Reshaping the energy system through Electrification, Decentralization & Digitalization

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The way forward – 70 % by 2030

Over the next ten years, Denmark must reduce carbon emissions by almost the same amount as in the past 30 years.

Full report, sources and more info at: www.climatepartnership.dk
Estimated reductions across sectors

<table>
<thead>
<tr>
<th>Contribution of own sector</th>
<th>Energy and utilities</th>
<th>12.9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contribution of other sectors</td>
<td>Transport</td>
<td>6.2</td>
</tr>
<tr>
<td></td>
<td>Industry</td>
<td>2.6</td>
</tr>
<tr>
<td></td>
<td>Buildings</td>
<td>0.3</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>22</td>
</tr>
</tbody>
</table>

All circled initiatives require renewable energy (electricity)

Full report, sources and more info at: www.climatepartnership.dk
70% by 2030 – electrification plays an important role

Estimated increase in power demand towards 2030 (TWh)

- Power demand in 2019: 35 TWh
- Power-to-X: 10 TWh
- Data centres: 7 TWh
- Heat pumps: 9 TWh
- Electric vehicles, buses and trucks: 4 TWh
- Electrification of rail transport: 1 TWh
- Electrification of North Sea production: 2 TWh
- Other: 3 TWh
- Total: 71 TWh

Full report, sources and more info at: [www.climatepartnership.dk](http://www.climatepartnership.dk)
A successful transformation with new skills and instruments

From ambitious goals to more RES and more electricity

New technologies, new skills and new ways of thinking about the energy business needed

- Digitalization of grid planning and operations
- Ability to forecast long term and near real term
- Activation of Flexibility through redesign of tariffs and markets for flexibility
- More specific and complicated contact with customers
- Platforms instead of separated “pipes and tubes”
Energy companies surrounded by new trends they need to handle

- Increased climate goals & Electrification
- Decentralisation
- Digitalization
- Customer activation
- New mindset
- New regulation framework

Microtrends

Macrotrends
What will the future bring?

Average outage minutes

Outage due to:

- Generation adequacy
- Robustness
- Grid – Transmission
- Grid - distribution

Source: Energinet (2020) – Danish TSO

- However this scenario does not take into account the political agreement to reduce emissions with 70% by 2030 compared to 1990.
Maintaining a high level of security of supply towards 2030 requires further initiatives:

- Increased build-out of renewables
- Development of interconnections
- Utilization of battery or storage capacity
- Less peak load and more demand-side response
- Correct price signals
- Optimal investments in Grid

Catalyzed by digitalization.
Figure 24. **Examples of smart measures in the power grid**

- Updated pricing
- Flexibility in households
- Flexibility via sector coupling
- Release of supply data
- Local flexibility markets
- Innovation
- Geographical signals
- Peak-shaving
- Market agreements on automatic disconnection of consumption

Source: Danish Energy and Energinet.
Figure 25. **Maximum 24-hour load on the power grid in inflexible and flexible consumption scenarios**

Power consumption (kW) in the low-voltage grid (0.4 kV), hours a day

**Inflexible**
- Power grid capacity

**Flexible**
- Power grid capacity

Source: Danish Energy.
New pricing philosophy – pricing toolbox for DSOs

Forwarded to regulator October 2020 for approval

- Time differentiated tariffs
  - Time differentiated tariffs 2.0
  - Time differentiated tariffs 3.0
- Interruptible tariffs and connection products
- Geographically defined tariffs

+ 10-year grid development plans every second year (focus on the role of flexibility)

+ Tariffs for suppliers of electricity
New electricity act in Danish Parliament - with effect from new Year (20/21)

Tariffs seen as an important instrument to activate Flexibility

Non-market based instruments can be utilized if there is no market for flexibility or if delimited local bottlenecks are addressed

Market based instruments should be pursued. Method to be developed by the DSOs
European perspective

<table>
<thead>
<tr>
<th>Domestic Customers</th>
<th>• Increasingly “Time of Use” tariffs being implemented</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non Domestic customers</td>
<td>• Wider range of tariffs and more capacity components along with charges for reactive power.</td>
</tr>
<tr>
<td>Geographic differentiation + interruption</td>
<td>• Several countries are using geographical differentiation of the tariffs plus Interruptible tariffs</td>
</tr>
</tbody>
</table>

Domestic grid tariffs

- >80% fixed / capacity
- 50-80% fixed / capacity
- 30-50% fixed / capacity
- <30% fixed / capacity
- Geographic variance
Geographically defined tariffs to reward local simultaneity between local feed in of electricity and local load

RES feed in

Same part of local distribution grid

District heating company

Rest of distribution grid
Figure 22. Investments in power grid infrastructure towards 2030

DKK billion (2019 prices)

Maintaining the existing power demand
- Transmission (already decided)
- Distribution

Build-out to support the 70% target with smart solutions
- Transmission
- Distribution

Fulfilment of the 70% target with smart solutions
- Transmission
- Distribution

Fulfilment of the 70% target without smart solutions
- Transmission
- Distribution

Investment range. The DKK 79 billion is conditional upon customers being willing to shift some of their power consumption to less-congested times of the day if they are rewarded for doing so.

Note: Investments in transmission already decided are budget figures at the beginning of 2020 and mainly comprise functionality upgrades and costs for a new interconnection to the UK. Other investments in maintaining the existing demand for power are reinvestments in the period 2019-2030. Transmission figures for investments not yet decided represent the mean of large intervals and are exclusive of investments in additional interconnections, a potential energy island and cabling to shore. For the transmission grid, the illustrated effect of a non-smart transformation is an example. Calculations for the distribution grid are exclusive of investments to support the 3 TWh increase in consumption in 2019-2030 from agriculture and the private service sector (~5% of total consumption from the distribution grid in 2030).

Source: Calculations made by Danish Energy and Energinet based on the RUS Plan 2018.
The revenue cap is based on historic costs— that is, the regulations is backward looking. However, we need to look forward. Electrification is an important factor in the green transition and requires increasing investments in the grid. This can be problematic with the regulation we have today.

Same situation in other EU countries
What about the DSOs in Europe?  
- more about this soon

New study from Eurelectric

Public next year

Power Distribution Grid: Critical enabler of the European Green Deal
Final Deliverable