NILM in practice part 1: GIASES pilot project

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NILM in practice part 1: lessons from GIASES pilot project

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AGENDA

- Project Setup

- Overview of the Project Idea

- Quantity of Measuring Points

- Main Motivation

- Insights & Challenges

SFOE Pilot and Demonstration Project - GIASES

Based on the results of the predecessor project NILM4Bal, a load management and peak shaving solution is being evaluated in a broad pilot and demonstration project with several thousand measuring points, by using the shifting potential of flexibilities (heat pump, boiler and e-charging station).

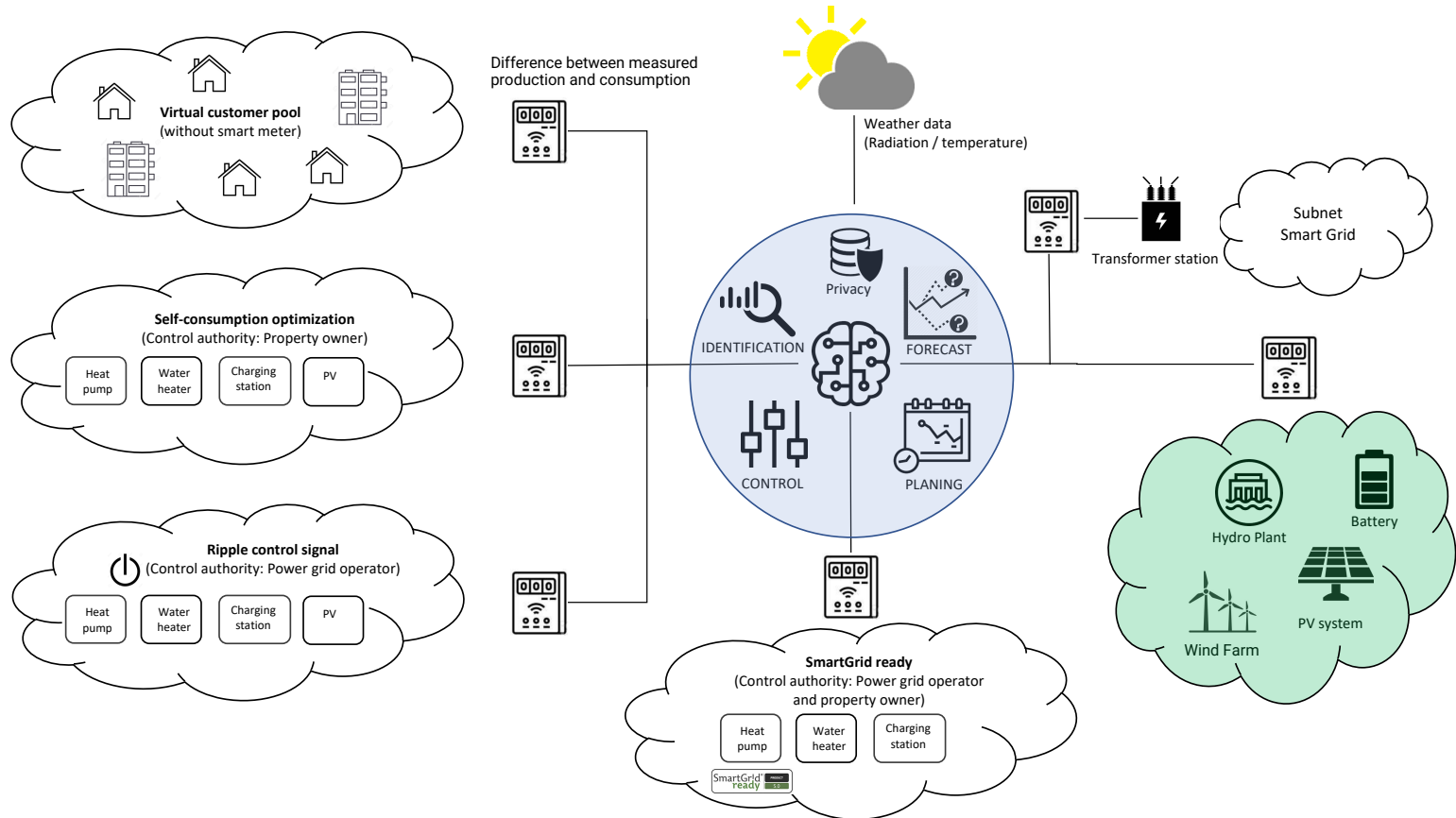Project Duration: 11/2021 – 11/2023

Research Partner: CC iHomeLab + Thermal Energy Storage (CC TES)

Funding: Swiss Federal Office of Energy

Industry Partner:

GIASES – General (Holistic) Integrative Adaptive Smart Energy System

Virtual customer pool
(without smart meter)

Difference between measured
production and consumption

Weather data
(Radiation / temperature)

Subnet
Smart Grid

Transformer station

Self-consumption optimization
(Control authority: Property owner)

Heat pump | Water heater | Charging station | PV

IDENTIFICATION

Privacy

FORECAST

CONTROL

PLANING

Ripple control signal
(Control authority: Power grid operator)

Heat pump | Water heater | Charging station | PV

Hydro Plant | Battery | Wind Farm | PV system

SmartGrid ready
(Control authority: Power grid operator
and property owner)

Heat pump | Water heater | Charging station

SmartGrid ready

GIASES - Quantities of the measuring points

49
EV Charging Stations

398
Photovoltaic

998
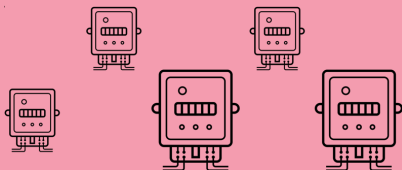Heat Pumps
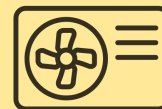
282
Boiler

17
Transformer Stations

5790
Total Measuring Points
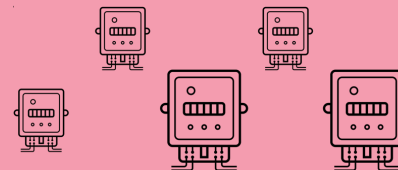
Main Motivation – Peak Shaving

- **Save grid expansion costs**
- **Reduction of the monthly peak load costs**

Case Study:

- Reduction of the maximum power costs by -16.7%

- Reduction of the monthly peak load by 884 kW

- The DSO saves CHF 6'100 per month, equivalent to CHF 73'200 per year

Betragsermittlung

Komponenten	Periode	Menge Einheit	Dauer	Ansatz [CHF]	Betrag [CHF]
Netznutzung NVM					
Normallast T1	01.01.21 - 31.01.21	1'026'251 kWh		0.0097	9'954.63
Schwachlast T2	01.01.21 - 31.01.21	1'645'273 kWh		0.0061	10'036.17
Blind Verrechnung	01.01.21 - 31.01.21	0 kVarh		0.035	0.00
Monatsmaximum	01.01.21 - 31.01.21	4'407.0 kW	1 Mt.	6.90	30'408.30
Grundpreis je Netzübergabestelle gemessen	01.01.21 - 31.01.21	4	1 Mt.	170.00	680.00
Total Netznutzung					**51'079.10**

Monthly maximum with a grid cost share of 59.5%

Total Objekt exkl. MWST		51'079.10
MWST Total	7.7 %	3'933.10
Total Objekt inkl. MWST		**55'012.20**

reduction of the peak load by 16.7%
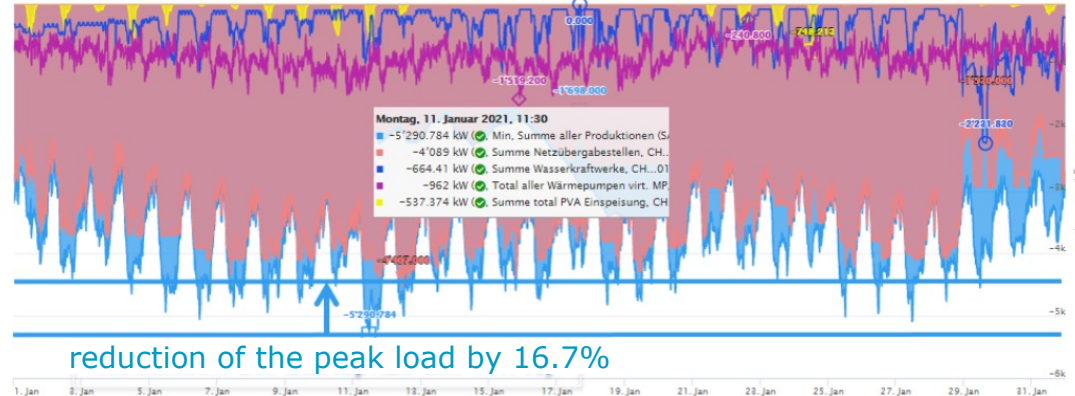
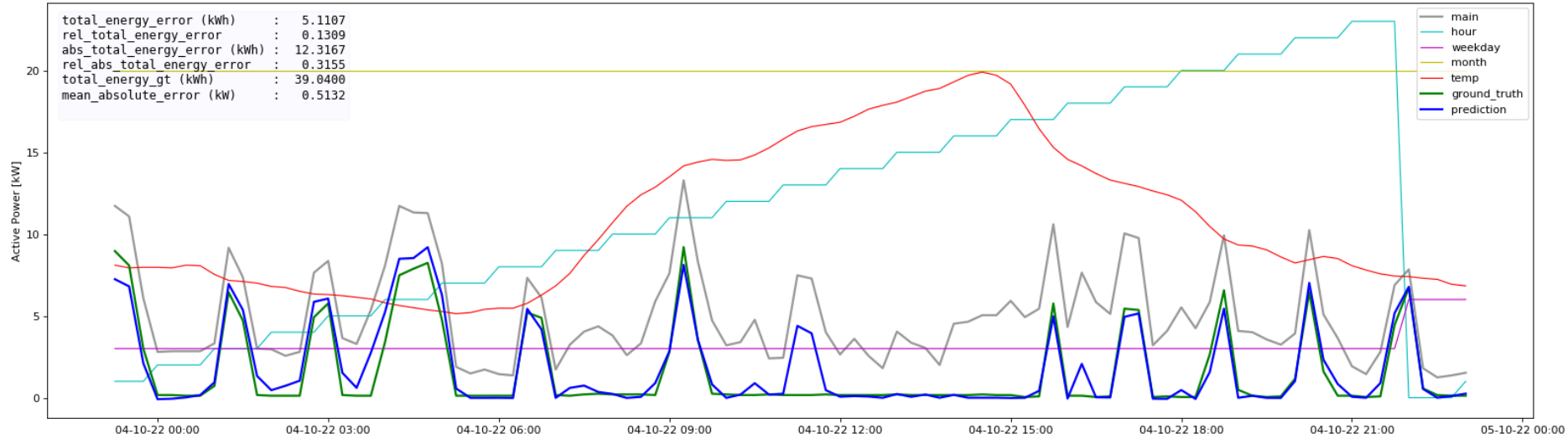# GIASES – Disaggregation-Algorithms based on WaveNilm Architecture

WAVENILM: A CAUSAL NEURAL NETWORK FOR POWER DISAGGREGATION FROM THE COMPLEX POWER SIGNAL (A. Harell et al., 2019)

Inspired by WaveNet (DeepMind) a deep neural network for generating raw audio.

Duplicate relevant input N times
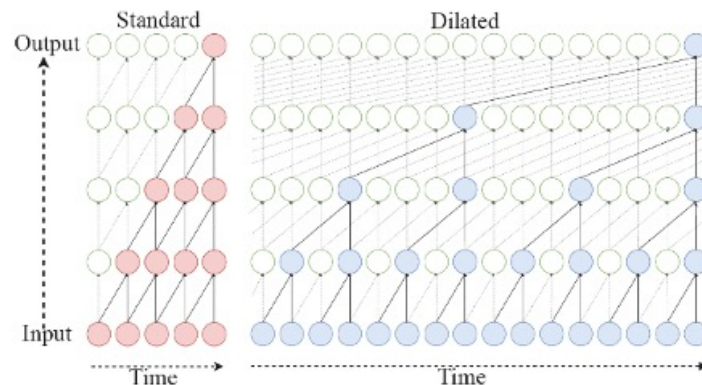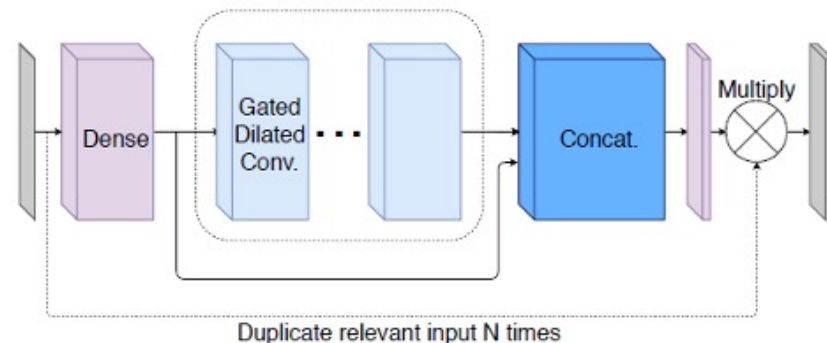
Example – Disaggregation of Heat Pumps (unseen apartment house)

GIASES - Insights & Challenges

- Values effectively identified via the detection algorithm and visually verified are significantly lower than the values listed in the installation notice

- In the case of boilers, it is often not known whether the connection is 1-phase or 3-phase

- Replacement of a boiler by a heat pump boiler is not always reported

- Installation notices of boilers are even up to 40 years old

- Distinction between Heat Pumps, Boilers, EV-Charging Stations and others

- Missing Ground Truth for single-family houses (augmented or synthetic data)

- Low Frequency Data (15 min)

Heat Pump (HP)
Reported: 7.2 kW
Effective: 5.2 kW

Boiler
Reported: 6.0 kW
Effective: 3.1 kW

Thank you!

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Engineering & Architecture
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