
alliander
Lunch lecture PowerWeb
Werner van Westering

Welcome!

- Quick introduction
- Intro Alliander
- Energy transition
- Sample projects
- ‘De Buurtbatterij’

Werner van Westering

Education:

2007 – 2010 Werktuigbouwkunde

2010 – 2011 Bestuur C.S.R. Delft

2011 – 2013 Master Systems & Control

TU Delft

Work experience:

2013 – 2014 Technical trainee

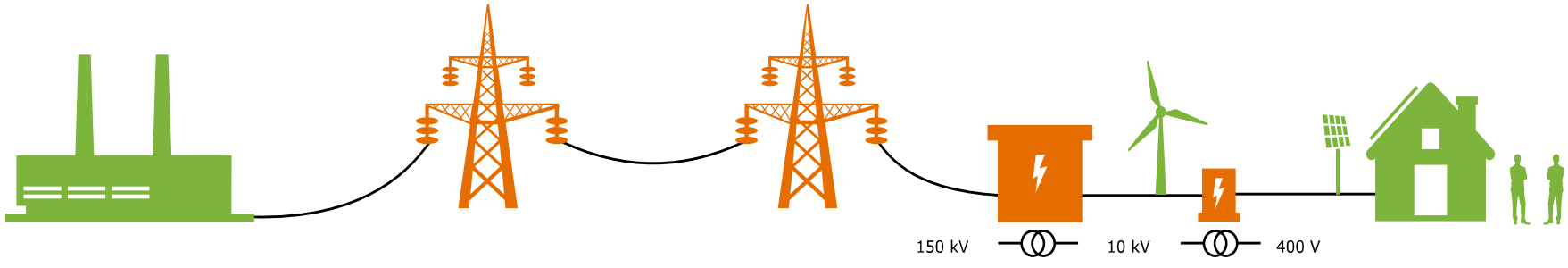
2014 – now (Senior) data scientist

2015 – now PhD. candidate (DCSC)

alliander

A small introduction

Introduction Alliander

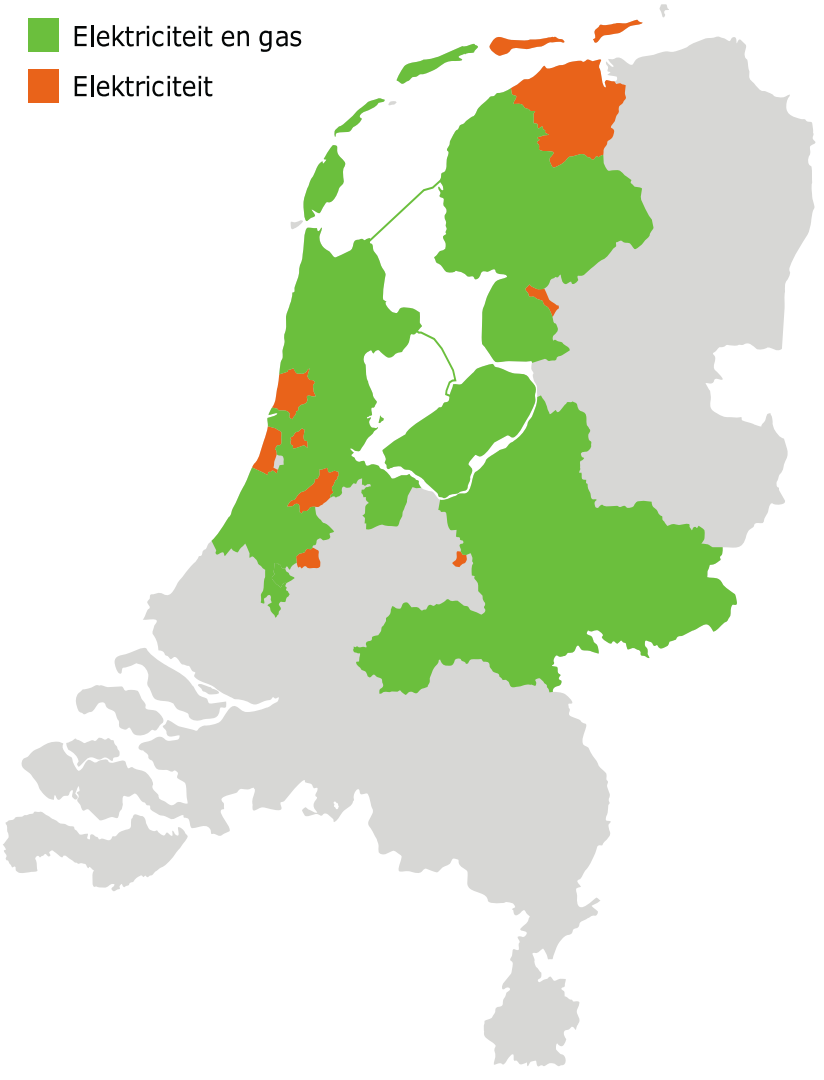


large-scale production

TSO
transmission system operator

DSO
distribution system operator

Illustrations by Enexis B.V.



Aantal klantaansluitingen
5,7 mln

Aantal medewerkers
7.170

Uitvalduur elektriciteit[1]
19,9 min.

CO_2-uitstoot
921 kton

Netto-omzet
1,7 € mld

Investeringen
570 € mln

Balanstotaal
7,7 € mld

Resultaat
323 € mln

Omvang elektriciteitsnetwerk
88.000 km

Omvang gasnetwerk
42.700 km

1 Betreft Liander

Gasnet

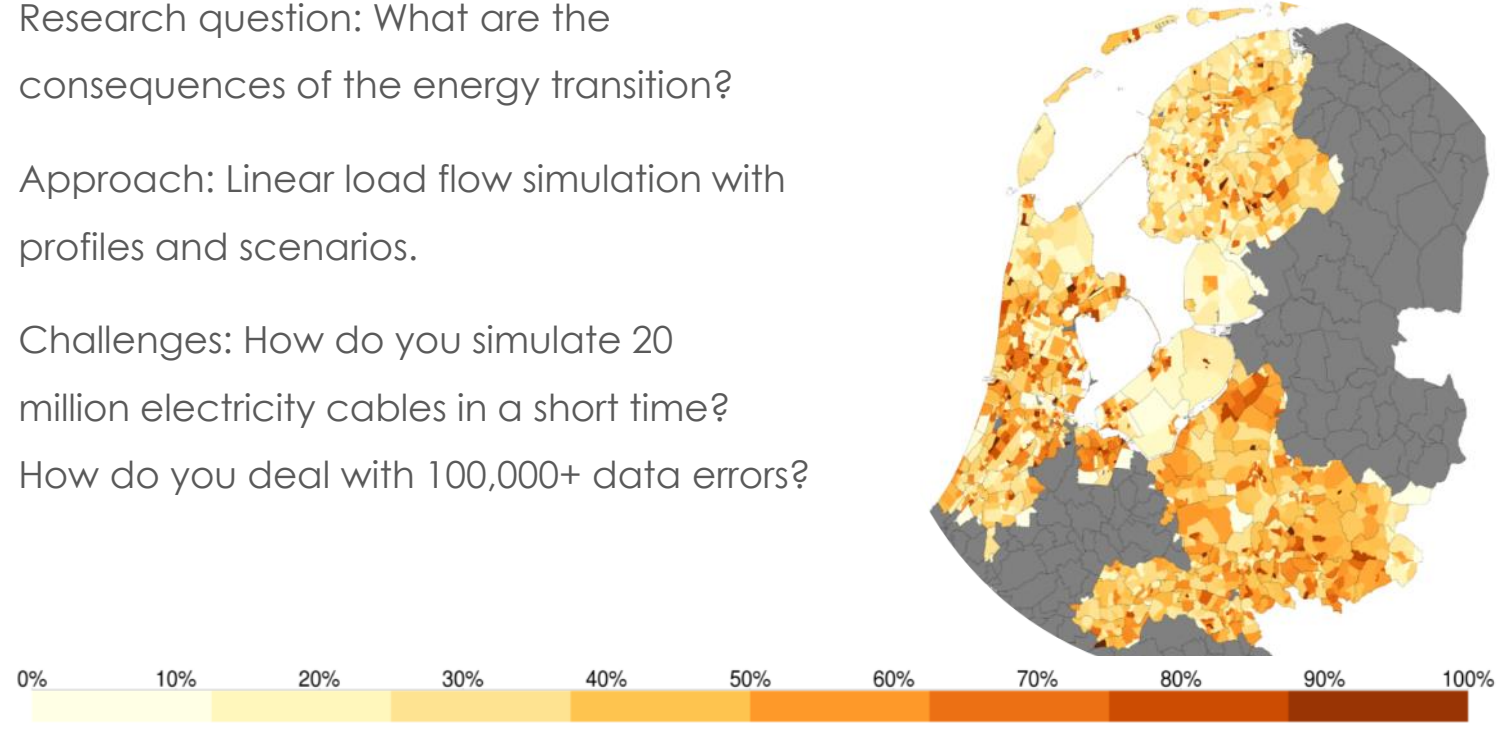

gasunie
transport services
Liander
national
transport network
40 bar
large consumer
gas receiving station
6
supply station
8 bar
compressor
supply station
large consumer
11
8 bar
district substation
100 mbar
% methane
7
4
12
Groen gas
CNG
10

Modeling the energy transition


G
E
PV:
8,9 kW
Heat
exchanger:
2 kW
E-boiler:
2kW
Heat pump:
1,6 kW

How often will this happen?

- Research question: What are the consequences of the energy transition?
- Approach: Linear load flow simulation with profiles and scenarios.
- Challenges: How do you simulate 20 million electricity cables in a short time? How do you deal with 100,000+ data errors?



Overloaded transformers per postal code area, 2050

ANDES technology adoption model

Input: 150 demographical aspects

Socio-demographic, e.g.:
- income
- education
- Life phase

House properties, e.g.:
- Type of house
- Value house
- Owned/rented

Financial info, e.g.:
- Savings
- insurance
- Other financial info

Vehicle information, e.g.:
- Number owned
- Segment
- Age

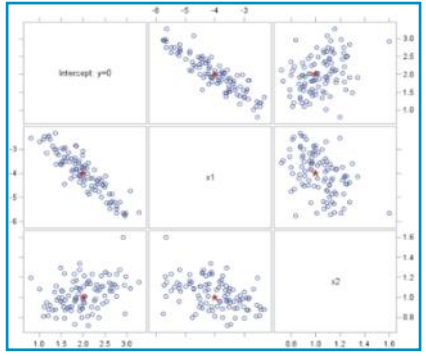
Media, e.g.:
- Internet behaviour
- Magazines
- TV channel preference

Buying habits, e.g.:
- Clothing segment
- Holidays
- Charity

Etcetera

Analysis: Probability of adoption is determined

- Multiple regression techniques were studied.



Regression analysis

Output: The adoption is predicted at zip-code level per technology up to 2050

- The result is an absolute number of EVs, HPs, and PV systems per zip code for every year.

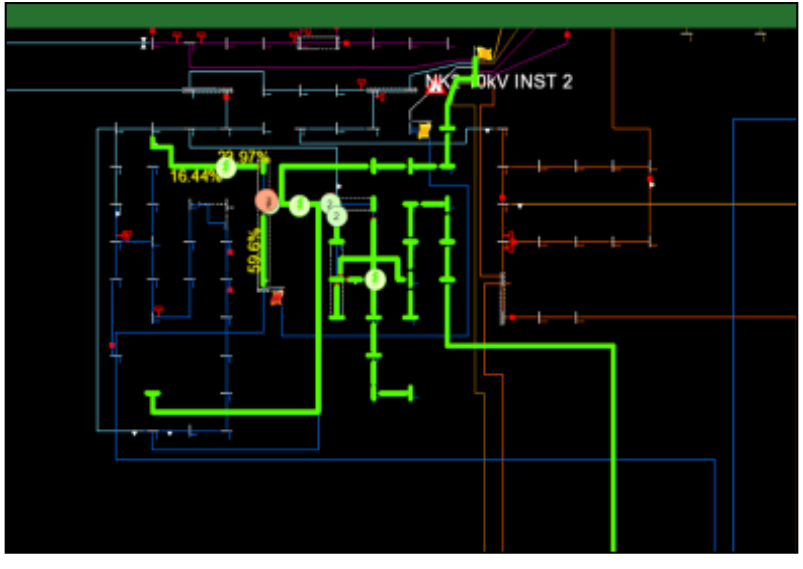
Local adoption for each household…

…in the Liander Service Area

New insights warrant new decisions

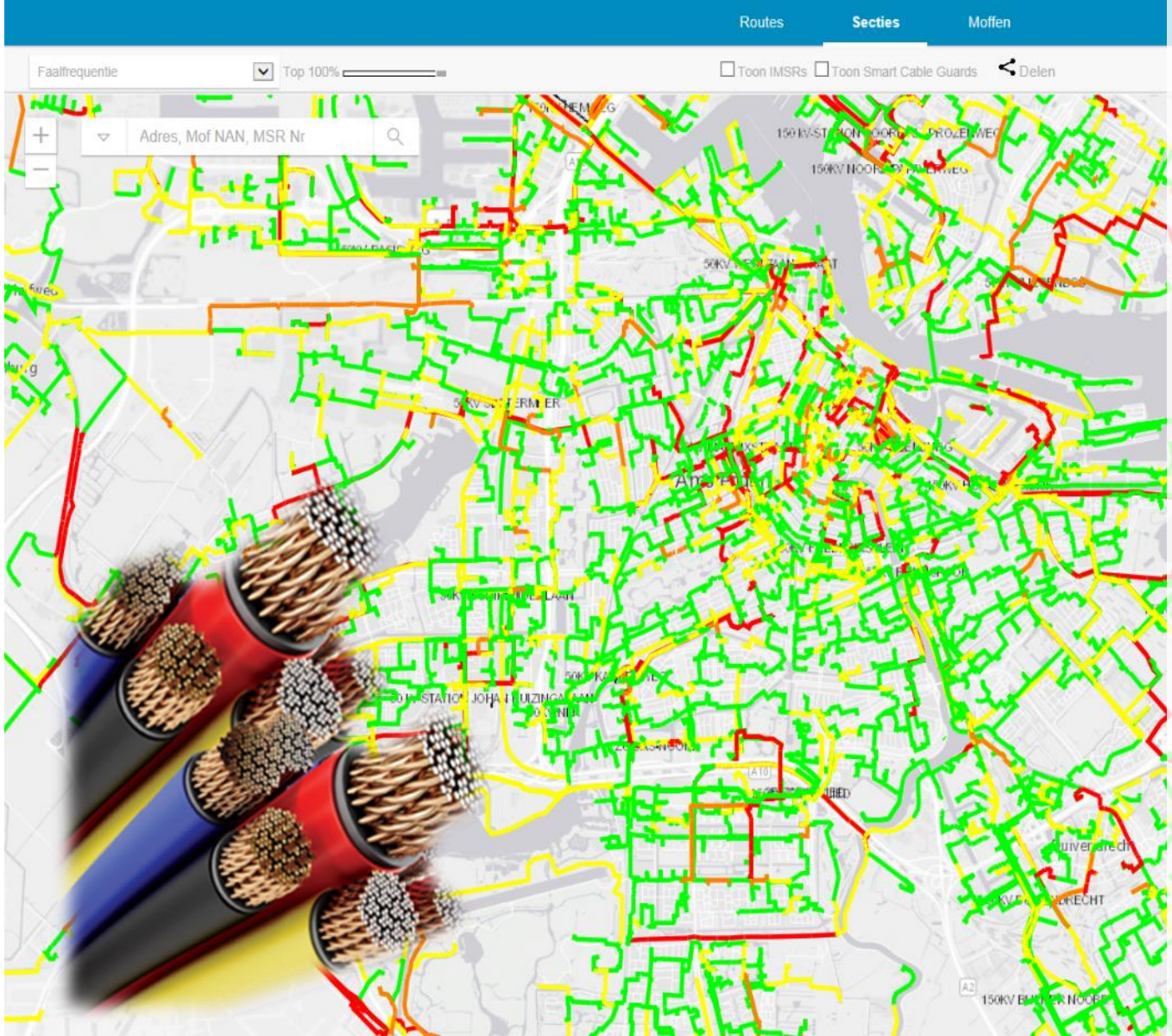
Dilemma I: Is everybody equal or are some more equal than others?

Dilemma II: Lower CO2 emissions or more reliability?



Other projects within Alliander

Prediction of energy profiles



Condition models MV/LV (Asset Management)

- **Joint replacement MV**
- **Investment portfolio AM**
- **Outage analysis and Smart Cable Guard placementSCG**

- **Outages (KLAK/Nestor)**
- **Assets (BAR/NOR)**
- **Environmental variables**
- **Dynamic variabelen**
- **22 data sources**

- **Monthly retraining**

AI is being been applied for several years now within Alliander

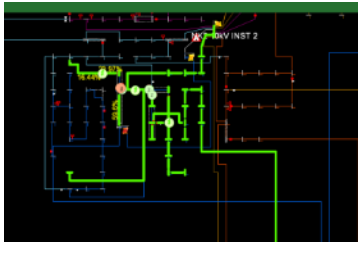
AI Applications

Risk models

Excavation damage model calculates risk score for KLIC reports.

Consumption models

Machine learning methods are used to cluster and anonomize 50,000 smart meter energy profiles. (Project PULSE)



Decision models

IntelEvent shows the outage cable and calculates a reconfiguration.

Innovation pilots

Image recognition

Customer installations are classified using photos from engineers and customers.

Natural language processing

Alliander has many years of (often hand-written) legacy documentation which contains valuable information.

Portfolio planning

Agent based models are used to train a decision AI which determines the optimal investment strategy

Other projects within Alliander

- Load flow engine development
- Automization
  - Grid design
  - Regional Energy Strategies (RES)
  - Network capacity checks
- Optimization
  - Grid topology
  - Outage reduction
  - Network losses minimization
  - Sensor deployment
  - Step changing transformers
- Network capacity extention
  - Large scale load flow
  - Substation transformer control
  - Curtailment
- Machine learning
  - Network portfolio generation
  - Nonlinear load flow
  - Fraud detection
  - Outage prediction
  - Smart meter deployment

Sample project: Community battery ‘De Buurtbatterij’

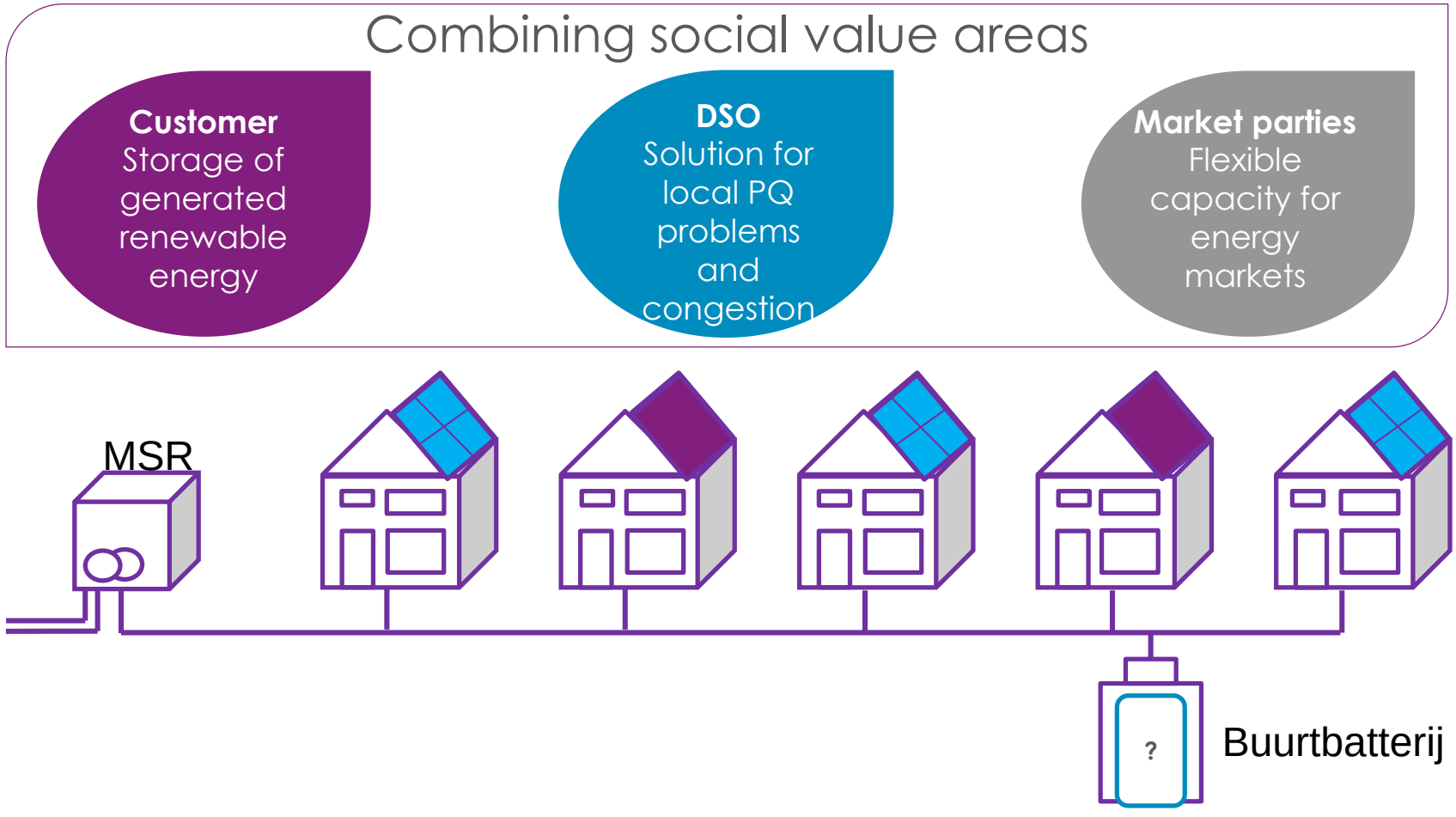
Je stroom bewaren in de buurtbatterij

Elektriciteitsopslag

Wind- en zonne-energie veroorzaakten dit jaar stroomoverschotten. In Rijsenhout experimenteren ze met opslaan in de buurt.

Hester van Santen 27 november 2017

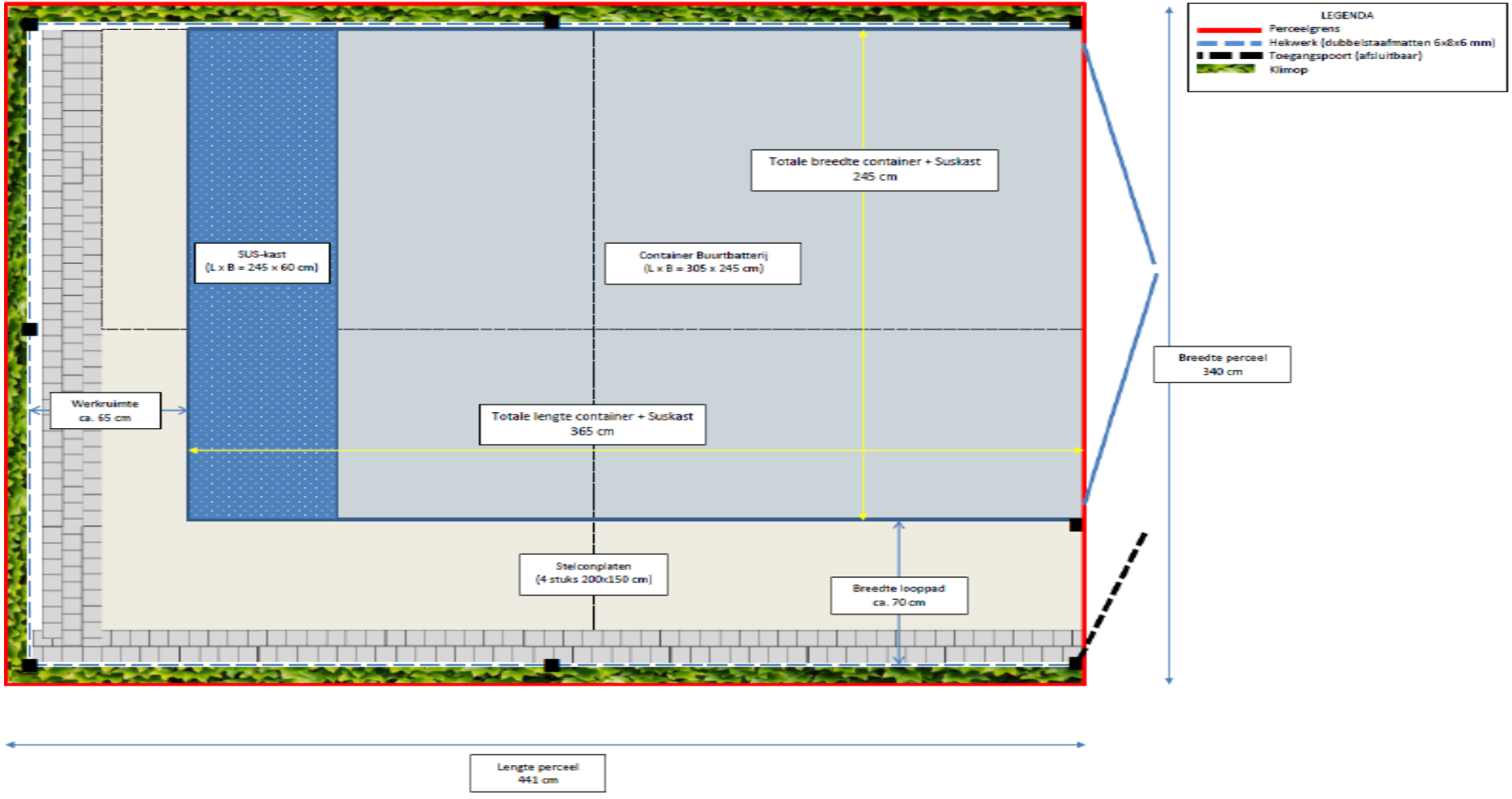
Project description Buurtbatterij



Location

Rijsenhout

Realization (detailed layout of the plot)



Realization (1)

Realization (2)

Measurement hardware

LV-cable and transformer

Measurement LV-case

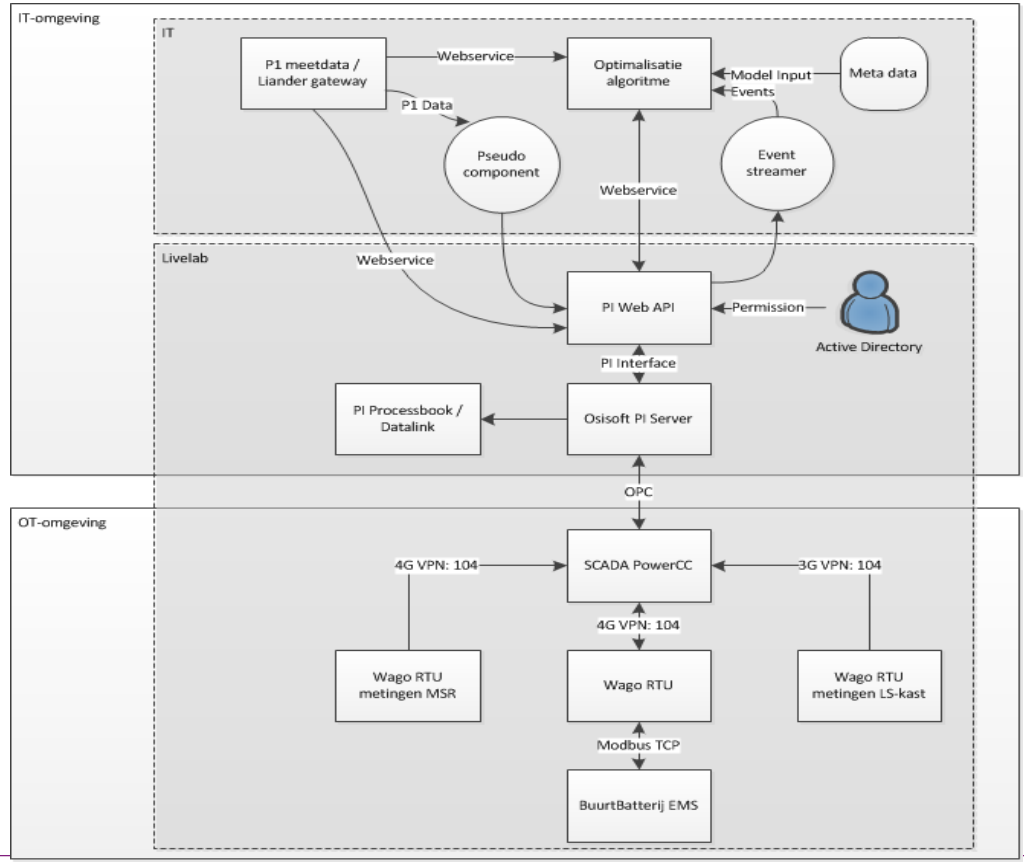
- Wago devices
- Wireless connection (4G)
- VPN-tunnel
- Rogowski-coils
- LV-cable Buurtbatterij

Measurement MSR

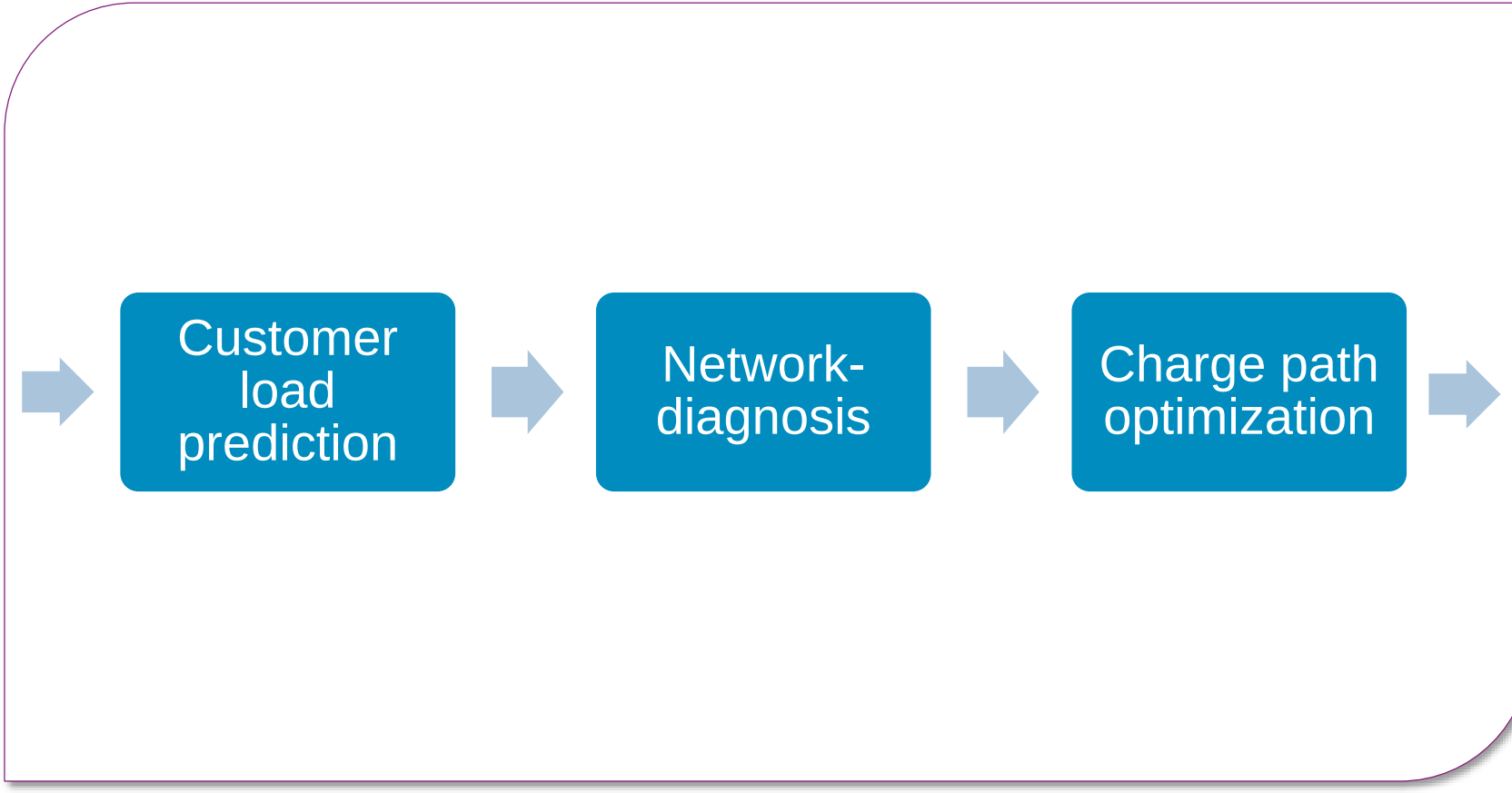
- Wago devices
- Wireless connection (4G)
- VPN-tunnel
- Rogowski-coils
- Secondary side of transformer

IT architecture

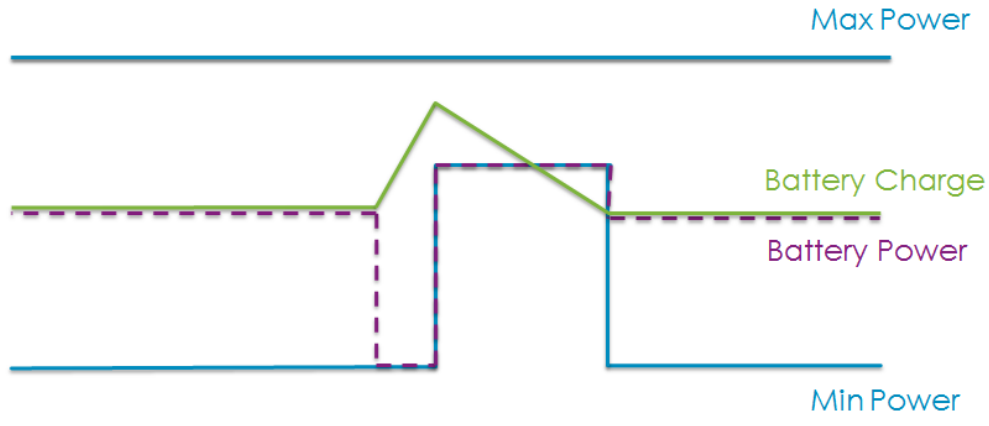
IT/OT

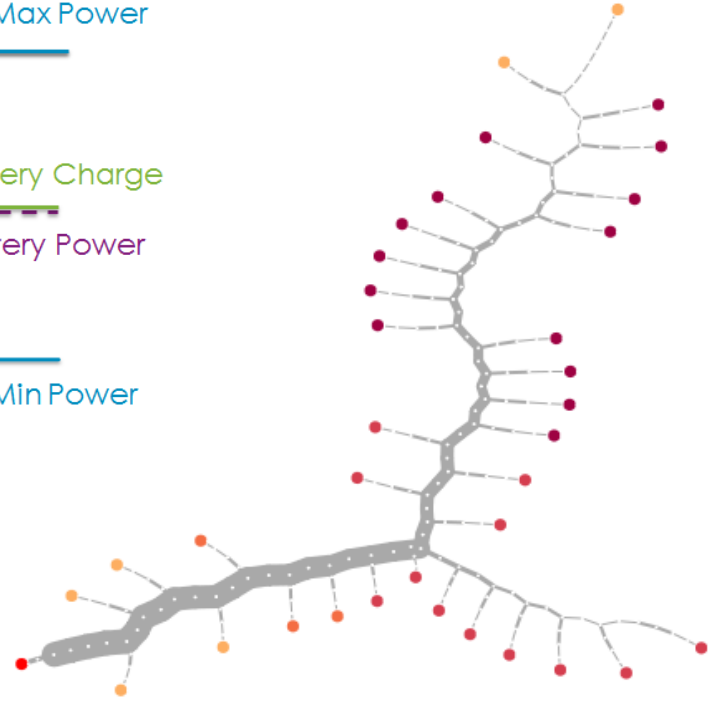


Charge path optimizer

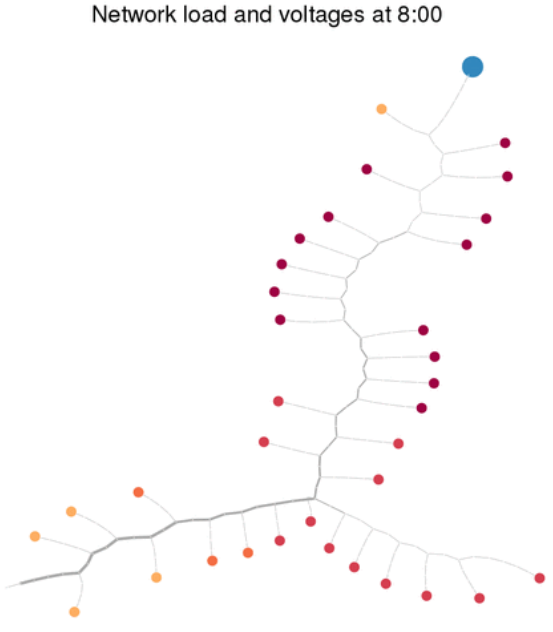


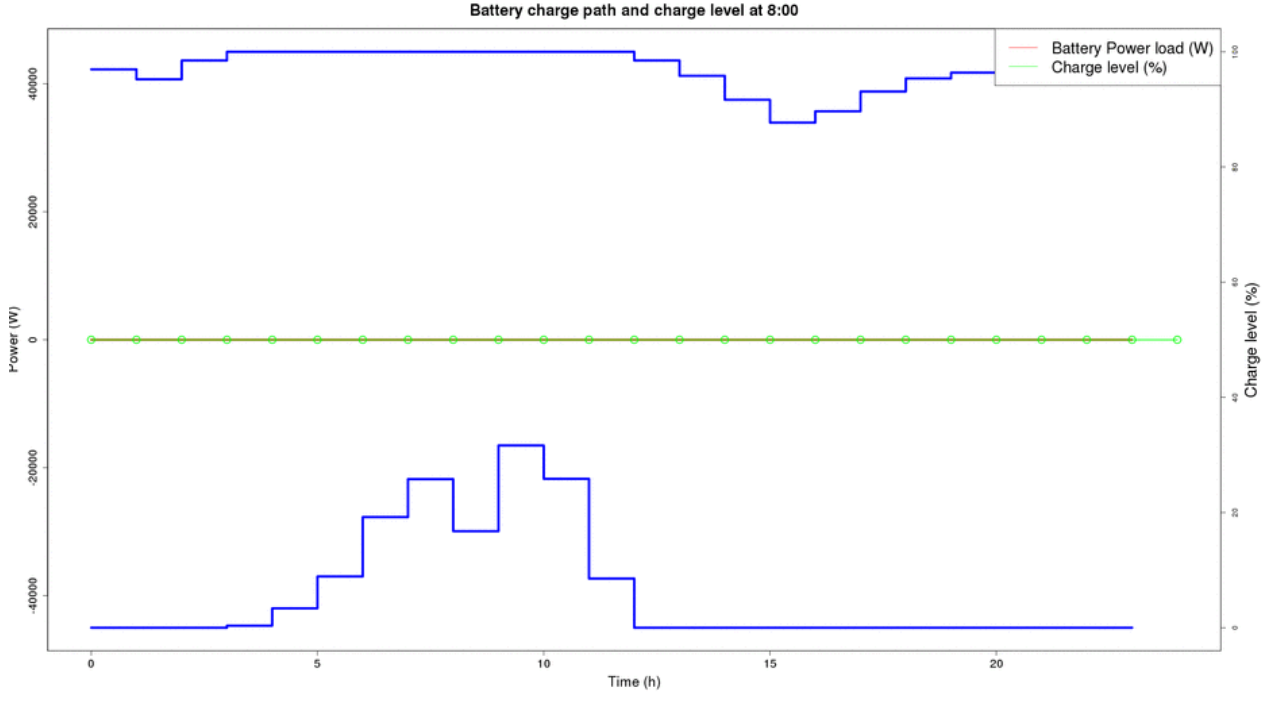
Control Buurtbatterij





Control Buurtbatterij





Paper Buurtbatterij

ELSEVIER

International Journal of Electrical Power & Energy Systems

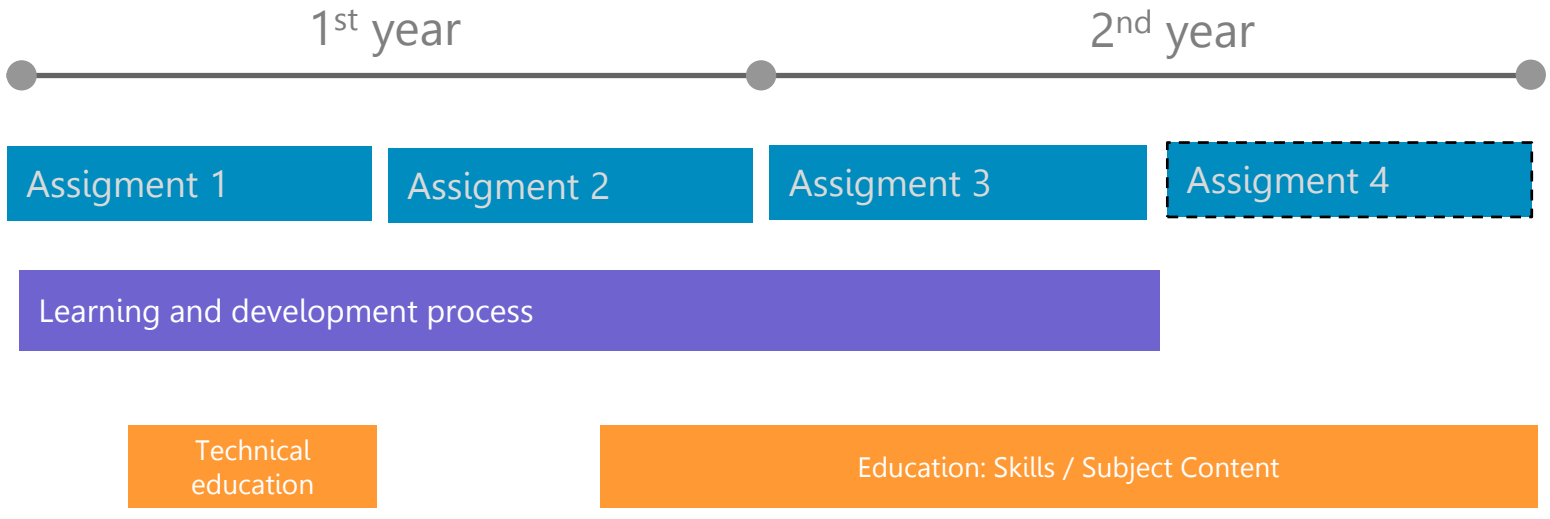
Volume 114, January 2020, 105349

Low voltage power grid congestion reduction using a community battery: Design principles, control and experimental validation

Werner van Westering [a, b] ✉, Hans Hellendoorn [a]

Traineeship Alliander

- https://www.werkenbijalliander.com/traineeships




Questions?
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Soon: Alliander.nl/research