Can the Nordic countries live up to the Paris Agreement?

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Negative CO₂

Project Shift

Flex4RES
Our atmosphere is like a bathtub filling up with CO₂. We need to stop the tap and start draining the tub.
The Nordic Carbon Budget from 2018

- Emissions 2018-2050
- 1.5°C
- < 2.0°C

~2-10 years with same emissions as today
why negative $CO_2$?

- To buy time
Critical Points

- Enough Sustainable Biomass?
- Sector Coupling and Integration
- Carbon Capture and Storage
- Greening Transport
- Disruptive Technology Development
Capture

Chemical Looping Combustion

Air → N₂ + O₂

Coal + Biomass → CO₂ + H₂O

Transport

Storage
How much CO₂ should we store?
Yearly CO₂ stored from 2040

Power sector

Industry

10-18 Mt/yr

1-3.5 Mt/yr

10-20 Mt/yr
Existing + planned lines

- Orange: 75 GW
- Red: 35 GW

New lines decided by model
Power trade with other countries

Today

5 TWh

20 TWh

2040

150 TWh
National and international aviation + shipping

- Bio-kerosine: 100 PJ in 2010, 200 PJ in 2030, 300 PJ in 2050
- Kerosine: 200 PJ in 2010, 2030, 2050
- Bio-diesel: >150 PJ in 2010, 2030, 2050
- Heavy fuel oil: 2010, 2030, 2050
<table>
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<tr>
<th>Scenarios</th>
<th>Demand proj.</th>
<th>Fuel prices</th>
<th>CO₂ tax</th>
<th>Carbon budget</th>
<th>No biomass and biofuel import</th>
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<tbody>
<tr>
<td>Nordic NETP</td>
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Result homepage – timesnordic.tokni.om
Research needs

- Electrofuels - H₂, Ammonia, ...
- Smart fuel factories
- What is sustainable biomass?
- Smart policies
We need to push technology development
Abraham Lincoln

"Best way to predict the future is to create it."

- Yes, but we need to speed up!

Check results: https://timesnordic.tokni.com

Projects: www.nordicenergy.org/projects/

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