DNV·GL

ENERGY

Energietransitie

Een veranderend omgevingsveld voor ProRail

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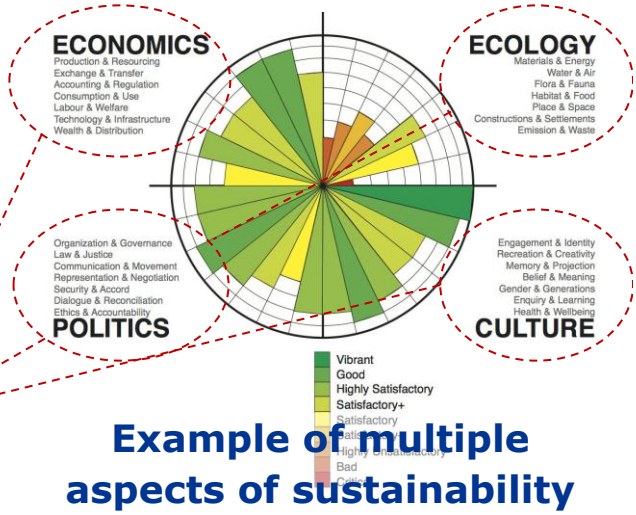
DNV GL Purpose

Energy Transition

Energy transition: shift to sustainable economies by means of *renewable energy*, *energy efficiency* and *sustainable development*.

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs

- **Fossil Fuels**
- **Emissions**
- **Generation**
- **Consumption**
- **Infrastructure**
- **Local energy**
- **Programmes**

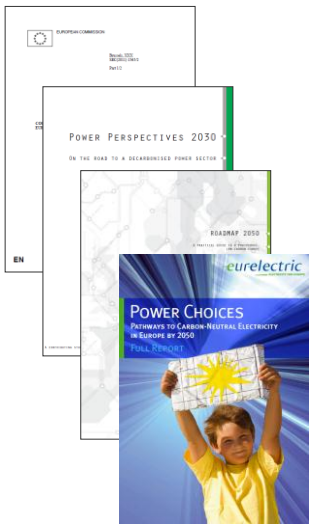


Example of multiple aspects of sustainability

Energy Trends

Decarbonisation of the electric power sector

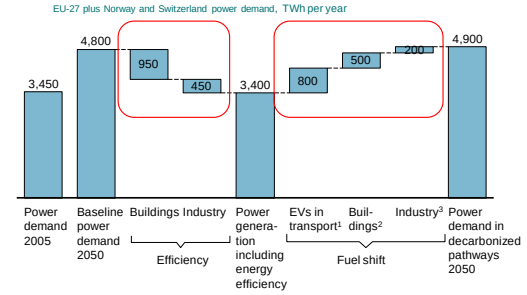
- Power sector will be key to reducing European carbon emissions by 80% until 2050
- Among others, this will require:
  - Almost complete decarbonisation of the power sector
  - Strongly increased role of renewable energy sources
- The European power sector will have to undergo a fundamental and unprecedented change
- Several studies have investigated the feasibility of this transition and the associated challenges, e.g.:
  - Energy Roadmap 2050 (DG ENER)
  - Roadmap 2050 / Power Perspectives 2030 (ECF)
  - Power Choices (Eurelectric)
  - E-Highways



Need to consider wide range of different developments

- Available studies have looked at a variety of choices and developments, e.g.:
  - Use of different types of renewable energy sources (RES), nuclear power, carbon capture and storage (CCS) etc.
  - Energy efficiency in the power sector
  - Electrification of other sectors (transport and heating)

Assumptions on future demand in the ECF Roadmap 2050



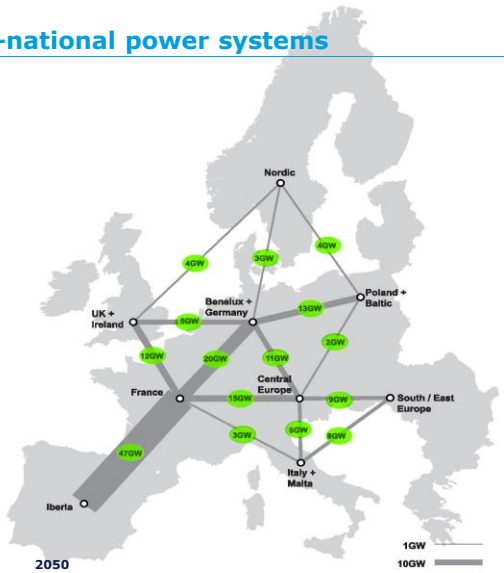
1 Electrification of 100% LDVs and MDVs (partially plug-in hybrids); HDVs remain emitting ~10% while switching largely to biofuel or hydrogen fuel cells
2 90% of remaining primary energy demand converted to electricity (heating/cooling from heat pumps); assumed 4 times as efficient as primary fuel
3 10% of remaining primary energy demand for combustion converted to electricity (heating from heat pumps); assumed 2.5 times as efficient as primary fuel

Source: ECF

Focus towards larger, supra-national power systems

Supra-nationalisation

- cross-border energy exchange
- interconnection capacity
- in Europe: industries cooperate at transnational level
- important driver: large-scale integration of renewable energy systems (RES)
- needed: large volumes of back-up generation, in order to ‚firm up' fluctuating RES during situations with low wind and solar radiation

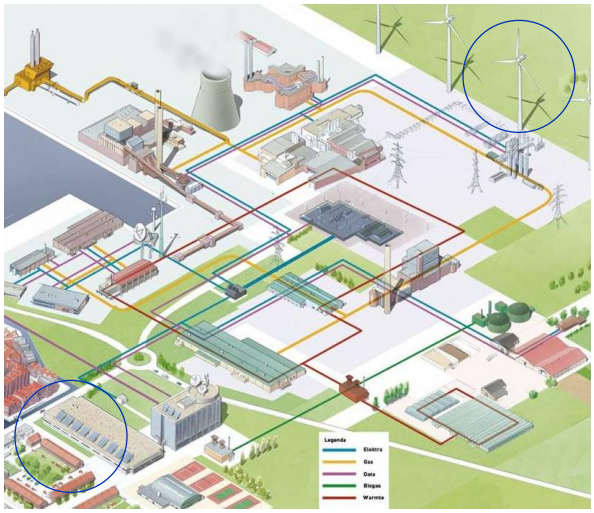


2050
Total Transmission Requirements Assuming 80% RES & 20% DR

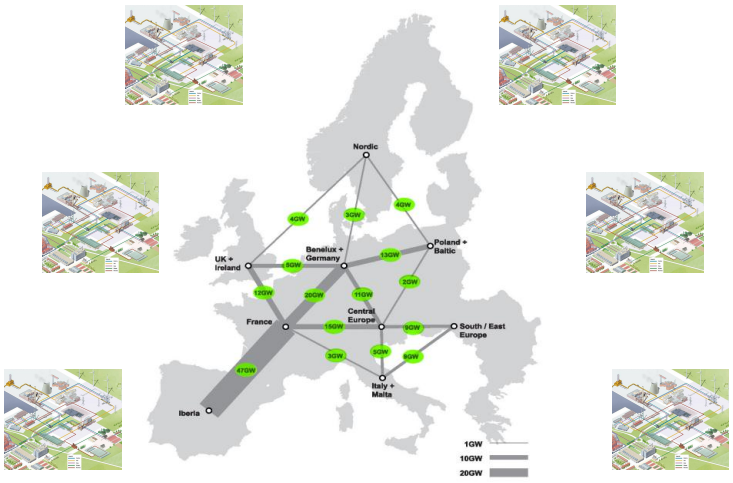
Focus toward decentralization in the power system

Decentralisation

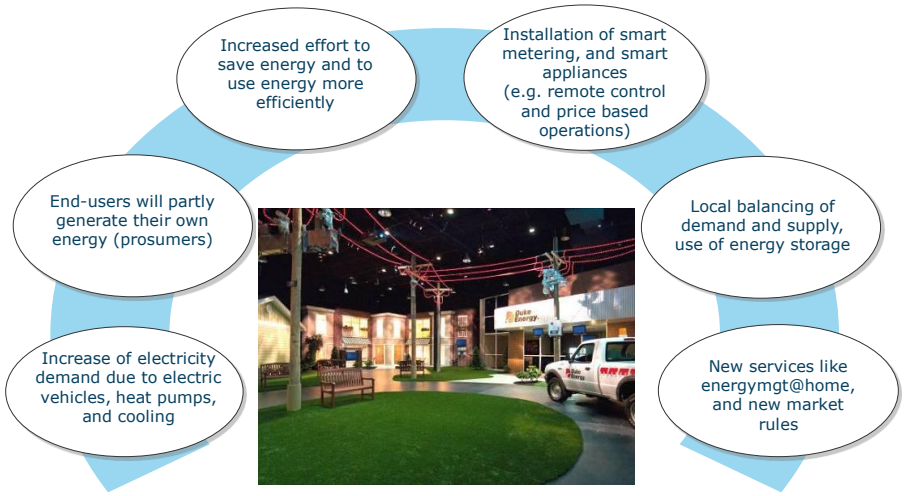
- local energy (DG)
- new initiatives from small companies, citizens, and municipalities
- innovative business models



Supra-nationalisation and decentralisation develop in parallel



Changes about to happen locally in the coming decades

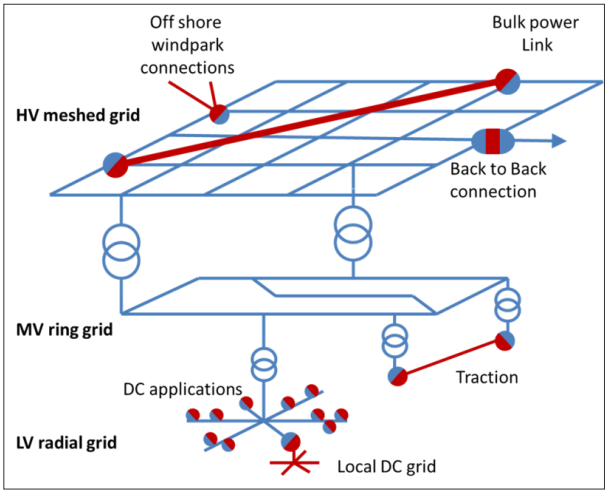


Developments are starting at individual homes, and neighbourhoods, the next step is development of Eco Cities

End users become a key player in this business

- Energy is not on top of their mind for most energy consumers
- However, many local corporations have been started recently and sustainability, 'produced locally', and costs are drivers for change …
- … and quite an number of consumers are changing into energy prosumers, some of them will change in energy down- and uploaders

Trends in energy consumption affect all voltage levels in the grid

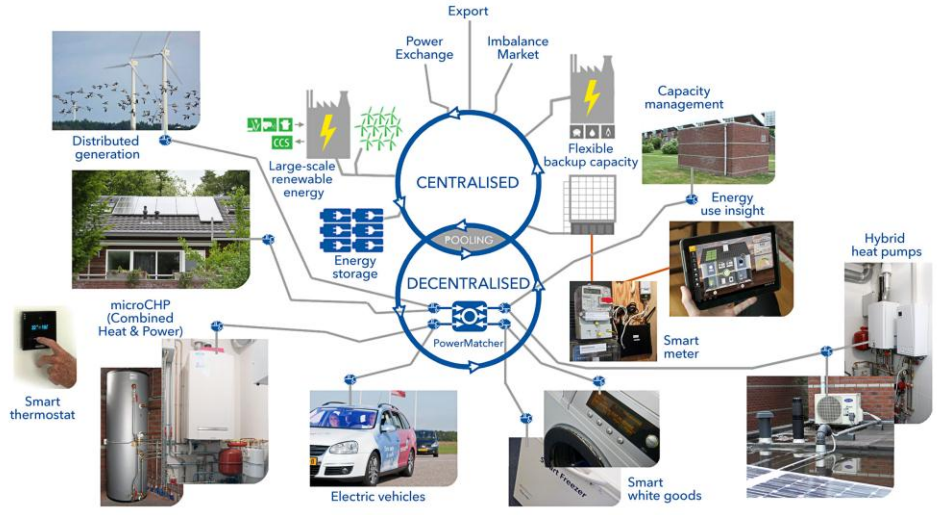


- Heavy industry
- Central electricity generation
- **Offshore wind**

- Industry & utilities
- CHP-generation
- **Onshore wind**
- **Collective EV charging**

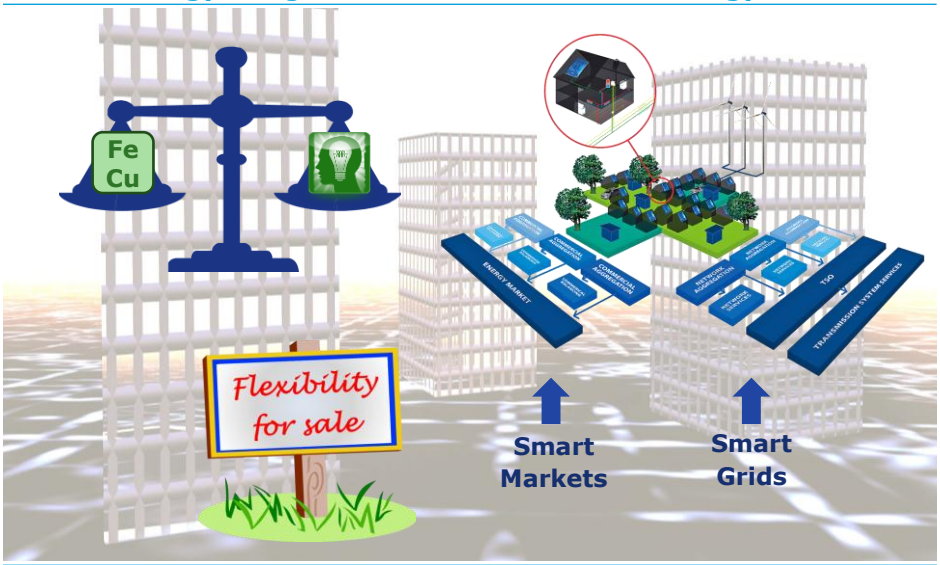
- Dwellings & SMEs
- **µCHP-generation**
- **solar PV**
- **Individual EV charging**

An example: PowerMatching City



Smart energy

Smart energy is regarded as an enabler of the energy transition



Key issues for smart grids and smart markets

Smart grids

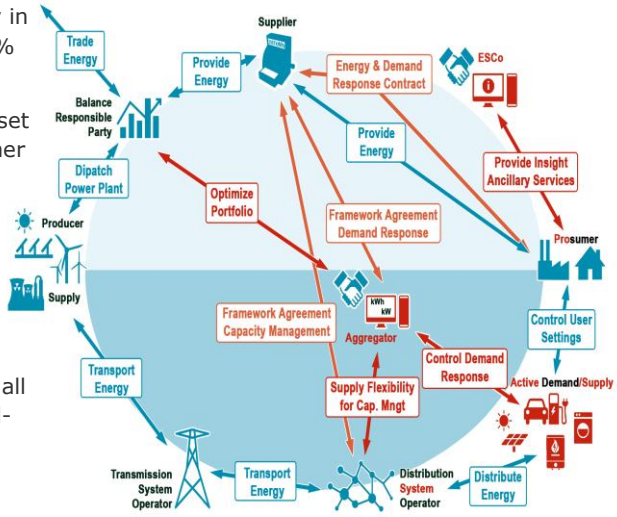
- Voltage quality
- Thermal limits of equipment
- Missing data and passive distribution grids
- Asset management and cost optimisation
- Revenue assurance
- Outage prevention and reduction of downtime
- Substantial interest in the short run will come from grid operators who have to deal with an increasing share of renewables

Smart markets

- Portfolio optimisation
- Short term balancing
- Medium term balancing
- Energy efficiency and local optimisation
- Interest will come from liberalized market players (retailers, aggregators and generators) and new market entrants although the business models doesn't seem to be very solid yet
- Strongest need – although less strong than for smart grids – is expected in optimising portfolios of BRPs, and to counteract the impact of renewables on balancing and capacity markets

Services and solutions to optimise smart energy systems, i.e. market, infrastructure and end-use

- Electricity share of energy in Europe will grow from 20% in 2020 to 50% in 2050.
- Data will become main asset of DNOs/DSOs, and of other stakeholders such as aggregators.
- Aggregator will optimally combine commodity, capacity, and flexibility.
- Providing insight is one of the services to provide to all key players, including end-users.



Concluding remarks

Energy Transition	▪ Increased generation by renewables ▪ From a centralized, one-directional energy system to a partly decentralized, two-directional system ▪ Electrification of the demand
Smart markets	▪ New roles (aggregator, energy service companies) ▪ Capacity becomes more important than energy ▪ Challenge to mobilize load flexibility in the market (demand response)
Smart grids	▪ Two-directional flow requires other ways of grid operation ▪ Tariff systems and reliability of solutions are important aspects

Workshops

ProRail

Wat overkomt ProRail?

Wat heeft ProRail te bieden?

Wat wil ProRail?

1. ProRail dient de ontwikkelingen in de lokale netten te gaan faciliteren, maar hoe? (Marcel)
2. Wat overkomt ProRail bij haar aansluitpunten bij de publieke netbeheerder? (Fedor)
3. Hier volgt een omroepbericht: De trein gaat pas rijden als de zon schijnt. (Rob)
4. Besluit 3 kV is genomen, hoe nu verder? (Teun)