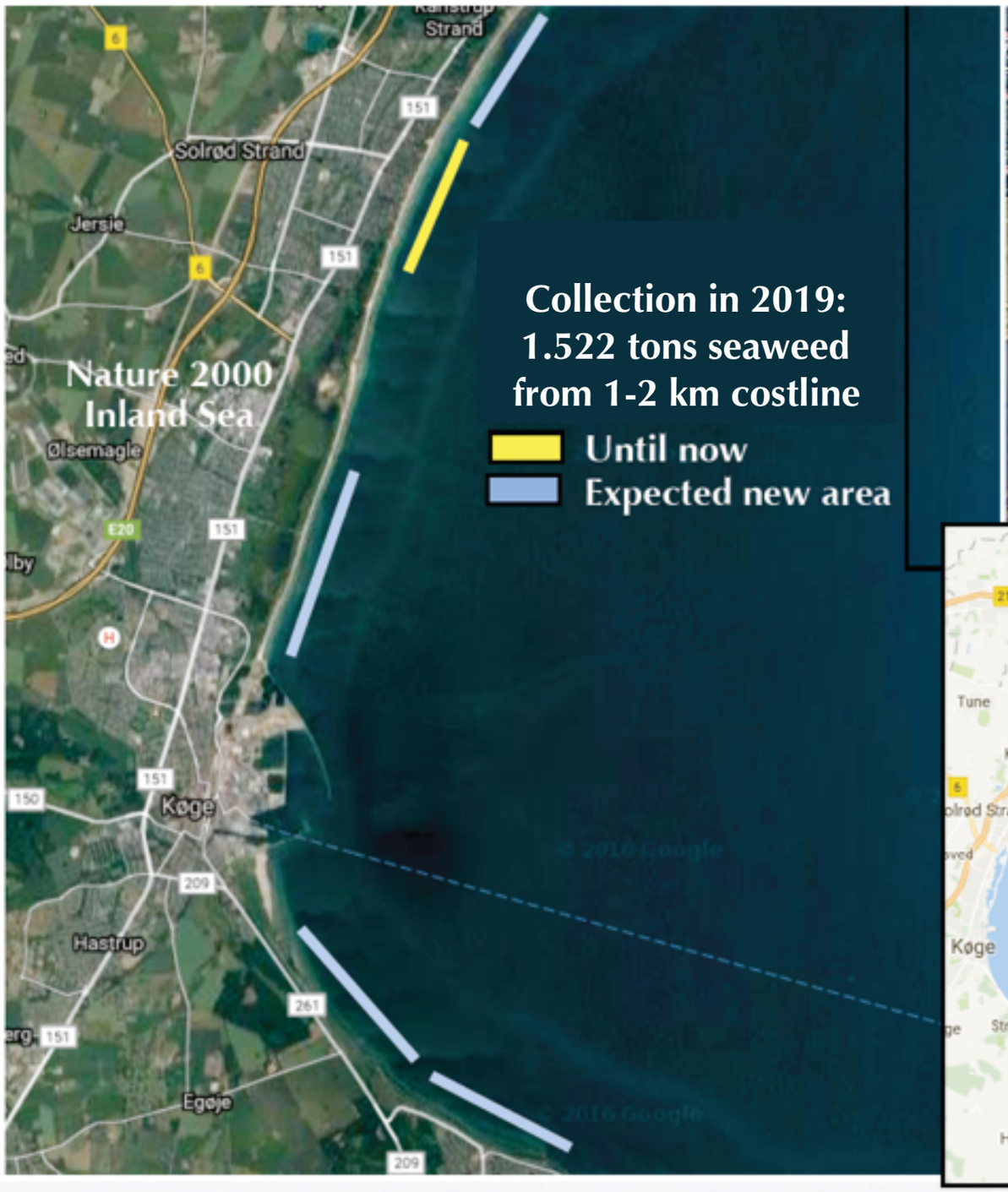
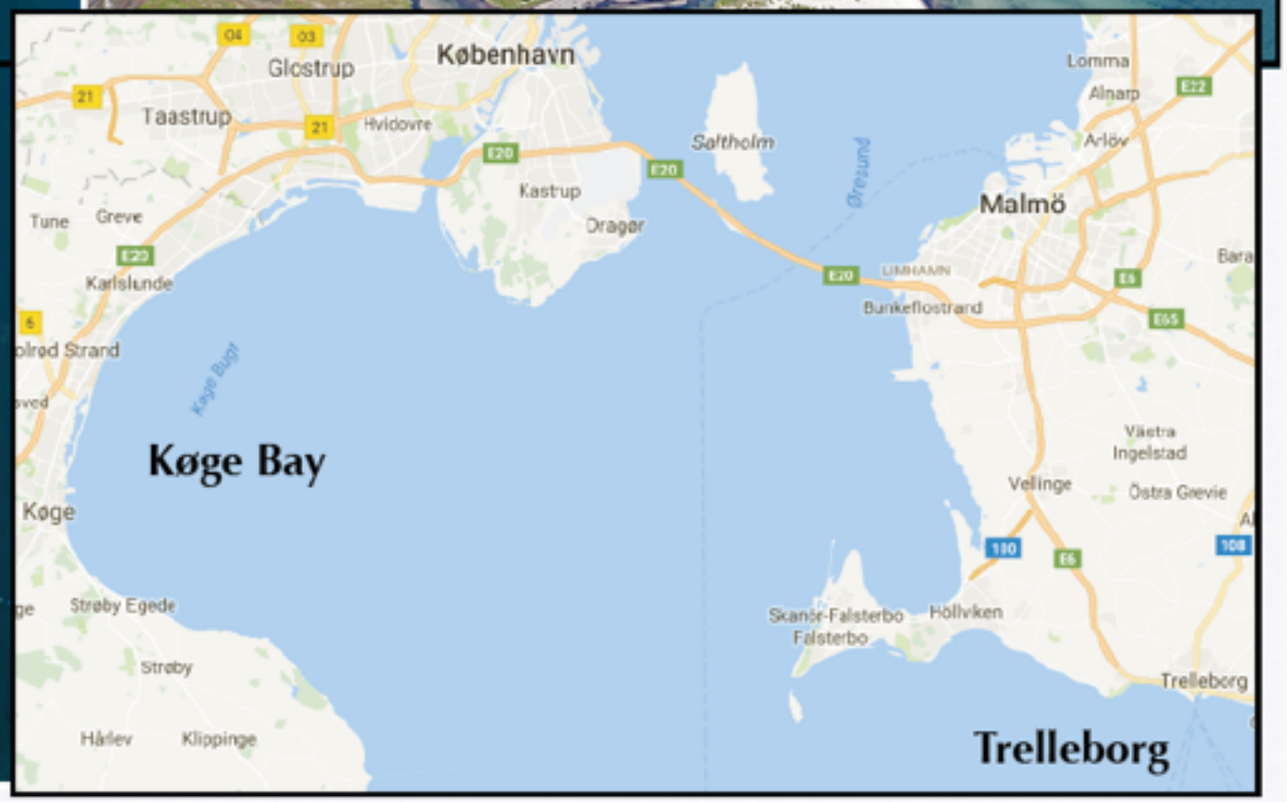
Seaweed - Collection area





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Collection - The first attempts

On land and at the seashore

In the water edge

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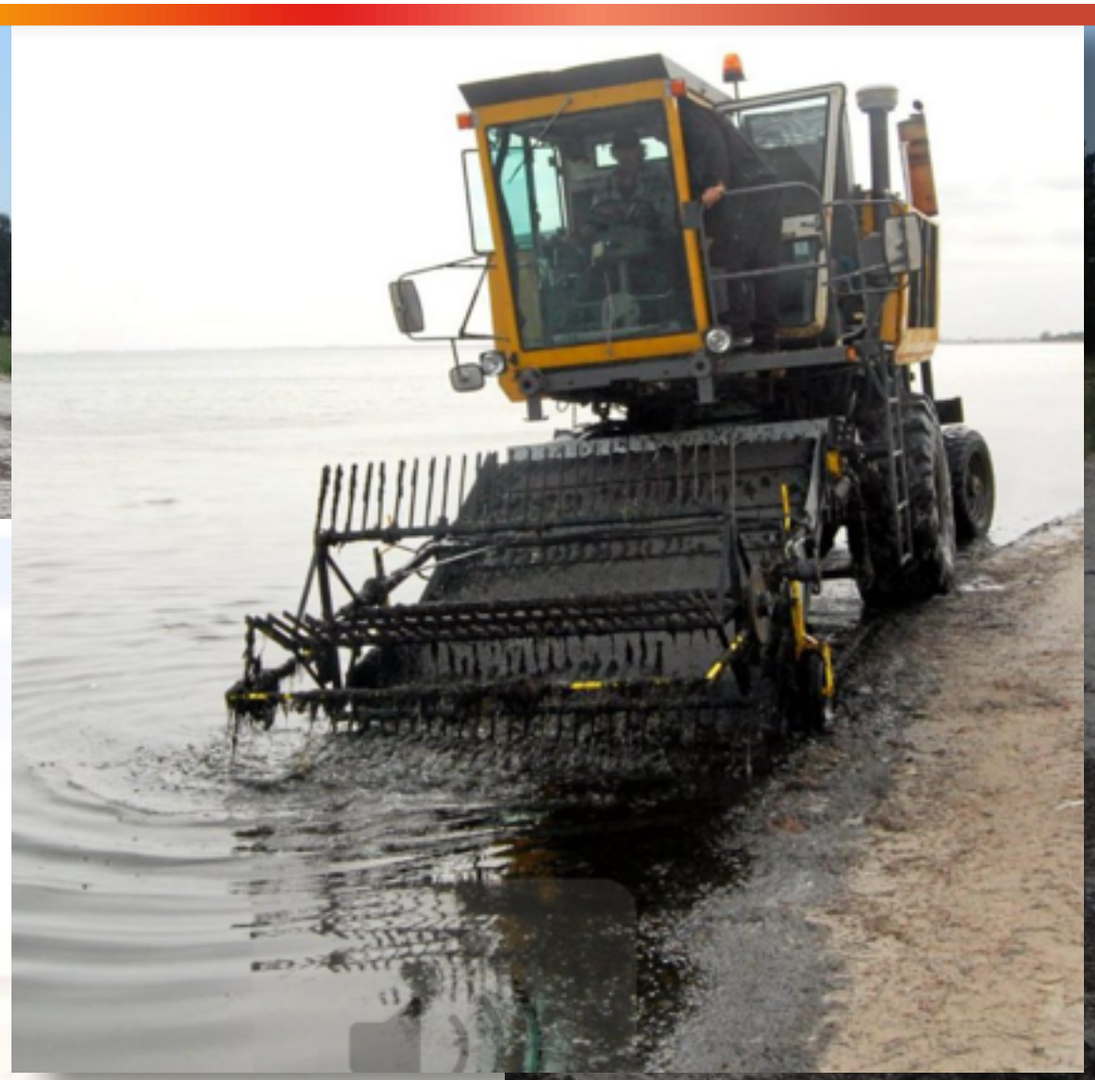
The next attempt

Out in the water • Machine from Halmstad



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Other solutions

Sorting of sand and seaweed on the beach

Rebuilt stone string puts

Several other attemps

Sorting of sand at the beach

Kampen for sandfri tangopsamling

Solrød - 26. juni 2014 kl. 14:00
Kontakt redaktionen:sndk@sn.dk

Sorting facility

Sorting on the beach.

Current solution

Three steps in the collection

First step
The seaweed on the beach is collected with a grab and thrown into the water's edge to reduce the content of sand

Second step
The seaweed are picked up with a grate grab

Third step
The seaweed are transportet to the plant - as fresh as possible

Local company

Three steps in the collection

The first step

The seaweed on the beach is collected with a grab
and thrown into the water's edge
to reduce the content of sand

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Three steps in the collection

The second step

The seaweed are picked up with a grate grab

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Three steps in the collection

The third step

The seaweed are transportet to the plant -as fresh as possible

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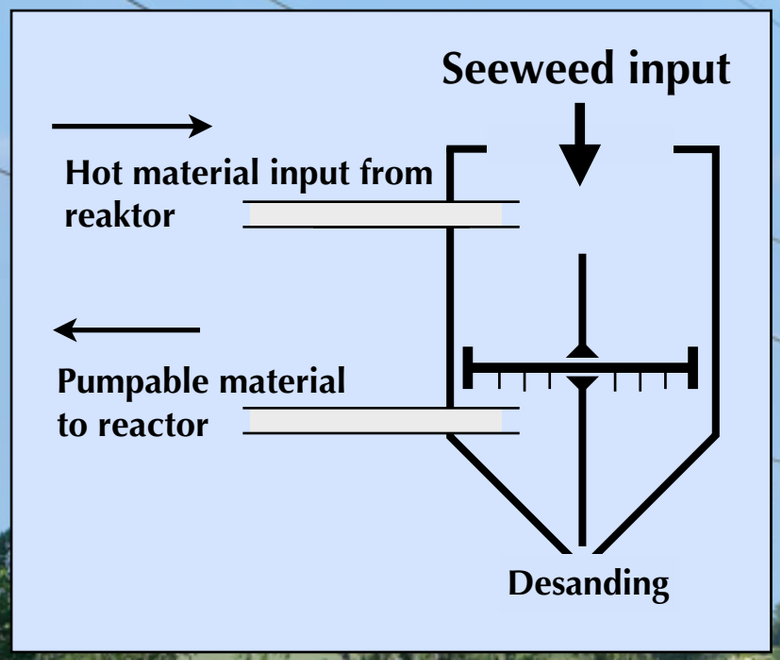
Treatment at the biogas plant

[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



Seaweed - requirements

Supplier: Solrød Strand Beach Cleaning Laug

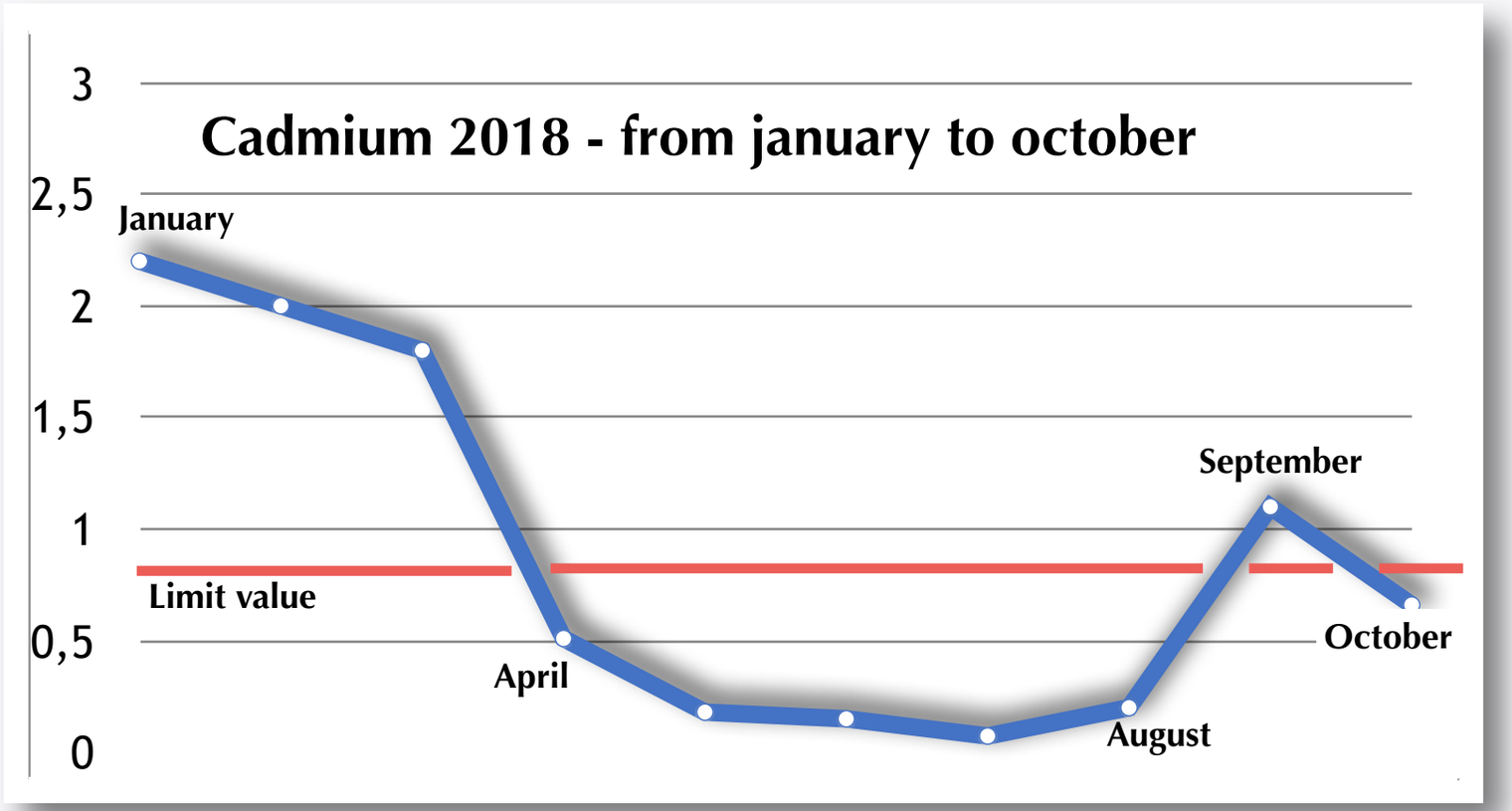
Delivery requirements:

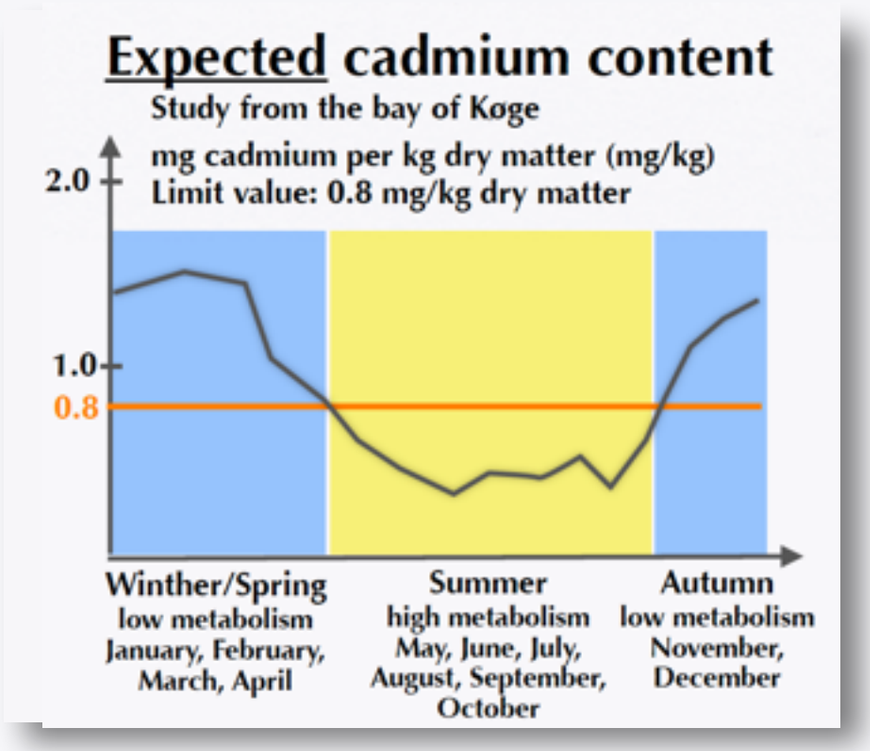
- Cadmium and other below limit values
- No visible plastic, metal and big stone
- Sand maximum of 60% of dry matter

Measurement

2009-2013 - mg/Kg dry matter

Parameters	Average	Limit value
Nitrogen, total	46,340	Non
Phosphor, total	732	Non
Leed (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





The same day after .....

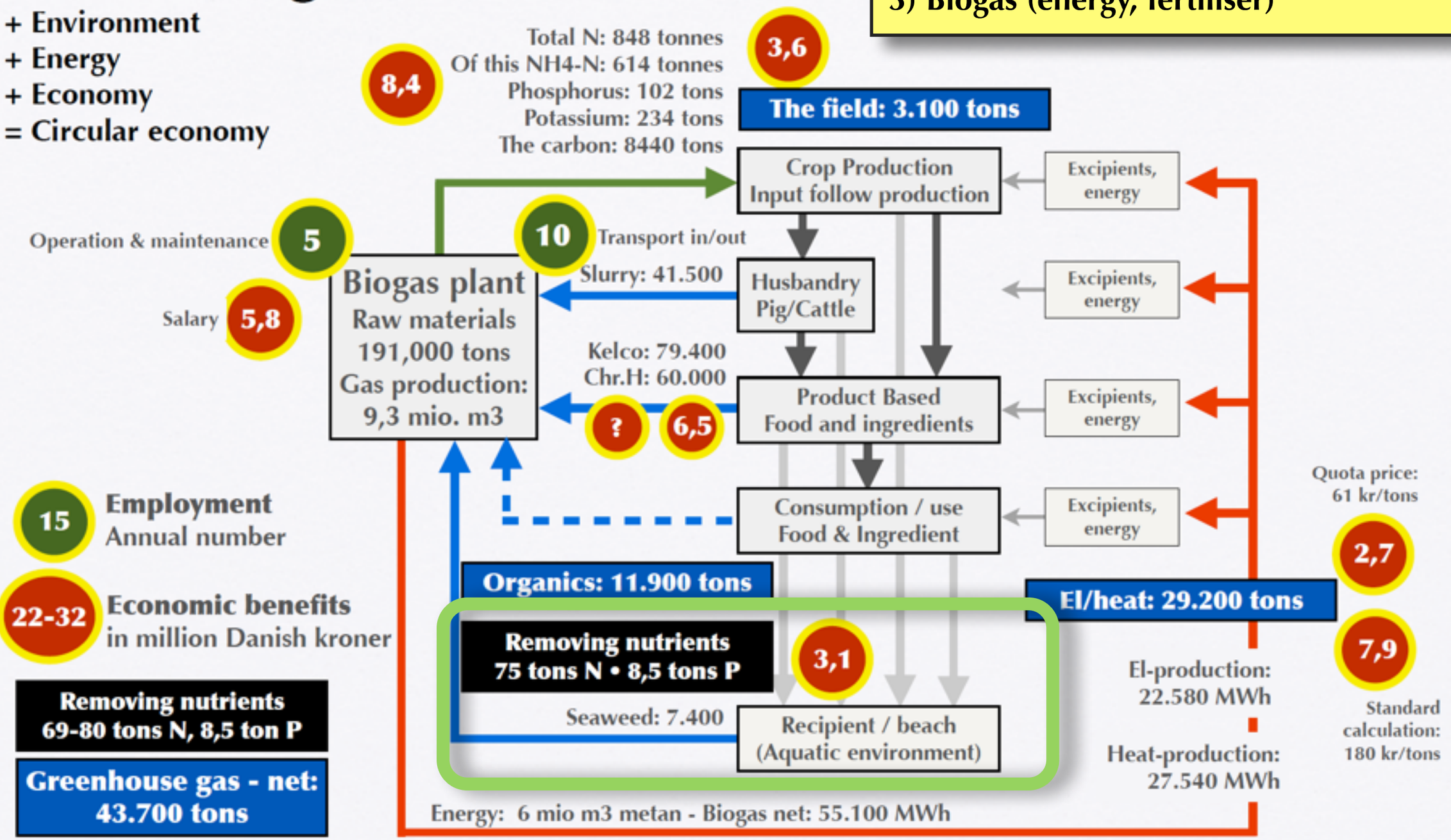
The benefit

Solrød Biogas

+ Environment
+ Energy
+ Economy
= Circular economy

Three seaweed benefits

1) Reduction of smell of rotten seaweed
2) Removal of nitrogen at the sea
3) Biogas (energy, fertiliser)



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The cycle of Seaweed in Solrød

Sådan bidrager Solrød Biogas med positive klimaeffekter.
De blå kasser illustrerer primære effekter og
de grønne cirkler viser sekundære effekter
af tangens cirkulære kredsløb

SOLRØD BIOGAS A/S

Her produceres vedvarende energi og biogødning

Vedvarende energi
Vedvarende energi er en fællesbetegnelse for energiformer, der ikke har begrænsede reserver, men som dog er begrænsede i sin nuværende form.
Anvendelse af vedvarende energi adskiller sig fra fossile brændstoffer (kul, olie og naturgas) ved at være CO_2-neutral – dvs. det har ikke en negativ påvirkning af klimaet.

Solrød Biogas producerer vedvarende energi svarende til ca. 4.000 husstandes elforbrug og 2.800 husstandes varmeforbrug i Solrød Kommune.

Biogødning
Biogødning er restproduktet fra produktion af biogas. Det er et gødningsprodukt, som er rigt på næringssalte – og har en bedre gødningseffekt end rågylle.

Biogødningen optages bedre i planterne sammenlignet med andre gødningsprodukter. Det er med til at reducere risikoen for fordampning af ammoniak fra marker-ne.

Solrød Biogas producerer i alt 199.000 tons biogødning om året. Det udspredes på i alt ?? ha landbrugsjord på Sjælland

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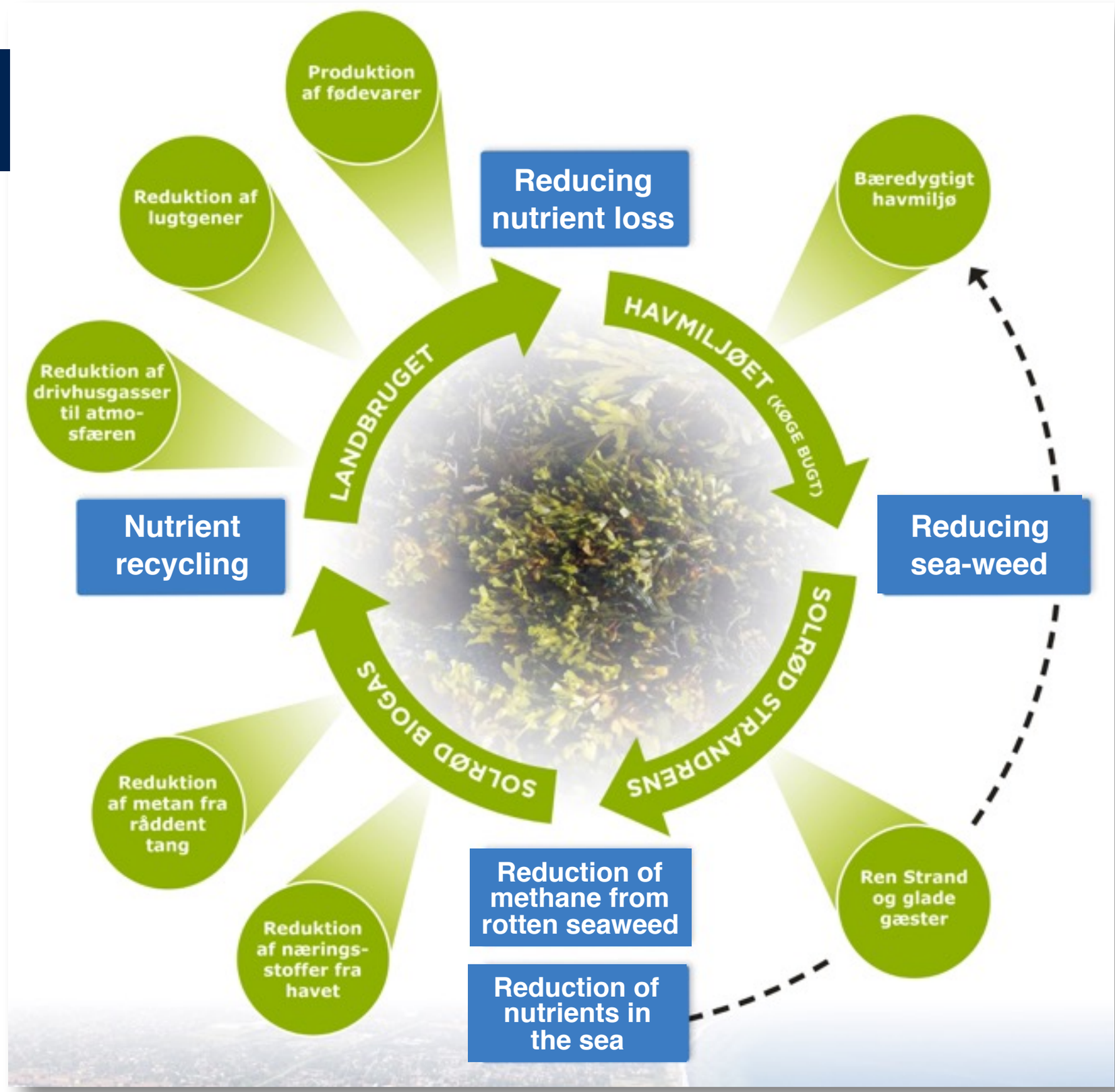

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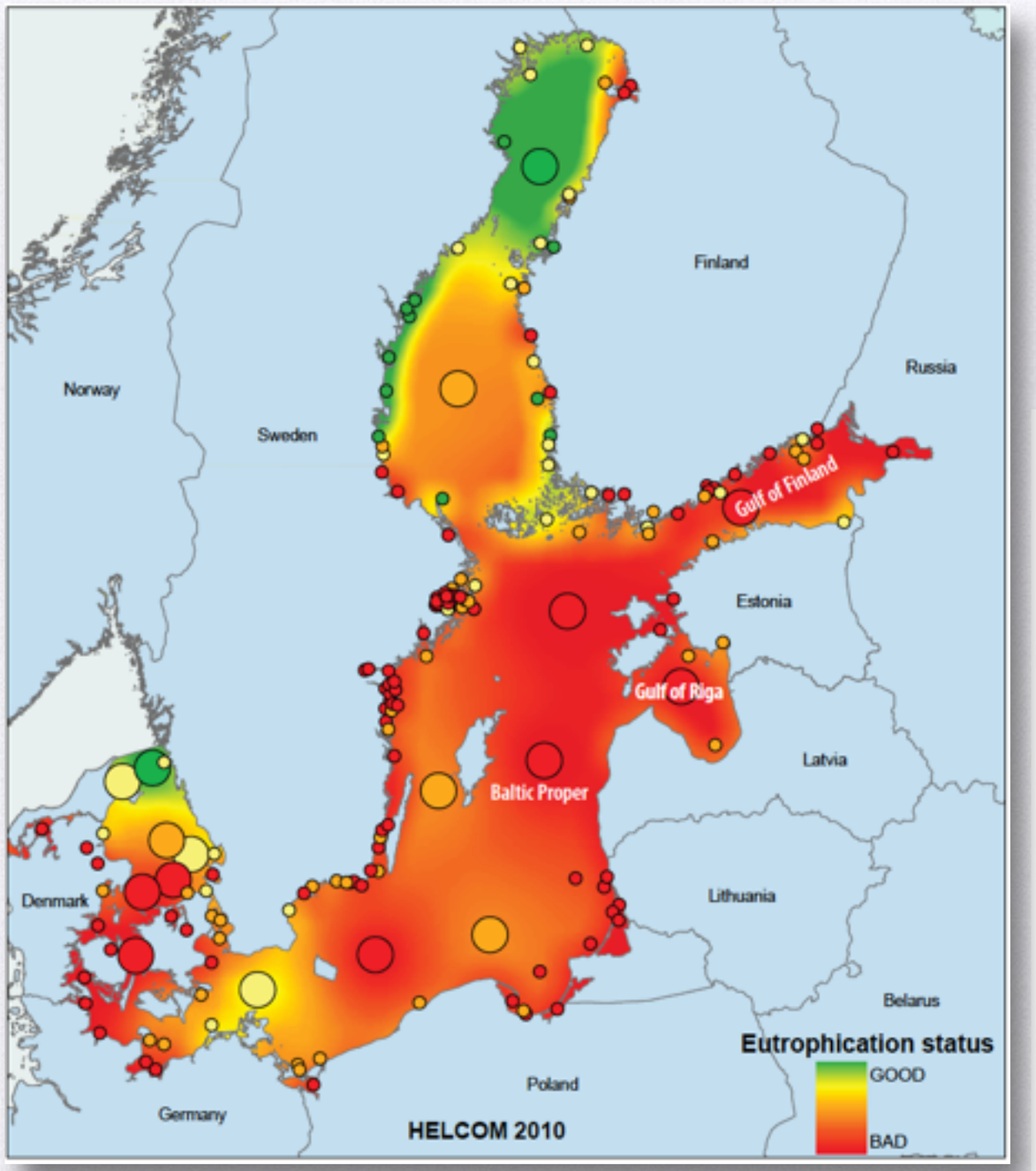
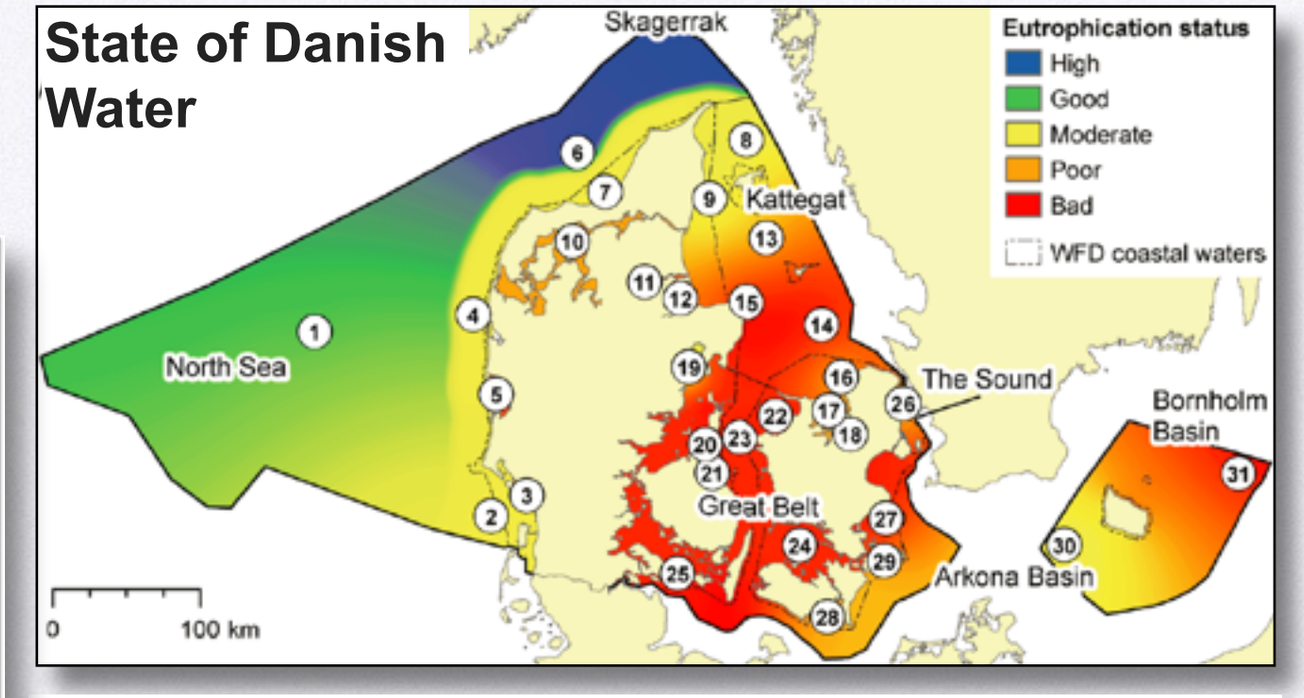
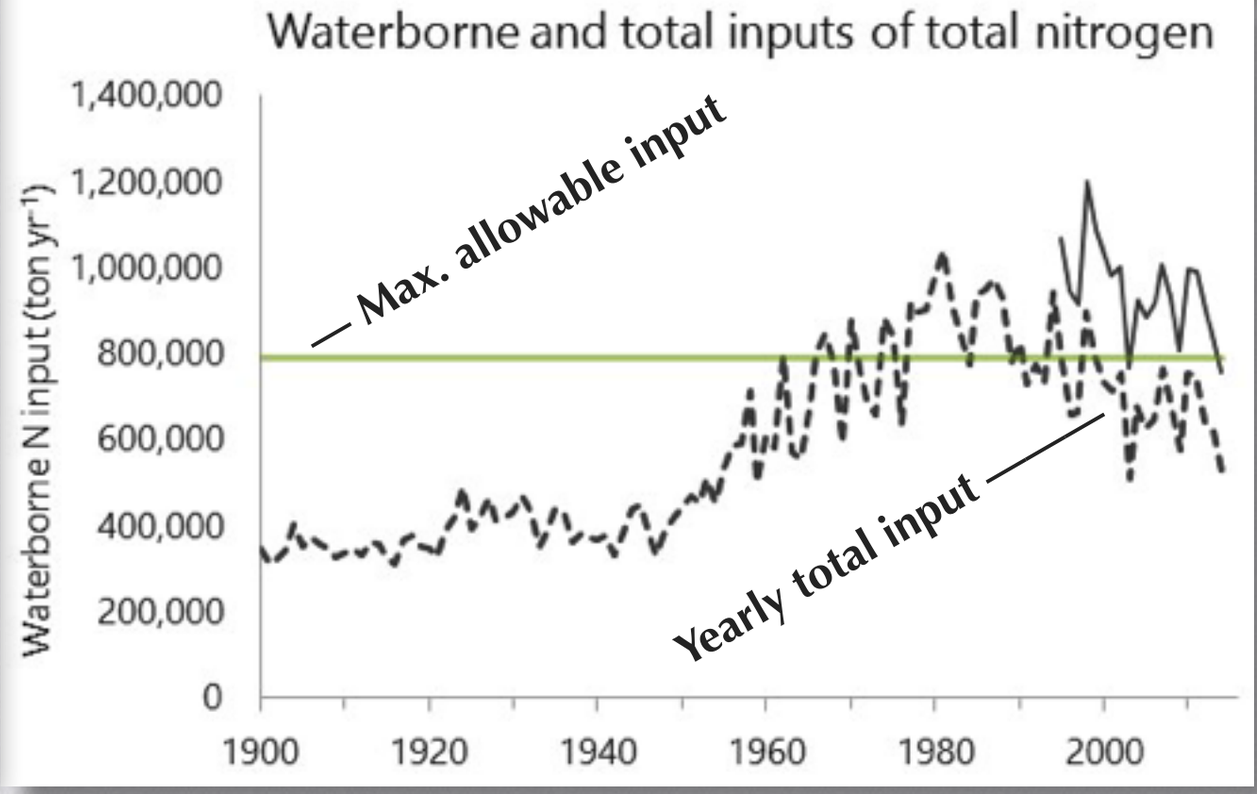
Nitrogen/Phosphorus

Helcom, 2018





Helcom, State of the Baltic Sea, 2018



Triple helix - creation of local involvement

- Authority (municipality)
- Enterprises (energy, etc.)
- Knowledge institutions

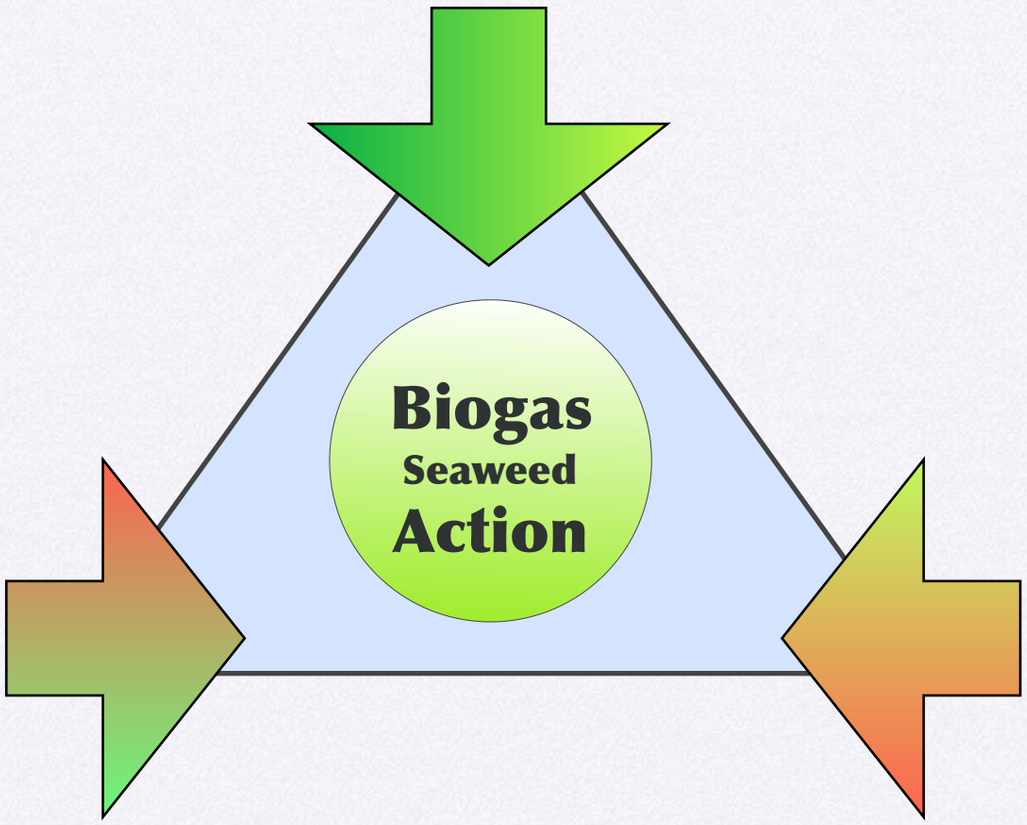
Triple helix:
- not created in advance
- but developed through the proces

See the **timeline** and the Involvement schemes at next page:

The municipality

Three main roles

- Authority
- State Representative
- Entrepreneur
- Energy producer and consumer



Companies

- Private companies
- Municipal company
- Associations

Knowledge

- Knowledge institution
- Advisors
- R&D institutions (universities, etc.)

Timeline

År 2008	2009	2009	2010	2010	2012	2014	2014	November 2015
Years of genes of rotting seaweed on the beach	Local coopera-tion on cleaning the beach	New climate plan in Solrød (55%). Biogas on seaweed	Inital re-search of seaweed. Grants from Regional Fund	Results of survey: Large gas yield. Ad-ditionel biogas surveys	Authority approval 2010-14. Grants from the Regional Fund	Subsidies from the EU for preparing turnkey contracts PDA	Solrød Biogas formed as A/S Contract conclu-ded	Bigadan selected as total contractor plus 5 years operation	The plant completed Official opening Produc-tion starts

Stakeholders
- Creating stakeholder involvement through the planning & construc-tion process

Operation & Ownership:
- Owned by the Municipallity
- Operated by Bigadan A/S
- Biogas engine owned and operated by VEKS

Roskilde University

Research Center Foulum, Aarhus University

CHR HANSEN
Improving food & health

BIGADAN

BREGENTVED
www.bregentved.dk

CPKelco
A HUBER COMPANY

Local farmers pig & cattle

VEKS
District heating trans-mission company

SolrødBiogas
- helt naturligt

Solrød Kommune

Landbruget

VÆKSTFORUM SJÆLLAND

INTELLIGENT ENERGY EUROPE

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Eelgrass - ålegræs
Brown algae - brun alger
Fedtemøj

Thank you for your attention