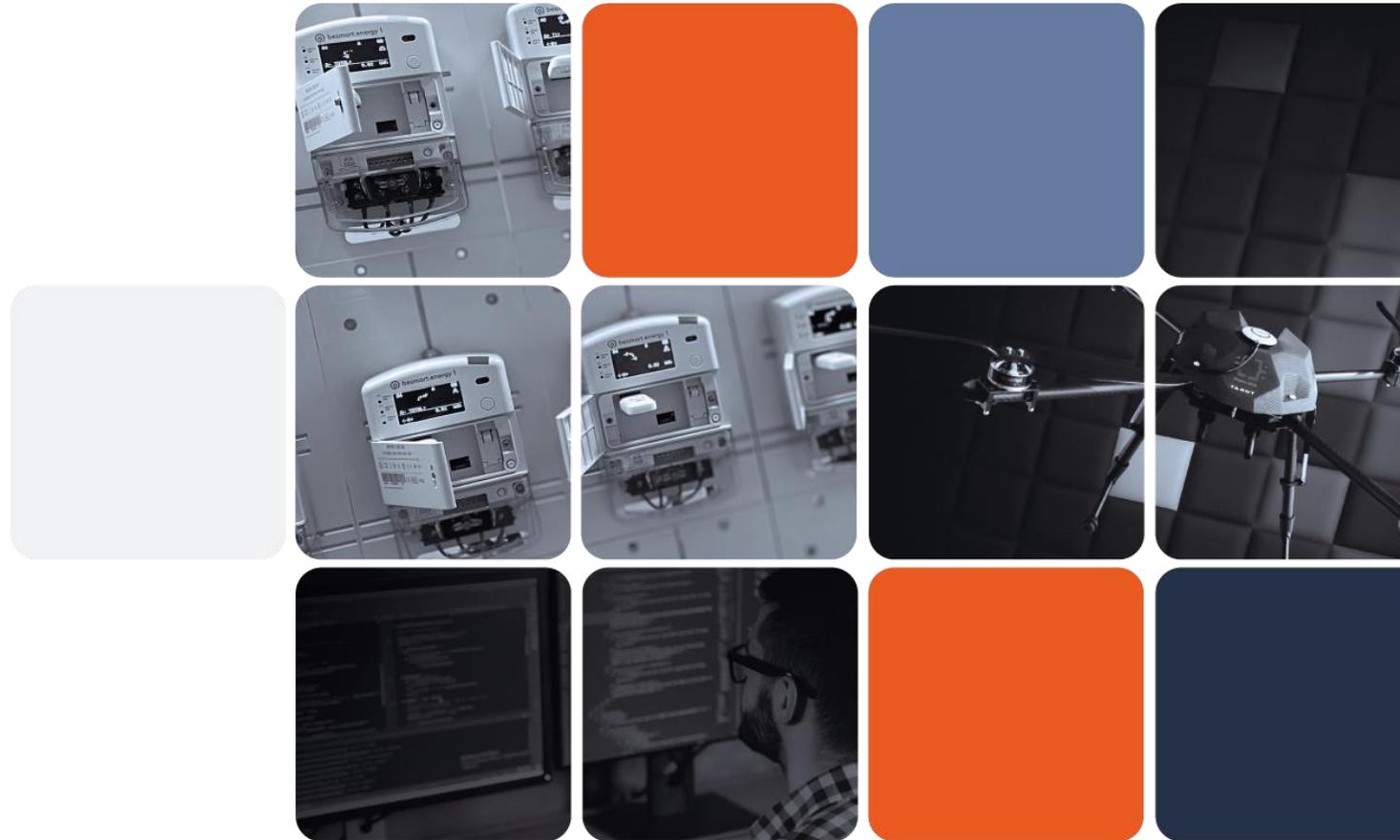


# Phoenix Systems

developer of Phoenix-RTOS

## EDGE-IOT ELECTRICITY METERS AND NEW DSO BUSINESS MODEL

Kaja Swat





# Phoenix Systems

developer of Phoenix-RTOS



Phoenix Systems is a European high-tech company with over 10 years of experience, that develops its core product – **Phoenix-RTOS** – an open-source, real-time operating system for Edge-IoT.

It employs **over thirty talented**, highly-qualified software engineers focused on both innovative products' development and R&D activities.



Phoenix-RTOS

## Phoenix-RTOS

- Phoenix-RTOS is an open-source, real-time operating system with a **highly-scalable, microkernel-based** architecture.
- Its source code is available under BSD license on GitHub: [github.com/phoenix-rtos](https://github.com/phoenix-rtos).
- Phoenix-RTOS is being developed since 1999, with its prototype created at the Warsaw University of Technology. The current version is based on a microkernel written from scratch.



## Market sectors

- Phoenix-RTOS has already been massively deployed in Smart Grid sector (1.1M smart metering devices: energy meters, gas meters, data concentrator units)
- Phoenix-RTOS is now expanding to other industry sectors - aerospace and space.
- Certification packages and support for development methodologies compliant with Software Safety Assurance standards (DO-178C, ECSS standards) are currently under development.

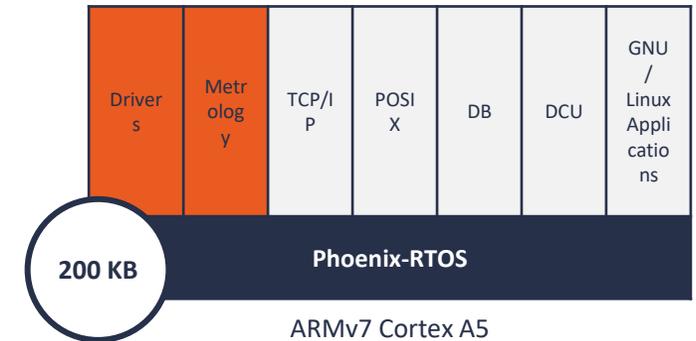
# Smart Grid deployments (1)



**Data Concentrator Unit - 8K devices** for Energa-Operator S.A., gather data from 2M smart meters in power grid (the largest implementation in Poland). Devices with TCP/IP communication and several security protocols used (IPSEC, 802.1X, TLS), support PRIME 1.3.6, PRIME 1.4 PLC standards.

## Data Concentrator Unit

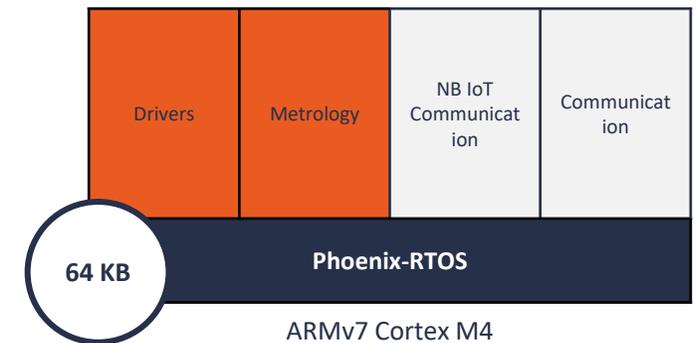
RAM: 128 MB



**iSmart1 Gas Meter - 16K devices** for PSG (Poland). Smart gas meters with GSM (2G) communication. With optimized resource usage the device battery lifetime is over 10 years.

## Smart Gas Meter

RAM: 384 KB



**iSmart2 Gas Meter - 1M devices** for the Belgian market (Fluvius System Operator CV), using Wireless M-Bus, NB IoT communication and OMS protocol. With optimized resource usage the device battery lifetime is over 15 years.



# Smart Grid deployments (2)

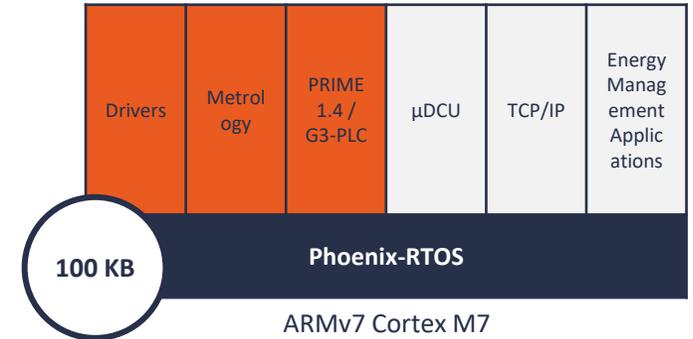


**besmart.energy Smart Energy Meter** – 1-phase and 3-phase meters with **energy management** functionality (realised by additional user Edge applications), rich connectivity (PRIME 1.3.6, PRIME 1.4, G3-PLC standards, LTE, Wi-Fi), USB stack and optional PLC data concentrator function.

**Prototype with open-hardware license.**

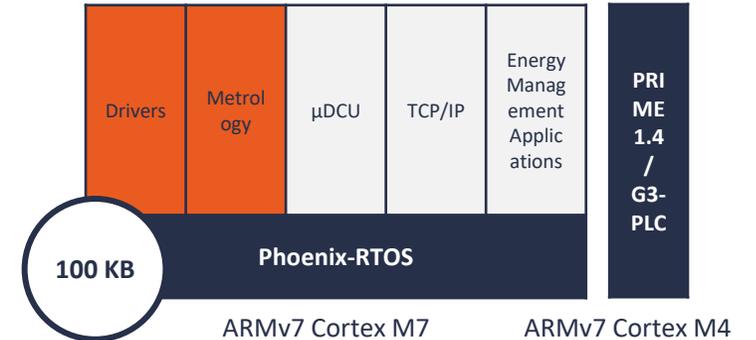
## besmart.energy

RAM: 1 MB



## Apator NILEE

RAM: 2 MB



Critical applications



Regular applications



**Apator NILEE Smart Energy Meter** – 1-phase and 3-phase meters with **energy management** functionality (realised by additional user Edge applications), rich connectivity (PRIME 1.3.6, PRIME 1.4, G3-PLC standards, LTE, Wi-Fi), USB stack and optional PLC data concentrator function.

**Meter adapted for mass production and deployment.**

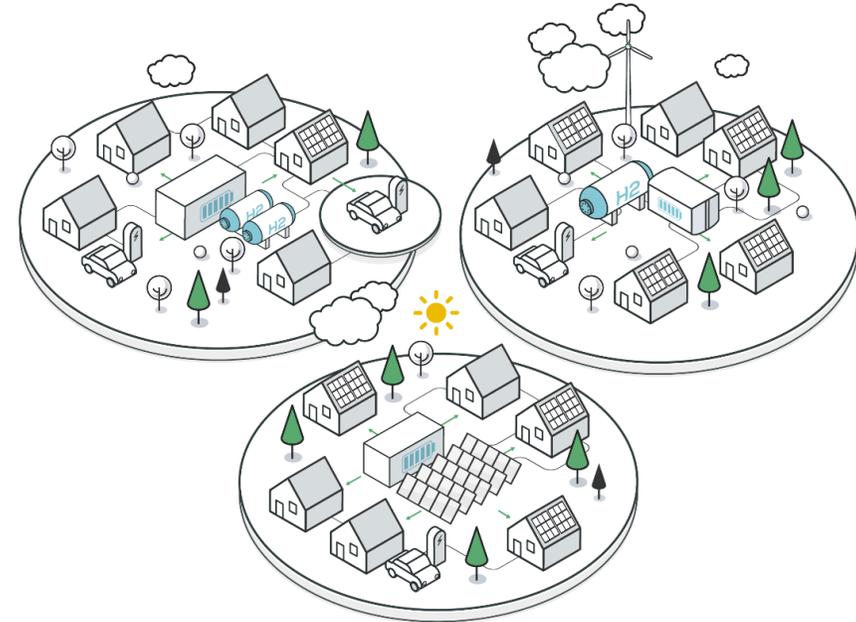
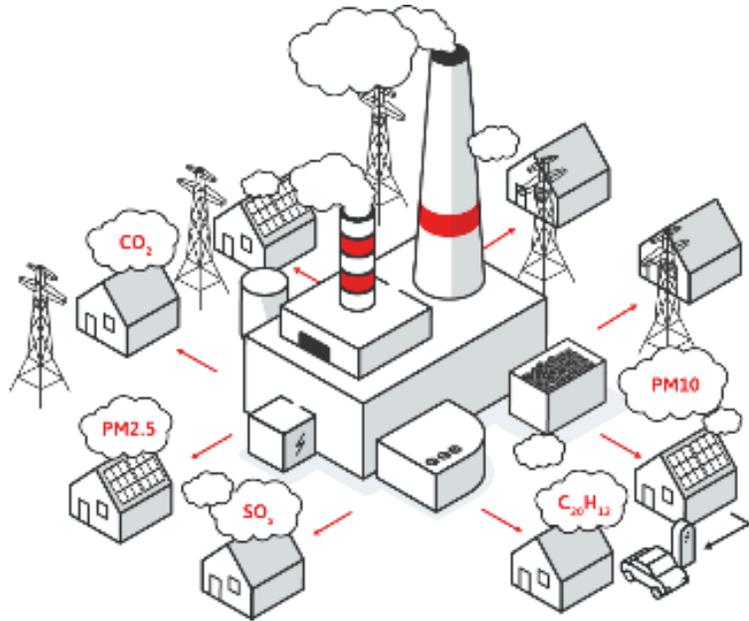
# Phoenix Systems



Edge-IoT meter



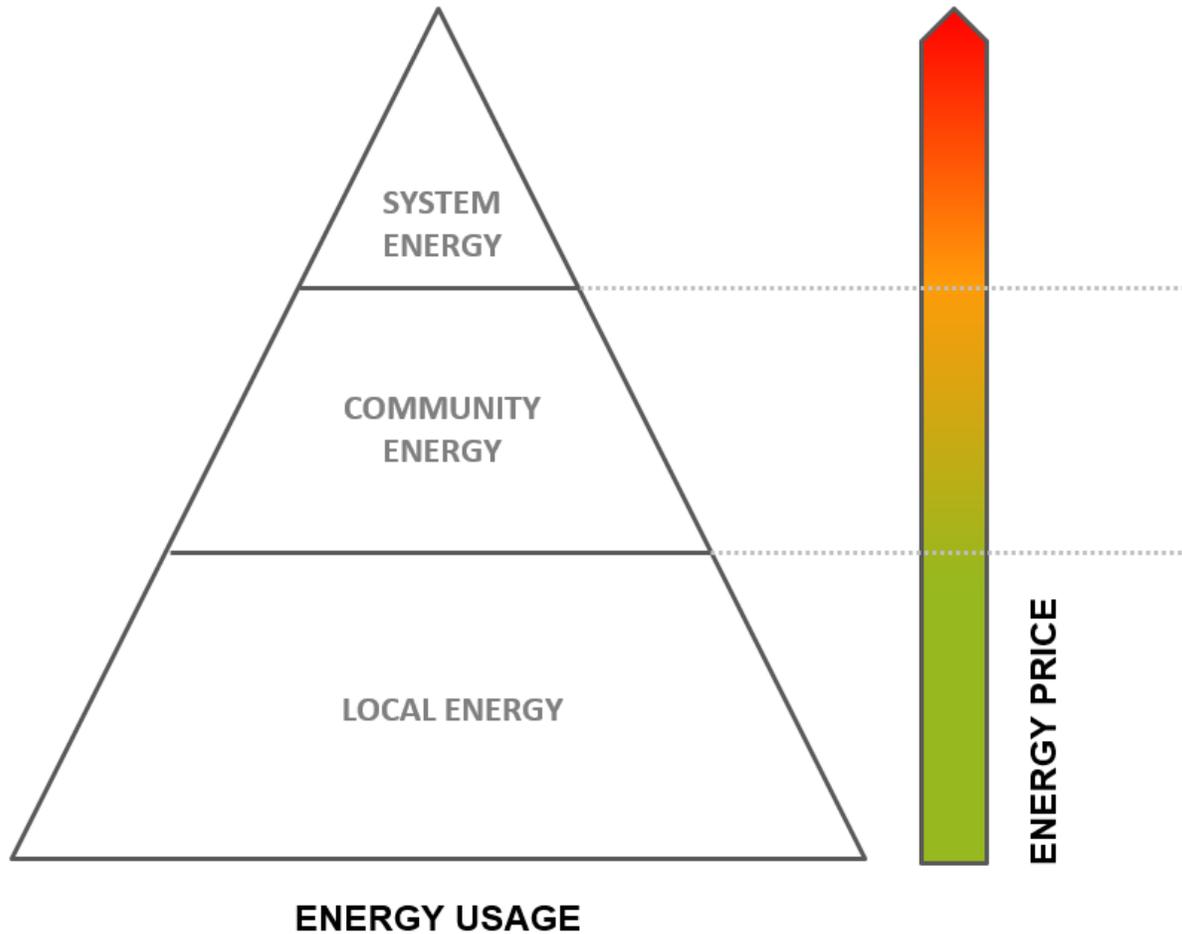
# ENERGY SECTOR TRANSFORMATION



- Centralized model - multiple recipients and one source
- Extensive transmission and distribution network - large energy losses
- Rising system maintenance costs = higher bills
- Every failure affects a significant part of the system
- Distributed model - set of energy communities
- Energy consumers can also be energy producers (prosumers)
- Energy produced locally is consumed locally
- Failure in a single community does not affect the system

# ENERGY CONSUMPTION MODEL

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## Distributed model:

- assumes three levels of electricity generation and consumption
- prioritizes consumption of green / cheap local energy and minimize consumption of expensive system energy

**Edge-IoT meter** enables smart energy management and ensures optimal balance between local, community and system energy usage

# SMART IS NOT ENOUGH

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Smart meters perform measurements and send data to the upper-level system

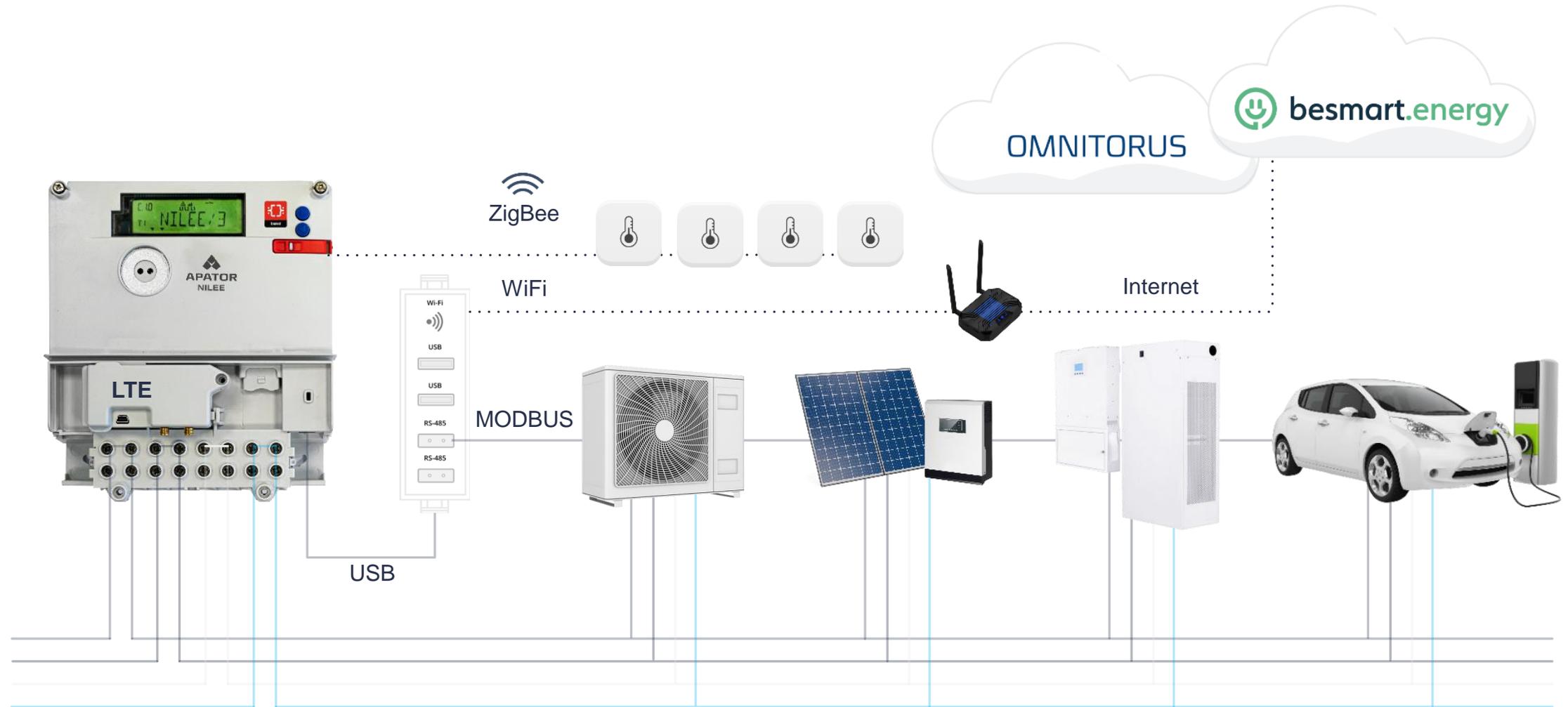
Data acquisition and processing occurs far from the point of origin and is too slow to impact the community and enable energy management

Energy production and consumption management possible only if decisions are made on the Edge with data processed on the device

Energy meter transformed into active Edge-IoT device not only communicating with the Cloud but also analyzing and making decisions by itself

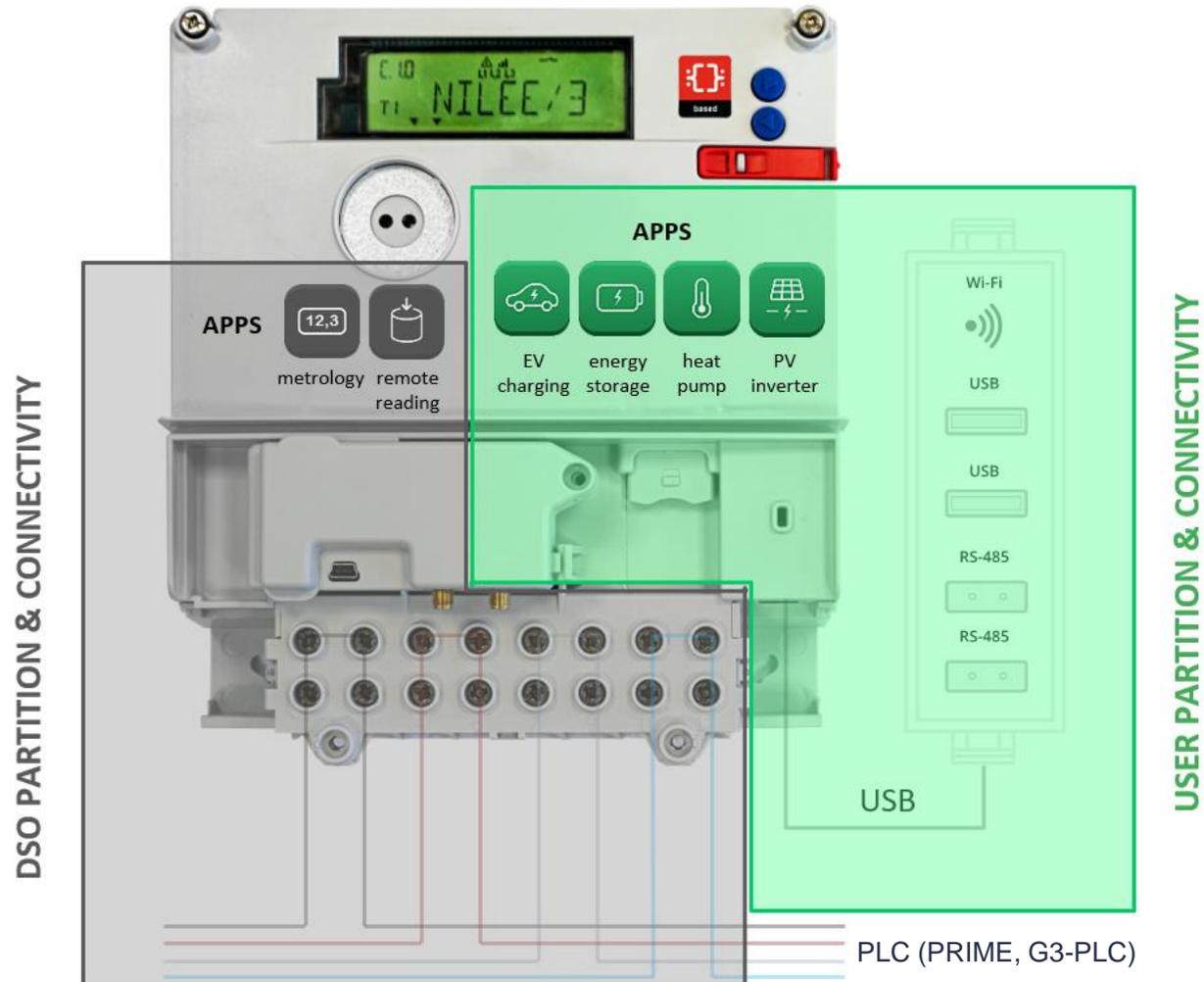
**We need an Edge-IoT metering device**

# EDGE-IOT METER – ENERGY ASSISTANT



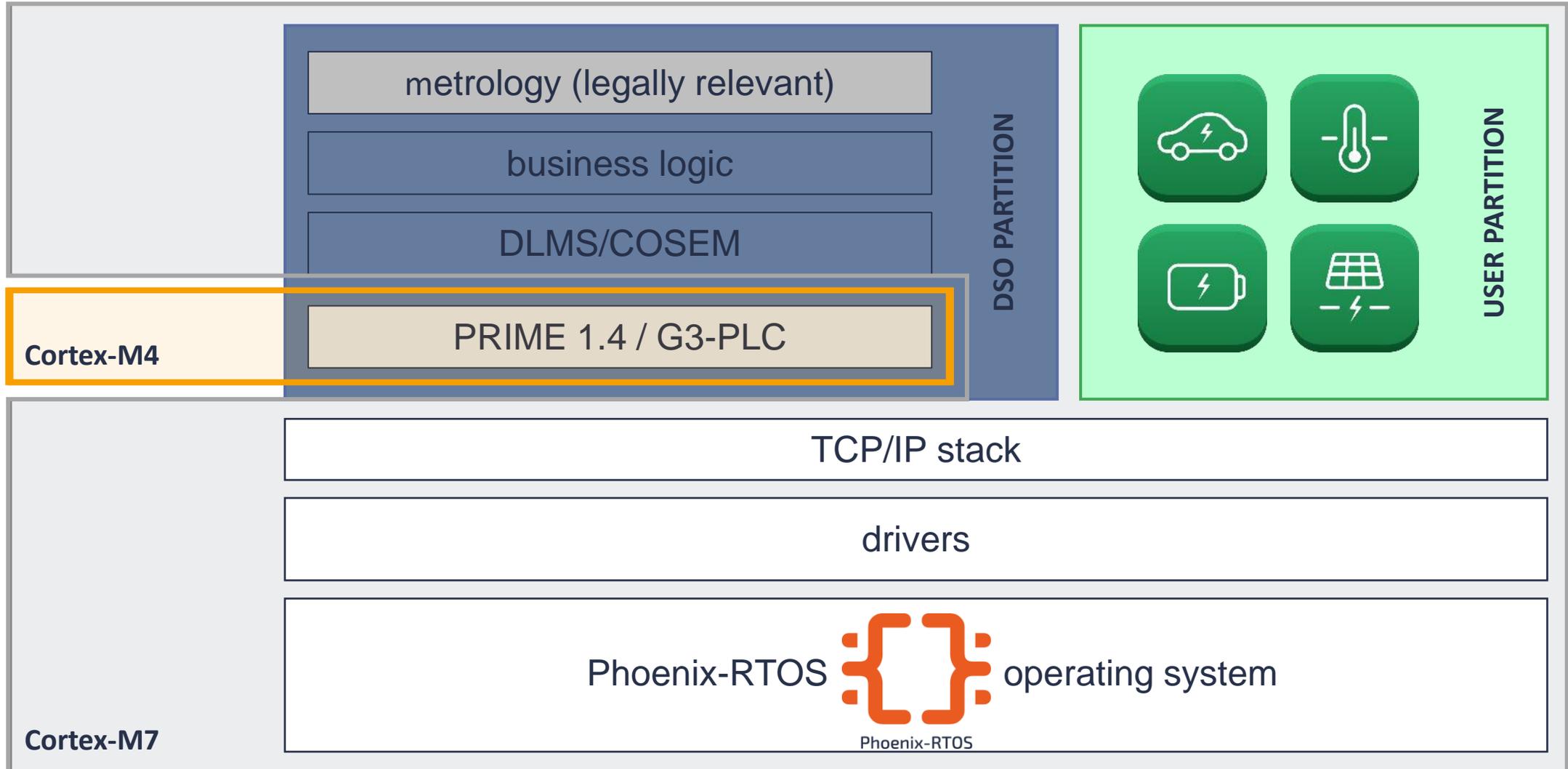
PLC (PRIME, G3-PLC)

# EDGE-IOT METER – PARTITIONING

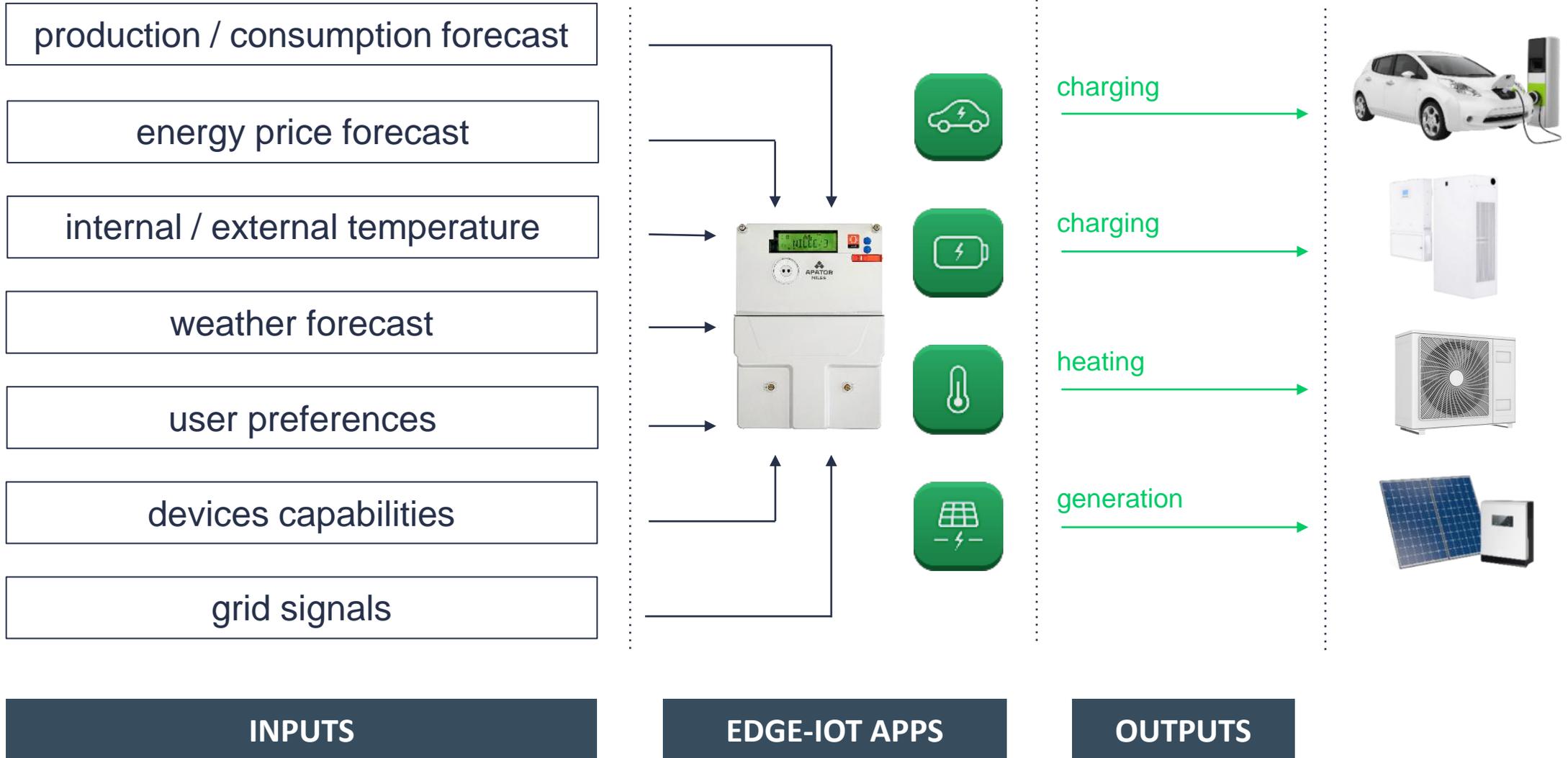


- Energy DSO's space to fulfill regulatory requirements (depicted in grey)
- User application's space for energy management Apps integrated with the Cloud (depicted in green)
- Additional external communication hub for user's communication
- **Space separation due to operating system (Phoenix-RTOS) usage**

# EDGE-IOT METER ON i.MX RT1175



# EDGE-IOT METER – LOGIC



# EV CHARGING MANAGEMENT

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- Edge-IoT meter communicates with EV charging station using existing wired or wireless interfaces
- Edge-IoT meter app controls EV charging process to optimize local energy usage
- **Charge when you want vs. charge when it's green / cheap**

# ENERGY STORAGE MANAGEMENT

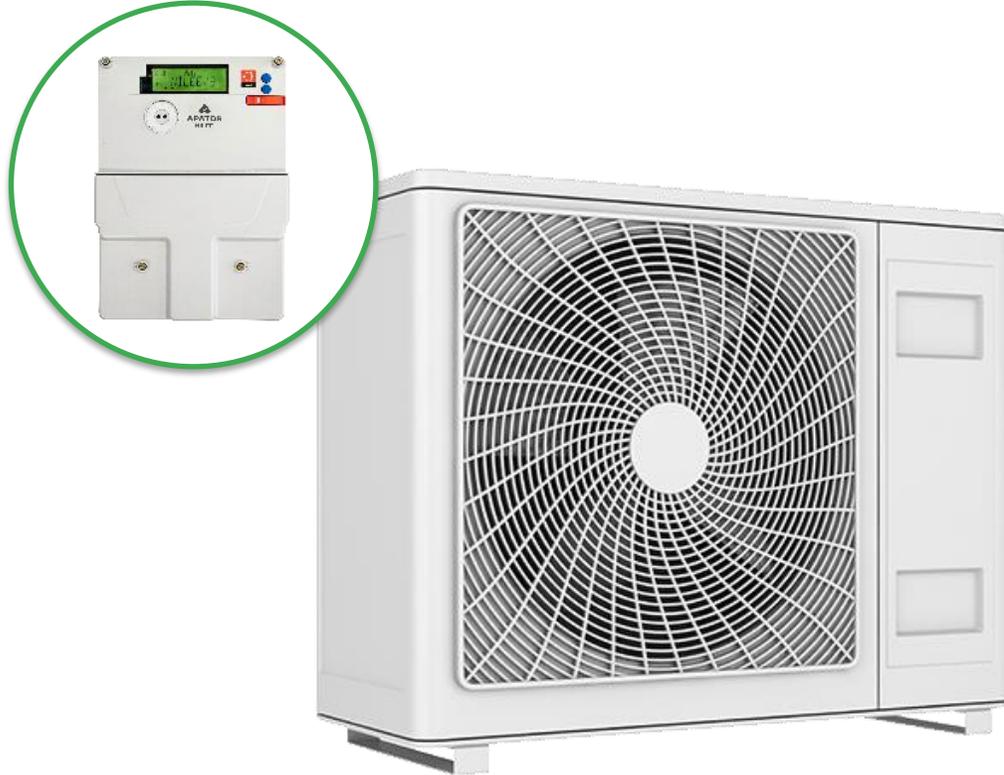
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- Edge-LoT meter communicates with energy storage to maximize green energy utilization
- Ensure optimal balance between local, community and system energy usage
- Prevent storage overload and ensure optimal grid parameters
- **Charge to maximize green energy usage**

# HEAT PUMP MANAGEMENT

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- Edge-IoT meter communicates with heat pump to optimize energy cost
- Edge-IoT meter app learns the house thermal characteristics and user preferences to control heating process
- Edge-IoT meter app regulates heating schedule using machine learning methods
- **Heat when it's green / cheap**

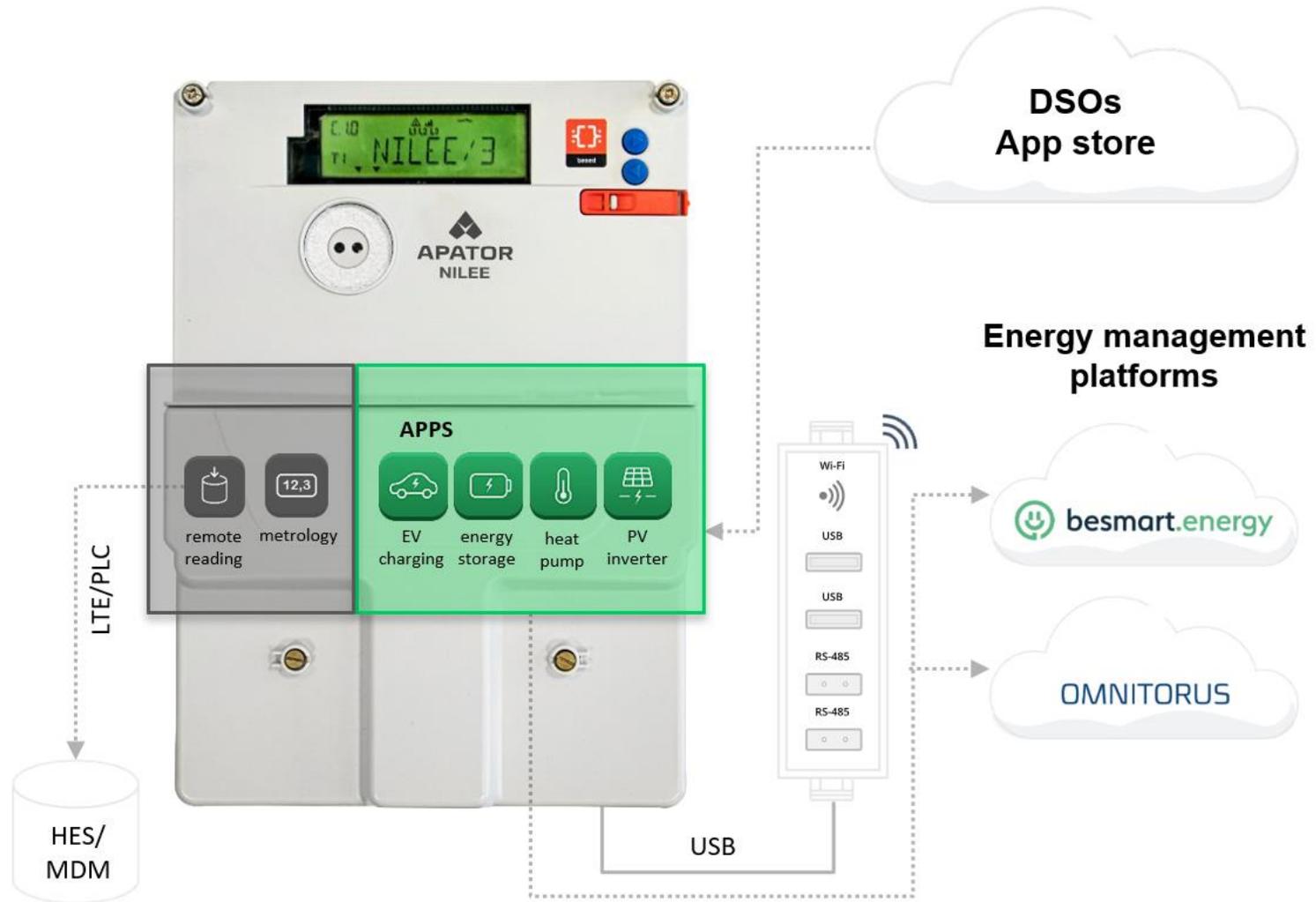
# PV INVERTER MANAGEMENT

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- Edge-IoT meter communicates with PV inverter to ensure optimal grid parameters (prevent grid overload)
- Edge-IoT meter measure grid characteristics and controls inverter according to provided DSO demands
- **To produce less or not to produce at all**

# NEW BUSINESS MODEL



## User apps:

- are installed on Edge-IoT meter using DSO's App store portal and user connectivity
- communicate with cloud-based energy management platforms
- are qualified by DSOs

**Additional income for user space rental compensates the Edge-IoT meter cost**

# CONCLUSIONS

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- Growing number of new photo-voltaic, heat pump, storage installations and EV popularization indicates the **market demand for Edge-IoT meters**
- Use of Phoenix-RTOS (operating system for Edge-IoT) enables **seamless partitioning between DSOs and users spaces and user apps execution**
- Easy implementation of the new apps thanks to POSIX like API.
- Implementation of Edge-IoT meters gives DSOs a **new source of income while providing users with an energy management tool**

# Phoenix Systems

developer of Phoenix-RTOS

## Thank you for attention

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