

LV Network Monitoring

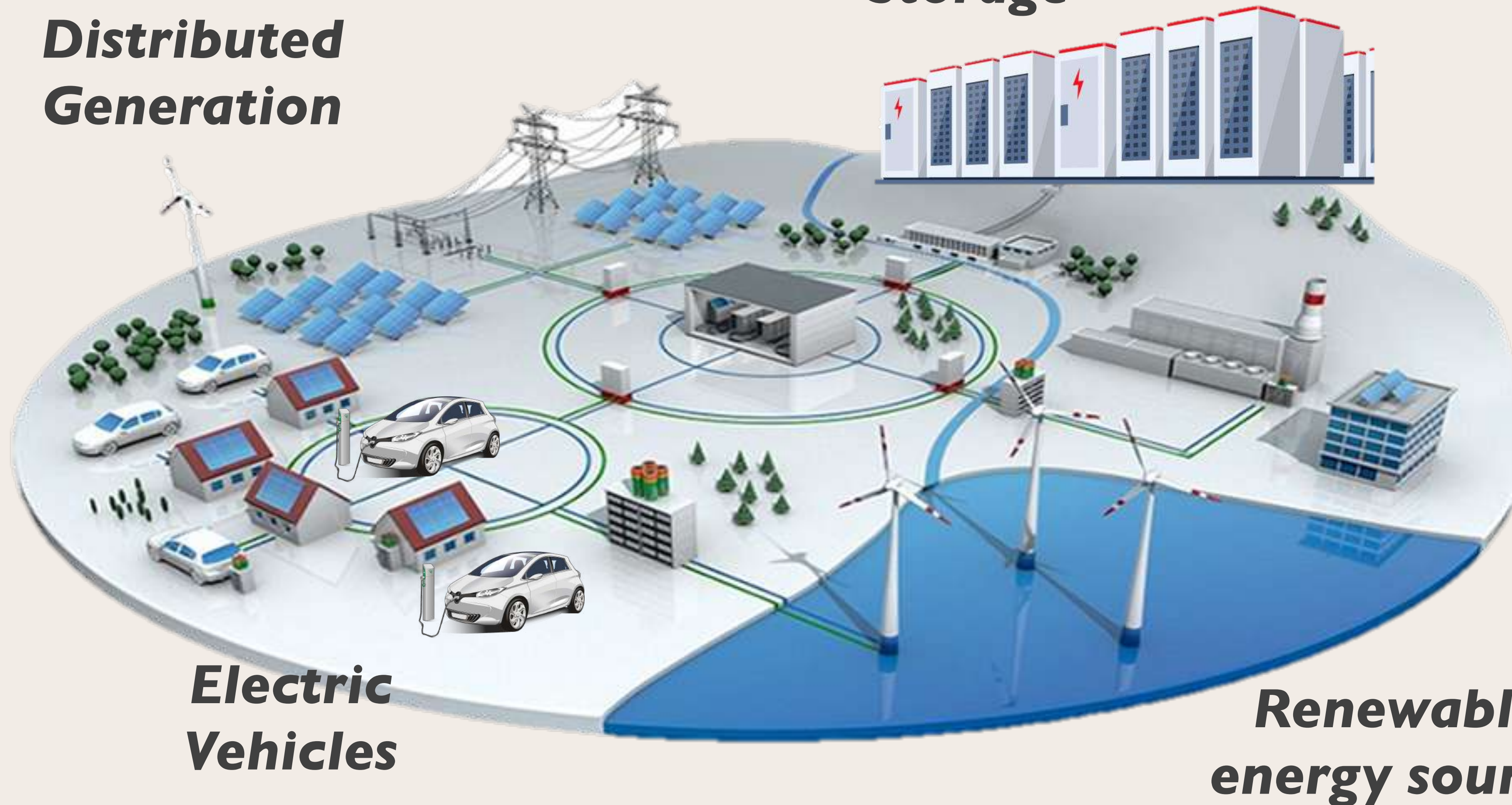
Understanding the benefits of including LV monitoring on in-house training programme for engineers to achieve greater workforce engagement

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Why LV Network Monitoring?

***Distributed
Generation***

Storage



**Smart grids also
bring complexity!**

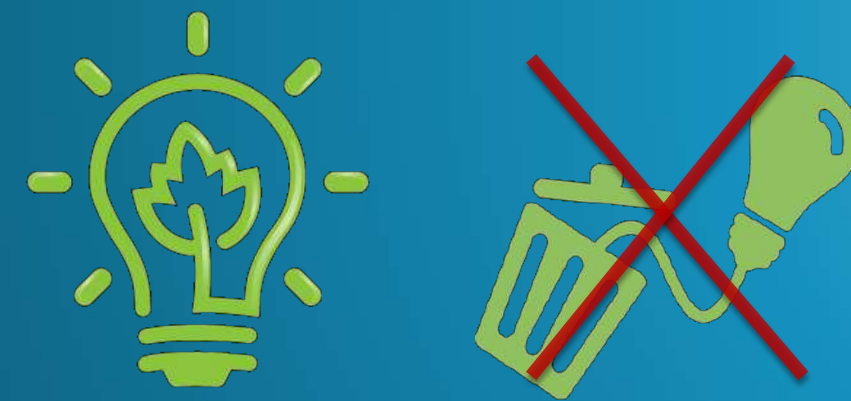
LV Network Monitoring goals



LV Monitoring as first step to:

1. Enable smart operation of the grid
2. Unlock grid automation
3. Better asset utilisation and larger integration of renewables
4. System awareness for more reliable planning and decision making

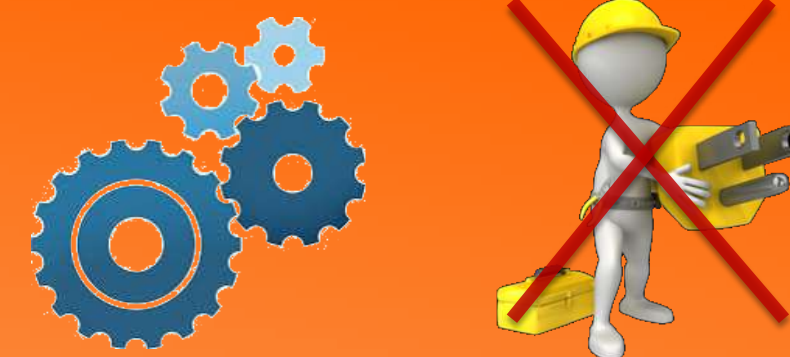
System awareness for efficient and reliable operation



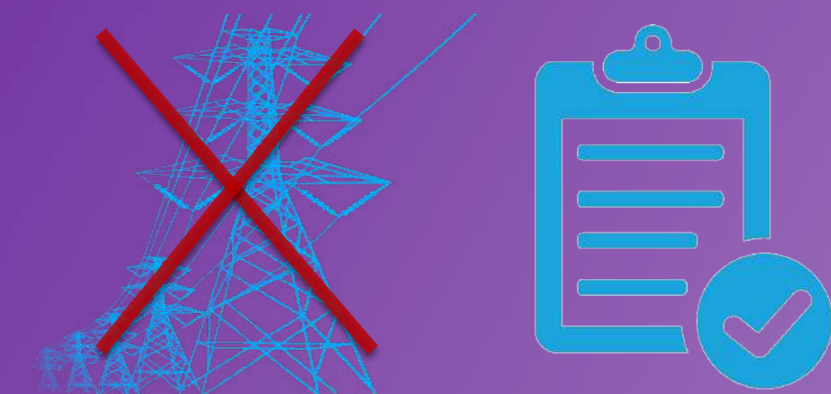
Integration of more renewable generation



Grid Monitoring



Real-time monitoring as basis for grid automation



Accurate and fine grained data for secure planning



LV Monitoring - technical challenges



EUROPEAN DISTRIBUTION GRIDS



2400 DSOs



260M customers



**2700 TWh/year
distributed
generation**

DISTRIBUTION OPERATORS NEEDS

**RT monitoring LV
and MV networks**

**Accurate forecast of
load and DG**

**Integration DG and
orchestration RES**

**Key indicators for
planning future
investments**

TECHNICAL CHALLENGES

Very large grids

- **10 million km of lines**
- **4 million MV and LV transformers**

Mainly poorly monitored grids

- **No visibility of conditions in LV**
- **Smart meters mainly for billing purposes**

Unpredictable and dynamic profiles

- **Intermittent operation of RES**
- **Effects of randomness in LV**

Unbalanced conditions

- **More complex power system analysis**
- **Detailed grid models needed**

LV Monitoring – other challenges

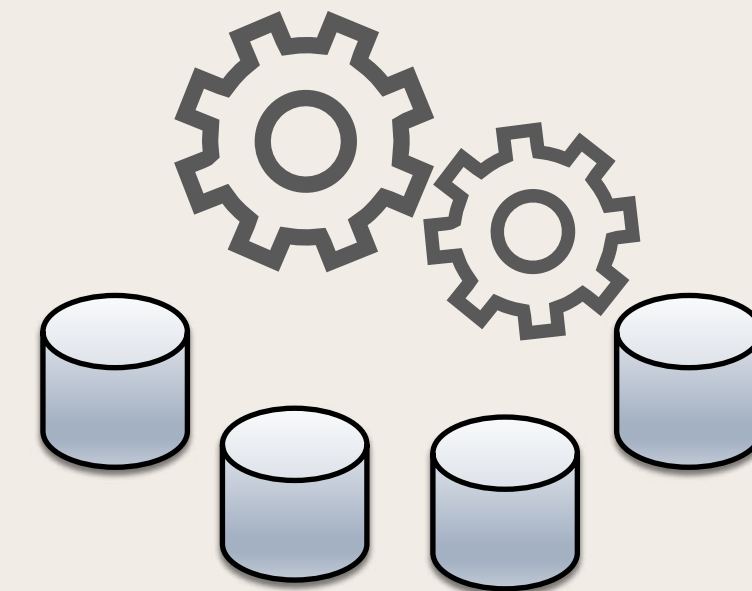


Grid digitalisation

- still in progress
- model of LV grids sometimes unavailable
- grid data stored in obsolete formats

Data heterogeneity

- multitude of devices talking different communication protocols
- lack of standardized approaches for data management and software interfaces



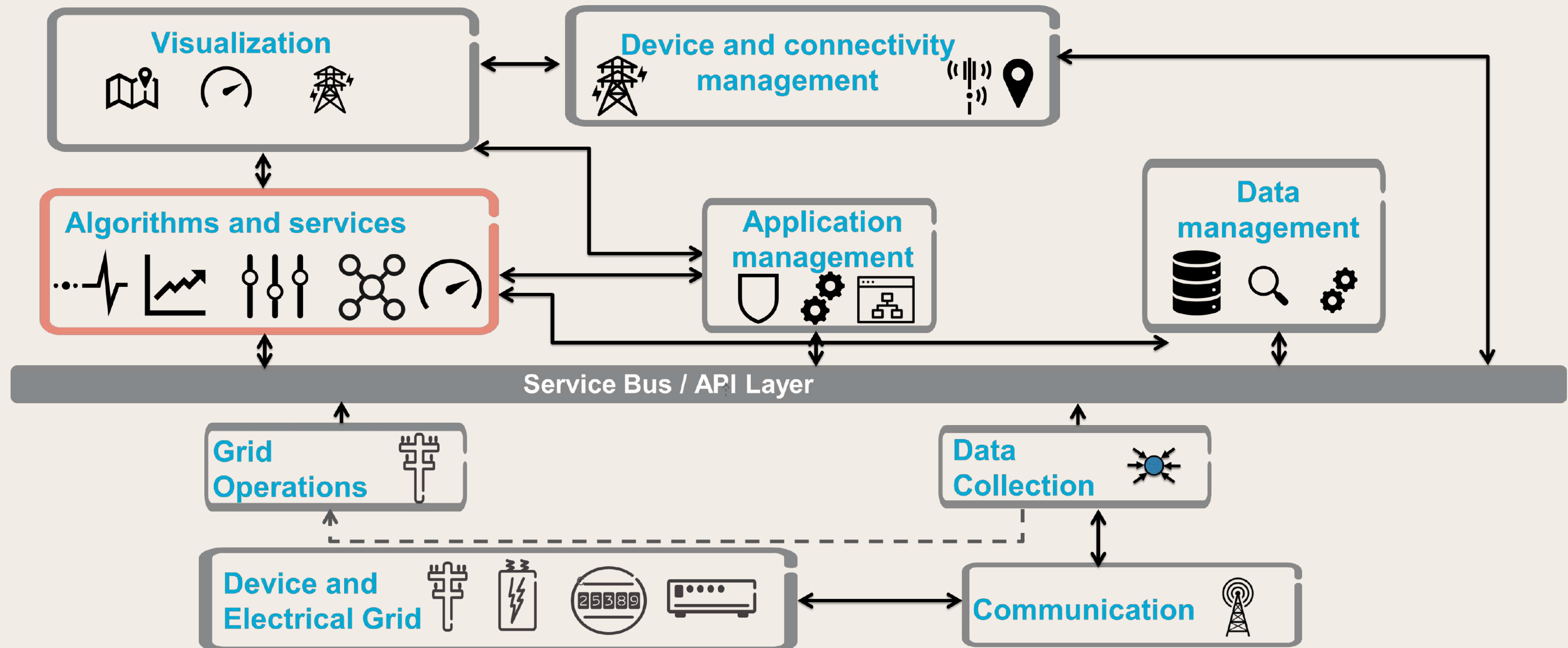
Cybersecurity

- general threat for critical infrastructure
- data “closer” to the final customer when working with LV grids

LV Monitoring architectures



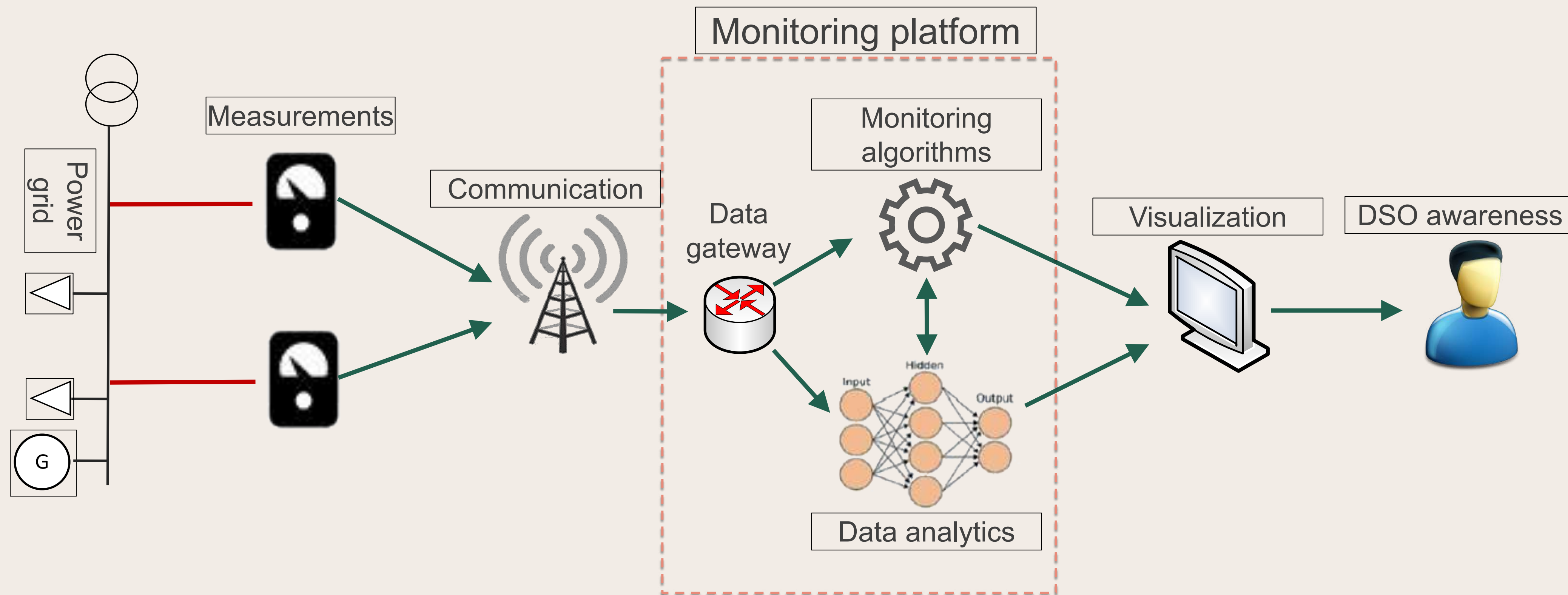
Much more than power system algorithms...



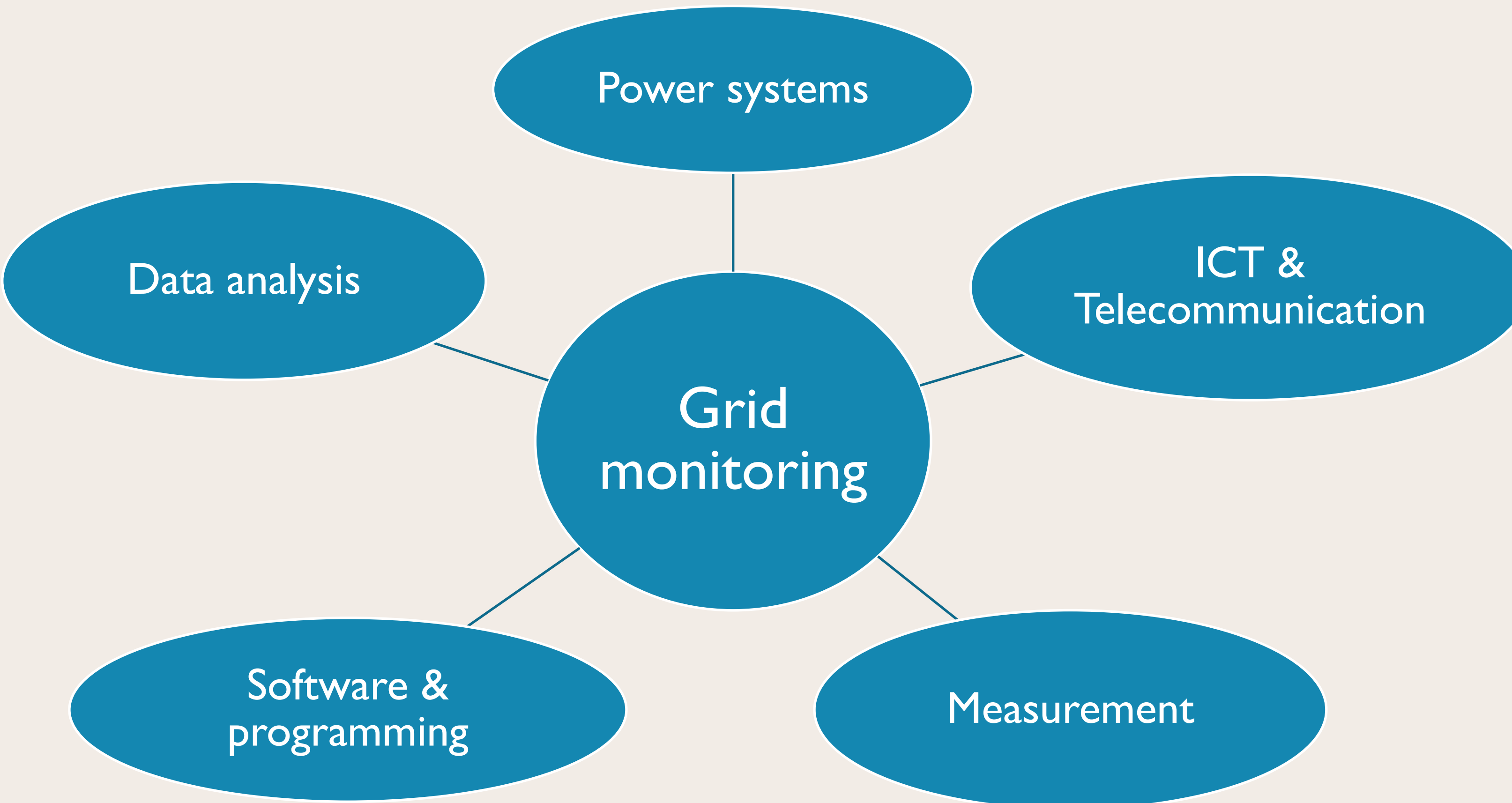
LV Monitoring needed tools



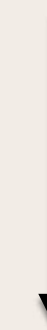
Implementing efficient monitoring requires expertise and smart decisions over the **whole monitoring chain!!!**



LV Monitoring – required skills



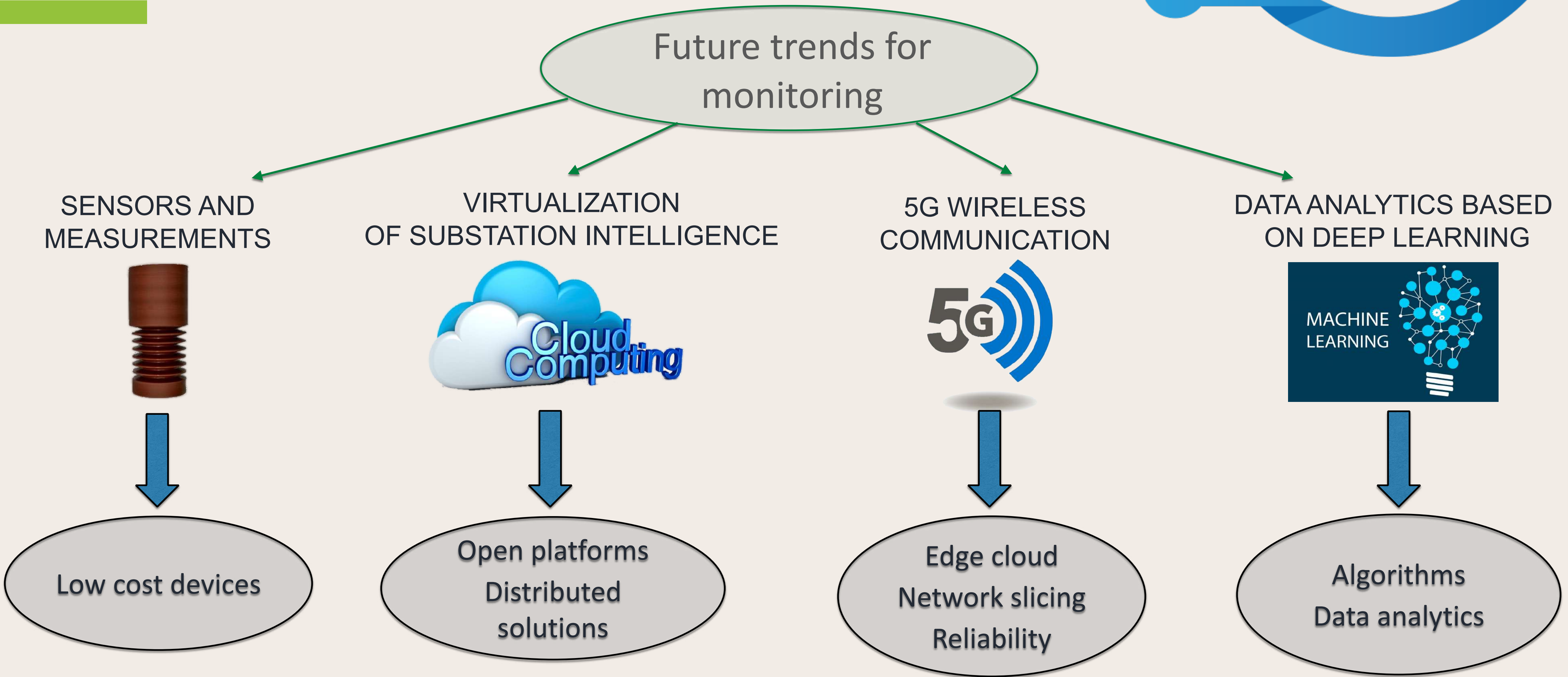
Strong expertise in a single area
is not sufficient anymore



Complex tasks require
interdisciplinary approach and
combination of different skills



LV Monitoring ingredients

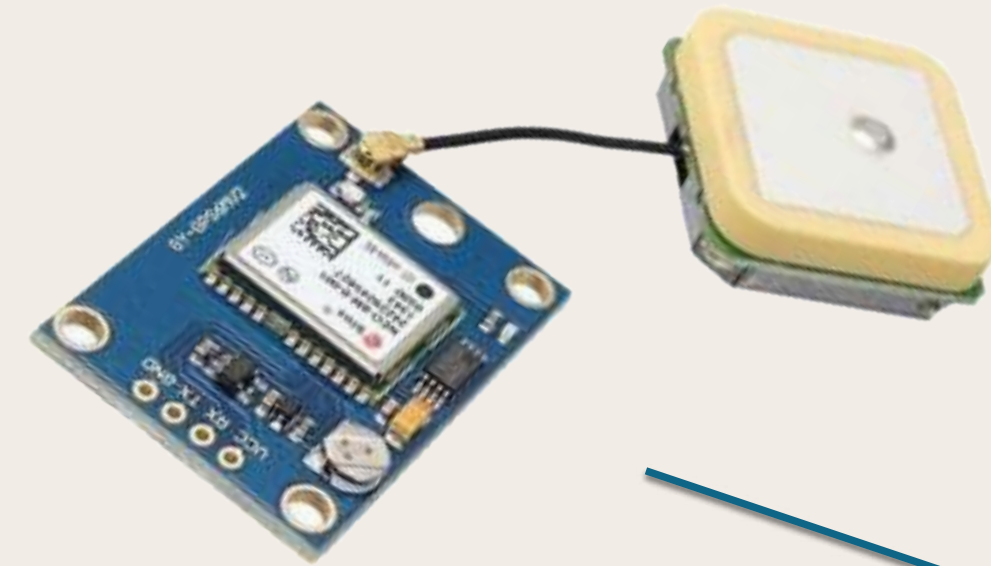


LV Monitoring – low cost PMUs



Possibility to build **low cost** measurement units based on general purpose hardware

GPS module



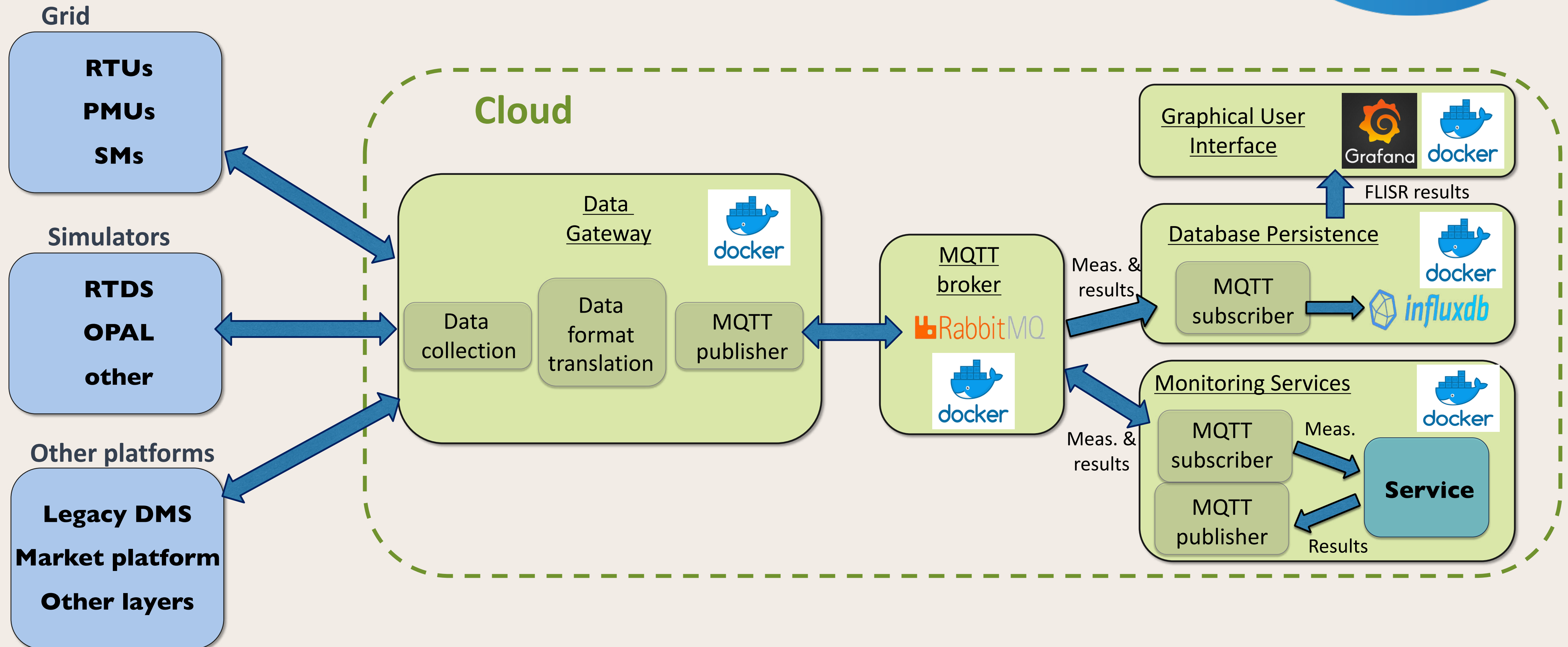
Acquisition board



Computing board



LV Monitoring – open platforms



LV Monitoring – role of 5G



PERFORMANCE REQUIREMENTS



Critical Communications

<5ms e2e delay
99.999% transmission reliability
500Kmph relative velocity



Intelligent Transport Systems

Massive Communications

>10yrs battery lifetime
>80% cost reduction
20dB better coverage



Connected Sensors

Extreme availability

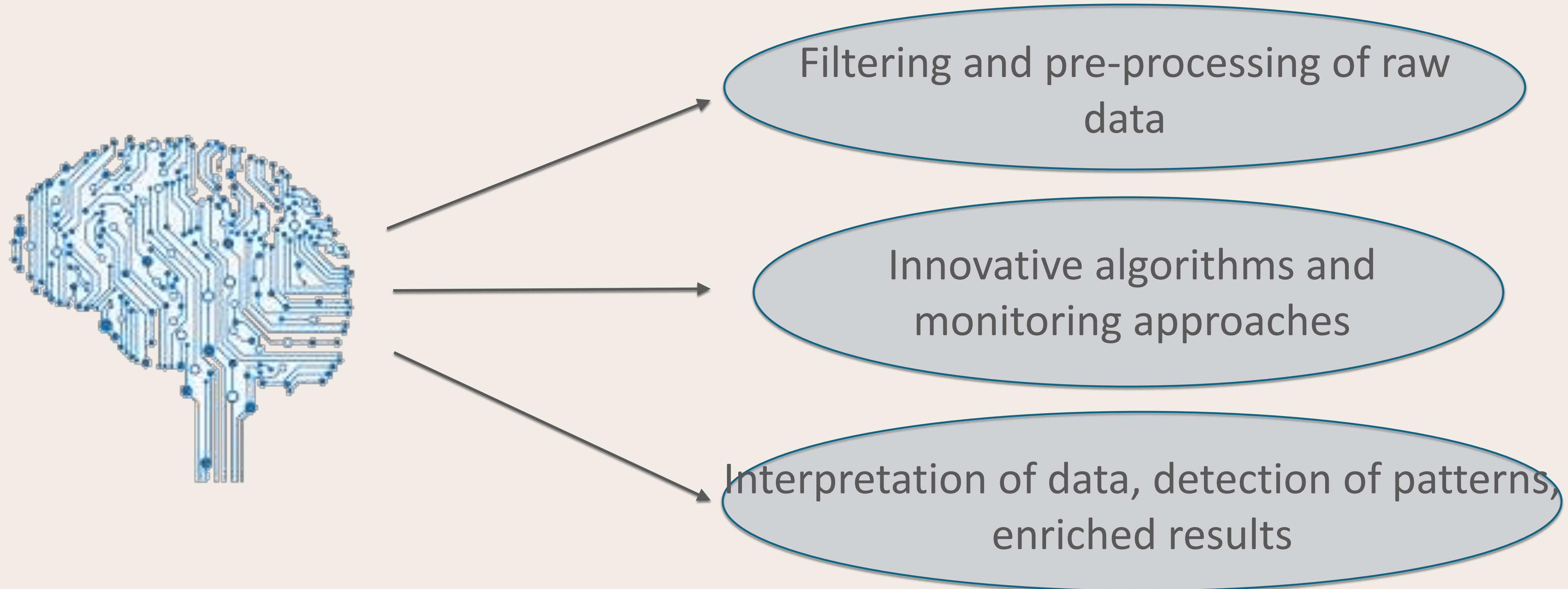
Scalability and flexibility



LV Monitoring – advanced AI tools



Artificial Intelligence unlocks new opportunities for the smart monitoring of the LV grids:



Monitoring data: how to deal with them?



- Interpretation of the monitoring data and how this information will be used are the key aspects
- Machine learning tools can help to compress large data into meaningful information
- Advanced analytics tools can offer quick and easy visualization of statistics
- Despite the automation of many processes, human will still be at the basis of strategic decision making

Beyond traditional monitoring

Grid monitoring

- network steady state operating conditions

Wide frequency monitoring

- PQ monitoring
- Monitoring dynamic events
- Digital twins

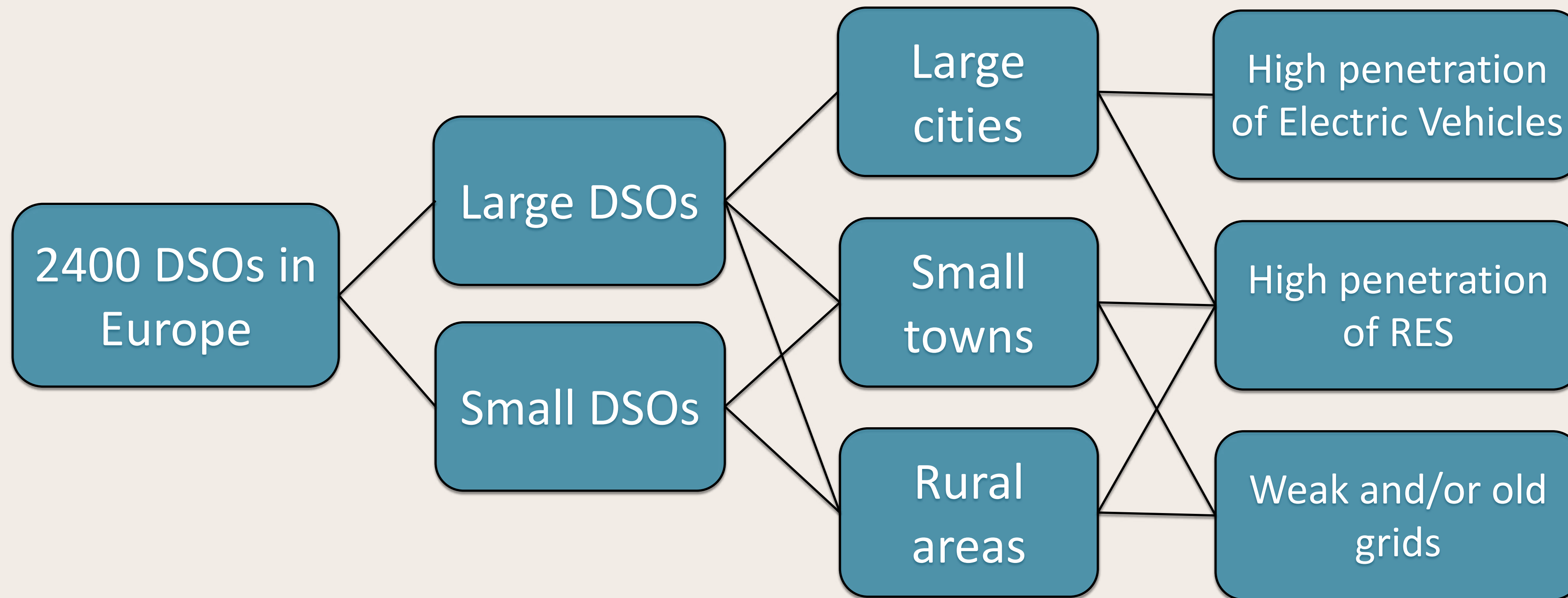
Prediction

- Identification patterns
- Predictive contingency analysis
- Predictive grid stability indicators

Condition monitoring

- Monitoring state of health at component level
- Predictive maintenance policies

LV Monitoring – utility requirements



DSOs can differ due to a number of reasons:

- all of them require (or will) monitoring to have an insight on their grid operation;
- The best way to deploy grid monitoring varies depending on the DSO

Monitoring as a service – TOTEX approach



“The situation today”

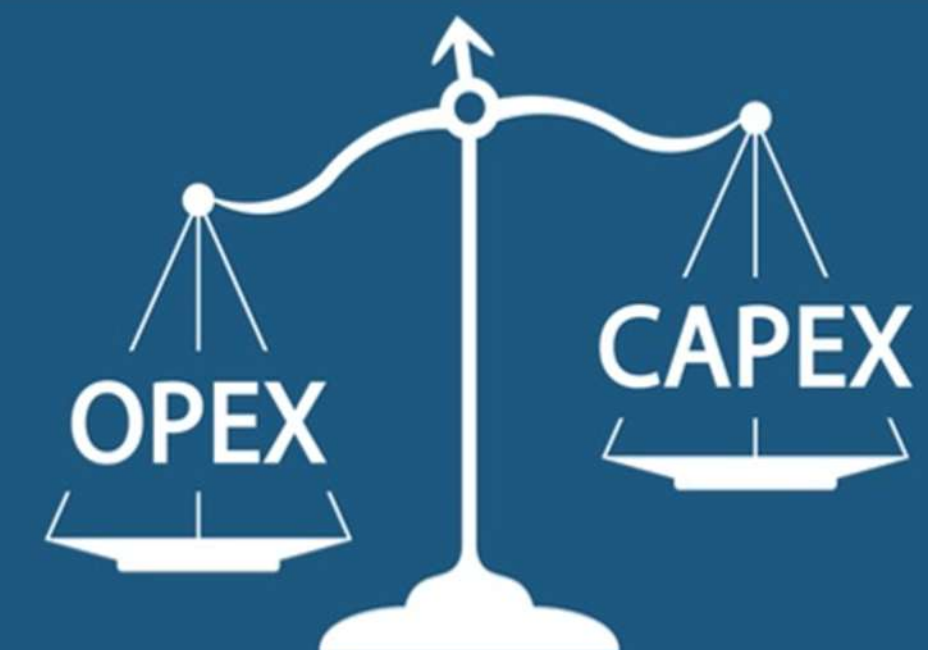
Supporting
CAPEX:
Incentives for
investments in
physical assets

OPEX – “Cost of
Services” not
supported at all

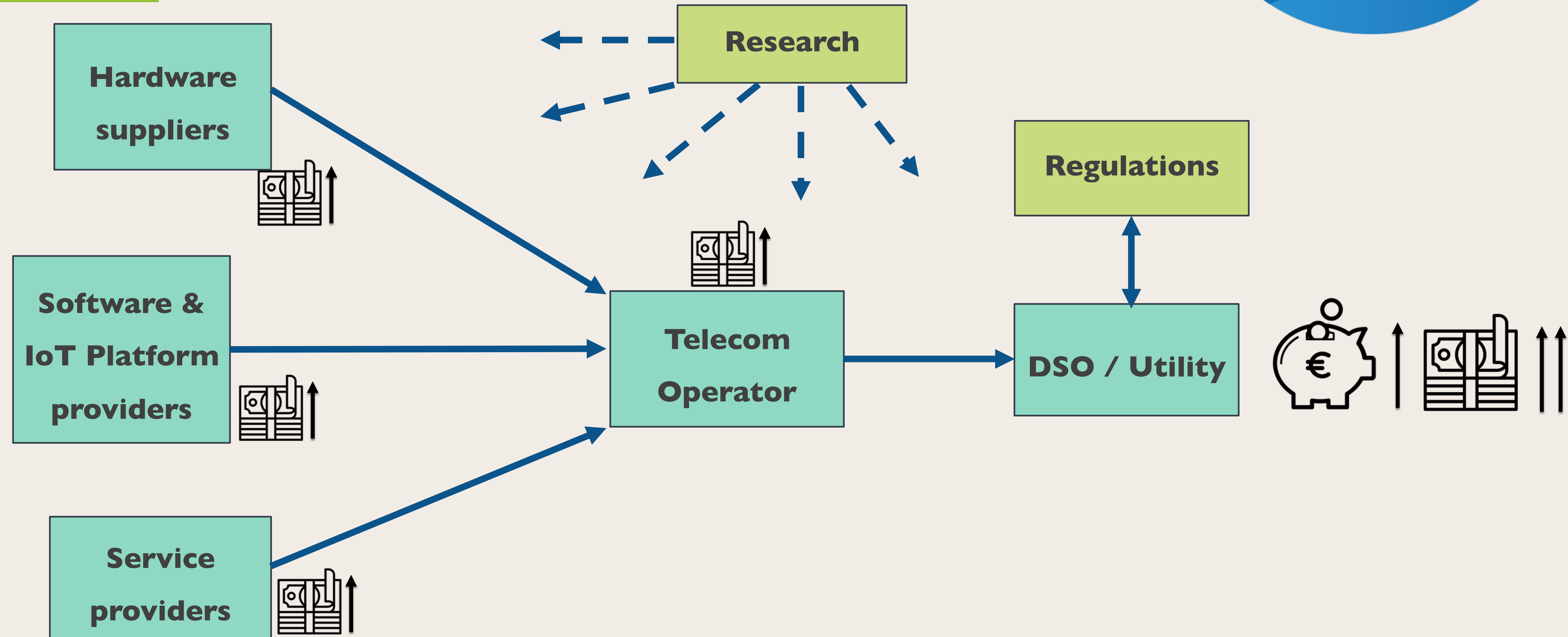
CAPEX – “Cost of
Investments” not
properly supported:
development of the
network in order to
respond to “peak
values”

TOTEX approach

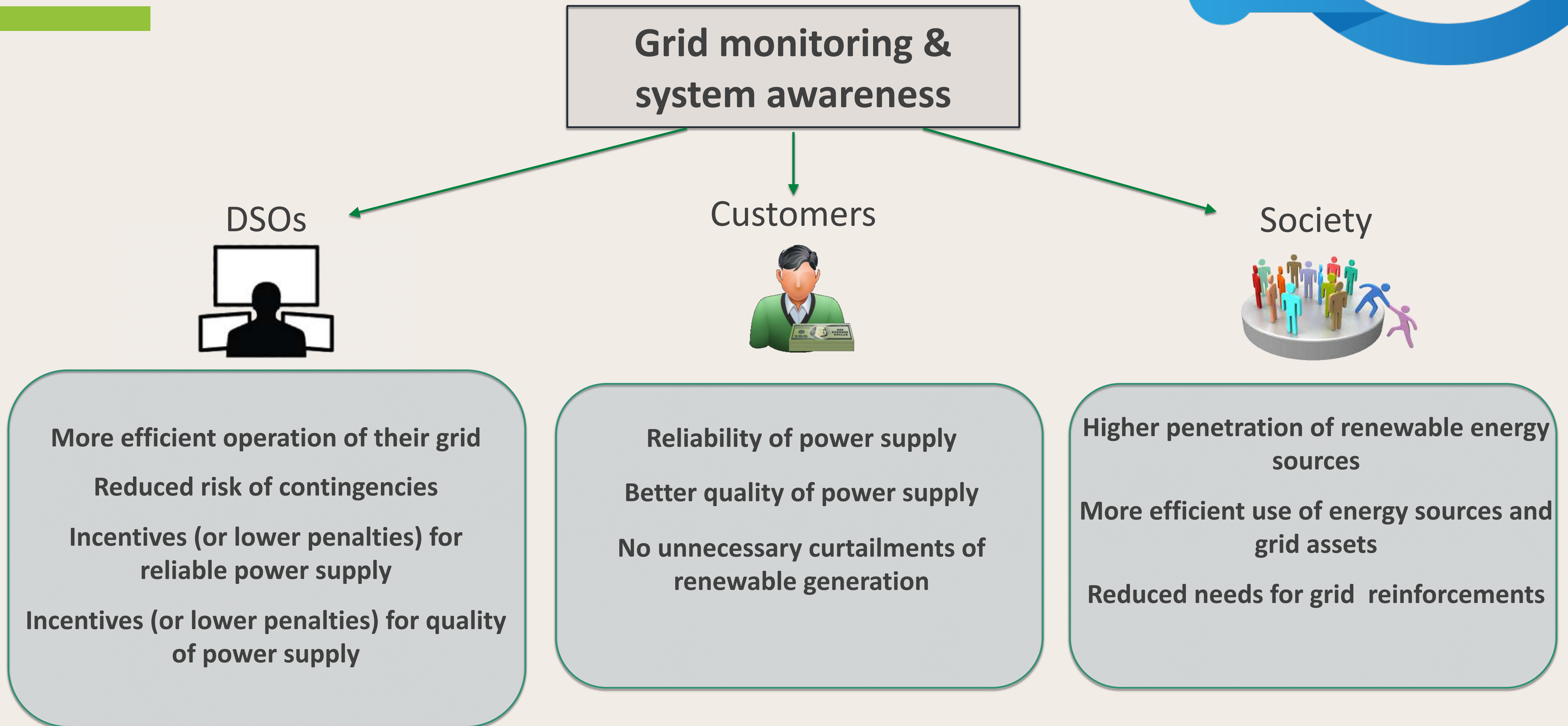
EC recommendation from
“Winter package”: The
Regulatory framework to
support **OPEX** –
cost of services



Grid monitoring business chain



Grid monitoring value



LV Monitoring future scenario



	Today LV grids	Next gen LV grids	Future LV grids
Sensors and measurements	Low accuracy and expensive measurements	Accurate sensors and medium cost measurements	Very accurate sensors and cheap measurement units
Monitoring availability	Sparse monitoring data rarely available	Monitoring data with real-time network status	Deep monitoring data with insight on real-time and predicted status
Smart management enabled via monitoring	Few algorithms available, not scalable	Conventional algorithms for grid management	Advanced optimization via conventional and AI algorithms
Monitoring deployment	Large upfront investment	Trials of monitoring solutions as a service	Large availability of monitoring services
Monitoring platform	Monolithic DMS platforms	Single modules in parallel to legacy DMS	Open, distributed, scalable and modular IoT platforms



Conclusions



- Monitoring the LV grids is a must for many DSOs
- Implementing monitoring tools is a complex task that involves different skills and expertise in different areas
- New technologies in each of these areas are going to revolutionise the way monitoring is done and the business around it



Thank you!

