

Deep Learning Based Non-intrusive Load Monitoring for Buildings **DeepEnD**

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**AMBIENTE
CASCAIS**



CERTH
CENTRE FOR
RESEARCH & TECHNOLOGY
HELLAS

Challenge



>200

Buildings



≈ 1000

Sensor

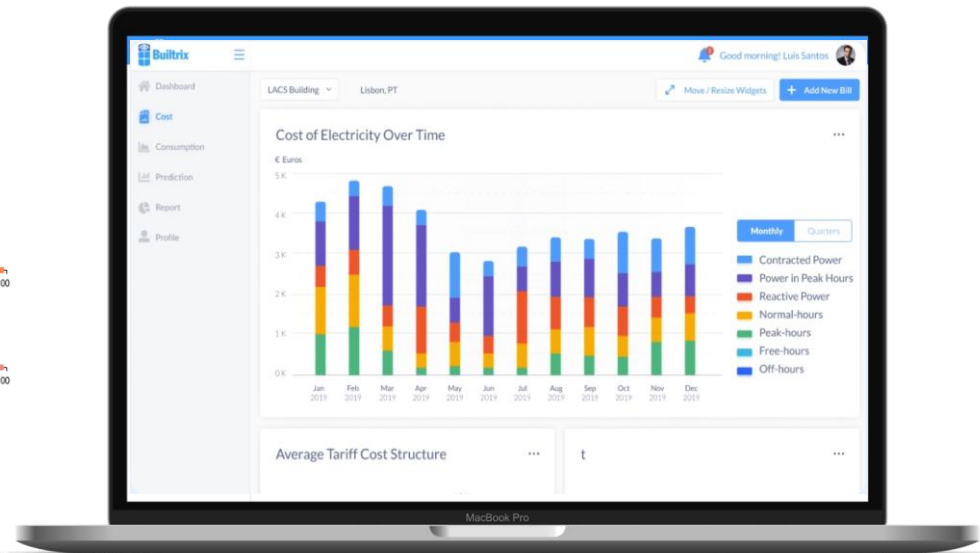
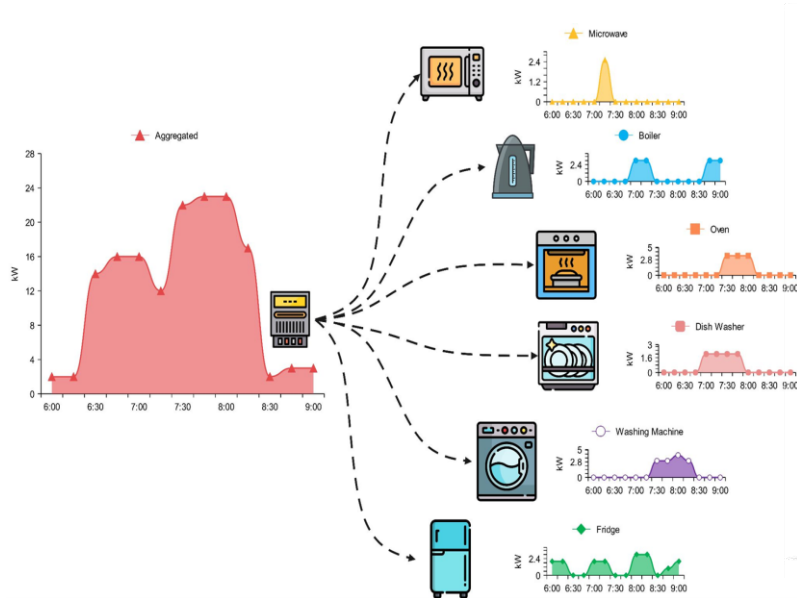


> 500 K €

CAPEX

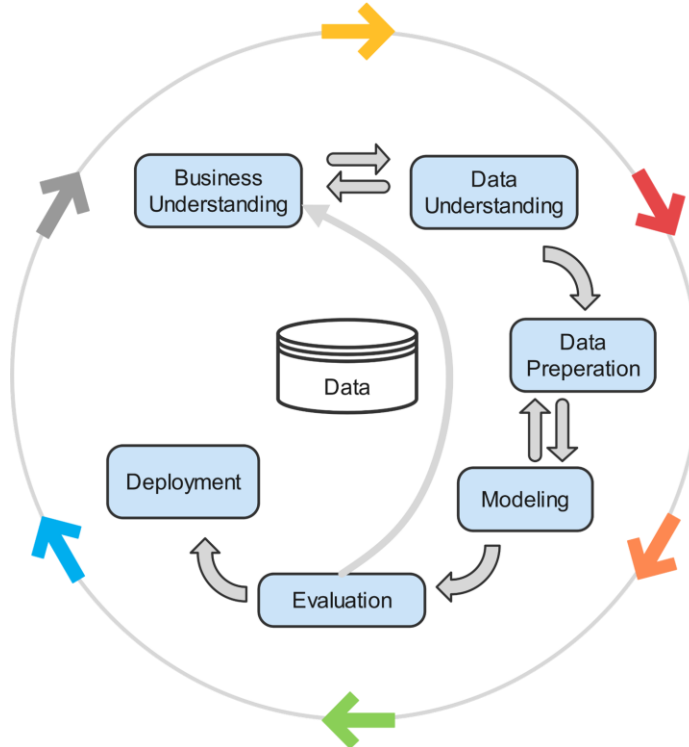
Virtual Load Disaggregation - Non-Intrusive Load Monitoring (NILM)

A cloud-based software



Methodology

Cross Industry Standard Process for Data Mining (**CRISP-DM**)



REFIT, CERTH, Cascais

- Velocity: Timestamped and sampled at **8 second intervals**,
- Variety: **20 households** & 9 appliances per house,
- Volume: **7 GB (300-400 MB per household)**
- Format: **CSV**,
- **Open access, UK**

REFIT, **CERTH**, Cascais

- Velocity: Timestamped and sampled at **1-minute intervals**,
- Variety: **1 Living lab** & 5 appliances per house,
- Volume: **100 MB**
- Format: **CSV**
- **Private data, Greece**

REFIT, CERTH, **Cascais**

- Velocity: **15 minutes** timestamp in a **24 hours data package** per day,
- Variety: **4 Office buildings**,
- Volume: **30 MB**
- Format: **JSON** package - **DSO API**
- **Private data, Portugal**

Data Preparation

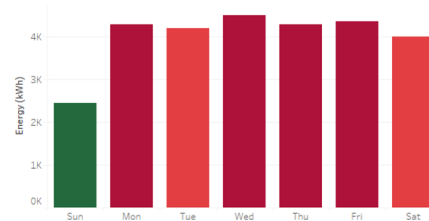
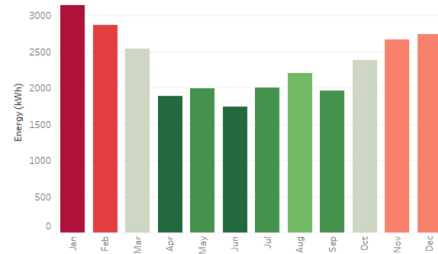
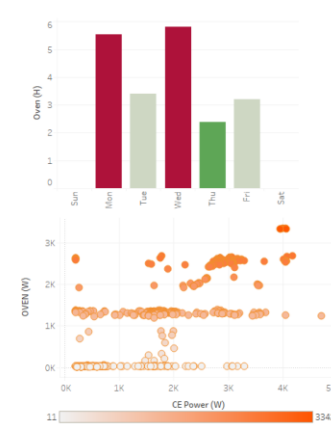
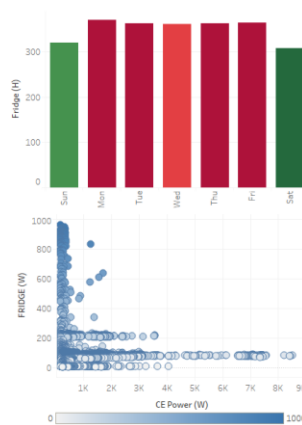
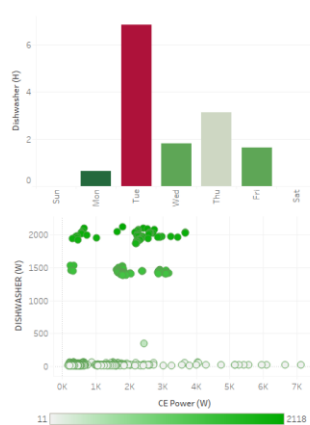
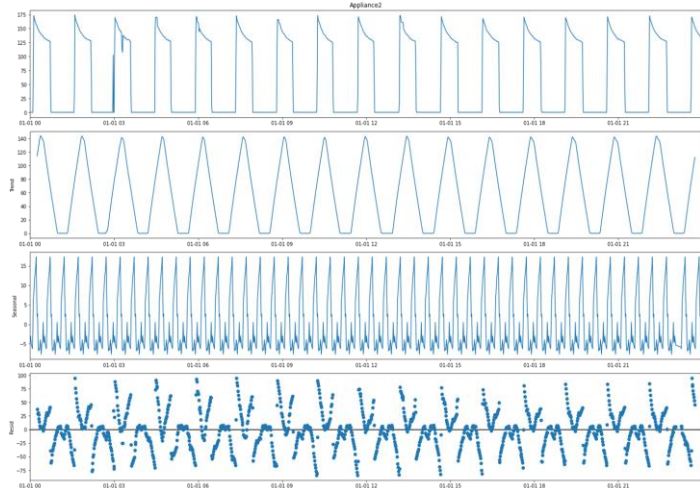
Statistical analysis,

Time series feature analysis,

- Months,
- Weekdays,
- Hours,
- Sub-hour

Feature scaling,

Clustering



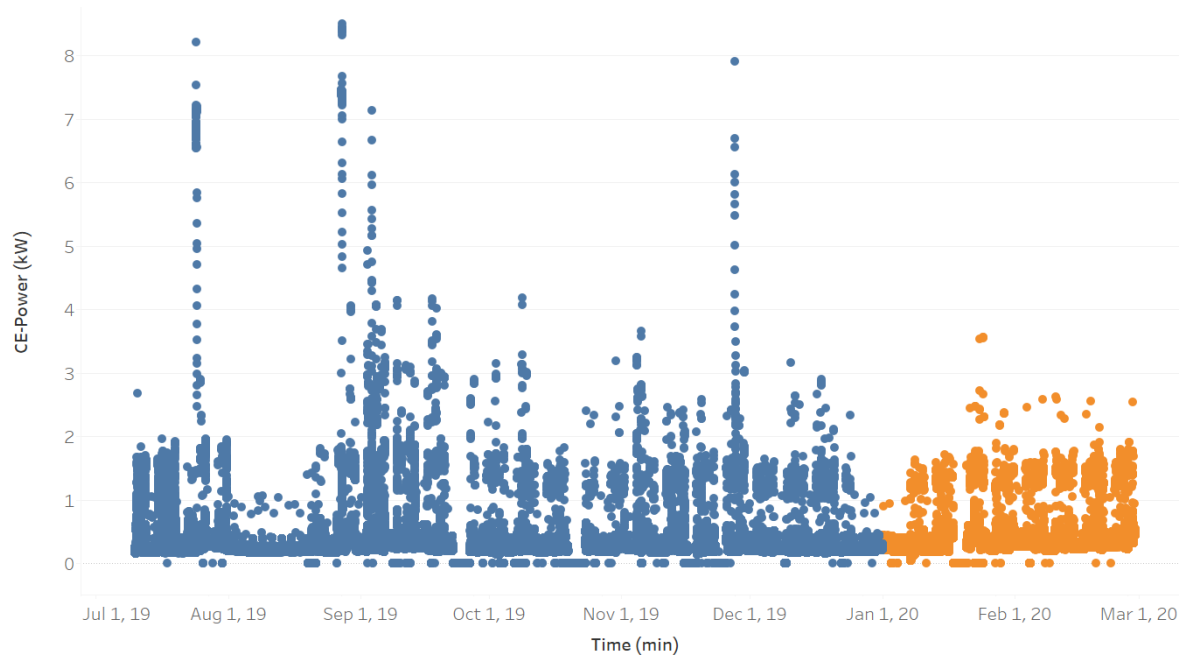
Modeling

Train & Test

The size of data is huge!

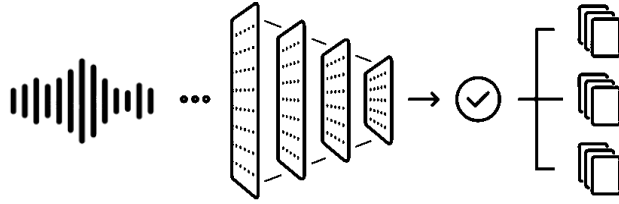
- Computational cost
- Training and test

Train: 80%, Test: 20%



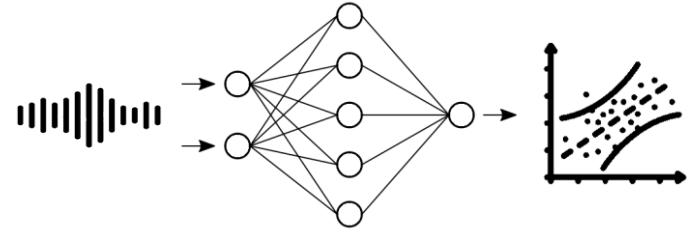
Modeling

Deep Learning Models



Classification

ON/OFF



Regression

**Forecasted Appliance
consumption**

Hyperparameter Tuning

- Nodes and Layers
- Number of epochs
- Batch Size
- Learning Rate

Scalability and Flexibility of the Solution



Interoperability



Data models



Containerization



Cluster computing

+250 Buildings pilot in **Cascais - Portugal**
+50 Buildings pilot in **ENERGIE STEIERMARK - Austria**



Builtrix
Connected-Building Solution



NEXT GENERATION DATA INCUBATOR

Data Governance and Legal Compliance

- **DMP and DPIA documents**

- Legal
- Compliance



- **Infrastructure Access Management (IAM)**

- User management
- Authentication
- Access decisions and token enforcement



- **SSL encryption via https protocol and transferring data via FTPS/SFTP**





Builtrix
Connected-Building Solution

**Intelligent, Affordable, &
easy-to-integrate solution**

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