

# Al for Efficiency in Energy Intensive Industries





Our vision is to optimize increase energy efficiency via 'smart' energy consumption and Demand Response Flexibility of domestic and industrial consumers.

Toward that end, we aim to build the best state-of-the-art AI energy optimization engine to leverage the end-to-end Big Data Value Chain, from CPS/IoT sources of flexible assets, Transmission Service Operator (TSO) and Energy aggregators.



#### Outline



- The problem: limits of grid flexibility
  - New Energy system: smart demand
- ➤ The FlexyAl solution
- ➤ Technological dimension
- ➤ Conclusion

## The problem: non efficent energy use



# Cost of ~€33B <sub>/year\*</sub>

 55% CO2 emission reduction by energy efficiency by 2030 (-1.65 GTon/year EU27)

\*Elaboration of IRENA 2021





Al-lot Artificial Intelligence SaaS platform for Energy 'Smart Demand' and Flexibility management.

### The Solution: AI for Energy intensive industry flexible demand



- ✓ Reach Idea75
  - $\cdot$  Active power
  - · Active energy
  - · Current/Voltage
- ✓ Market open data
  - · Zonal prices (GME)
  - Zonal unbalance (Terna)
- ✓ Alternative data (Phase II)
  - · Weather (Meteo provider partners)
  - · Earth Observation (ESA)

#### REACH Idea75 CHALLENGE



## The Solution: AI for Energy intensive industry flexible demand





EU Platoon Data Value Chain architecture:

- Marketplace
- Intelligence (AI)
- Interoperability
- Physical Infrastructure
- External Data / Open Data



# Data Management

- Our Big Data solution is microservices based, super scalable due to solutions such as Kubernets, Kafka and others, capable of tackling intense data management issues and volumes.
- ➤ Let's zoom into Data Management



### **AI Tasks**



- > Three tasks:
  - Load Forecasting and Constraint
  - El. Price Forecasting (zonal price)
  - Detecting Imbalance (TSO anomaly detection)
- > Goal:
  - Optimal load profile for cost reduction and imbalance reduction





\*based on asset physical and process constraints











## **Price Forecasting**

- 10-years of in-house industry-lead experience in machine learning electric price forecasting
- Robust, scalable, accurate models based on gradient-boosted decision trees
- Ensamble of Catboost, XGBoost, LightGBM
- State-of-the-art results with fast inference time for immediate response and fast training
  - Key in constraint retraining





## Load Forecasting

- 15-years of in-house industry-lead experience in machine learning based load forecasting
- Seminal papers by our team e.g. Ceperic et. all A Strategy for Short-Term Load Forecasting 2013 cited over 300 times.
- Robust, scalable, accurate, proven
- Used for Load Profiling
  - A load profile will vary according to customer type (typical examples include residential, commercial and industrial), temperature and holiday seasons.









### **Anomalies**

- ➤ Detecting anomalies in:
  - El. price
  - El. load
  - El. production
- Key for fast rebalancing of the network
- Our approach extract probabilities from our models
  - If uncertainty is high -> the anomaly is flagged
  - Based on prediction intervals



## FlexyAl Powered by TechBricks

## Optimization

- Optimize the load profile based on forecasted electric price, load range set by manager and predicted normal load requirement.
- > Bid curve is automatically as in Figure top and left.
- An exception is when bid can be placed above marginal costs, capacity can be withheld, or plants can be decommissioned. A bid above marginal costs is useful for market-oriented providers if this increases the MCP and, despite a possible reduction in volume. Additional revenues compensate this loss.

#### **GDPR** compliance problem

#### **Requirements**

- Anonymity
- Erasable
- Purposes of data processing
- Data Controller

#### **Compliance solutions**

- HTTPS protocol
- Private cloud solution
- Parallel development of Hybrid DLT solution
  - Ο Salted hash
  - Encrypted data (keys hosted by 3<sup>rd</sup> party, by deleting keys we are Ο putting data beyond use)
  - Collecting just data needed for processing Ο
  - Ο Legal Entity

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#### Conclusion

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/Introducing an innovative state-of-theart energy optimization tool

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![](_page_17_Picture_5.jpeg)

Continuous energy efficiency based on **real-time analytics**, visualization of the data on power consumption and **optimal load** forecasting/profiling. Reduce operating costs of energyintensive industrial plants, through the **reduction of 10-20% energy consumption** and with less occurrence of **nonstop plant downtime scheduled**.