The CES Risk Assessment Framework for distribution companies

Climate risk assessment in distribution companies in Denmark

Edward James-Smith
Ea Energy Analyses
Objectives

• VTT developed risk assessment framework for hydro power generators

• Ea Energy Analyses role to adapt the framework for use by grid companies
Methodology

• Qualitative methodology
• Case studies
  – Two Danish grid companies
  – Interview with Danish Energy Association
• Multi criteria analysis
  – Well suited to initial identification of consequences of risk elements
  – Identifies most important risk elements for further analysis
Multi criteria analysis

• Based on two elements
  i. Priority criteria for assessment
  ii. A character scale given to each risk factors influence on the priority criteria
Priority criteria for distribution companies

Influence climate change will have on:

- Infrastructure/security of supply
- Distributed generation
- Demand
- Income
## Character scale

- -10 for very negative influence
- 0 for no influence
- 10 for very positive influence

<table>
<thead>
<tr>
<th>Probability</th>
<th>Consequences</th>
<th>Adaptation</th>
<th>Risk estimation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Infrastructure</td>
<td>Security of supply</td>
<td>Demand</td>
</tr>
</tbody>
</table>

1. **Temperature**

1. Increased winter temperatures, milder, warmer winters

1. Increased summer temperatures
Inclusion of climate element - seasonal clock
Risk opportunity evaluation
Case studies

NOE Net

SEAS-NVE
Findings of case studies

- Distribution companies generally well equipped for climate change
  - Cabling of all overhead lines well under way
  - Distribution boxes in areas with increased risk of flooding are elevated already
  - Salt spray further inland is becoming an increasing problem for substations and transformers
# Cabling in Denmark

<table>
<thead>
<tr>
<th></th>
<th>Kabler i km</th>
<th>Luftledninger i km</th>
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</thead>
<tbody>
<tr>
<td><strong>400-132 kV</strong></td>
<td></td>
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</tr>
<tr>
<td>Hele landet</td>
<td>1 022</td>
<td>1 035</td>
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<tr>
<td>heraf søkabler</td>
<td>216</td>
<td>213</td>
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<tr>
<td><strong>60-30 kV</strong></td>
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<td></td>
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<tr>
<td>Hele landet</td>
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<tr>
<td>heraf søkabler</td>
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<tr>
<td><strong>20-6 kV</strong></td>
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</tr>
<tr>
<td>Hele landet</td>
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<td>55 382</td>
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<tr>
<td>heraf søkabler</td>
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<td>181</td>
</tr>
<tr>
<td><strong>0,4 kV</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hele landet</td>
<td>85 114</td>
<td>87 415</td>
</tr>
<tr>
<td>heraf søkabler</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

|                      |      |      |      |      |      |      |
|                      | 142 665 | 146 723 | 151 558 | 27 519 | 24 821 | 22 261 |
| heraf søkabler       | 497   | 509   | 513   |      |      |      |

Ea Energianalyse
Infrastructure

• Greatest challenge is changing political targets for addressing climate change

• Increased levels of wind power
  – Grid companies must pay connection costs
  – Grid dimensioned according to wind production, 80% of demand in winter – increased storm strength could be a problem
  – Maintenance in Spring and Autumn – sensitive to increased wind and fluctuations in demand
Demand

- Increased efficiency - fewer kWh to distribute costs between
- Increased temperatures – lower demand
- Danish system not dimensioned for electric heating – increasing use of heat pumps could put pressure on 0.4 kV
- Political goals for electric cars will put great pressure on 0.4 kV grid in some areas
- Increased summer demand – better income
CES Risk Framework

- Distribution companies are not climate aware as hydro companies are – do not have own climate scenarios
- They are load aware – climate changes must be included in framework
- Conservative organisations – only the large distribution companies develop ”strategies” – small ones implement practical necessities – keep it as simple as possible
- Everyone loves the seasonal clock!
Seasonal clock – SEAS-NVE

- Wind power responsible for 75 – 80 % of load
  - Increased strength of storms means risk of greater fluctuations in wind power production – could require new investments in infrastructure
  - Warmer winters = lower demand = lower income
  - Stronger storms = higher tidal flooding which can flood transformers

- Maintenance undertaken in spring – sensitive to large fluctuations in production and demand

- Maintenance undertaken in autumn – sensitive to increased production and demand in this period

- Wind power responsible for 25 – 50 % of load
  - Warmer summers = high demand = greater income
  - Increased rainfall in 24 hour periods can threaten distribution cabinets locally
  - Increased temperatures over longer periods of time may reduce life span of transformers

- Warmer winters = lower demand = lower income
- Stronger storms = higher tidal flooding which can flood transformers