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MACRO ALGAE AS SUBSTRATE FOR BIOGASPRODUCTION

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AU RESEARCH FROM LAB TO FULL SCALE



ALGAE SPECIES TESTED FOR BIOGAS

Brunalger (*Phaeophyceae*)



Fingertang (*Laminaria digitata*)



Sukkertang (*Saccharina L*)



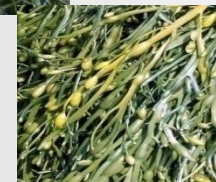
Søsalat (*Ulva lactuca*)



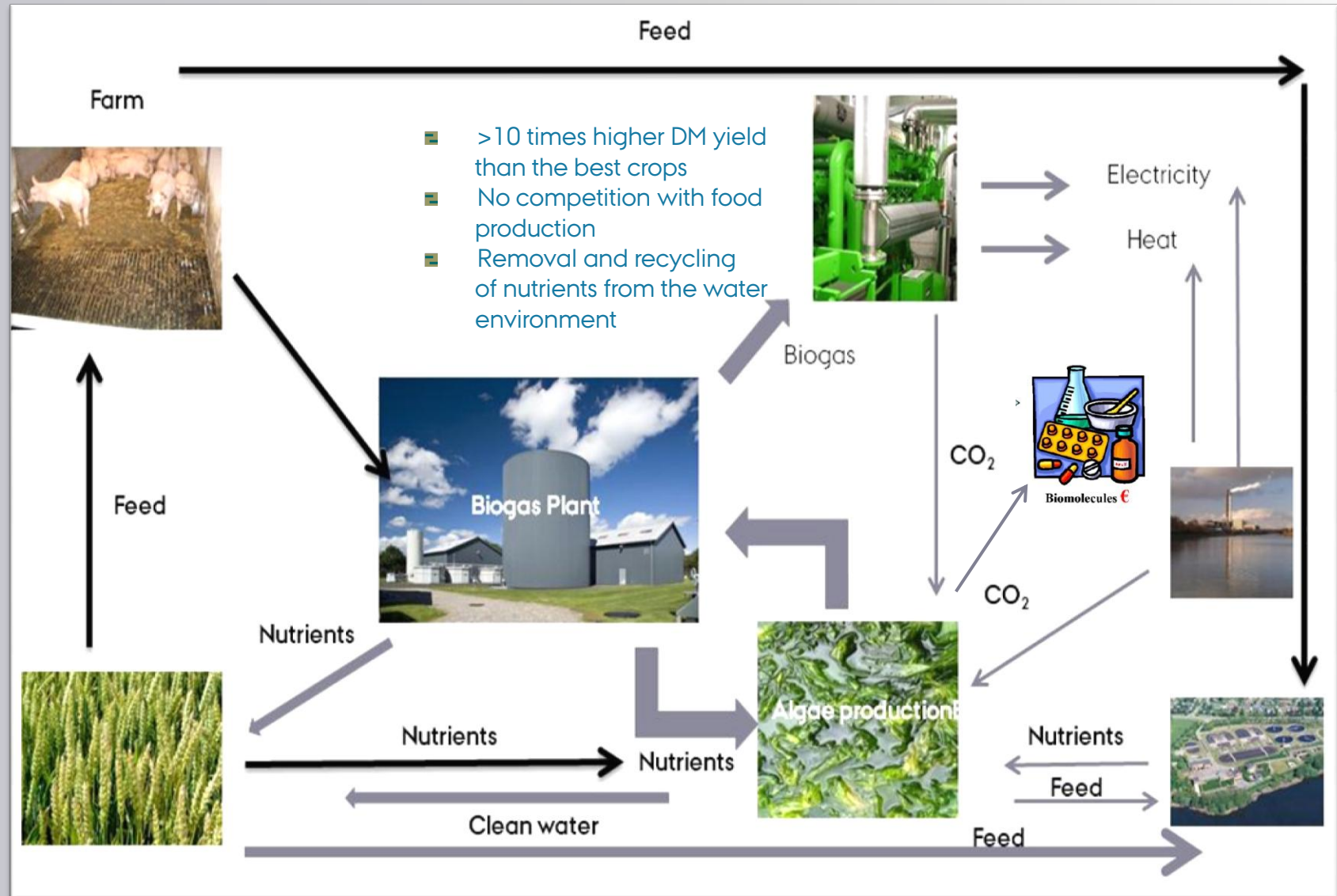
Krølhårstang (*Chaetomorpha linum*)



Buletang (*Ascophyllum nodosum*)

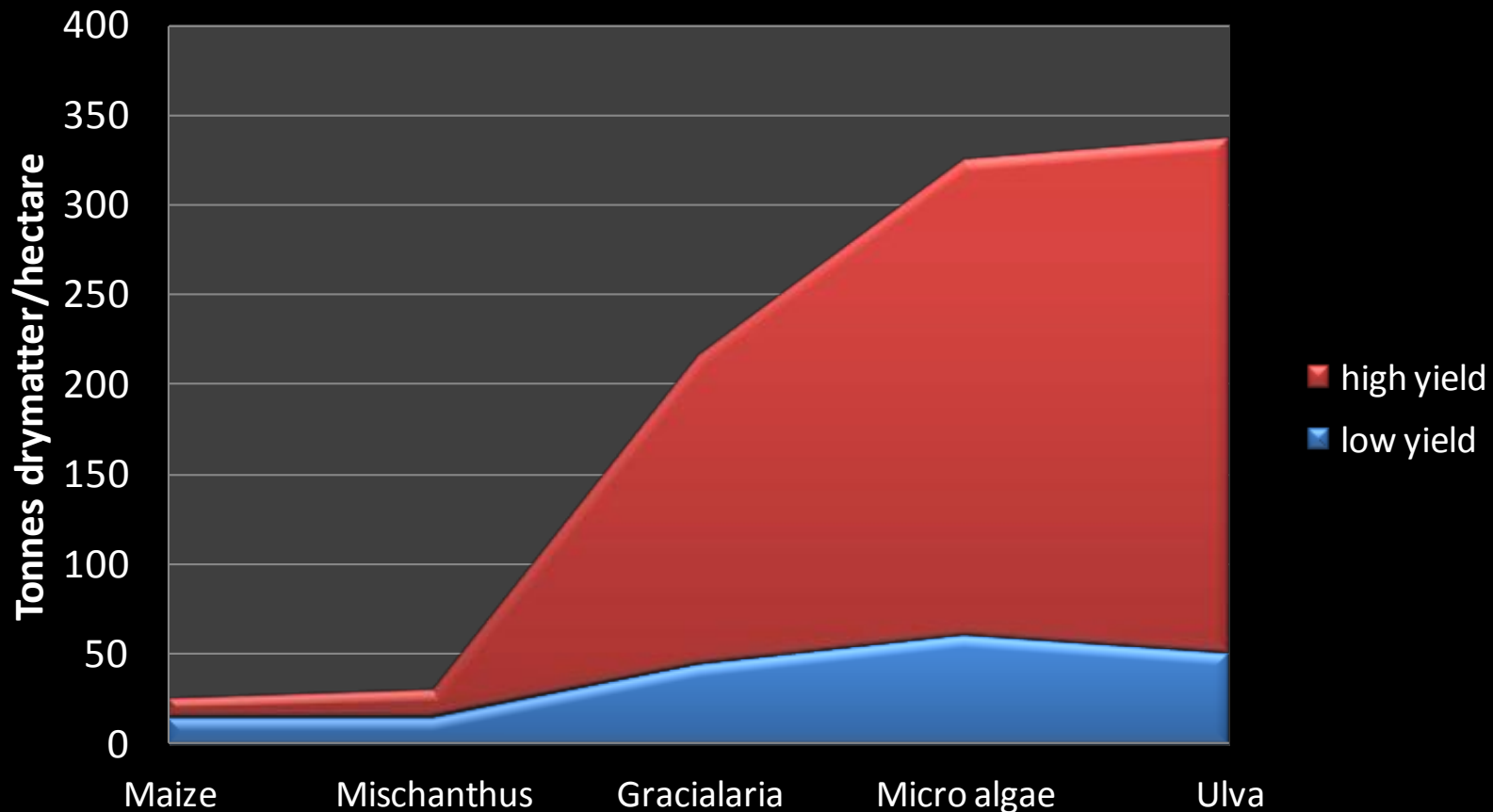


WHY ALGAE FOR BIOGAS

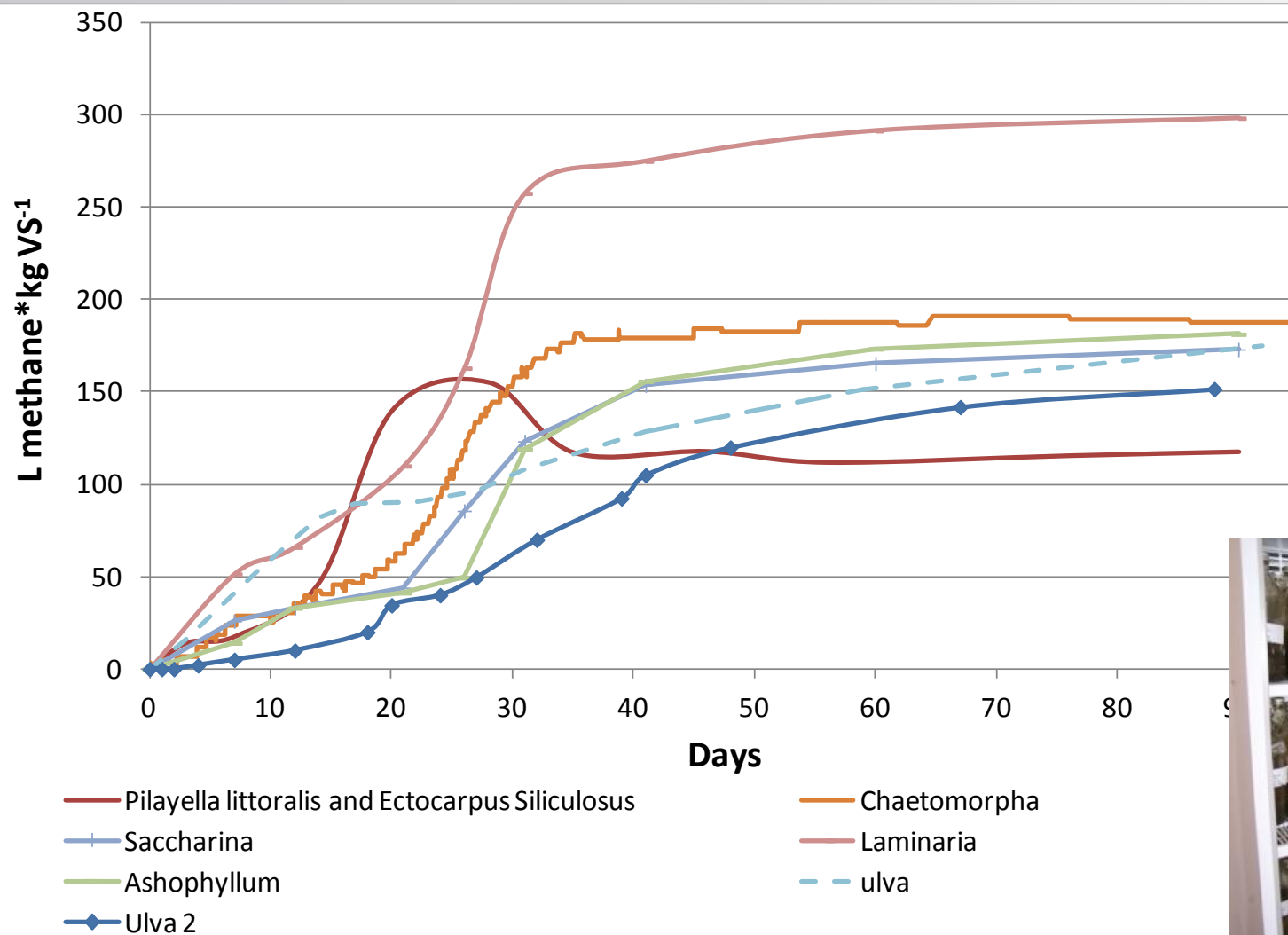


HARVEST POTENTIAL

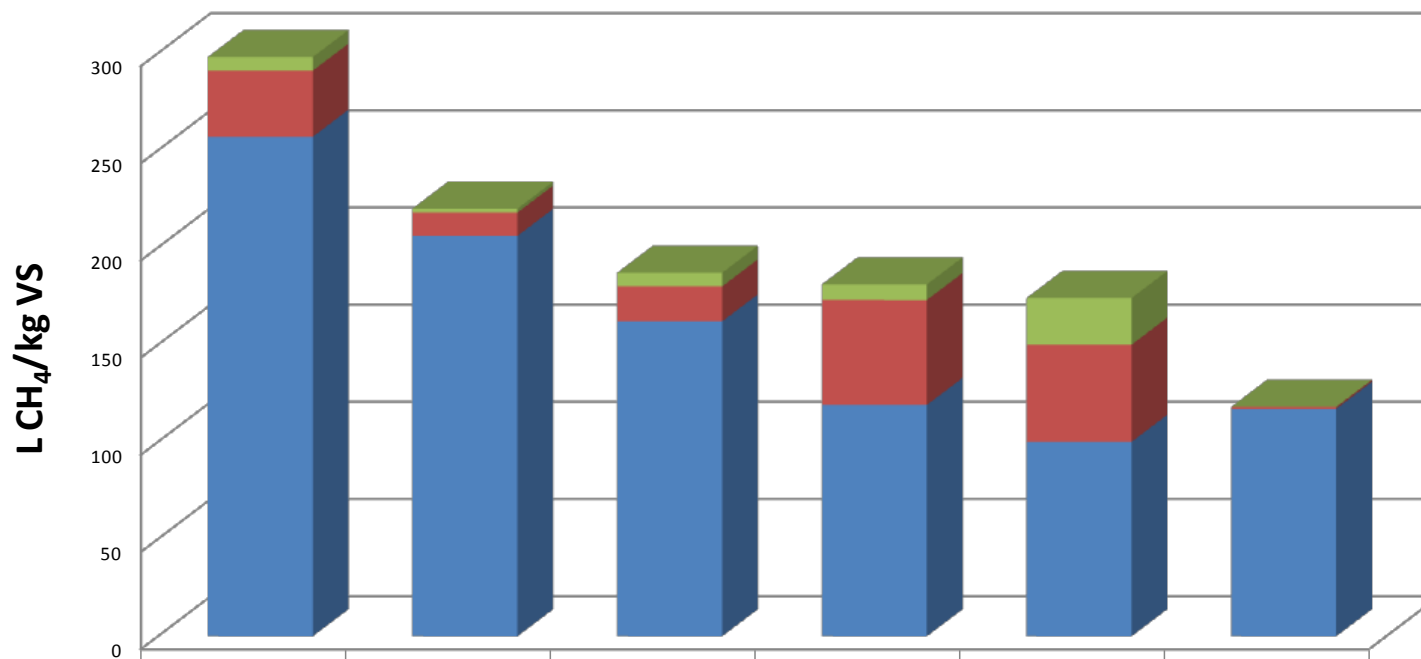
Biomass yield



BIOGAS EXPERIMENTS-BATCH

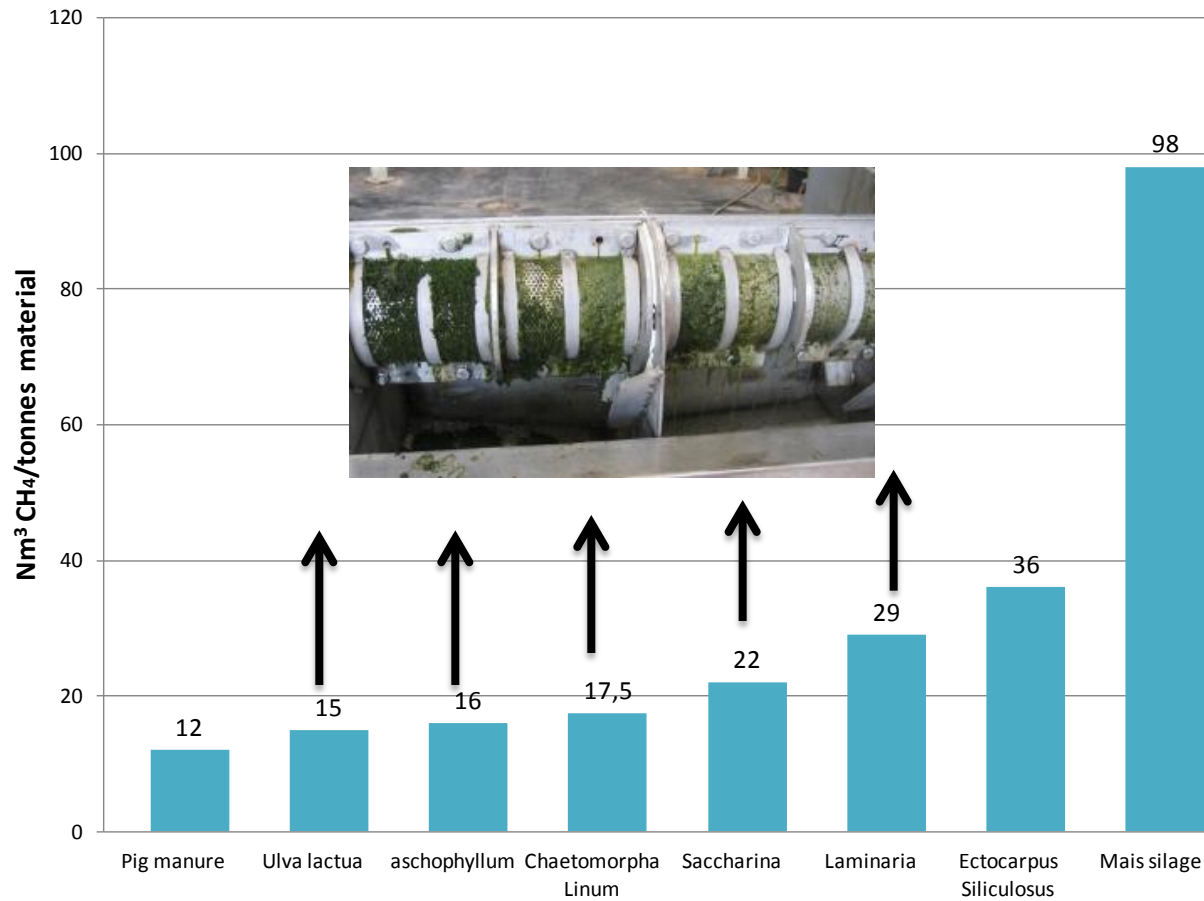


Methane potentials

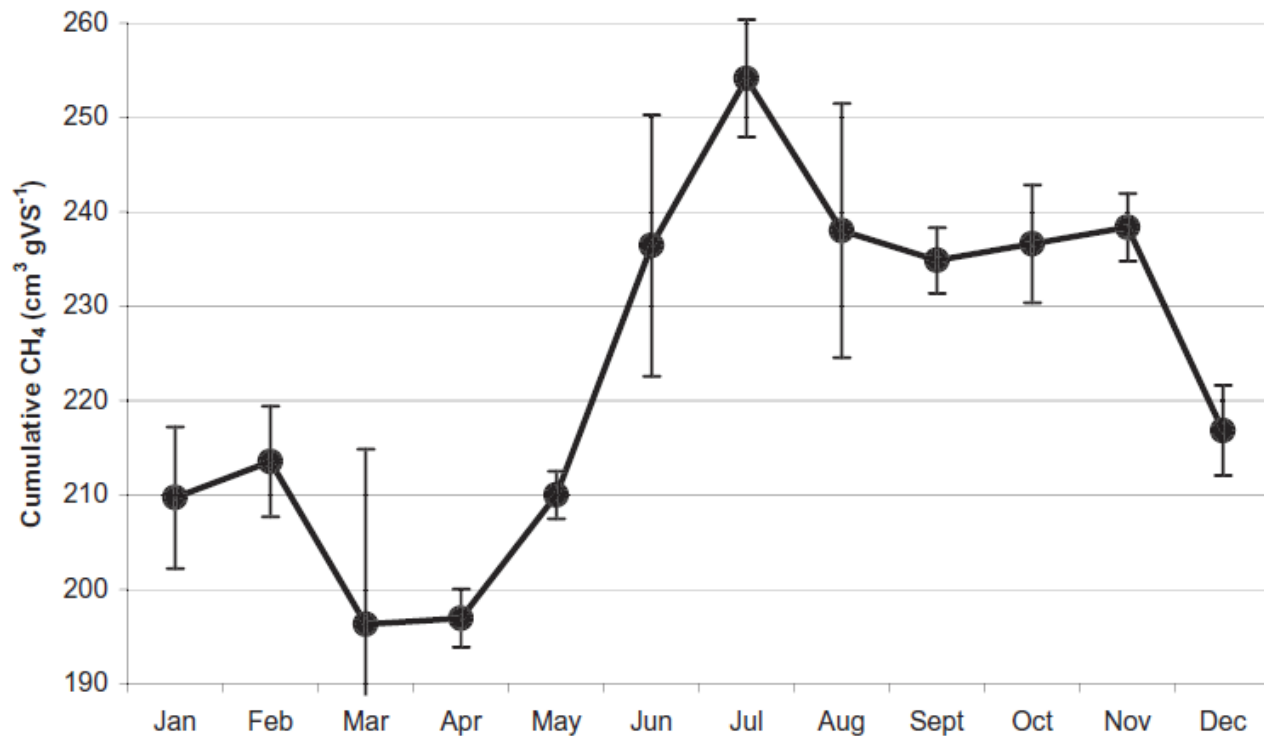


	Laminaria	Saccharina	Chaetomorpha Linum	aschophyllum	Ulva lactua	Pilayella littoralis and Ectocarpus Siliculosus
90 days	7	2	7	8	24	0
60 days	34	12	18	54	50	1
30 daYS	257	206	162	119	100	117

METHANE POTENTIALS



SEASONAL VARIATION OF BMP IN LAMINARIA

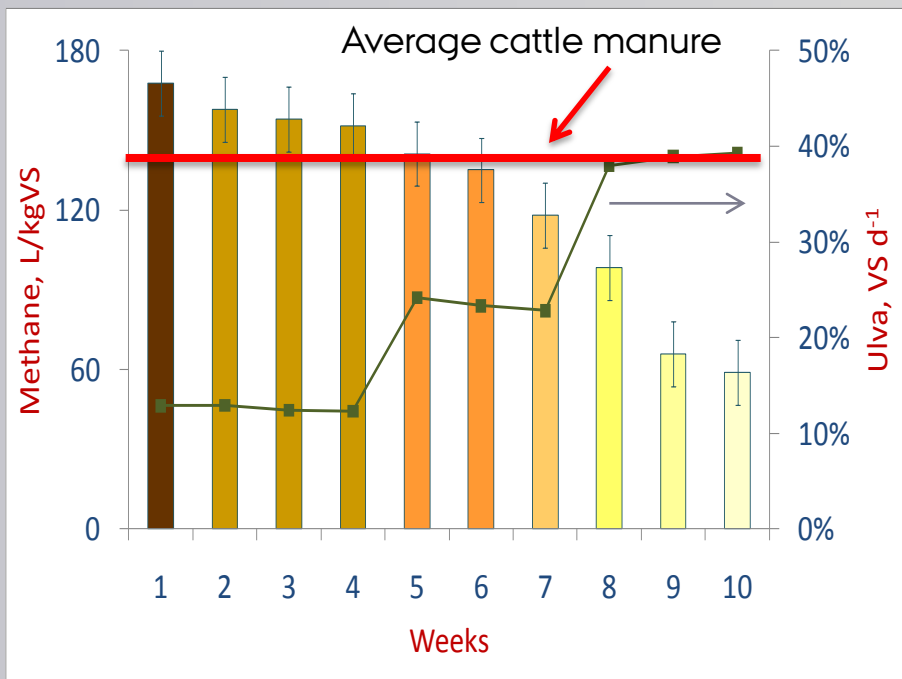


From Adams et al. 2011

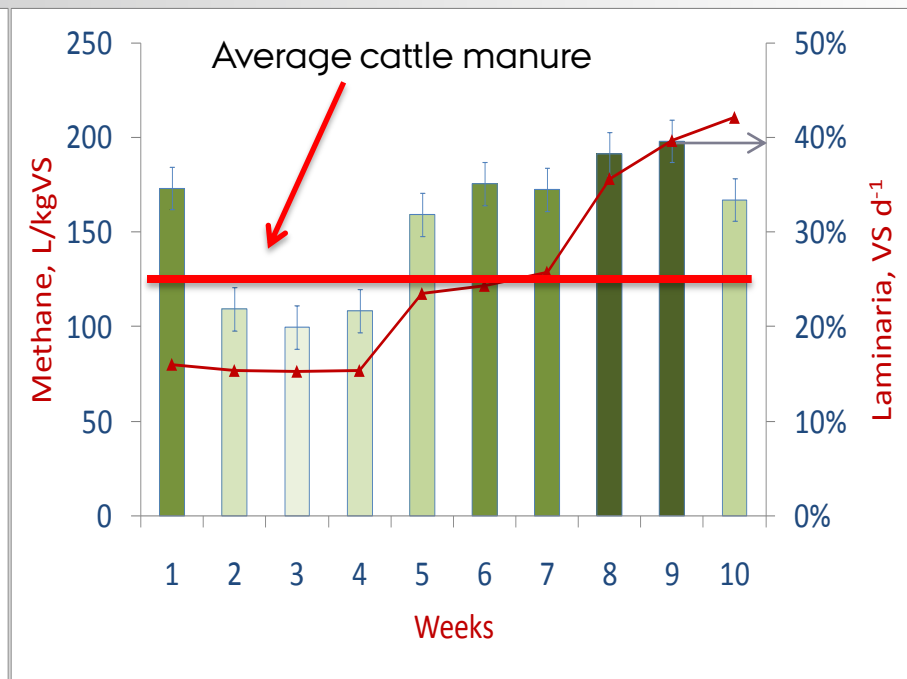
CONTINUOUSLY EXPERIMENTS – CODIGESTION OF MANURE AND ALGAE

	<i>Ulva</i>			<i>Laminaria</i>			Control
%VS (algae:manure)	11:89	24:76	37:63	15:85	24:76	41:59	0:100
HRT, days	22			22			22
Temp.(°C)	50			50/35			50/35

RESULTS OF CONTINUOUSLY THERMOPHILIC EXPERIMENTS

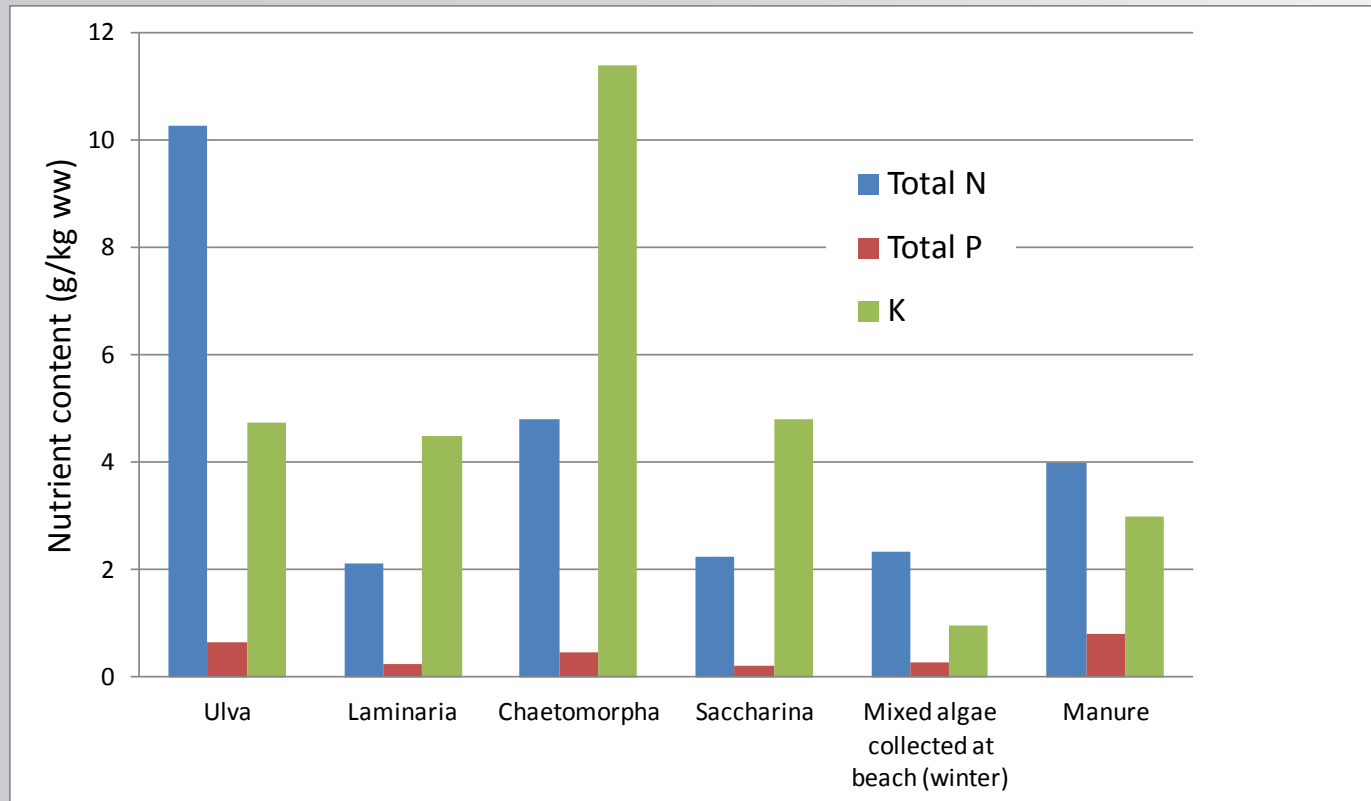


Ulva lactuca

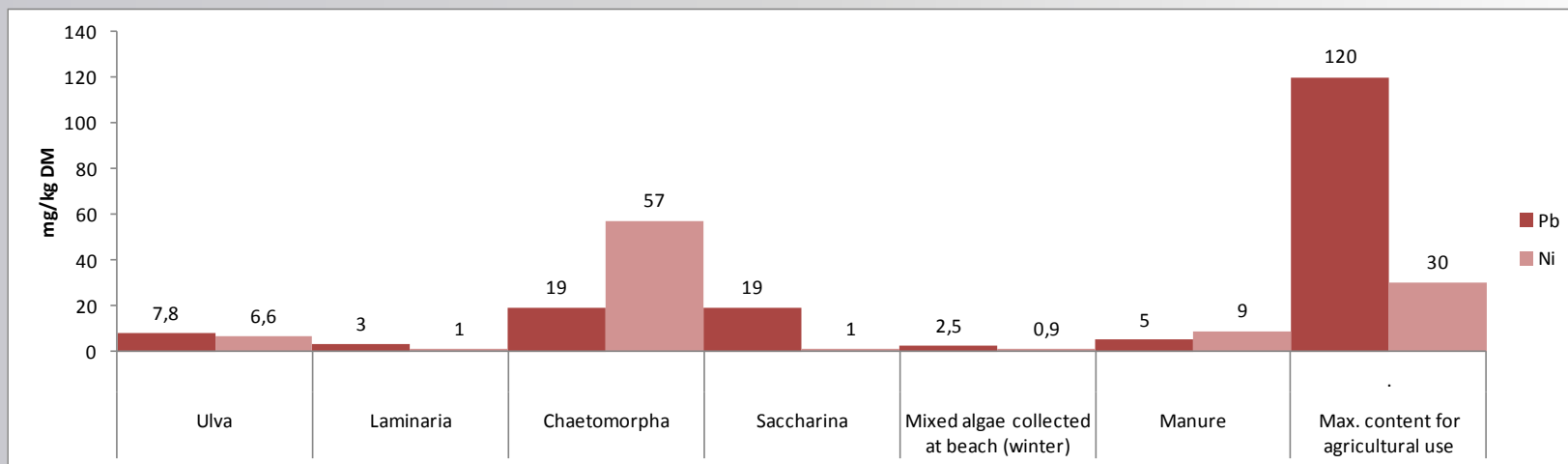
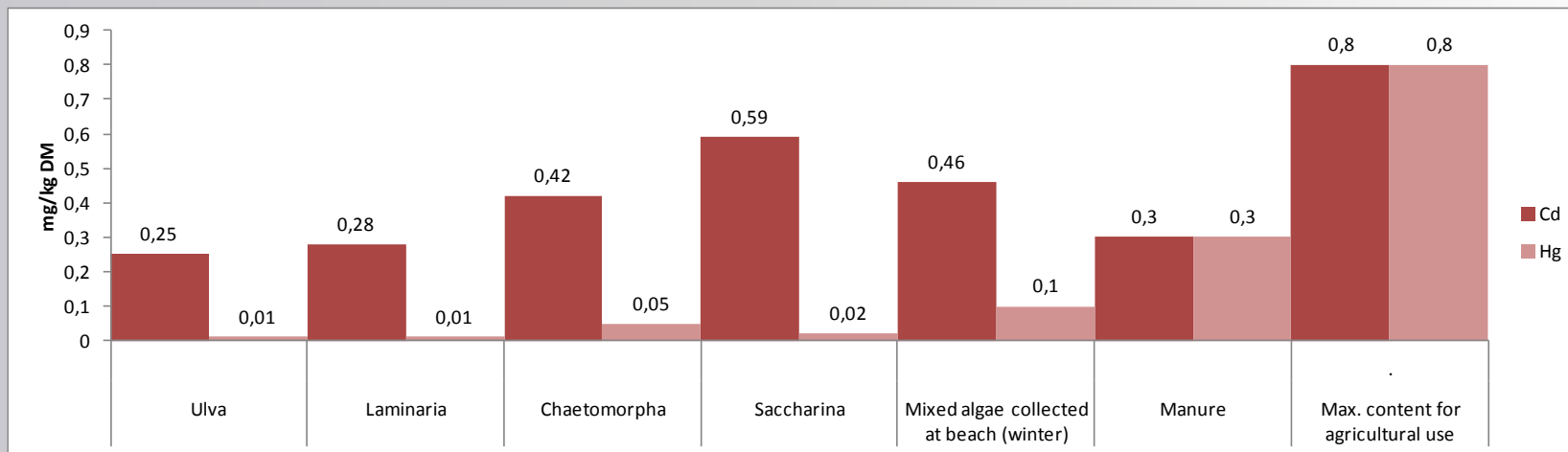


Laminaria

FERTILIZER VALUE – DIGESTATE USE FOR ORGANIC FARMING



FERTILIZER AND HEAVYMETALS



OFF SHORE HARVEST/CULTIVATION OR CULTIVATION IN BASINS

Line cultivation



Basin cultivation



Sea harvest

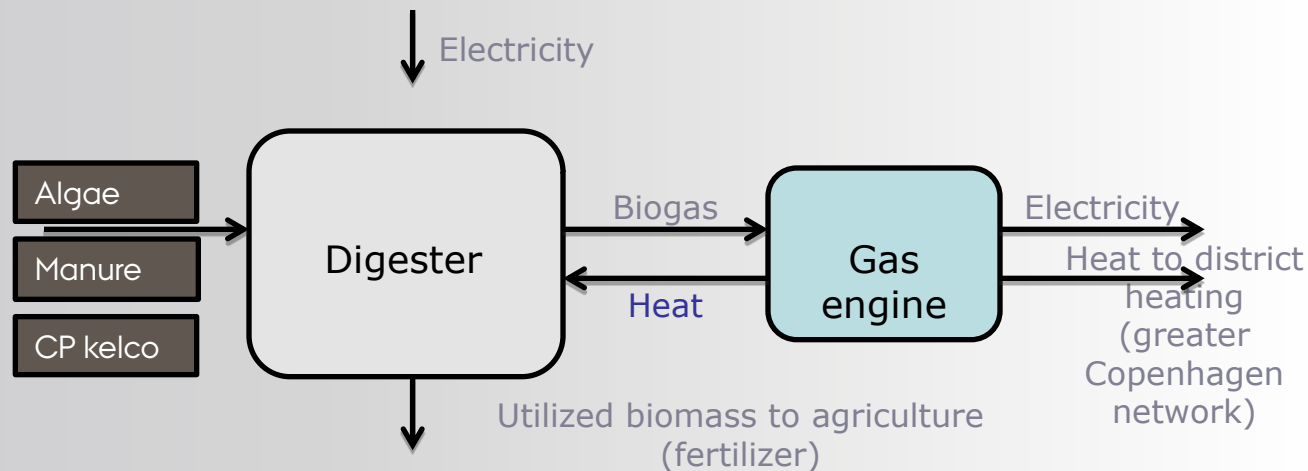


Beach 'harvest'

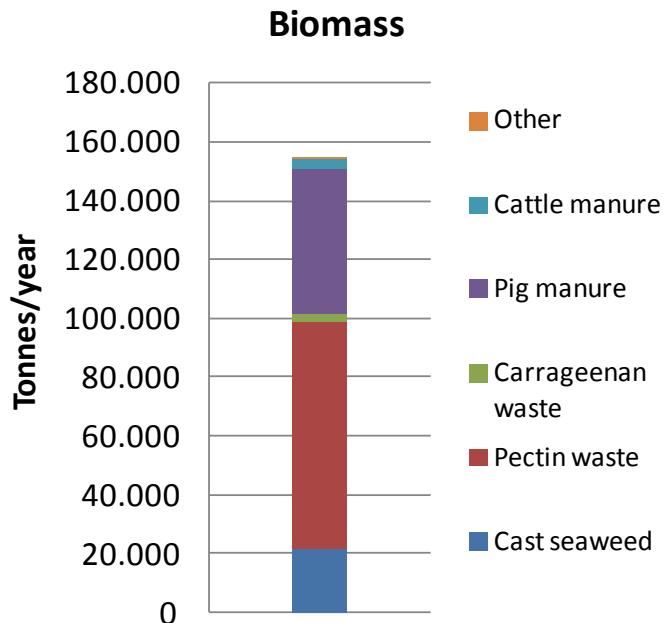
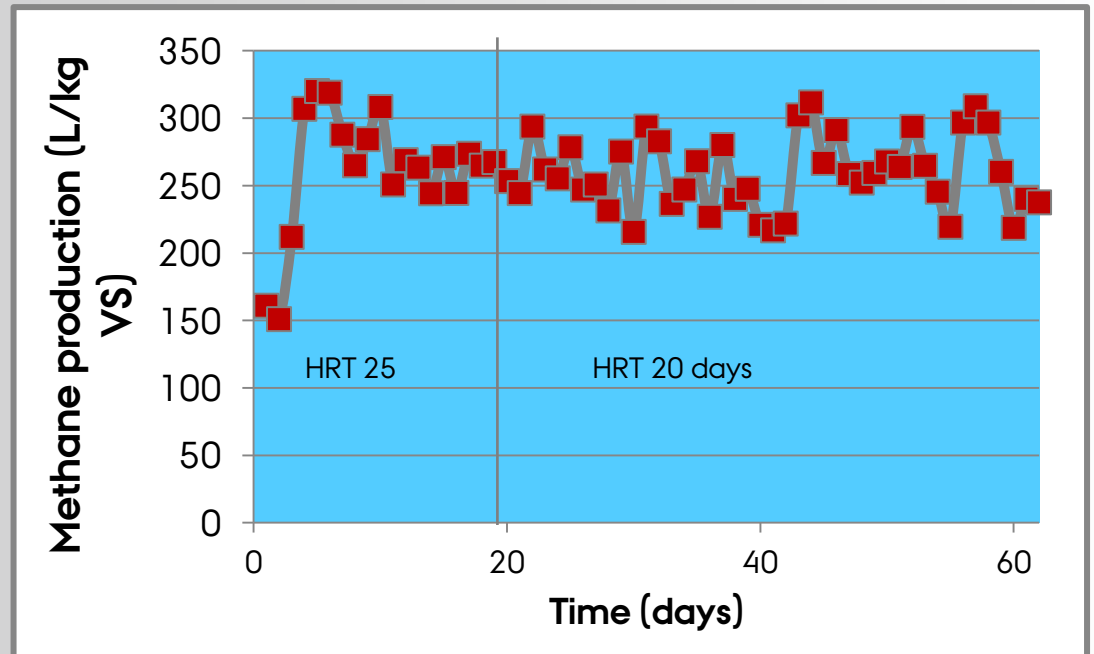
ECONOMICS

- › Production costs: **3 kr/kg DM**
- › Methane value: **1-2 kr/kg DM**
- › **How to make it profitable:**
- › Value of nitrogen for organic farming:
- › **0,5 kr/kg DM (15 kr/kg N)**
- › Payment for N removal from water environment: **>75 kr/kg N**
- › Extraction of products of high value and only using the by product for biogas
- › Value on the removal from beaches etc. **??**

EXAMPLE OF A COMING BIOGAS PLANT BASED ON ALGAE - SOLRØD



BIOGAS PLANT BASED ON ALGAE - SOLRØD



The process is very stable, Methane Production >260 L/kg VS or 1.61 l/l of reactor per day, Methane content : 59%

CONCLUSIONS

- › Algae is a very high yielding biomass that will not compete with food production. Ulva can have a drymatter yield that is more than 10 times higher than crops
- › Laminaria was found to be the macro algae with highest gaspotential 250-300 L CH₄/kg VS.
- › Co-digestion of algae with manure is advantageous but the ratio that can be used depends on algae species, Laminaria is superior
- › Digestate is a high value fertilizer with low heavy metal content
- › Cultivation of algae for biogas is not economical feasible today, but valuing environmental benefits, extraction of high value components or collection of cast seaweed at beaches might be ways to integrate algae in biogasplants as in Solrød



THANKS FOR YOUR
ATTENTION