FUTURE TRENDS IN INCREASING, OPTIMIZING AND GIVING ADDED VALUE TO BIOGASPRODUCTION

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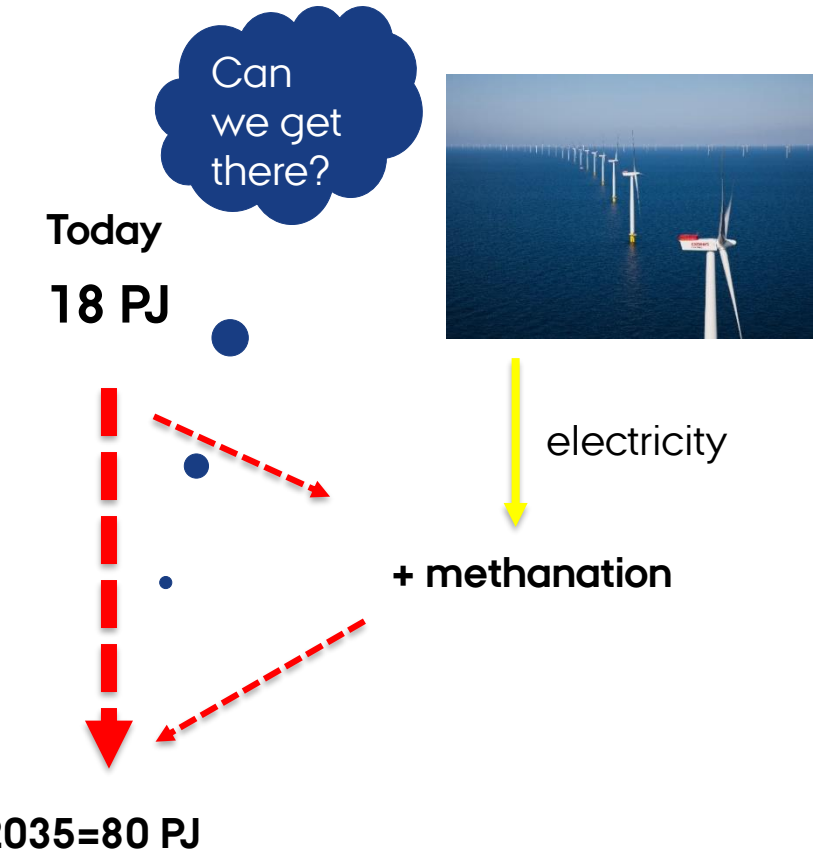
SOTA AND FUTURE TRENDS

State of the art

- High share of liquid manure
- Limited retention time
- Limited pre-treatment
- High loss from in house storage of manure
- High cost of nutrient re-distribution (phosphor)
- 1-2 % loss of CH_4

Future trends and challenges

- High share of ligno-cellulosic biomass →pre-treatment
- Increased SRT and/or longer HRT
- Methanation
- Low losses from stables (>0,5% CH4 loss)
- High share of cows on sand bedding ☹
- Reduction/collection of methane emissions from biogas plants
- Income and added value of byproducts



THE FUTURE BIOGAS PLANT

Low GHG emission stables

Substrate mix

Optimised mix:
C/N ratio
Use of synergy

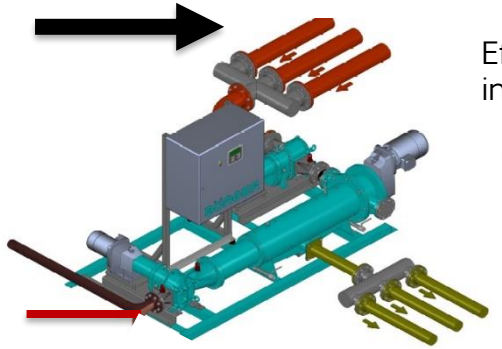
Pre-treatment

Mechanical
Chemical
Biological
Combined

Digester

Direct injection with gasmix system

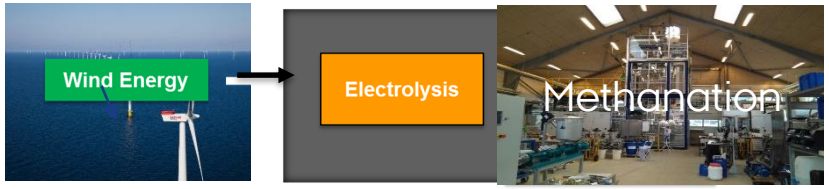
Decoupling of SRT/HRT



Effluent for further processing in centrifuge

Valuable sidestreams:
Designer fertilizer

Closed/open systems)



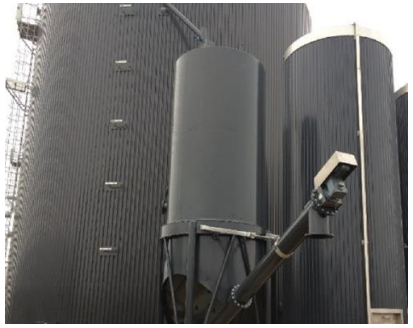
In situ or catalytic (2 steps)

THE FUTURE BIOGASPLANT
- EXAMPLES

Pre-treatment of straw and ligno-cellulosic substrate
- Maceration and grinding
- N-steaming

Ensilage of pre-treated material
- Improved gaspotential with low losses from ligno-cellulosic biomass
- Co-ensilage of straw and other biomasses (optimal mixtures)

Removal of sand
- System for sand removal during operation
- Removal of sand from cattle manure with sand bedding



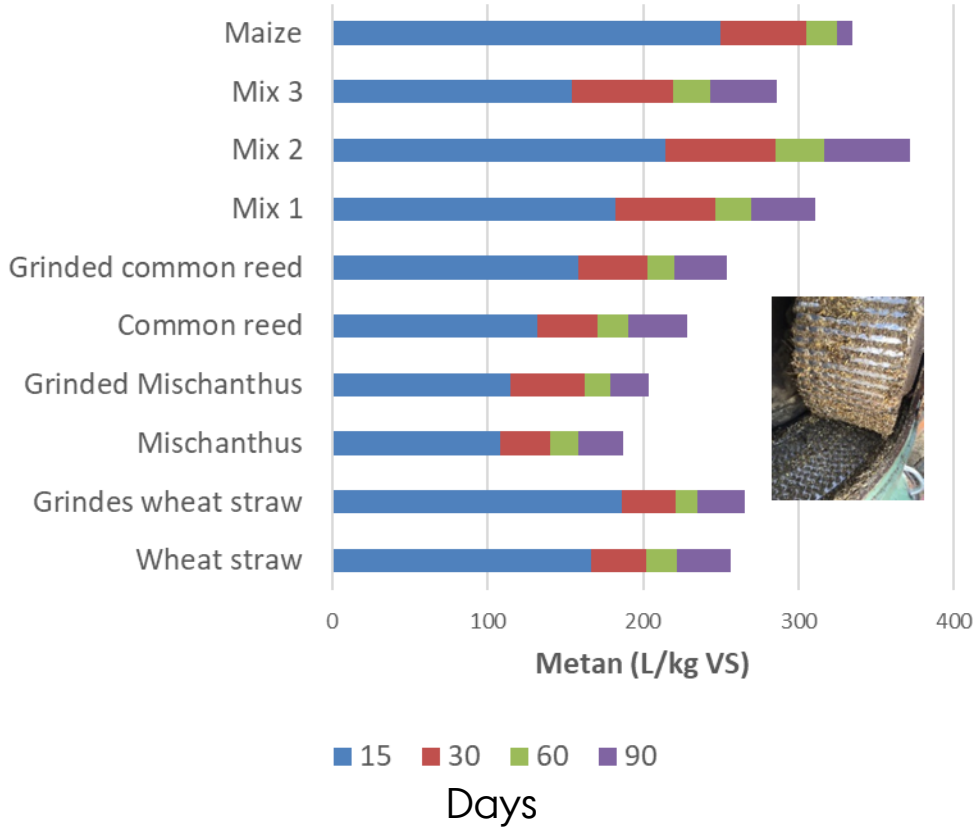
PRE-TREATMENT

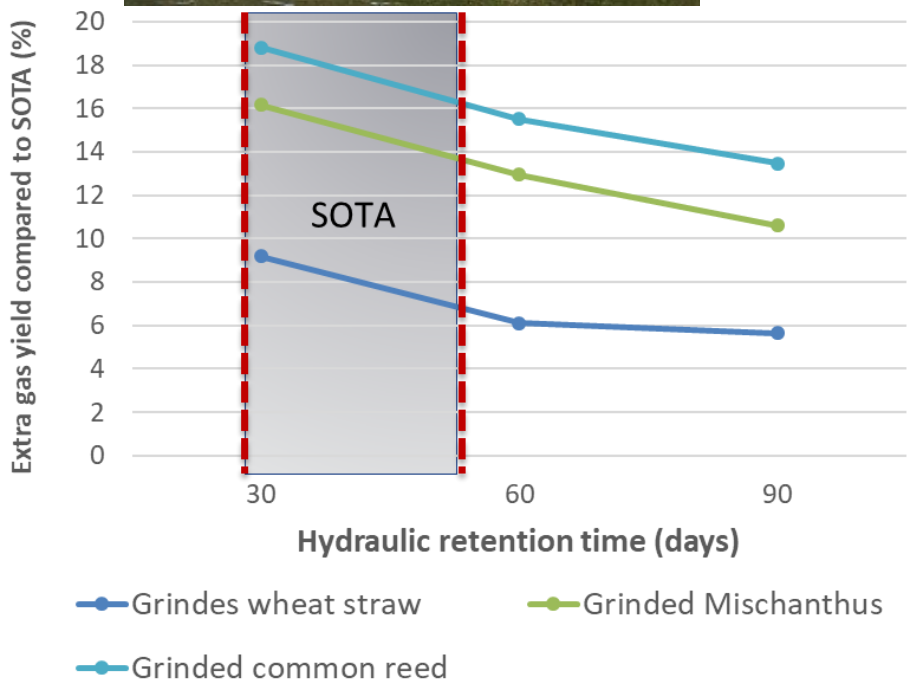
Pre-treatment: “grinding”
- mobile unit

NH_3 steaming

Co- ensilage
Layers or mixing?

PRE-TREATMENT
-NEW BIOMASSES

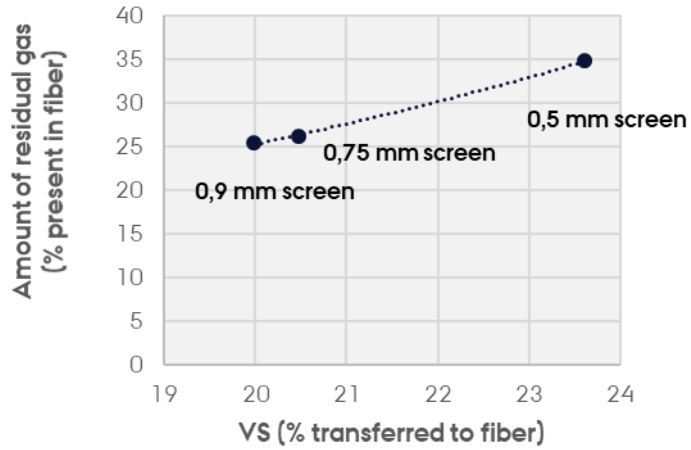


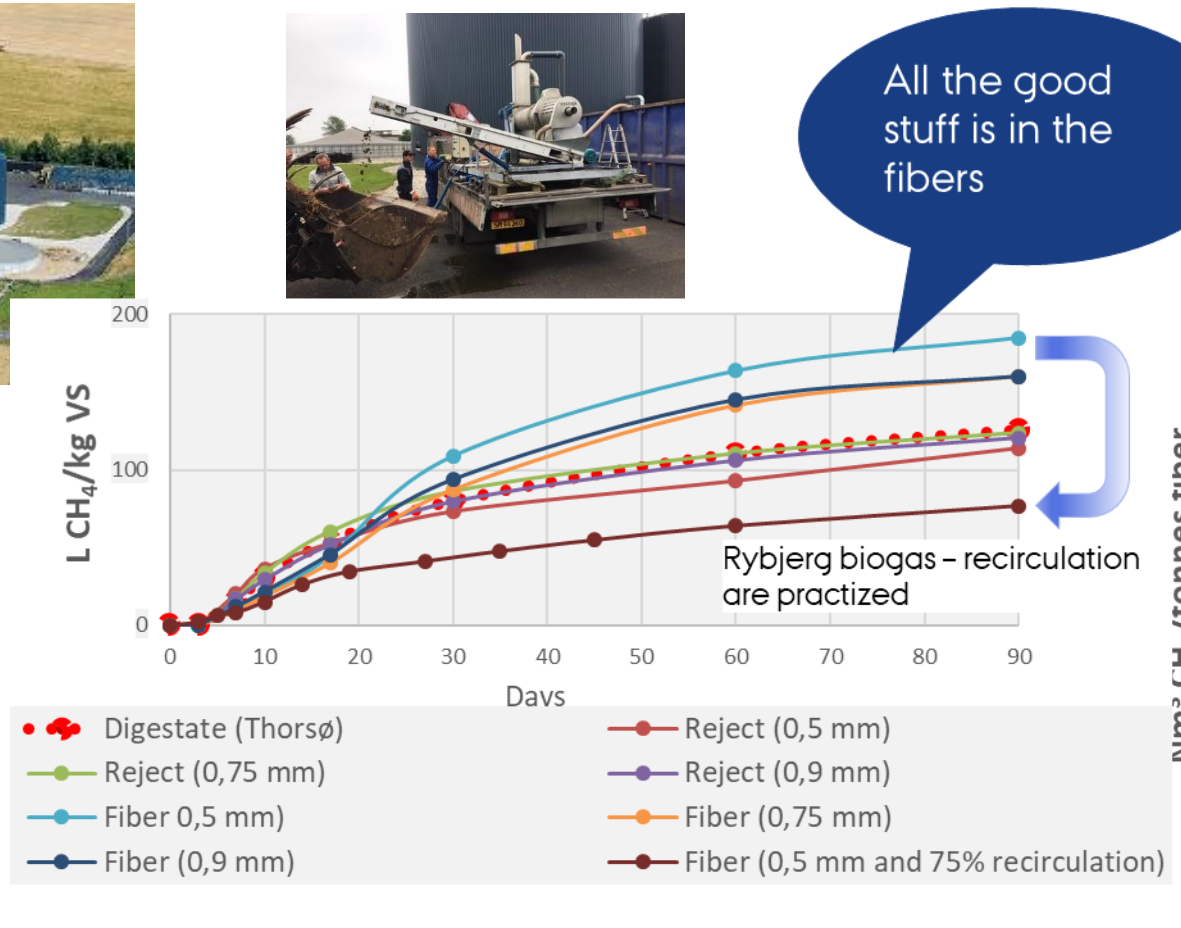


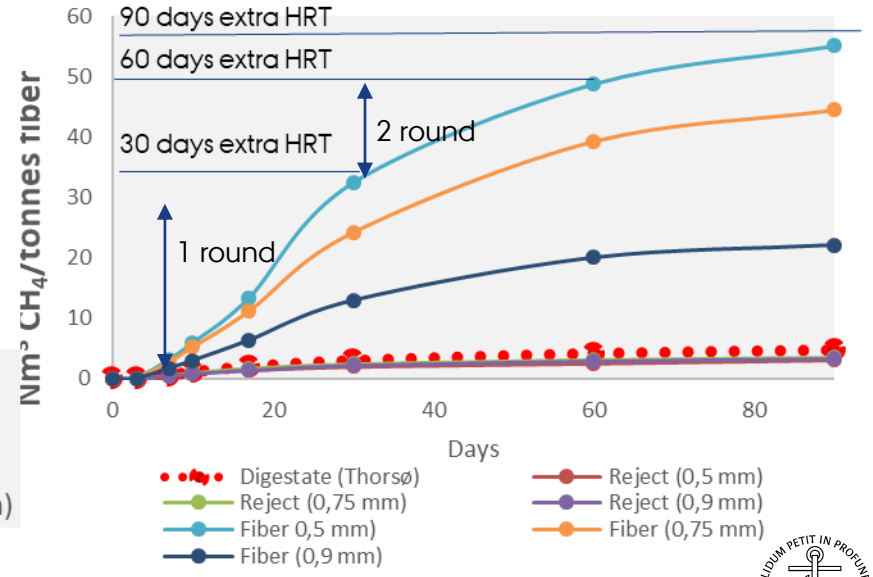
RECYCLING OF FIBERS

- MORE GAS AND LESS EMISSION

HRT=30 days,

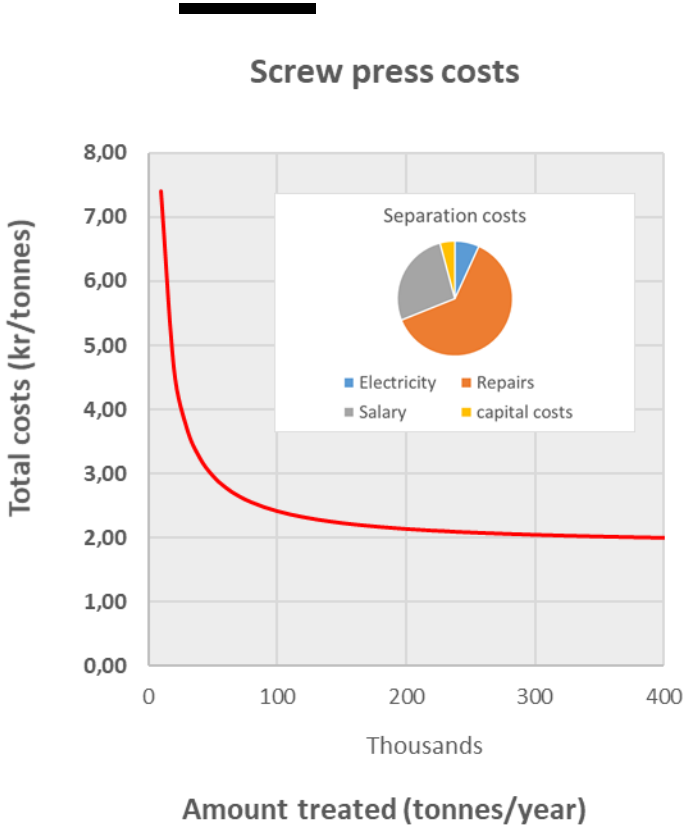


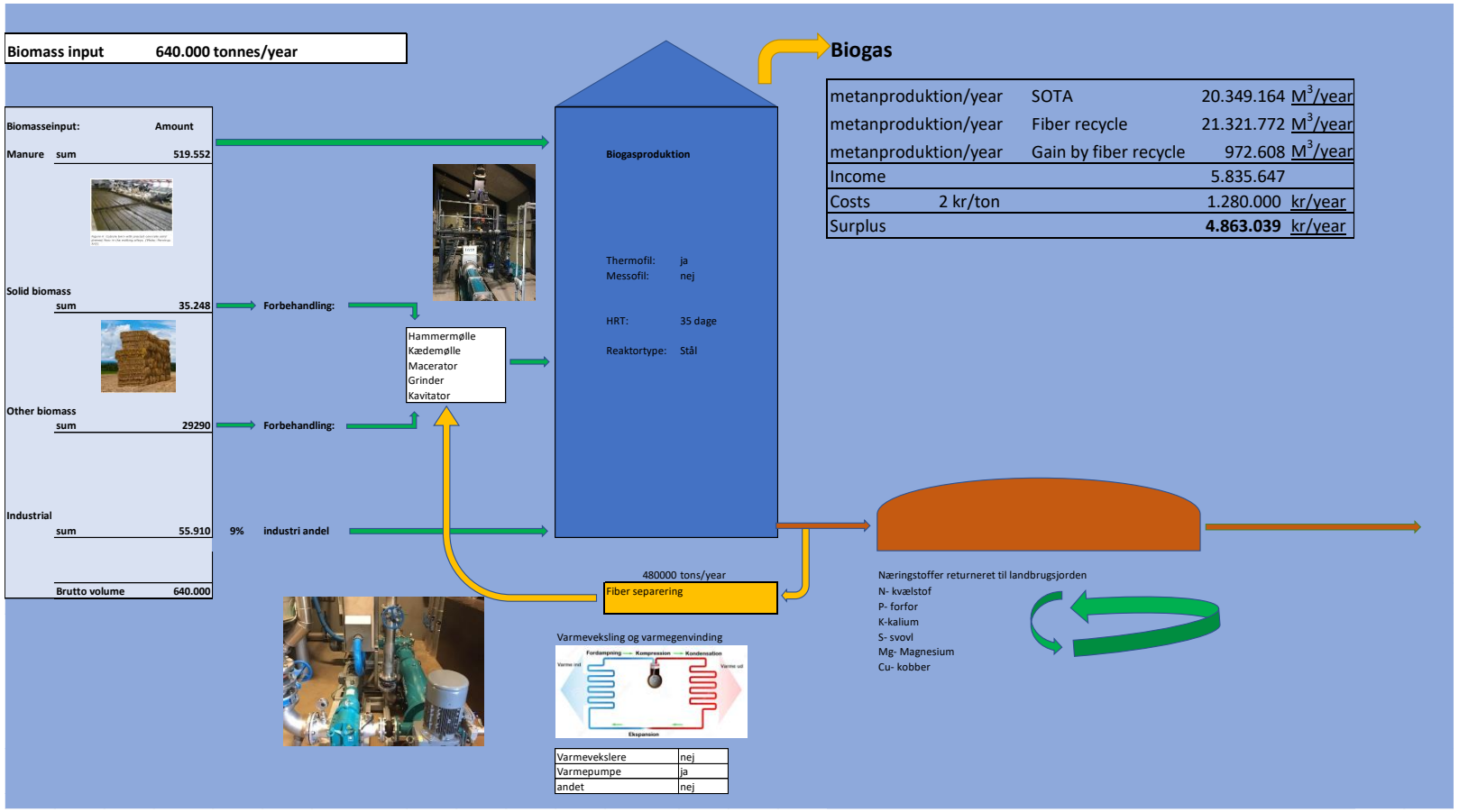




THE FUTURE BIOGASPLANT

-RECYCLING OF FIBERS - ECONOMY

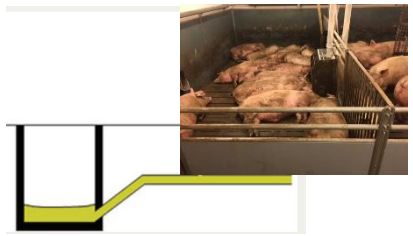




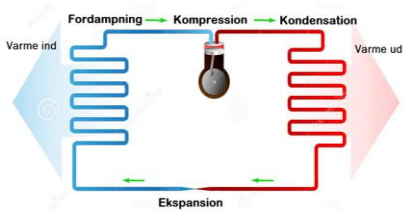
REDUCTION OF LOSSES

-STABLES

New project aiming at visiting 400 pig producers delivering manure for 30 biogas plants.

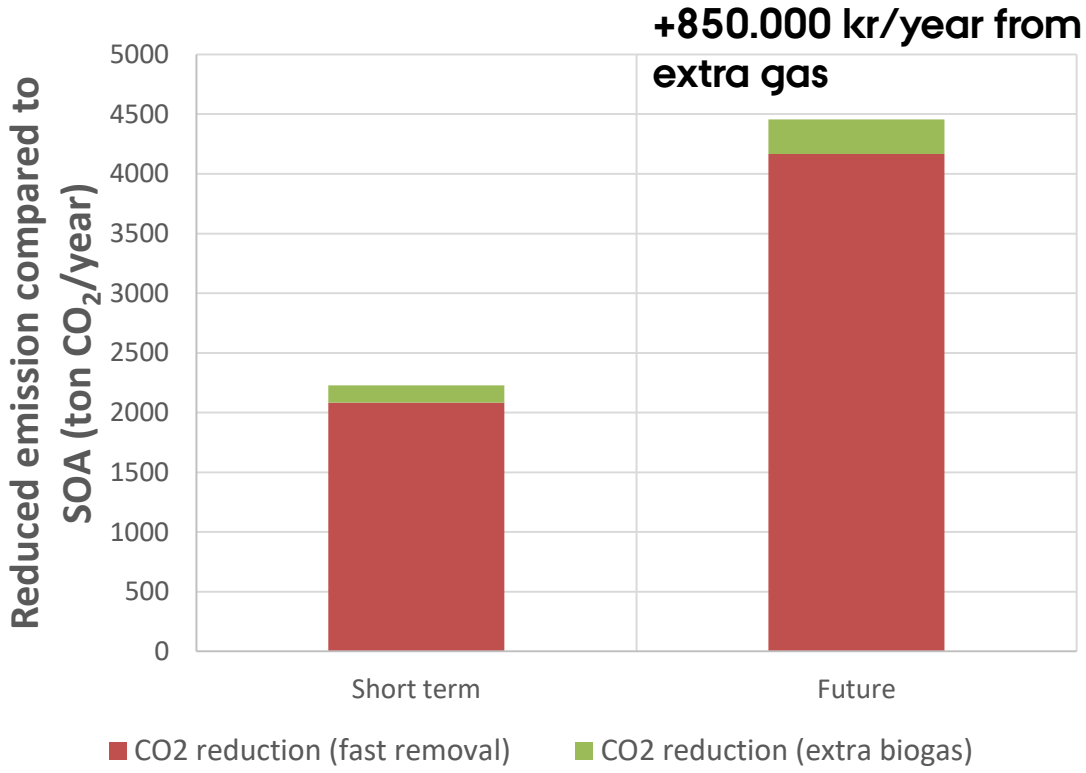


SOTA: 18,6 C and 19 days.



Future: 1 days and/or 14 C.

Example for biogasplant with 200.000 tons of pig manure



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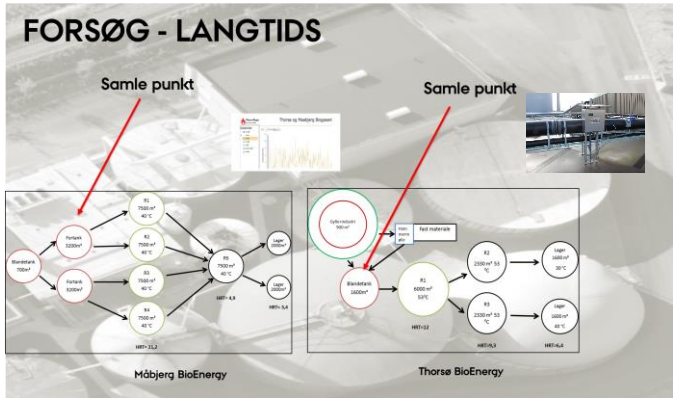
SENIOR RESEARCHER

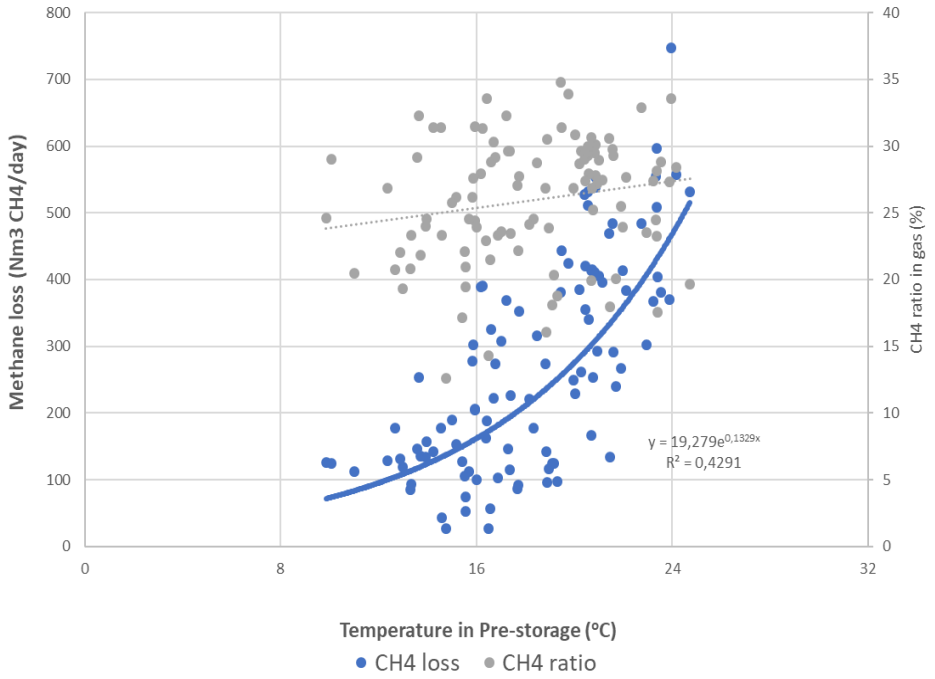
REDUCTION/RECOVERY OF METHANE LOSSES

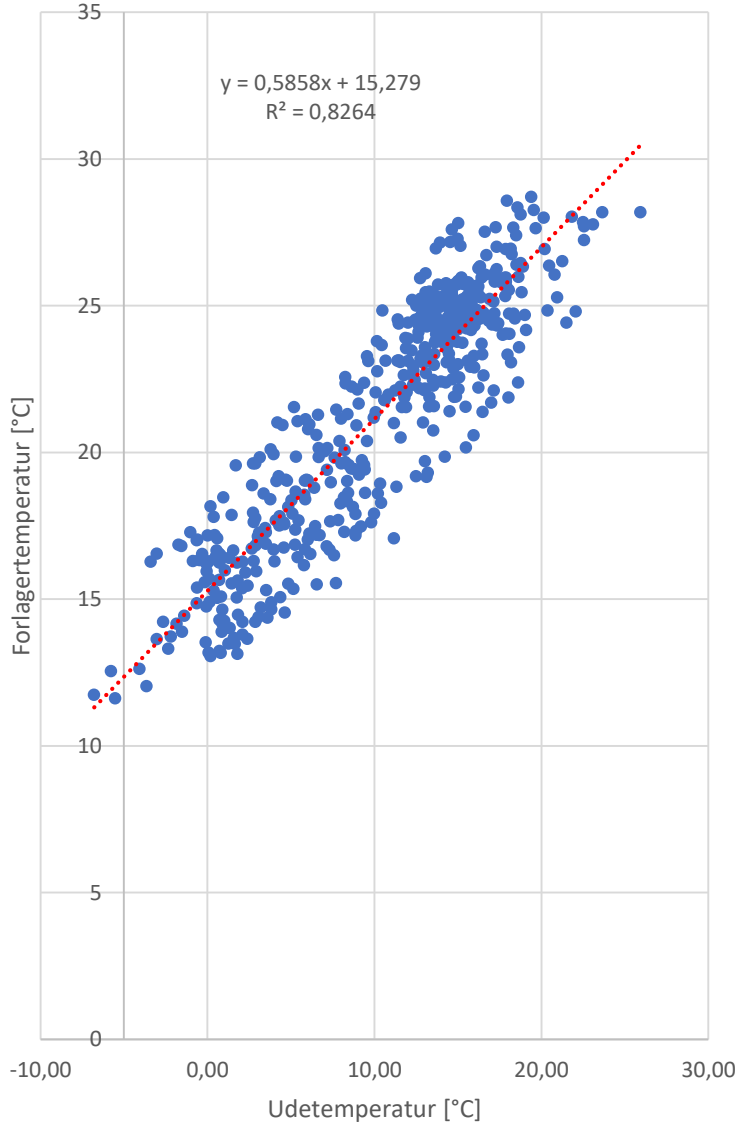
-BIOGAS PLANT



Pre-storage of biomass
Biomass is stored at around 4 days at ambient temperature

- Screening of 10 plants
- Long time measurement of 4 plants

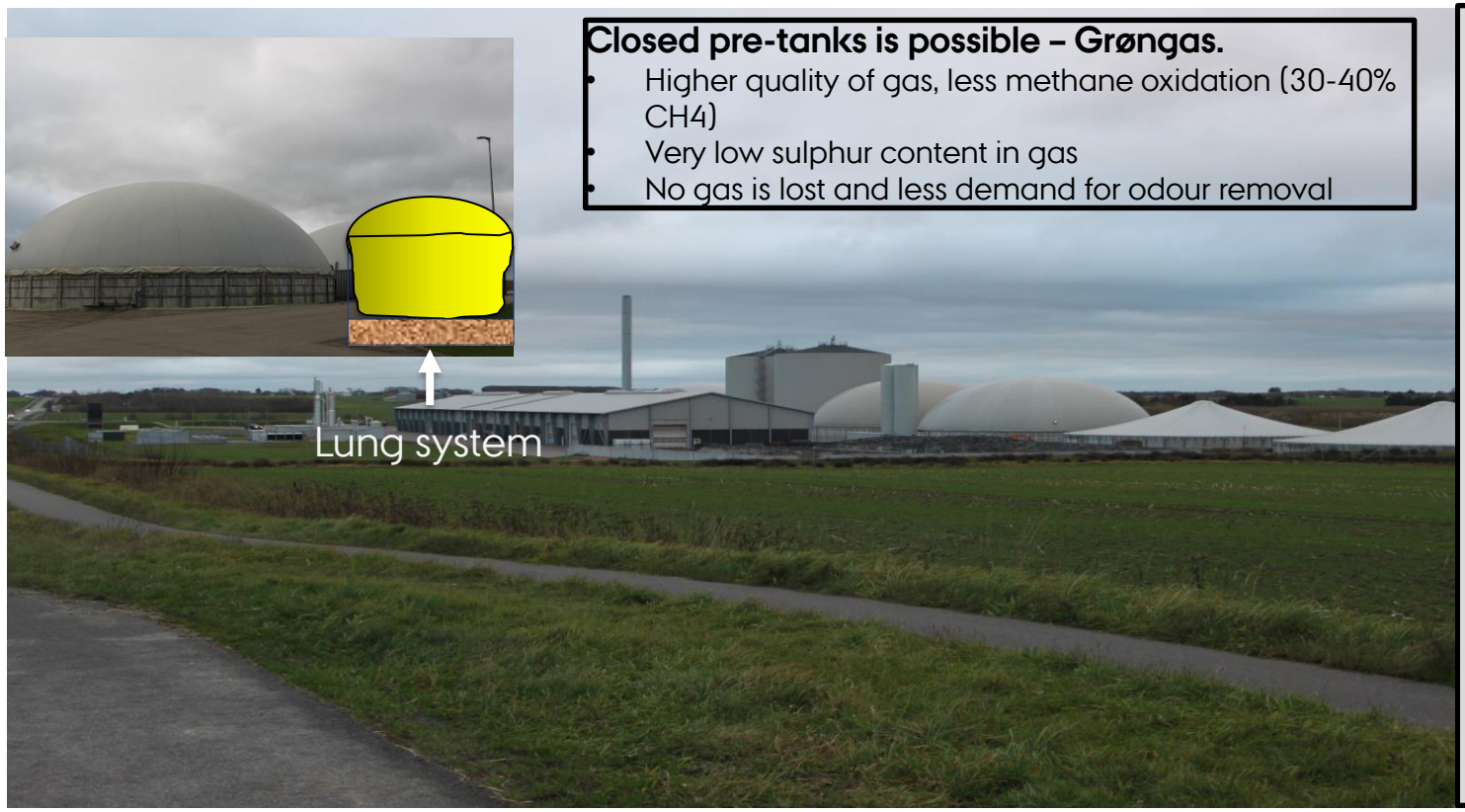




Initial screening show around 2% of production lost in pre-tank, long terms show 0,7%. Losses are highly temperature dependent.

REDUCTION/RECOVERY OF METHANE LOSSES

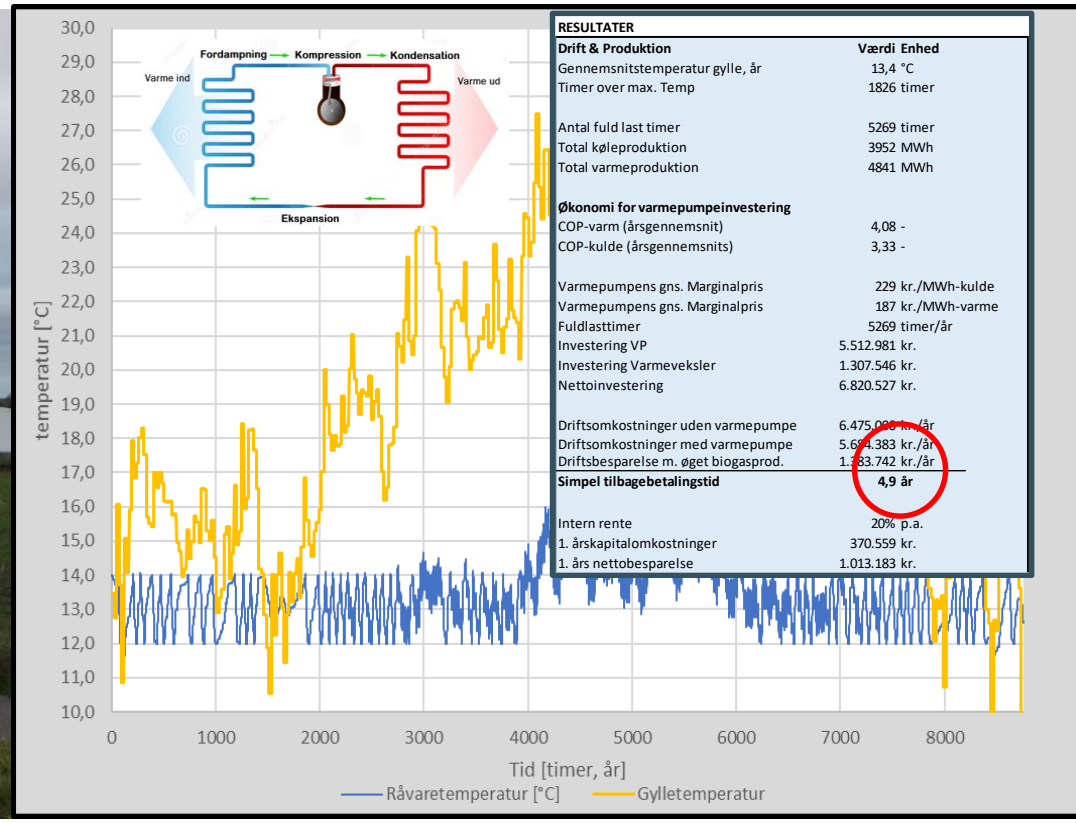
-BIOGAS PLANT



Closed pre-tanks is possible – Grøngas.

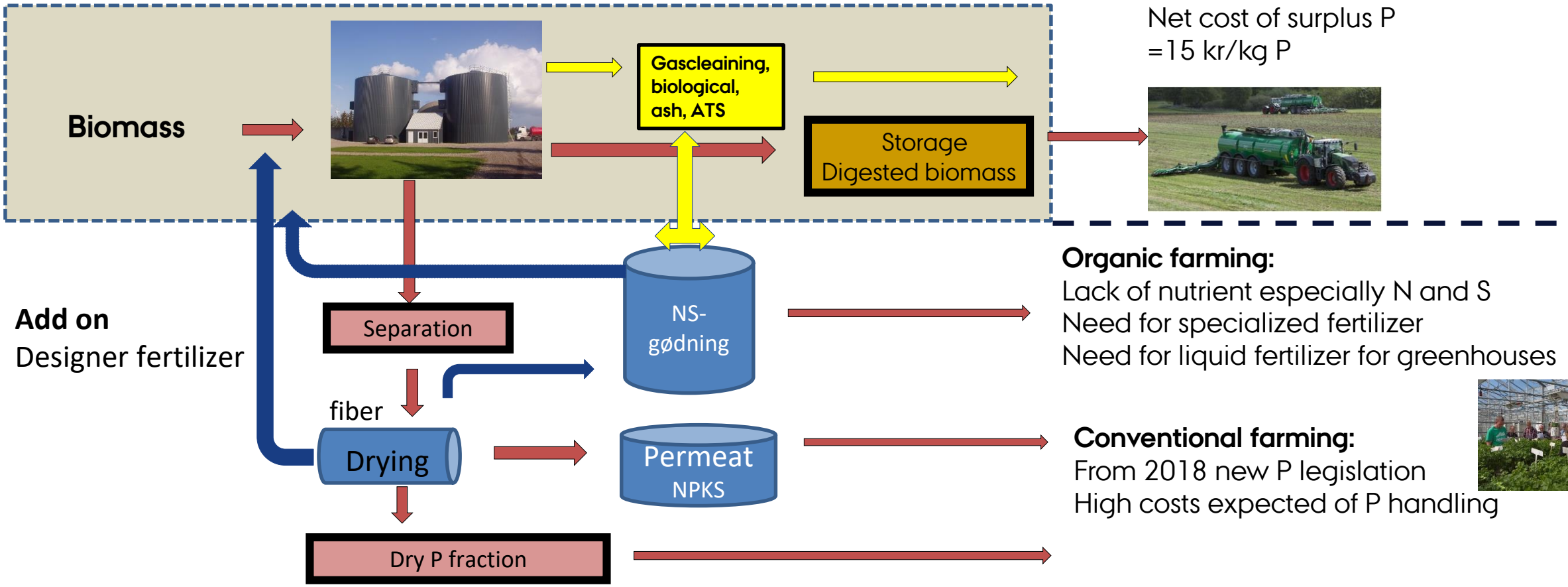
- Higher quality of gas, less methane oxidation (30-40% CH4)
- Very low sulphur content in gas
- No gas is lost and less demand for odour removal

Heat pump to cool the pre-tank



RESULTATER		
Drift & Produktion	**Værdi**	**Enhed**
Gennemsnitstemperatur gylle, år	13,4	°C
Timer over max. Temp	1826	timer
Antal fuld last timer	5269	timer
Total køleproduktion	3952	MWh
Total varmeproduktion	4841	MWh
Økonomi for varmepumpeinvestering		
COP-varm (årsgennemsnit)	4,08	-
COP-kulde (årsgennemsnits)	3,33	-
Varmepumpens gns. Marginalpris	229	kr./MWh-kulde
Varmepumpens gns. Marginalpris	187	kr./MWh-varme
Fuldlasttimer	5269	timer/år
Investering VP	5.512.981	kr.
Investering Varmeveksler	1.307.546	kr.
Nettoinvestering	6.820.527	kr.
Driftsomkostninger uden varmepumpe	6.475.0	kr./år
Driftsomkostninger med varmepumpe	5.6	kr./år
Driftsbesparelse m. øget biogasprod.	1.3	kr./år
Simpel tilbagebetalingstid	**4,9**	**år**
Intern rente	20%	p.a.
1. årskapitalomkostninger	370.559	kr.
1. års nettobesparelse	1.013.183	kr.

ADDED VALUE

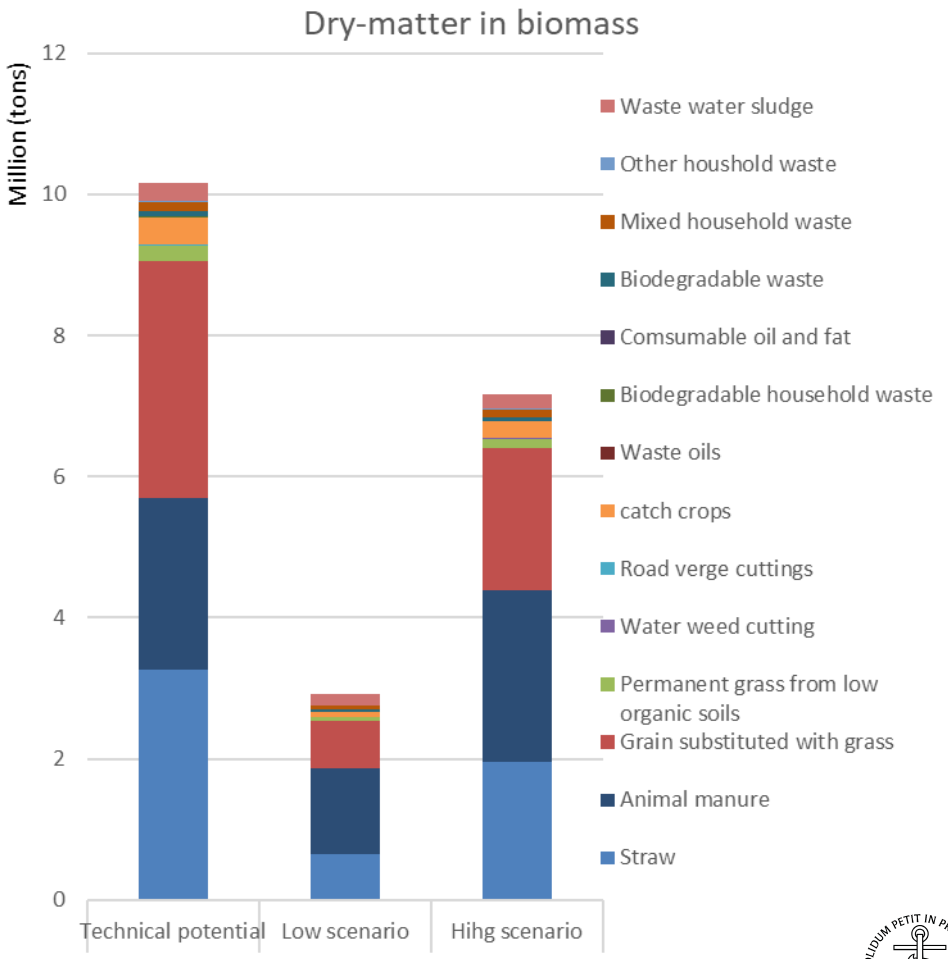

Biomass
Gascleaining, biological, ash, ATS
Storage Digested biomass
Net cost of surplus P
=15 kr/kg P
Add on
Designer fertilizer
Separation
NS-gødning
fiber
Drying
Permeat NPKS
Dry P fraction
Organic farming:
Lack of nutrient especially N and S
Need for specialized fertilizer
Need for liquid fertilizer for greenhouses
Conventional farming:
From 2018 new P legislation
High costs expected of P handling

BIOGAS IN THE DANISH GAS SUPPLY – HOW HIGH CAN WE GO?

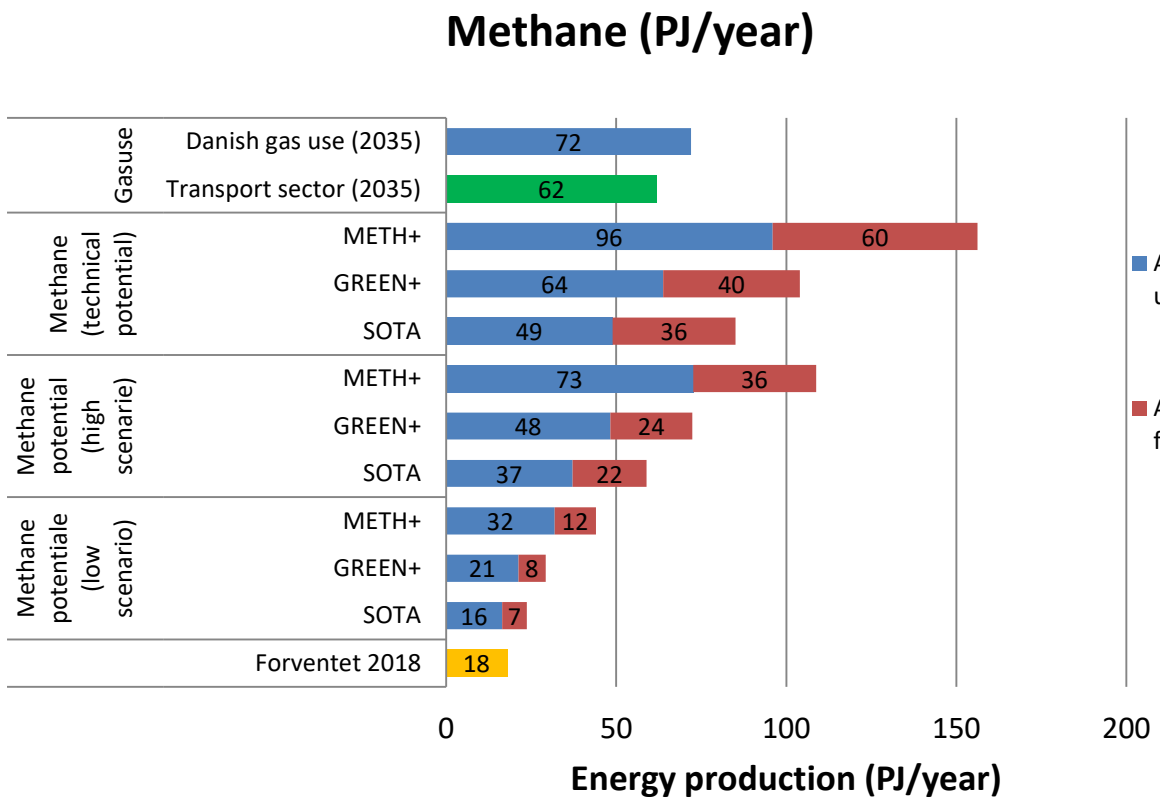
No crops but some areas used for grain are changed to grass

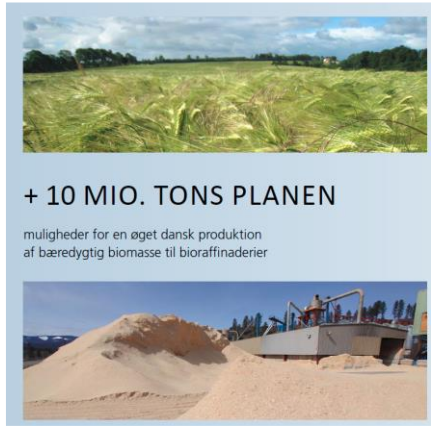
	Low biomass scenario	High biomass scenario
Biomass (technical potential)	Environmentally-optimized	
Animal manure	50%	100%
Green biomass and straw	20%	60%
Household and industrial waste	50%	100%
Sewage sludge	80%	80%
Biogas/biomethanation technology	**1) SOTA (State-of-the-art):** Average plant (HRT= 33 days and 1 % methane loss. In House methane loss from pig manure is 10% and from cattle 2%.	
	2) GREEN+ (Environmental optimzed): HRT= 60 days and pre-treatment included. Methane loss before, during and after AD is reduced to 0,5 %.	
	2) METH+ : Green+ including methanation of CO_2 (90%)	

How high can we go in a sustainable way.



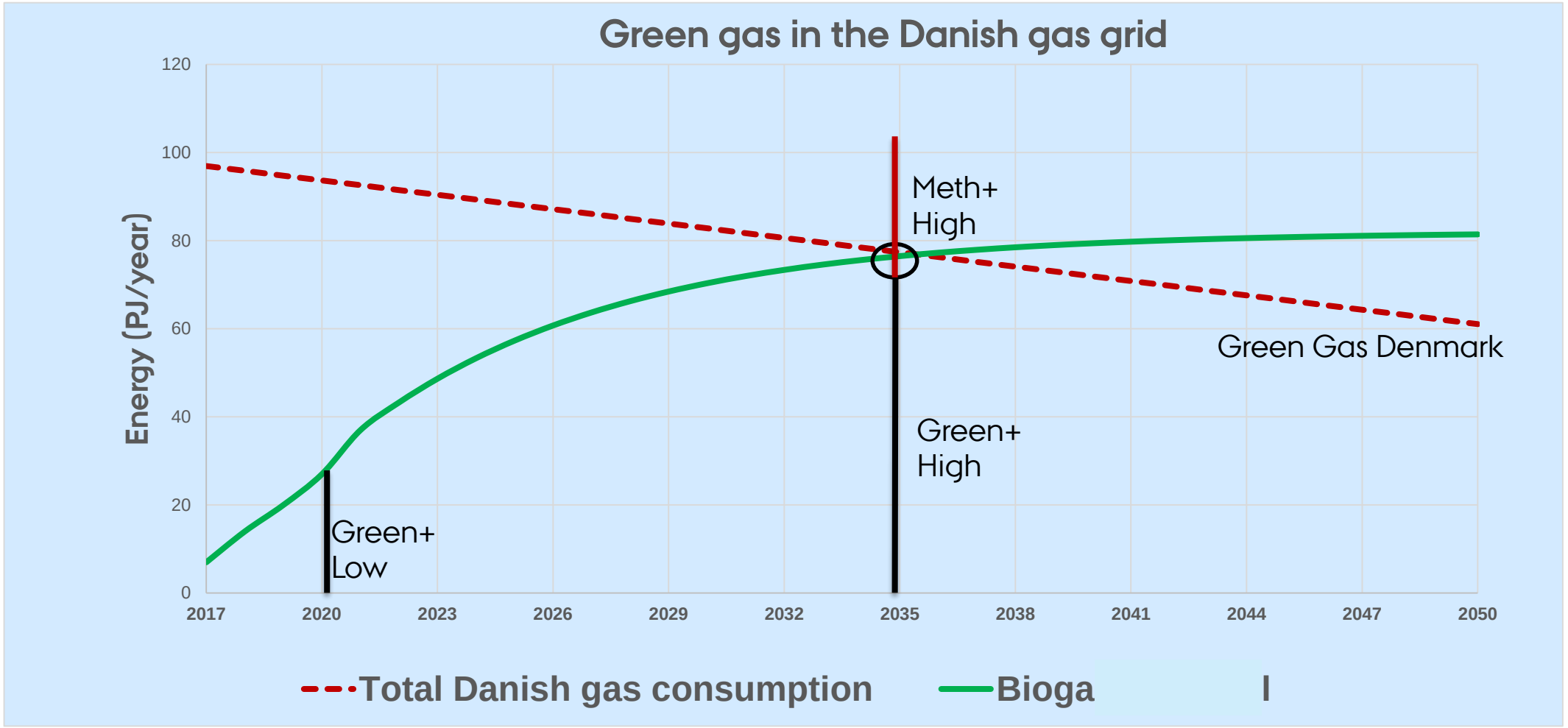
BIOGAS IN THE DANISH GAS SUPPLY – HOW HIGH CAN WE GO?

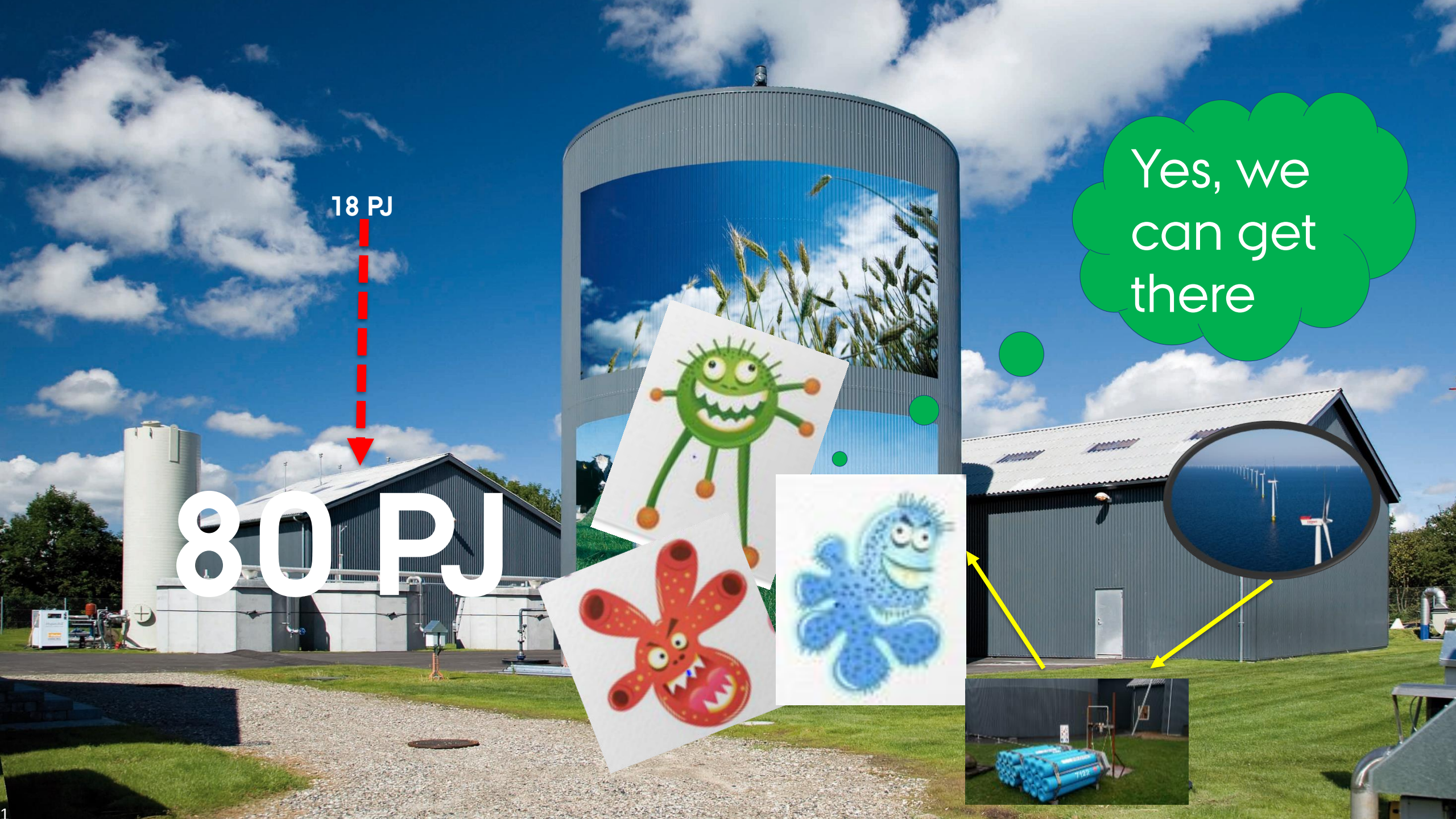


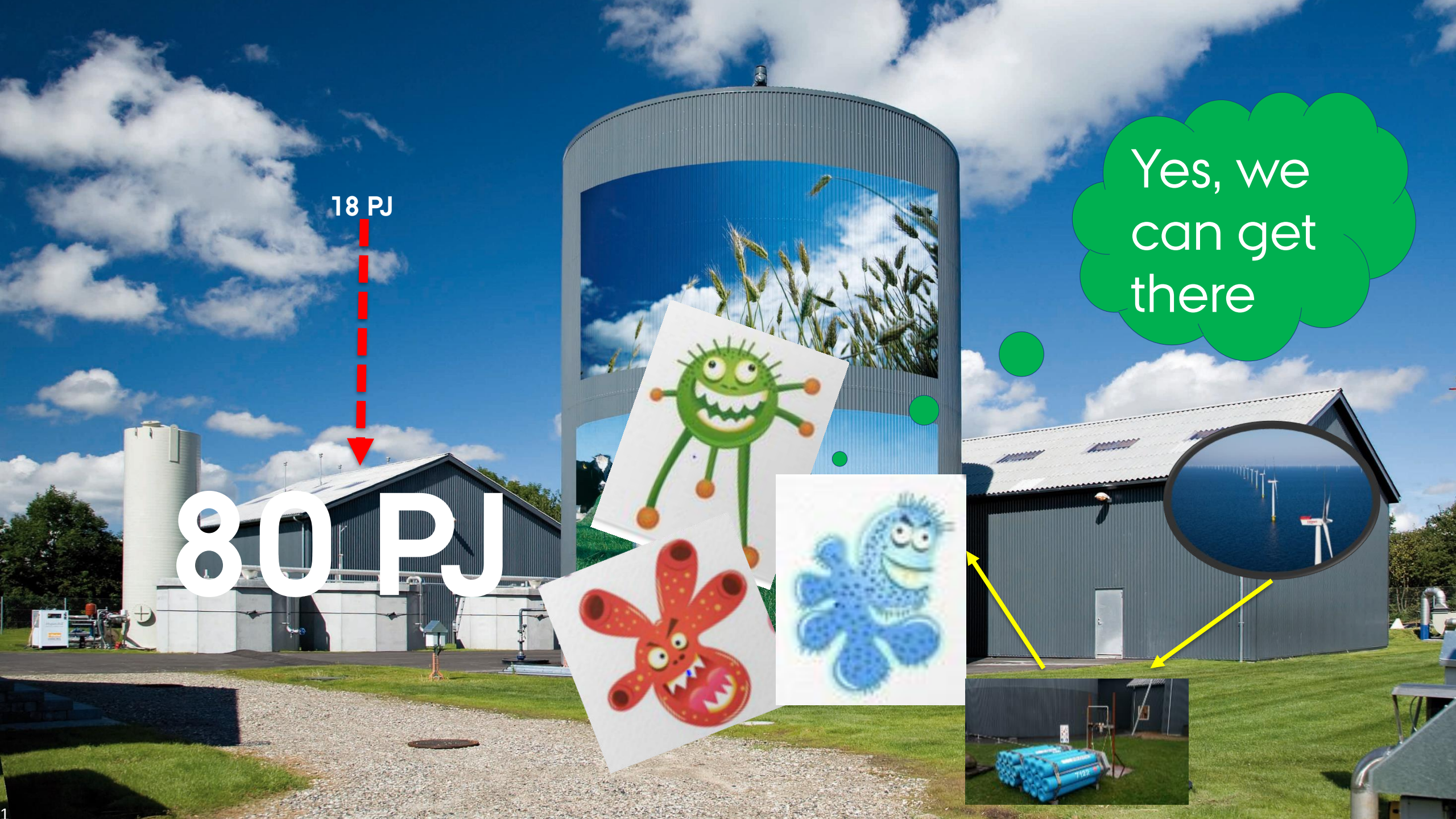


High biomass scenario:
Areas is used for grass/perennial crops in environmental sensitive areas

BIOGAS IN THE DANISH GAS SUPPLY




18 PJ
80 PJ
Yes, we can get there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