Smart Grids supporting the Energy Value Chain

Theory and experiments

Seminar *The Future of our Energy Supply*

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Enschede, October 18th, 2013

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Agenda

- Introducing Enexis
- Enexis' vision for the future energy supply
- Contribution of Smart Grids
- Pilots and experiments
- Conclusions

Key figures Enexis

No. of employees:
app. 4.200

Offices:
12, mainly in East-NL

Turnover (2012):
1.367 MEURO

Profit after taxes (2012):
229 MEURO

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Service area Enexis

Electricity:

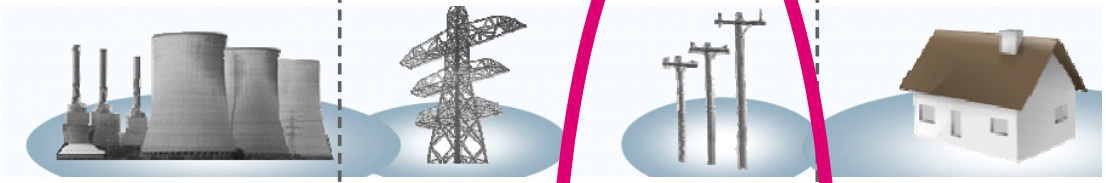
- 2,7 million connections
- 135,000 km MV / LV grid (50 kV –LV)
- 53,000 transformer cabinets

Gas:

- 2,1 million connections
- 45,000 km HP / LP (8 bar – 30 mbar)
- 25,000 stations

Organisation of the Dutch energy sector

Liberalized | Regulated | Liberalized

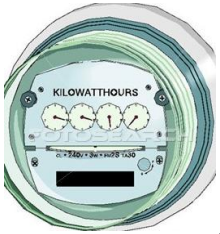


	Production	Transport	Distribution	Supply	Related businesses
Electricity	Large scale generation: Delta, Eletrabel, Eneco, E.ON, Essent, Nuon Other decentralised generation Import	Operator 110 – 380kV: TenneT Import & export	Enexis , Alliander, Endinet, Rendo, Stedin, Westland Energie, Delta Netwerkbeheer, Cogas, etc.	Delta, Dong, Electrabel, Eneco, E.ON Benelux, Essent (RWE), Nuon (Vattenfall), NEM, etc.	Enexis Other parties, such as Installation companies
Gas	Maatschap Groningen: a co-operation between the State, Shell and ExxonMobil	Operator HP grid (40-60 bar) Gas Transport Services (GTS) Import & export Enexis , Delta (Zebra HD leiding)	Enexis , Alliander, Endinet, Rendo, Stedin, Westland Energie, Delta Netwerkbeheer, Cogas, etc	Delta, Dong, Electrabel, Eneco, E.ON Benelux, Essent (RWE), Nuon (Vattenfall), NEM, etc.	Enexis Other parties, such as Installation companies

Grid operators and energy grids

Market party 1

Market party 2



Energy grids –
Foundation for the market and crucial link between supply and demand

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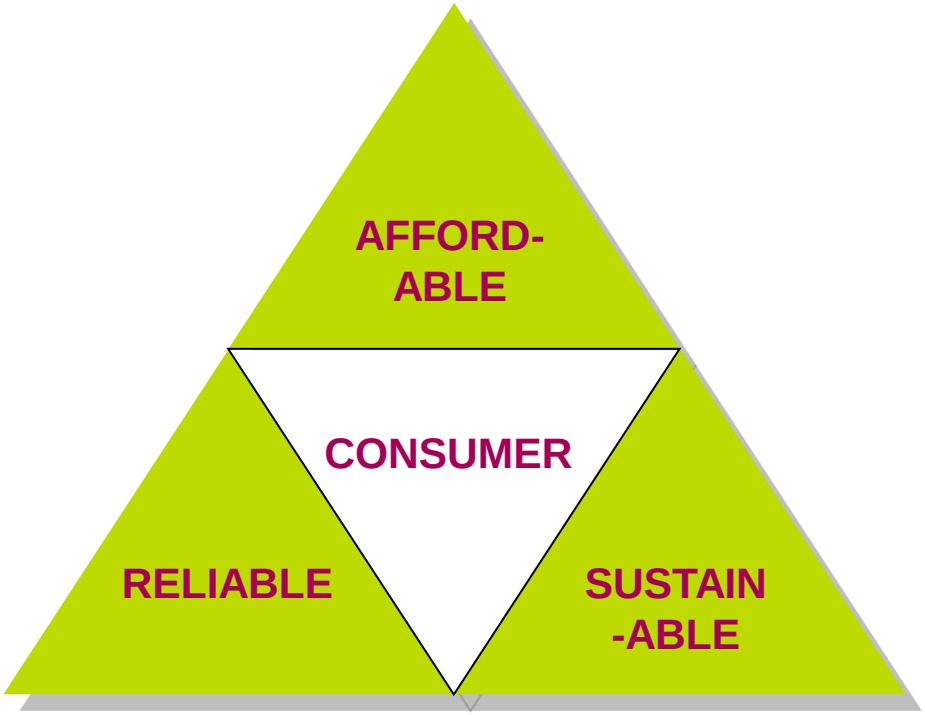
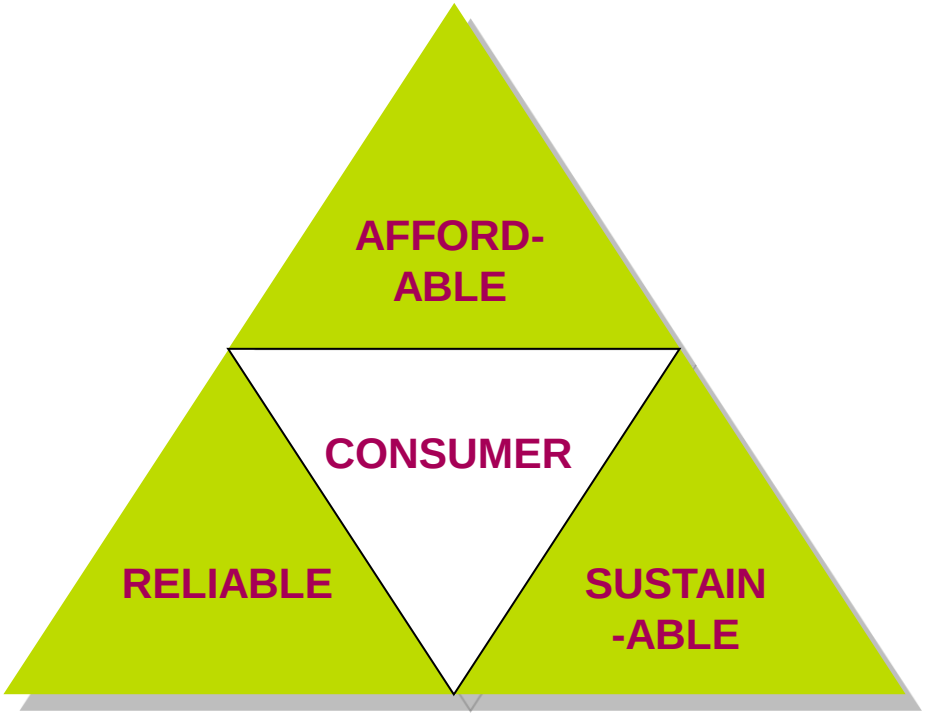
Strategy Enexis



Mission Enexis

We do our utmost to achieve sustainable, reliable and affordable energy distribution.

Grid operation is a balancing act



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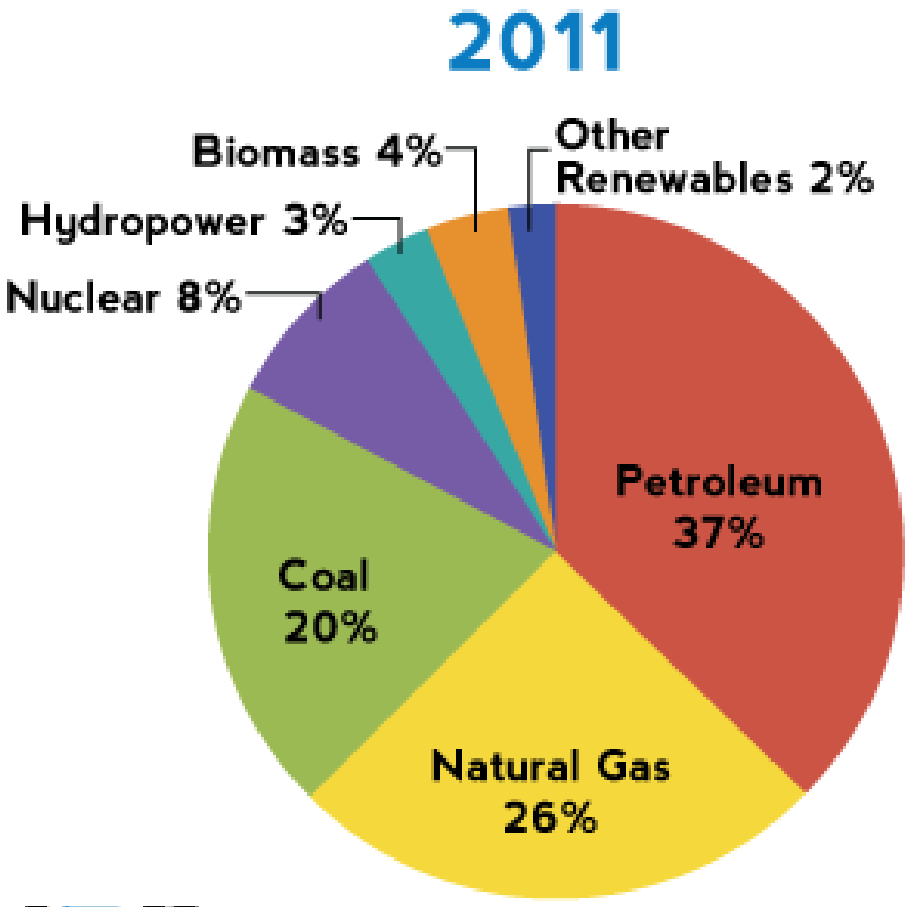
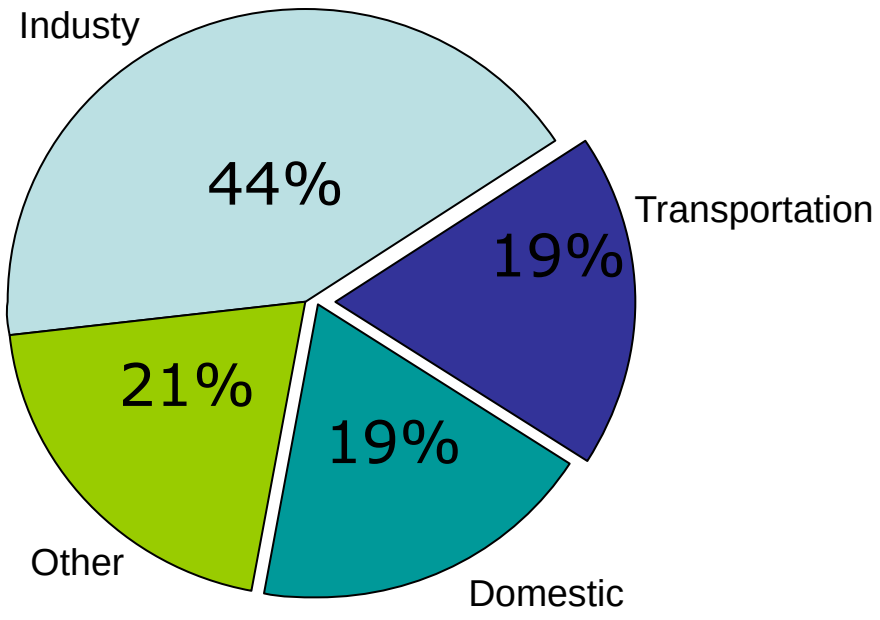
Fossil fuels dominate energy consumption



Energy consumption in the Netherlands

Overall energy consumption



Household consumption

- Electricity	10% 3.200 kWh
- Gas	48% 15.000 kWh (1500 m^3 gas)
- Transportation	42% 13.000 kWh (1500 liter)

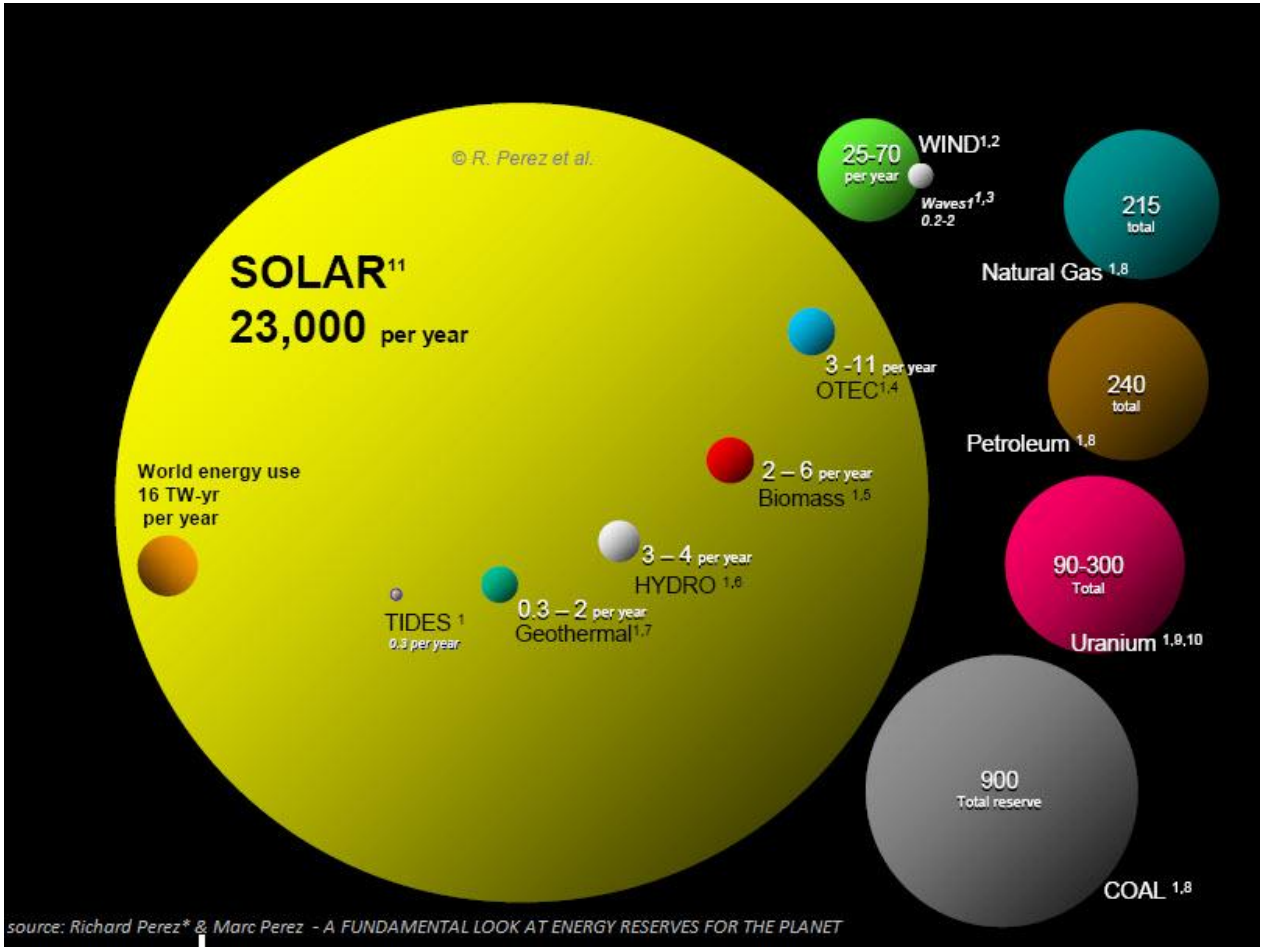
The road towards a sustainable energy supply

The energy transition is the transition from an energy supply relying on fossil fuels to an energy supply using renewable energy sources

Foundations of the energy transition:

- Produce energy from renewable sources
- Save energy by increasing conversion efficiency and reducing energy losses

Sustainable energy is abundantly available



Enexis's vision for a sustainable energy supply

Contribution of electricity will increase

- Most technologies for sustainable energy generation produce electricity
- Increased energy efficiency leads to substitution of gas and liquid fuels by electricity

Scale of electricity/energy production will decrease

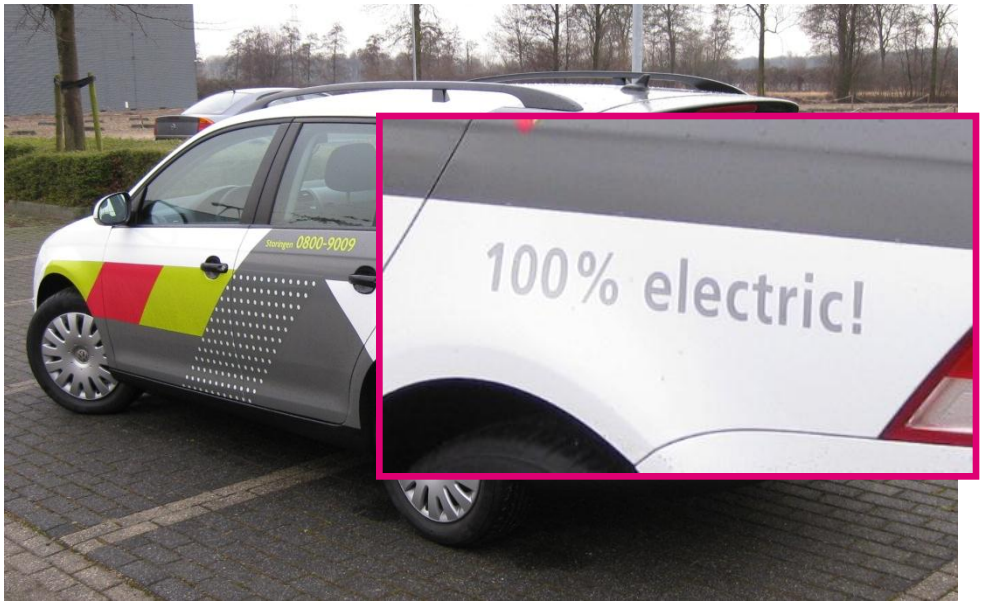
- Make use of waste heat produced by thermal electricity production (difficult to transport)
- Low energy density of renewable energy sources

Controllability of electricity/energy production will decrease

Amount of flexible consumption will increase

- Electrification of less time critical applications such as mobility and heating

Contribution of electricity will increase



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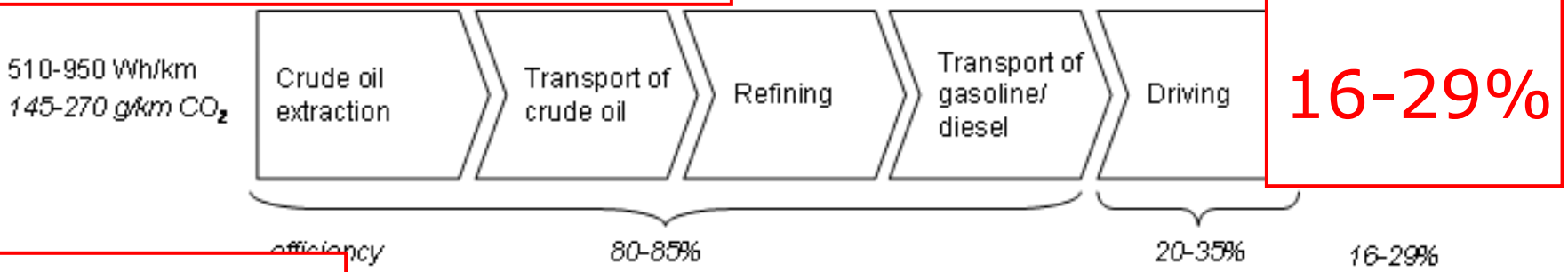
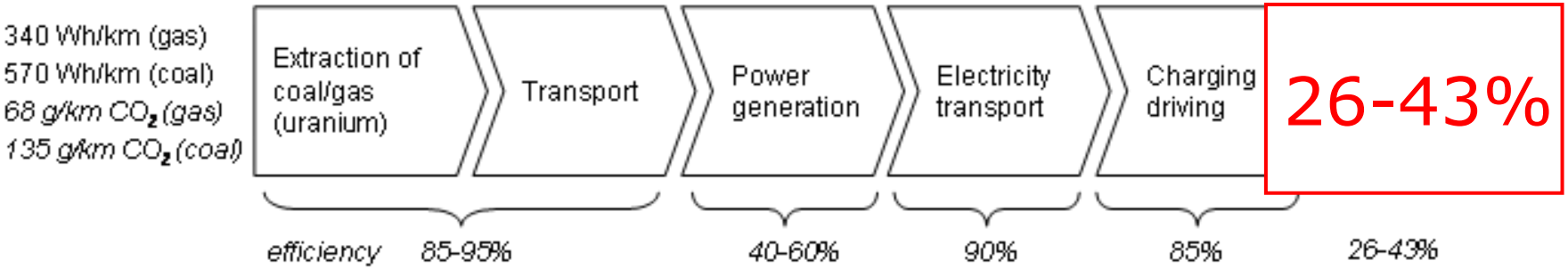
Electrical vehicles increase efficiency

Internal combustion engine



Electric drive



Source: European Union, 2006

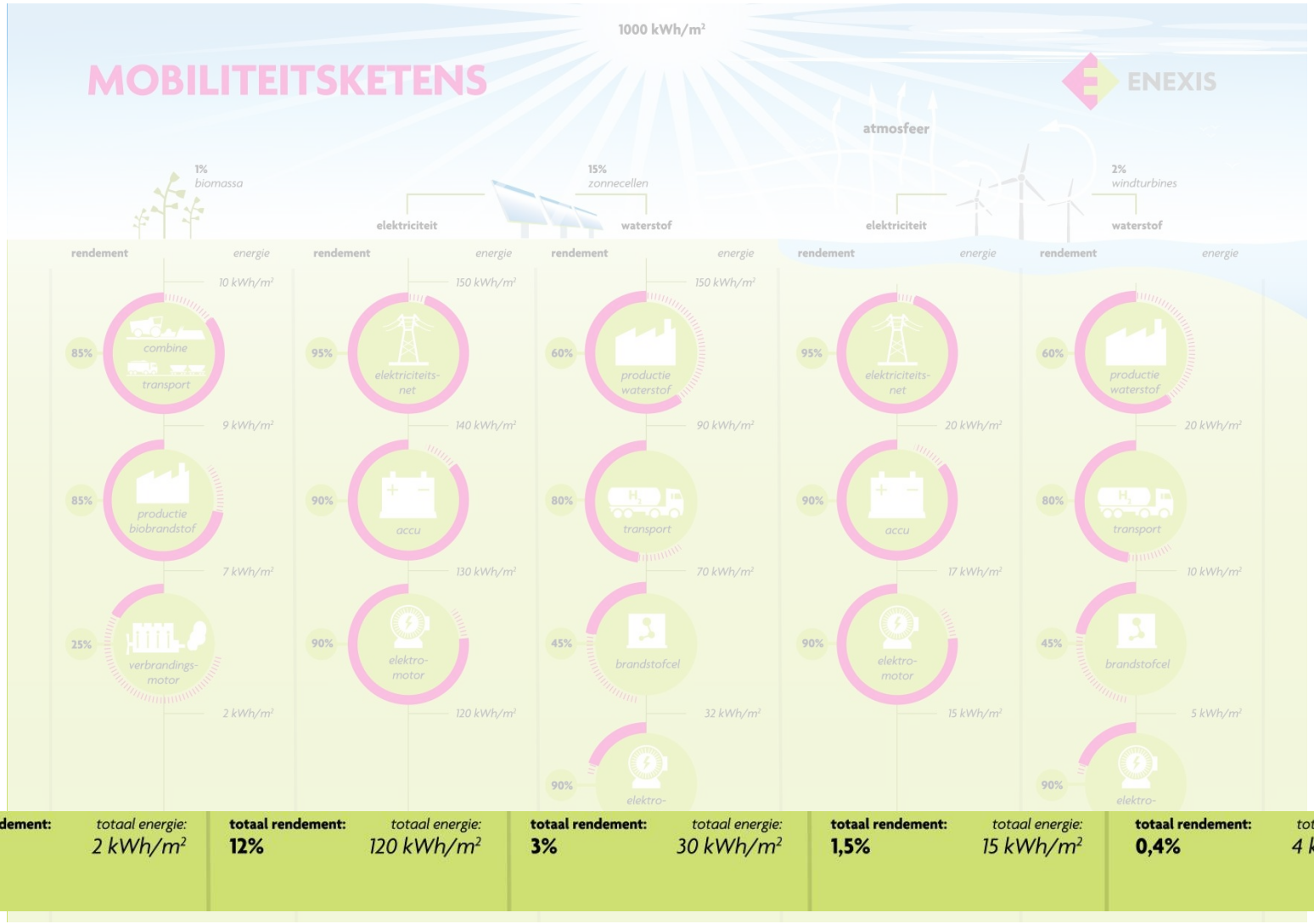
Example 1: VW Golf Variant

- Battery capacity: 37 kWh
- Range: 150-200 km
- Top speed: 150 km/h
- Acceleration 0-100 km/h: ~7s

Example 2: Lotus Elise

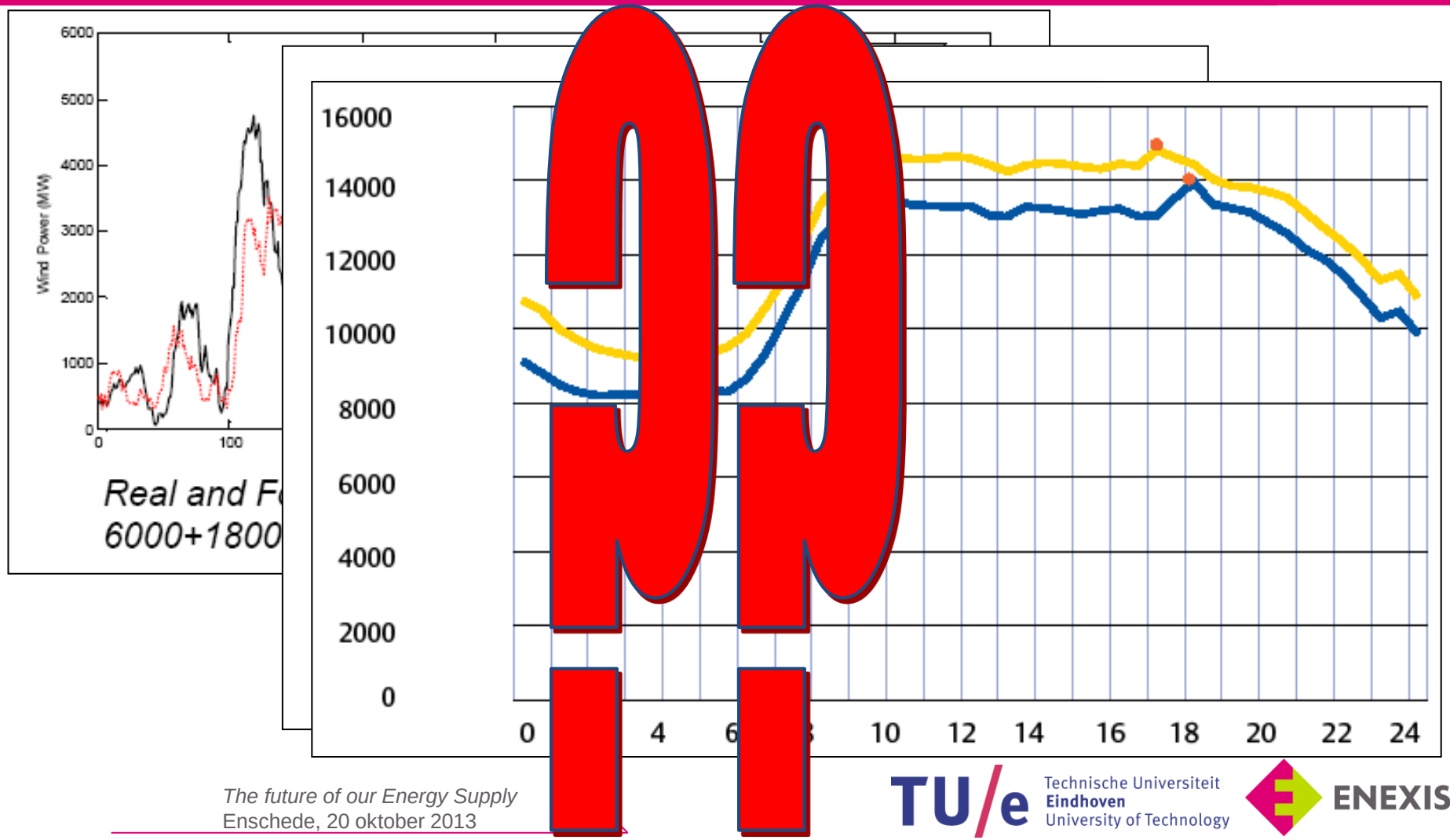
- Battery capacity: 32 kWh
- Range: 200-250 km
- Top speed: 220 km/h
- Acceleration 0-100 km/h: <4s

Energy chains for powering mobility



Scale of electricity/energy production will decrease

Controllability of electricity/energy production will decrease



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Amount of flexible consumption will increase

Electric vehicles:

- Electric vehicles stand still for 20 to 22 hours per day
- Charging the average daily driving distance in NL takes 2 to 6 hours
- Spreading 2 to 6 hours over 20 to 22 hours reults in flexibility

Heat pumps:

- Temperature in a modern, isolated building is quite constant
- Within boundaries, heat pumps can be controlled without affecting temperature in the building too much

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Smart Grids –a definition

A Smart Grid is:

- An electricity network with technologies that make available information on the energy flows in the network
- and the state of its components
- and that allow control of energy flows in order to support the energy transition efficiently

netbeheer nederland

energie in beweging

Smart Grids – an impression

Courtesy by Siemens AG

Smart Grids supporting the future Energy Value Chain

Smart Grids support the future energy value chain by:

- Enabling exchange of information between parties with repect to actual system balance/prices on the energy market
- Enabling (sustainable) energy collectives
- Balancing available flexibility and (forecasted) production of sustainable energy sources
- Informing consumers about their consumption and cost
- Enabling new commercial propositions and increased consumer choice

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Your Energy Moment (JEM) – Smart Grid Pilots Zwolle and Breda

Goal:

- Mobilizing consumers' flexibility in electricity consumption

Required:

- Communication with consumers/participants
- Financial and emotional incentives
- Technologies (ICT)
- Interaction/User interfaces

Smart Grid pilot Breda

60 “energy neutral” family homes
Between Oosterhoutseweg and Cadettenkamp

Heat pumps
PV panels

250 “CO2 neutral” appartments
Ettensebaan

Combined Heat and Power – biomass fired
Collective PV system

Smart Grid pilot Zwolle

Muziekwijk

266 family homes

PV panels

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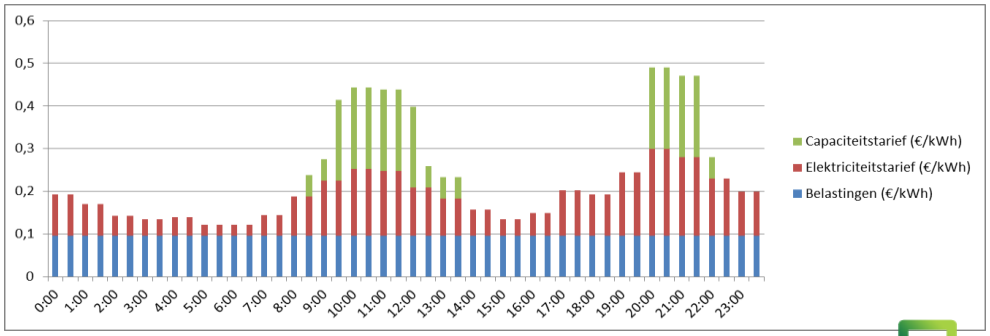
Financial & emotional incentives

Consumer can shift the use of apliance during agreed timeframe: most optimal moment to use is determined by operator of demand side management

Optimal time slots are communicated to user 24hrs in advance

Consumer makes choices based on:

- Costs preferences
- Efficient use of locally produced electricity



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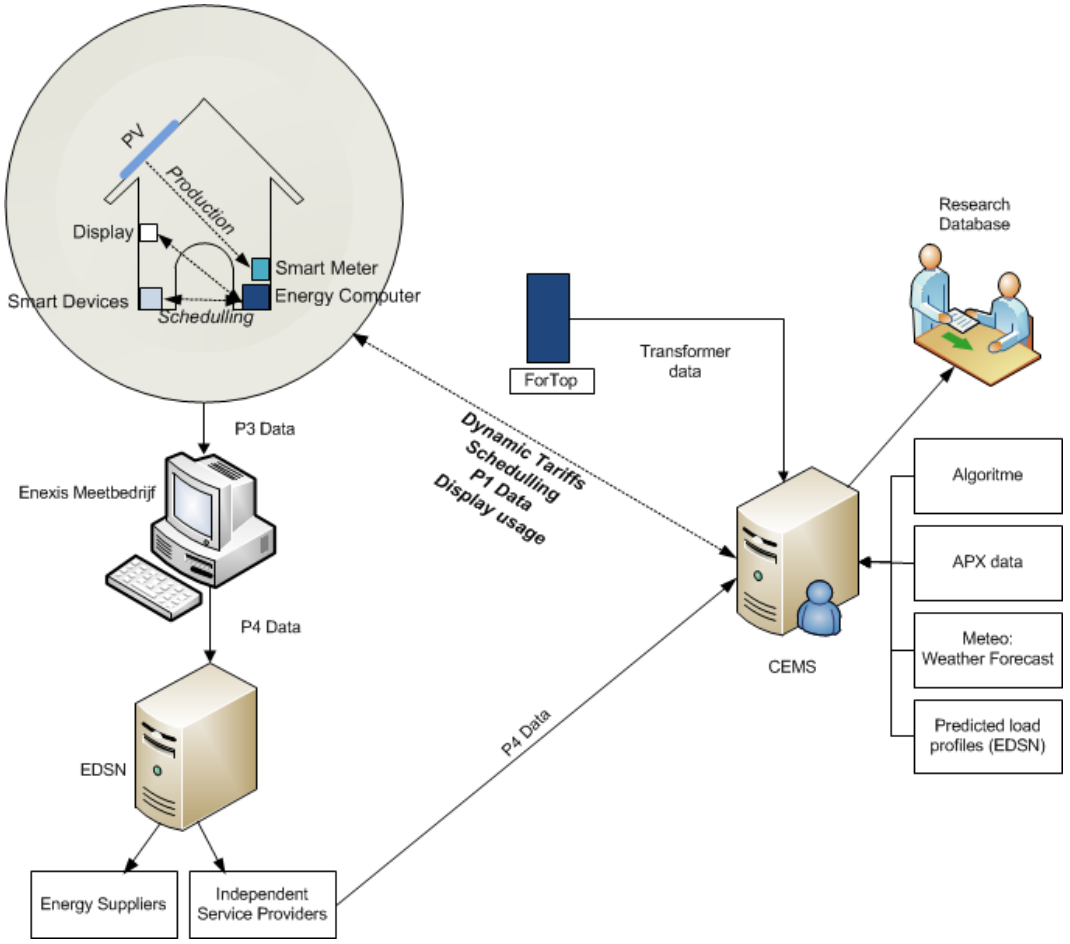
Display interfaces

Zwolle:

Breda:

Ingredients

- Dynamic Energy Tariff *(DONG, Greenchoice)*
- Dynamic Grid Tariff *(Enexis)*
- Smart Meter - DCMR 2.3 *(Enexis)*
- Smart Appliance *(Aqualtis AQ113D 69 - Indesit)*
- ICT *(Technolution, Flexicontrol and CGI-Logica)*



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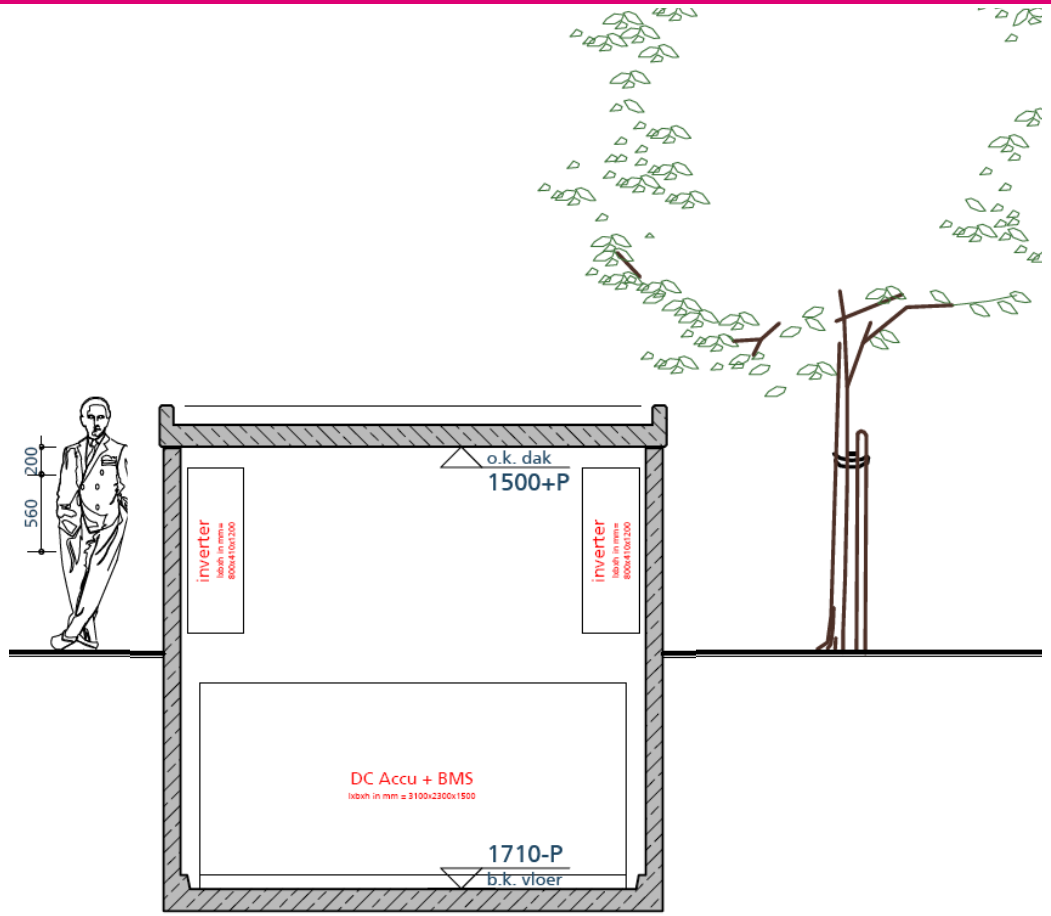
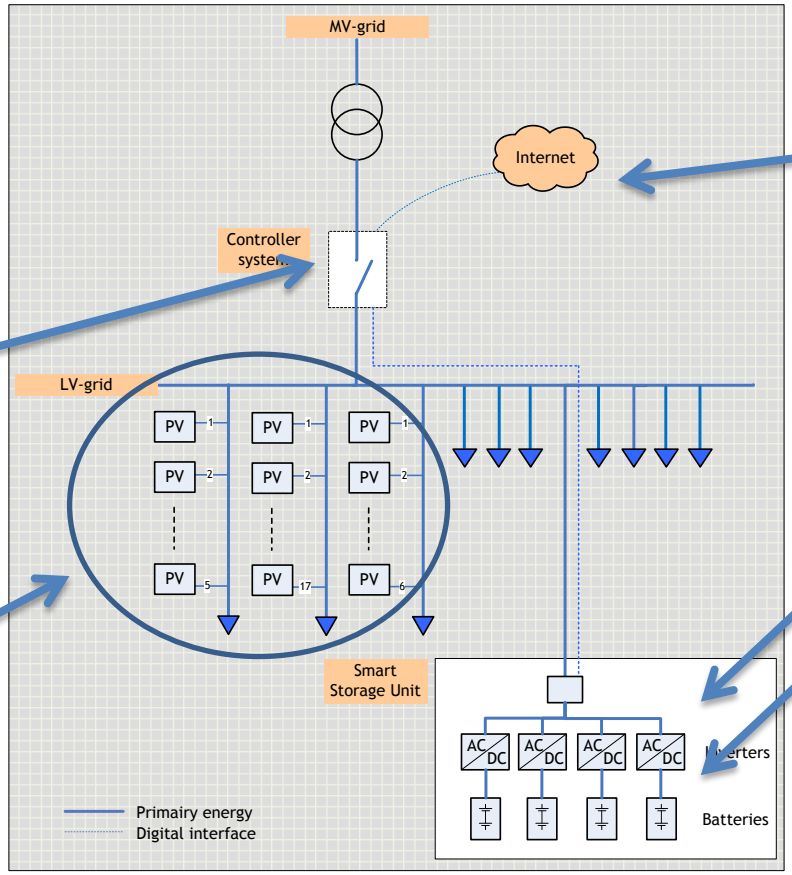
Smart Storage Unit/‘Buurtbatterij’



Smart Storage Unit

System design



Internet connectivity

Power breaker switch

Inverters

Batteries SSU

PV panels

Location: De Keen in Etten-Leur

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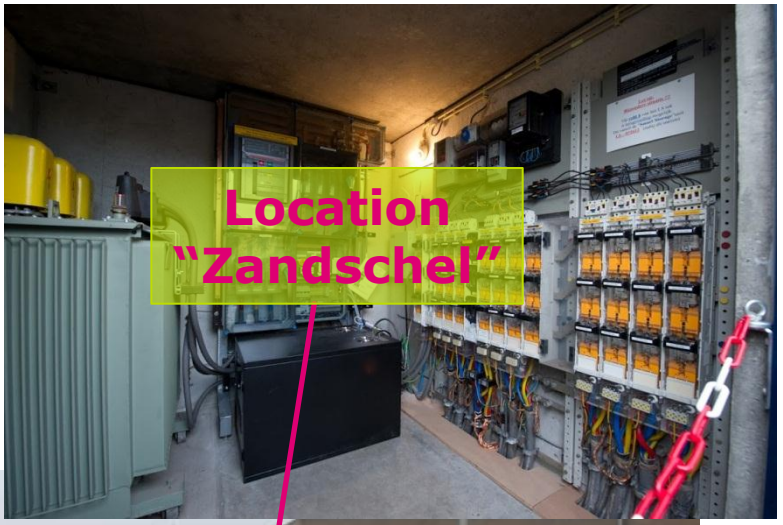
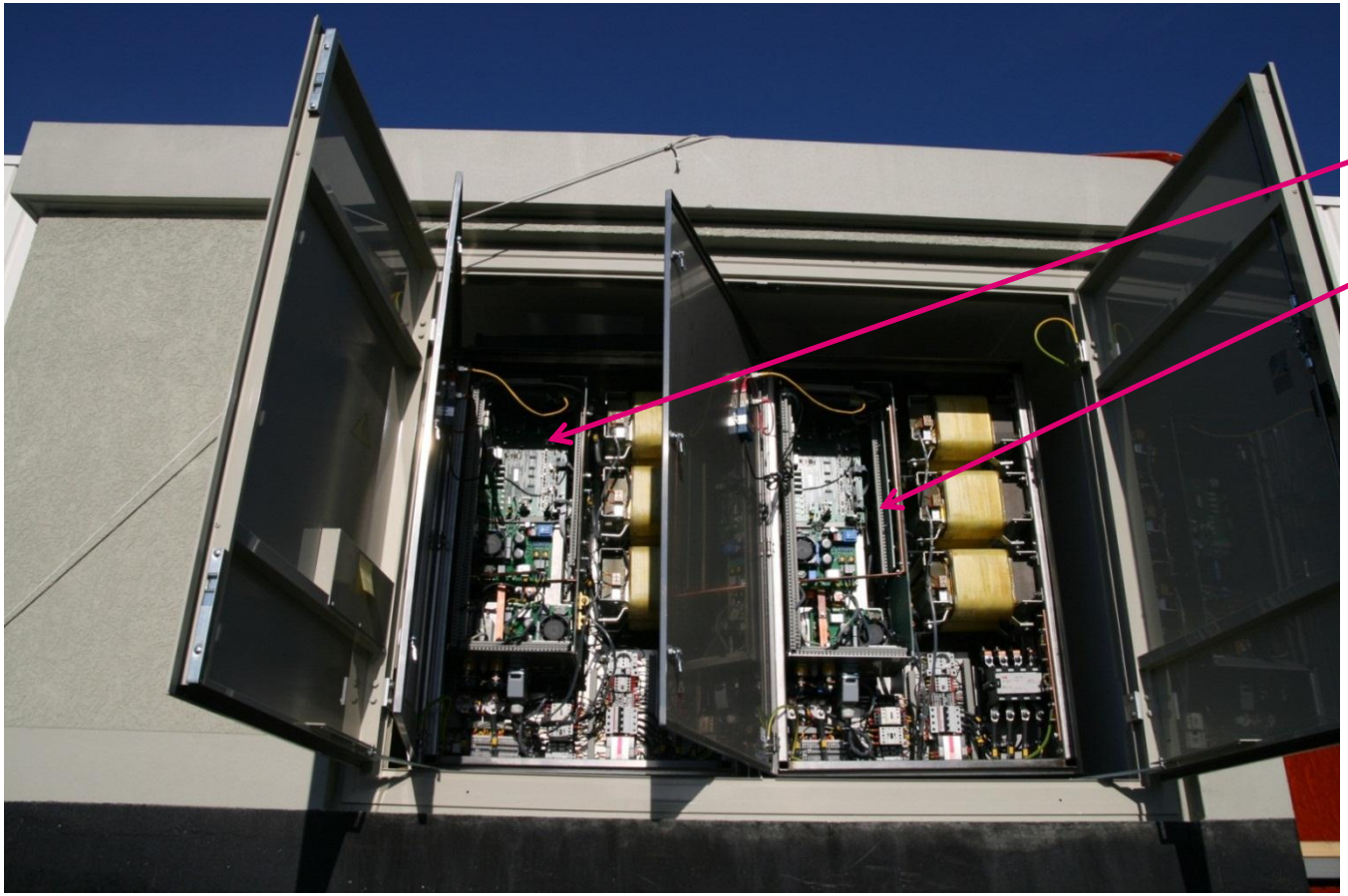
Impression

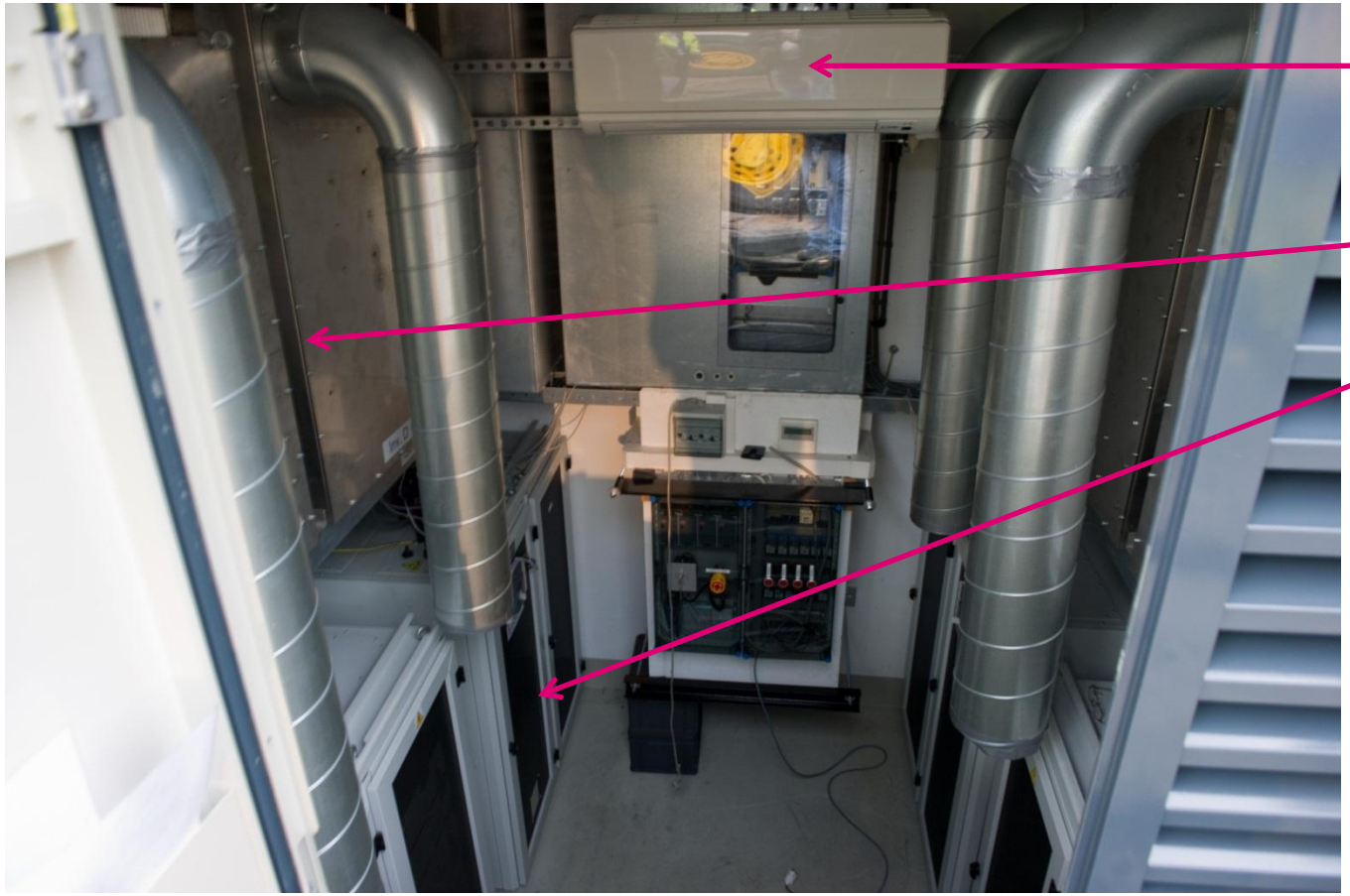


SSU: Inverters



2x 100 kW inverters

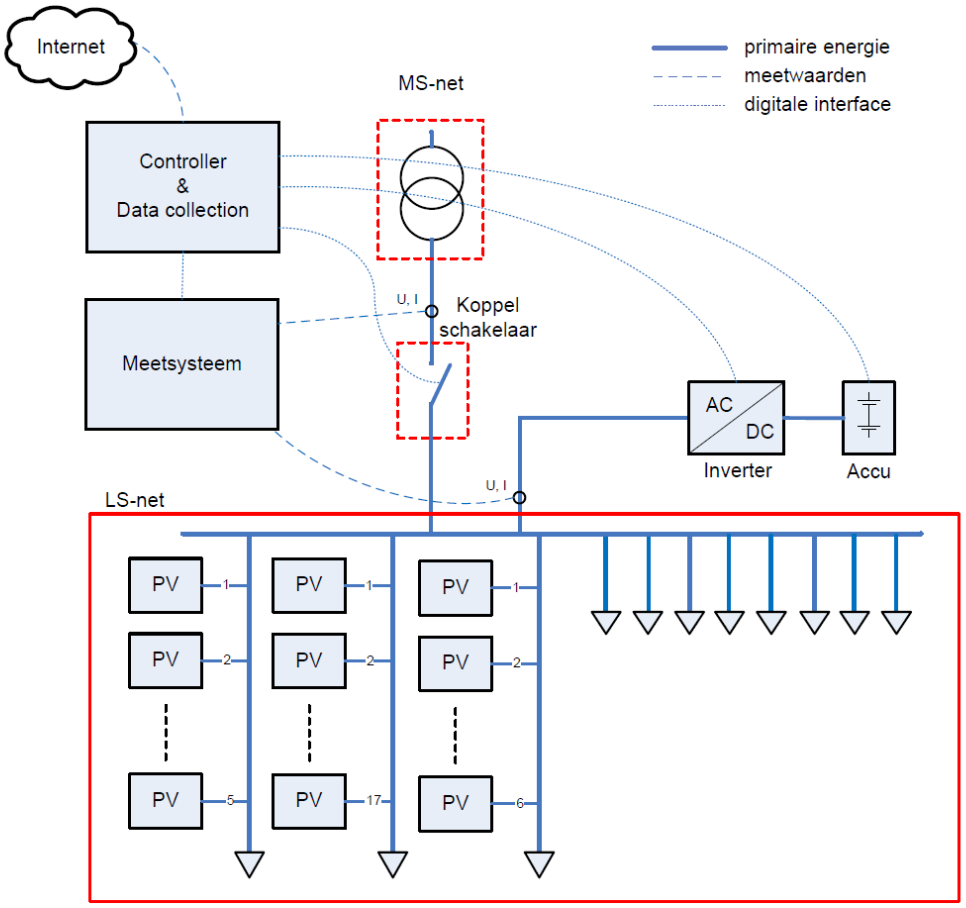
SSU: Interior



Smart Storage: Controller

Control SoC based on:

- Sun
- Wind
- Temperature
- Percipitation
- Decentral energy generation
- Load forecast
- APX
- ..?



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More examples of pilots and experiments by/with Enexis

- Smart charging of electric vehicles

- Power Matching City Hoogkerk

- KRIS: cost reduction of MV/LV grid instrumentation through standardization

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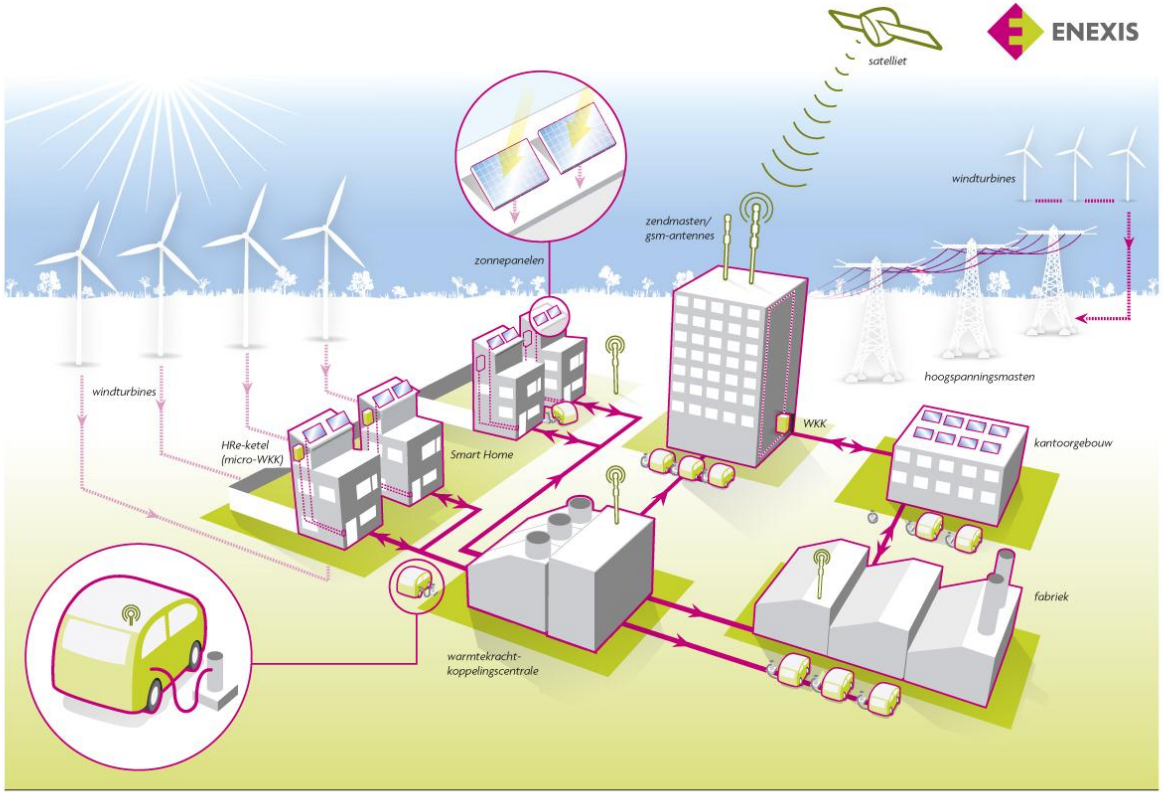
Conclusions

- A transition towards a sustainable energy supply is required
- This energy transition strongly affects electrical power systems:
  - Increasing role of electricity as an energy carrier
  - Downscaling electricity generation
  - Decreasing controllability of electricity generation
  - Increasing flexibility of consumption
- “Traditional” grids have not been designed to cope with these challenges
- Smart Grids are required to support a reliable, affordable and sustainable future energy supply
- Smart Grids pose significant technological and regulatory challenges

Our common future*



*Title of a report issued in 1987 by the World Commission on Environment and Development (WCED), generally considered to first ever put sustainablity on the global agenda