

Fortum Oslo Varme's CCS project

Energy from waste with negative emissions



Energy sources:



EXCESS
WASTE HEAT



ELECTRICITY



HEATPUMP/
SEWER



DATACENTER



WOOD PELLET



BIOFUEL

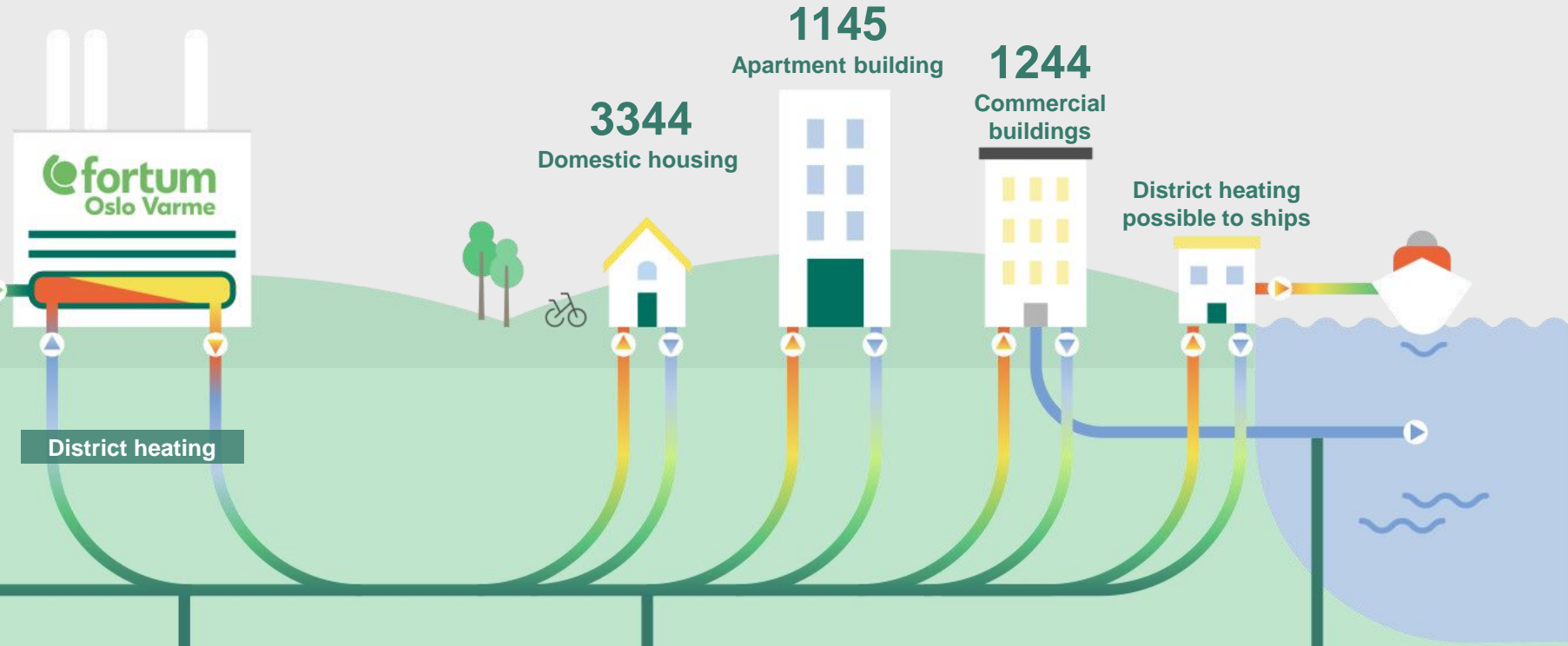


FOSSIL OIL



LNG

Fortum Oslo Varme AS



ENERGY RECOVERY
FROM 400.000 TONNES
WASTE/ YEAR

600 km district
heating network

30 mill liters hot water
distributed
throughout Oslo

District cooling

Production approx
152 GWh
electricity (est. 200)

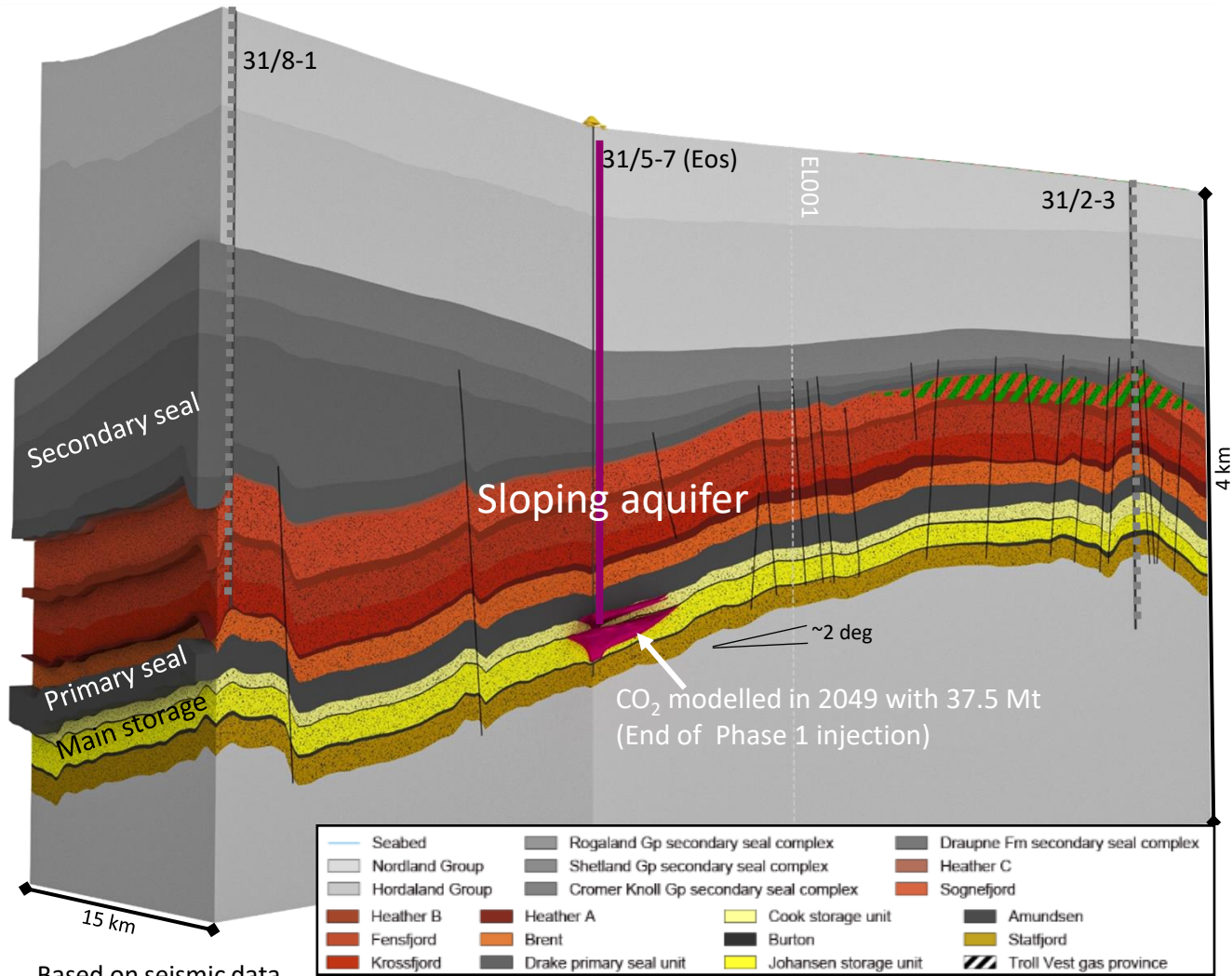


World's first full-scale CCS project on Waste-to-Energy

- Part of **Longship** CCS project; permanent geological storage below seabed
- **400 000 tons CO₂/year, 90% CO₂ capture**
- **CCS on Waste-to-Energy provides 50 % CDR**
- **Studies completed 2015-2019**
- **Demonstrates truck transport of CO₂ to port**
- **Successful testing on real flue gas 2018, new test period with Shell amine concluded**
- **Technology supplier with full-scale experience (Shell's amine), EPC contractor Technip Energies**

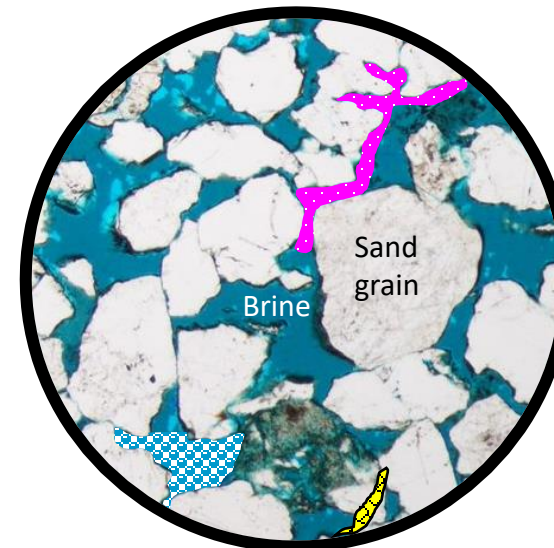


Northern Lights storage concept



Based on seismic data from CGG

- High pressure and temperature
- CO2 injected in a porous sandstone layer
- Layer(s) of shale above the sandstone
- The CO2 will slowly dissolve in the salt water
- Over time the CO2 will form into minerals



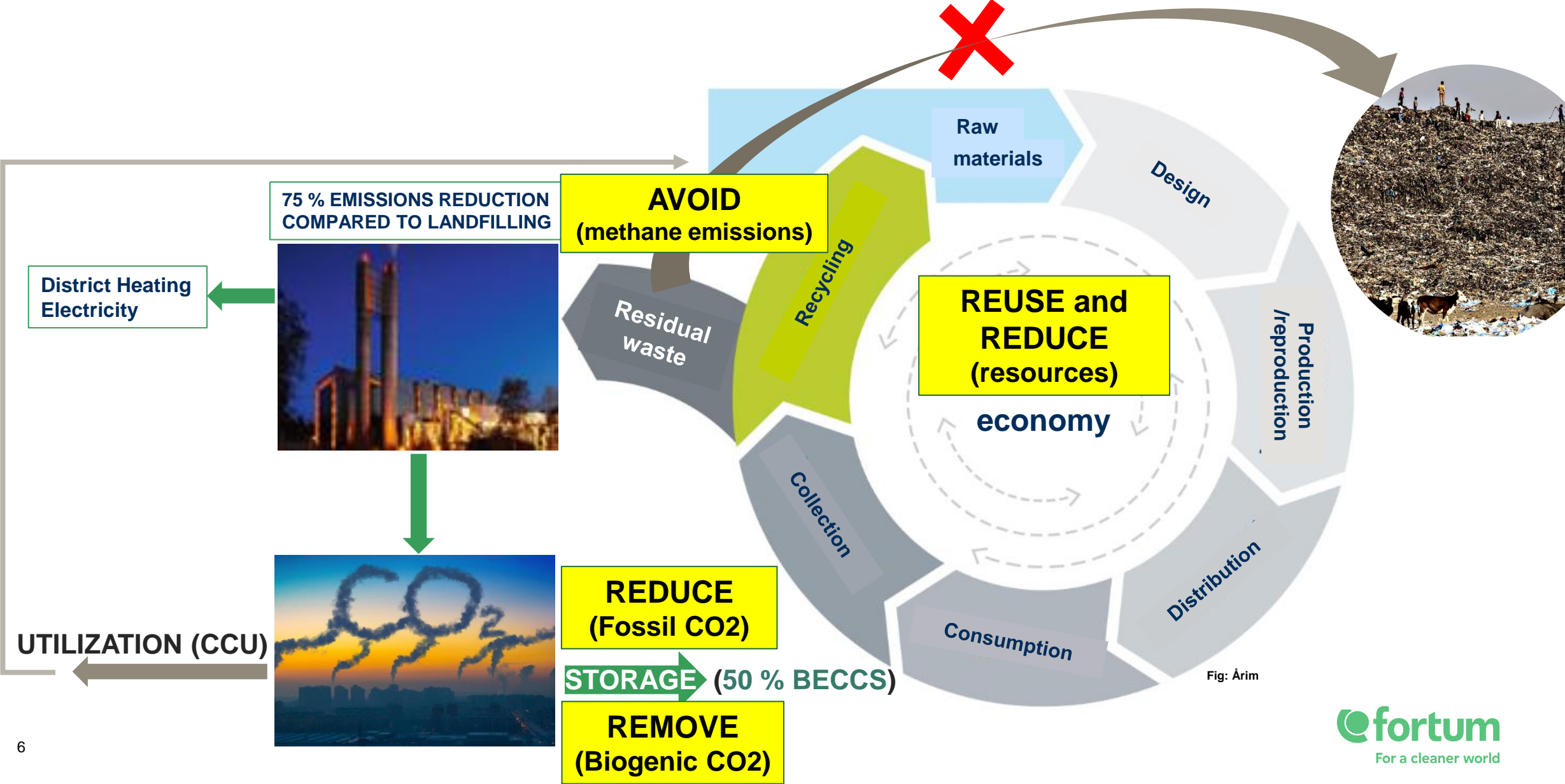
All data (83 GB) from well made public

Waste is one of the world's biggest climate challenges

- 
- A worker in an orange safety suit and yellow hard hat stands next to a large pile of garbage. The worker is wearing a white face mask and dark gloves. The background is a vast, open area filled with a massive pile of waste, including plastic bags, cardboard, and other debris. The sky is overcast and grey.
- **Waste amounts increasing**
 - **Cities are growing**
 - **Methane from landfills ~20% of global warming**
 - **40 Mill tons missing capacity for treatment of residual waste**

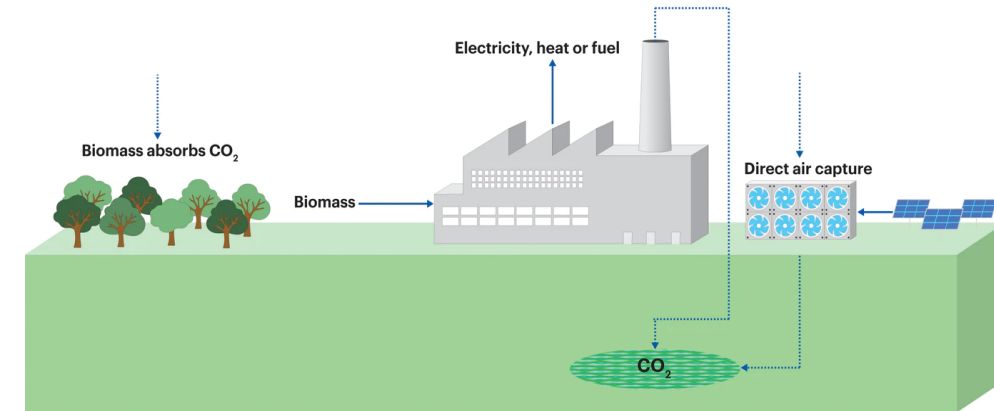
Avoid, reduce, reuse, recycle - and remove!

Circular economy with CO₂ handling on end-solution for waste



The potential of Carbon removal

- No regulatory mechanism in place to encourage the deployment of technology-based removals (BECCS, DACS)
- Countries, cities and public companies committing to **net zero** by 2050
- Private initiatives and voluntary marketplaces for verified CO2 removals emerging
- EU legislation/framework for certifying carbon removal methods (CORC) in 2022. Anticipated to address
 - Permanence
 - Sustainability
 - Single counting of removal



puro • earth

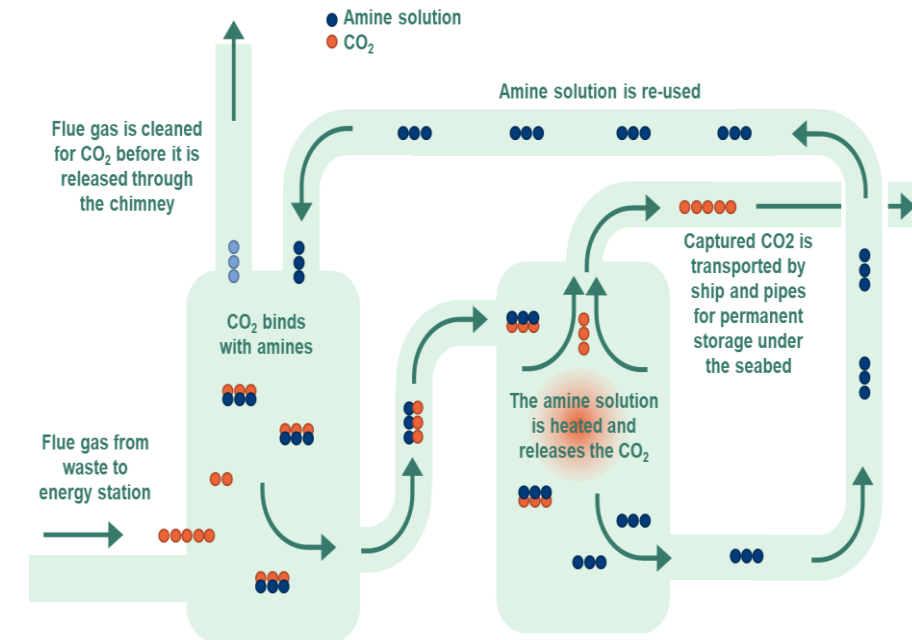
CARBON REMOVAL STARTS HERE

The world's first B2B marketplace, standard and registry focused solely on carbon removals.

NEUTRALIZE YOUR EMISSIONS NOW

Technology vs cost and local conditions

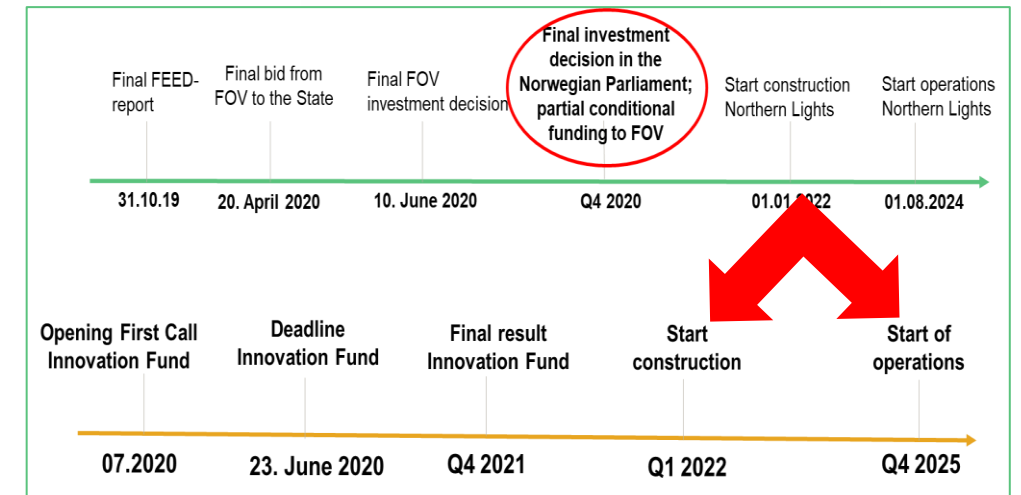
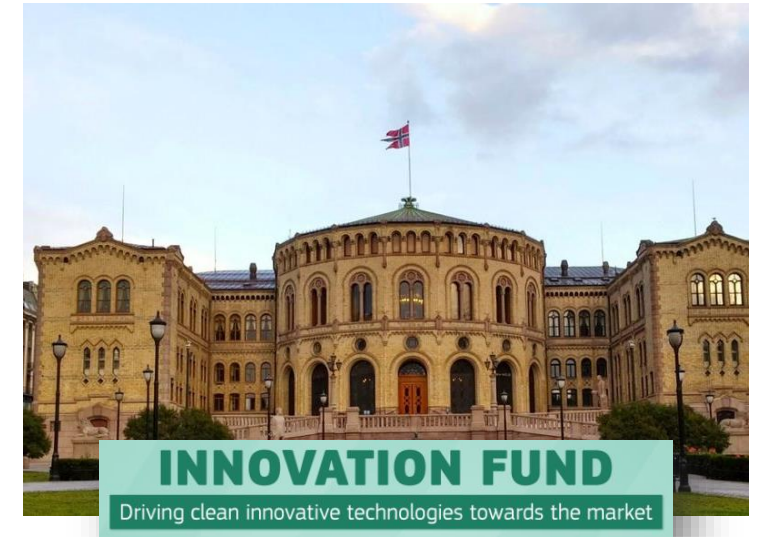
- Different technologies handle impurities differently.
- Availability and costs for (waste) heat, cooling water, steam and electricity can favor some technologies
- Common to all technologies is that they require large amounts of energy to "release" the CO₂ molecules, either in the form of electricity or thermal energy - or both.
- Local energy costs (electricity, steam, water, cooling) are decisive for which solution should be preferred
- HSE challenges, such as amine and ammonia emissions related to absorbents, can be handled



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LONGSHIP (Dec. 2020); State financing of CCS in Norway

- **2020: Full support** to the transport and storage project; *Northern Lights*, and to Norcem capture project (cement)
- **Conditional support** to FOV's capture project (**300 Mill E**)
- Application to EU Innovation Fund 1. call unsuccessful
- Fortum is selling its share in Fortum Oslo Varme. New owner structure;
 - Hafslund ECO 60 &
 - Infranode 20 %
 - Hitec Vision 20 %
- **Remaining financing now in place** (new owners and City of Oslo), estimated start of constructions Q3 2022



CCS project financing

- **Total Project cost 900 Mill EUR**
 - CAPEX 550 Mill EUR
 - OPEX 350 Mill EUR for 10 years operation
- State support 300 Mill EUR
 - 10 year support period for operations (support = ETS price)
 - 10 years transport and storage service
- City of Oslo direct investment in pref. shares of 210 Mill EUR.
- Remaining funding 390 Mill EUR shared between new owners
 - Hafslund Eco 60% - 234 Mill EUR
 - HitecVision 20% - 78 Mill EUR
 - Infranode 20% - 78 Mill EUR
- Total investment from City of Oslo; 444 Mill EUR, or **49% of the total project cost.**



Thank you

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