

# **Thermal Biomass Gasification for CHP**

## **Danish Success Stories**

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M.Sc. Morten Tony Hansen

Senior Project Manager

FORCE Technology - Biomass & Waste

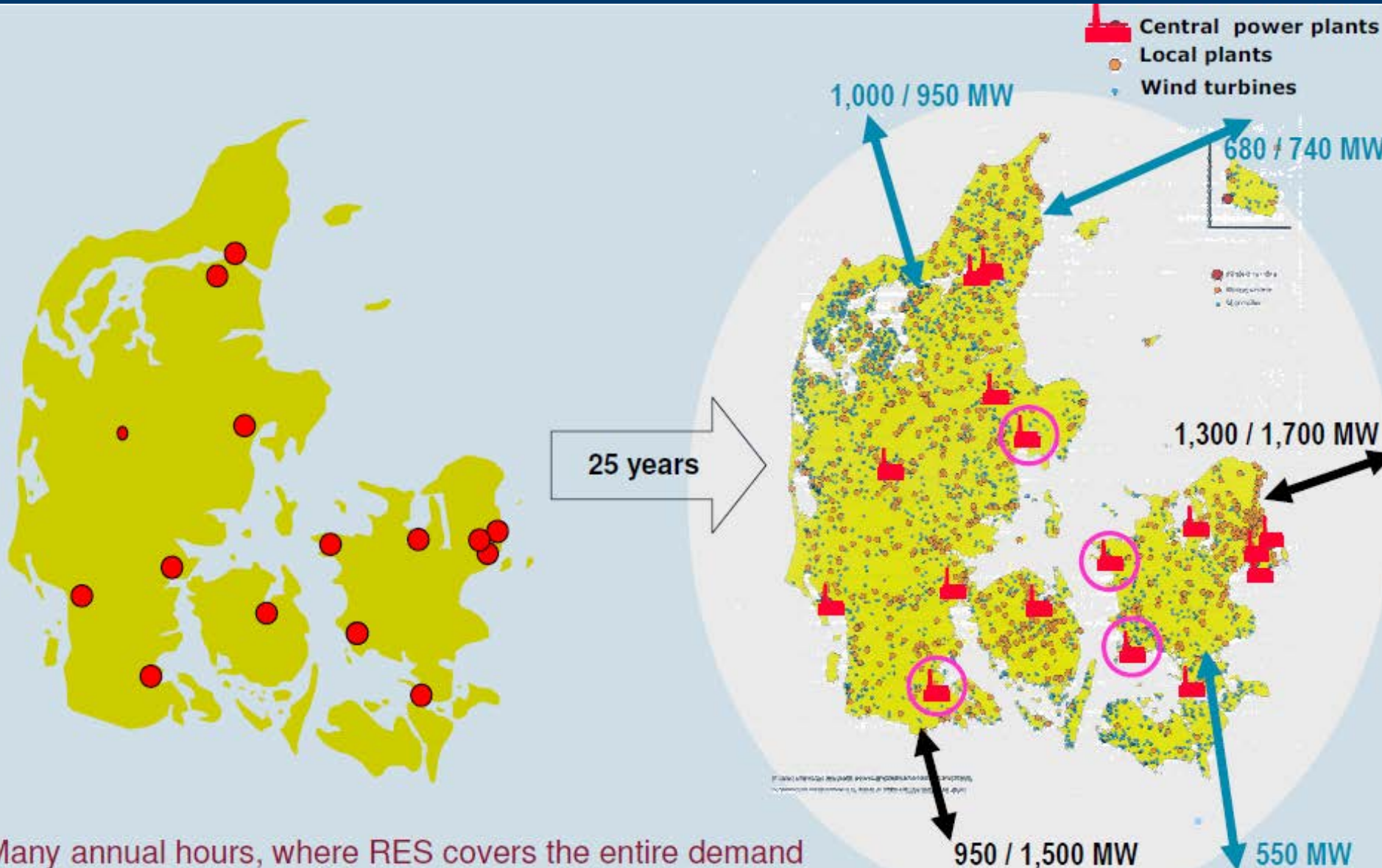
# Biomass for energy in Denmark



- Residential buildings  
Heating: Log wood, pellets, wood chips, straw
- Public and private service  
Heating: Pellets, wood chips
- Industry  
Heating & CHP: Pellets, wood waste & chips
- District heating plants  
Heating & CHP: Wood chips, straw, pellets
- Central CHP plants  
Electricity & district heating: Pellets, straw, wood chips



# The Danish electricity system



# Danish biomass gasification technologies



Technology name	Stakeholders	Technology	Purpose	State	Plants	Hours	T to c.
Alternating Gasifier	Ammongas, Vølund	Twin Bed Filter	Fuel (gas)	Pilot	1	50	1-2
Vølund Updraft Gasifier	B&W Vølund	Updraft	CHP	Commercial	4	130000	0
CHP System of BioSynergi	BioSynergi	Open core dd	CHP	Pilot	1	6000	2-3
Staged Down Draft Gasification	Weiss, DTU, Cowi	Multiple steps dd	CHP	Demonstration	2	4000	1
Pyroneer	DONG, DFBT, DTU	LTCFB	CHP	Pilot	4	700	>4
Close Coupled Gasification	EP Engineering	Vibrating grate FB	CHP	Pilot	1	1000	2
Sublimator	Frichs	CDP	CHP	Commercial	0	?	0
Catalytic Low Temp. Pyrolysis	Organic Fuel Tech.	Catalytic LT Pyrol.	Fuel	Pilot	1	300	1-2
Up Draft Gasifier & Stirling	Stirling DK	Updraft	CHP	Commercial	6	12000	0
BlackCarbon	Stirling DK	Pyrolysis	CHP	Demonstration	1	2400	2
Biomass Gasification Gas Engine	Carbona, Aaen	CFB	CHP, fuel	Demonstration	1	6500	2-3
?	TK Energi	?	?	?	?	?	?

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Vølund Updraft Gasifier	B&W Vølund	Updraft	CHP	Commercial	4	130000	0
CHP P	<div style="border: 1px solid black; border-radius: 15px; padding: 10px;"> <p>20 year of operation in Harboøre</p> <p>CHP operation for 12 years - 650 kW(e)</p> <p>Tar challenge turned into advantage – provides flexibility for DH plant</p> </div>						
Sta							
Py							
Cl							
Su							
Ca	Stirling DK	Pyrolysis	CHP	Demonstration	1	2400	2
Up D	Carbona, Aaen	CFB	CHP, fuel	Demonstration	1	6500	2-3
?	TK Energi	?	?	?	?	?	?



# Danish biomass gasification technologies

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Alternating Gasifier	Ammonga						
Vølund Updraft Gasifier	B&W V						
CHP System of BioSynergi	BioSy						
Stage							
Py	<p>Successful unmanned plant in Græsted North of Copenhagen</p>						
Cl	<p>New demonstration plant construction in Hillerød –</p>						
Su	<p>300 kW(e) - wood chips</p>						
Ca							
Up							
Blac							
Biomass Gasification Gas Engine	Carbon						
?	TK Energi	?	?	?	?	?	?



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Vølund Updraft Gasifier	B&W Vølund	Updraft	CHP	Commercial	4	130000	0
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Staged Down Draft Gasification	Weiss, DTU, Cowi	Multiple steps dd	CHP	Demonstration	2	4000	1
Pyro...	...	...	...	...	...	...	...
Cl...	...	...	...	...	...	...	...
Su...	...	...	...	...	...	...	...
Ca...	...	...	...	...	...	...	...
Up...	...	...	...	...	...	...	...
Bl...	...	...	...	...	...	...	...
Bio...	...	...	...	...	...	...	...
?	TK Energi	?	?	?	?	?	?

Successful Viking gasifier at DTU

Demonstration plant at Weiss' premises

New 600 kW(e) demonstration plant started up in Hillerød 2012



# Danish biomass gasification technologies

Techno

Altern

Vølun

CHP Sy

Stage

Pyron

Close

Su

Ca

Up

Bl

Bi

?

0 c.

2

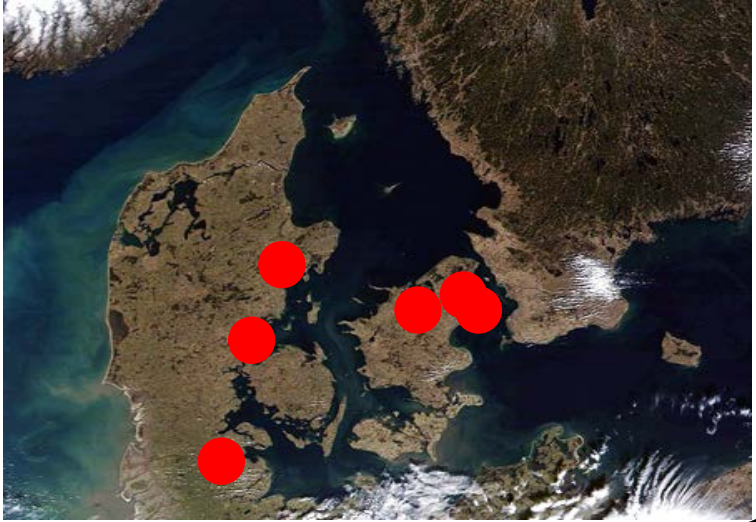
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# Danish biomass gasification technologies

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Alternating Gasifier	Ammongas, Vølund	Twin Bed Filter	Fuel (gas)	Pilot	1	50	1-2
Vølund	10 plants in Danmark and abroad		Company is slowly expanding while continuously developing the sold plants				
CHP	New engine design to come						
Stirling							
Pyrolysis							
Cl							
Su							
Catalytic Low Temp. Pyrolysis	Organic Fuel Techn.	Catalytic LP Pyroly.	Fuel	Pilot	1	500	1-2
Up Draft Gasifier & Stirling	Stirling DK	Updraft	CHP	Commercial	6	12000	0
BlackCarbon	Stirling DK	Pyrolysis	CHP	Demonstration	1	2400	2
Biomass Gasification Gas Engine	Carbona, Aaen	CFB	CHP, fuel	Demonstration	1	6500	2-3
?	TK Energi	?	?	?	?	?	?

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Technology name	Stakeholders	
Alternating Gasifier	Ammongas, Vølund	T
Vølund Updraft Gasifier	B&W Vølund	
CHP System of BioSynergi	BioSynergi	
Sta	The Skive plant – 6 MW(e) wood pellet fuelled pressurized CFB	
Py	DOE co-financed	
Cl	Liquid fuel generation being teste	
Su		
Ca		
Up		
BlackCarbon	Stirling DK	
Biomass Gasification Gas Engine	Carbona, Aaen	
?	TK Energi	

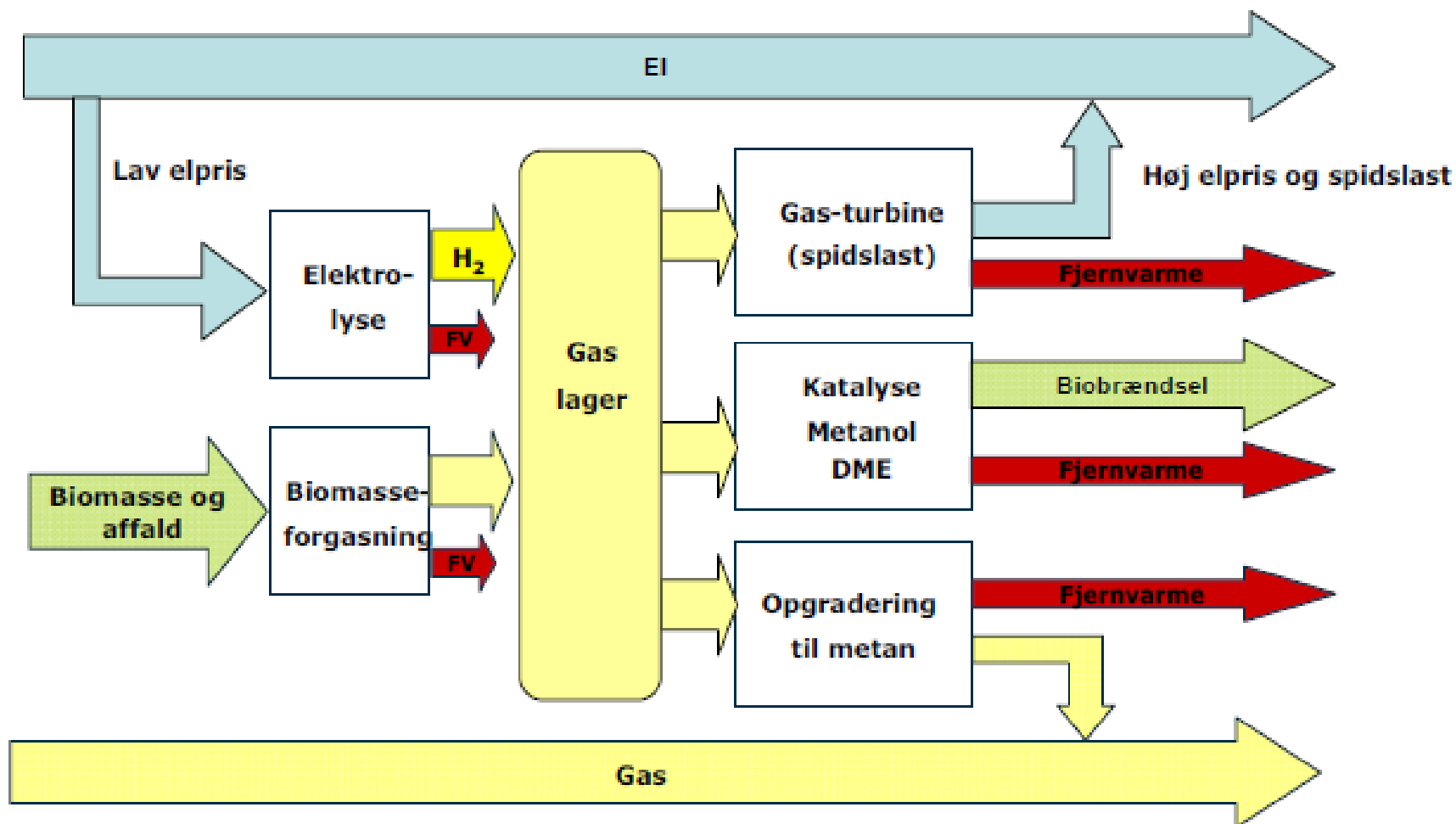


# New framework conditions

- "New" government increased green targets
  - 2020: Half of electricity demand covered by wind
  - 2030: No coal at power plants, no oil heating
  - 2035: Electricity and heating fully covered by RE
  - 2050: Complete energy supply fossil free
- Energy agreement in Spring 2012
- Focus on electricity, wind and gas, less on combustion of biomass
- Current feed-in tarif: 15 €/kWh



# A vision for the energy system in 2050



# Who is FORCE Technology?



- Independent non-profit company
  - Advanced Technology Group
  - Testing, consultancy and technology development
  - 1000 employees, 133 M€ turnover
  - Present in DK, SE, NO, RU, US, CN, SG
- Unique combination of competences, biomass examples
  - Ultrasound & biomass combustion
  - Corrosion from combustion of special biomass
  - CFD modelling of combustion chambers and flue gas systems
  - Simulators of MSW-plants – training of operations managers
  - Monitoring of biogenic carbon (C14) – to be elevated for ISO
  - GrateVision – video based grate combustion control



- Consultancy on fuels and conversion technology
  - Fuel market analyses and resource studies
  - Plant feasibility studies
  - Project- and system planning and engineering
  - Emission monitoring and fuel laboratory analyses
  - Call for tenders and evaluation
  - Construction supervision and management
  - Training of staff for operation and maintenance
  - Connecting manufacturers, consumers, investors
- Large experience and special competences, e.g.
  - Centre for Biomass Technology
  - Strategies and action plan on biomass CHP & gasification
  - Feasibility studies for pellet plants, CHP and gasifiers
  - Fuel market analyses - Denmark and abroad
  - Public and commercial projects - market and RD&D



A photograph of a wood processing site. On the left, there are large stacks of cut logs. On the right, there are large mounds of wood chips. A dirt path runs between the stacks and mounds. The sky is blue with some clouds.

Thank you!

M.Sc. Morten Tony Hansen - FORCE Technology - T: +45 7215 7700 - E: [mth@force.dk](mailto:mth@force.dk)  
[www.forcetechnology.com](http://www.forcetechnology.com)