UNIVERSITY OF TWENTE.

DE ENERGIETRANSITIE

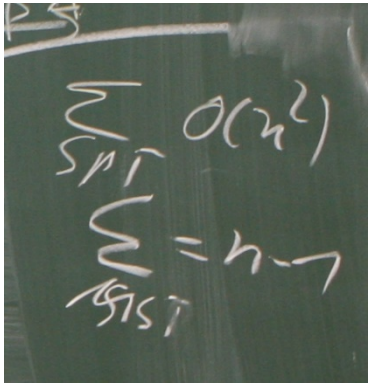
BEDREIGING OF KANS?

JOHANN HURINK

OUTLINE

- Some background on my person
- Positioning of the content of this talk
- Energy transition
- Energy Management and Control

JOHANN HURINK



MAIN MESSAGE AT THE END

THERE IS NO ALTERNATIVE TO A SMART GRID

The organisation of our energy systems has to change fundamentally

from

top-down and centralized

to

bottom up and decentralized

CONTEXT

EU SUSTAINABLE DEVELOPMENT GOALS

POLITICAL GOALS

MOTIVATED BY DRIVE TOWARDS SUSTAINABILITY

- EU statement 20-20-20 scenario: in 2020:
  - 20% CO2 reduction (compared to 1990)
  - 20% of generated energy stems from renewable sources
  - 20% better energy-efficiency

- Key targets for 2030
  - At least 40% cuts in **greenhouse gas emissions** (from 1990 levels)
  - At least 32% share for renewable energy
  - At least 32.5% improvement in energy efficiency

- National Goals/Programs in almost all countries

ENERGY TRANSITION

PAST/CURRENT ENERGY SYSTEMS - DISTINCTION BASED ON ENERGY CARRIERS

- Electricity
- Gas
- Heat
- Fuels: Gasoline/Diesel/Oil

Are used to fulfil specific energy demands

Not Sustainable

ENERGY TRANSITION TOWARDS SUSTAINABILITY

ONGOING/UPCOMMING CHANGES

- National Goals/Programs in almost all countries:

  Reduce/omit use of non-renewable energy sources

  →Phase out natural gas for heating

  →Electricity generation based on renewable sources

  →Electrification of transport

  →....

ENERGY TRANSITION TOWARDS SUSTAINABILITY

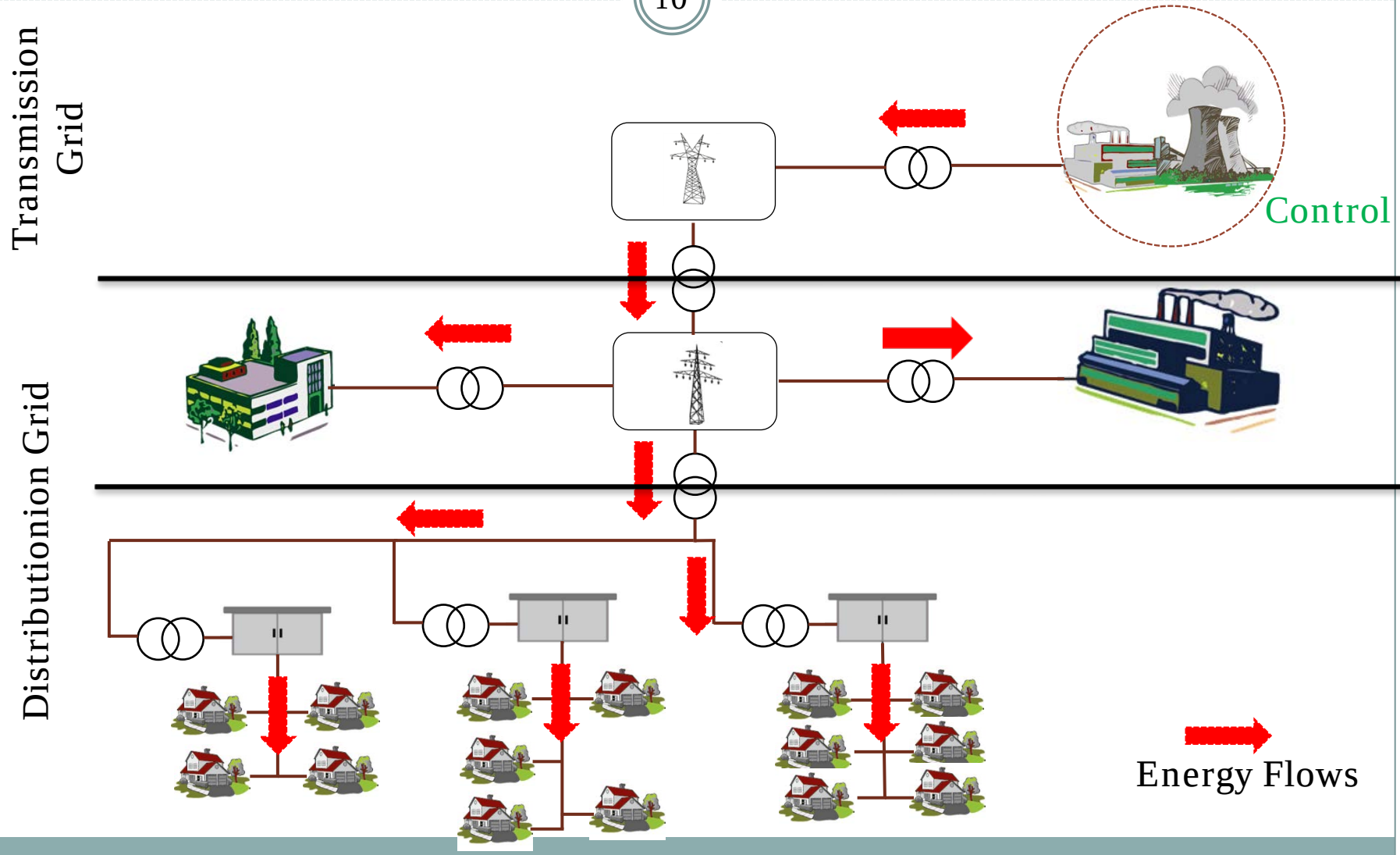
OBSERVATION

Electricity plays a core role these intended changes

Reason: Electricity can be generated based on sustainable sources

ELECTRICITY SYSTEM IN THE PAST

DEMAND AND SUPPLY MUST MATCH AT ALL TIMES → SUPPLY FOLLOWS DEMAND



ELECTRICITY SYSTEM in the past

Control Problem: generations follows demand (unit commitment problem)

- Plan/control the commitment of the large power plants based on demand
- → fulfil the overall energy demand at all times
- → respect the constraints of the power plants
- → include ´reserve´ capacity (upwards and downwards)
- → ....
- → minimize costs

A well researched area for decades!

ELECTRICITY Markets

Different Time scales

- Long Term - Day ahead – Intra Day

Different Parties

- Energy consumers – Energy Suppliers – Energy Producers - Network Operators
- System has to be operated at a stable 50 hz; i.e. supply and demand have to be balanced on European level at all moments in time
- Network constraints have to be taken into account

Impact of the changes/transitions

1. Production by sun/wind is not controlable

2. Charging = large and partly synchronized loads

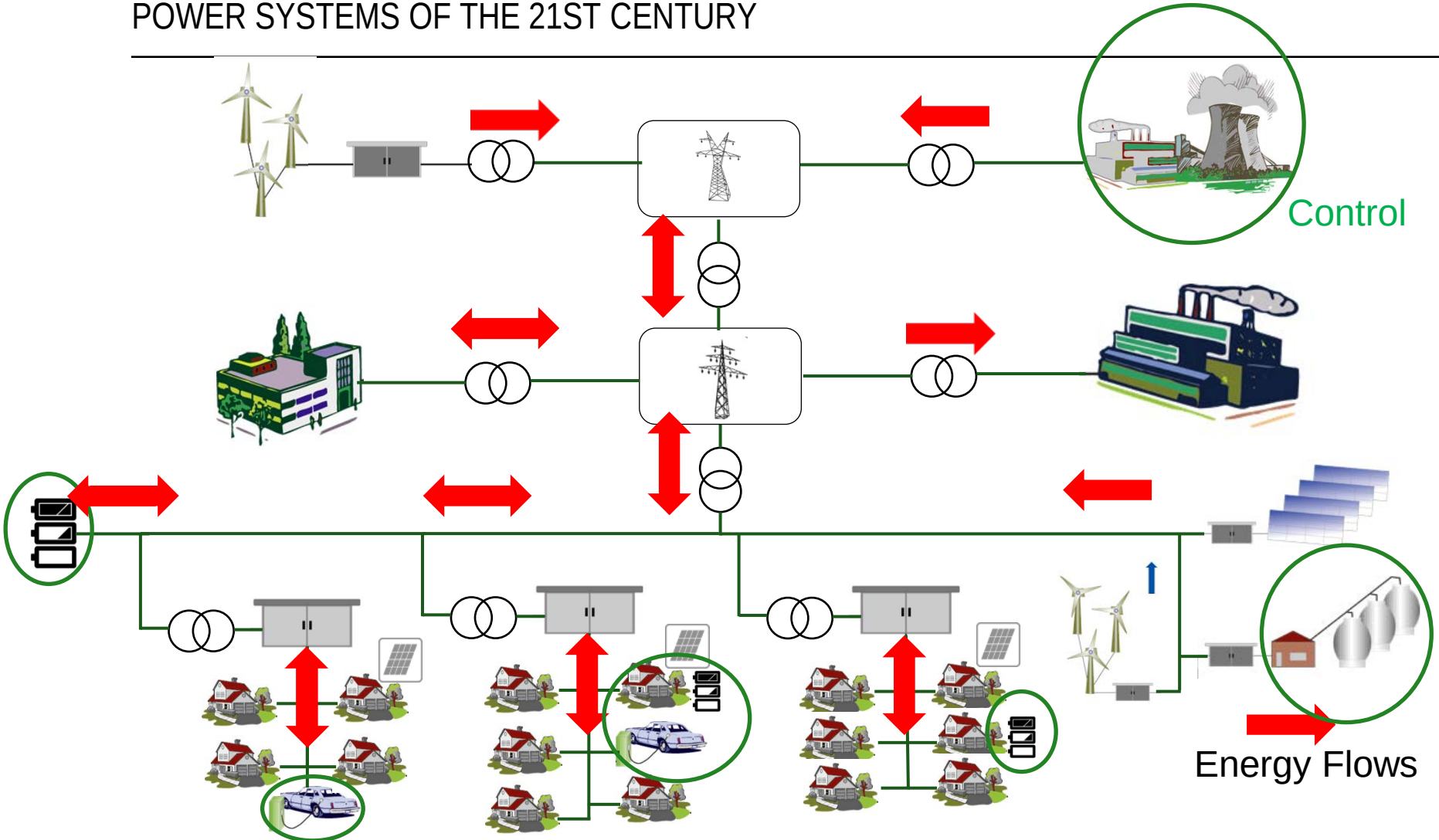
5. Storage = flexible and controlable

3. Heating = large and partly synchronized loads

4. Some (new) assets are controlable

ENERGY TRANSITION

POWER SYSTEMS OF THE 21ST CENTURY



ELECTRIFICATION

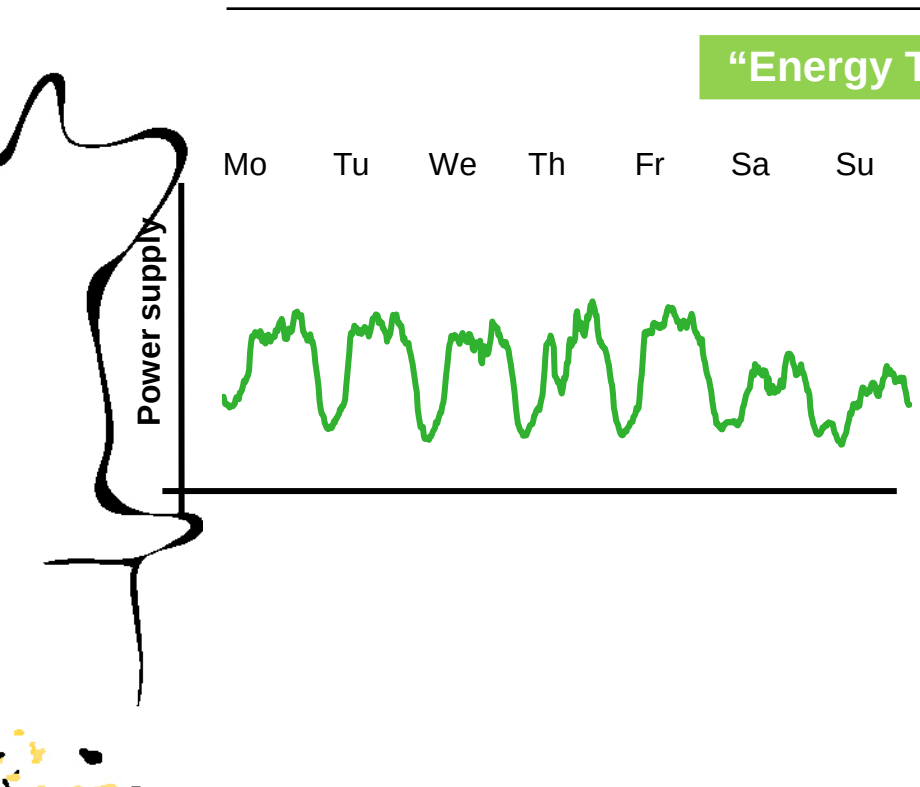
DOMESTIC LOADS, TYPICAL CONSUMPTION

Some energy consumption figures:

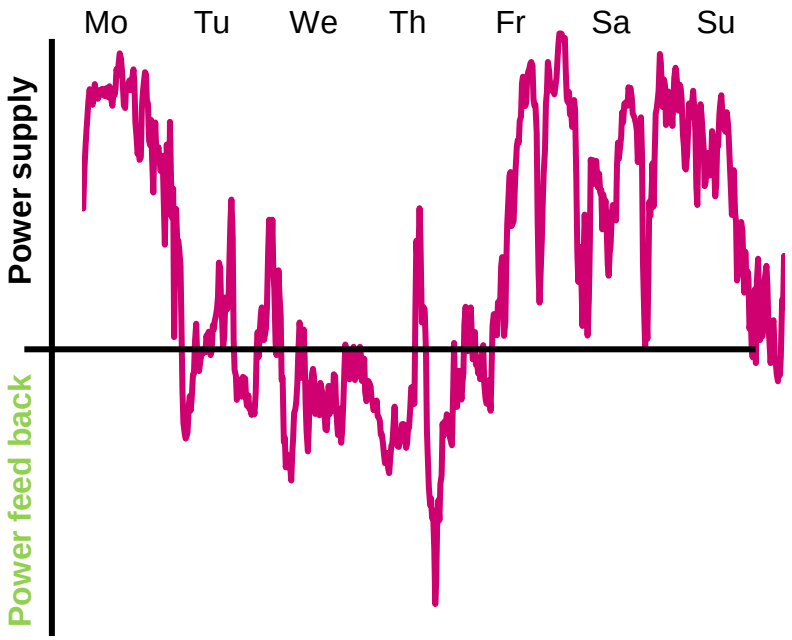
- Household:
  - Energy: ~3000 kWh/year, ~ 10 kWh / day (when home)
  - Power: 0.5-1 kW during evening, not often above 3 kW
- Electric vehicle:
  - Energy: 20-100 kWh battery, 10 kWh = ~60 km of range
  - Power: up to 7 or 11kW charging at home
- Heat Pump:
  - Energy: ~4000 kWh electric (depending on insulation)
  - Power: 2 to 3 kW electric when heating

THE ENERGY TRANSITION TAKES PLACE IN THE DISTRIBUTION GRID!

FLUCTUATING POWER FLOW IN DISTRIBUTION GRIDS

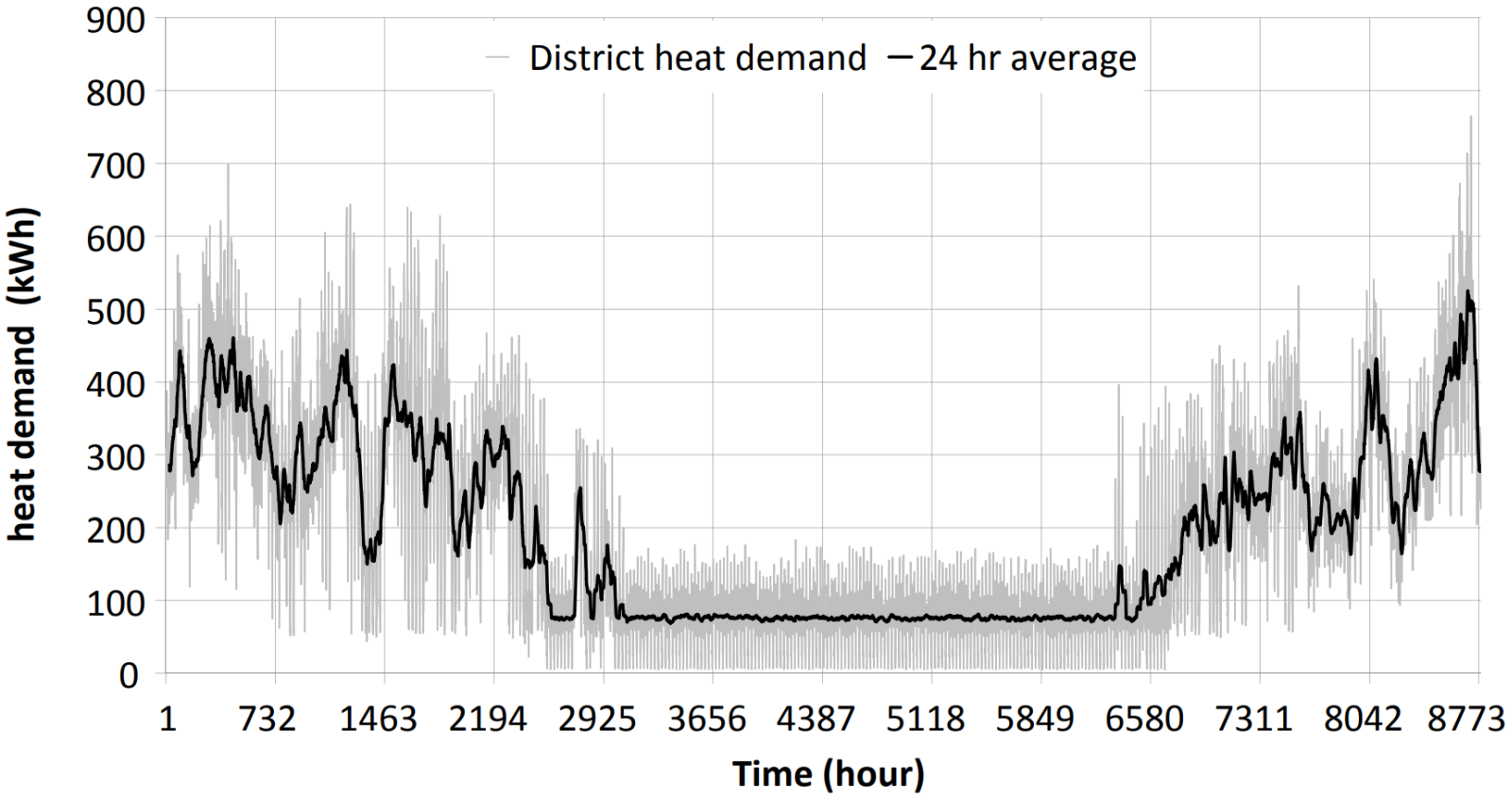


“Energy Transition”



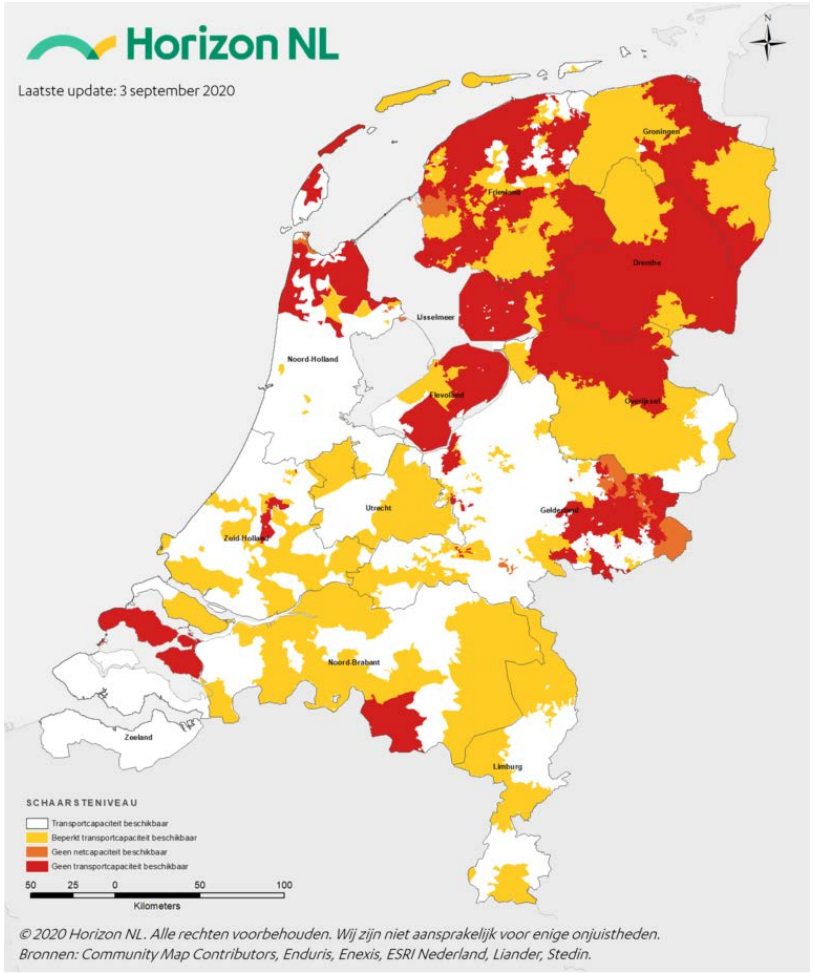
ELECTRIFICATION

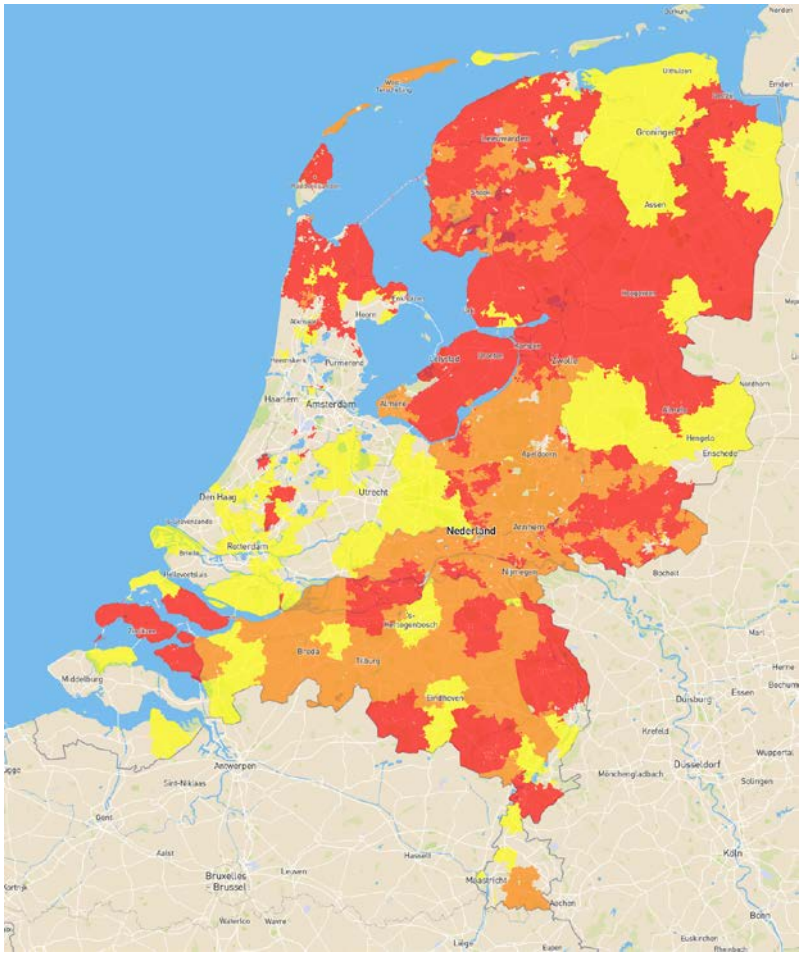
HEAT DEMAND



NEED FOR SMARTNESS

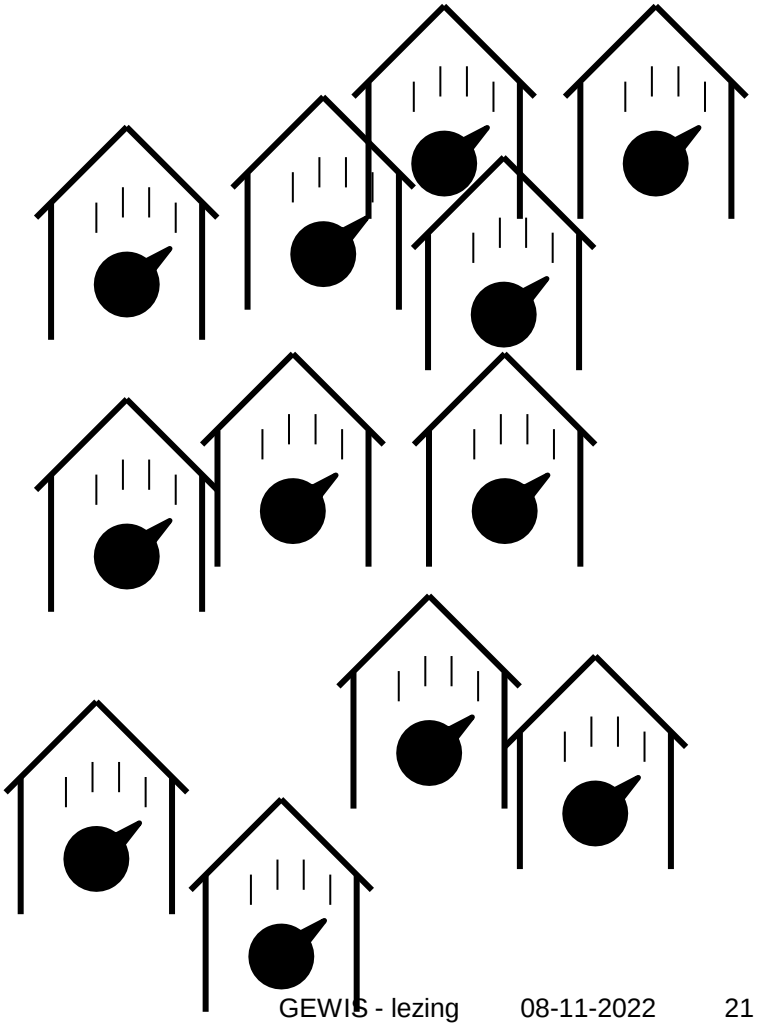
CONGESTED GRIDS IN THE NETHERLANDS





FUTURE PLANNING IN THE ENERGY SUPPLY CHAIN

CHANGE FROM ‘CENTRALIZED ’TO ‘DECENTRALIZED’ CONTROL

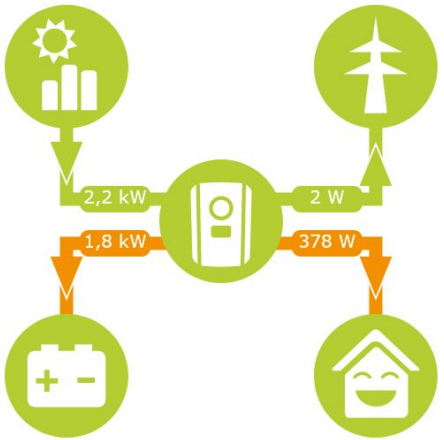


NEEDED: CHANGE IN ENERGY MANAGEMENT

- Energy Management Systems (EMS) needs to get also inside homes
  → Decentralized Energy Management (DEM)
  - Integrate smart appliances in homes → ‘Home Energy Controllers’

HOUSE – PV – BATTERY

HOW TO COMBINE?



Standard Solution for Battery Control?

- Maximize local consumption
- Keep value at meter to 0 (as long as possible)

Intelligent/Suistainable Solution?

- Reduce also peak loads (support total energy system)

NEEDED: CHANGE IN ENERGY MANAGEMENT

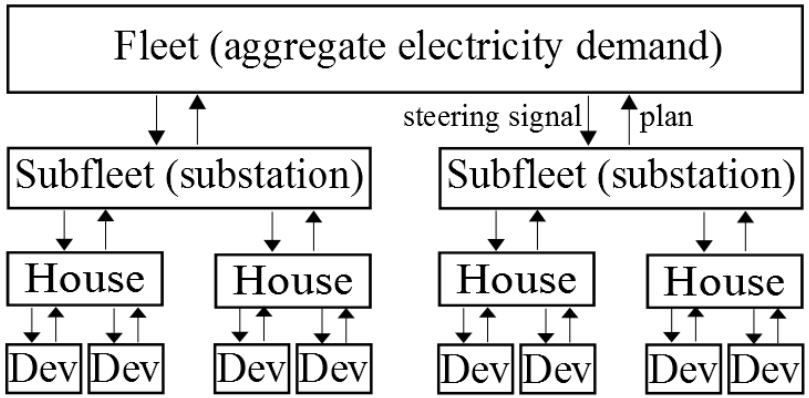
- Energy Management Systems (EMS) needs to get also inside homes
  → Decentralized Energy Management (DEM)
  - Integrate smart appliances in homes → ‘Home Energy Controllers’

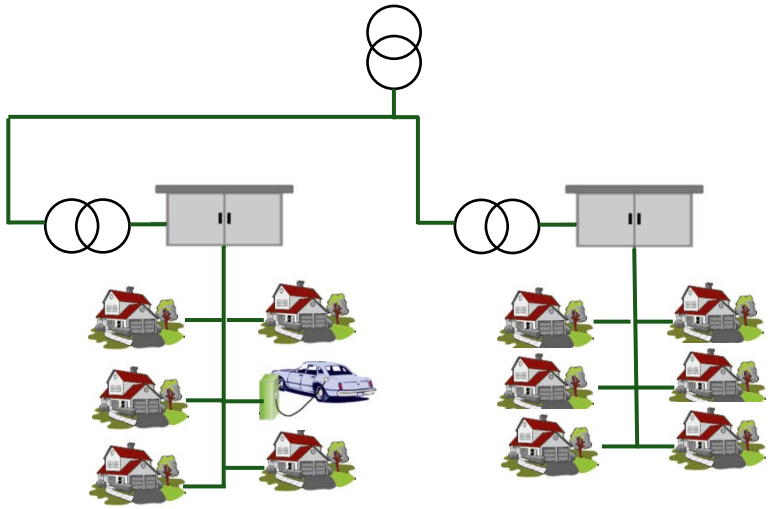
- The local systems have to be integrated to a global system

DECENTRALIZED ENERGY MANAGEMENT

CORE OF OUR TOOL ´DEMKIT´

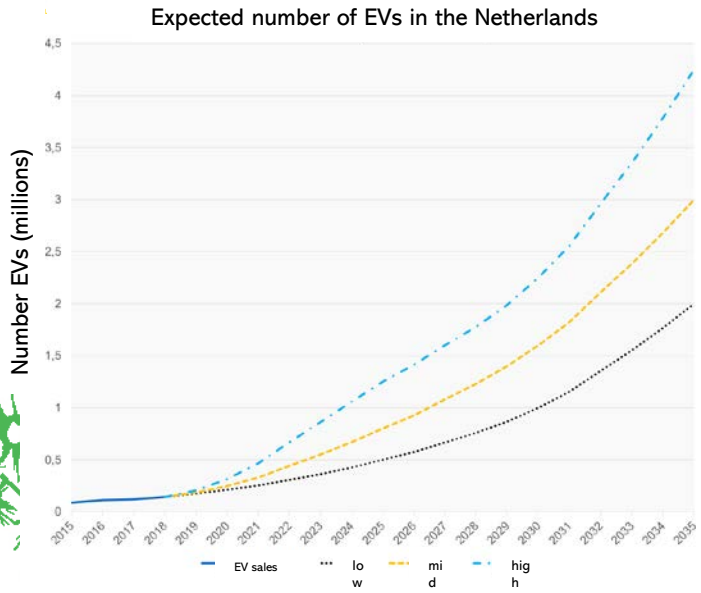
- Use structure of the grid

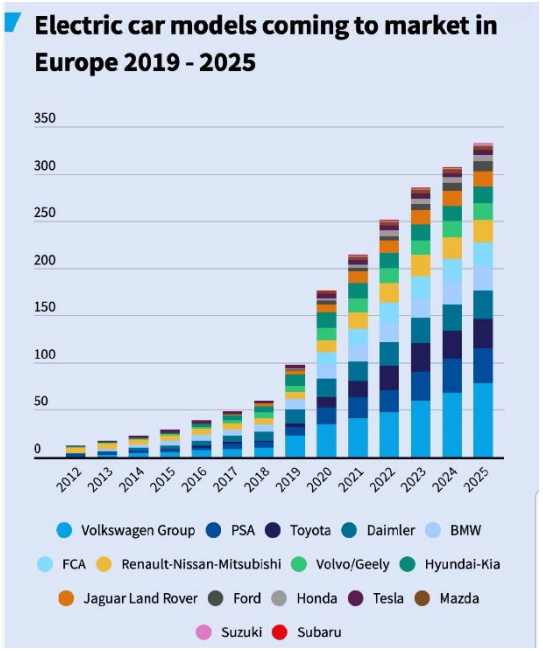




- Allows for integration of ´privacy aspects´

ONE CHALLENGE: INCREASE OF ELECTRIC VEHICLES





LOCHEM

ACTIVE COMMUNITY IN THE ENERGY TRANSITION

Focus on:

- Effects of PV and EV integration
- Demand Side Management

LOCHEMENERGIE
Je eigen energie

alliander

Locamation
smart smart grid solutions

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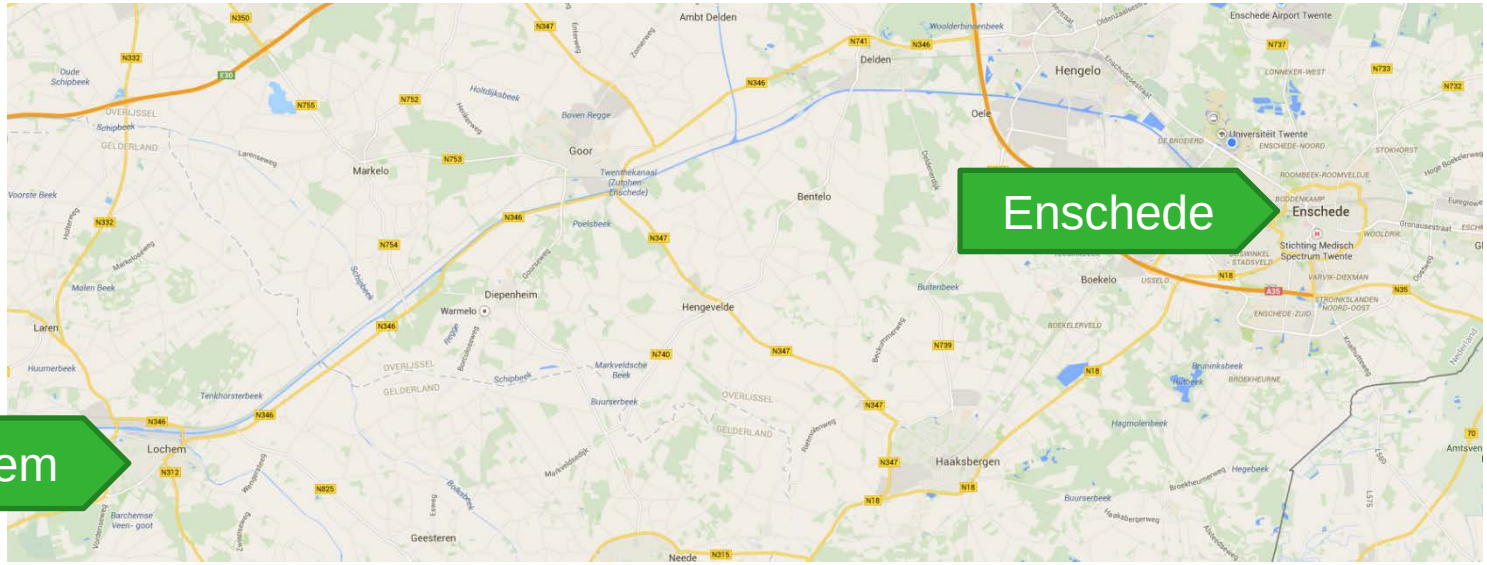
EATON
Powering Business Worldwide



LOCHEM

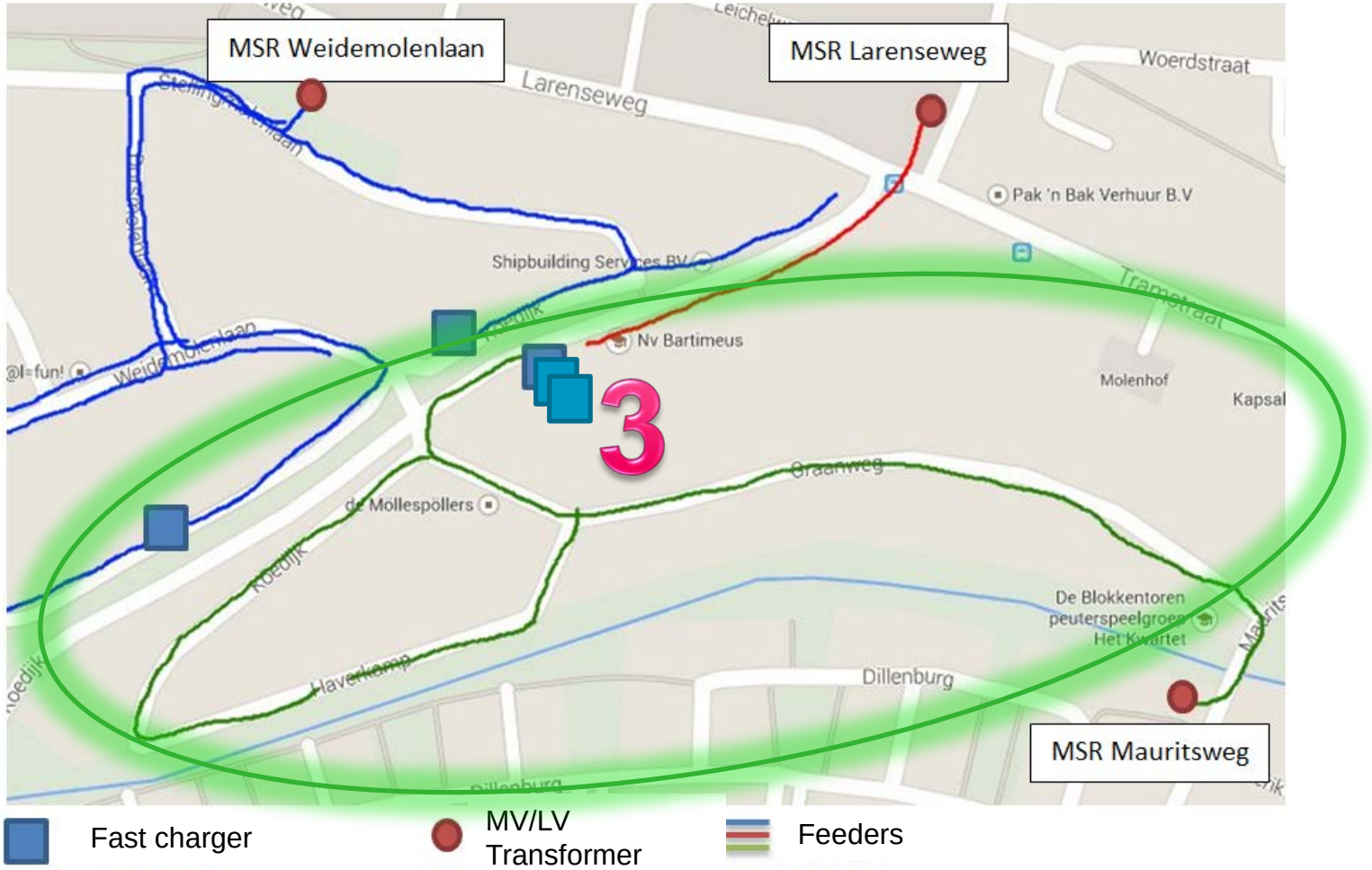
PROJECT X LOCHEM (2016)

Test a 2025 scenario

- 12,5% market share of EVs in NL by then
- 80 households in considered network
- So ~10 EVs
- However:
  - “rich” neighbourhood
  - Rural area
  - **What if it is 25% penetration of EVs?**
- Furthermore: **Electrification**
  - Getting rid of gas for cooking and space heating

LOCHEM FIELD TEST

PROJECT X LOCHEM

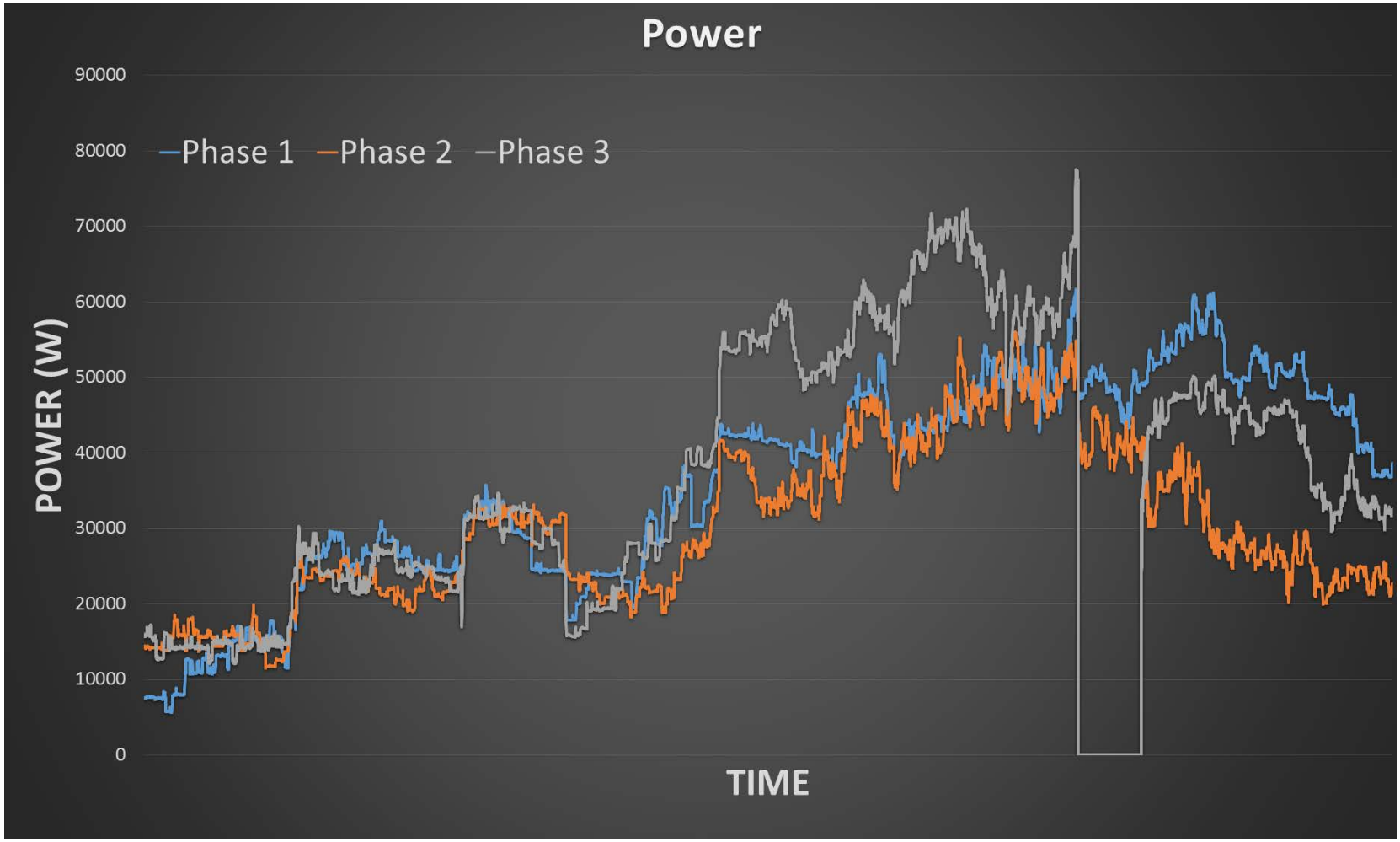


LOCHEM
TEST SETUP

- Field test setup:
  - 18:30: Initial measurement
  - 19:00: Attach 3 Fast charging EVs, charging at 3 x 32A
  - 19:30: Add 17 other (PH)EVs, charging at 1x 10-16A (2kW – 3.7kW)
  - 19:45: Bake 20 pizzas
    - substitute for induction cooking, you need to be creative ;-)
  - 20:00: Further electrification using other electric loads
    - heaters and washing machines

LOCHEM

POWER AT TRANSFORMER



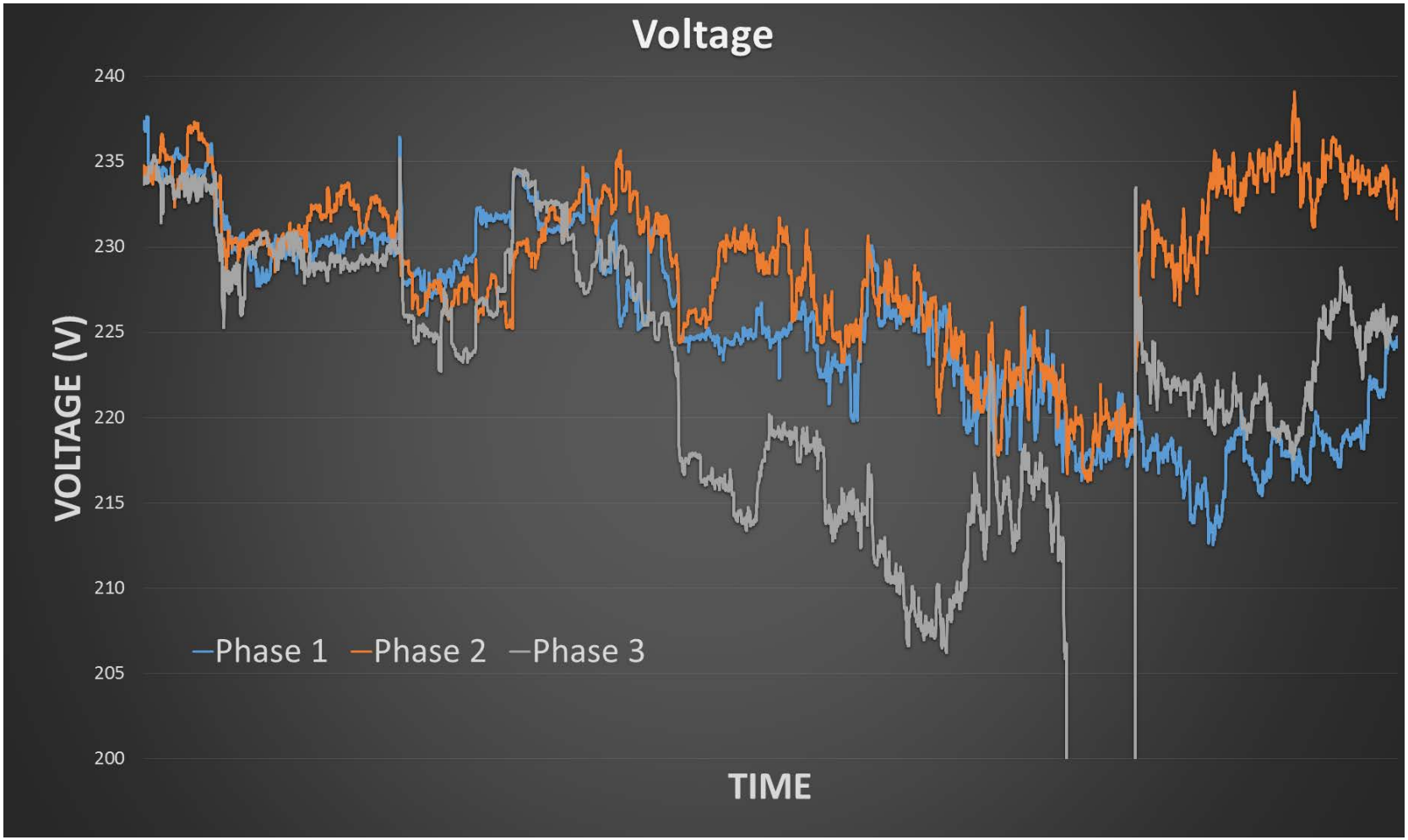

BigEZ
VOLTCRAFT.
MODE
max
min
205.7
0.00
49.96


WEBER
160A
NHGFF 2
500V~ I, 120 kA
gFF


1-ZPL-40
NL
TESLAMOTORS.COM
Model S

LOCHEM

VOLTAGE AT THE CHARGING POLE (END OF NETWORK)

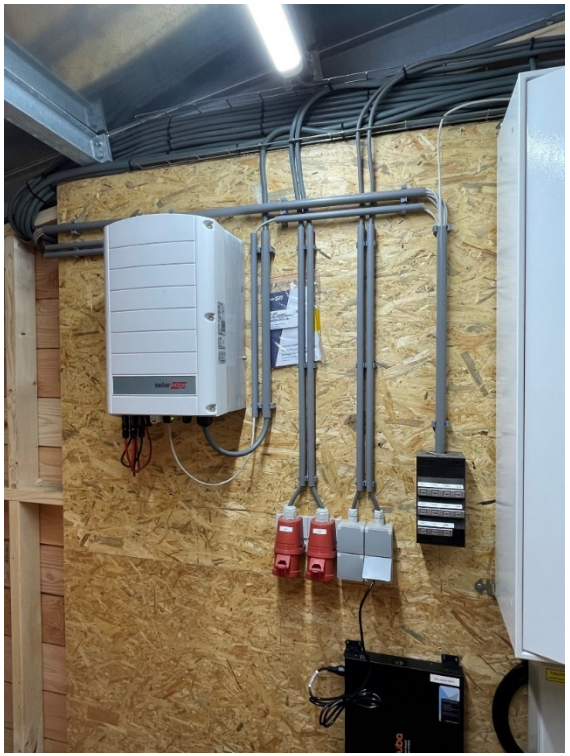


PILOT SITE LOCATED AT OUR CAMPUS

USED IN RESEARCH PROJECTS (SLIMPARK AND GRIDSHIELD)

PILOT SITE LOCATED AT OUR CAMPUS

EQUIPMENT



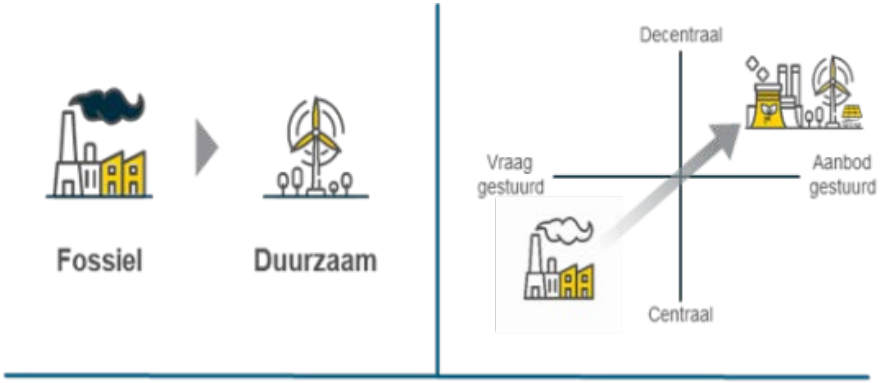
PILOT SITE LOCATED A.S.R. (INSURANCE COMPANY)

USED IN RESEARCH PROJECT (GRIDSHIELD)

SUMMARY

THERE IS NO ALTERNATIVE TO A SMART GRID!

The control of the energy system has to change
from
top-down and centralized
to
bottom up and decentralized



QUESTIONS?

MORE INFORMATION: WWW.UTWENTE.NL/EEMCS/ENERGY/