

The VTT logo consists of the letters 'VTT' in a bold, white, sans-serif font, centered within a solid black square. The background of the slide is a complex geometric pattern of overlapping triangles in shades of blue, orange, grey, and black, creating a dynamic, crystalline effect.

VTT

Dynamic Energy Landscapes: VTT's Leading Role in Unlocking Innovation and Powering Tomorrow

**in Microgrid Symposium 2023, Genk, Belgium
Senior Scientist, DSc. Katja Sirviö**

13/09/2023 VTT – beyond the obvious

Content

1. Introduction of VTT
2. Success Stories – Projects, Partnerships, and Achievements in the Microgrid Sector
3. Leading Edge
4. Innovation Unlock
5. Future Directions
6. Closing and Q&A

1. Introduction of VTT

VTT – *beyond the obvious*

VTT is a visionary research, development and innovation partner for companies and society and one of the leading research organisations in Europe.

Our role is to promote the utilisation and commercialisation of research and technology in business and society. Through science and technology, we turn global challenges into sustainable solutions for business and society in a responsible way.

261 M€

turnover and other
operating income

2,213

employees

43%

of the net turnover
from abroad

32%

a doctorate or a
licentiate's degree

Establishment year

1942

Steered by Ministry
of Economic Affairs
and Employment

VTT IntelligentEnergy lab

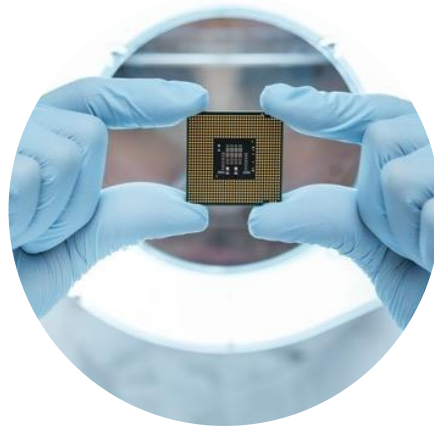
VTT Micronova

VTT FutureHub (Main Building)

We create solutions in three business areas



**Carbon neutral
solutions**



Digital technologies

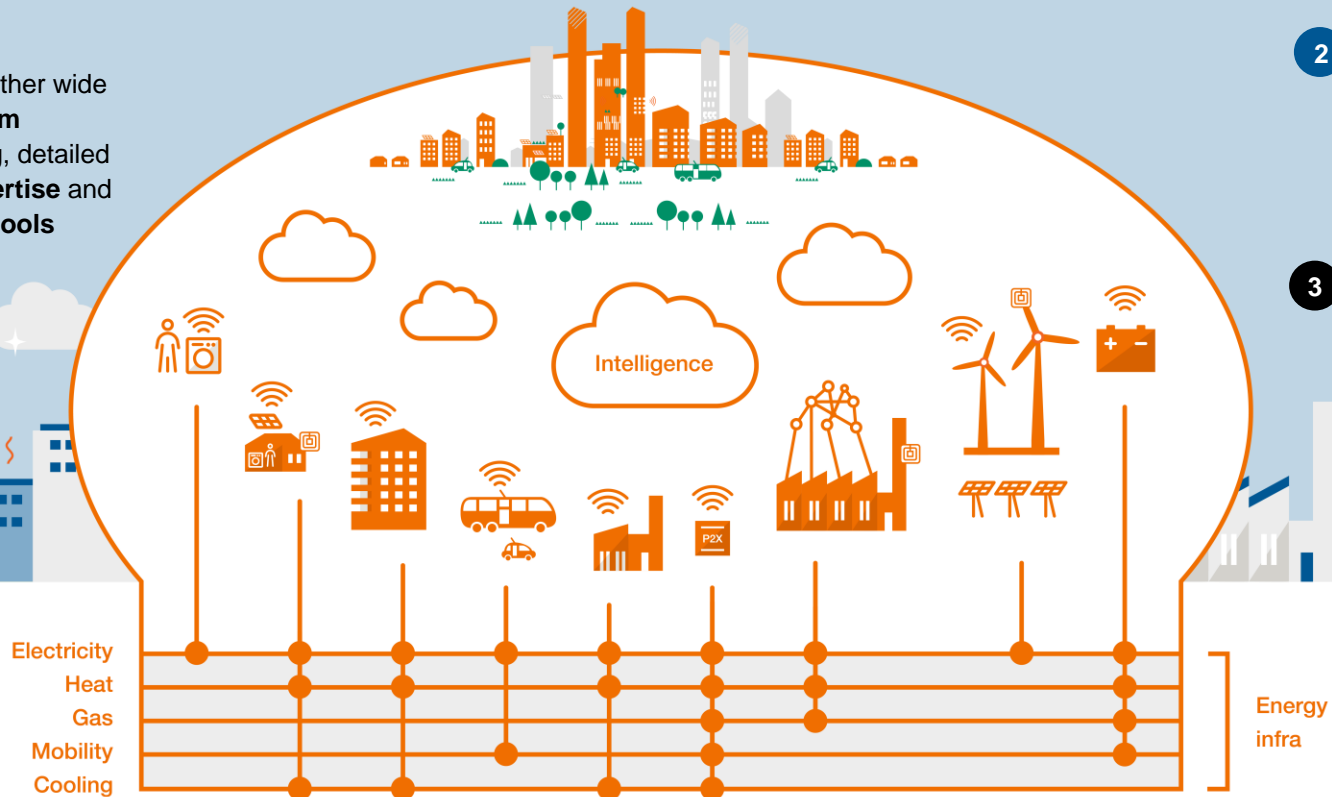


**Sustainable products
and materials**

VTT builds sector-integrated ecosystems

1

We bring together wide **energy system** understanding, detailed **sectoral expertise** and latest **digital tools**



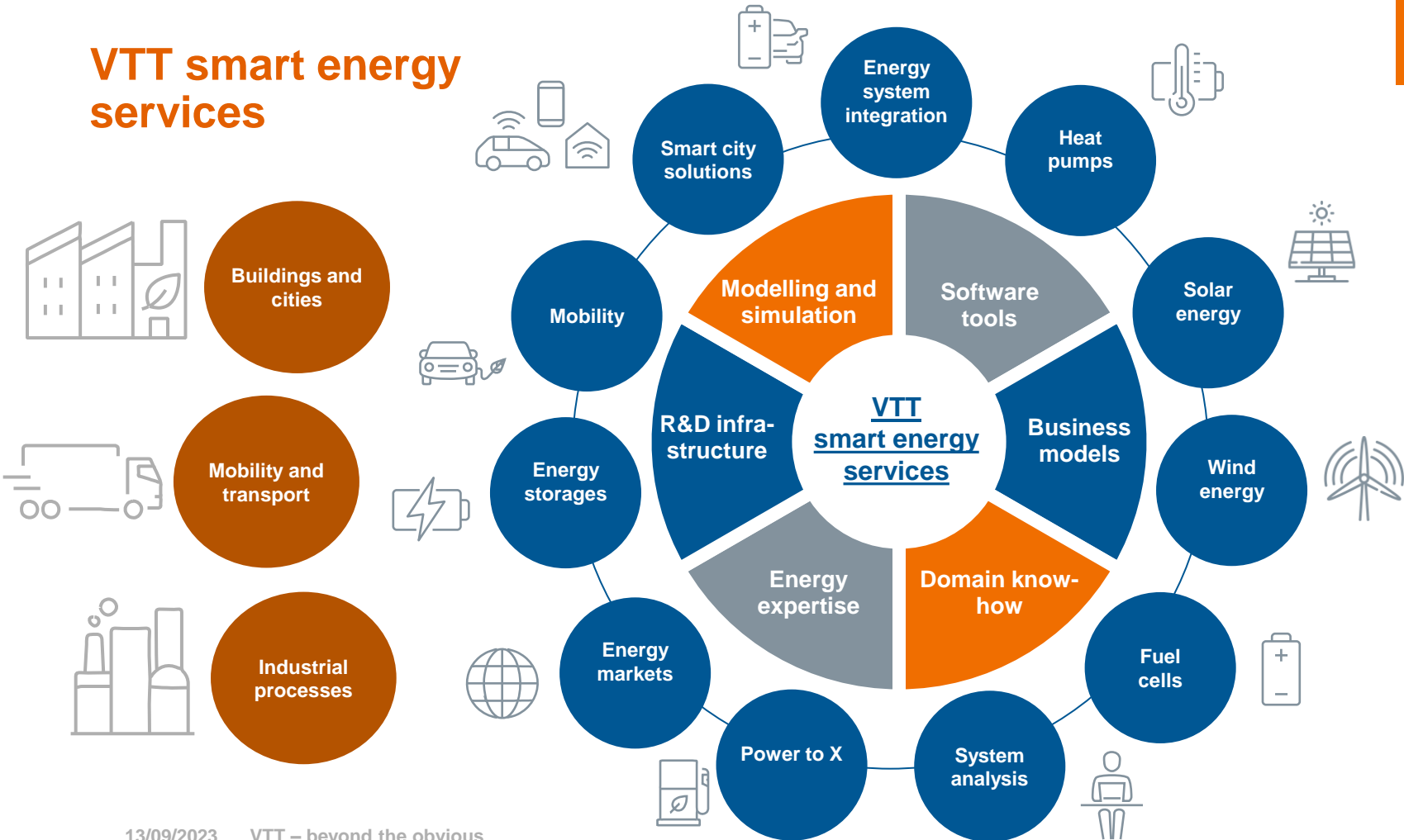
2

We bridge highest level **applied research** with **companies' solutions** in dynamic setups

3

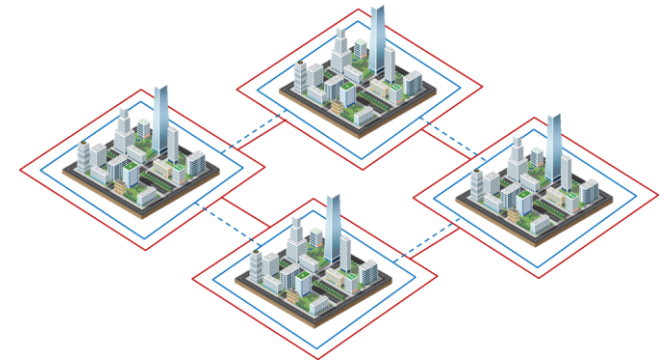
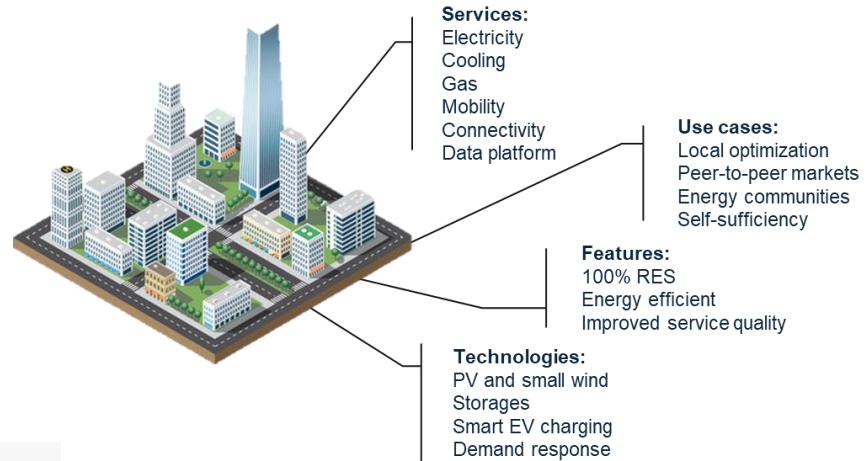
We aim for **concrete** and **impactful** results through **joint pilot cases**

VTT smart energy services



VTT's Vision of Microgrids – Modular Web-of-Cells concept

- Microgrids as enablers of Energy Communities, Local Energy Markets, and Sector Integration
- Provide a modular approach from building to city level



2. Success Stories

Track Record – Past EU Projects

- **ELECTRA** EU, 2013–2018, 13.1 M€
 - “European Liaison on Electricity Committed Towards long-term Research Activities for Smart Grids”
 - 21 participants, led by Ricerca Sul Sistema Energetico - RSE
 - Concept of the distribution network being operated as a **"web-of-cells"** that were interconnected microgrids.
 - Evenblij , B., Rikos, E., Heussen, K., Hu, J., Rezkalla, M. M. N., Marinelli, M., Löf, A., Pasonen, R., Hänninen, S., Merino-Fernández, J., Rodriguez Seco, E., Guillo Sansano, E., Syed, M. H., Johnstone , K., & Kosmecki, M. (2018). *Core functions of the Web-of-Cells control scheme*. ELECTRA Consortium.
- **SysFlex** Horizon 2020: 2017–2021, 20 M€
 - “Pan-European system with an efficient coordinated use of flexibilities for the integration of a large share of RES”
 - VTT’s key findings: **Analysing and demonstration the potential of EVs and battery storage system in the Finnish Flexibility market**
 - VTT

Track Record – Past National Projects

- **EL-TRAN**, Academy of Finland: 2015–2021, 6.0 M€
 - VTT Technical Research Centre of Finland, Tampere University (lead), University of Eastern Finland, Tampere University of Applied Sciences (TAMK), University of Turku
 - The outline requirements for **Finnish energy policy actors to implement the transition and a roadmap for the public sector to support the process**
 - VTT's focus was to study **how microgrids could be an alternative solution to grid investments**
 - VTT publications
- **ProCemPlus** (Prosumer centric energy communities), Business Finland: 2019–2021, 670 k€
 - VTT Technical Research Centre of Finland, Tampere University (lead), Tampere University of Applied Sciences (TAMK)
 - The project aims to address **technical challenges, promote value sharing, and advocate for legislative changes in energy communities for a prosumer-centered energy system**
 - VTT publications
- **DisMa** (Distributed management of electricity system), Academy of Finland: 2019–2023, 1 M€
 - Tampere University & VTT (325 k€)
 - VTT developed and analysed use cases
 - The approach we typically have with microgrids: we consider the **technology as an enabler for the formation and operation of energy communities.**
 - VTT publications

Track Record – Ongoing EU Projects

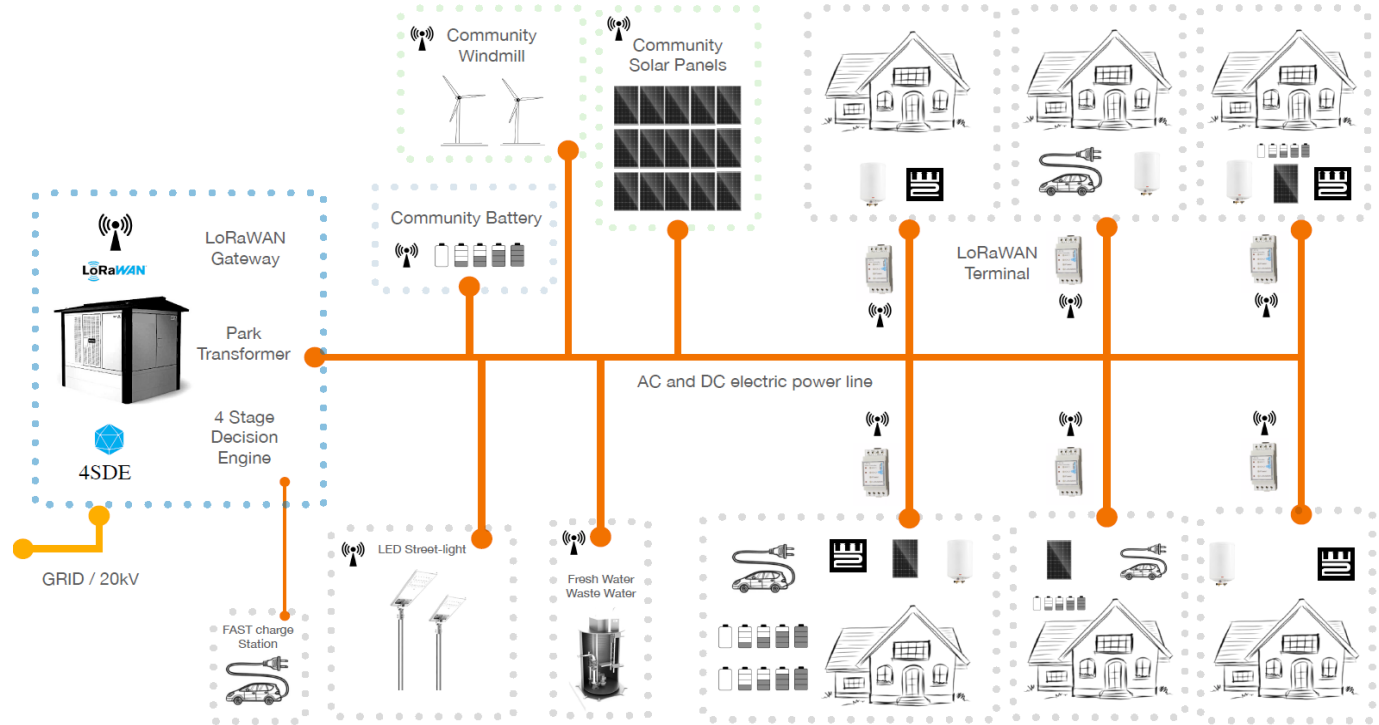
- **SENDER** Horizon 2020: 2020–2024, 6.6 M€
 - “Sustainable Consumer engagement and demand response”
 - 15 partners, led by Smart Innovation Norway AS
 - VTT’s focus on **residential demand response and consumer engagement – microgrid controls and role to support aggregation**
 - VTT publications
- **LocalRES** Horizon 2020: 2021–2025, 7.2 M€
 - “Empowering local renewable energy communities for the decarbonisation of the energy systems”
 - 21 partners, led by CARTIF Technology Center
 - VTT’s role is to **model and validate aggregation platforms specifically designed for energy communities or islanded microgrids**
 - VTT publications
- **RESPONSE** Horizon 2020: 2020–2025, 23,6 M€
 - “integRatEd Solutions for POSitive eNergy and resilient CitiEs”
 - 53 partners, led by EIFER – European Institute for Energy Research
 - Turku demonstration is a **LVDC microgrid including PV installations, battery storage, EV charging stations and a large residential building, including heat pumps and a connection to the local district heating network.**
 - VTT publications
- **GLocalFlex** Horizon 2020: 2023–2026, 10.3 M€
 - is looking into local P2P energy markets

Track Record – Ongoing National Projects

- **STRATA**, ERA-Net MICALL20, Business Finland: 2022–2025, 450 k€ (VTT)
 - The focus is on **smart transformer technology and its role as an enabler to operate microgrids as energy communities**. What kind of services could be implemented in a smart transformer/smart digital node, and which business models would make sense for it?
 - Recently published paper: K. Mäki, S. Motta, et al. Smart Transformer as an Energy Community Service Node and Integrator of Local Resources in CIRED Rome 12-15 June 2023.
 - Key objectives
 1. Advanced resiliency management through digitalization of smart grids **incorporating DC microgrids** (integration of STs and digital platforms to achieve resiliency and security of grids and digital platforms).
 2. Concept for **smart transformer as an energy community service node and integrator of local resources** (customer involvement for local flexibility markets, energy sharing and other community-level use cases).
 3. **Increasing hosting capacity** for new electrical generation and loads in LV grids and **contributing to resiliency of the power supply** (integration and aggregation of private digital nodes with flexibly controllable power limits).

Case: STRATA ERA-NET project: Community services

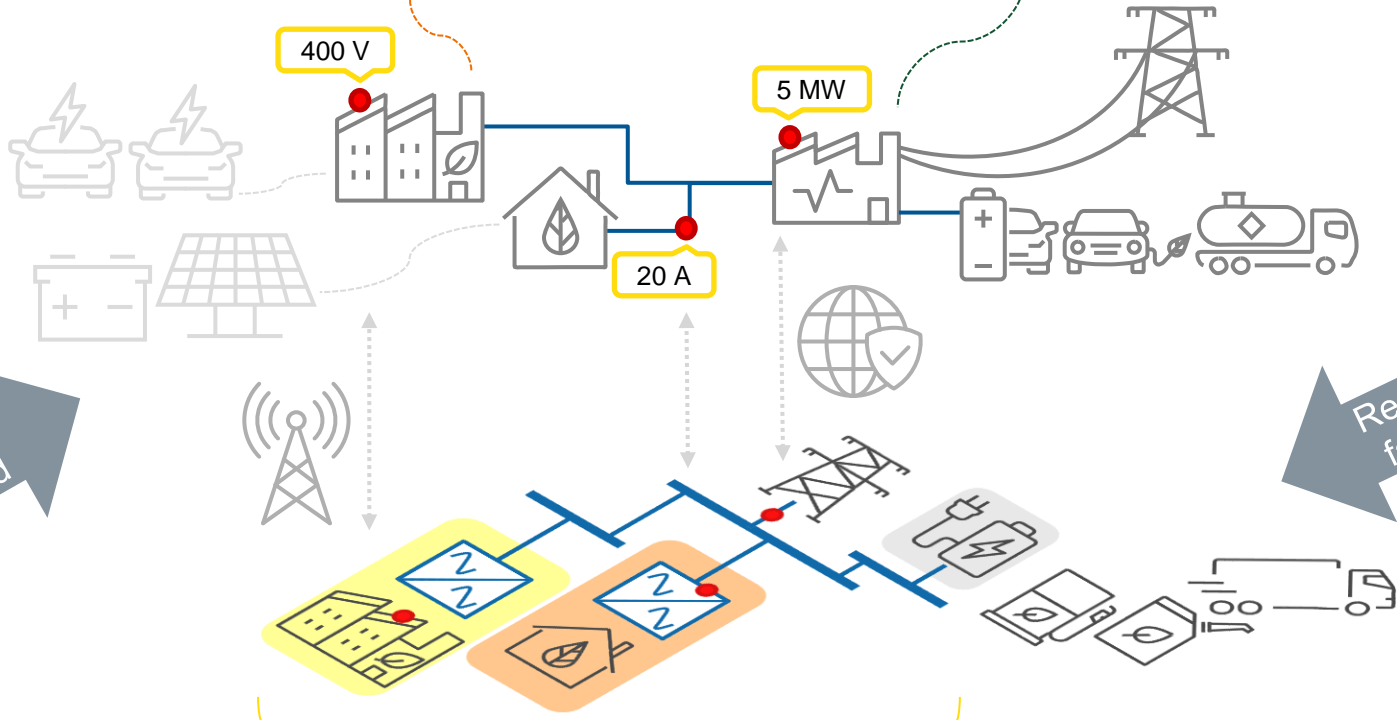
- Use cases and needs – Caruna
- Smart transformer unit – MSc Electronics
- IoT control system – THT Control
- Energy community model research, simulations, piloting, coordination - VTT



3. Leading Edge

International co-operation

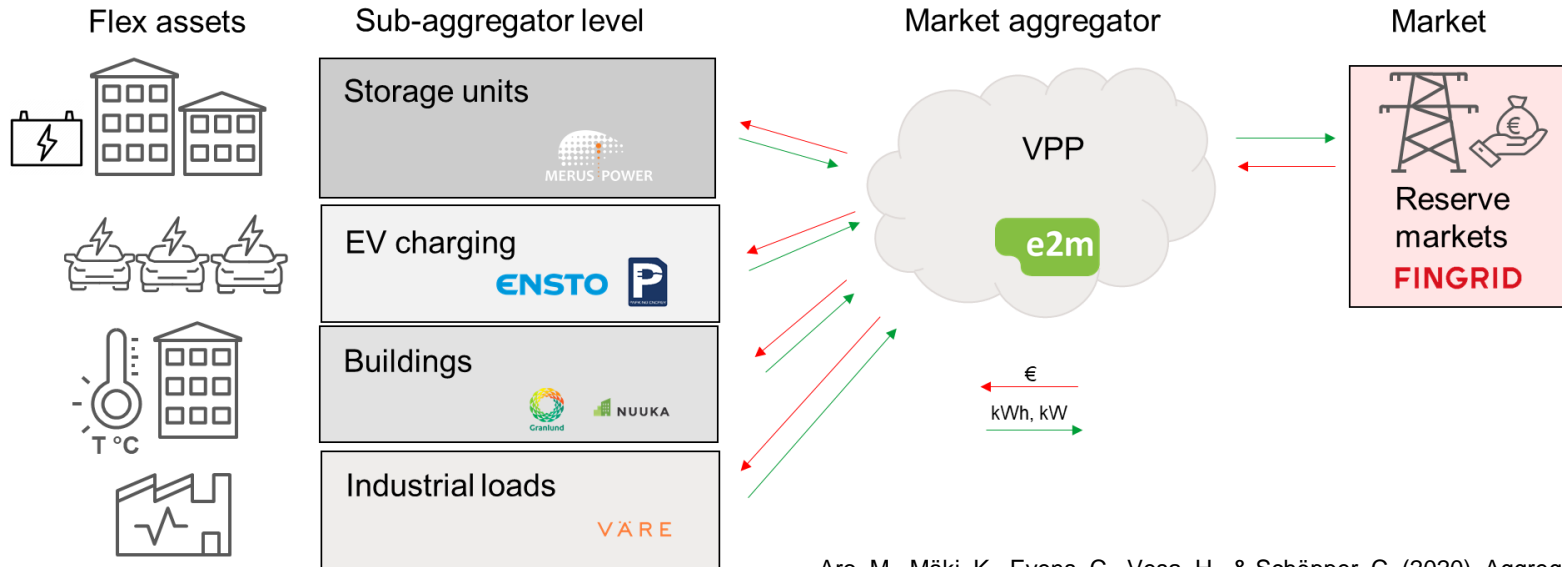
Platforms with national partners



SMART OTANIEMI

Aggregator Business Pilot

- Within Smart Otaniemi ecosystem, Business Finland project in 2018-2020
- **Business model development for aggregator and sub-aggregator**
- **Concrete piloting at VTT office building**



Aro, M., Mäki, K., Evens, C., Vesa, H., & Schöpfer, C. (2020). Aggregator Business Pilot. VTT Technical Research Centre of Finland. VTT Research Report No. VTT-R-01187-20

Intelligent Energy Testbed

3 CINERGIA ELECTRONIC LOADS



RTDS REAL-TIME SIMULATOR



11 PROTECTION & CONTROL IEDS

2 COORDINATED IEDS

3 MERGING UNITS

Hardware
Grid

Device
under
Test

Simulated
Grid

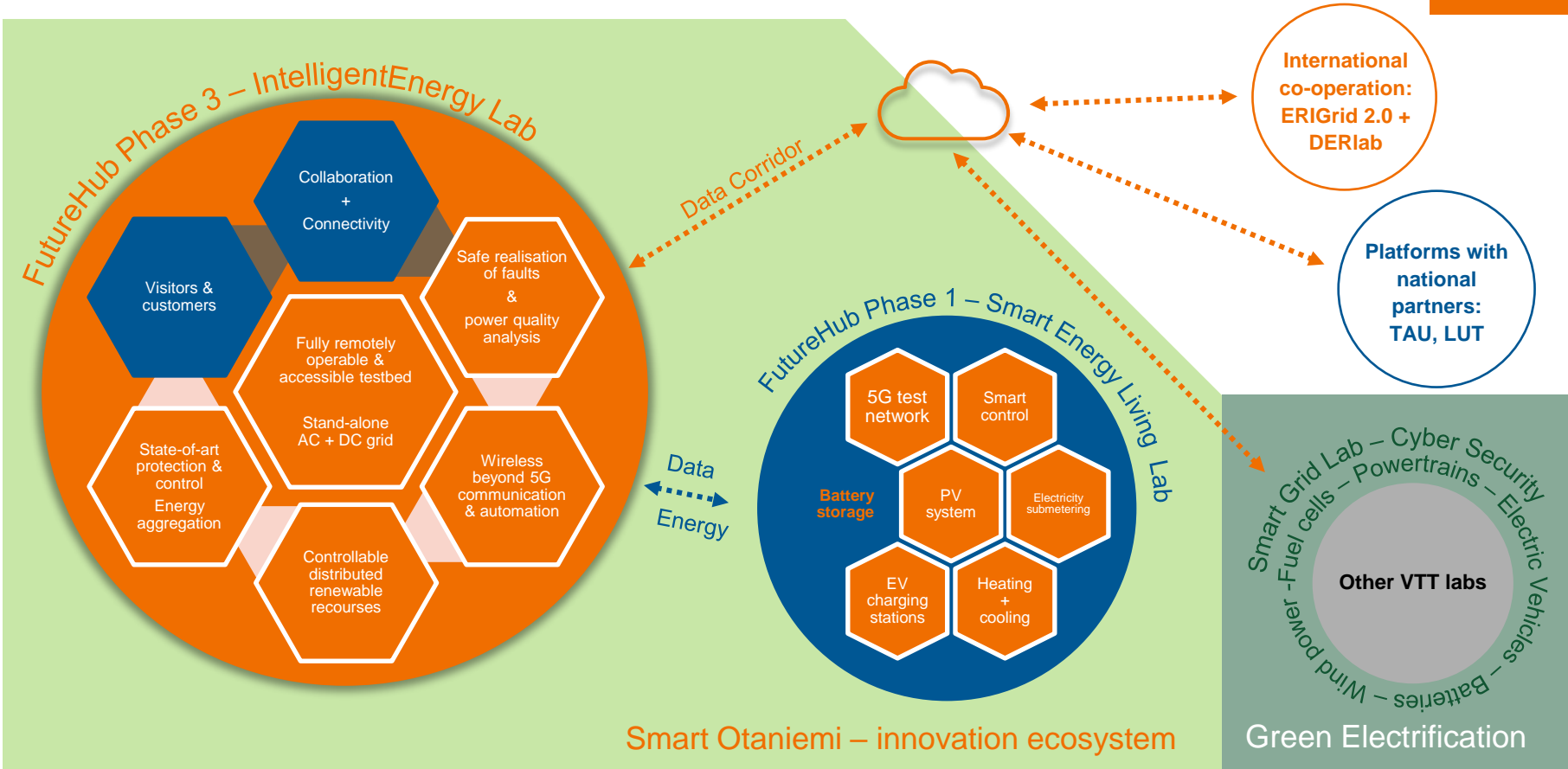
CYBER SERVER EMULATING CYBER
ATTACKER

COMMERCIAL & TEST WIRELESS
NETWORKS

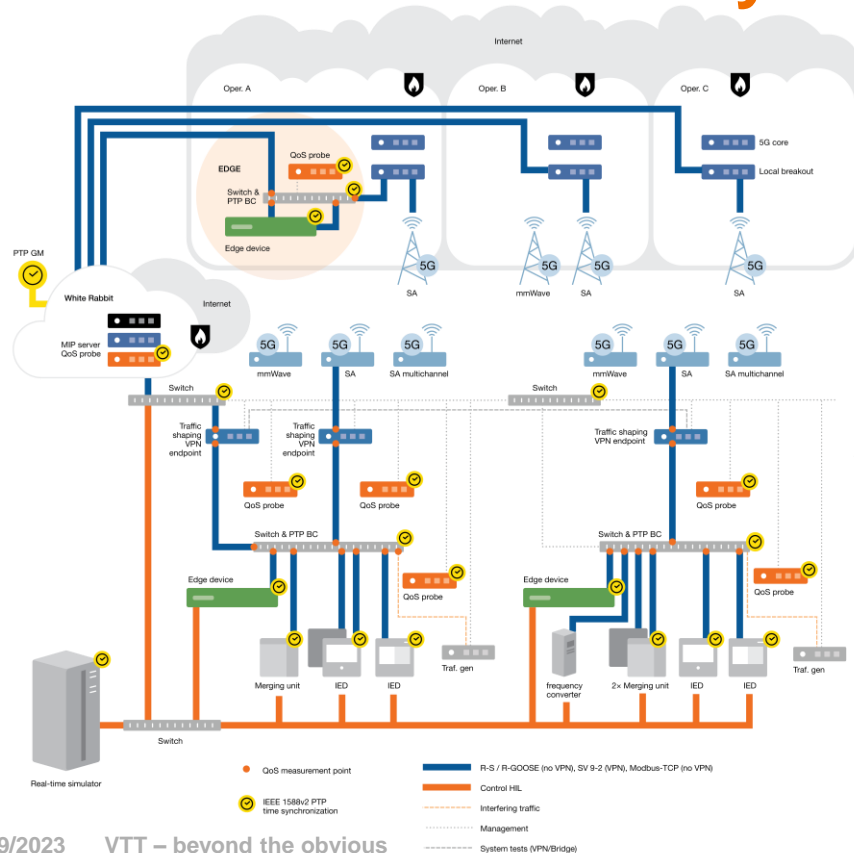
MIKES ATOMIC CLOCKS TIME
SYNCHRONISATION



Links to other facilities



Pilot Environment – A System Under Test



BUSINESS
FINLAND

NOKIA

ABB



FINGRID

Telia

caruna

DNA

åea
Ålands Elandslag

GOODMILL
Always online

4. Technological Innovations – Innovation Unlock

Some important partners and customers

HITACHI
Inspire the Next

NOKIA

enermix

SANDVIK

SIEMENS

OMAVOIMA

OptiWatti

thi control

ABB

**TAMPEREEN
ENERGIA**

PKS

BONAVA

MSc

HELEN

Fortum



MERUS POWER

IGL

FINGRID

caruna

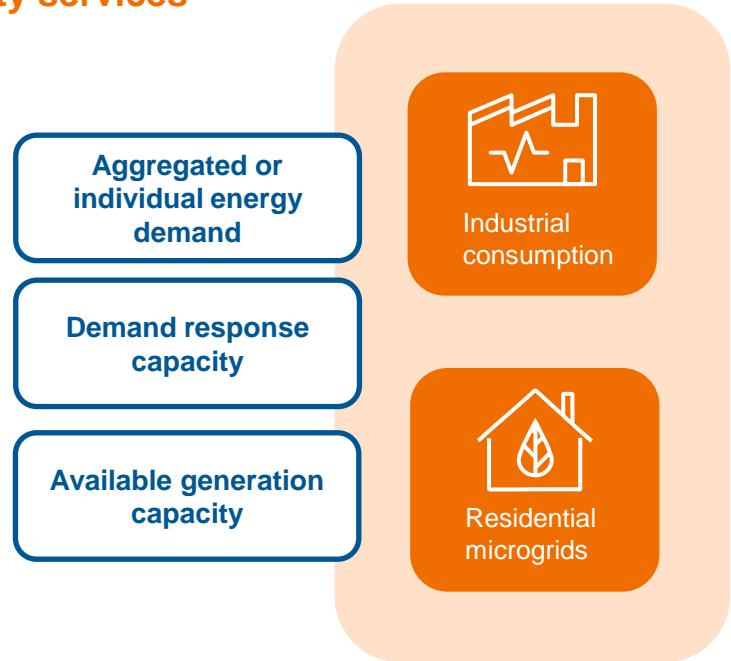
ELENIA

KEMPOWER

EnergyTeller

Combining our short-term energy forecasting solutions to support microgrid operations and Energy Community services

- Industrial and residential microgrids energy demand forecasting
- Flexibility capacity forecasting
- Available generation capacity from distributed renewable resources



Energy Management Agent: Deep learning for optimised microgrid operations

Grid congestion signals,
electricity pricing



Weather forecasts
and warnings



Electric vehicles
and flexible loads

Data analytics for
consumer behaviour,
power quality



Energy Management Agent

Deep-learning agent optimising
Microgrid towards different operating
modes, such as self-consumption,
demand response, economic
optimisation, grid ancillary services.



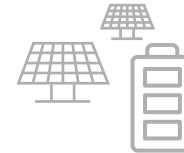
Intra-microgrid peer-
to-peer energy trading



Heating/cooling demand
and flexibility



Self-consumption,
lowering carbon emissions



Distributed generation
and storage

5. Future Directions – Research and Development

Research Roadmap of Smart Energy and Built Environment 2023–2030

- Integrated, flexible and resilient energy system (from system point of view)
- 24/7 clean & affordable power in Northern regions
- Swarm intelligence of buildings, districts and industrial sites for energy management
- Climate neutral buildings and neighbourhoods
- Healthy and resilient building in sustainable way



Integrated, flexible and resilient energy system (from system point of view) by 2030

- Sector Integration
 - Sector Integration Machine
 - Tools enabling integration of sectors for planning and management
 - Automated control and optimization of energy vector integration
 - Quantum & traditional computing super optimization runtime models
- Energy Communities
 - Hubs for sector coupling and flexibility
 - Integration of municipal/regional energy communities
 - Enhancing flexibility in energy systems with decentralized district heating
- Highly automated solutions for low threshold participation to energy (flexibility) trading for individuals
 - Aggregation methods for small-scale loads
 - Operation models tailored to different frequency markets in different sectors

6. Closing and Transition to Q&A

bey⁰nd

the obvious

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