International workshop

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The conventional grid

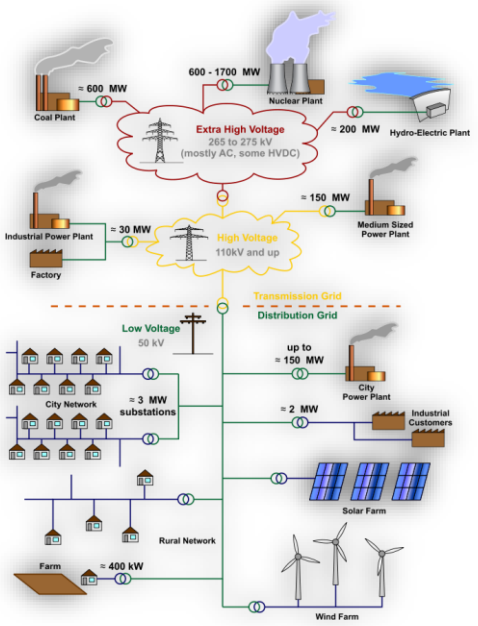
Source: E.ON / www.youtube.comwatchv=SnOp83-aKgk

The old grid

An electrical grid is installations, substations, lines and cables for the transmission and distribution of electricity. (IEV ref. 692-01-03)

generated power = consumed power

- Centralized generation
- One-way structure
- Control
  - voltage magnitude
  - frequency
  - phase
  - wave shape / harmonic content

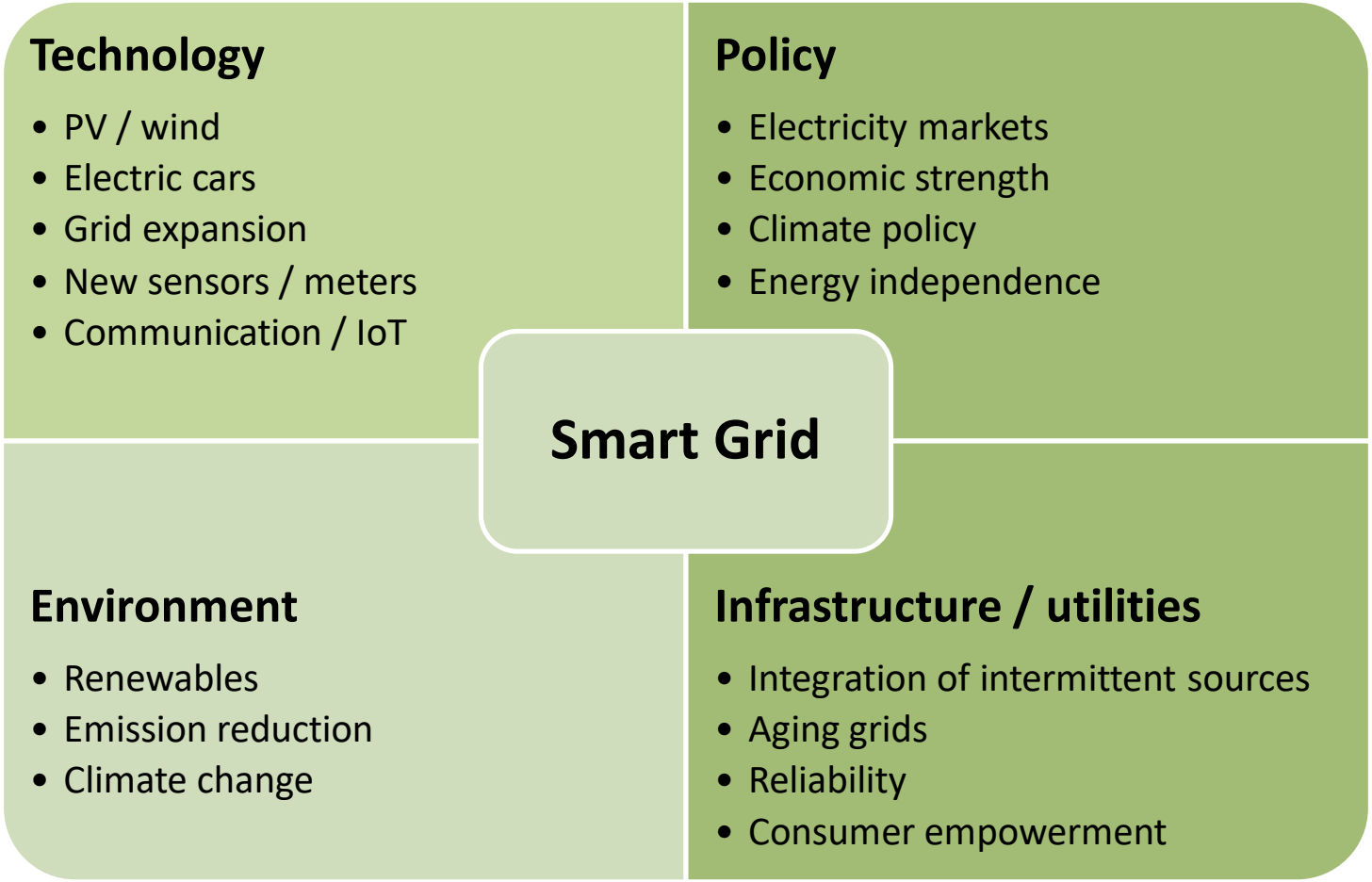


Picture: wikimedia.org

The Smart Grid

Source: E.ON / www.youtube.comwatchv=SnOp83-aKgk

Drivers for new grid structure



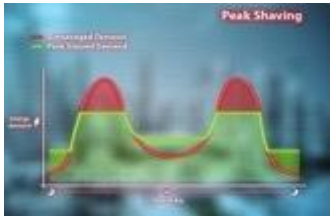
Need for decentralized structures

Significant demand for grid stability

Cheap & Scalable

Sustainable

High-volume & Short-term

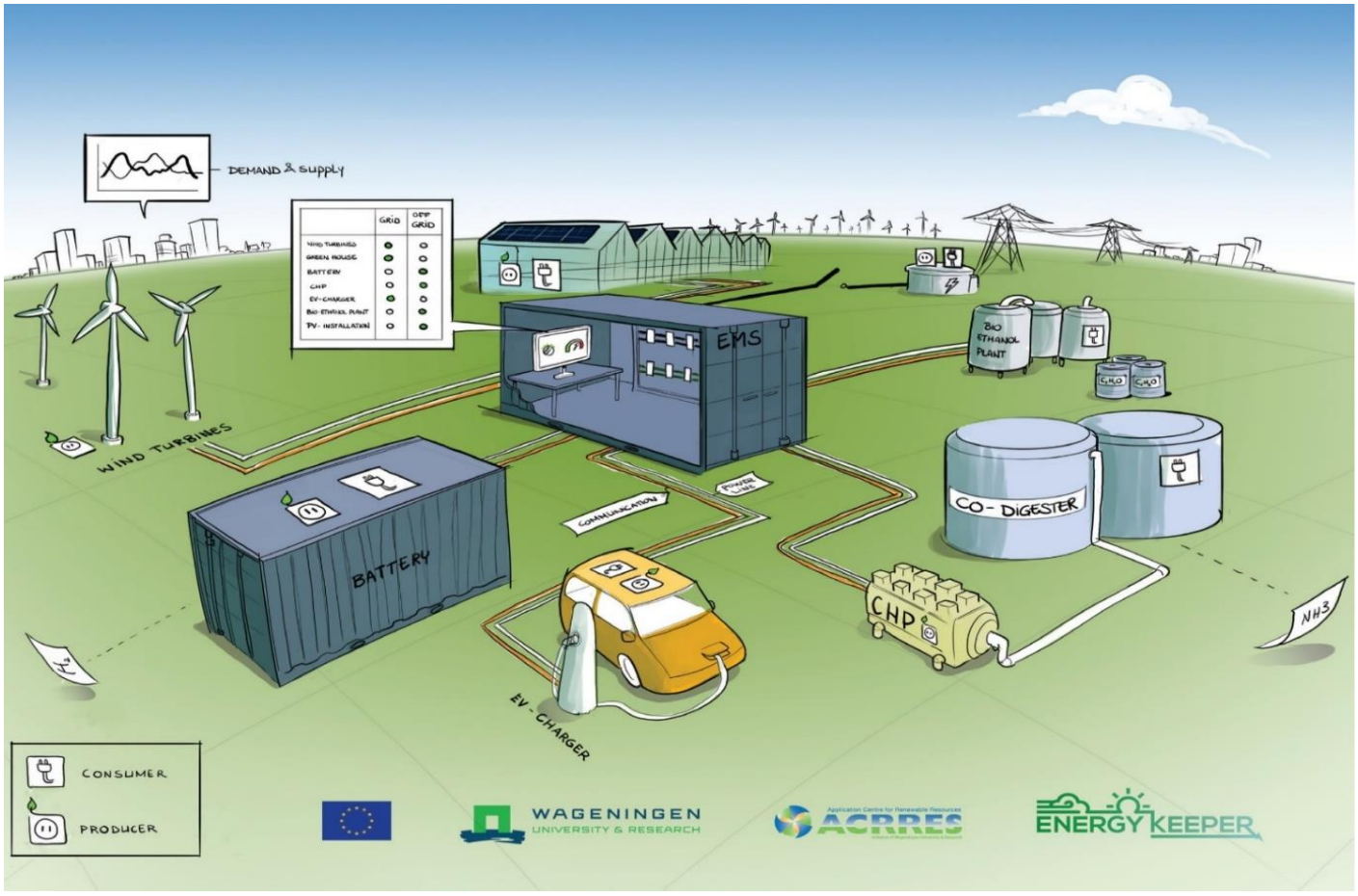


Benefits of smart grids

- Two-way communications and distributed "intelligent" devices

- Smart, resilient, flexible and reliable power grid
- **Improved grid efficiency**
- Integration of **energy storage**
- Reduction in transmission and distribution losses
- Integration of **larger share of intermittent**, renewable generation plants
- Integration of **distributed generation** and storage (+micro grids)
- Participation of consumers → "**Prosumer**" (business models)
- Handling of new loads (e.g. **charging stations**, electric cars, demand response, …)
- Reduced emissions/pollution → low carbon society
- Enabling of new business models
- New jobs

Goals

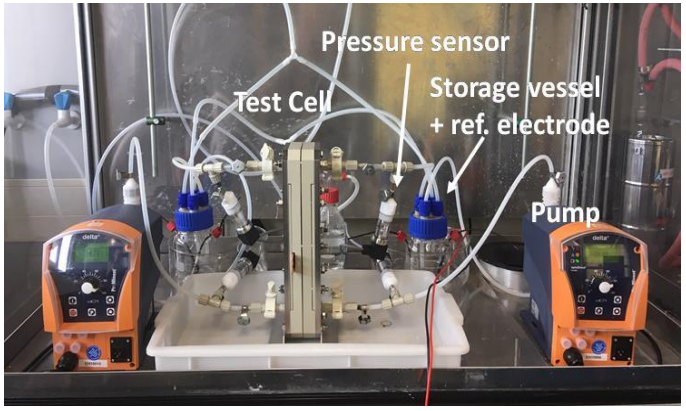

DEMAND & supply
GRID
OFF GRID
WIND TURBINES
EMS
BIO ETHANOL PLANT
BATTERY
COMMUNICATION
POWER LINES
CO-DIGESTER
CHP
NH3
EV-CHARGER
CONSUMER
PRODUCER
WAGENINGEN UNIVERSITY & RESEARCH
ACRRES
ENERGY KEEPER

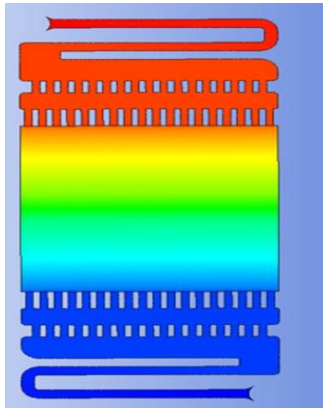
EnergyKeeper partners

Coordinator

Active material & stack research

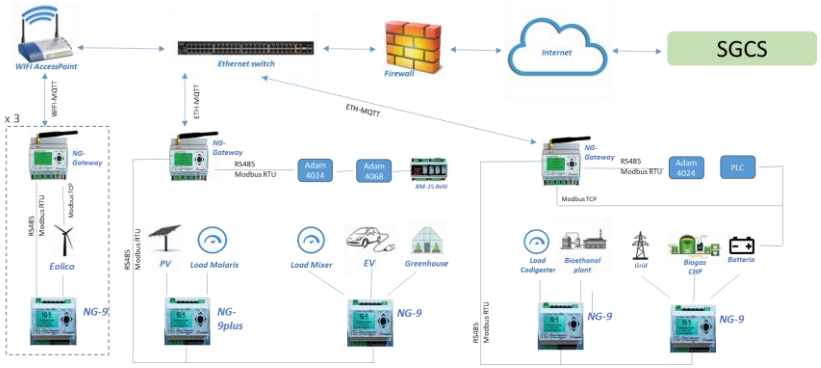
- Synthesis of three new organic electrolytes
- Modeling of the electrochemical reactions and transport processes as well as computational fluid dynamic (CFD) models of cell stacks
- Design and construction of a 100 cm2 redox flow battery cell for rapid aging tests on membranes
- Autumn school on RFB in Barcelona (2018)

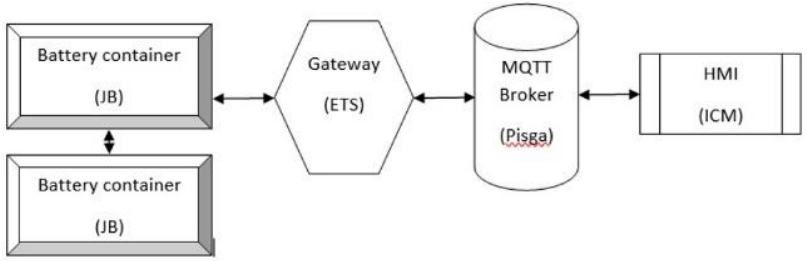




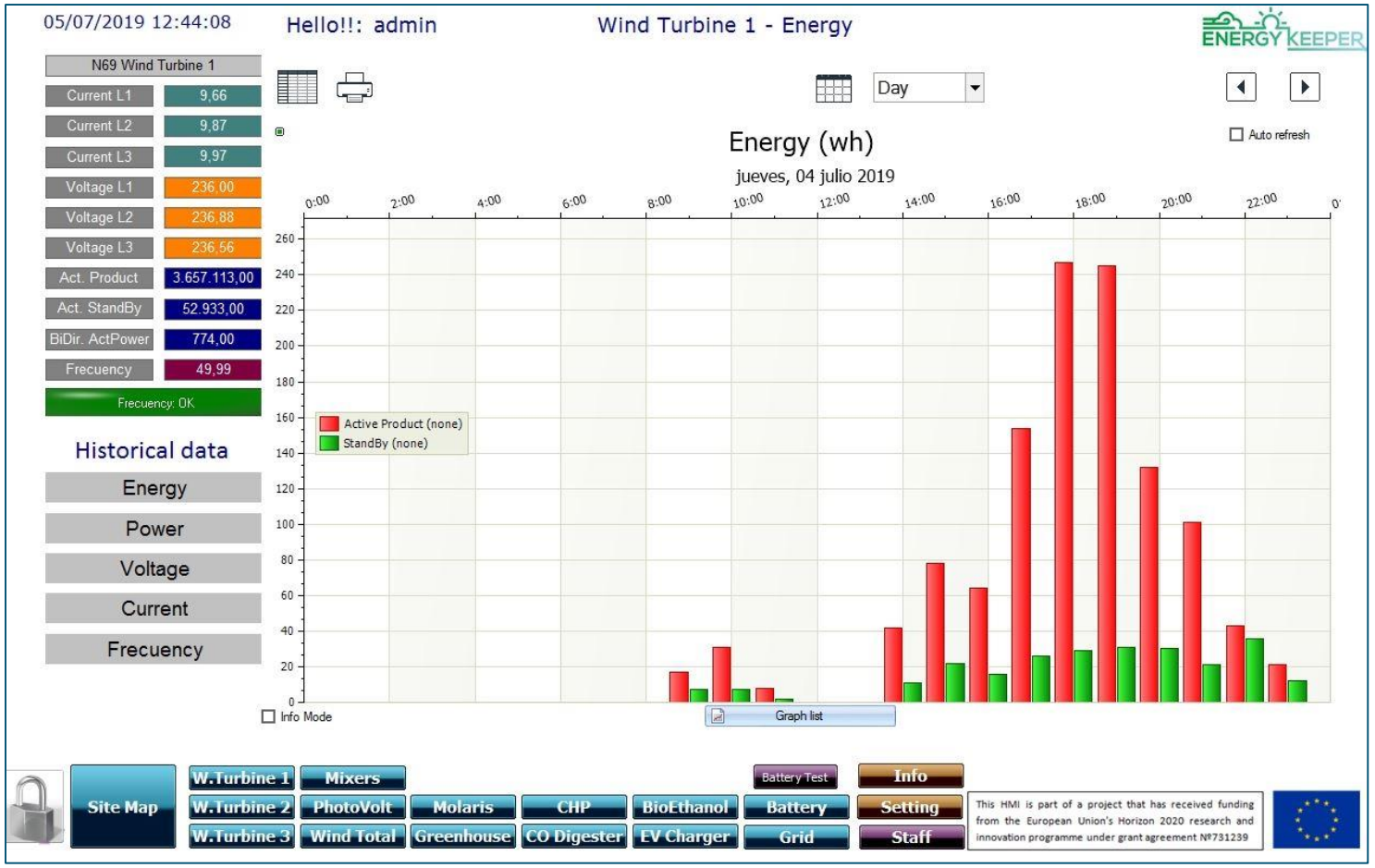
Smart grid control system

- Complete system for the control of the network able to optimize the use of the EES system and enabling interoperability, functioning mode prediction and capable of fast response to grid change
- Smart grid control algorithm based on prosumer business models
- Control and monitoring interface

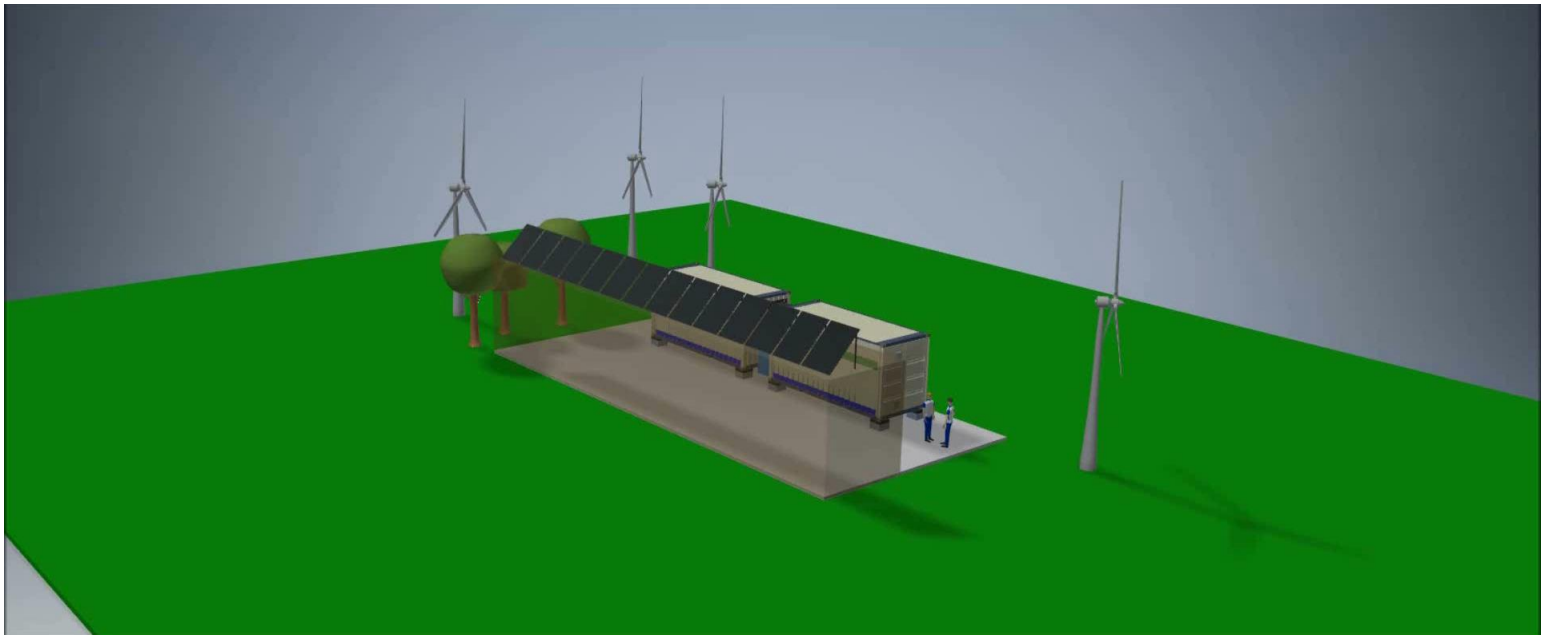




Human machine interface



Metal-free redox flow battery

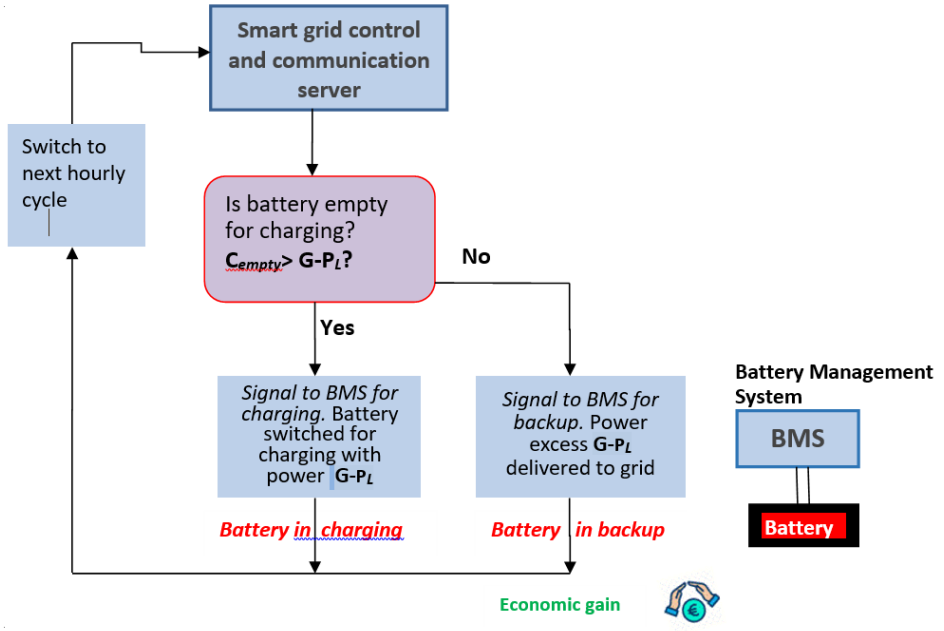


JENA BATTERIES

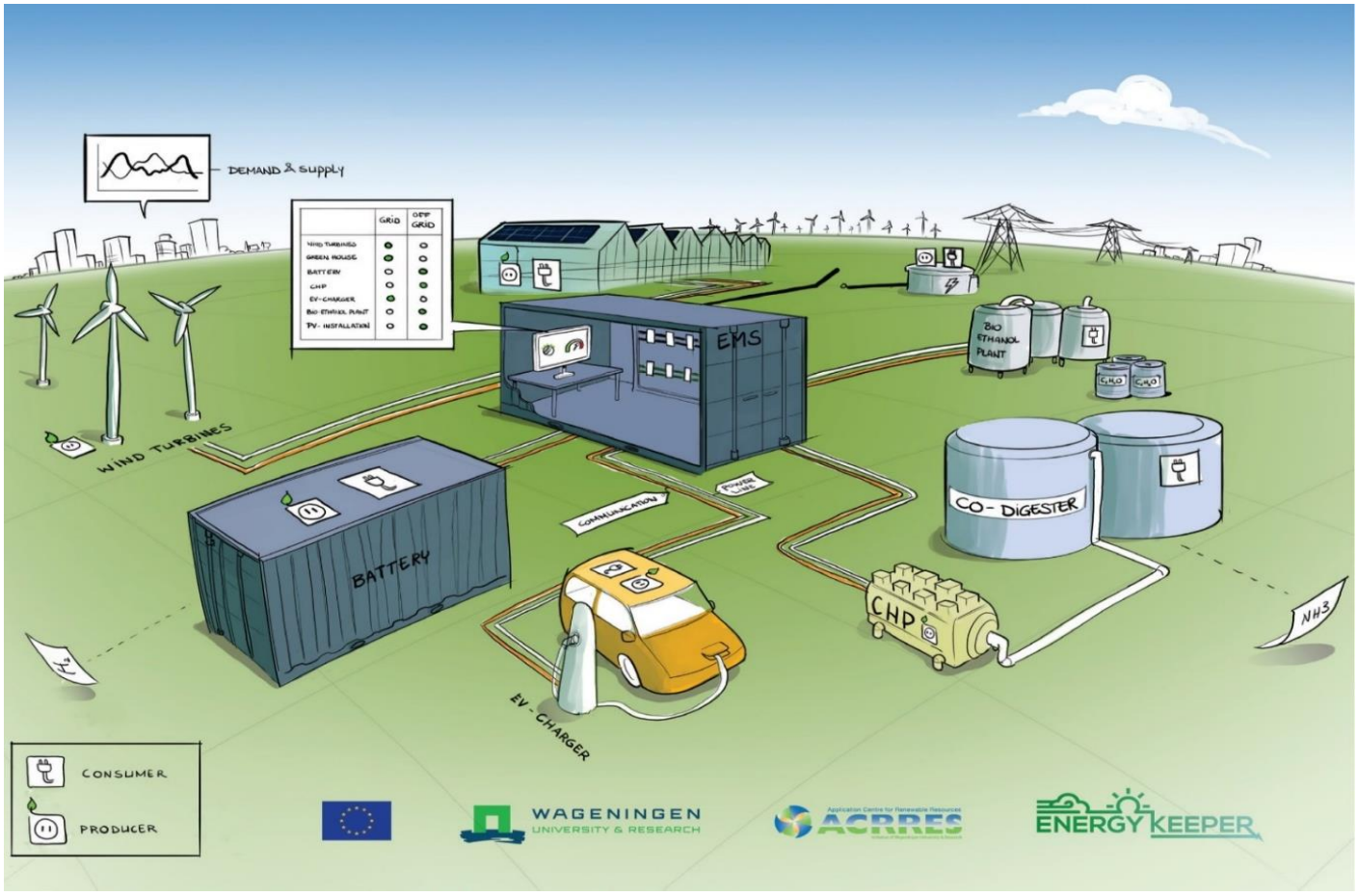
Business models & policy

- Investigation of prosumer business models centered on electrical energy storage → Prosumer = active consumer (consumes and produces electricity)

- Microgrid model
- Energy trade model
- Demand response model



ACRRES test site



The ACRRES smart gird test site

Andries Visser

ACRRES Mission & assets

To develop, test and demonstrate innovative technologies (prototypes) for renewable energy and biobased resources

- First step to market application
- Room for experiments
- Experience in licenses, construction, project research
- Independent support

VETZUREN
ANTI-OXIDANTEN
ELECTRICITEITSPRODUCTIE
METHAAN
REST
ALGENCAKE
ALGENCAKE
ALGENCAKE
OLIE
OMEGA 3
ALGENPERS
MAIS...
DIGESTAAT
...STRO-REST
...KORREL
CO_2
STRO-RESTEN
STRO-RESTEN
DIGESTAAT
ALGENTEELT
VOORBEWERKER
BIOGAS
COVERGISTER
MAISKORRELS
CO_2
WARMTE
FERMENTATIERESTEN
BIO-ETHANOL
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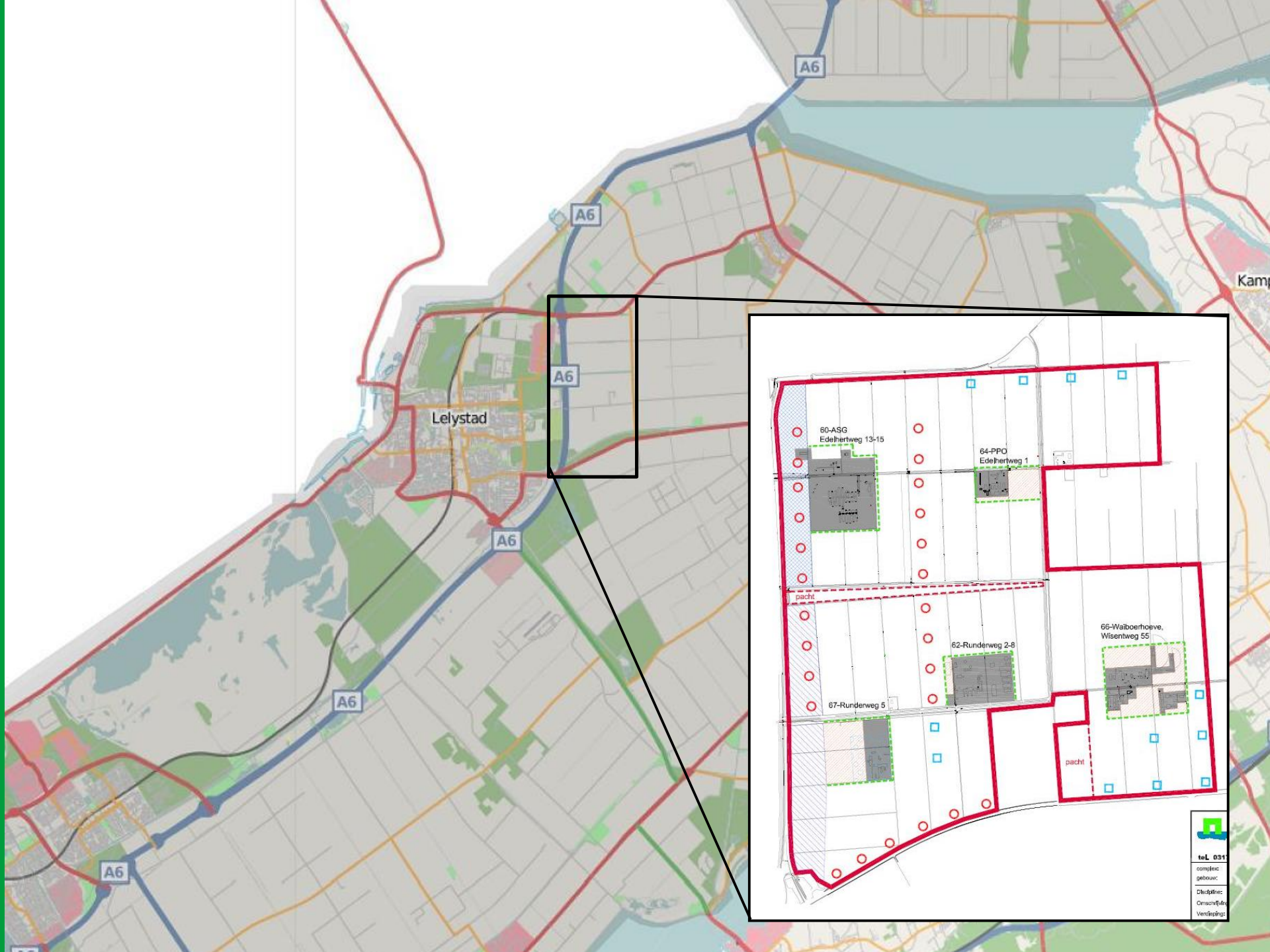
ELECTRICITEITSPRODUCTIE
ZONNEWEIDE
BIO-ETHANOL
BIO-ETHANOL


A6
A6
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Lelystad
60-ASG
Edelhertweg 13-15
64-PPO
Edelhertweg 1
pacht
62-Runderweg 2-8
66-Waiboerhoeve,
Wisentweg 55
67-Runderweg 5
pacht

Wageningen wind park

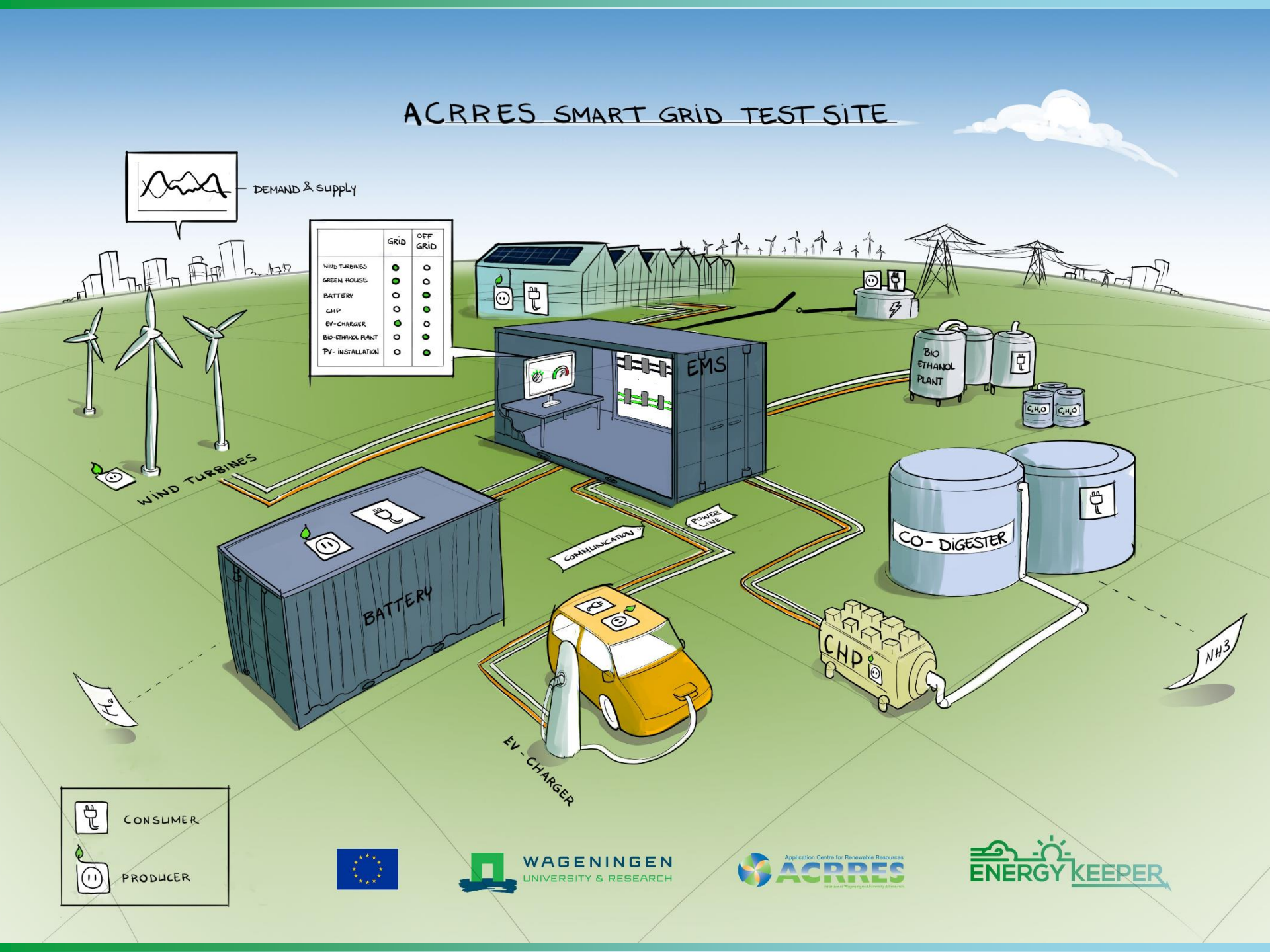
- 2004: 6 x Negmicon 1 MWe
- 2006: 20 x Enercon 2,3 Mwe
- 2015: 3 x Enercon 3 MWe

Total capacity: 52 MWe

Annual production of 85.000.000 kWh

Test site for windturbines (12 locations)

Info: Andrea Terbije


ACRRES SMART GRID TEST SITE
DEMAND & supply
GRID
OFF GRID
WIND TURBINES
GREEN HOUSE
BATTERY
CHP
EV-CHARGER
BIO-ETHANOL PLANT
PV- INSTALLATION
EMS
BIO ETHANOL PLANT
C2H5O
C2H5O
WIND TURBINES
POWER LINE
COMMUNICATION
CO-DIGESTER
BATTERY
CHP
NH3
EV-CHARGER
CONSUMER
PRODUCER
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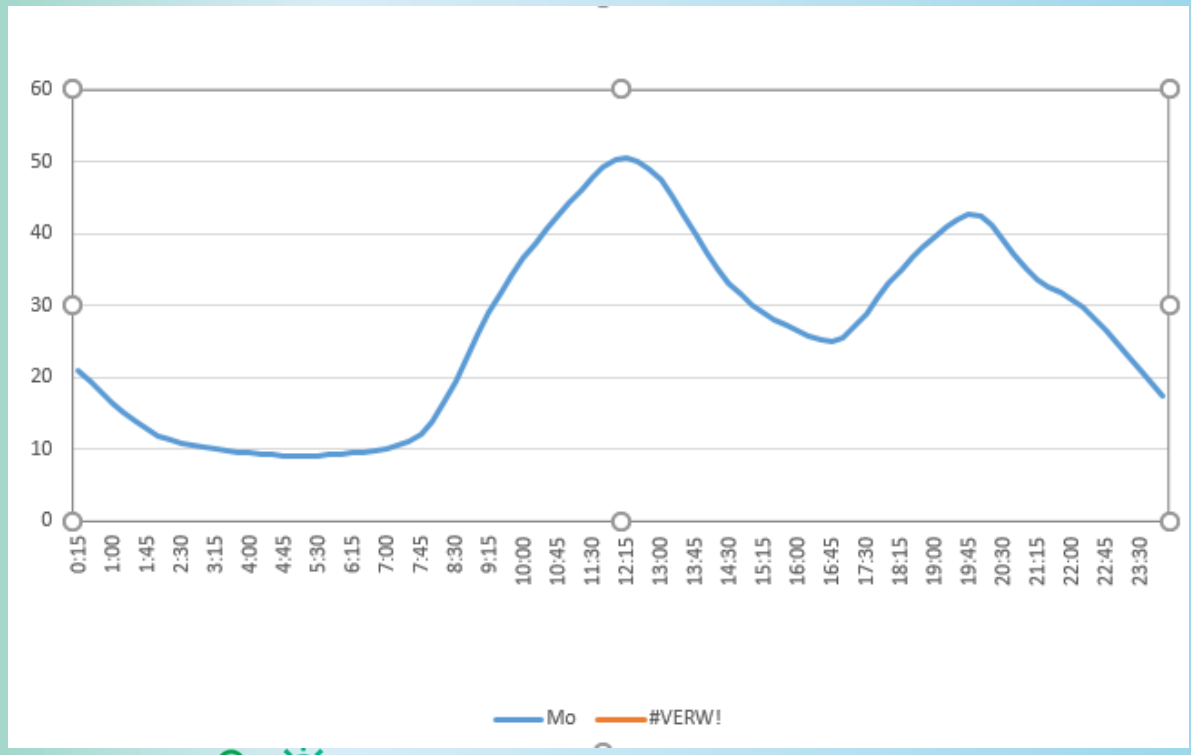
Application Centre for Renewable Resources
ACRRES
ENERGY KEEPER

Testing for EnergyKeeper

- An additional load: 210 households based on an average German household



Visit to the test site at lunch

Energy Square (ACRRES test site 2.0)

- Translocate test site to main location
- Upscaling
  - 100 kW wind (4 x 10, 2 x 30 kW)
  - 2 MW solar panels
  - Hydrogen production unit (50 kW) in collaboration with ECN-TNO
- Integration with new energy / climate neutral farming systems (no diesel, electrification of machinery and processing etc.)

Thank you for your attention

ENERGY KEEPER