






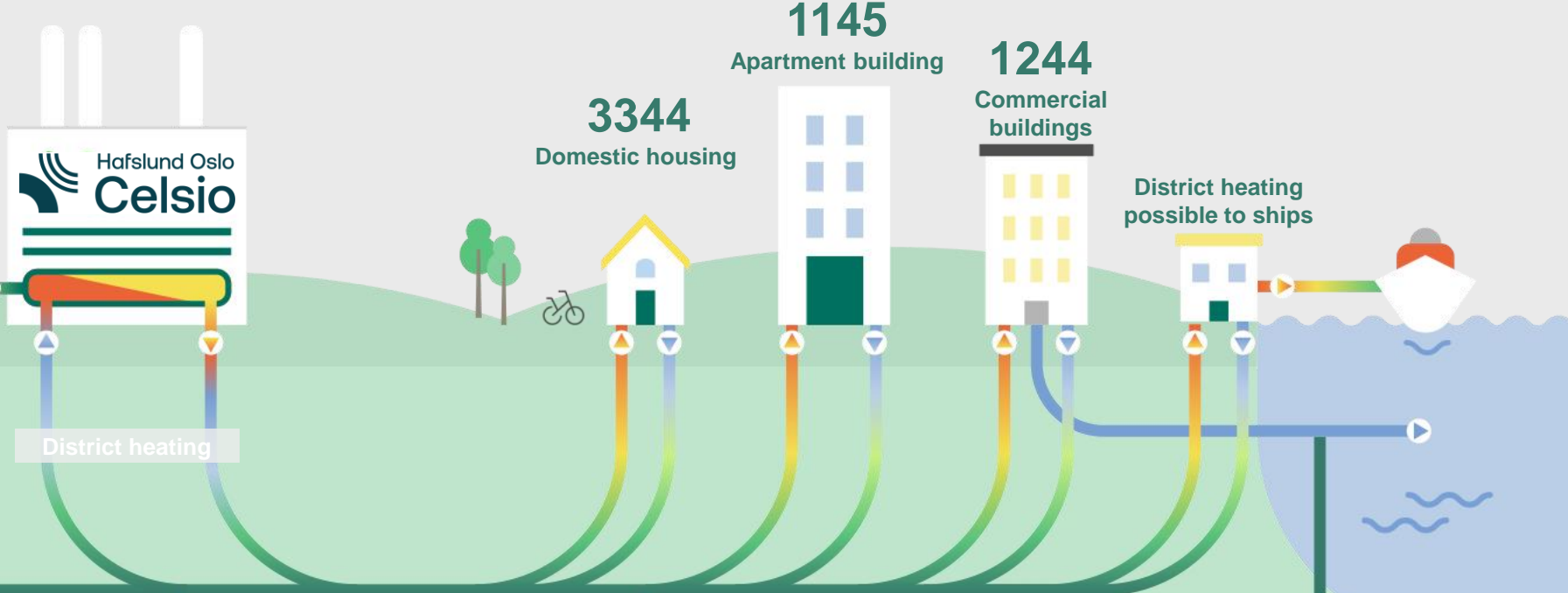
Hafslund Oslo Celsio CCS project

Waste-to-Energy with negative emissions

Celsio

Energy sources:

-  EXCESS WASTE HEAT
-  ELECTRICITY
-  HEATPUMP/ SEWER
-  DATACENTER
-  WOOD PELLET
-  BIOFUEL
-  FOSSIL OIL
-  LNG



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)



Celsio with new owners



(60 %)

HITECVISION

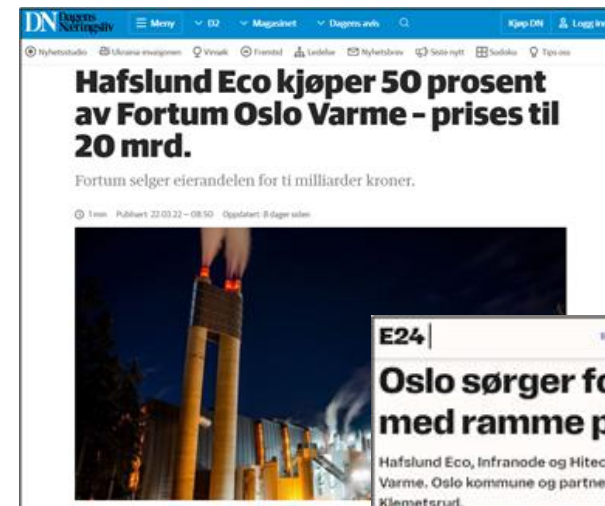
(20 %)



(20 %)

- Agreement signed 22. March 2022
- Transaction completed 19. May 2022
- FID 28. June 2022, start 1. July 2022

- CCS financing secured with contributions from State, City of Oslo and Celsio



De vil satse milliarder på å kjøle ned folk i Oslo

De nye eierne av Fortum Oslo Varme har planer som går langt utover fangst av CO₂. De lover å investere nær 10 milliarder kroner i både fjernvarme og fjernkjøling i Oslo de neste årene.



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

Part of Longship

400 000 tons CO₂/
year, 90% capture

CCS on Waste-to-
Energy; 50 % CDR

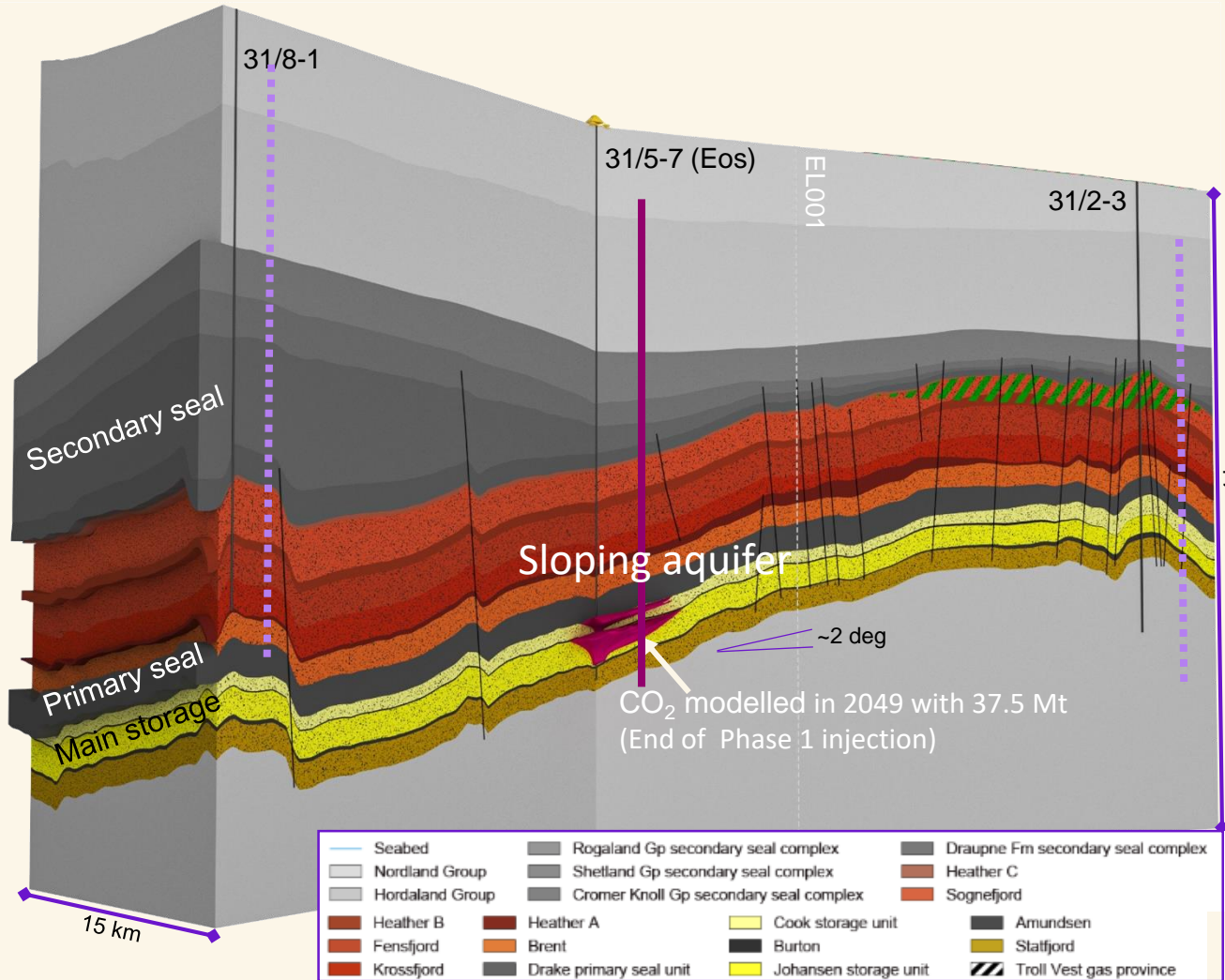
Constructions
aug 2022 - ?

Truck transport of
CO₂ to port

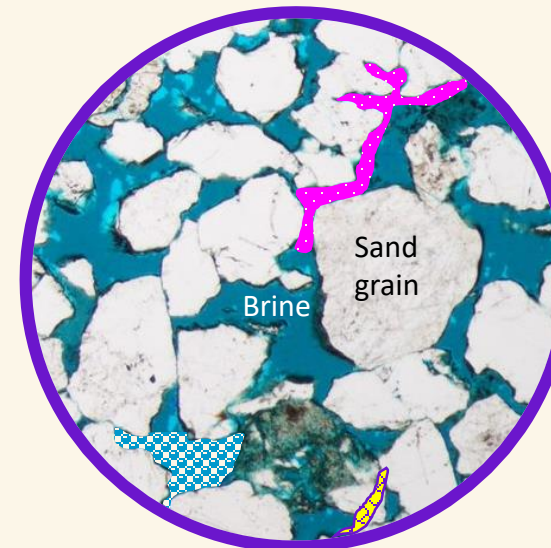
Successful testing
on real flue gas



Northern Lights storage concept

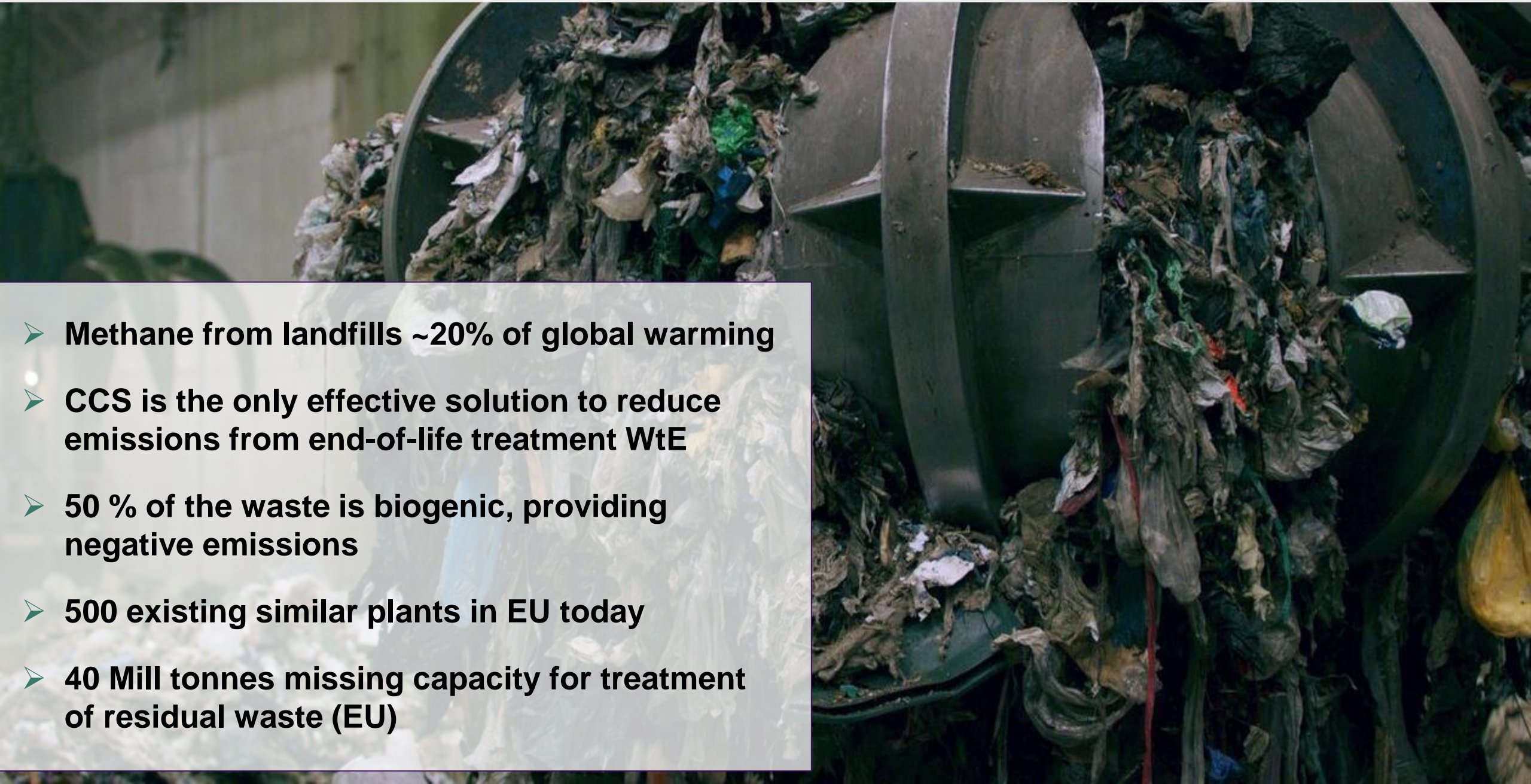


- High pressure and temperature
- CO₂ injected in a porous sandstone layer
- Layer(s) of shale above the sandstone
- The CO₂ will slowly dissolve in the salt water
- Over time the CO₂ will form into minerals



All data (83 GB) from well made public

Based on seismic data from CGG



- **Methane from landfills ~20% of global warming**
- **CCS is the only effective solution to reduce emissions from end-of-life treatment WtE**
- **50 % of the waste is biogenic, providing negative emissions**
- **500 existing similar plants in EU today**
- **40 Mill tonnes missing capacity for treatment of residual waste (EU)**

CCS project financing FID 2022

- **Total Project cost 910 Mill EUR**
 - **CAPEX 550 Mill EUR**
 - **OPEX 350 Mill EUR** for 10 years operation
- **State support 300 Mill EUR**
 - +10 years transport and storage service
 - +10 year support period for operations;
Payment per ton CO2 delivered at port (= ETS price)
- **City of Oslo direct investment in preference shares of 210 Mill EUR**
- **Remaining funding 390 Mill EUR** by Celsio



Parliament of Norway
Acc: Stortinget.no



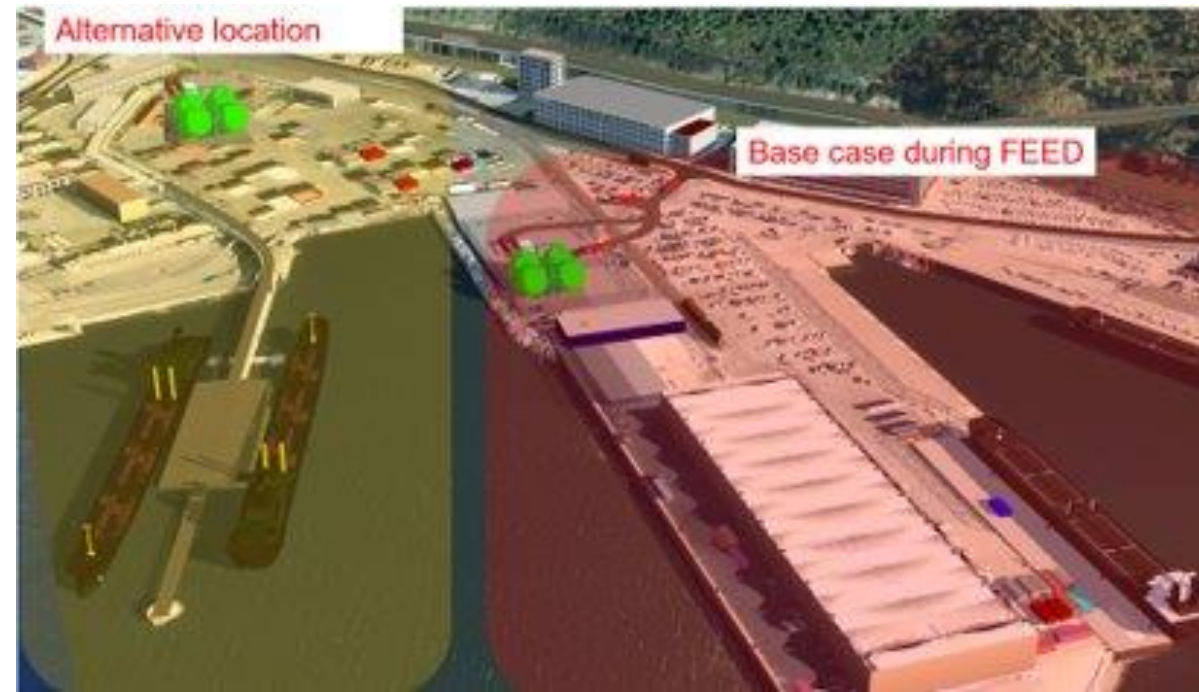
Oslo City Hall

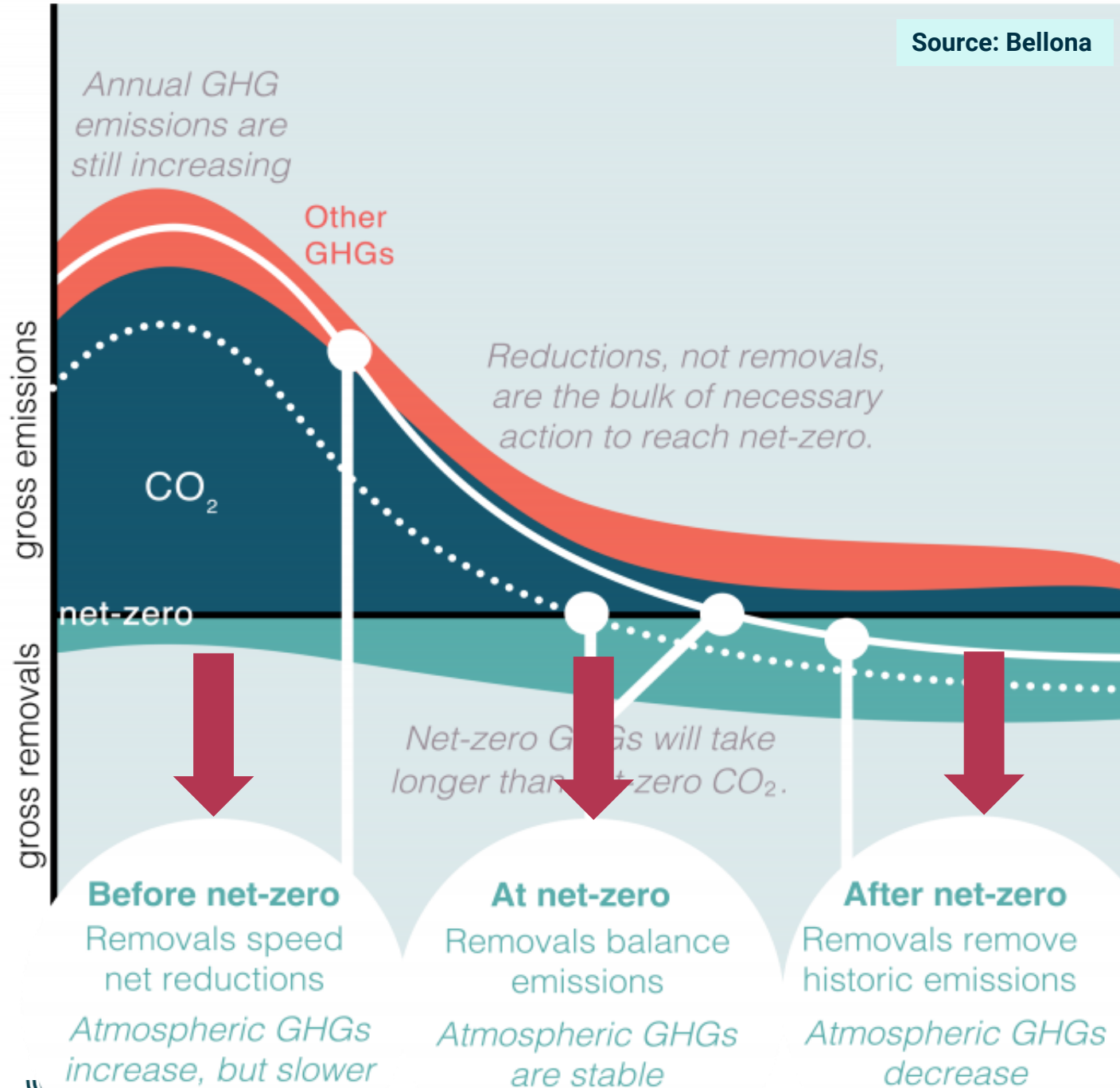


Celsio plant

Cost increases causes pause

- 1) Inflation, power prices, market situation, currency
- 2) Organization – necessary with more resources
- 3) Area demand and infrastructure
 - a) Logistics and rig areas
 - b) Temporary solutions for parking, admin etc.
 - c) New entrance to incineration plant
- 4) Final location at Port of Oslo changed
- 5) Local power demand and timeline for new transformer station





Future enablers

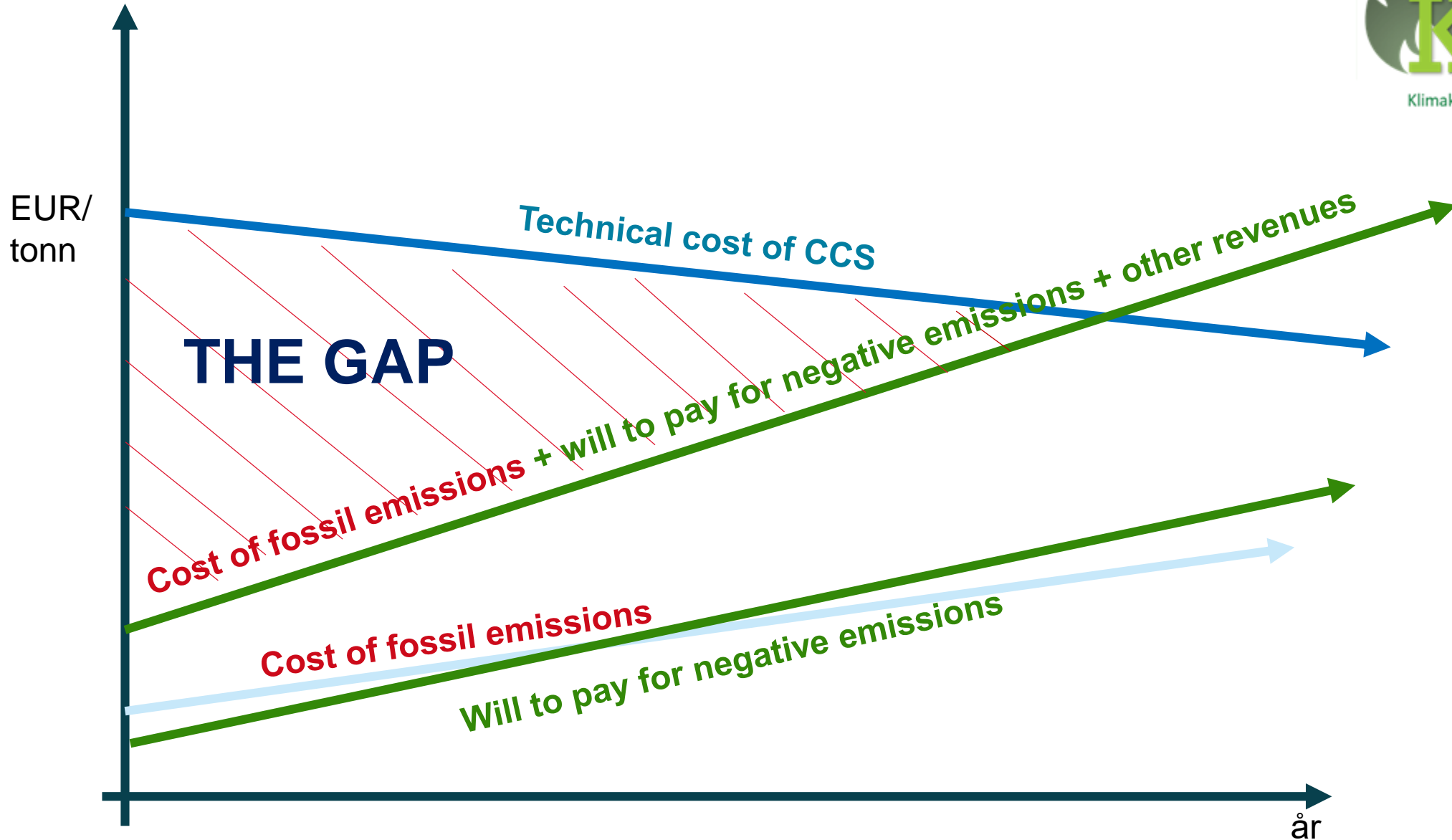
Avoided costs (fossil part of emissions)

- Norwegian CO₂ tax
- Future ETS price

Cannot be cheaper to move waste down the waste pyramid!

1. Carbon removal (CDR) certificates (BECCS)
2. Net Zero Plastic certificates
3. Higher gate fee for carbon free waste services
4. Improved standing for district heating

Need for public funding of THE GAP, but for how long?



Easter 2023





To sum up:

- **WtE is first and foremost sustainable handling of residual waste**
- **CO₂ handling on WtE will be a requirement in near future (BAT)**
- **Early stage; financing of CCS is a challenge**
- **Important potential in carbon removal from biogenic waste (appr. 50 %)**