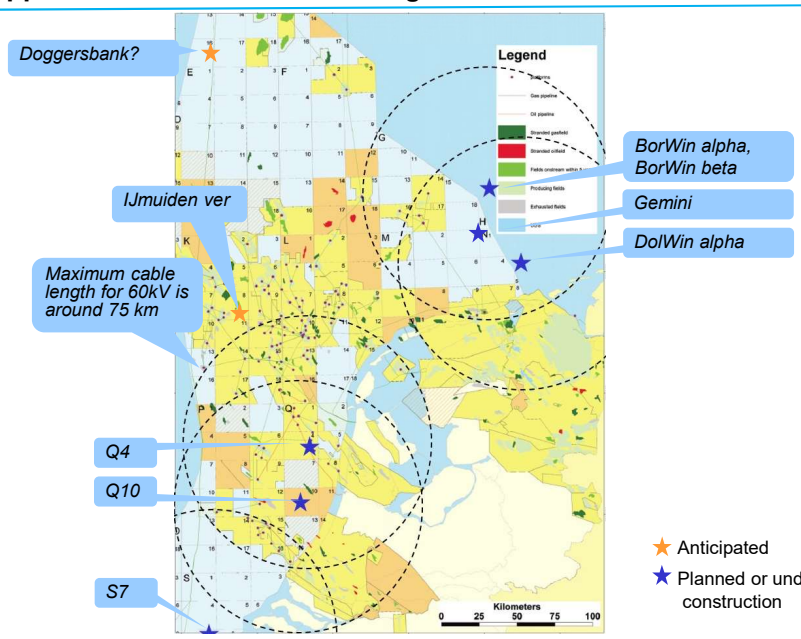
CIRCULAR ENERGY BV

CO_2-free control power

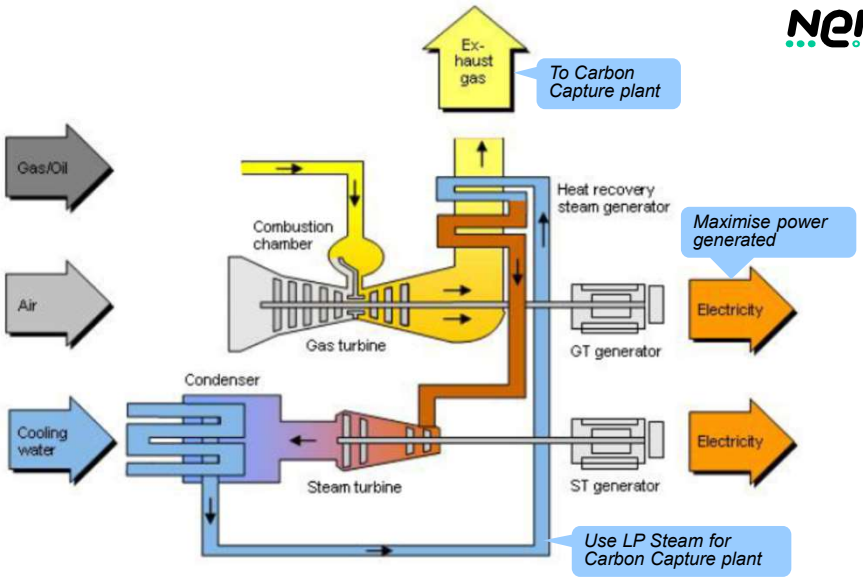
CATO 4 December 2018

Arnold Groot

Opportunities for offshore Powergen



Power Generation plant



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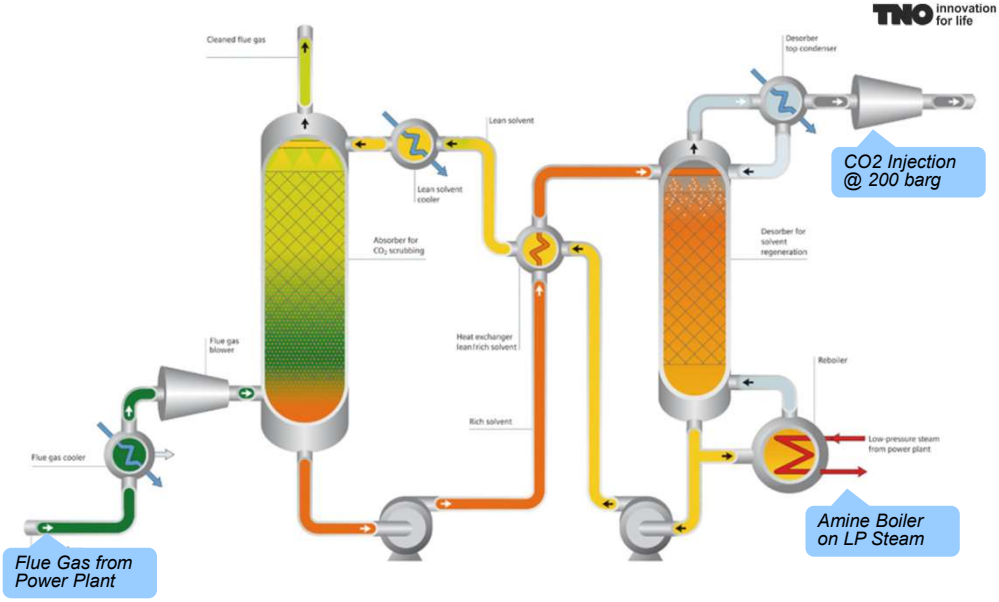
Carbon Capture Plant



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Reservoir pressure decline is counteracted

Ambient air comprises typically of 21% oxygen and 79% nitrogen

The processing of Nitrogen is a major source of inefficiencies for power plants

$$CH_4 + 2\ O_2 + 7.5\ N_2 \longrightarrow CO_2 + 7.5\ N_2 + 2\ H_2O$$

Natural gas comprises typically of:

93.00% C1
2.85% C2
0.35% C3
1.70% CO_2
1.90% N_2

For every mole of CH_4 produced one mole of CO_2 is injected, assuming perfect capture effectiveness.

The reservoir receives a similar volume of CO_2 as the volume of natural gas produced from it.

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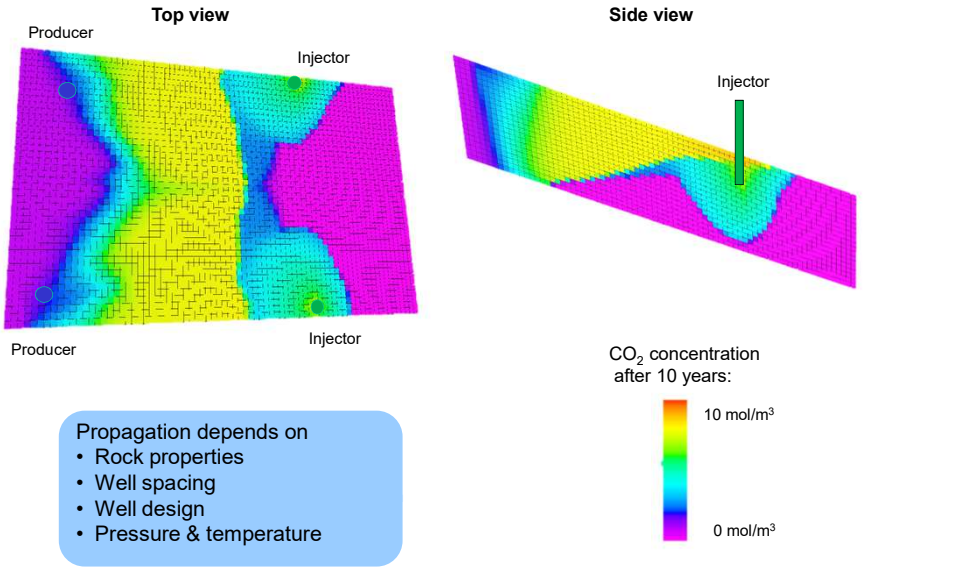
Propagation of CO_2 through the reservoir can be managed

TNO innovation for life



Propagation depends on
- Rock properties
- Well spacing
- Well design
- Pressure & temperature

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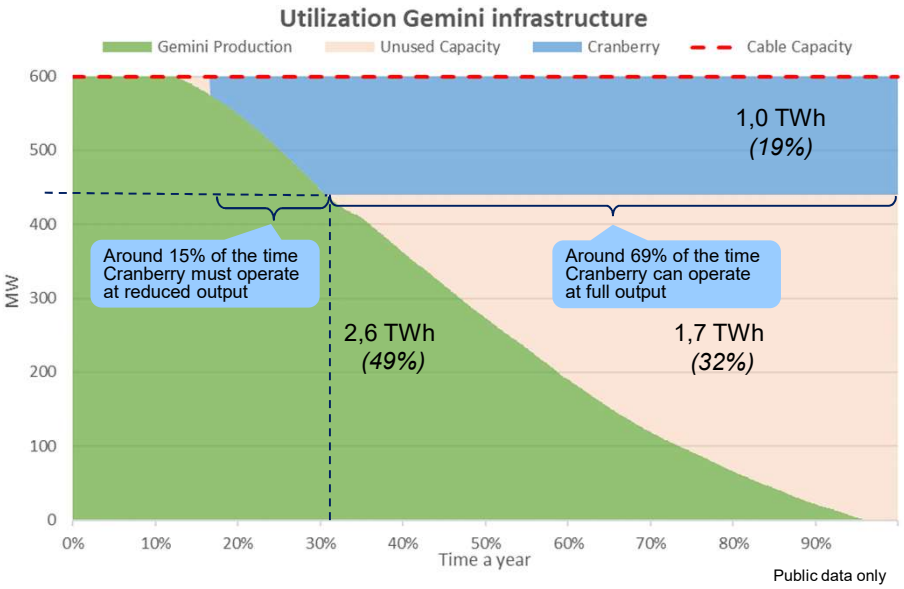
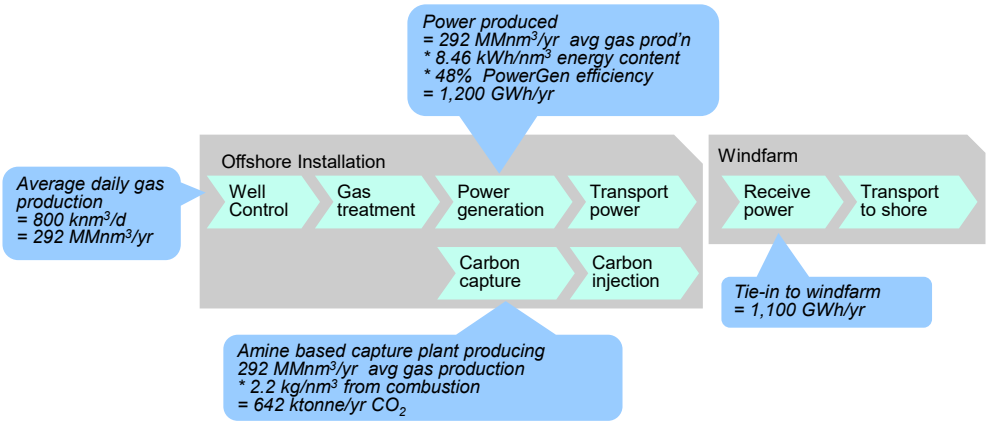
Case study: producing into Gemini

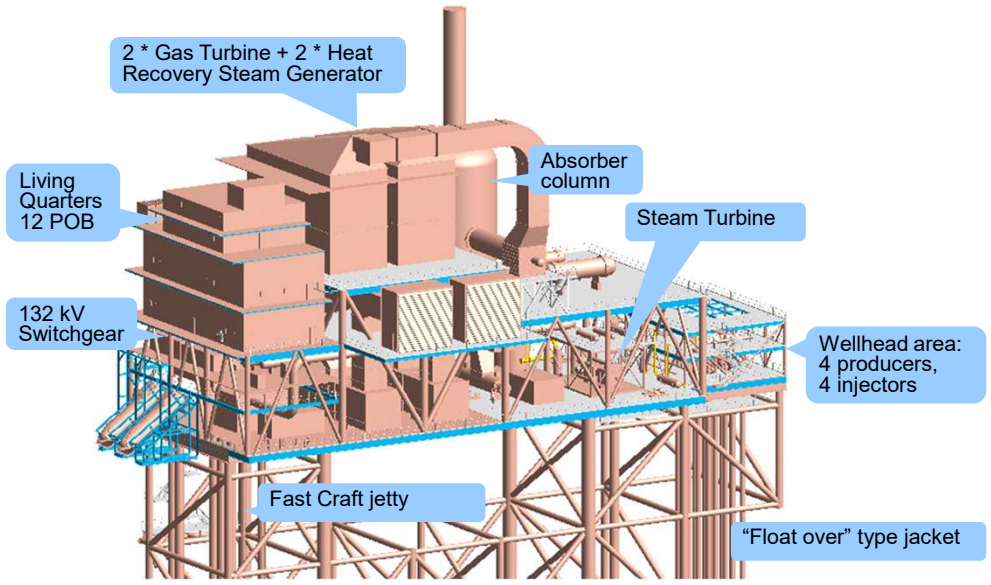


Public data only

A 185 MWe Zero Emission Power Plant



Topsides 6,500 tonne



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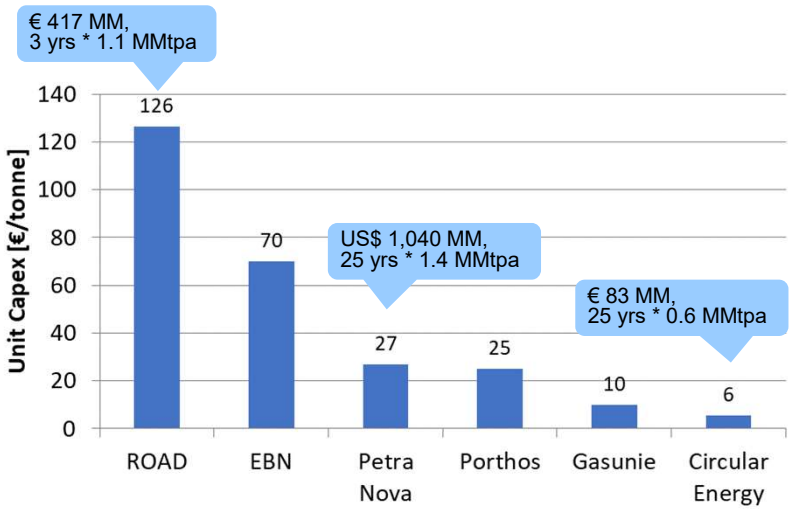
CCS on the cheap



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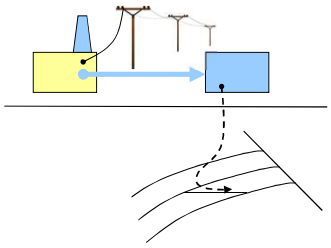
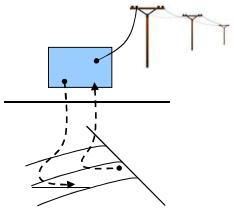
How come Circular Energy is economic at current ETS prices?

End-of-pipe solution	*Integrated concept*
	
~~*Gas treatment Plant*~~	*Gas treatment Plant*
~~*Power Plant*~~	*Power Plant*
Capture Plant (standalone)	*Capture Plant (integrated)* !
CO_2 Flowline	~~*CO_2 Flowline*~~ !
Injection Plant	*Injection Plant*
Revenues: none	*Revenues: sale of power* !

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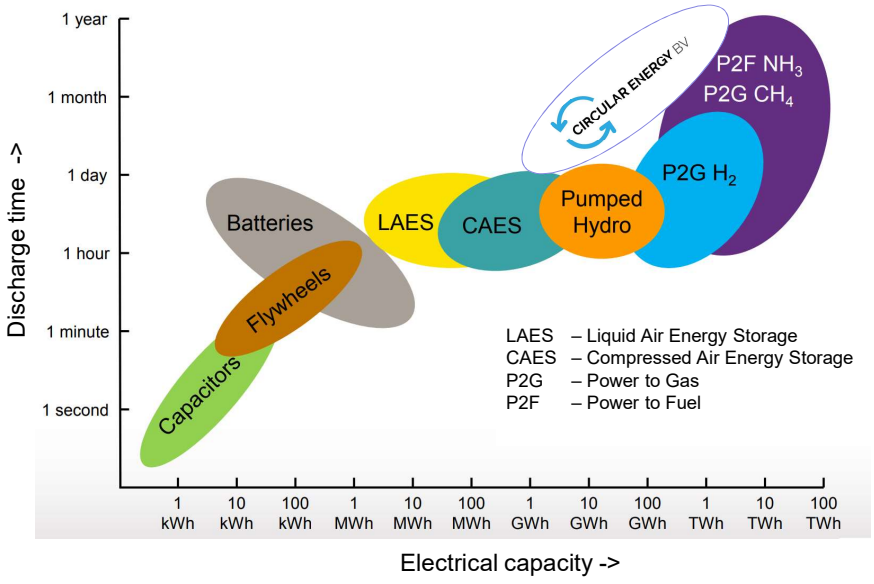
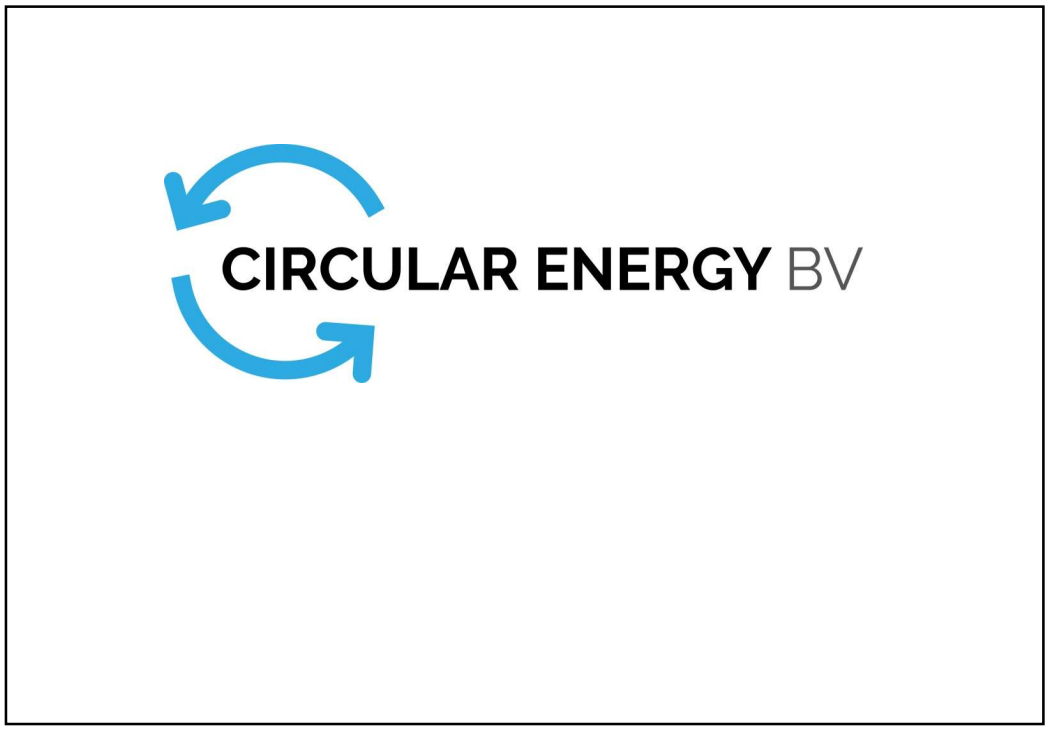
"Cranberry is an offshore battery project"

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