ENERGY

Prosumers and distributed energy resources: New challenges for network tariffs

Energy Lab: Efficient and Sustainable Electricity Markets

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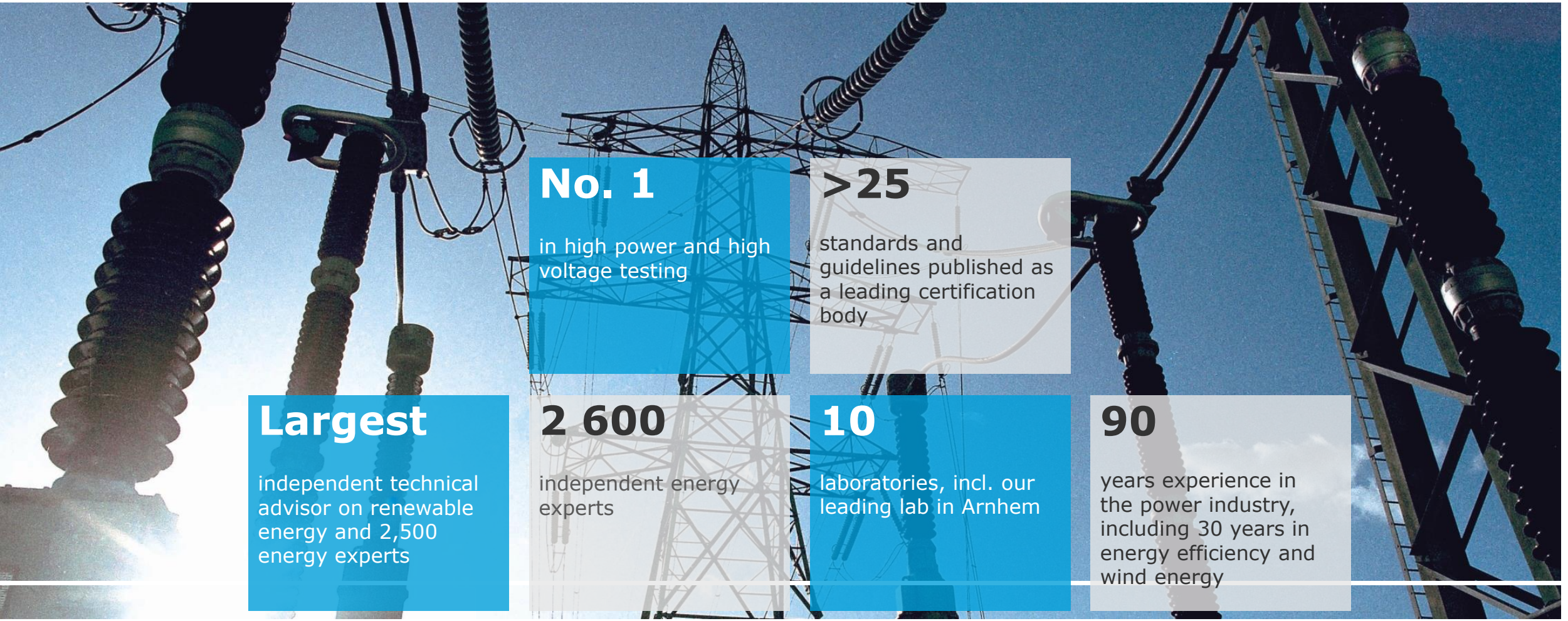
13 September 2017

A global classification, certification, technical assurance and advisory company

OUR PURPOSE

TO SAFEGUARD LIFE, PROPERTY AND THE ENVIRONMENT

An energy technology powerhouse



No. 1

in high power and high voltage testing

>25

standards and guidelines published as a leading certification body

Largest

independent technical advisor on renewable energy and 2,500 energy experts

2 600

independent energy experts

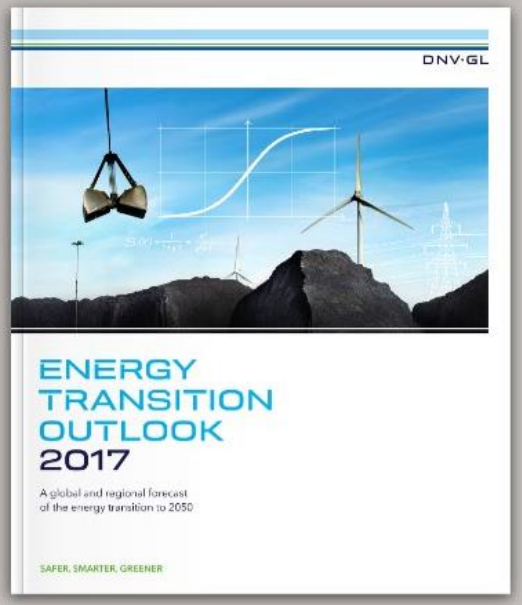
10

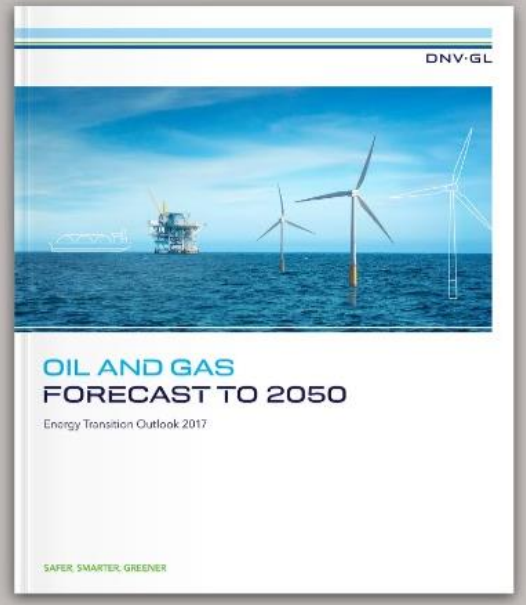
laboratories, incl. our leading lab in Arnhem

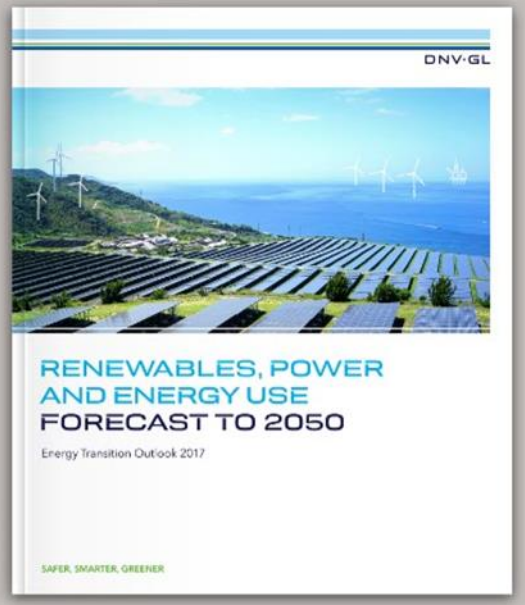
90

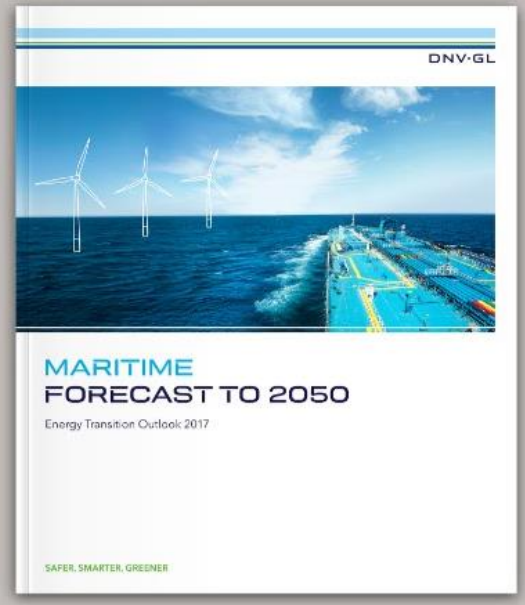
years experience in the power industry, including 30 years in energy efficiency and wind energy

DNV GL's Energy Transition Outlook 2017







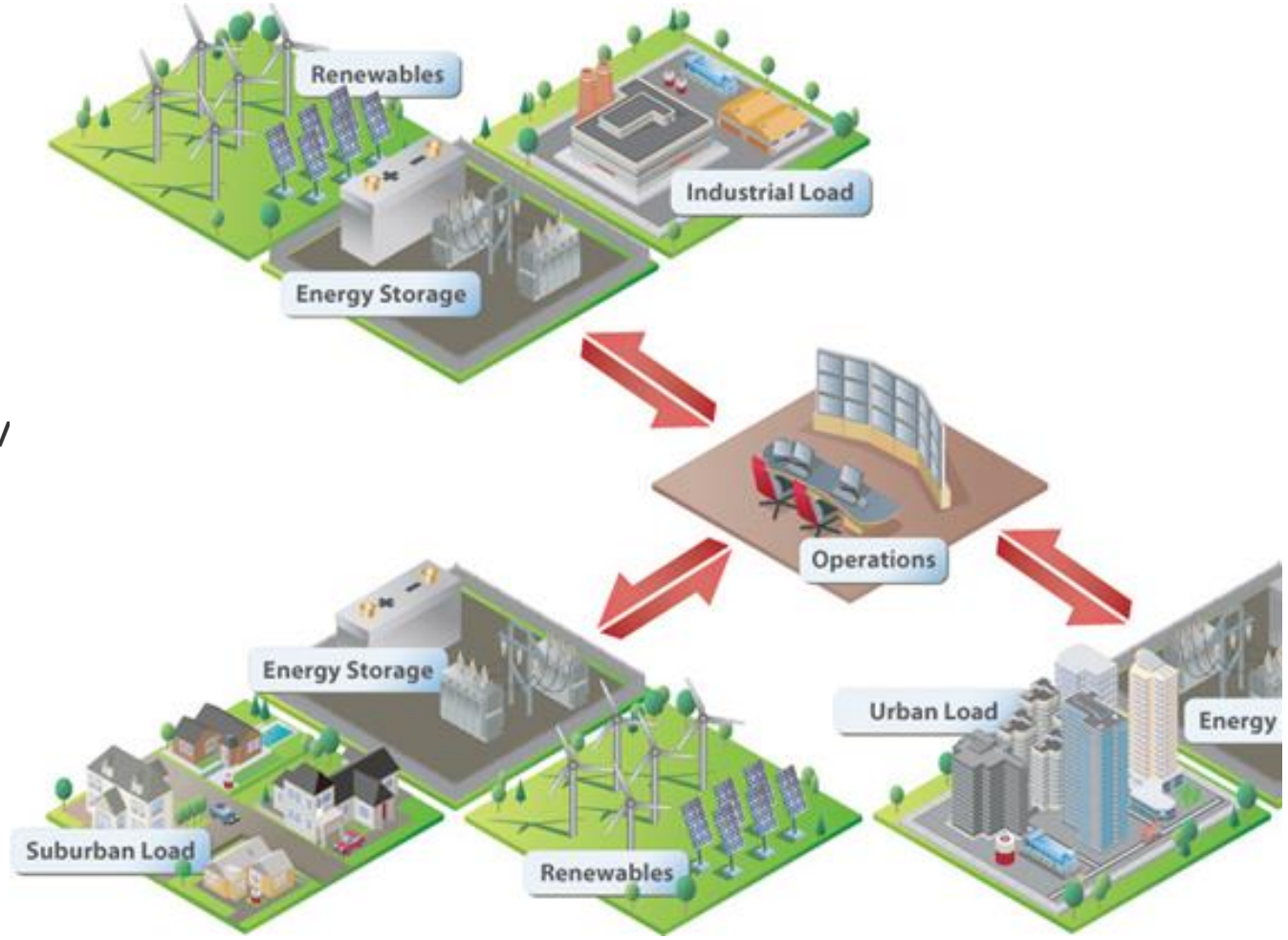


A cleaner, more electrified world is within our reach…

but we all need to act now to achieve this

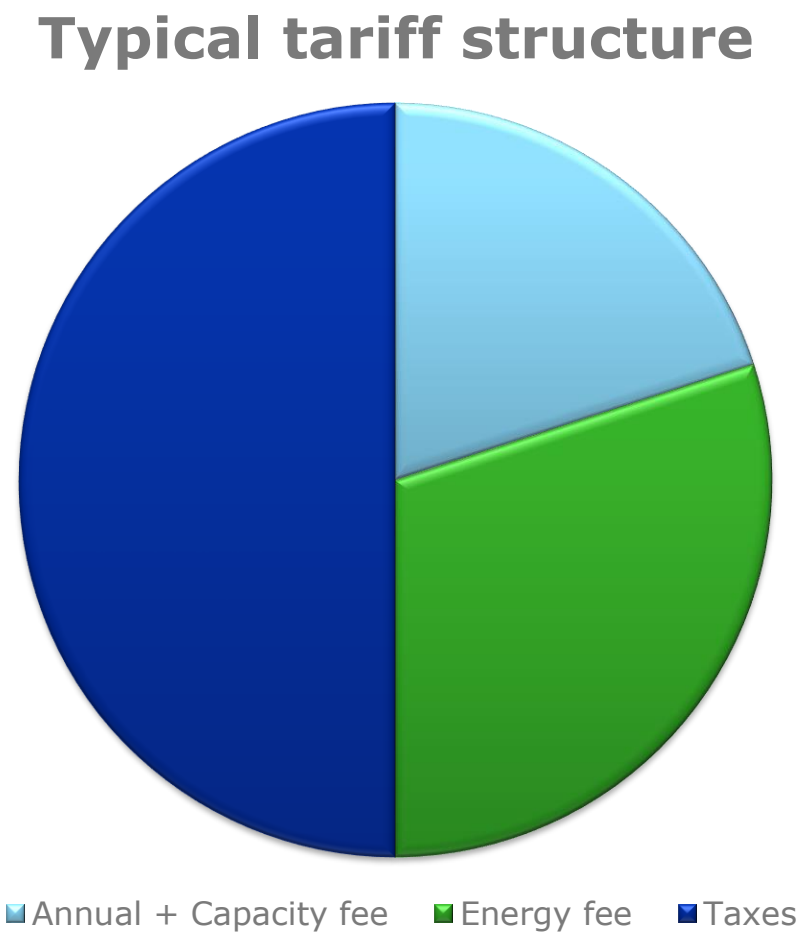
Changing properties and behavior: What is the impact for efficient pricing?

- Current tariffs for normal end users
- What are the new features of demand
- Cost structure for provision of network serv
- Tariff design: Lessons from theory
- Implications for actual tariff design



Building blocks of most network tariffs

- Annual fee – €/year
  - Equal to all customers, or equal for all similar customers but varying between categories of customers
- Capacity fee – €/kW [€/kWh/h]
  - Annual or monthly payment depending on actual or subscribed capacity per year or month
  - Equal (in €/year) for small customers
    - Decreasing rate (€/kW) for metered customers
- Energy fee – €/kWh
  - Payment depending on energy used (or supplied) per month/quarter/…
- Taxes – €/whatever
  - Per kWh is perhaps the most common format



Different network bills for similar network connections

NOK 5 000 per year

NOK 15 000 per year

Key features of typical future grid customers

- Reduced energy demand/use per task
- Increased capacity use per task
- Prosumers

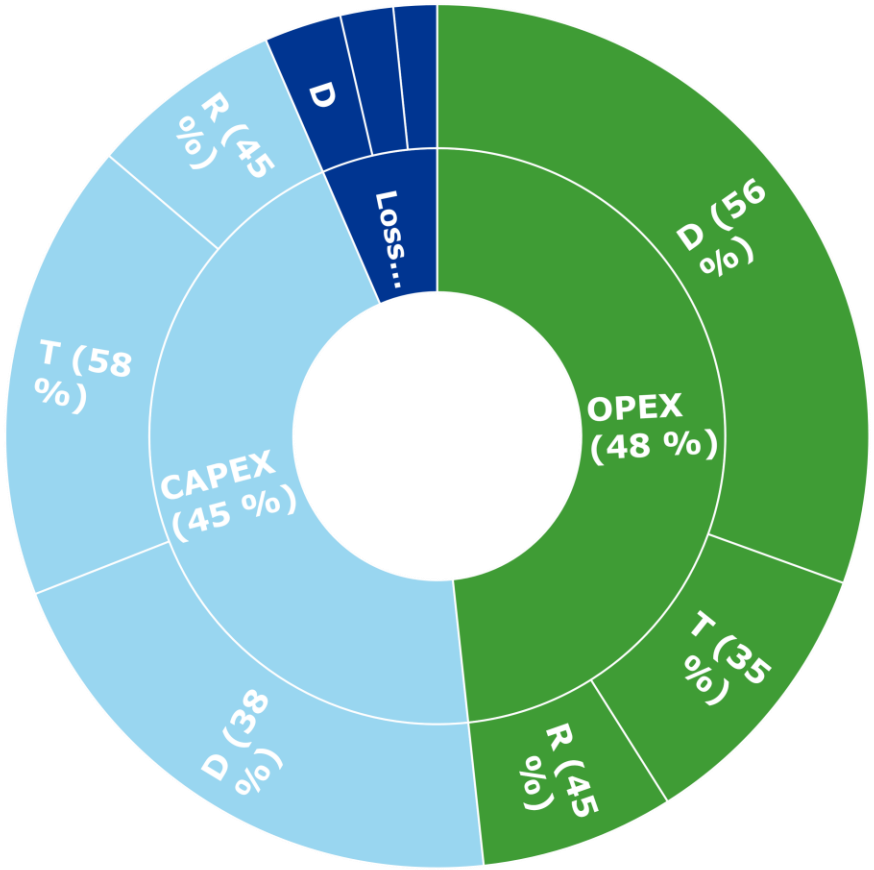
27 kW water heater –
for residential use

- Ability to manage electricity use
  - Automatically based on algorithms and sensors and/or price signals

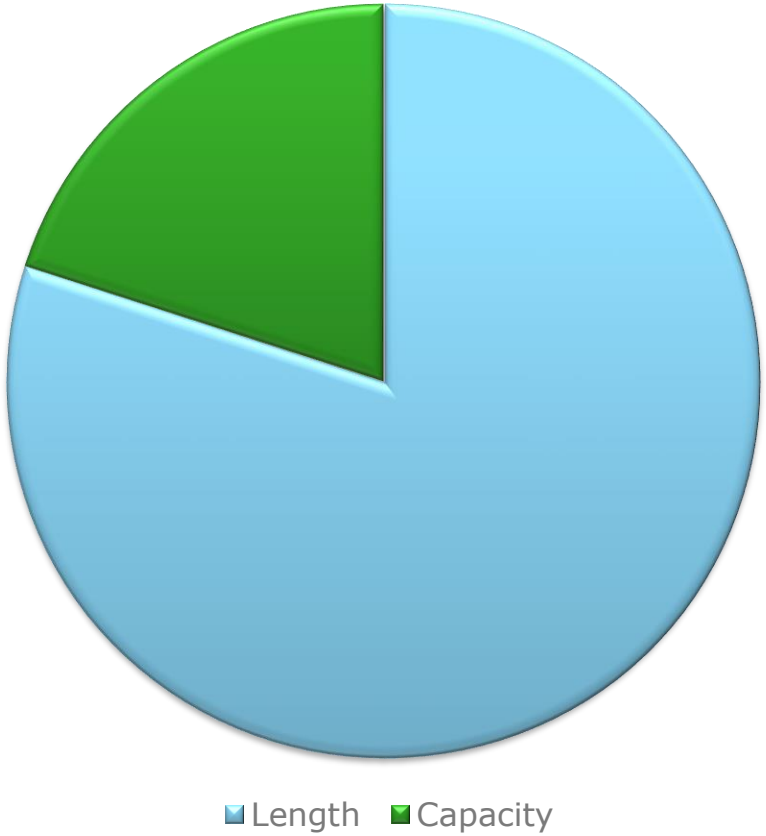
- Current ‘reward’ for prosumers is far higher than cost reductions in the grid

Cost structure of electricity networks

Cost structure



Determinants of capex+opex



Two important lessons from economic theory

Pricing rule

- Ensure efficient utilisation

$$P = MC$$

Investment rule

- Facilitate efficient expansion

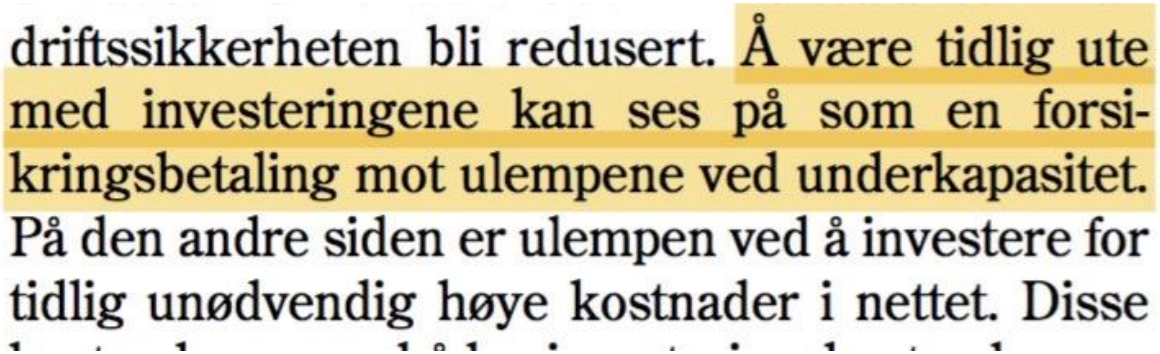
$$SRMC = LRMC$$

So what is the marginal cost of providing grid services?

- Sufficient capacity
  - Marginal cost = marginal network losses
    - Network losses ≈ 6 % [2015]
    - Average marginal loss ≈ 12 %
      - Varies between ALL grid customers
      - Varies from negative to positive
      - May reach 40-50 % at remote buildings in scarcely populated areas
- Insufficient capacity
  - TSO-level: Incorporated in energy prices
  - DSO-level: Not very common (yet)

Photo: ABB

Why is insufficient capacity at DSO-level so rare?


driftssikkerheten bli redusert. Å være tidlig ute med investeringene kan ses på som en forsi-kringsbetaling mot ulempene ved underkapasitet. På den andre siden er ulempen ved å investere for tidlig unødvendig høye kostnader i nettet. Disse

White paper about network policy;
St.mld. 14 (2011-2012), p. 56

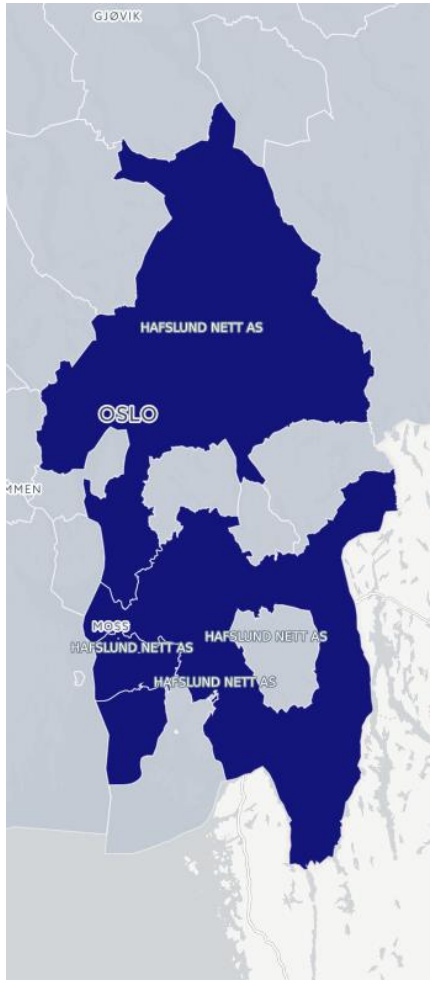
(Investing ahead of demand is an insurance payment against disadvantages of insufficient capacity)

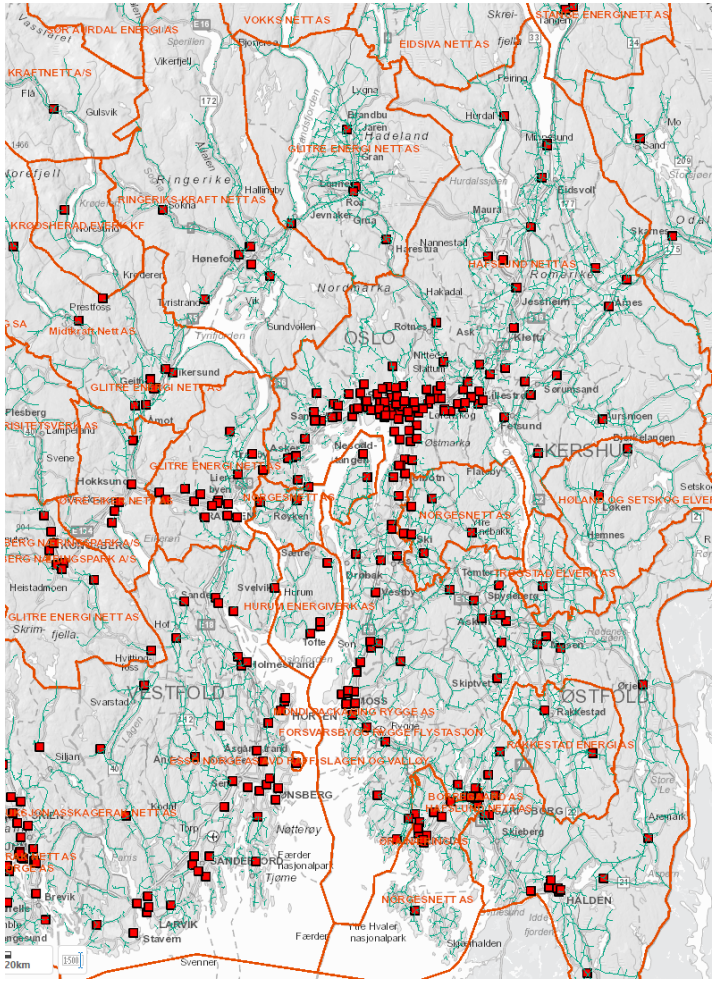
- Life time considerations
  - 50-70 years technical lifetime and low marginal cost of capacity at time of investment
- Cost optimisation: losses vs. capex and opex?
  - Capacity is not an important cost driver
- High loads are short-lived
  - kW is not the same as kWh/h
    - kWh/h: thermal capacity limit
    - kW: voltage quality
  - Dimensioning for high thermal capacity results in much higher instantaneous capacity
- Manageable unit of time has been hour, not seconds or minutes
  - This is currently changing (IoT, AI, etc.)

Implications for pricing

- Marginal cost of using the grid (the energy fee)
  - Might account for 15-20 % of regulated revenue
- How to cover the rest?
  - Equal payment for all customers?
  - Equal payment per kWh?
  - Equal payment per kW?
  - Payment according to elasticity of demand?
  - Let other grid customers pay?
  - Send the bill to the state?
  - Localisation signal (=approach to LRMC)?
    - Or 'equalisation'?
- **Residual fee – similar to tax collection; avoid distortion**
  - Minimum impact on short term utilisation

Implications for grid expansion

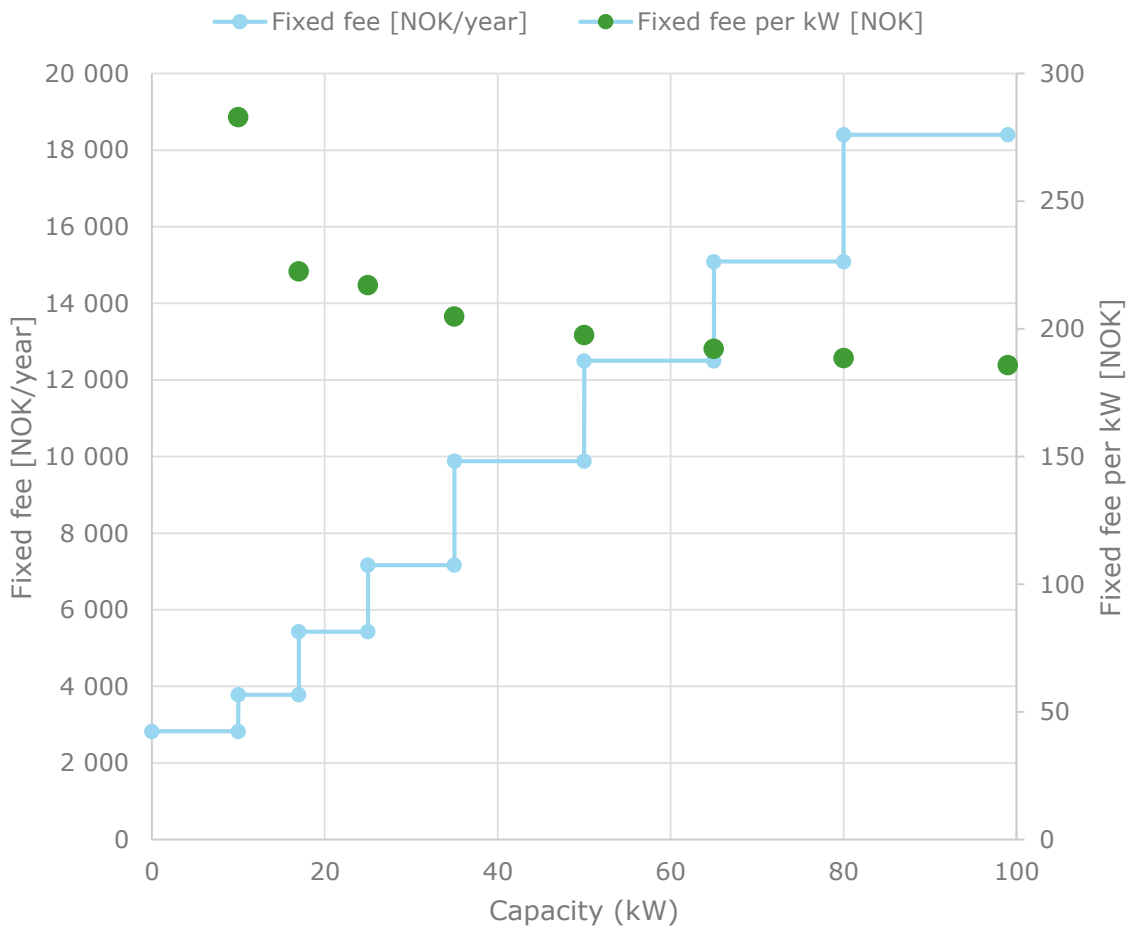




- A low energy fee encourages increased use, without signalling the cost of expansion
  - SRMC < LRMC
    - Will be the case at DSO level
      - Despite SmartGrid, IoT, etc.?
- Network companies are obliged to connect new customers
  - Connection charges apply for customer specific costs only
    - Costs in meshed grids not chargeable (by regulation)
- How to mitigate increased demand for capacity?
  - …, if tariffs should be equal across the country?
    - …, or at least within the DSO area?

Combining fairness, adequate investment signals, and efficient use

- A (highly) variable energy fee
  - Depending on energy price and marginal losses
  - But what about granularity?
    - End-user vs. substation vs. transmission node?
    - Second/minute/hour/day/week/ month/season/year?
- A fixed annual residual fee
  - Depending on customer size (capacity demand)
    - Metered?
    - Installed?
    - Subscription?
  - Depending on location?
    - Substation, DSO-area or larger zones?



Source: Retail tariff, Eidsiva Energi Nett

Thank you!

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