Carbon capture from Waste-to-Energy in Oslo

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Fortum Oslo Varme, the new joint venture
Waste; a problem and a resource
Huge health, climate and environmental challenge
Almost 4 billion tons of waste generated yearly
Energy recovery best solution for sorted waste
Carbon Capture gives great global transfer value
Oslo’s cycle based waste system

- Extensive source sorting
- Two optical sorting plants
- One biogas plant

- Two Waste to Energy plants
- Heat pumps, wood pellets, bio-oil. Etc.

- District heating
- Sorptive cooling

Norway’s largest WtE plant
- Capacity: 350’ (405’) t./year, 45 t./h
- Local and international residual waste
- El production: 150 GWh
- Heat production: 690 GWh
Residual products after incineration

Establishing carbon capture opens new possibilities for reducing emissions – gains both the climate and the local environment
The complete Norwegian project

Smeaheia

Mulig plassering landanlegg, Kollsnes

Heimdal

Utsira Sør

Skip for CO₂-transport

Fortum Oslo Varme, Klemetsrud

Yara Ammoniakkbrik, Porsgrunn

Norcem Sementfabrikk, Brevik
Klemetsrud – Carbon capture

- **Design capacity after concept phase:**
- A future maximum capacity of 460,200 ton CO$_2$ per year with 90% capture ~ 414,200 ton CO$_2$ per year
- This equals around 405,000 tons of waste per year.
- Budget for 2017 = 350,000 tons of waste, but with potential for future increase.
# The CO₂ capture business model

<table>
<thead>
<tr>
<th>TODAY:</th>
<th>PHASE A:</th>
<th>PHASE B:</th>
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<tbody>
<tr>
<td>Reduced emissions from landfills</td>
<td>CO₂ capture and sales; Sales revenue from 400’ tons of CO₂ for 5 - years.</td>
<td>Increased income from gate-fees.</td>
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<td>Income from gate-fees</td>
<td>Investment-support. Possibility for limited profit. Cost sharing.</td>
<td>Synergy’s from integration and O&amp;M.</td>
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<td>Sales of renewable heat and electricity</td>
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<td>Recycling of metals</td>
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**Business development**
- CO₂ criteria in EU tenders.
- Income from sales of ‘bio-CO₂’- CO₂-negative.
- Business development in CCS market.
Challenges

• Expensive ‘first of a kind’ plant
• Immature supplier/sub-suppliers
• Immature/dysfunctional CO₂ -market
• Transportation to port
• Complete value chain must be developed – and work
• NIMBY?
District heating production are upheld
Transfer value - Europe

Large European waste market
- Waste to Energy plants extensive sources of emissions
- 450 plants in Europe
- 82 t. incinerated yearly in the European union (EU)
- 98 mill. t. landfilled yearly in EU
- Politically well regulated business
Transfer value - USA

- Potential of approx. 32 mill. tons captured CO\textsubscript{2}/year from existing combustion with energy recovery
- 136 mill. tons landfilled = lost opportunity of mitigating GHG, capturing CO\textsubscript{2}, producing energy and getting increased recovery of metals.

Source: EPA
CCS from Waste-to-Energy can be profitable

- Low CO₂-footprint profitable in the long run
  - climate criteria in public tenders of energy recovery & consumer awareness
- Negative CO₂/Bio-CCS.
  - A brand new product for the WtE-business
- Combined landfill/WtE with CCS.
  - Landfill mining, and the use of CCS and steam to produce Hydrogen from landfill gas.
- Utilizing a CCS-infrastructure to build “Hydrogen mobility”
- Growing green jobs based on technological solutions
Reduced climate emissions throughout the value chain

1. Reduced landfilling of waste prevents methane emissions
2. Recycled waste saves CO$_2$ by replacing new raw materials
3. Energy recovery of residual waste replaces fossil heat sources
4. CO$_2$ can be captured post combustion
5. Carbon criteria in tenders will stimulate the market for both MRF and WtE with CCS
6. Bio CCS; climate positive!
Conclusion

• Carbon capture is possible and necessary!

• Great potential in the waste sector

• Carbon capture from waste incineration fits well in a circular economy

• Creates new industry, new jobs and utilizes national resources in a new way.
Join the change!

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