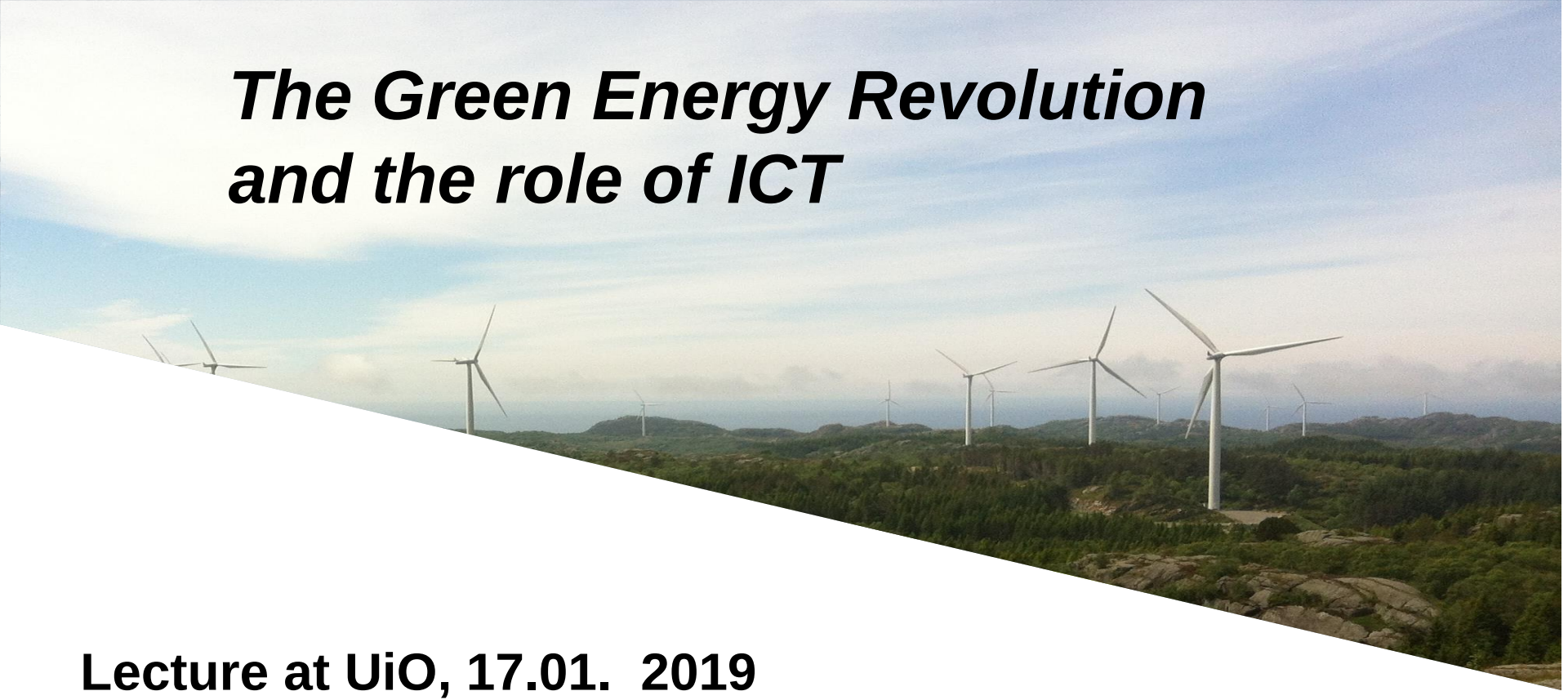
The Green Energy Revolution and the role of ICT



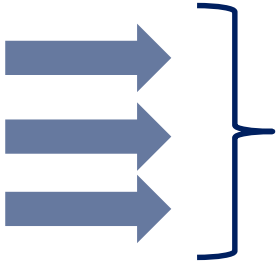
Lecture at UiO, 17.01. 2019

Jan Bråten, Special advisor

Statnett

Overview

- **Sustainability**
- Digitalisation
- Economic growth



Electrification

- **Sustainability ➔ Wind and Solar ➔ <u>Need for flexibility</u>**
  - ✓ Norway is in a special situation due to large hydro reservoirs

➔Smarter and more complex power and energy systems

➔Better markets requires <u>many</u> new ICT-solutions

- And a lot of other ICT-solutions for every operation - like any other industry
- **Cyber security important**

Sustainability ➔ Electrification

- **Fossil fuel ~ 80 % of world energy consumption**
  - And demand for energy services increases
- **Fossil fuel must to be replaced** - Climate and local environment
- **Sustainable biofuel can (probably) only cover a small share of the demand. What is the alternative?**

➔ **Energy efficiency + zero emission electricity**
  - The world need to ramp up energy efficiency improvements towards 3%/y
  - **Renewable electricity** + nuclear power where it is accepted
  - Also: Solar heating, geothermal, sustainable bio energy

The green energy revolution

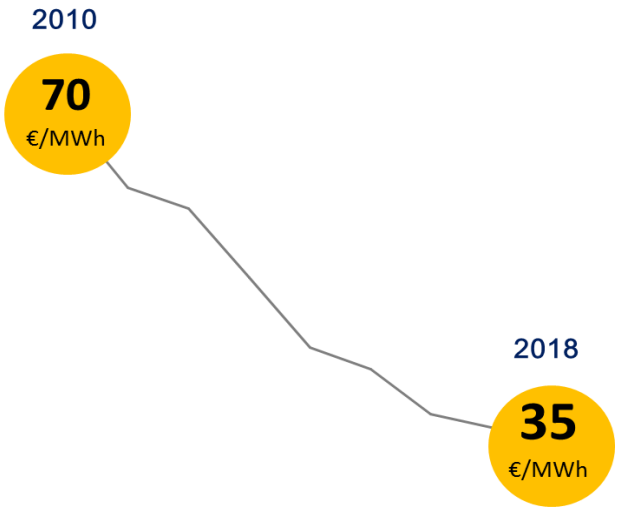
The green energy revolution

The technology optimists were wrong…

They were far too pessimistic!

Cost reductions	
Solar panels1970 - now	**> 99 %**
Utility scale PV 2008 - 2015	**64 %**
Onshore wind power 1980 - 2015	**96 %**
… 2008 - 2015	**41 %**
Batteries (EVs) 2008 – 2015	**73 %**
Fuel cells (H_2) 2008 - 2015	**95 %**
LED 2008 - 2015	**94 %**

Wind power is now increasingly competitive without subsidies in Norway



Source: Norwea/Statnett

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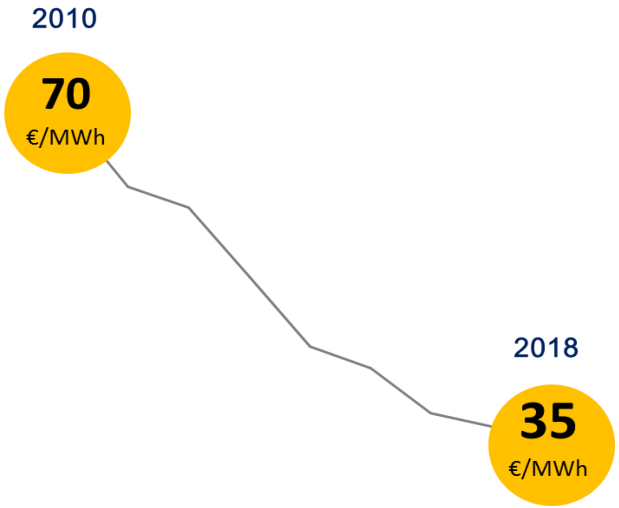

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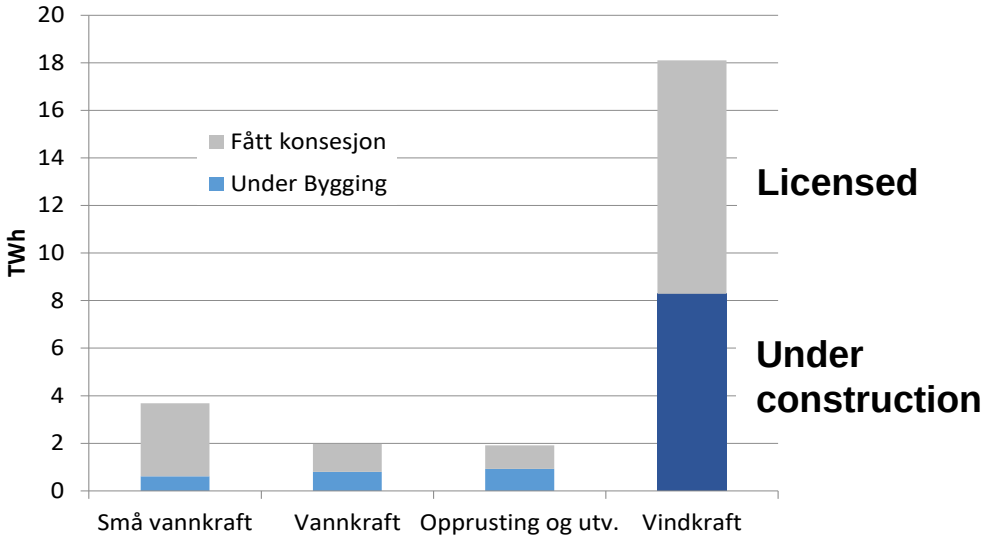

Source: NVE November 2018

The balancing challenge for wind power and solar electricity

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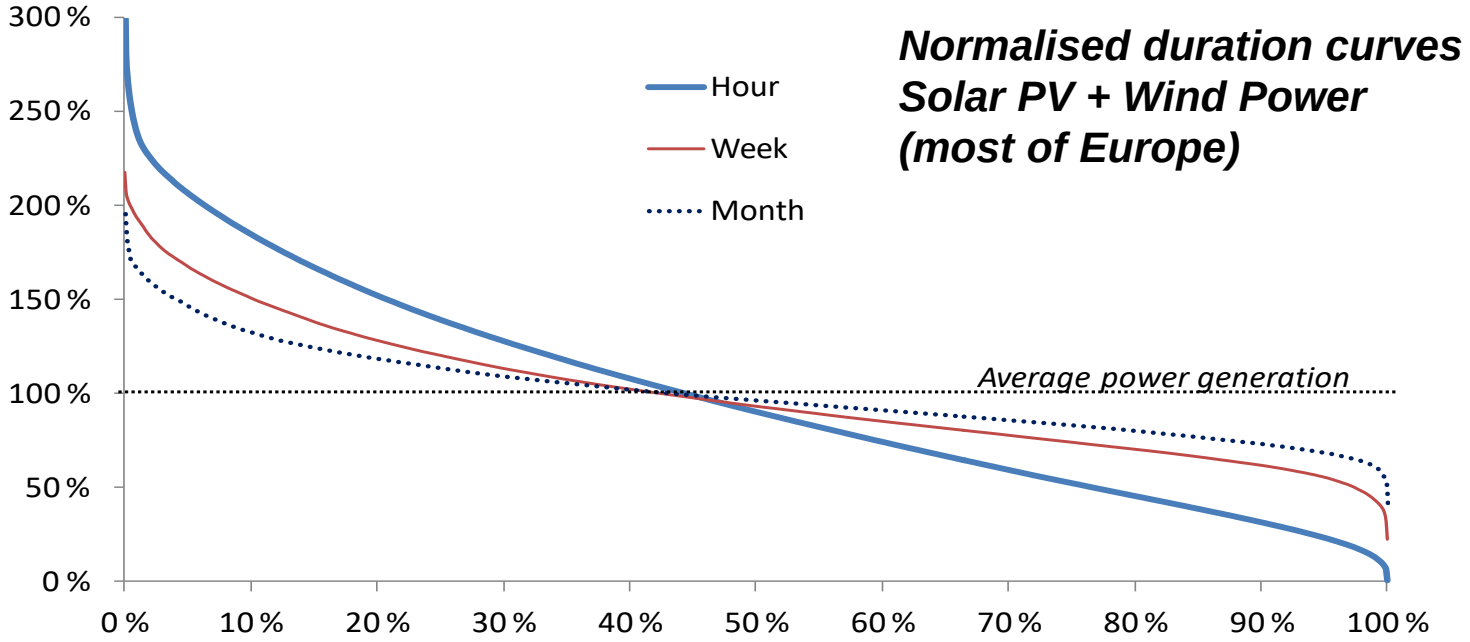

Normalised duration curves Solar PV + Wind Power (most of Europe)

More transmission capacity is important, but not enough in the longer term

Source: Statnett and Kjeller Vindteknikk.

Two challenges: Replace fossil fuel and balance the power system

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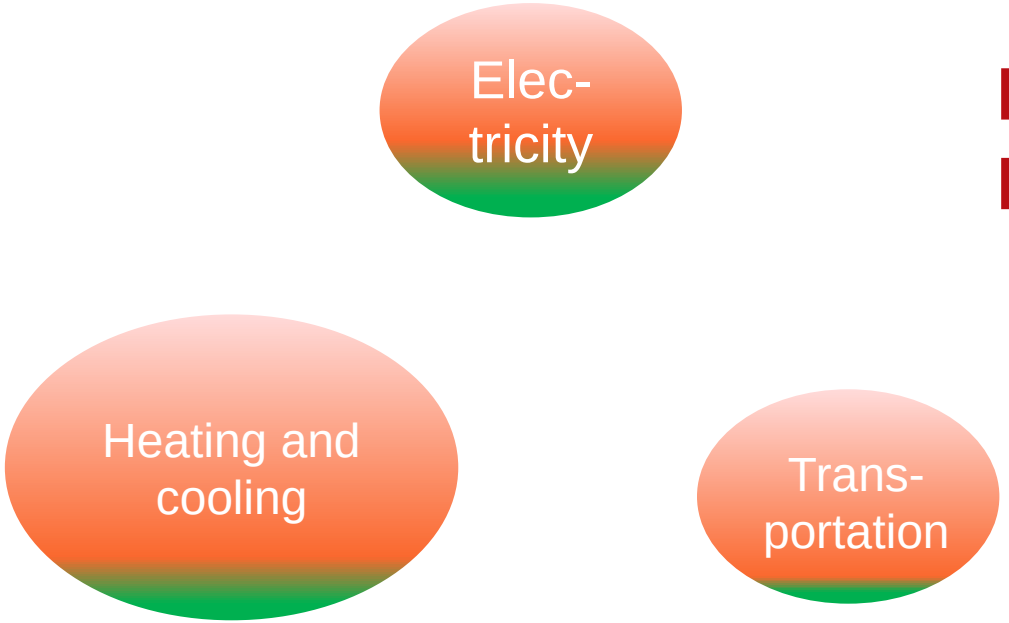

**EU: 20%
RES by 2020**

Example: Solar panels covers approx 8% of German power consumption ~ 2% of total energy

Electrification of heat and transport gives Decarbonisation + Flexibility

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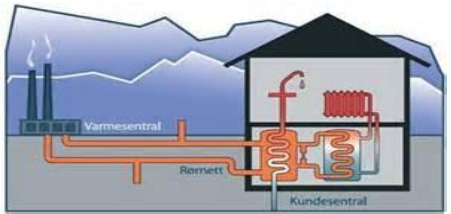
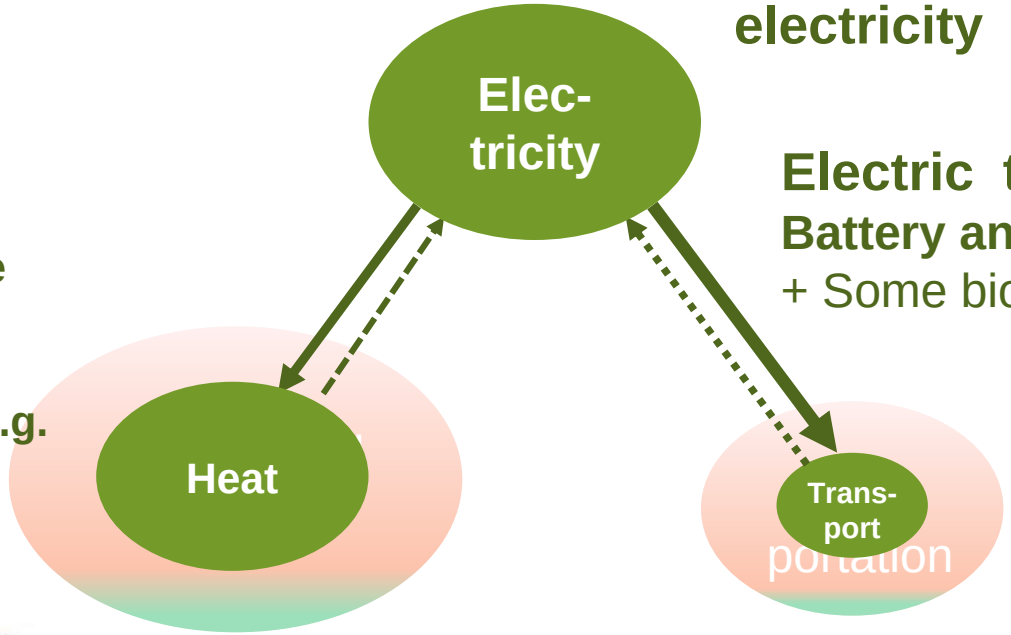
More zero emission electricity

Energy efficiency

Solar heating
Geothermal
Bio fuel and waste (partly incl. CHP)
Heat pumps
Electric heating (e.g. boilers)

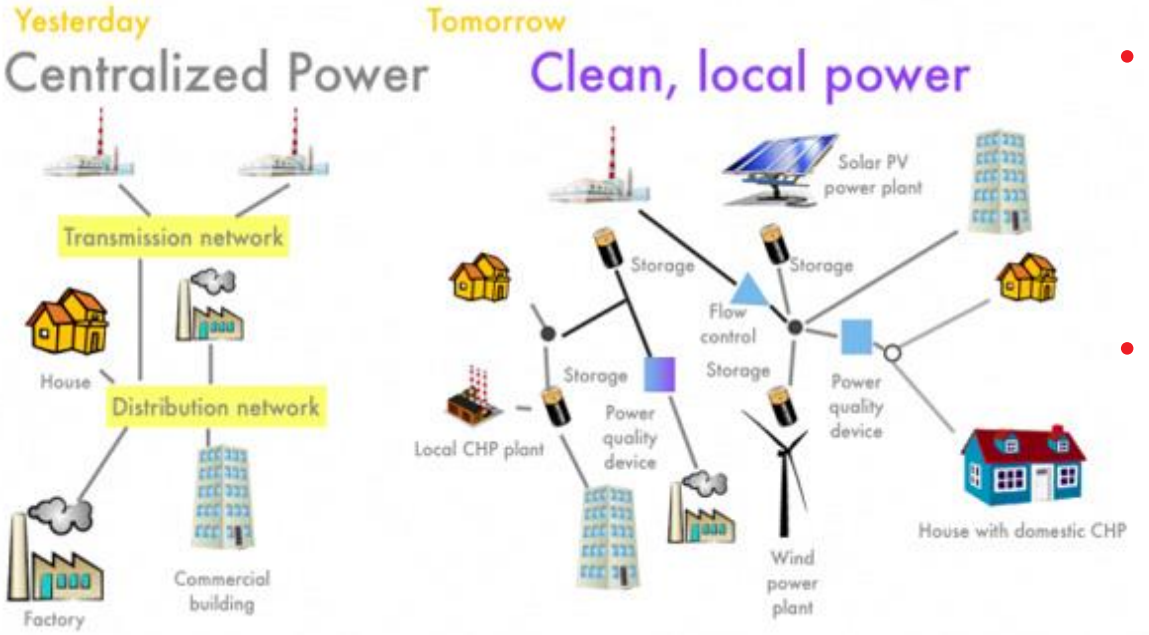
Heat storage





Electric transportation
Battery and hydrogen
+ Some bio fuel

The future power system is Connected, Complex and Computerized



- **Yesterday**: Central and relatively flexible fossil power production (national). Consumption varies, power production adapts
- **Tomorrow**: Cross border trade, many variable renewable power generators, storage, new sectors (electrification), active consumers, markets

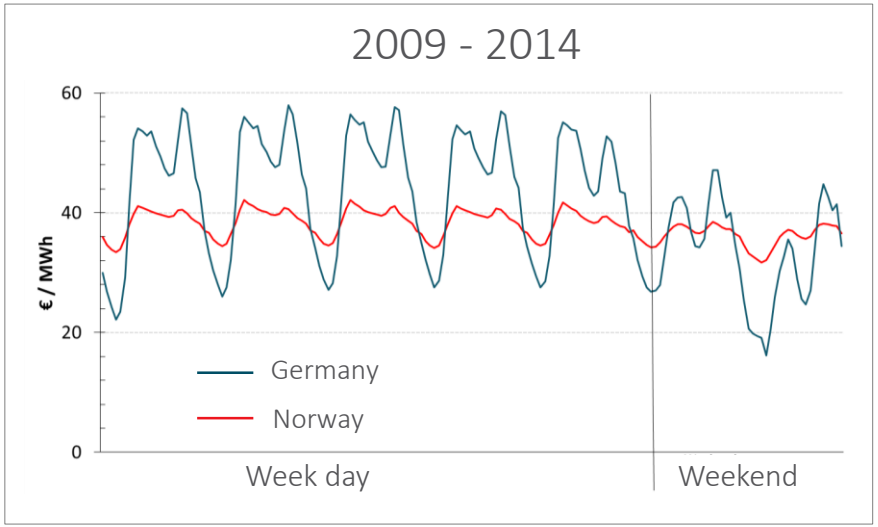
Norway is different

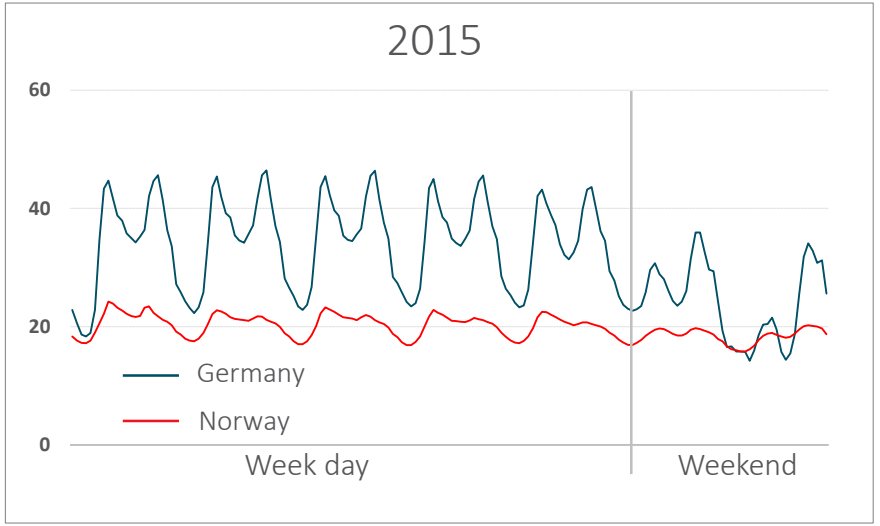
- **Almost 100 % renewable power, mostly hydro**
  - High potential for more hydro- and wind power
- **Reservoirs with capacity 85 TWh**
  - Annual electricity consumption ca. 130 TWh
- +/- 25% variation in annual inflow – balanced by reservoirs and trade
  - Seasonal patterns and short term variations

Blåsjø
7,8 TWh

The value of trade

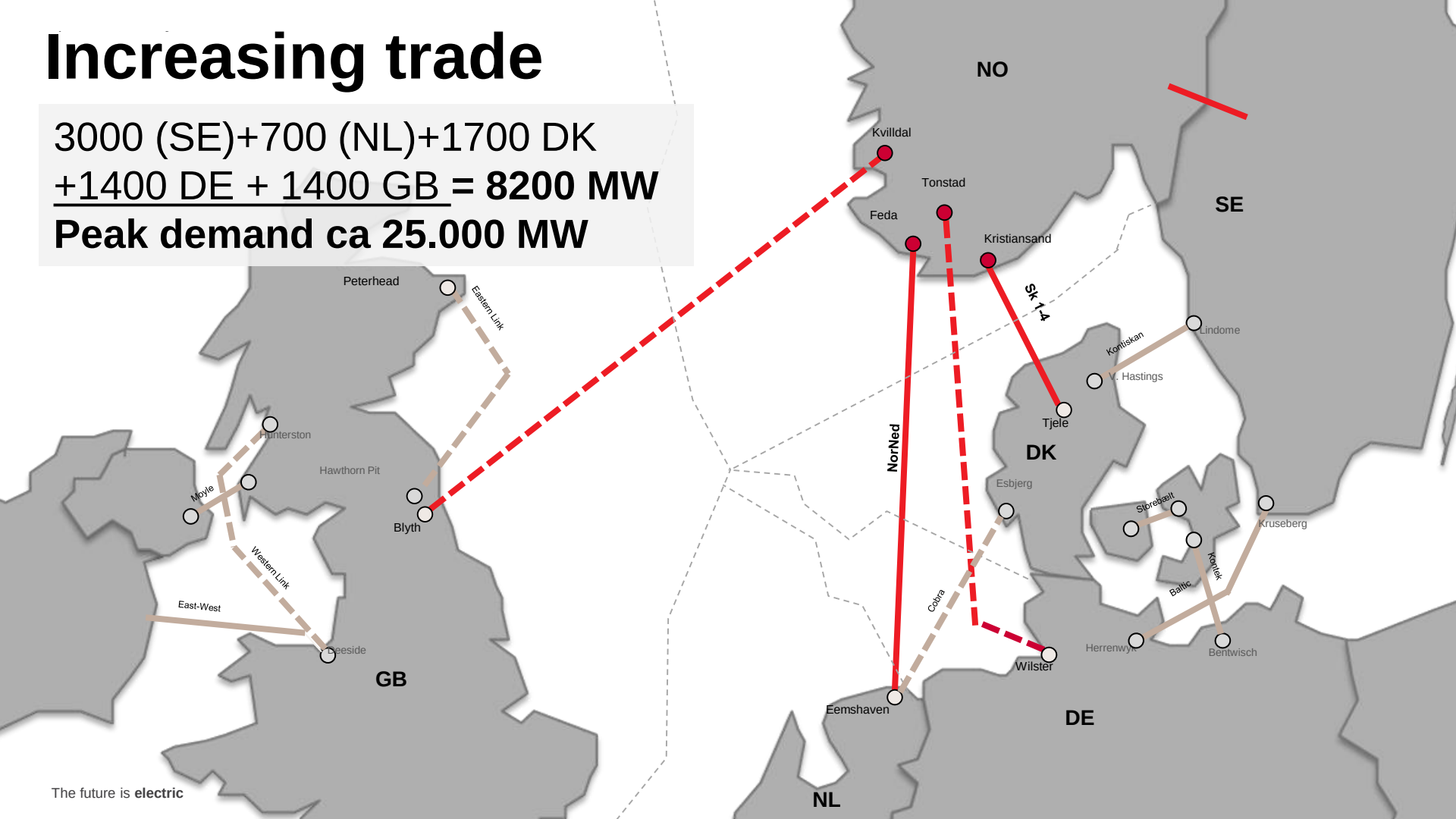
Spot prices in Germany and Southern Norway – average week





Increasing trade

3000 (SE)+700 (NL)+1700 DK
+1400 DE + 1400 GB **= 8200 MW**
Peak demand ca 25.000 MW

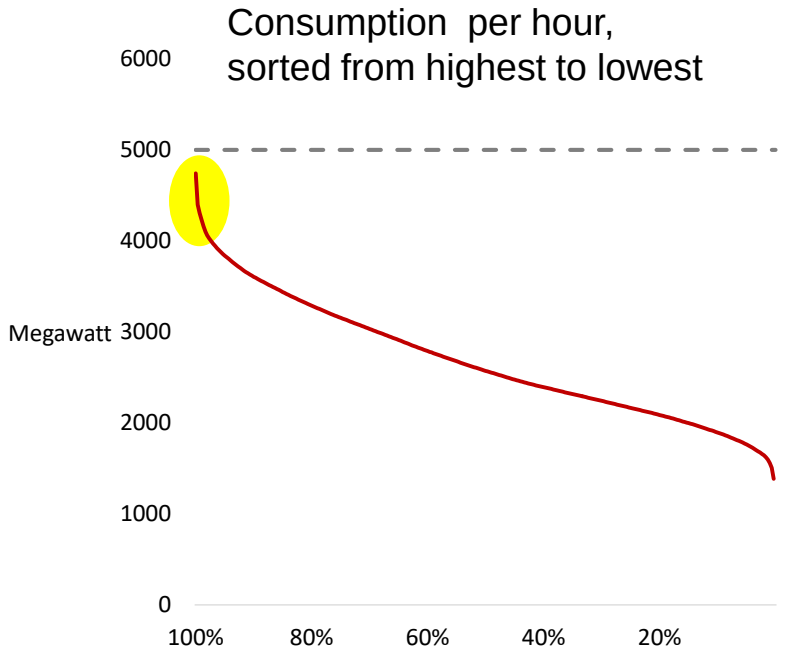


The critical power balance

- 50 Hz – only minor deviations allowed. *Nordic*
  - *Inertia and virtual inertia*
- Voltage kept within acceptable limits. *Local*
- More challenging to maintain the balance with faster and bigger changes is wind, solar, trade on interconnectors and in consumption
- ➔ **Better markets with the help of digitalization**

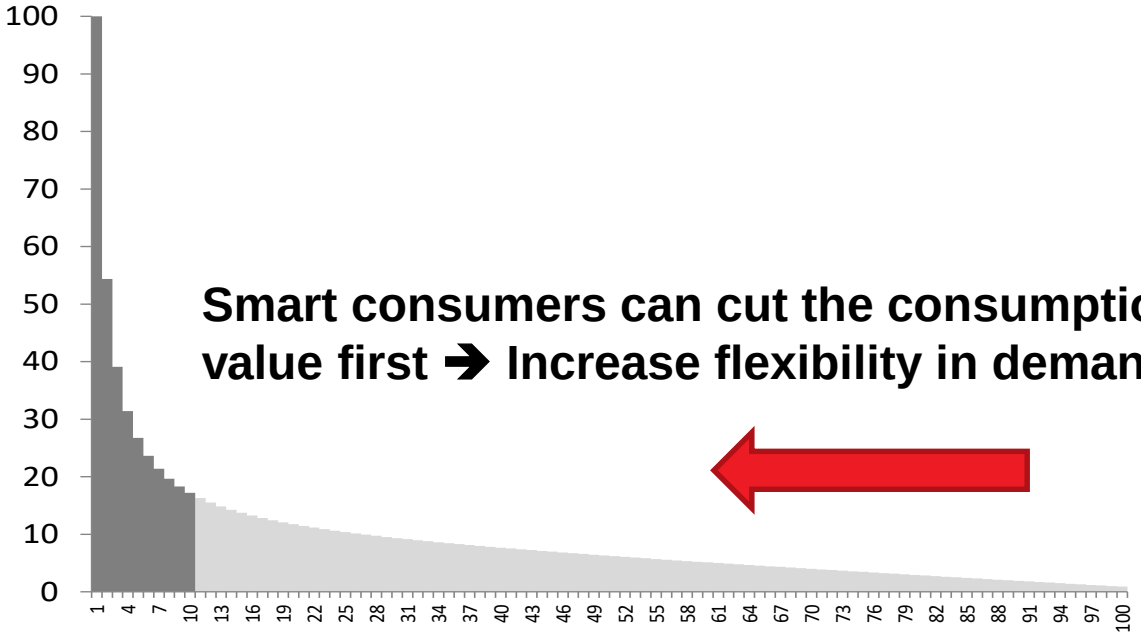
The digitalization of energy

- Smarter system
  - Markets are digital and we need to develop them
  - Response from consumers – reduce grid investments ➔
  - Operation of power production
  - Operation of storage
  - Communication



The digitalization of energy

- **Smarter <u>system</u>**
  - One example: A case with shortage of power or a very high price



Smart consumers can cut the consumption with lowest value first ➔ Increase flexibility in demand

The digitalization of energy

- **Cyber security is crucial**

- **Digitalizing everything**
  - Automation
  - Surveillance
  - Optimal construction
  - Maintenance
  - System planning

Welcome to a future that needs your talent

KUBE – Sommerprosjekt
i Statnett

https://statnett.easycruit.com/vacancy/2211367/58443

Lyst til å bruke sommeren på et morsomt og meningsfullt prosjekt?

Sommerprosjektet KUBE

Statnett forvalter kritisk infrastruktur, og sørger for at du har strøm. Forsøk å se for deg hvordan livet ditt hadde vært uten.

Feil i strømnettet kan føre til strømbrudd som er veldig kjedelig for deg og meg, og veldig dyrt for samfunnet. I årets KUBE-prosjekt, ønsker vi å utfordre seks studenter til å levere ny funksjonalitet til Statnetts løsning for automatisk analyse av feil i strømnettet; AutoDig. Teamet vil jobbe med utvikling, testing, interaksjonsdesign, dataanalyse og elkraftfaglig ingeniørarbeid. Dere vil arbeide tett opp mot det anerkjente DevOps-teamet som utvikler og drifter AutoDig. AutoDig håndterer data i sanntid fra vår data lake, og brukes i den operative styringen av kraftsystemet. Utstrakt sensorbruk og maskinlæring er viktig i løsningen. Tekniske ressurser vil bistå dere gjennom sommeren og gi nødvendig opplæring. Eksempler på språk og teknologier dere kan få bruk for er Python, Java, Angular JS, Git og SQL.

Hva kan vi tilby?

- Et ambisiøst og utfordrende sommerprosjekt
- Erfaring med å jobbe i et autonomt team med smidig utvikling/scrum
- Muligheten til å utvikle et viktig produkt for Statnett
- Tilgang på svært dyktige fagmiljøer innen energisektoren og IKT
- Presentasjon av sluttresultat for konsernledelsen og hele selskapet
- Sosiale arrangementer gjennom sommeren
- Konkurransedyktig lønn
- En uke fri midt i prosjektet, studenter fortjener også sommerferie!

Vi ser etter deg som liker å kode, blir motivert av utfordringer og ser etter løsninger. I tillegg er du nysgjerrig, initiativrik og en god lagspiller. Du har fullført minst 2 år av høyere utdannelse sommeren 2019, og tar utdanning innen datateknologi, kommunikasjonsteknologi, data science, informatikk, energi og miljø, kybernetikk, statistikk, matematikk, interaksjonsdesign eller industriell økonomi. Søkere med andre utdanningsretninger vil også bli vurdert.

Fylke:
Oslo

Jobbtype:
Engasjement

Heltid/Deltid:
Heltid

Arbeidstid:
Dag

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