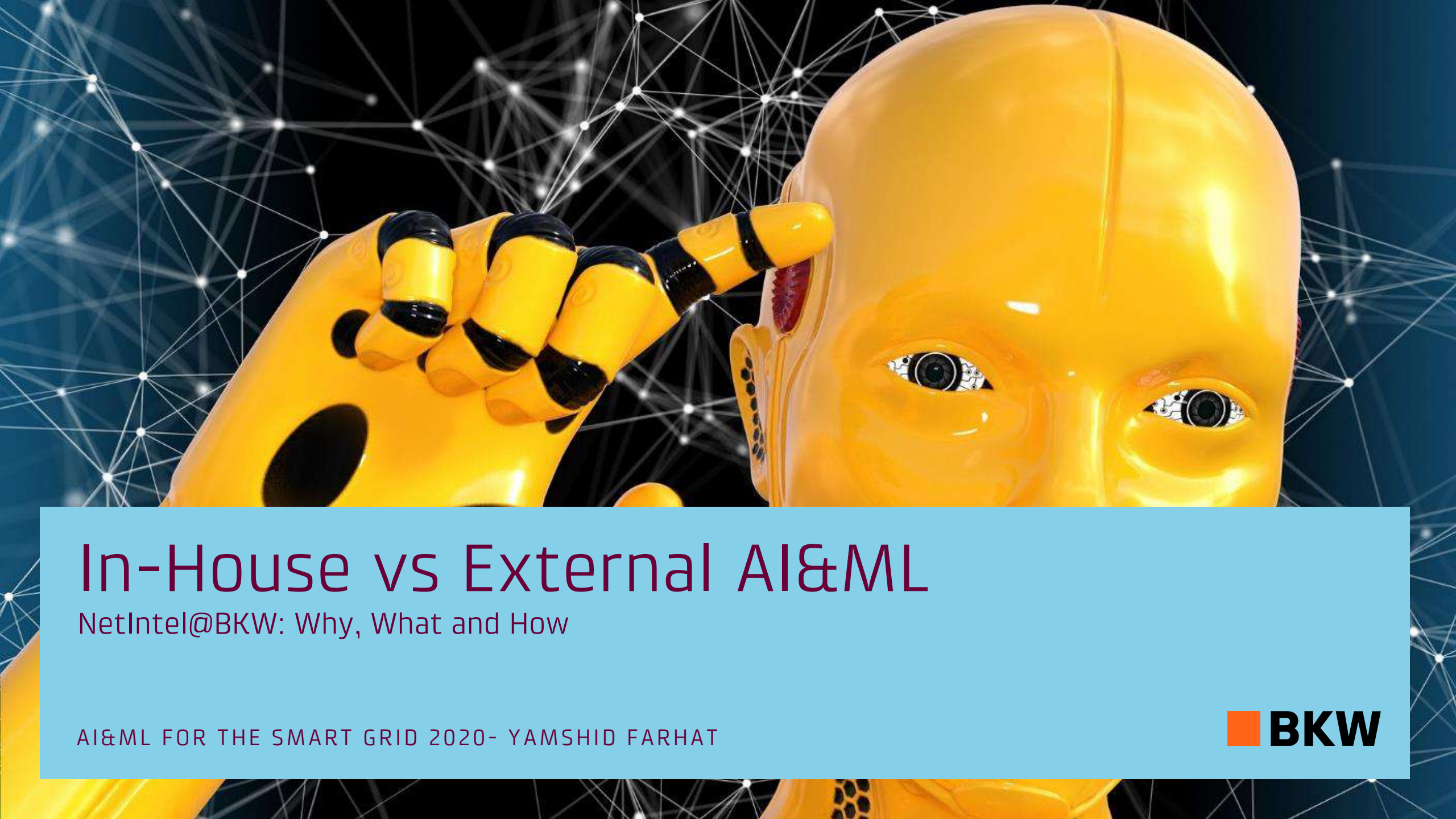
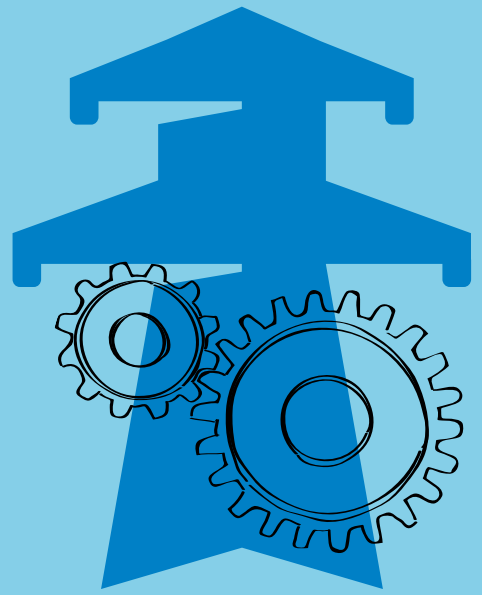


In-House vs External AI&ML

NetIntel@BKW: Why, What and How

BKW



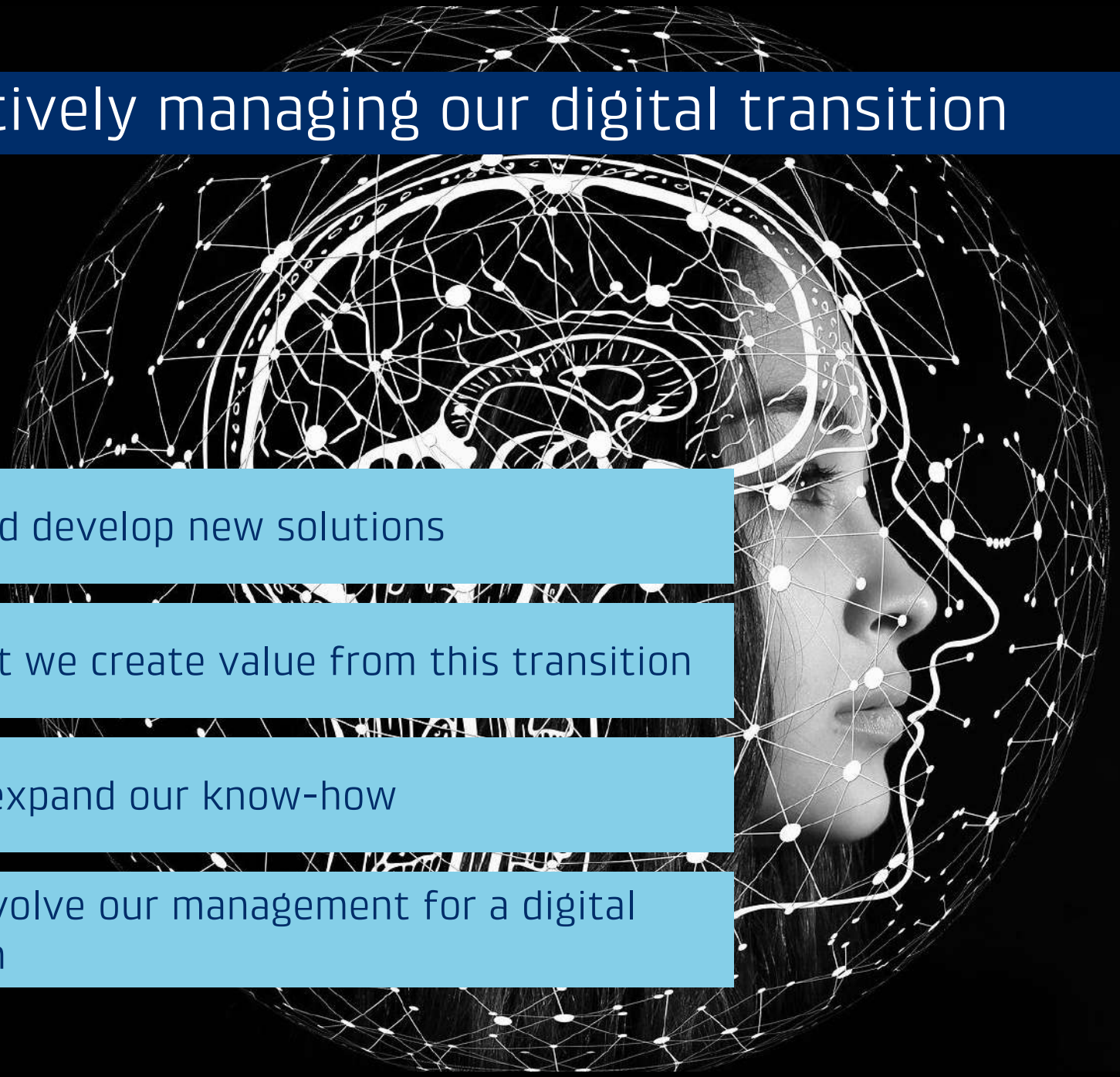
BKW Energie AG: Who are we?

1893 - Energy for the industrial revolution

1972 – More power for a growing society


Future – Decentralised and fluctuating energy production...

… and actively managing our digital transition



We identify and develop new solutions

We ensure that we create value from this transition

We protect & expand our know-how

We actively involve our management for a digital transformation

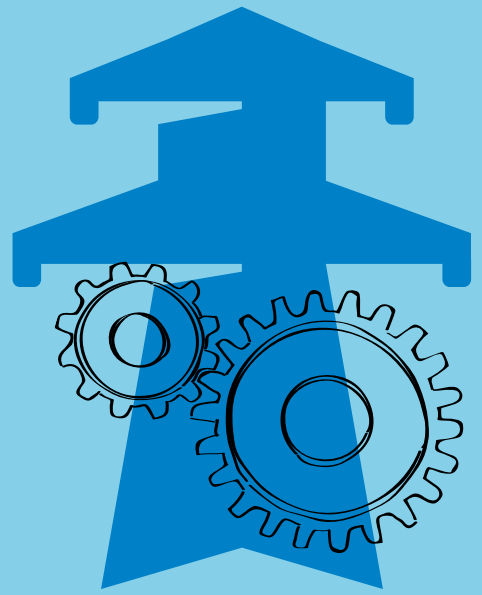
How & when did we start with AI?

In 2013, we created our Smart Grid department

Focus: Develop new solutions for a more efficient & reliable distribution networks

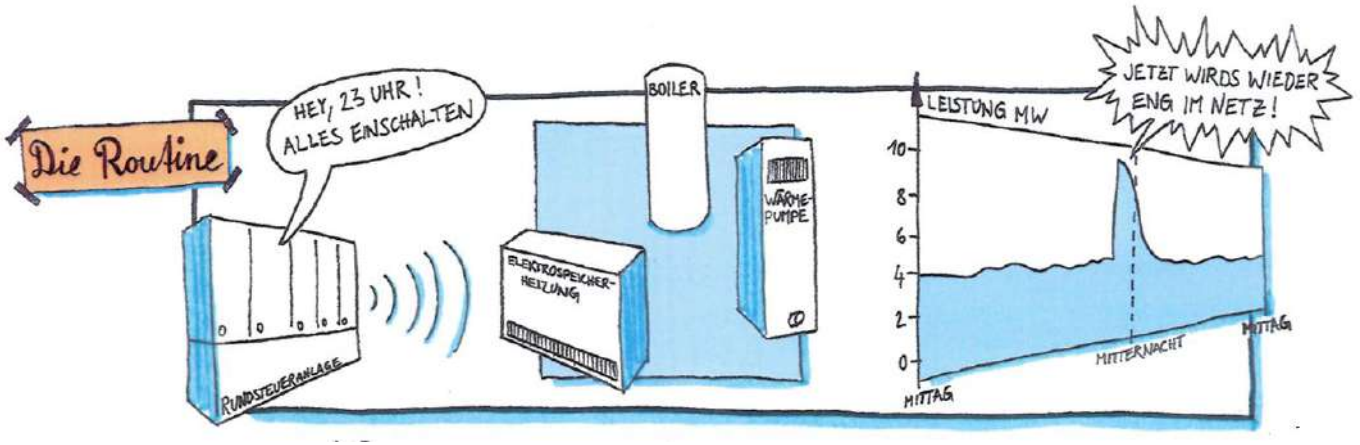
Potential for providing new services → towards In-House Solutions

First projects: Demand Side Management & Real-Time Grid Optimization

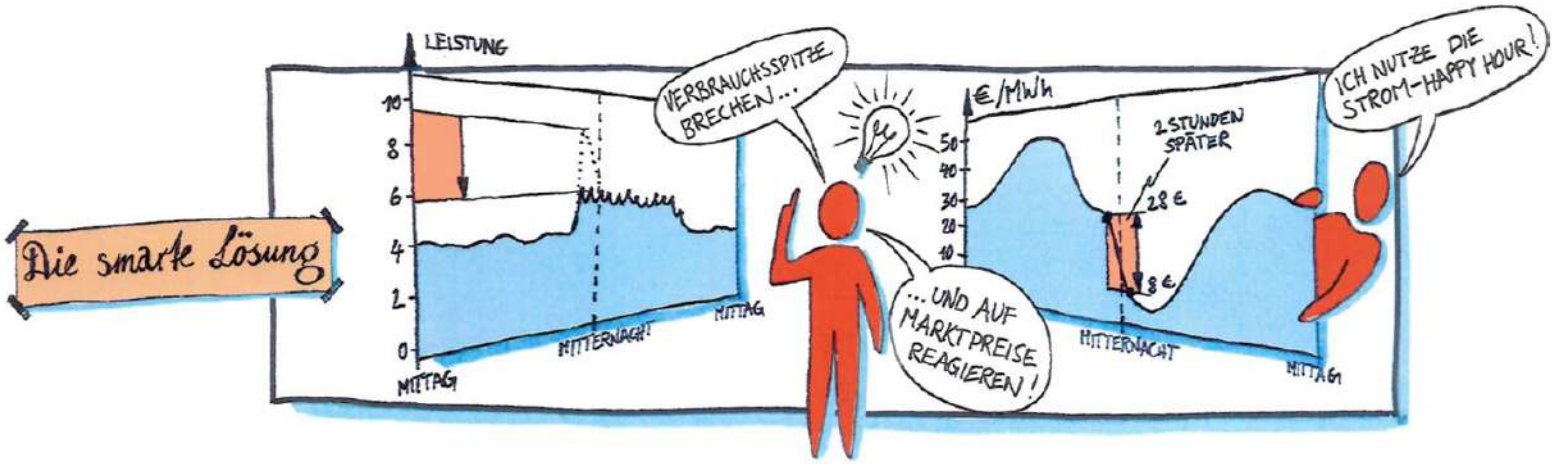


First AI&ML Projects

SmartRSA: Demand Side Management

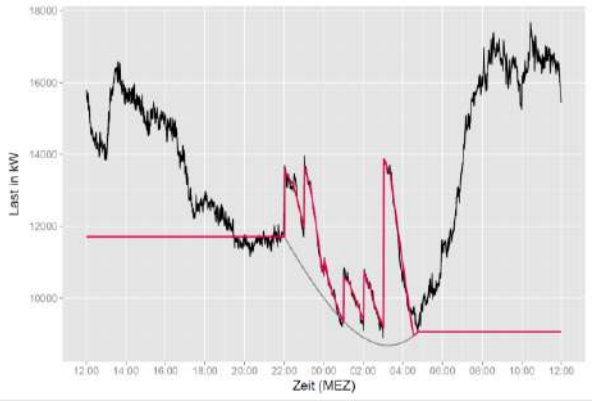


Since 1960, boilers and heat-pumps of **100'000 BKW**-customers are ripple-controlled by static programs



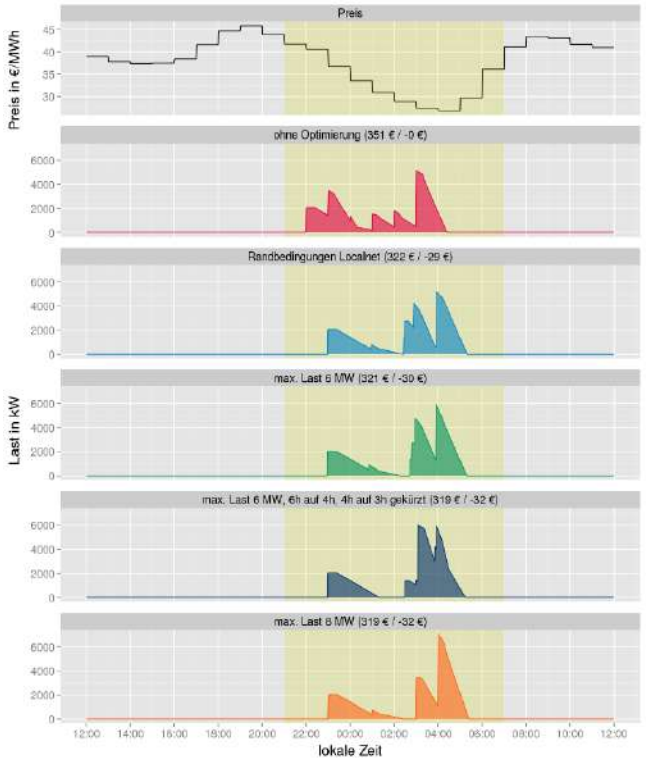
The new **SmartRSA** solution is sensitive to real production on a daily basis, saving more than 100kCHF per year on the day-ahead trading.

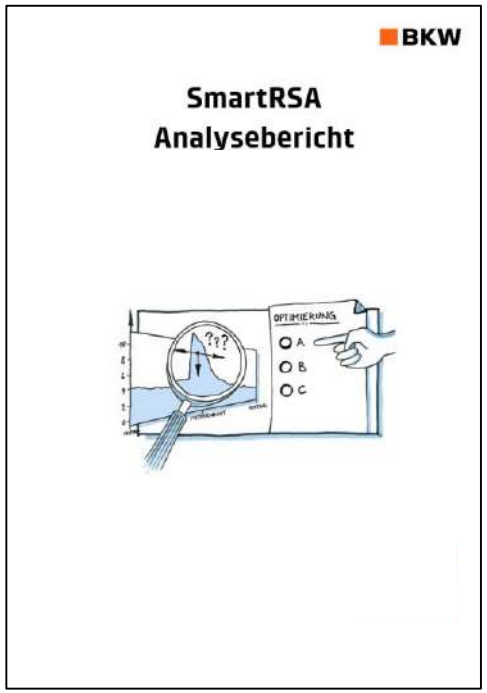
SmartRSA: Prozess



1. Build the model

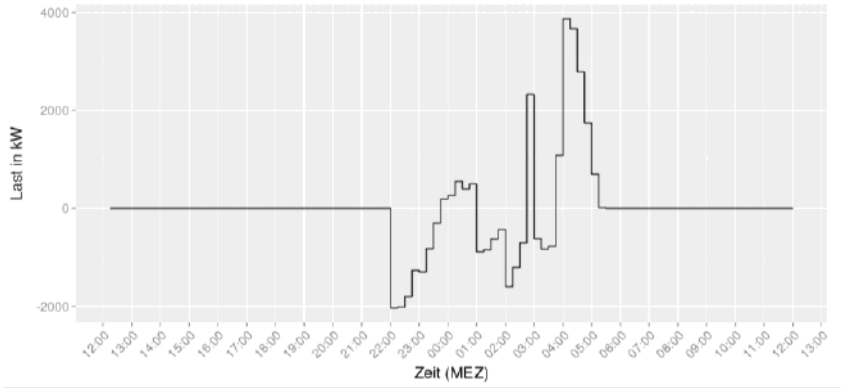
2. Optimize Energy



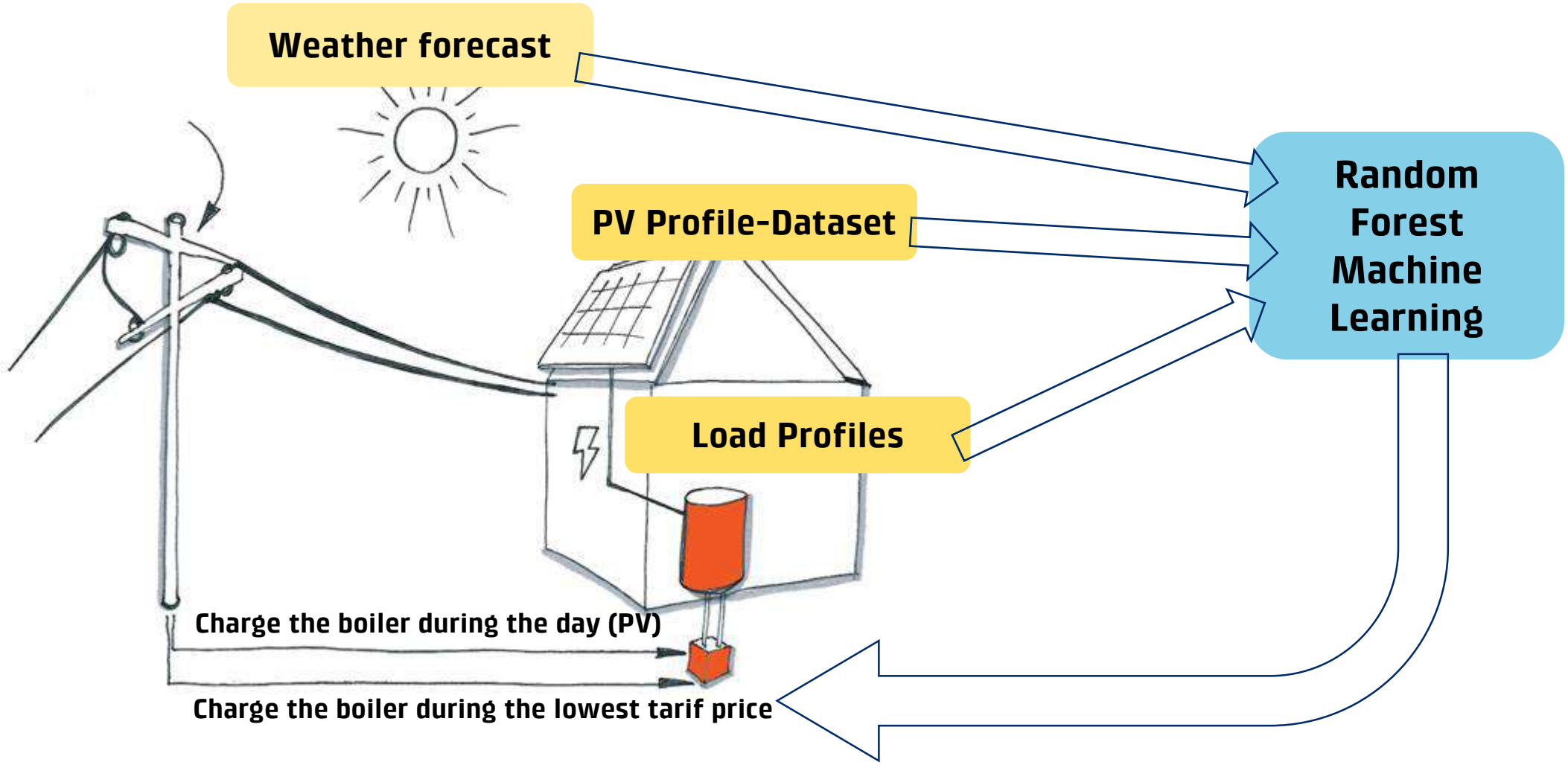


3. Report: Business Potential

4. Implementation

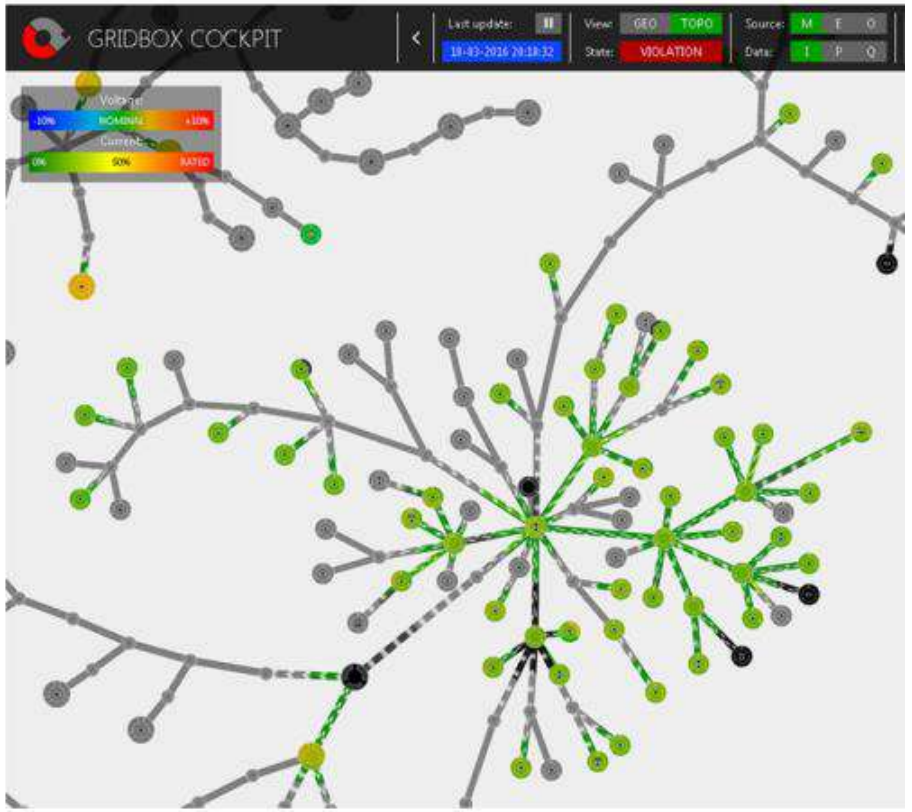


BKW mySun: Optimize Self-consumption



GridBOX: Monitoring and Active Control of Distribution Grids

PMU-Device: Measuring U, I, φ every second



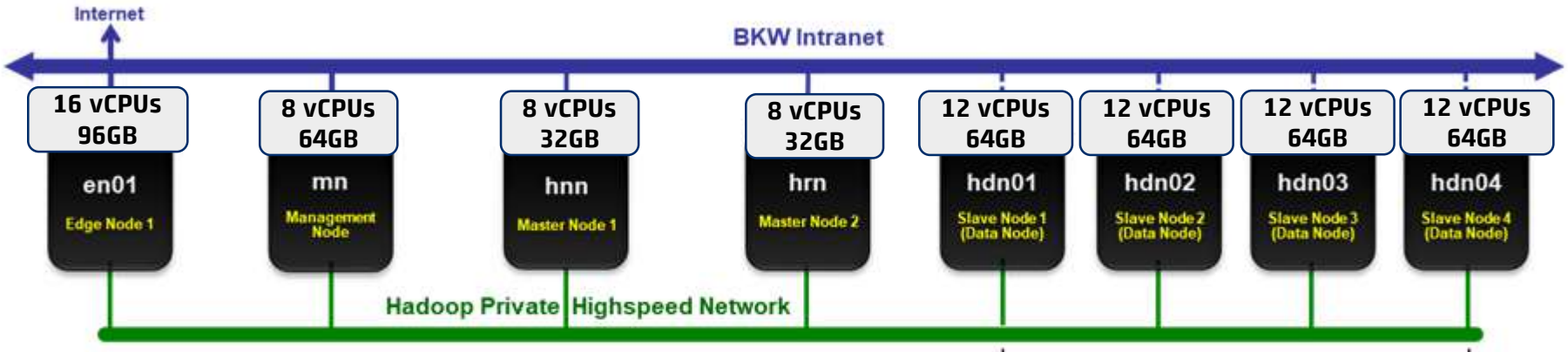
Real-time **observation** of the **state** of the **distribution grid**

→ **Measuring** current and voltage

→ Applications for an **optimized** (active) **operation of the grid** Implemented on a GridBox Master in the respective regions

→ **Control** of dispersed generators and loads

On-Premise Big Data Architecture 2015



Hadoop Edge Components

1) RStudio Server Pro
2) Shiny Server Pro
3) GitLab Repository
4) GridLab-D Simulation
5) Apache Zeppelin
6) ElasticSearch
7) Apache Nifi
8) OpenTSDB
9) Grafana

Hadoop Server Components

1) Ambari Metrics Monitor
2) SmartSense Agent
3) ZooKeeper Server
4) HDFS NameNode
5) HDFS JournalNode
6) HDFS ZKFailoverController
7) HDFS NFS Gateway
8) Hbase Master
9) HiveServer2
10) Hive Metastore
11) Oozie Server
12) Storm DRPC Server
13) MR2 History Server
14) YARN App Timeline Server
15) YARN ResourceManager
16) Spark History Server
17) Hue Server

Hadoop Client Components

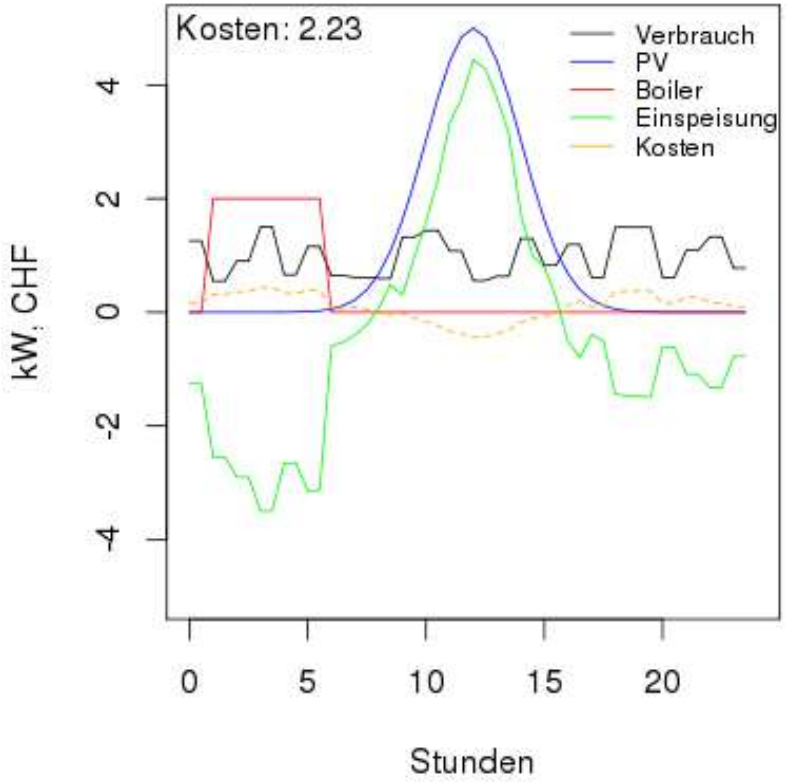
1) Falcon Client
2) HBase Client
3) HCat Client
4) HDFS Client
5) Hive Client
6) MapReduce2 Client
7) Oozie Client
8) Pig Client
9) Sqoop Client
10) Tez Client
11) YARN Client
12) ZooKeeper Client

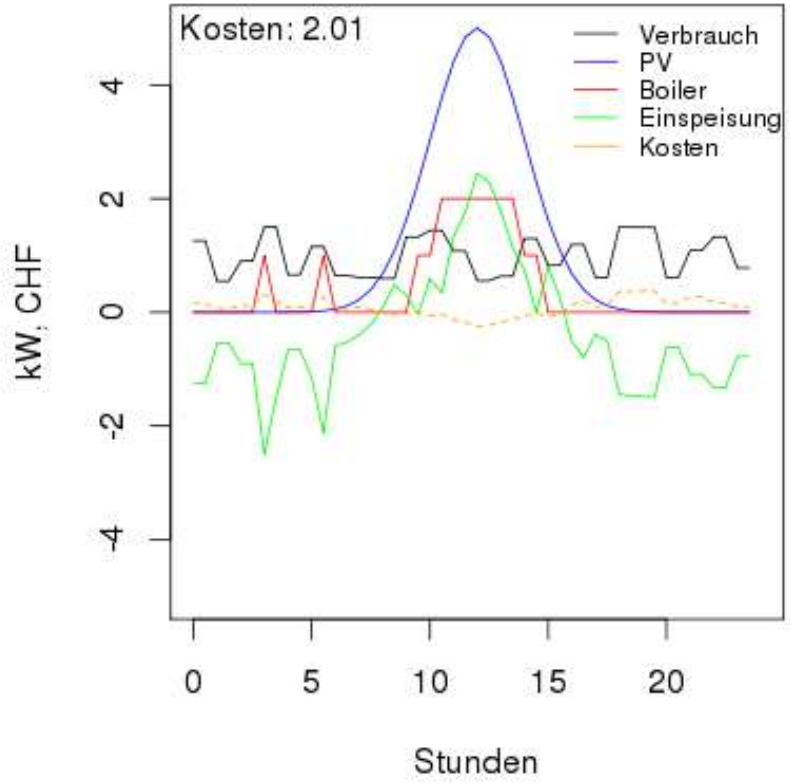
Hadoop Server Components

1) Ambari Metrics Monitor
2) SmartSense Agent
3) HDFS DataNode
4) HBase RegionServer
5) YARN NodeManager
6) Storm Supervisor
7) Flume Server

Results: BKW mySun

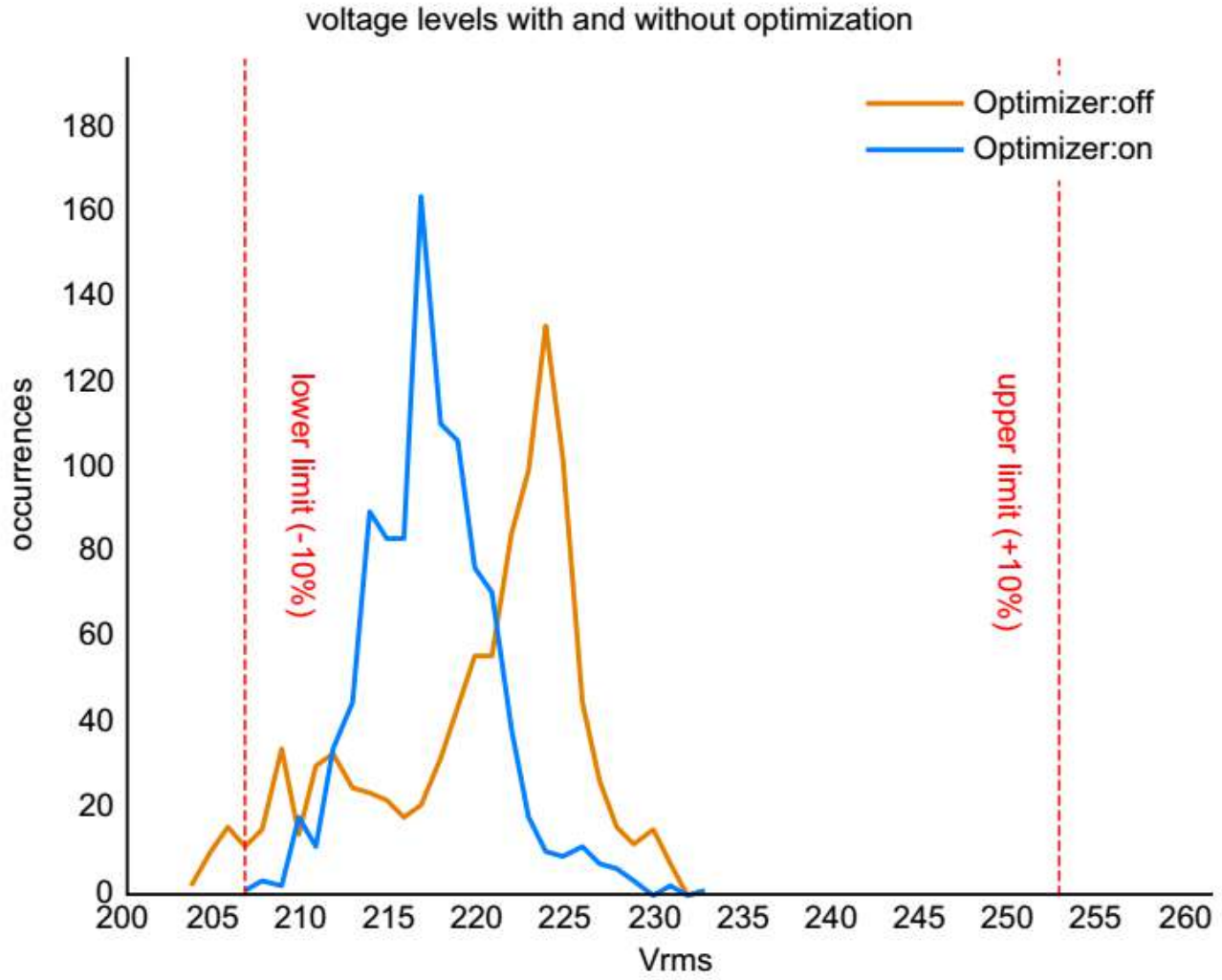
The boilers will be charged during the day if enough PV-Production is expected. No additional operation costs are required





Results: GridBox

The real-time control using our Optimization algorithms ensures an optimal Power Quality



Expectations vs Reality

On Premise:

- Build Know-How
- Data Compliance
- Flexible
- Potential consultance services

On Premise reality:

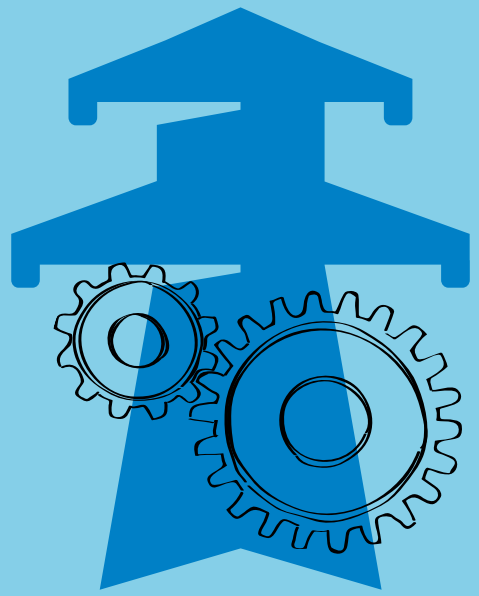
- High operational costs
- Just specialists can run the platform
- Updates & Modifications are not easy implemented (no flexible)

Innovative Applications:

- Smart Solutions for the Grid of the future
- Build Know-How
- Develop new products

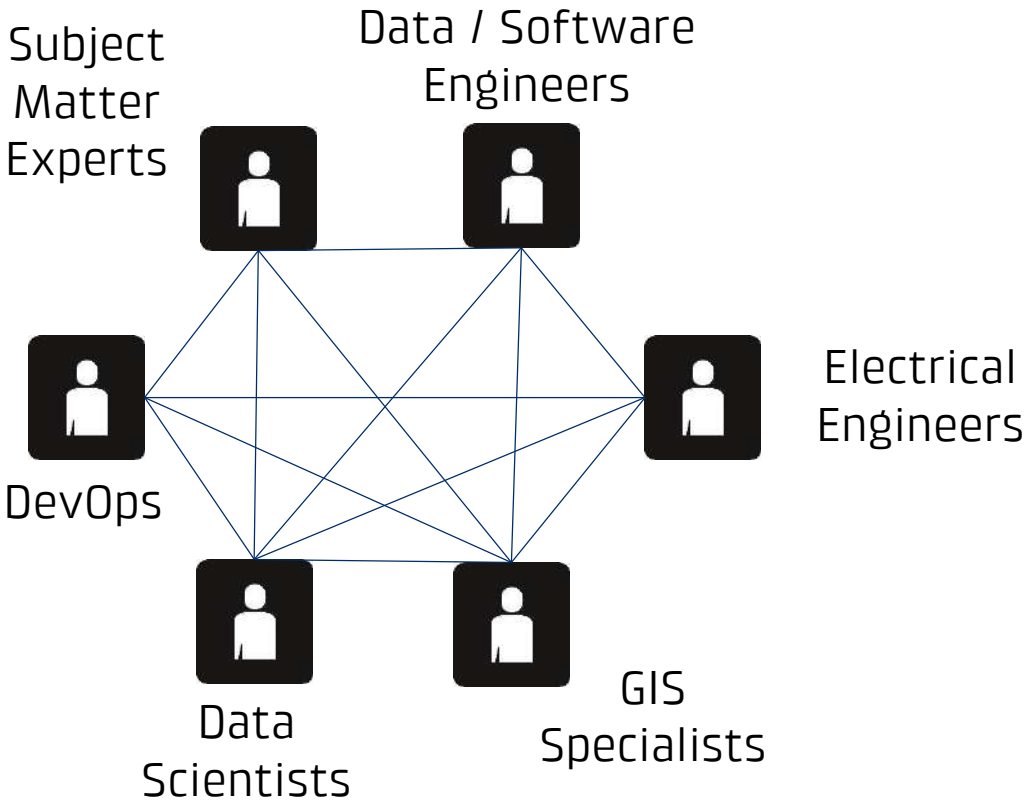
Innovative Applications reality:

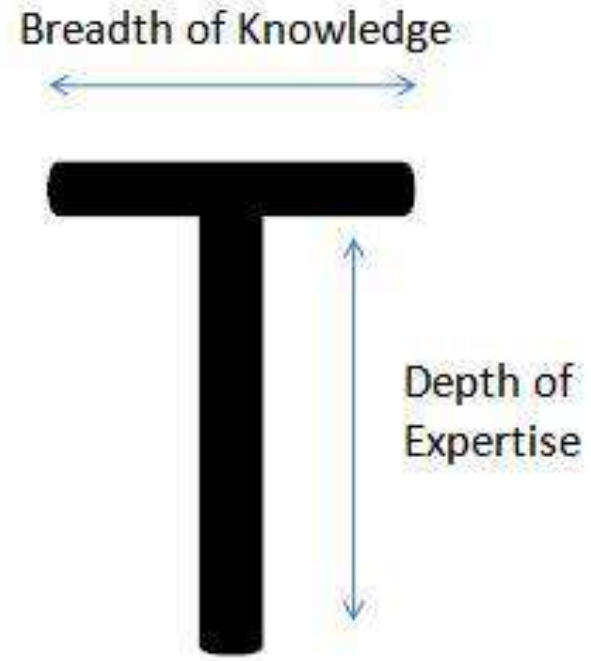
- No Business Case with actual regulation
- Products were not developed (or are no longer available)



Lessons learned:
What we have learnt and implemented

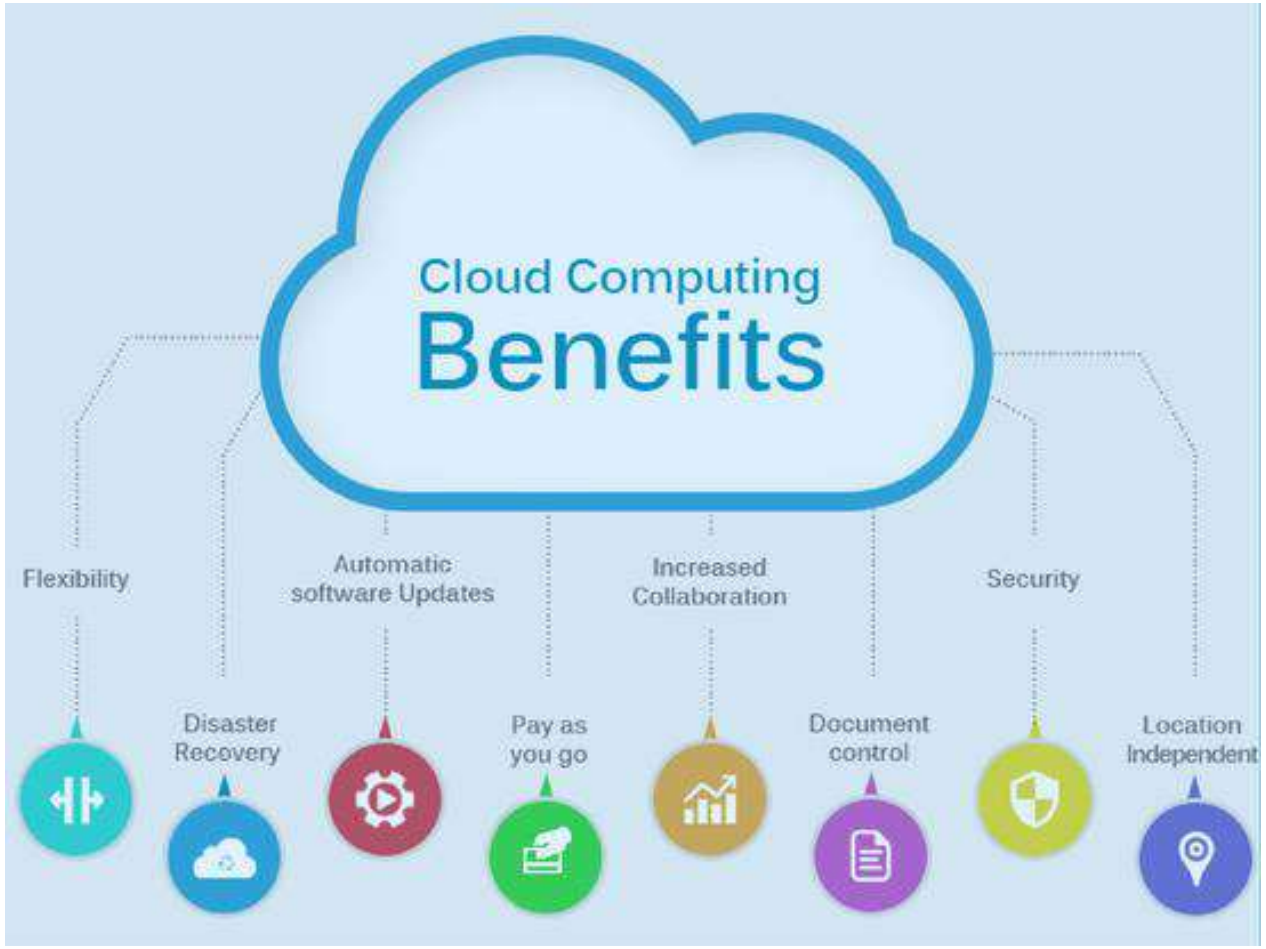
Be Flexible & Work together

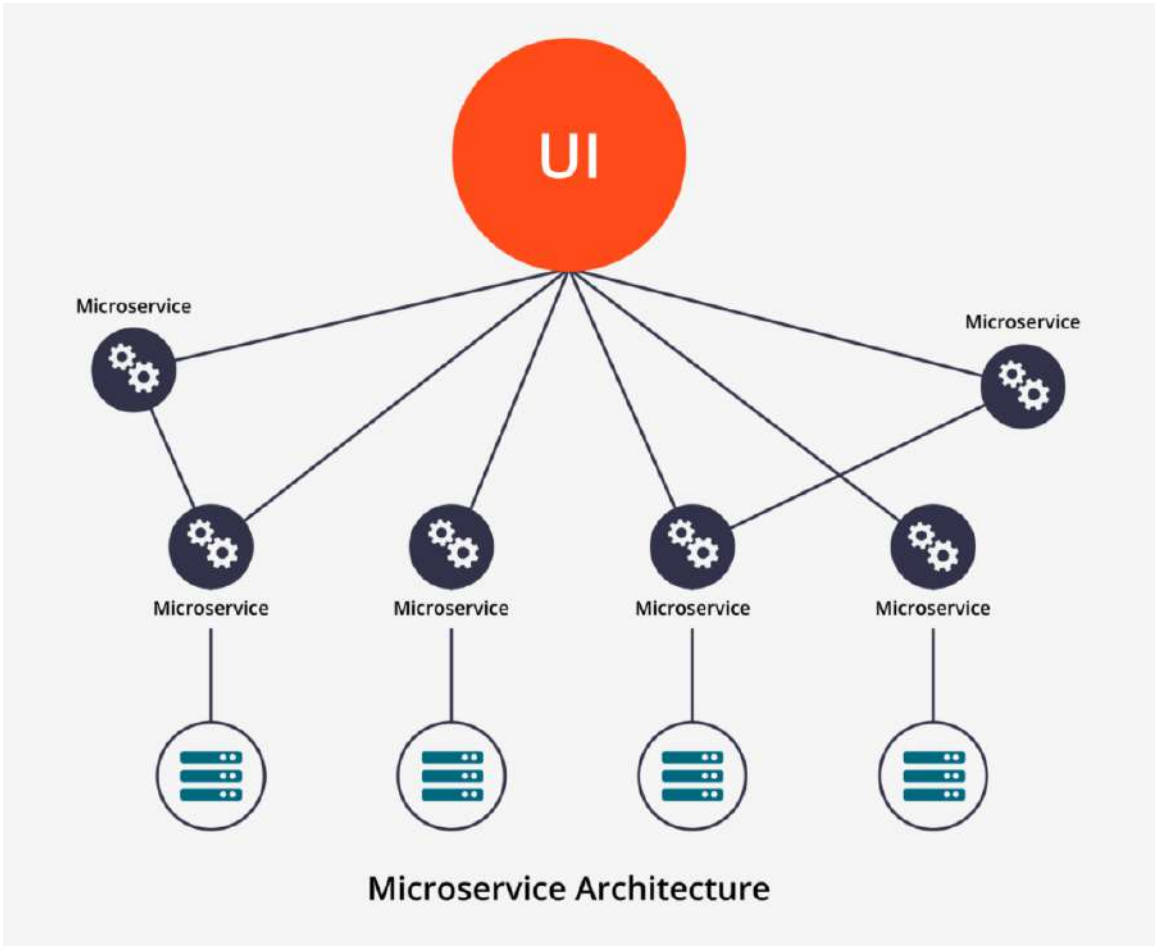




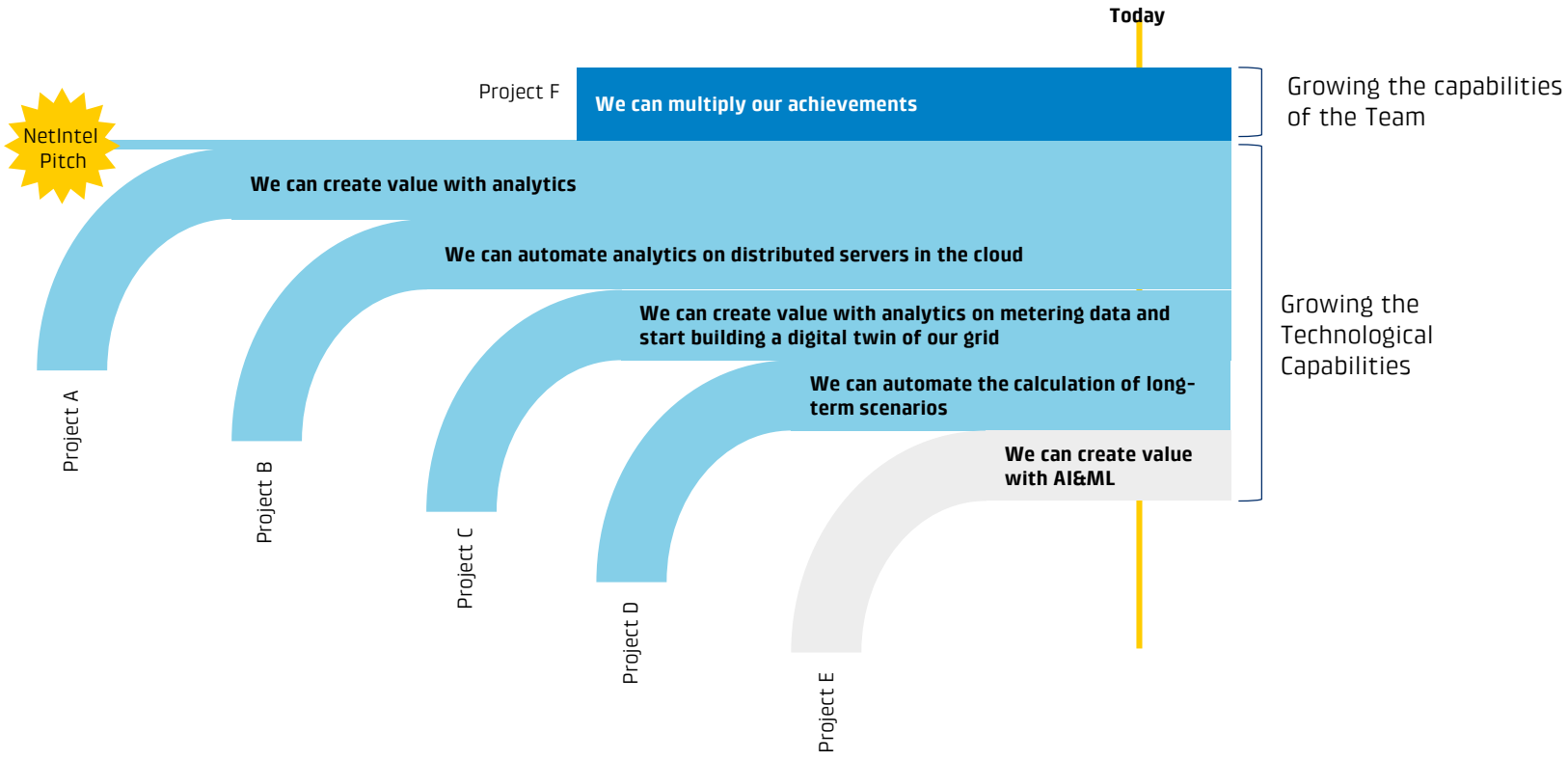
An interdisciplinary and agile cell (that survives)

IT-Flexibility: Cloud & Microservices

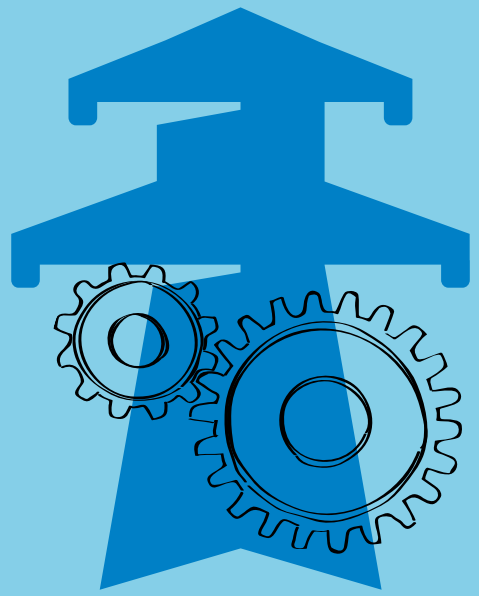




Focusing on the return of investment while improving the capabilities of the platform and the team



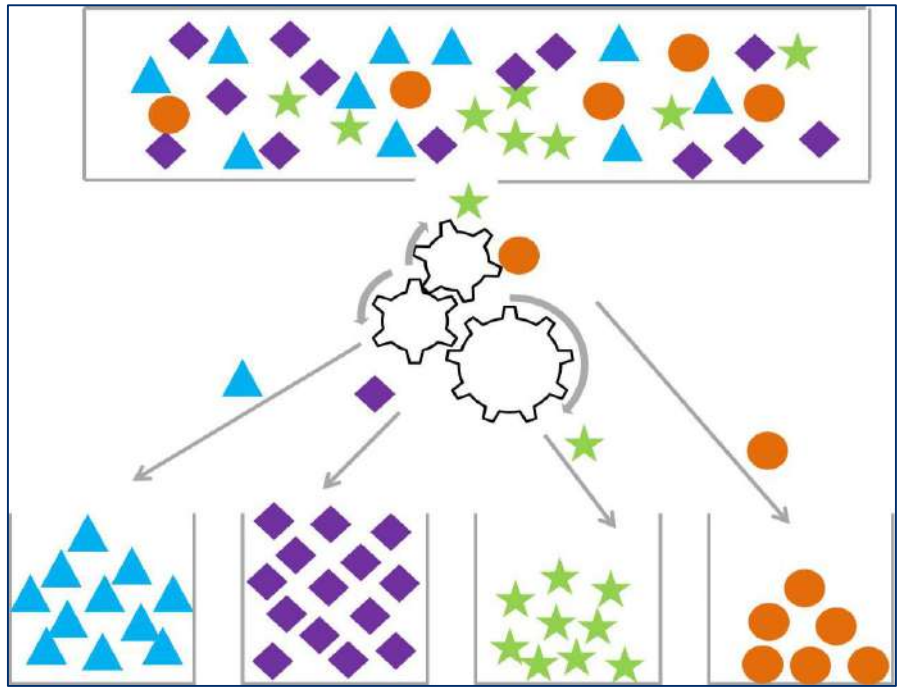
No big budget up front, but small steps with a good ROI



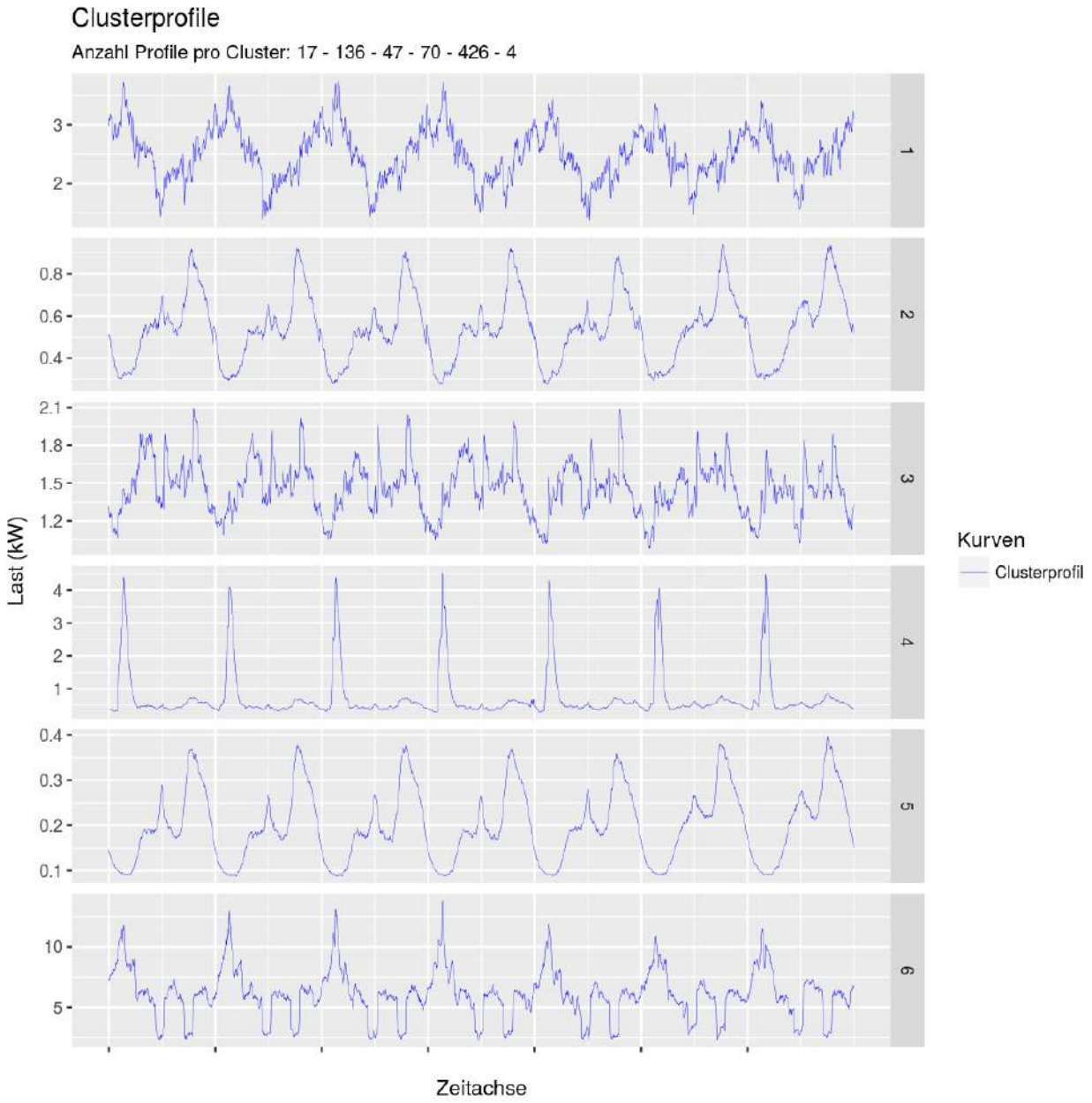
NetIntel: Where are we today?

We build our own Models (In-House)

Standard Load Profiles for Network Planning

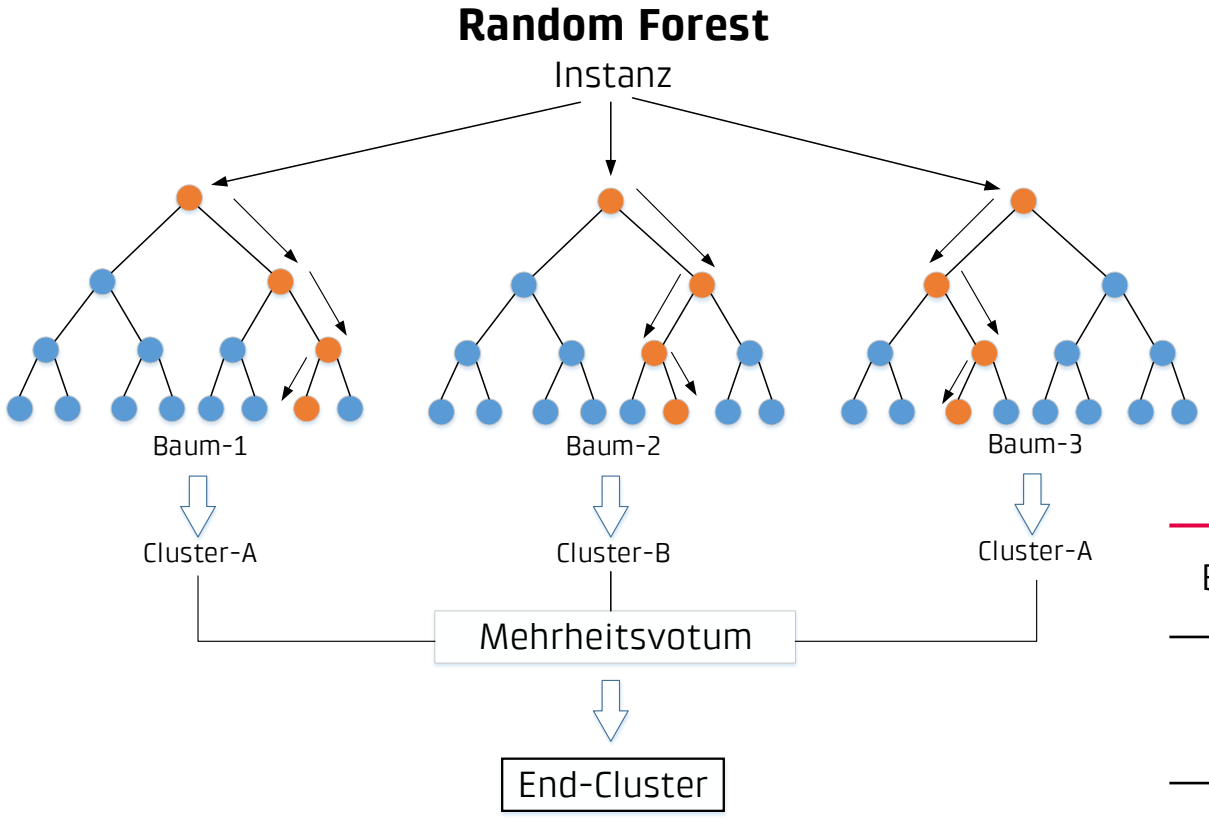


Clustering with K-Means Algorithm



Our goal is to categorize our customers for "realistic" network calculations

ML-Load Profile classification



Customer Input Data:

1. Energy consumption per year (E_{year})
2. Number of rooms
3. Type of warming water system
4. Type of Heating system
5. Maximum Power (P_{max})

Parameter	4 Cluster	5 Cluster	6 Cluster	7 Cluster
Building information	83 %	81 %	67 %	69 %
All Data except energy	90 %	84 %	73 %	73 %
All Data except Pmax	90 %	90 %	88 %	91 %
All Parameters	96 %	94 %	92 %	94 %

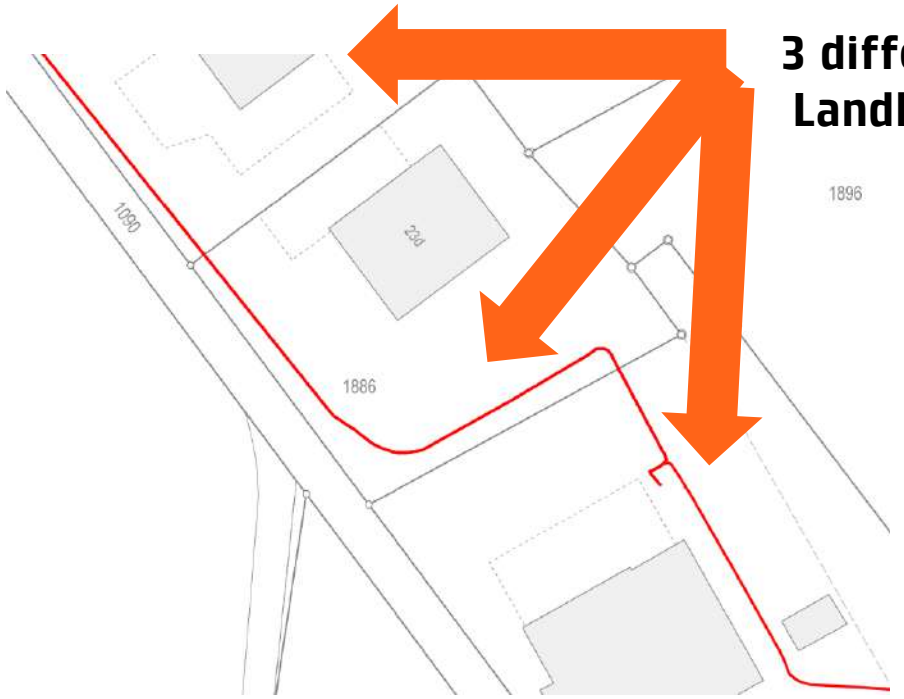
We use AI for Document classification (In-House + Expert Support)

Digitalization of existing processes: Contracts

- **First Case: Easement Contracts (Dienstbarkeitsverträge)**

  - When we require to install our assets (ie. Cable-lines, transformers), we must make a contract with each landlord.
  - Our assets have an average life of 40 years (or more!), therefore we should track the contracts for renewal or regular payment purpose

Underground Cable



Digitalization of existing processes: Contracts

- Documents need to be digitalized
- How? The important information needs to be extracted
- The non-valid contracts need to be sorted
- **Most important:** An added-value needs to be generated

PDF != Digital

- Landlord
- Addess
- Contract-type
- Relevant dates

ie. Asset no longer exists

- Access to the data
- Increase quality
- Reduce costs

First approach: Digitalize the contracts manually

- ±10% of the contracts have been scanned and loaded into our systems
- Experts have also extracted the information and analyzed the validity of the contracts

First estimations show that digitalizing 100% of the contracts require…

>5 years

Investment is not feasible

Second approach: AI Solution

Challenges:

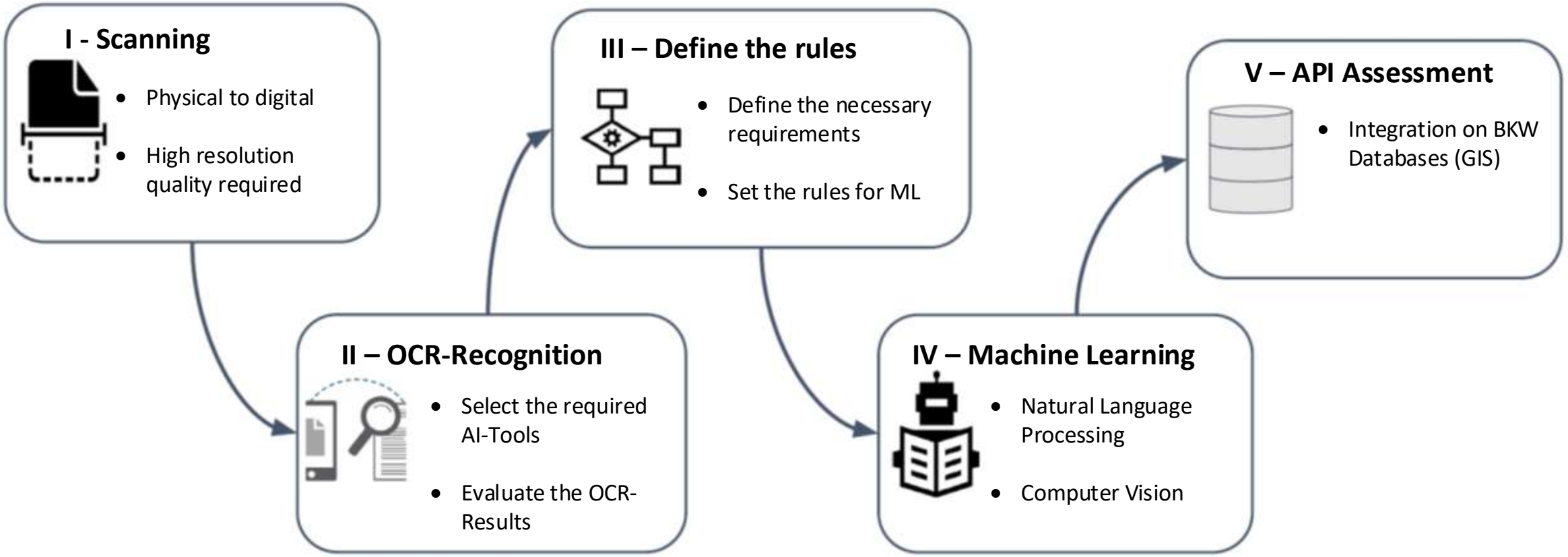
- Up to 200k Contracts for the last +100 years
- Two different languages, more than 100 different contract-types
- Some documents include hand-writting or remarks
- Some contract owners, addresses or lot numbers no longer exist
- No AI (Text-recognition) Experience within our company

Expectations:

- We want to build Know-How for further similar Use-Cases
- We want to operate our solution for further development

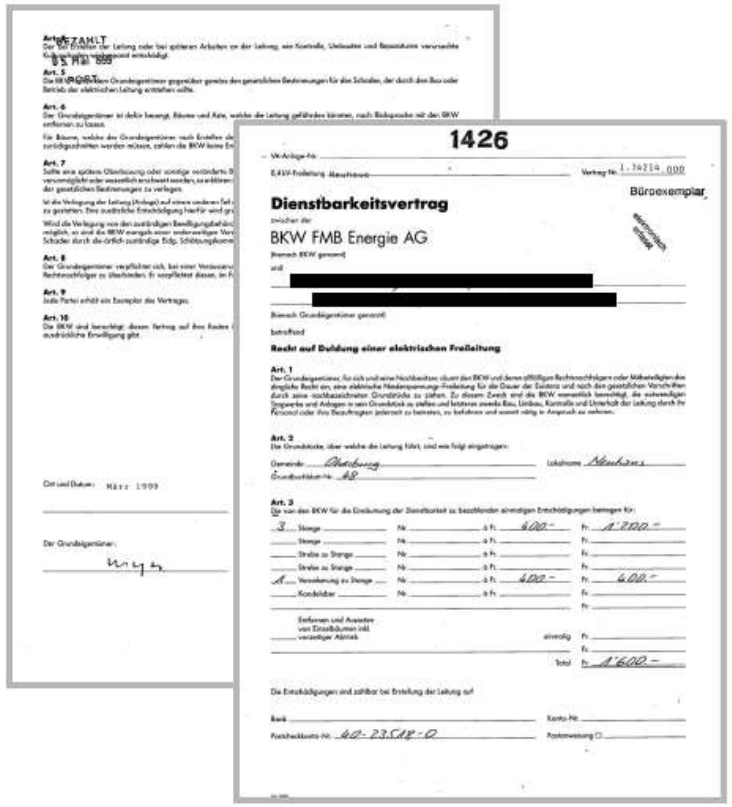
Development of an In-House Solution with an external Expert Partner

Digitalization of the Easement Contracts



Generating value from AI

Unstructured Data



Structured data

Type	0.4 kV-Freileitungsvertrag
Municipality	Oberburg
Lot Number	48
Date	03/1999
Signatures	OK
Validity	OK

Integrated with
internal DMS
e.g. SAP S/4HANA

VISIUM

We use AI for Visual Recognition for our Asset Management

(External AI Solution)

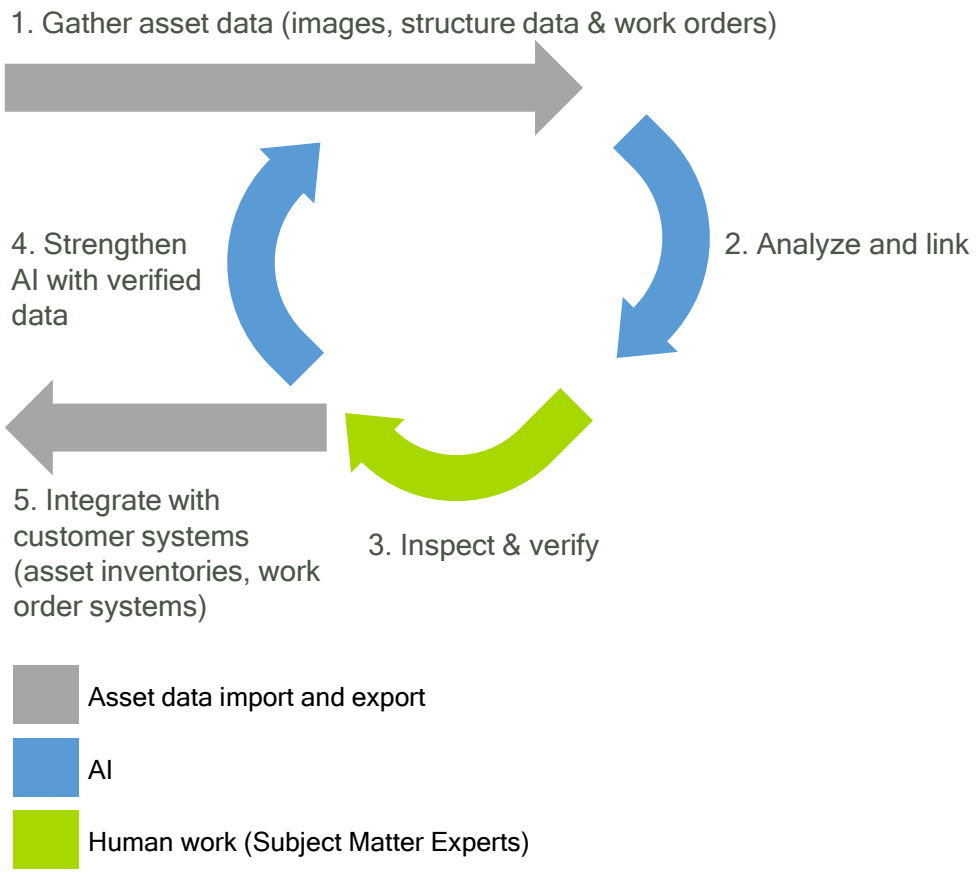
Current inspection methods are labour intensive, expensive and dangerous

Current inspection methods are manual, dangerous, slow and costly

Data is manually processed – defects are not detected in a timely manner

Turning inspection data into asset insight

How?



Why?

1. **Improve the efficiency of inspection work** by facilitating the ability ability to turn image data into annotated asset records
2. **Enhance reliability** by acting on a problem before it causes issues issues
3. **Improve safety** by keeping people out of harms way
4. **Optimize capex** through more targeted capex spend
5. **Easily comply with regulatory requirements** through extensive documentation of the grid

Why using an external AI-Solution?

- AI Solutions based on Visual recognition require big datasets
- Required ressources for picture classification & Model development are too high
- We profit from the development done together by eSmart with other utilities
- We can still shape & strengthen the AI with our Expert's classifications

What it is important for us:

- We can export & use the predictions for other purposes and in other environments
- We can build additional services & interfaces on top of this solution

But we can & will challenge them

Actual state of the collaboration

- We ran the AI-Solution on a first small dataset

- Assets are correctly identified & classified

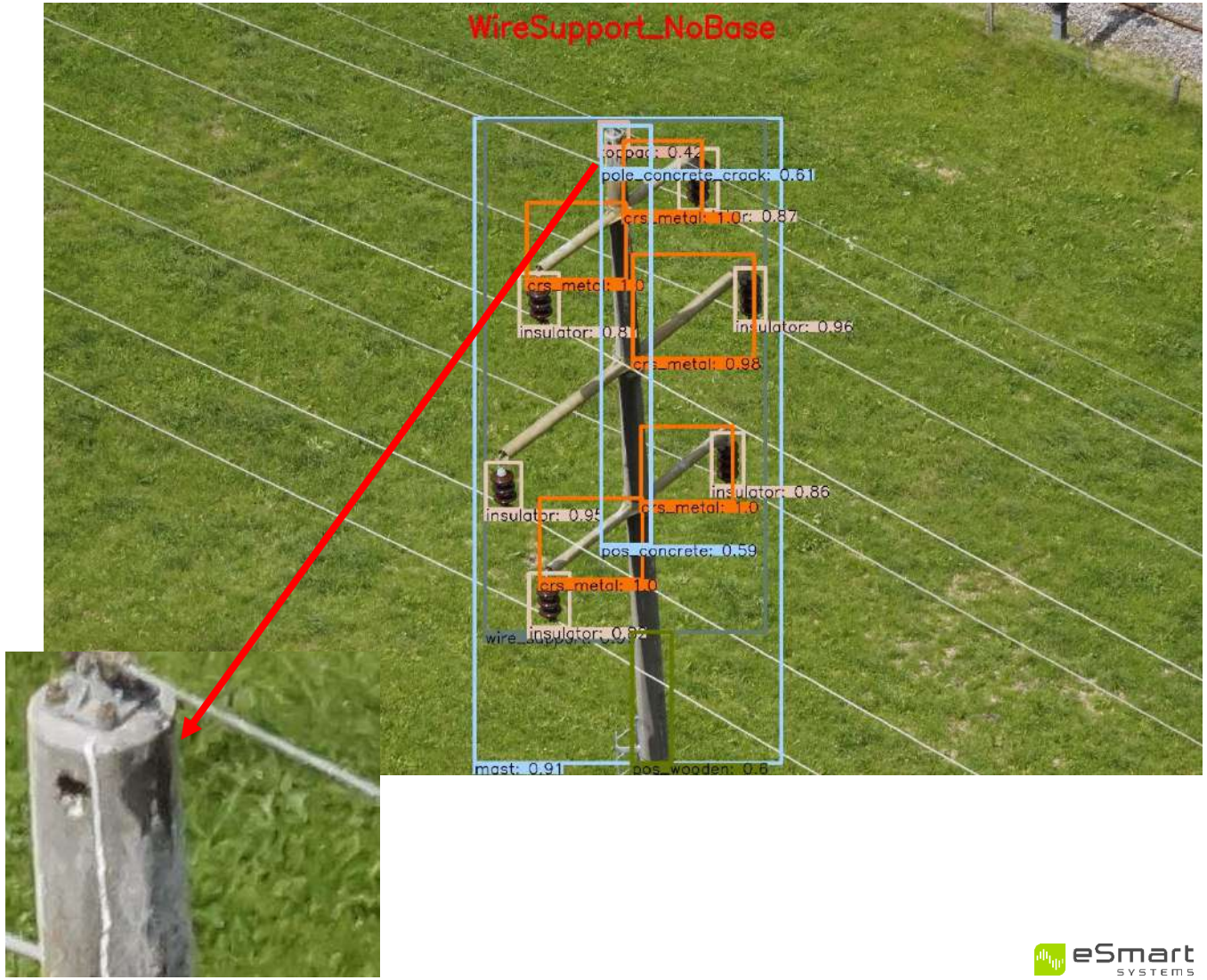
- Potential defects are identified

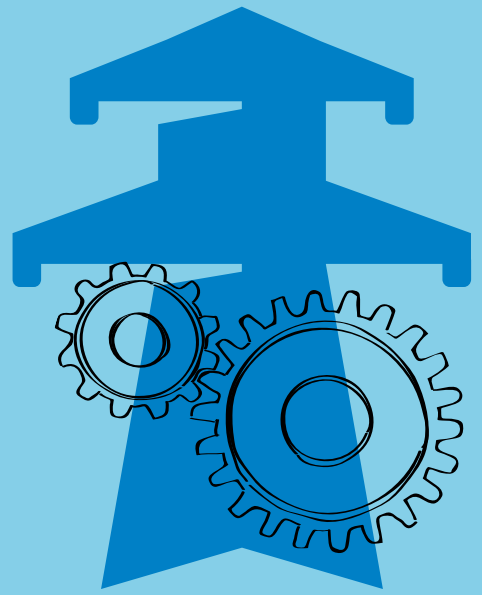
Next Steps:

- Our Experts will classify a training set using the Grid Vision™ manual inspection feature

- AI-Model will be improved and tested on a new Test data set

- Business Case analysis for the integration of the Grid Vision™ software in our process





Conclusions

Conclusions

- Accept your company culture and strategy, don't try to reshape the future alone
- Be flexible & agile. Requirements will change, try to understand them
- Main focus with AI should always be generate value
- In-House & External AI&ML solutions can be successful, try to define your strategy for each case
- Nobody better than ourselves to understand and fullfill our requirements
- Share success, involve rather than convince stakeholders. Being right is not enough!

Thank you for your attention

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