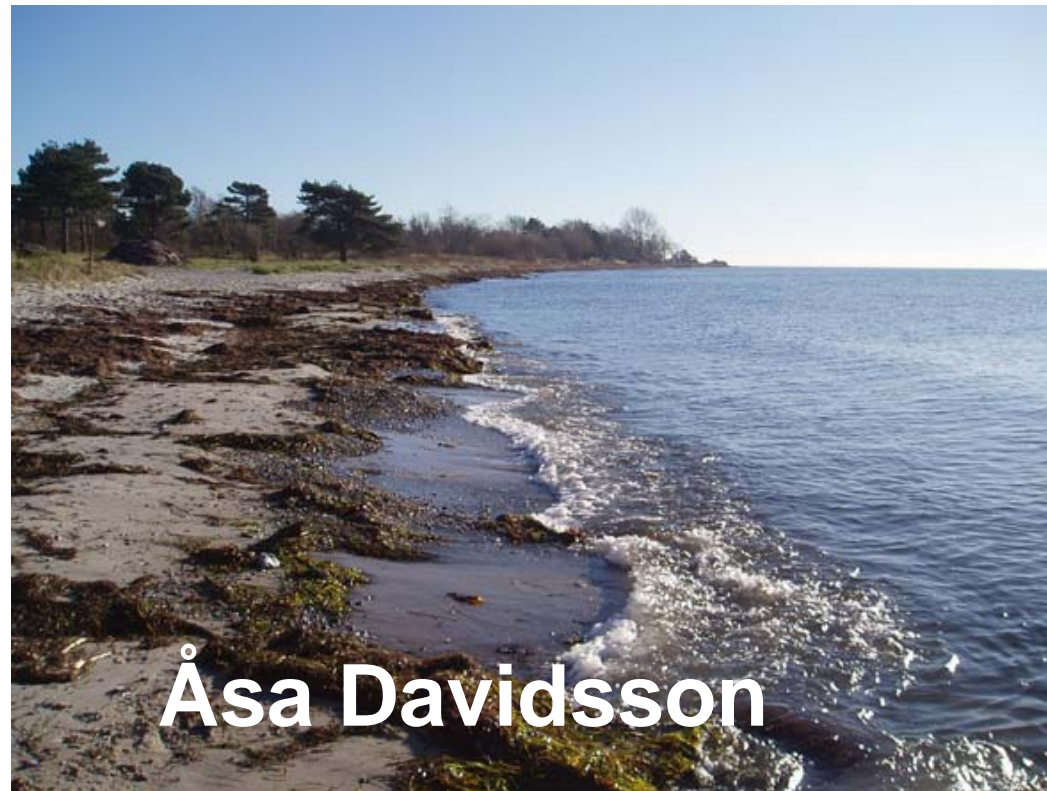

Biogas production from seaweed and waste





DETOX



It's all about clean soil and sound construction



Biogas potential (Sweden)

17 TWh (JTI, 1998)

14 TWh (SGC, 2005) – 7 TWh organic waste; 7 TWh energy crops (10% of agric. land)

1.3 TWh - current production (80% from WWTP and landfill)



Biogas production from waste

- Food waste
 - households, restaurants, shops
- Garden waste
- Industrial waste
- Waste from agriculture
 - manure and crop residues



New wastes for biogas production

How should we proceed?

- **Characterisation**

- toxicity, nutrients, physical, etc

- **Lab study**

- biogas potential, specific parameters

- **Pilot study**

- continuous operation, months-years

- **Full-scale**



Seaweed and algae – an example

Background

- Eutrophication
- Accumulation on beaches
- Waste problem
- Heavy metal content - Cd



Seaweed - characteristics

Biological
Chemical
Physical
Toxicity



Suitable for anaerobic digestion?

Seaweed – characteristics - results

Biological - Filamentous algae

Chemical - VS, C, N, P, K etc

Physical - sand

Toxicity - Cd, Na, Cl, S

Suitable for anaerobic digestion?



Seaweed – lab study

Biogas tests

- Batch tests, duplicate
- 35°C
- Volume: 2 litres
- 30-50 days

Heavy metal removal

- Extraction of Cd^{2+}
- Separation of Cd^{2+}



Biogas tests

Tested parameters:

- Different fractions of seaweed/algae
- Co-digestion with other waste
- Pre-treatment of seaweed/algae
- NaCl – inhibition
- Influence from Cd-separation

Some results

Different fractions of seaweed/algae

Biogas potentials
in 30 days



"wet" fraction:

148-172 Nml CH₄/g VS_{in}

"medium-dry" fraction:

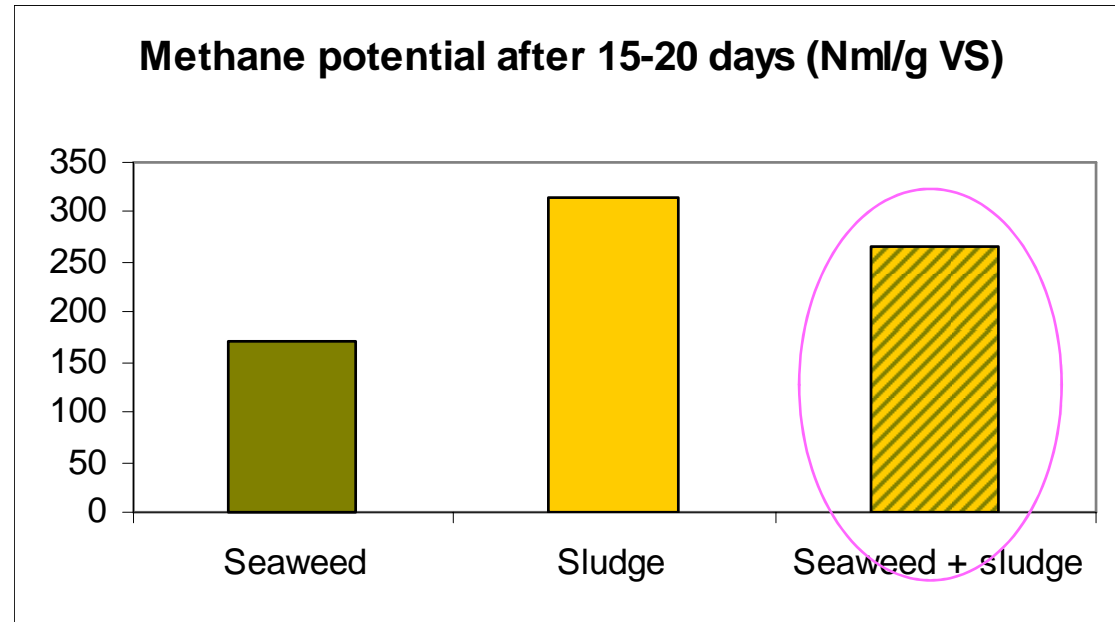
41-45 Nml CH₄/g VS_{in}

"dry" fraction:

57-81 Nml CH₄/g VS_{in}

Co-digestion with other waste

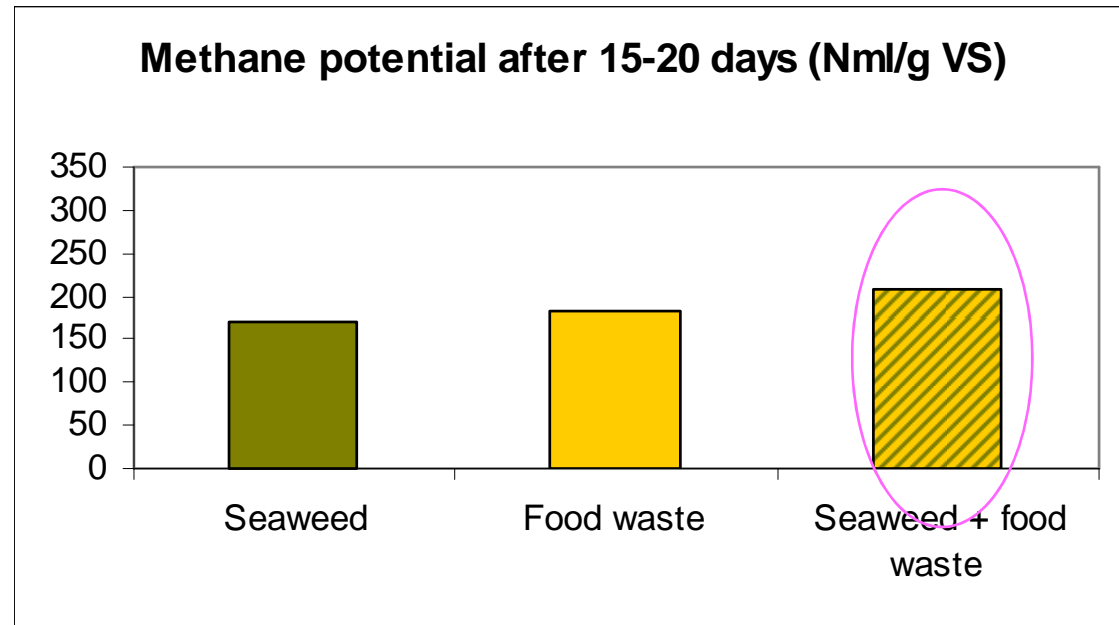
**Sludge from
wastewater
treatment plant**
50:50



Slightly increased potential

Co-digestion with other waste

**Vegetable food
waste
50:50**



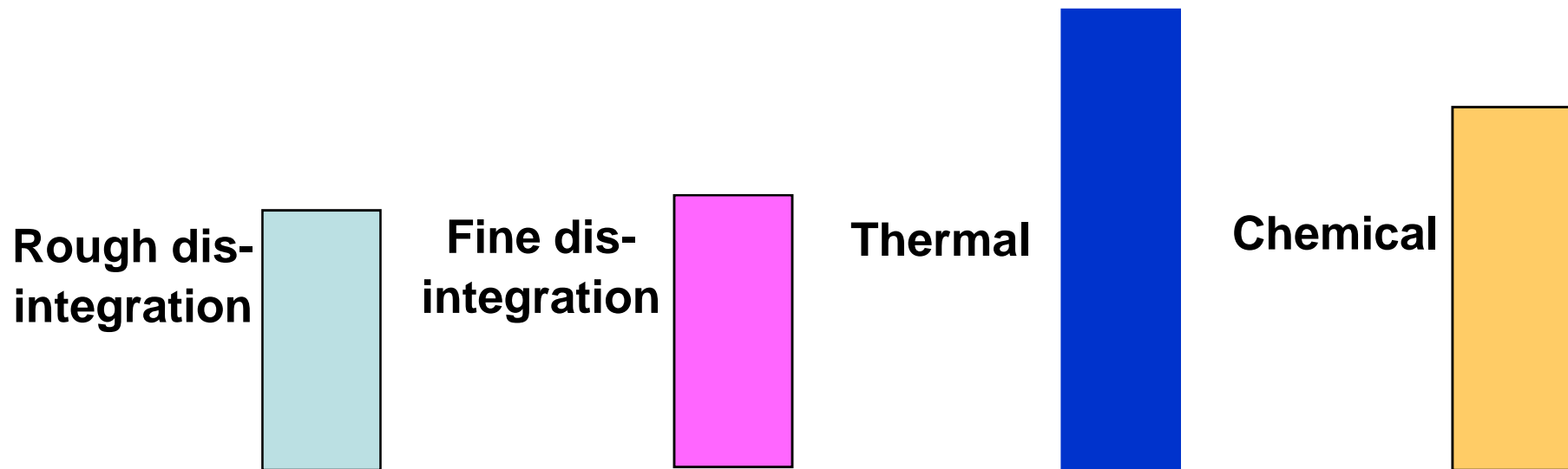
Clearly increased potential

Pre-treatment of seaweed/algae

Mechanical disintegration

Thermal treatment

Chemical treatment



NaCl – inhibition

Substrate	Methane potential Nml/g VS
Seaweed (low NaCl)	223
Seaweed (medium NaCl)	201
Seaweed (high NaCl)	211



Cd-removal

Extraction with acid

→ 75% of total-Cd

Separation

→ Adsorption, 4-94% of Cd^{2+}

→ Ion exchange, 99.5% of Cd^{2+}



Seaweed – energy potential

Biogas production from seaweed:

1. 0.7 GWh/y - limited beach collection - Trelleborg
2. 15 GWh/y - water collection - Trelleborg coast
3. 103 GWh/y - water collection - the south scania coast



Conclusions

- Seaweed/algae could be used for biogas production
- 75% of total Cd was removed with extraction and separation of Cd
- Dry seaweed/algae at beaches - low potential
- Wet seaweed/algae from water - medium potential

More conclusions

- Pre-treated seaweed/algae from water – high potential
- Co-digestion with other waste could improve biogas production
- More to come.....pilot-scale study