Fortum Oslo Varme AS

CCS will be the future for circular economy and urban societies

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TCCS10, 17. June 2019

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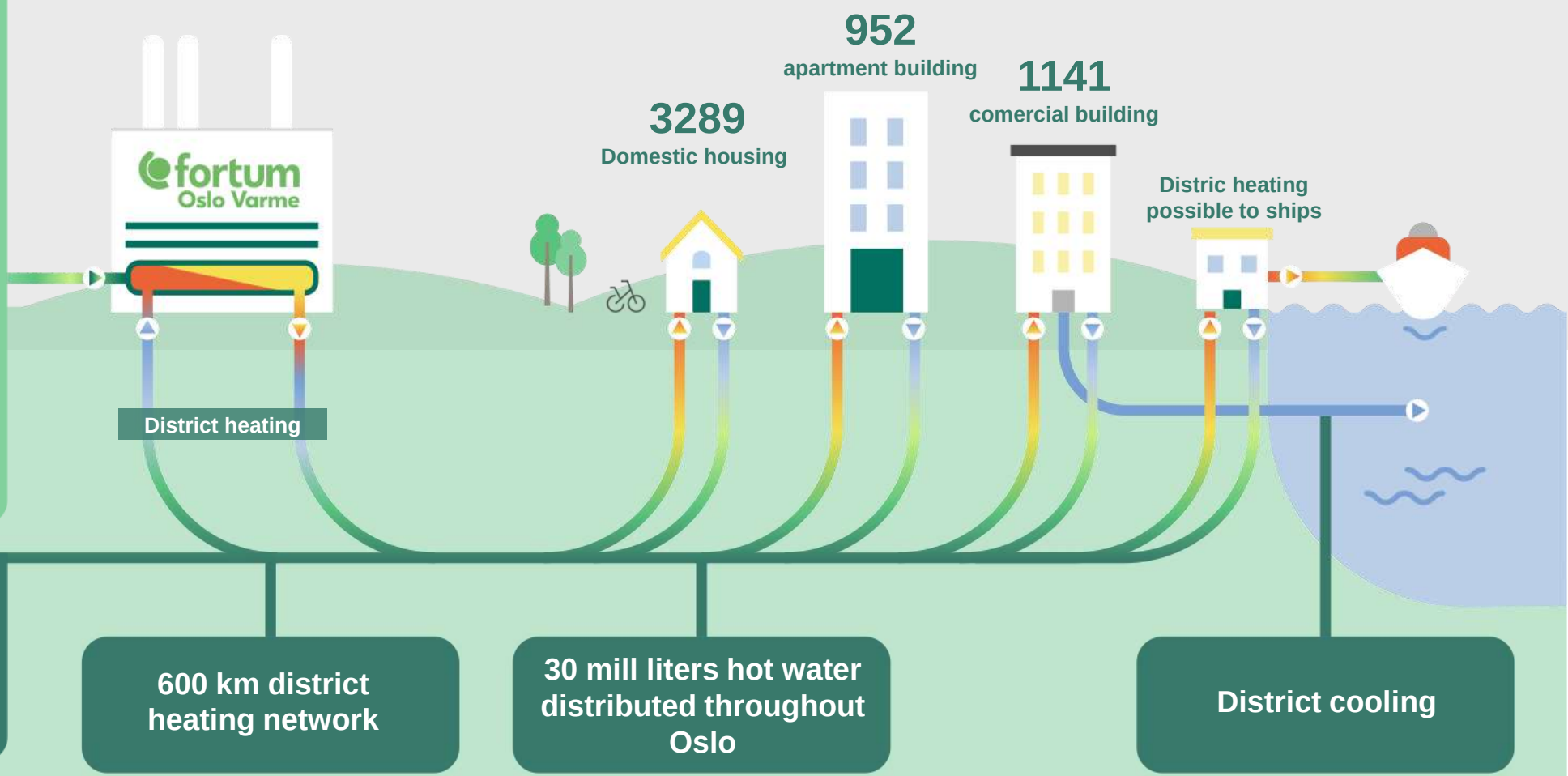
Energy sources:

- WASTE HEAT
- ELECTRISITY
- 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
150 GWh
electricity (est. 2017)

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Fortum – for a cleaner world

Nordics

Power production	45,4 TWh
Heat sales	5,0 TWh
Electricity customers	2,4 million

Poland

Power prod.	0,5 TWh
Heat sales	3,7 TWh

Baltics

Power prod.	0,7 TWh
Heat sales	1,4 TWh

Russia

Power prod.	26,3 TWh
Heat sales	19,8 TWh

India

Power prod.	0,3 Wh

Sustainable waste treatment
Decarbonizing energy systems → **CCS**

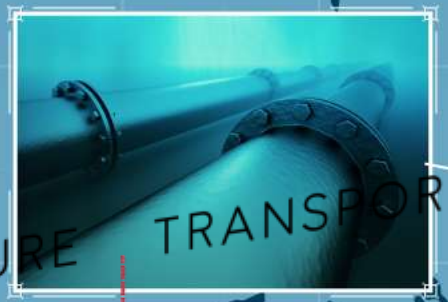
Oslo: Europe's Environmental Capital 2019

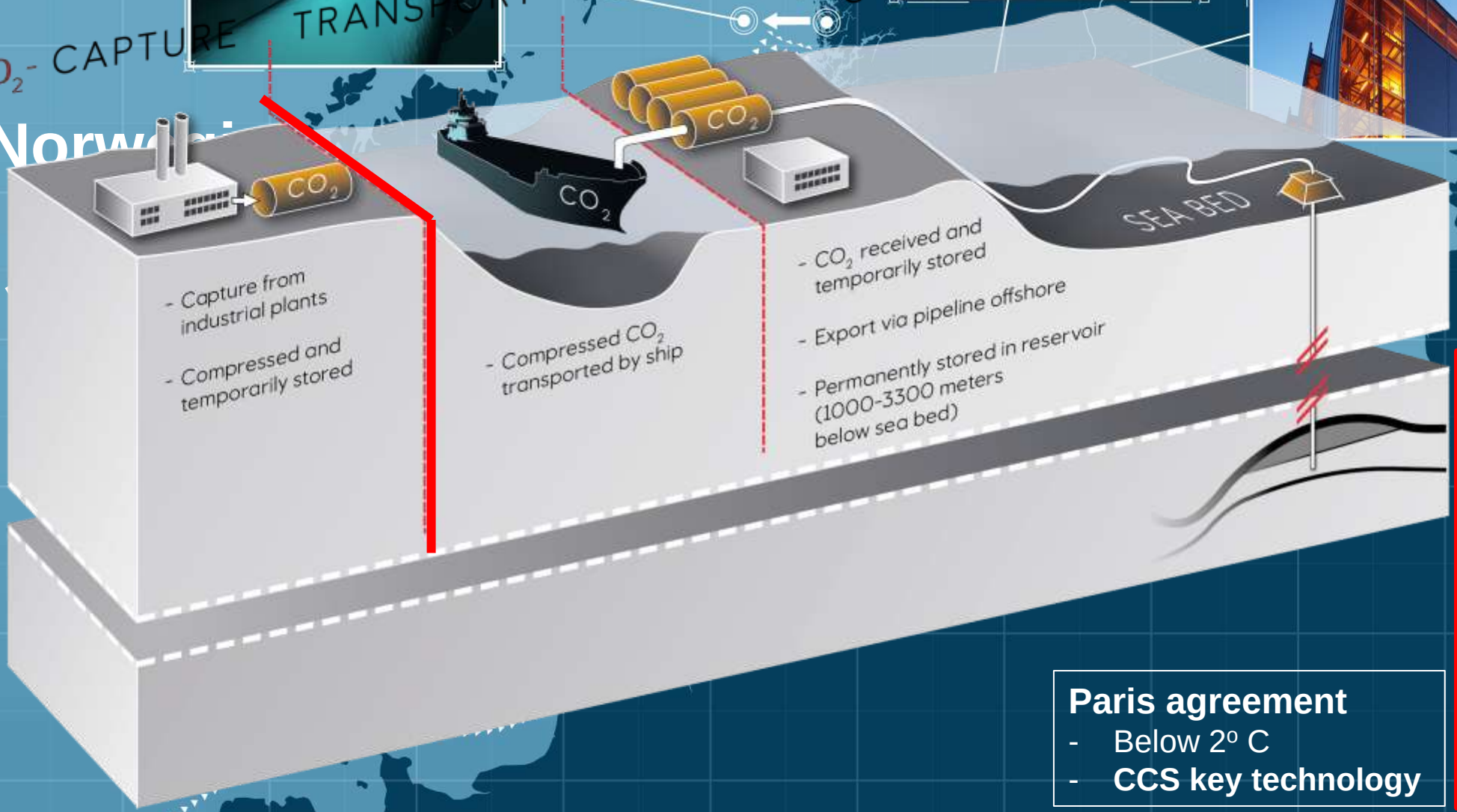
CCS from Waste to Energy

50 % GHG reduction within 2022

95 % GHG reduction within 2030

The Norw... CCS

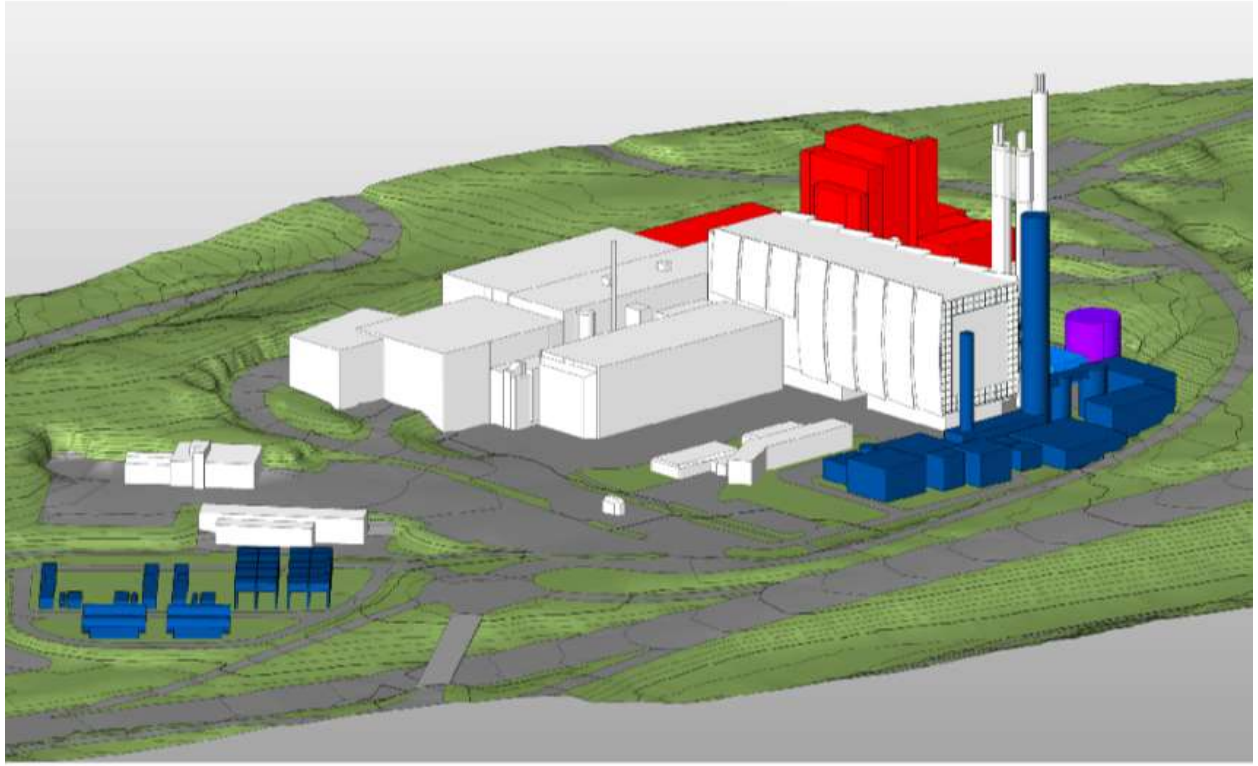




Paris agreement
- Below 2º C
- **CCS key technology**

CO_2 capture at Klemetsrud Waste-to-Energy plant

- Capture of about 400 000 tons CO_2 yearly
- Removes both fossil and biological CO_2 (appr. 50 % BIO-CCS)
- CO_2 transport to port via emission free cars
- Connection to the district heating grid gives effective utilization of waste heat
- 90% cleaning of CO_2 and technology supplier with full scale experience (Shell Cansolv)
- Pilot testing at Klemetsrud ongoing



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Pilot testing

- The pilot plant started capturing CO_2 Tuesday February 26th
- 24-hour performance test completed Friday March 1st
- Stable operation – 2000 hour test completed May 31st
- Test program with main focus emissions and degradation
- Cooperation with Gassnova, TCM, DNV, UiO and Rambøll

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We need a waste revolution!


Kilde: Wasteaid.org
Kilde: ISWA

Waste to Energy with CCS solves two global headaches

- Almost 2,2 bill. tons of waste is produced every year, doubling towards 2025
- Dumps and landfills cause large, diffuse methane emissions
- WtE is the best solution for residual waste that cannot or should not be recycled
- **A necessary addition** to sorting and recycling, and a part of the solution in a circular economy
- WtE with CCS can help avoid massive emissions from landfills, and help solve ocean plastics

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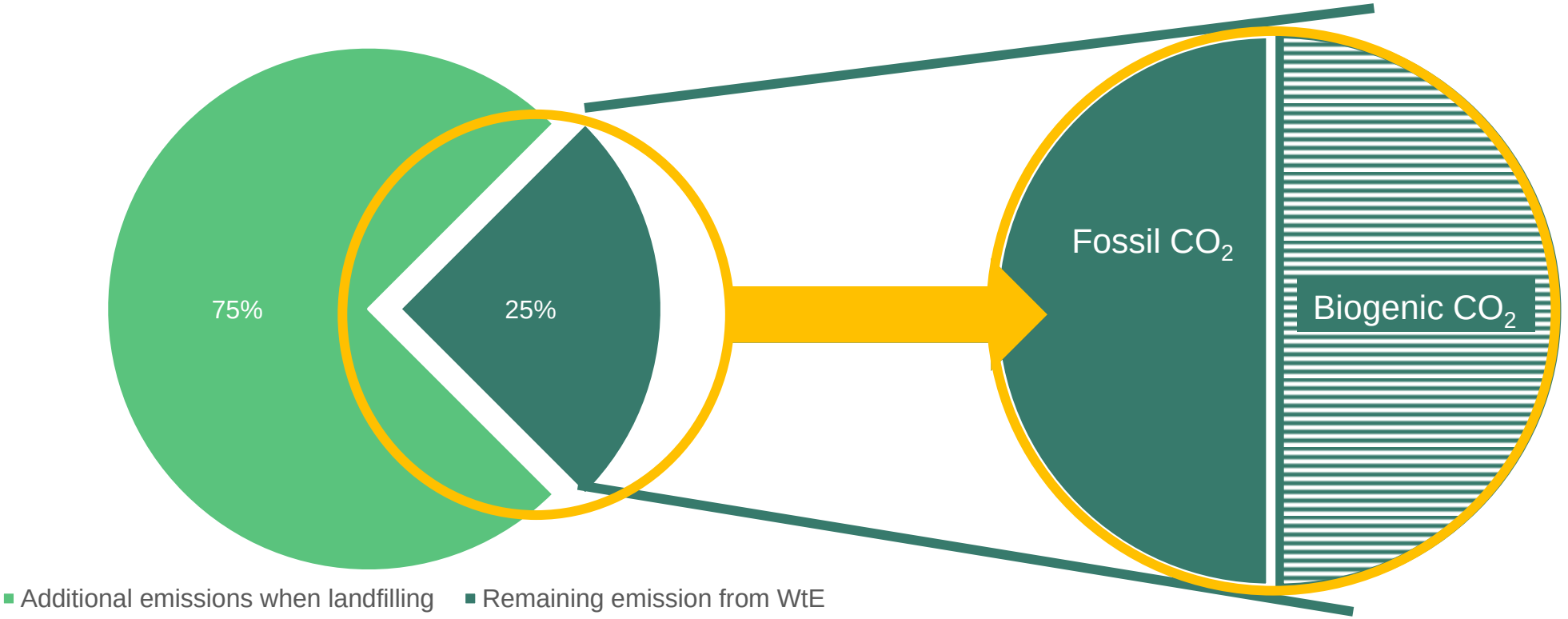
Decarbonizing the waste sector

Emissions from landfilling waste → **Energy recovery with carbon capture**



WtE with CCS gives negative CO2-emissions, and can neutralize other emissions that are difficult to reduce/remove

The transition from landfills to WtE reduces climate emissions with **75 %**

About 50% of the remaining emissions from WtE are biogenic. CCS ➡ carbon-negative solution

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Global increase in waste amounts - Large CCS potential in Europe

100
Million tons landfilled in EU yearly

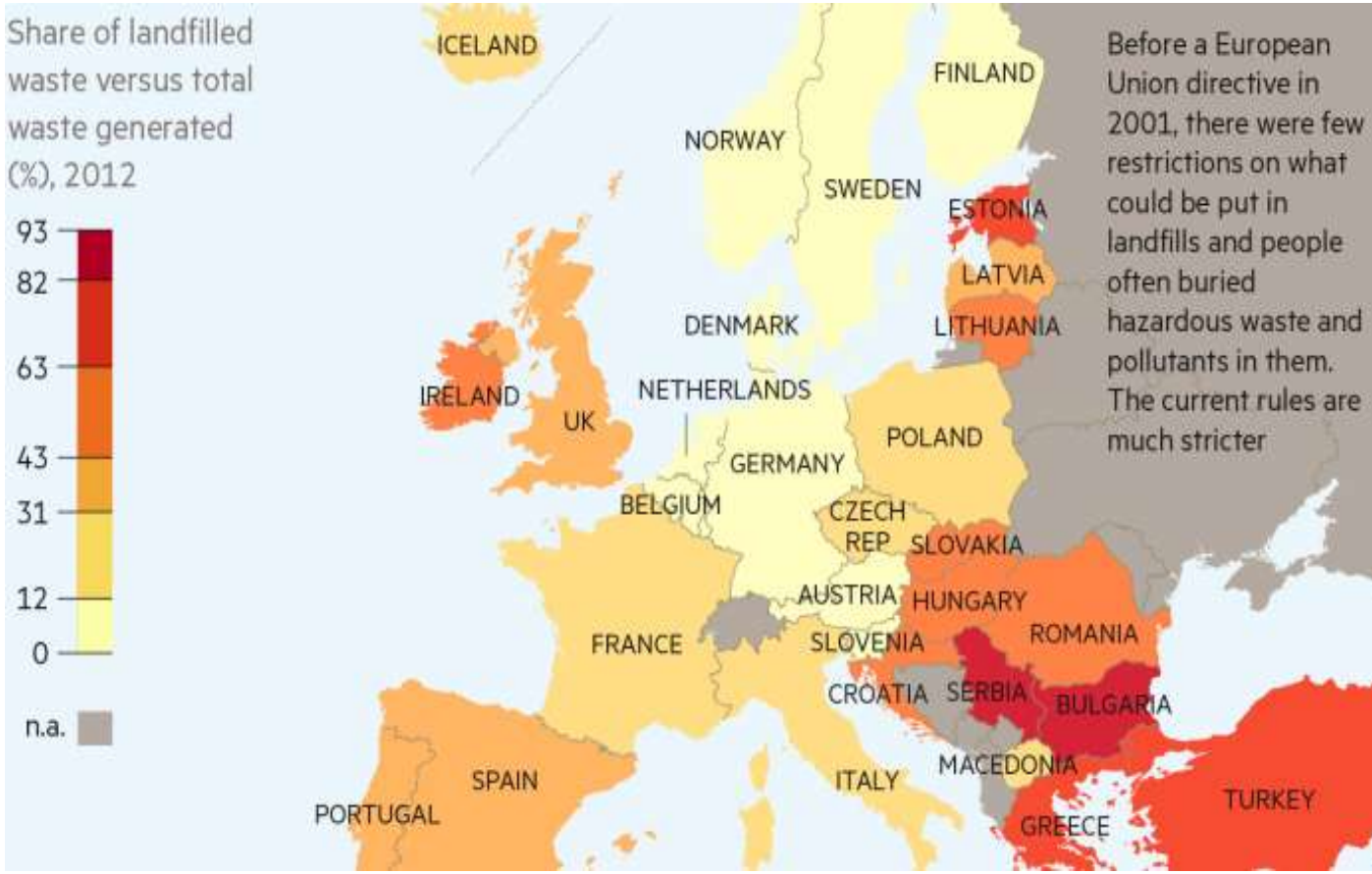
450
Waste-to-Energy plants in Europe

500 000 landfills

82 million tons
Energy recovered in EU yearly

Landfill directive

1 tonn waste = 1 tonn CO_2



Financial Times (Jan. 2018)

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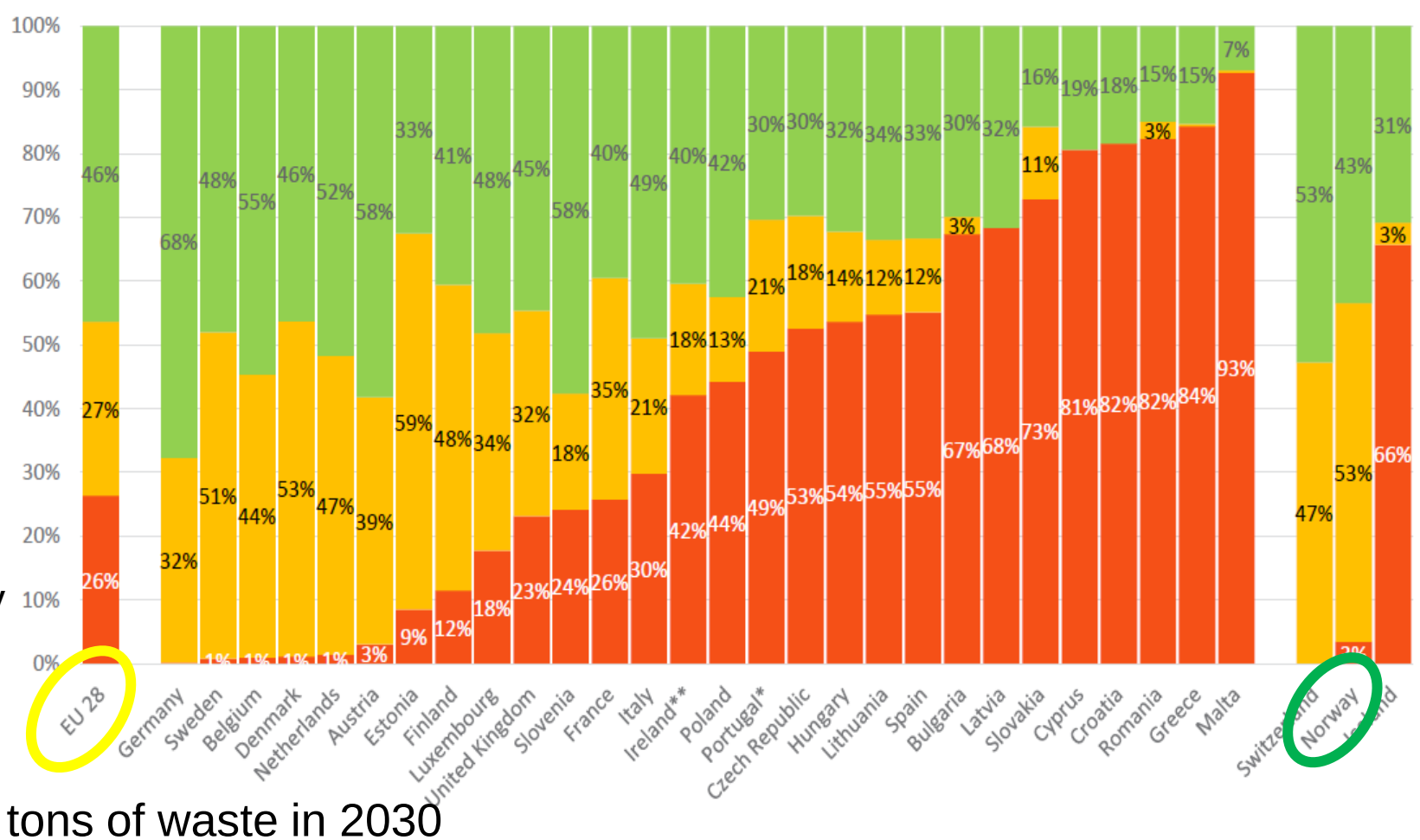
Great global potential for transfer of technology and competence

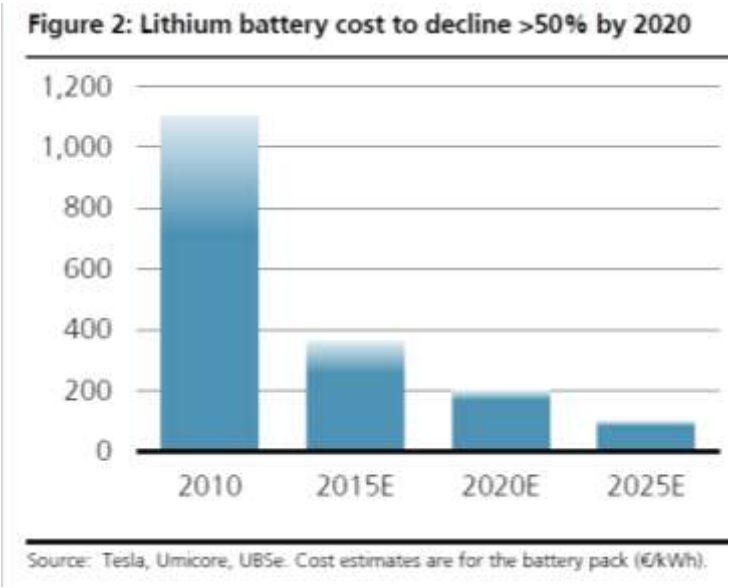
- Realistic global numbers in 2030
  - **40 % material recycling**
  - **50 % energy recovery (WtE)**
  - **10 % landfill**

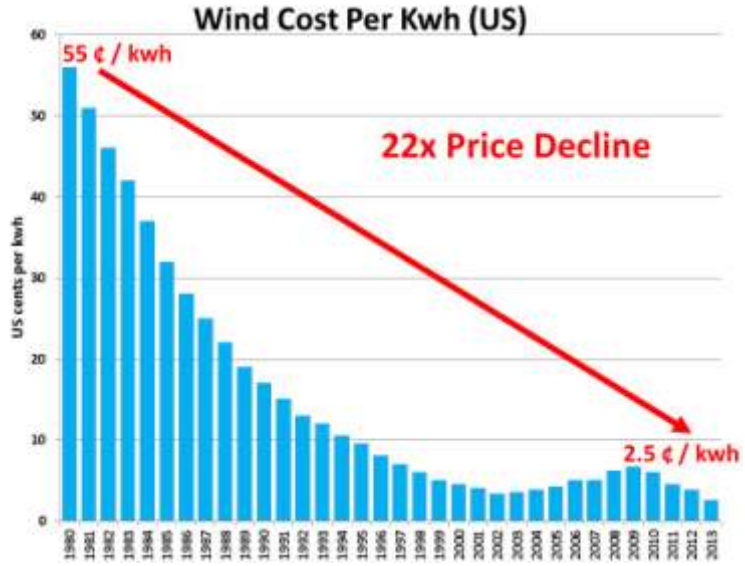


- 50 % WtE equals about 2 billion tons of waste in 2030
- Transfer of technology and competence to global waste industry and other process industry
- FPCC; carbonnegativity neccessary to reach the 2^{O} target

We need volume to cut costs

- Electrical cars
- Batteries
- Solar power
- Wind power

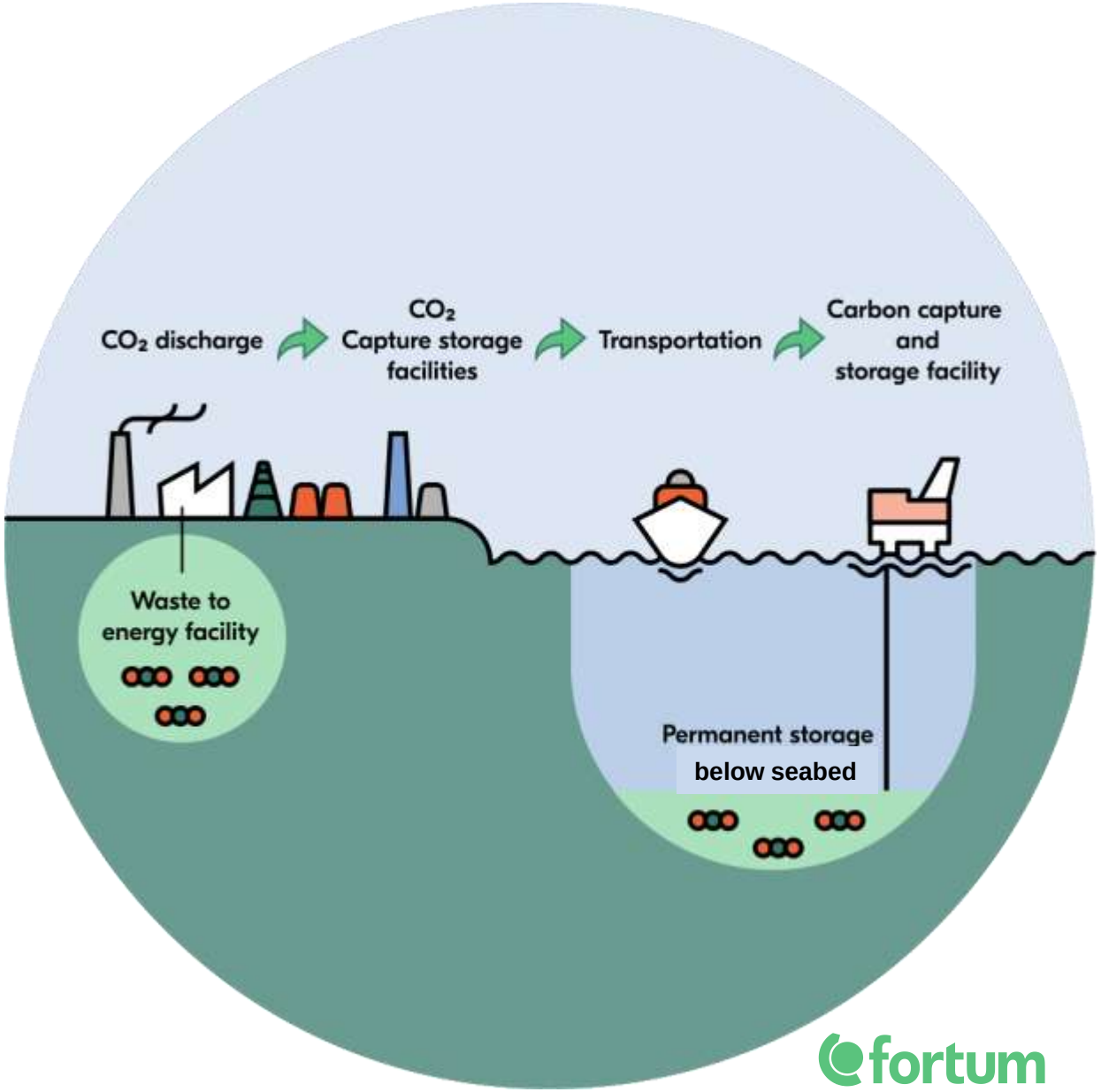




- A CO_2 capture plant at Klemetsrud will be the most expensive and the biggest - because it's the first! (in a long row of similar WtE CCS plants ☺).
- Klemetsrud as a starting point for learning, technology development and cost cuts

Waste to Energy (WtE); part of the climate solution

- IEA; at least 6 bill. tonn CO2 must be captured and stored within 2050 (20 000 new capture projects)
- CO_2 storage below seabed is a safe, proven and effective solution to mitigate climate change
- CCS on WtE will give negative CO2-emissions (BECCS/BIOCCS), and can neutralize other emissions that are difficult to reduce/remove
- The Fortum project shows how cities can cut emissions and mitigate climate change from waste handling as part of sustainable city solutions




Join the change!
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