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# Älyäkkö nää energiaa – Future of smart grids in Finland

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- Who we are
- What do we do with smart grids?
- What are our future research interests?



“The best way to predict the future is to invent it.”

- Alan Kay

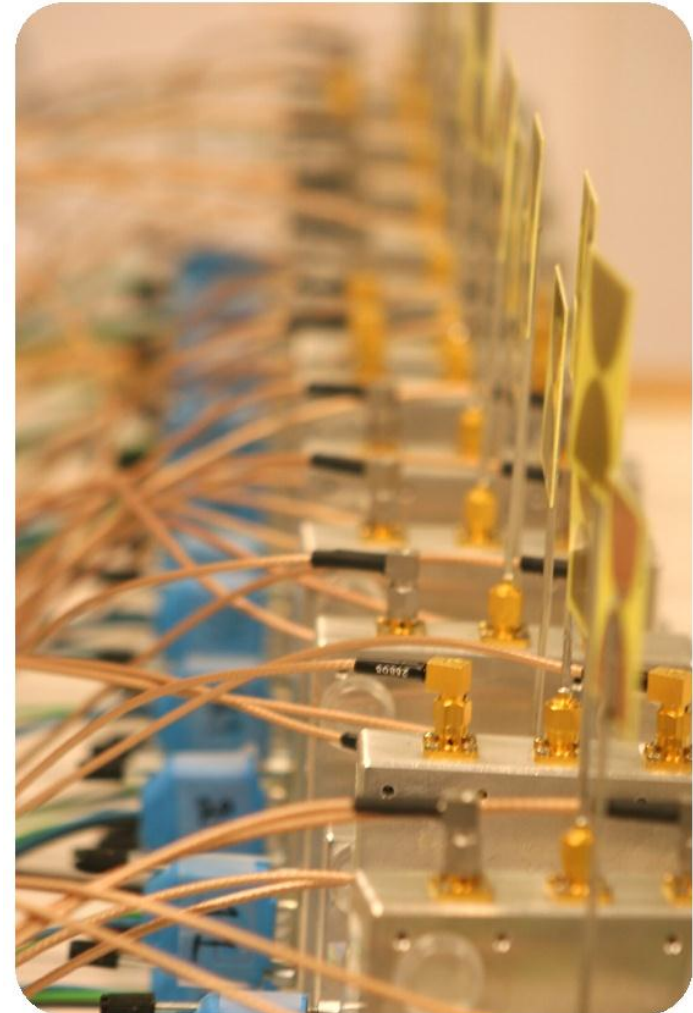
# Who we are

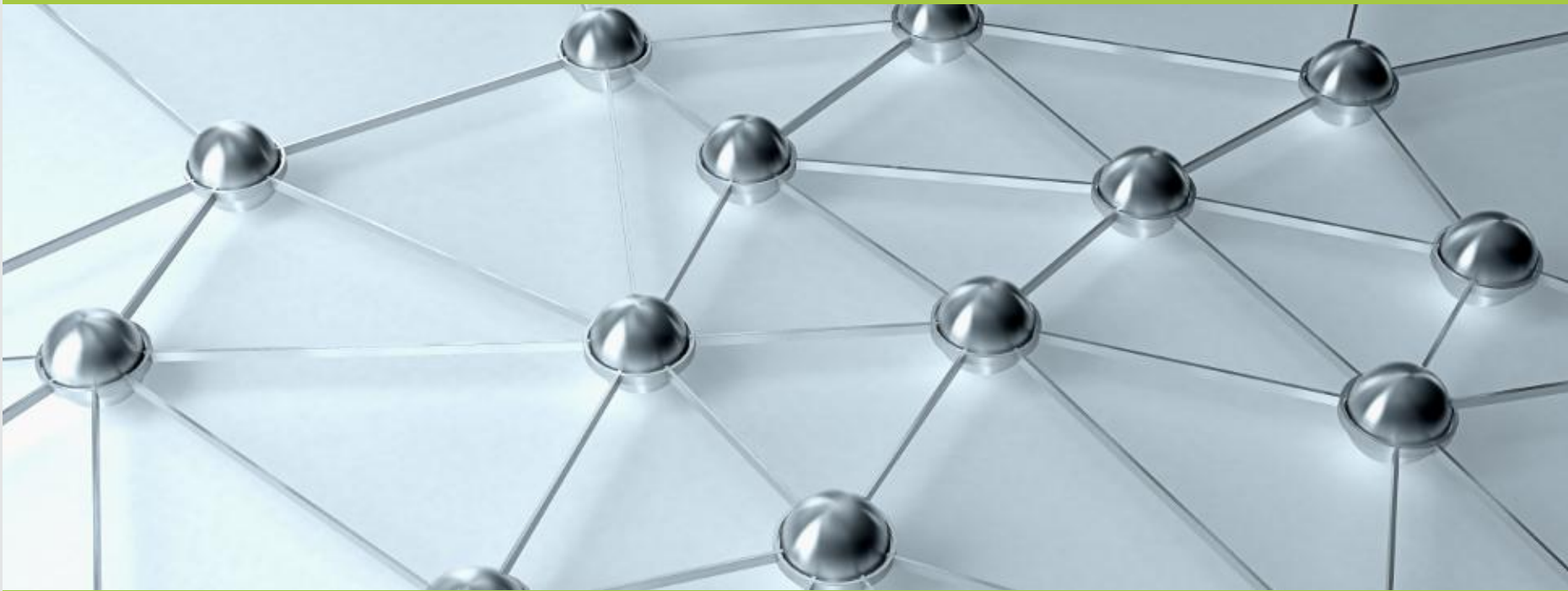
## CWC = Centre for Wireless Communications

CWC is the approach how research is organised in Department of Communication Engineering (DCE) at the University of Oulu

### Mission of CWC:

- World class research
- World class graduates
- Creation of new technology
- Support to industry





# Centre for Wireless Communications



CENTRE FOR WIRELESS COMMUNICATIONS  
University of Oulu

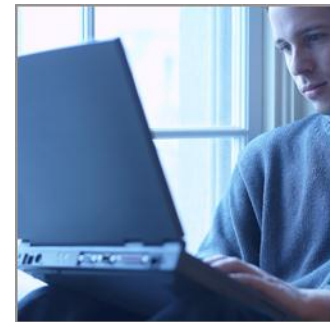
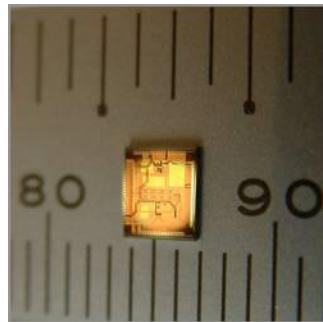
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UNIVERSITY of OULU  
OULUN YLIOPISTO

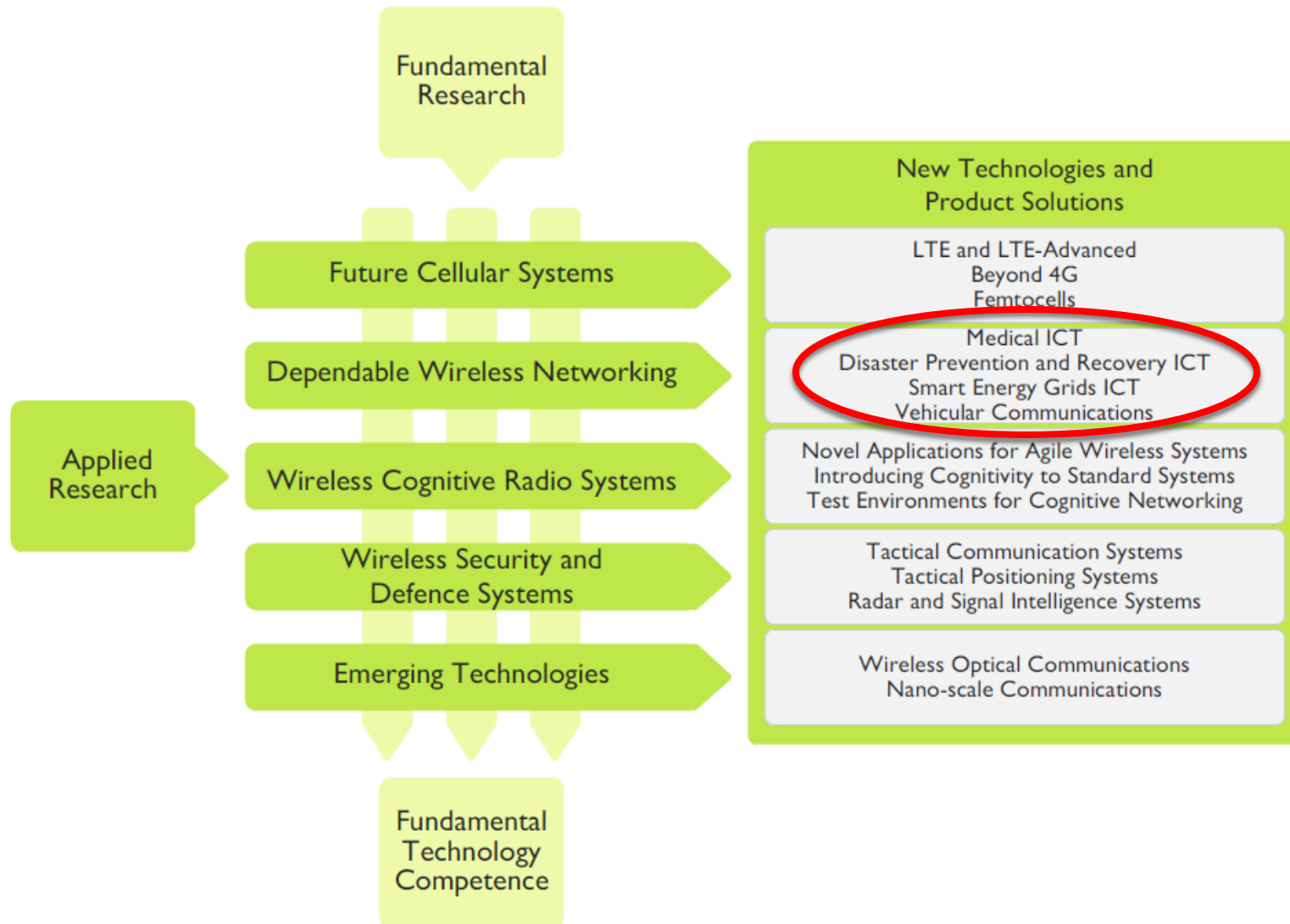


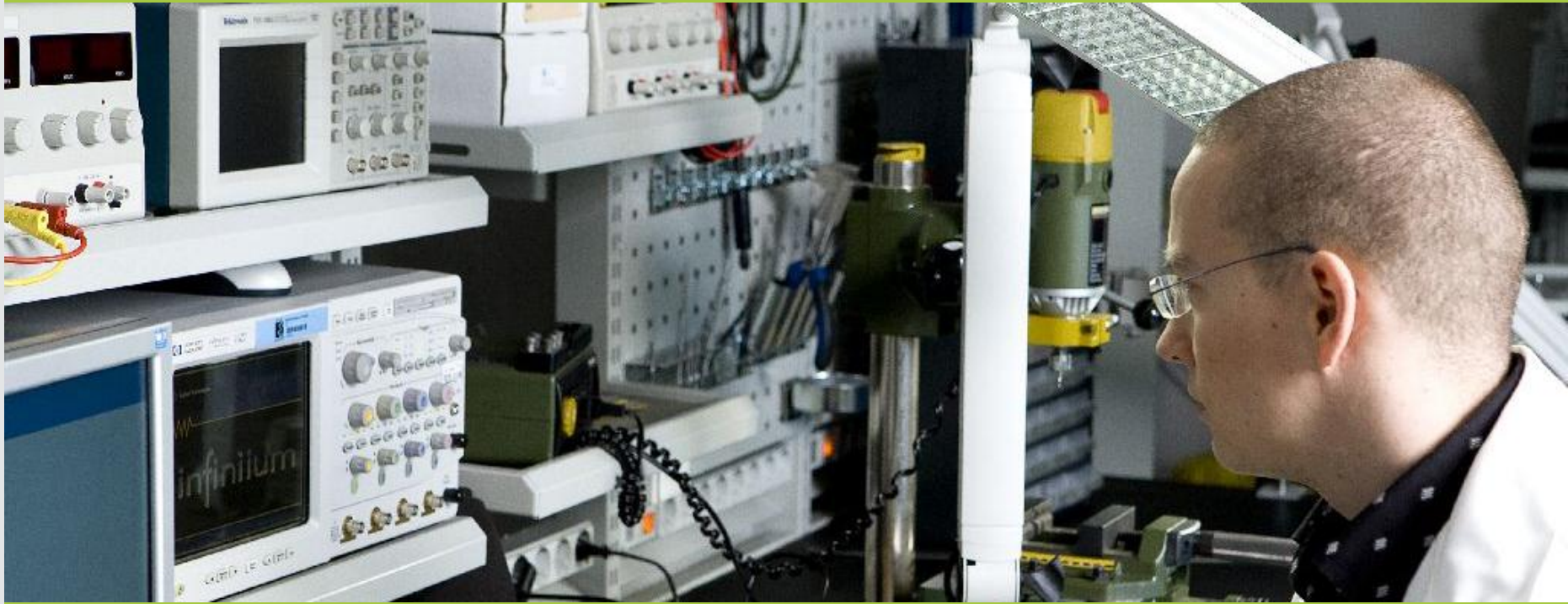
# Key Characteristics

- Project based operation, all funding **outside** university budget > 40 projects.
- Research partners include Tekes, Broadcom, Nokia, Nokia Solutions and Networks, Ericsson, Texas Instruments, Xilinx. Finnish Defence Forces, European Commission, European Defence Agency, European Space Agency, Patria, Insta, Elektrobit, Nethawk, Ponsse,...
- Annual research budget approximately 7 M EUR.
- Staff 134, 19 nationalities
- All new initiatives funded by own surplus, which is used for
  - CWC funded professorships (Currently 8)
  - Internal strategic research projects
  - Acquisition of high class research equipment
- Professional organisation and project management with separated daily management and scientific management.



# CWC Research Arena

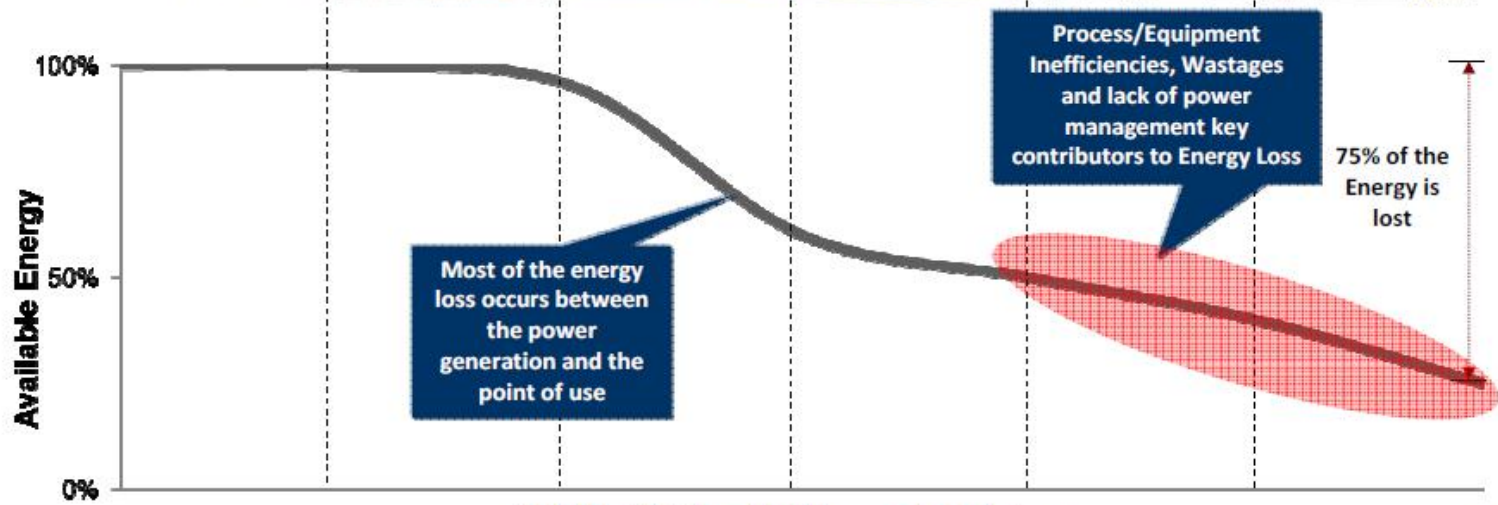
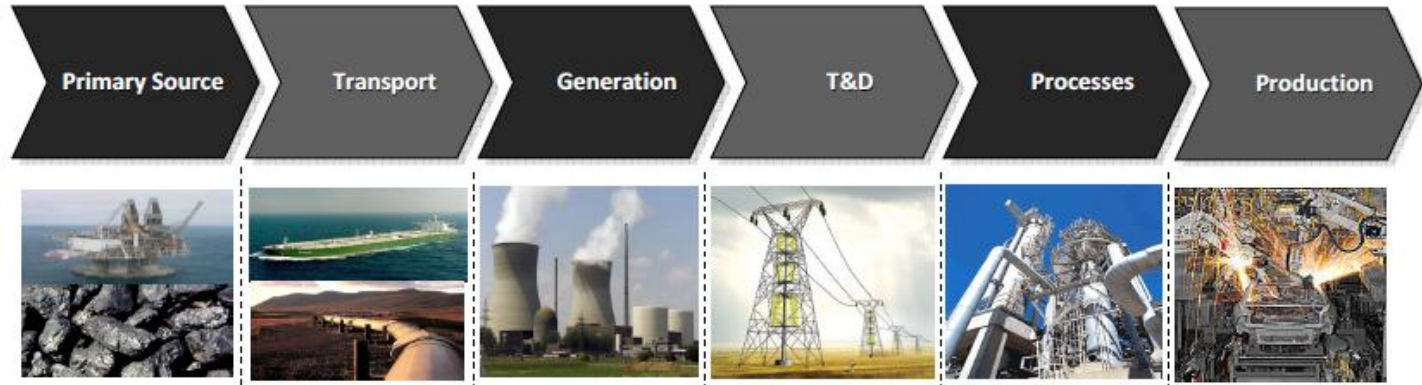




What do we do with smart grids?

# Main driver behind Smart Grid is the need to improve energy efficiency all the way from generation to the point of use

## Energy Management & Sustainability





# What do we do with smart grids?

Tekes Strategic Centre for Science, Technology and Innovation CLEEN programme **“Smart Grids and Energy Markets (SGEM)”**

Smart Grids are **changing** the way we do business.

In general Smart Grid has two main functions:

- **Enabler of energy-efficient and environmentally friendly energy market**
- **Critical infrastructure of society**

## Key Imperatives

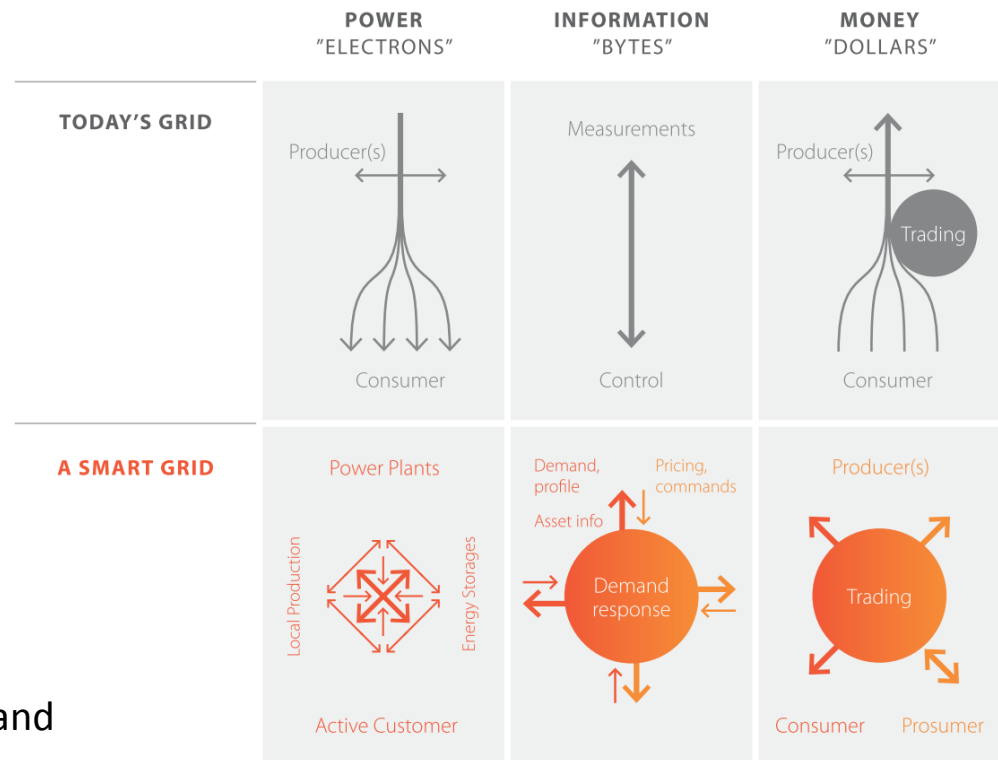
Create **Innovation foundation** to enable the Smart Grids vision

Build **internationally applicable** solutions

**Validate** in real environment

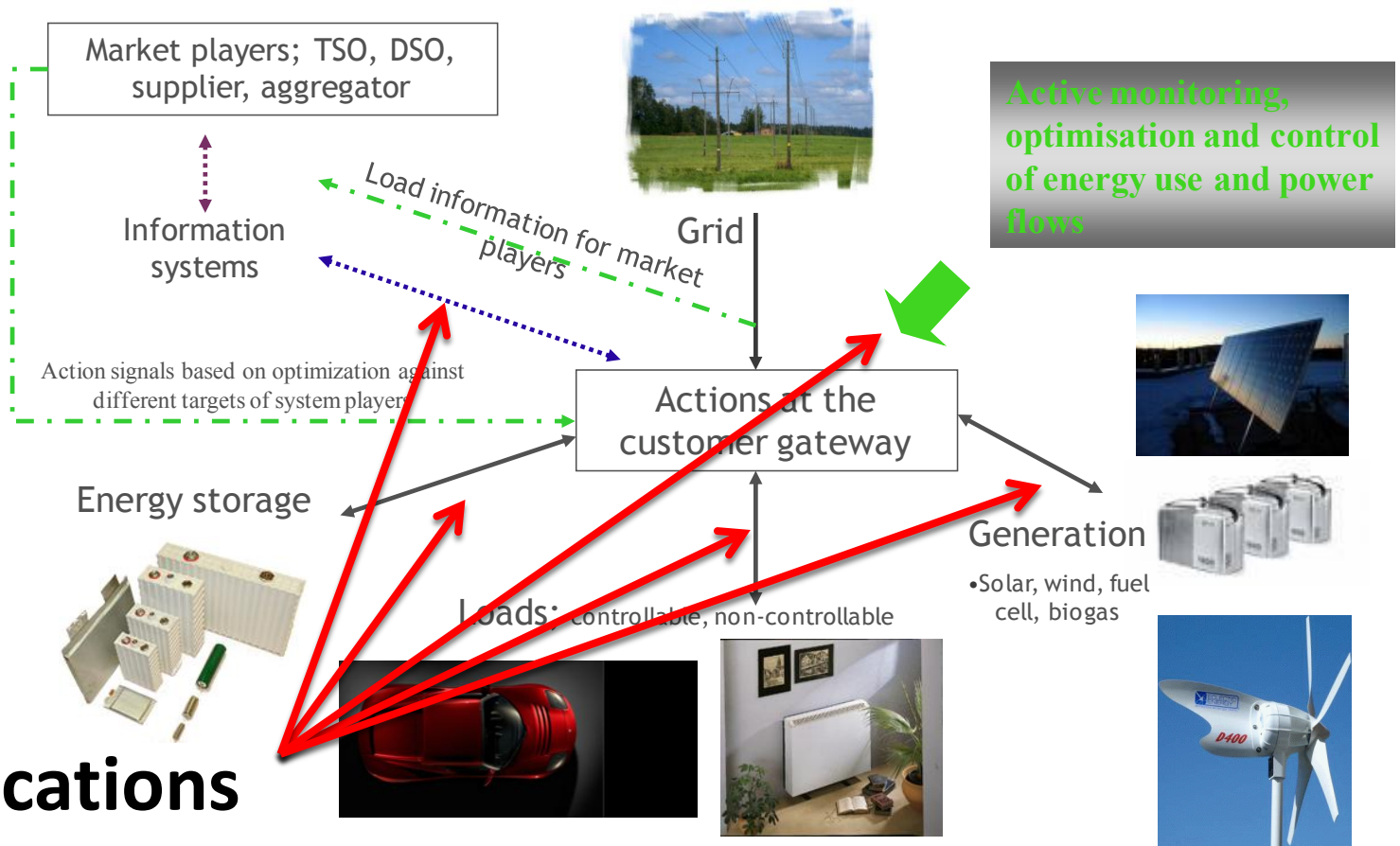
Ensure **competence** accumulation in research and business

Utilize **interactive** international research environment



# What do we do with SGEM?

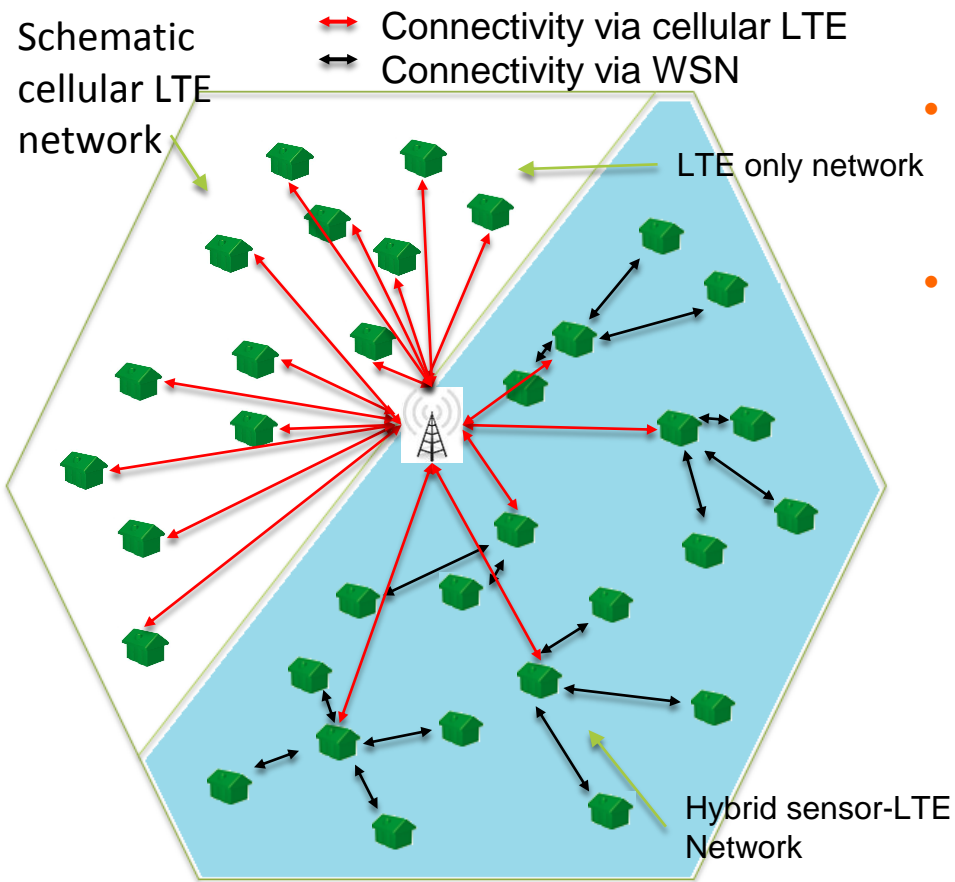
**Objectives; efficient use of grid and production capacity, enabler for distributed generation, load response and uninterrupted use of electricity**



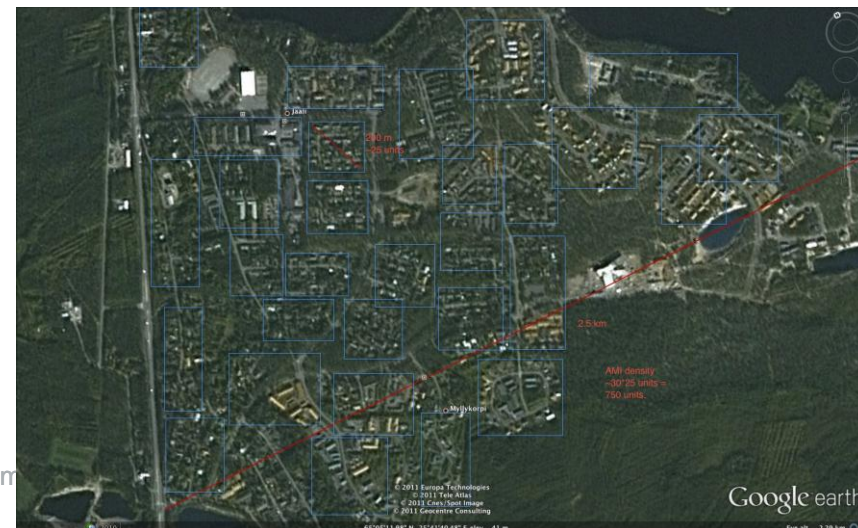
## Wireless Communications

- It is a key enabler

# Suburban Smart Grid Communications Modelling



- **Automatic meter reading**
  - Last gasp messaging
- **Advanced metering infrastructure**
  - Feedback from distribution system operator
- **Demand response**
  - Spot pricing and direct load control
  - Load balancing with local energy generation
  - High-intensity load balancing



# What technologies do we investigate? And why?



## Public LTE (4G) telecommunications infrastructure

- **Readily available access network with good coverage**

## Hybrid wireless sensor network – LTE

- IEEE 802.15.4-2011 standard wireless personal area network clusters coordinated by LTE capable remote terminal units
- **Possibility to offload communications from the busy public infrastructure**
- **Enables resilient communications**

## Low-energy, critical infrastructure monitoring

- IEEE 802.15.4k-2013 standard long-range wireless sensor networks
- **Wide-area network coverage with minimal infrastructure**
- **DSO/ISO/third party operable, private and unlicensed network**
- **Extreme resiliency**



What are our future research interests ?

# What are our future interests?

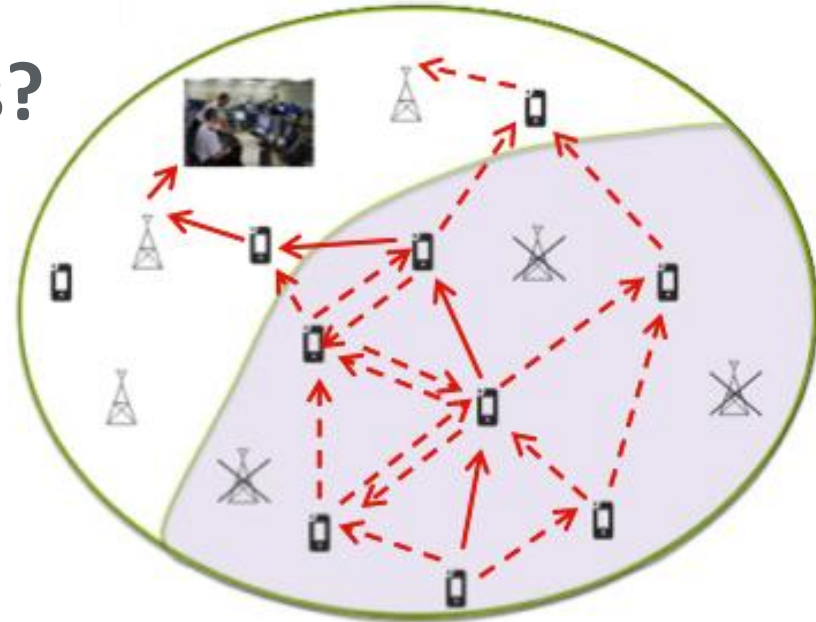
**Resiliency** in demand response networks

- Relaying in hybrid sensor – LTE
- Ad hoc LTE

**Innovations** to enable **wireless protection circuitry** in medium and high-voltage networks

- Communication latencies in the order of few milliseconds
- Not obtainable by current standards

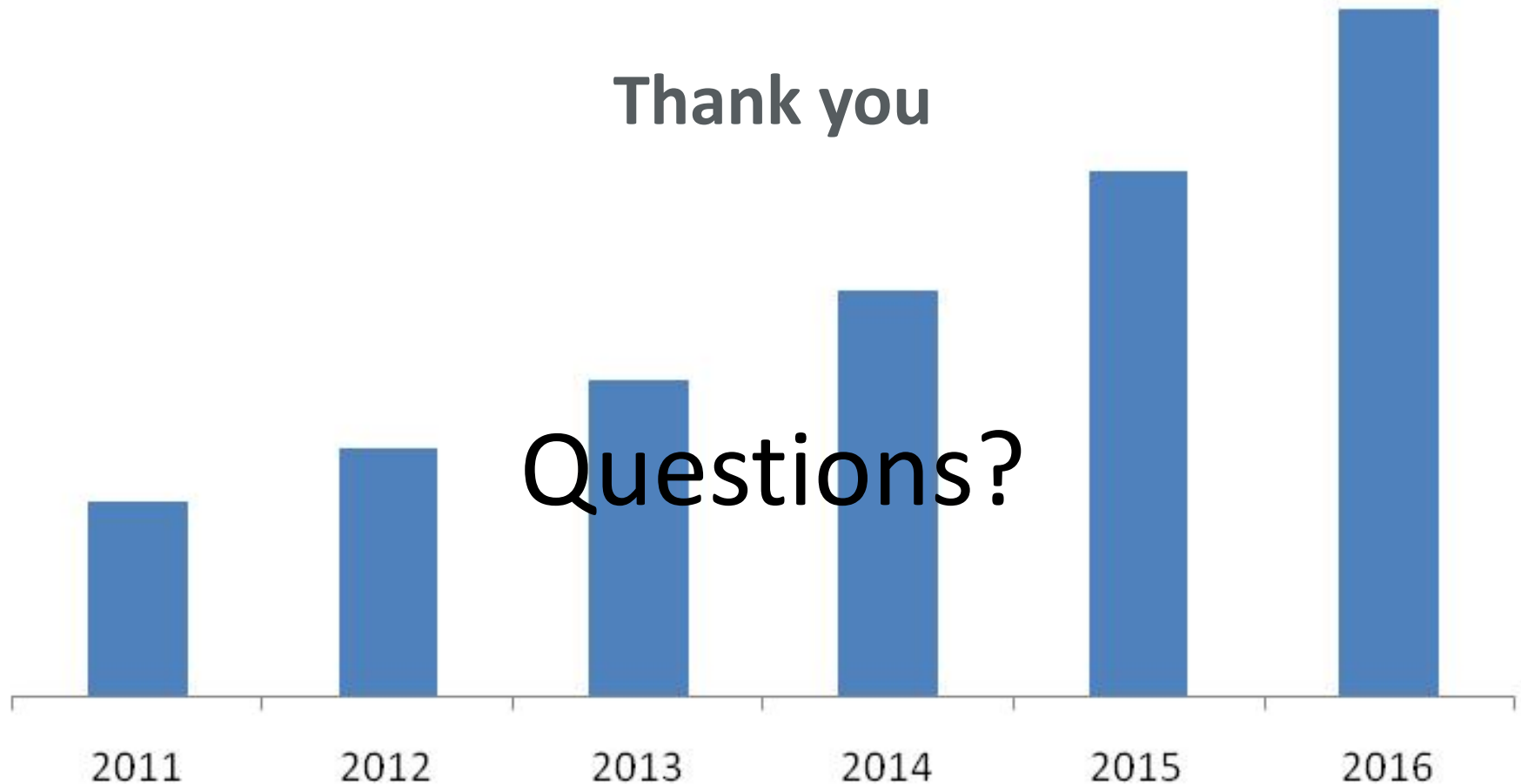
De-centralised **optimisation of energy flows with** distributed generation based on prosumer energy market place.



## Smart Grid Technology Market (2011 - 2016)

Thank you

Questions?



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