Energy Competence Centre

Energy Delta Convention Groningen 2008

System Integration : Track V
Hans Revier: Energy & Environment

Wim van Gemert: Wind & Gas

5A Knowledge & Environment

ecc

Hans Appel: SenErgy

5B Technology & Efficiency

Jan Peter Nap: Energy Farming

Jan de Wit: Bottom-up

Dave Pinchbeck: R&D network
Flexibility needs for the electricity supply

Contribution from gas infrastructure

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Wouter Swart Ranshuysen MSc, Philip Lely MSc (Hanze University of Applied Sciences Groningen)
Content

- Energy consumption in the Netherlands
- Wind energy contribution in the Netherlands
- Need for flexibility for the electricity supply
  - Centralised solutions
  - Distributed solution
- Summary
- Concluding remarks
Energy consumption in the Netherlands; source: eu
Wind energy contribution in the Netherlands; source: eu

- 2006 wind 2,6%
- 2020 wind ca 5 % (6000 MW in North Sea)
- 2030 wind ca 6 %
Example of the need for flexibility

• Windfarm IJmuiden 3-4 April 2006: 246 MWh/h
• All offshore windfarms in the Netherlands 2020: 6000 MWh/h

> Leveling is key
Possible solutions

Centralised

- Interconnecting wind farms (Greenpeace)
- Centralised storage (Lievense)

Distributed generation and storage

- $\mu$-chp + thermal storage
Centralised (Greenpeace) Interconnecting wind farms at the North Sea

A proposal from Greenpeace and 3E in the report:

“a north sea electricity grid [r]evolution”

September 2008
To connect all offshore windfarms of the Netherlands with all offshore farms in the North sea:

- About 6200 km grid line needed; costs 15 – 20 Billion Euro
- Investment for the Netherlands ca 2.5 Billion Euro
Advantages of interconnecting windfarms (Greenpeace)

- in the past by the need of interconnectors for security of supply and long-term trade,
- today by the demand for trade and the subsequent requirement for commercial interconnectors
- in the future by the need for grid connection of multi-gigawatt wind farm clusters far from shore
Centralised (Lievense)

Pumped hydro accumulation (PAS)

- 1500 MW of power supply average during at least 12 hours (2 million households)
- Investment euro 2.65 billion (quoted)
Centralised (Lievense)

Pumped hydro accumulation (PAS)
Distributed generation and storage

μ-CHP market development in the Netherlands
(source GasTerra 2008)

- 2020: 1.3 million μ-CHP’s
- 2030: 4 million μ-CHP’s
μ-CHP’s

Needed $E_{th}$ hot tap water / day: 11 kWh$_{th}$

Characteristics μ-CHP’s:
- Ratio Heat/Power = 2.5/1
- Storage capacity 0.20 m$^3$

Per day:
- Heat 11 kWh$_{th}$
- Power 4.5 kWh$_{el}$

2020: 1.3 million μ-CHP’s
Distributed generation and storage

![Graph showing distributed generation and storage](image)

- **Onshore μ CHP 2020**
- **Offshore all windfarms 2020 (NL)**
Comparison
Interconnecting windfarms; central storage; $\mu$-CHP

![Graph showing energy output comparison over 48 hours]

Legend:
- Light blue: Onshore Lievense
- Pink: Onshore $\mu$ CHP 2020
- Black: Onshore all windfarms interconnected 2020
- Dotted black: Offshore all windfarms 2020 (NL)
Interconnecting windfarms combined with central storage (Lievense) or μ-CHP 2020

Interconnected offshore windfarms + μ-CHP a perfect match!
Storage capacity Lievense too much!
### Occupation degree

**Lievense / \( \mu \text{-CHP} \)**

<table>
<thead>
<tr>
<th></th>
<th>Lievense</th>
<th>( \mu \text{-CHP} )</th>
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</thead>
<tbody>
<tr>
<td><strong>storage</strong></td>
<td>20 GWh(_{el})</td>
<td>5,6 GWh(_{el})</td>
</tr>
<tr>
<td><strong>Occupation degree</strong></td>
<td>57%</td>
<td>100%</td>
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## Conclusions

<table>
<thead>
<tr>
<th>Connecting windfarms (Greenpeace)</th>
<th>Central storage (Lievense)</th>
<th>μ-CHP</th>
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<tbody>
<tr>
<td><strong>Investment</strong> 2,5 Billion €</td>
<td><strong>Investment</strong> 2,65 Billion €</td>
<td><strong>Investment</strong> None</td>
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Concluding remarks

- Comparison qualitative
- μ-CHP competitive for flexibility
- Interconnected offshore windfarms + μ-CHP a perfect match
- Strategic for natural gas facilitating sustainability
- Extra investment in heat storage?
- Electricity storage?
- Increasing electric mobility?

Suggestion 1: work out strategy case of natural gas adding flexibility to the electricity supply

Suggestion 2: to define R&D and innovation to make the case a reality