



RAMBOLL - POWER

**CONVERSION TO BIOMASS FIRING –
AN ALTERNATIVE TO DECOMMISSION?**

BY
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PROJECT DIRECTOR

OVERVIEW

- **Ramboll in brief**
- Why consider alternatives to decommission?
- Biomass conversion – new fuel, new challenges
- Solutions & adaptation
 - Transport & Storage
 - Fuel preparation
 - CAPEX comparison to options
- Results – reference project performances
- Summary of key points

RAMBOLL IN BRIEF

- Founded 1945 in Denmark
 - Owned by Ramboll Foundation and hence a truly **independent engineering and design consultant**
 - **> 16,500 experts**
 - **> 300 offices in 35 countries**
 - **> EUR 1.9 billion revenue**
- Services across the markets:
 - Buildings
 - Transport
 - Environment & Health
 - Water
 - **Energy**
 - Oil & Gas
 - Management Consulting

GEOGRAPHICAL FOOTPRINT



LONGSTANDING COMPETENCIES FOR THE ENERGY SECTOR

Power



100 references worldwide. High efficiency fossil & biomass leaders

Waste-to-energy



Over 140 completed projects in 40 Countries

Off-shore wind



Over 65% of world off-shore turbines Ramboll designed

District energy



Global leading consultant. 200 projects of all scales

Transmission



onshore/offshore substations, o/h lines and system studies

Full Project life cycle services – Concepts, Feasibilities, Design, Construction & commissioning supervision, O&M support, Refurbishment & Life time extension, Decommissioning & Redevelopment

DISMANTLING & DEMOLITION

Oops ... what happened
to ...

Biomass conversion???



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WHY CONSIDER ALTERNATIVES TO DECOMMISSION?

Drivers to consider decommission:

- Emission requirements (like the IED EU Directive)
- Regulatory pressure on lowering CO₂ foot print
- End of economic life (in present configuration!)

But, **there is usually significant asset value**

- Site permits
- Grid connection
- Utility infrastructure
- Fuel delivery transport infrastructure
- Staff and skills base
- Employment (politics!)
- Written off capital !!!!

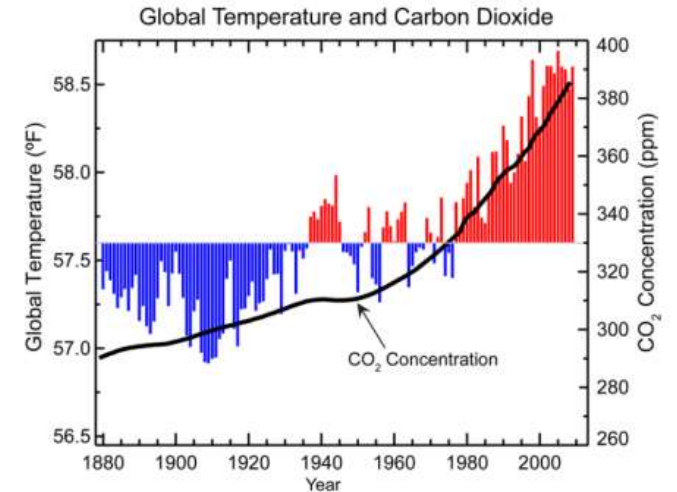
WHY CONSIDER BIOMASS CONVERSION?

- Capitalisation of asset values – a 'cheap' way towards sustainable power generation?

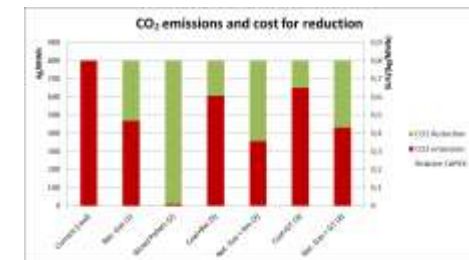
Squeezing the last MW out of the plant 😊

- Branding / Image: Renewable & sustainability

- Support local economy by maintaining or even increase number of job positions locally*



Ref: US National Climatic Data Center – NOAA



BIOMASS CONVERSION – FUEL TYPE?

Fuel type very dependent on the existing plant configuration, but

- **Wood Pellets**, the immediate option for PC fired plants - world market maturing fast
- **Local / Indigenous resources?***, like:
 - **Agricultural residues**, i.e. straw, PKS, Olive husk etc
 - **Forest residues**, i.e. thinning, roots etc.
 - **other by-products**, i.e. sawmill cut-offs, industrial waste wood etc.

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BIOCONVERSION – NEW FUEL



White wood pellets has different properties than coal:

- **Lower calorific value**
- **Lower ash melting point**
- **Hydroscopic**
- **Dusty**
- **Fire & explosion properties**
- **Health issues**

WOOD PELLETS SPECIFICATIONS	EN	
PARAMETERS AND REJECTION LIMIT	Standard	I1 industrial
Physical parameters		Limit
Diameter	EN16127	6 to 8
Length \leq 50 mm	EN16127	99.9%
Length \leq 40 mm	EN16127	99%
Water content	EN 14774	\leq 10 %
Bulk (apparent) density	EN 15103	\geq 600
Maximum bulk temperature	EN15234-2	\leq 60
Net calorific value at constant pressure	EN 14918	\geq 16,5
Ash content	EN 14775	\leq 1,0%
Elementary composition		
Cl	EN 15289	\leq 0,03%
N	EN 15104	\leq 0,3%
S	EN 15289	\leq 0,15 %
Trace elements		
As	EN 15297	\leq 2
Cd	EN 15297	\leq 1
Cr	EN 15297	\leq 15

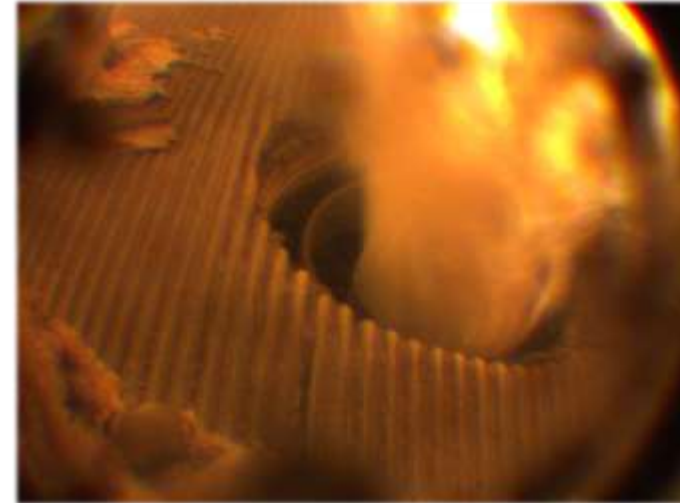
BIOCONVERSION – NEW FUEL, NEW CHALLENGES

Performance

- Milling throughput
- De-rating
- Slagging

Storage

- Stores (dry)
- Transportation (dry)
- Dust



Safety

- Dust explosion mitigation measures
- Fire control

Emissions

CO₂, SO₂, NO_x

BIOCONVERSION – NEW FUEL, NEW CHALLENGES

HEALTH, FIRE & EXPLOSION

Safety risks / issues to be paid special attention:

- ✓ **Fire risks, due to self ignition properties**
- ✓ **Explosion risks, due to dust properties**
- ✓ **Health risks, due to inhalation**



The damage



- Fire-fighting operations, handling of biomass
 - lasted 12 days
 - Up to 80 men a day
 - More than 10,000 external man-hours
 - 170 tons CO2/day
- Unable to burn wood pellets in 2 month
- Loss of 9,000 tons wood pellets
- 20,000 m³ storage and conveyor systems has to be rebuilt



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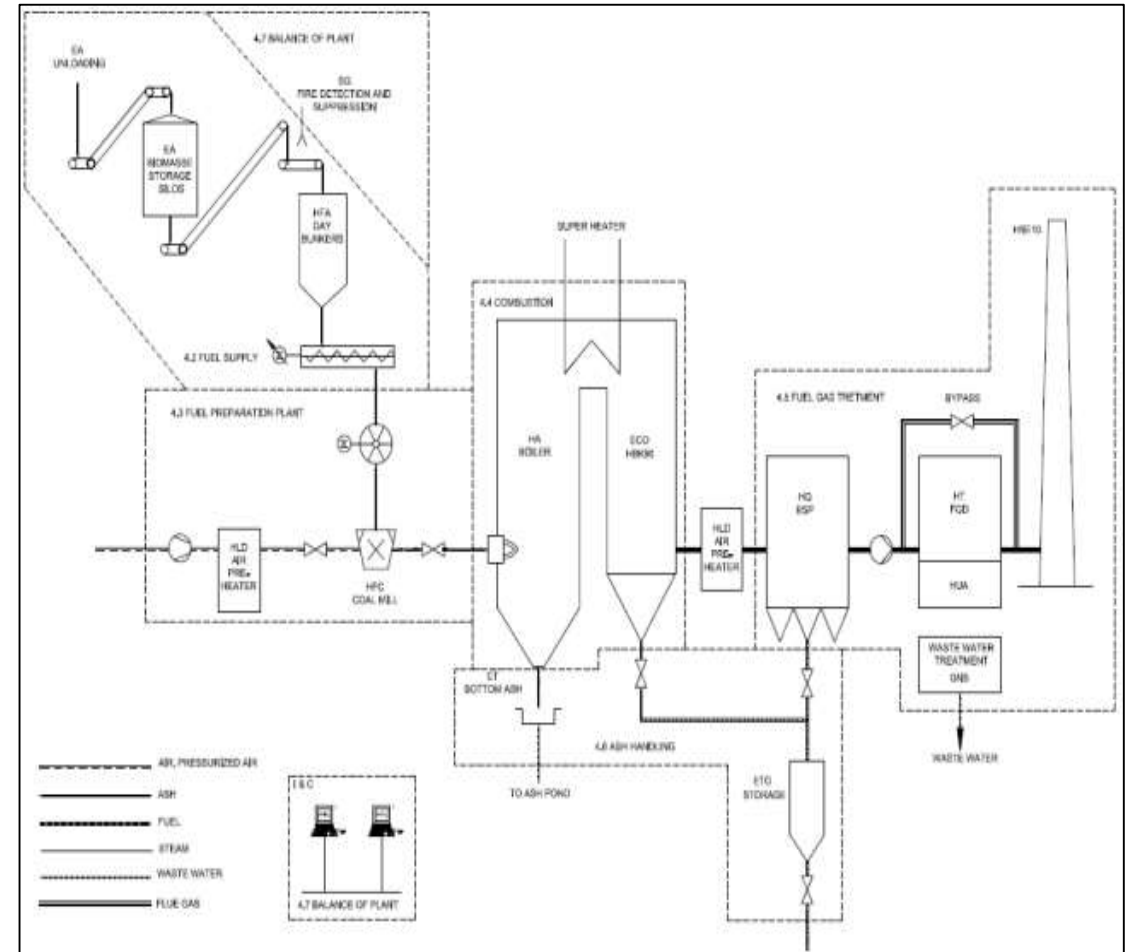
BIOCONVERSION - SOLUTIONS & ADAPTATIONS

Adaptations required throughout the Power station processes:

- **Wood pellet storage and handling**
- **Fuel preparation plant**
- **Combustion**
- **Flue Gas treatment**
- **Ash handling**
- **Balance of plant systems**

Bio-fuel combustion introduces new type of risks than those seen with coal combustion and gives rise to a an increased focus on:

- **Dust management**
- **Fire & explosion mitigations**



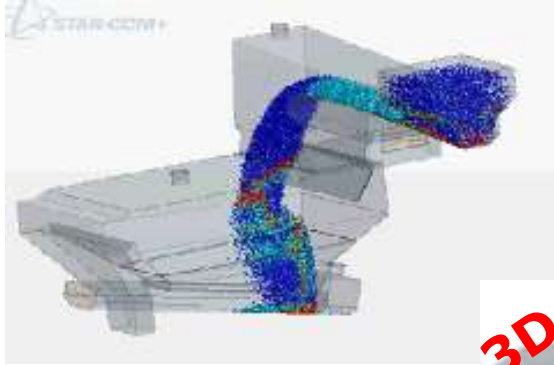
TRANSPORT & STORAGE - DESIGN

Layout & Design issues :

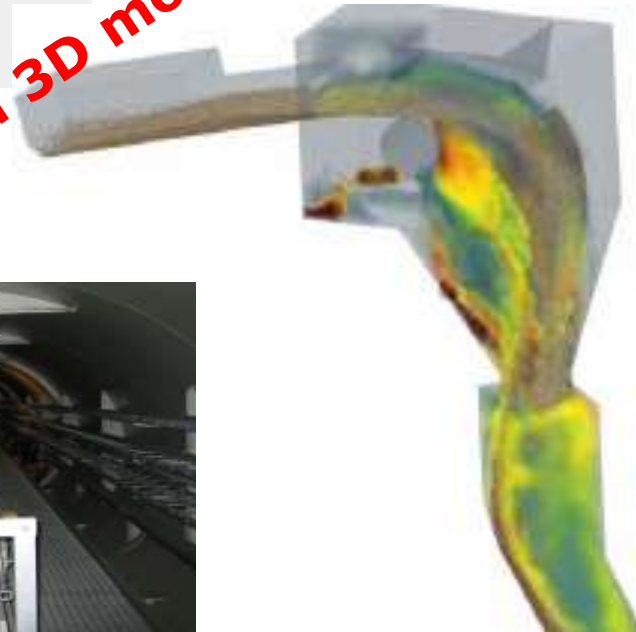
- **Fuel degradation**
- **Dust Management**
- **Redundancy strategy**
- **Operational risk scenarios**
- **Optimise footprint while maintain accessibility**



TRANSPORT & STORAGE - DUST MANAGEMENT



Optimisation through 3D modelling of chute's



Specific design areas to be considered:

- **Reception facilities**
- **Transfer points**
- **Transportation system**
- **Discharge system / concept**

Dust management imperative!

TRANSPORT & STORAGE – ONE OR MULTIPLE SILOS?

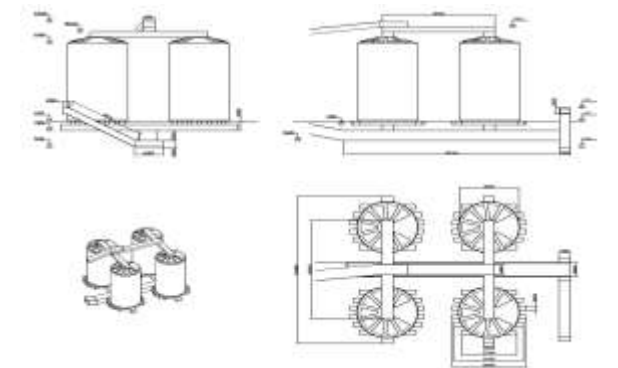
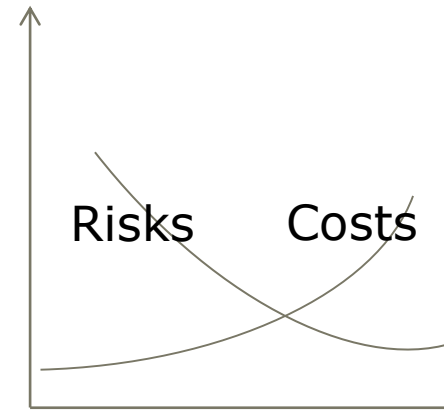
Pro / cons of few or one large silo:

- **Reduced CAPEX**
- **Reduced OPEX**
- **Small footprint**
- **Lack of redundancy**
- **The efficacy of fire suppression systems at risk**



Pro / cons of more but smaller stores:

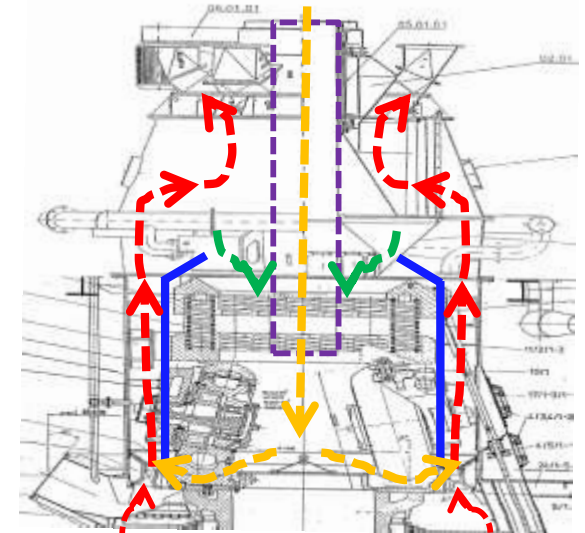
- **Increased redundancy**
- **Improved efficacy of fire suppression systems**
- **Reduced risk of fire propagation**
- **Increased footprint**
- **Increased CAPEX**
- **Increased OPEX**



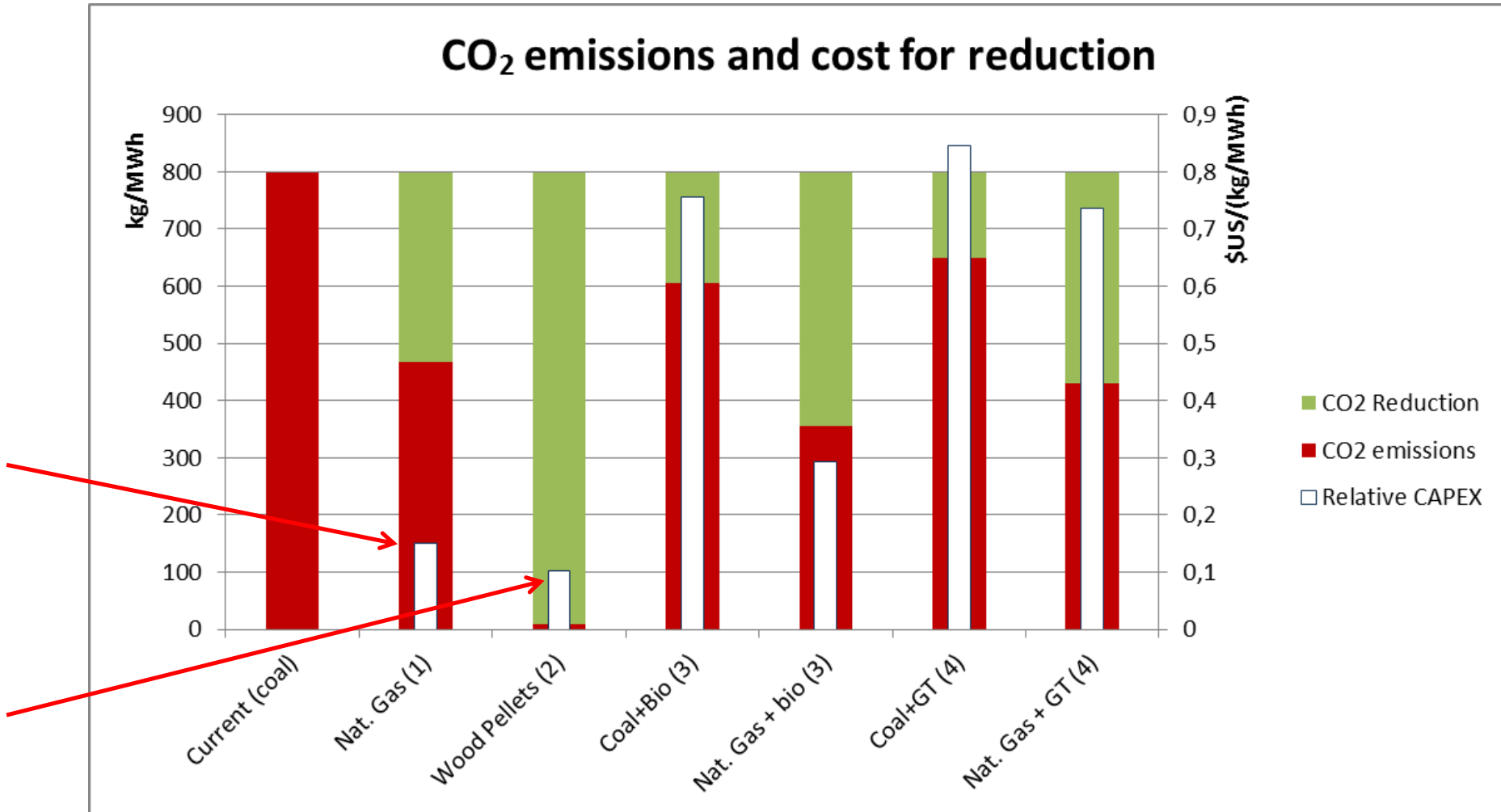
BIOCONVERSION - COAL MILL CONVERSION

Many brands and types of coal mills has through proper modifications proven suitable to grind wood pellets

– **without** the cost of new mills



CAPEX COMPARISON OF OPTIONS

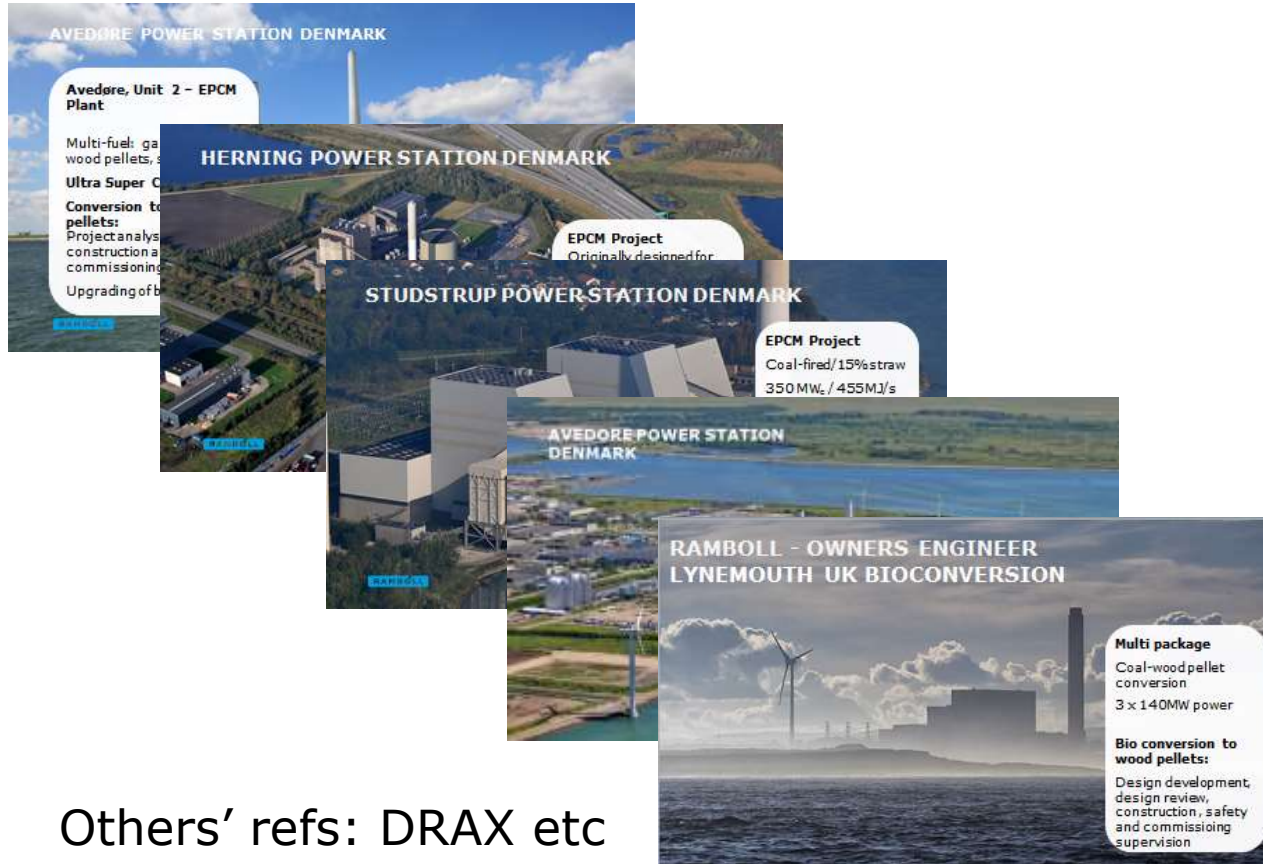


Direct conversion from coal to biomass carries the lowest relative CO₂ reduction costs

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COAL TO BIOMASS CONVERSION - RESULTS



Others' refs: DRAX etc

Performance achievable:

85 – 100% MCR

Emissions:

CO₂ reduced by >90%

SO₂ significantly reduced

NO_x reduced by >50%

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BIOCONVERSION - SUMMARY OF KEY POINTS

Large scale Biomass conversion is **Manageable and Viable** by

- **maintaining performance** and
- **providing significant carbon savings**, and
- **Providing significant emissions reductions as well**

And perhaps an alternative to Decommissioning considerations?

THANKS FOR YOUR ATTENTION

QUESTIONS?



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