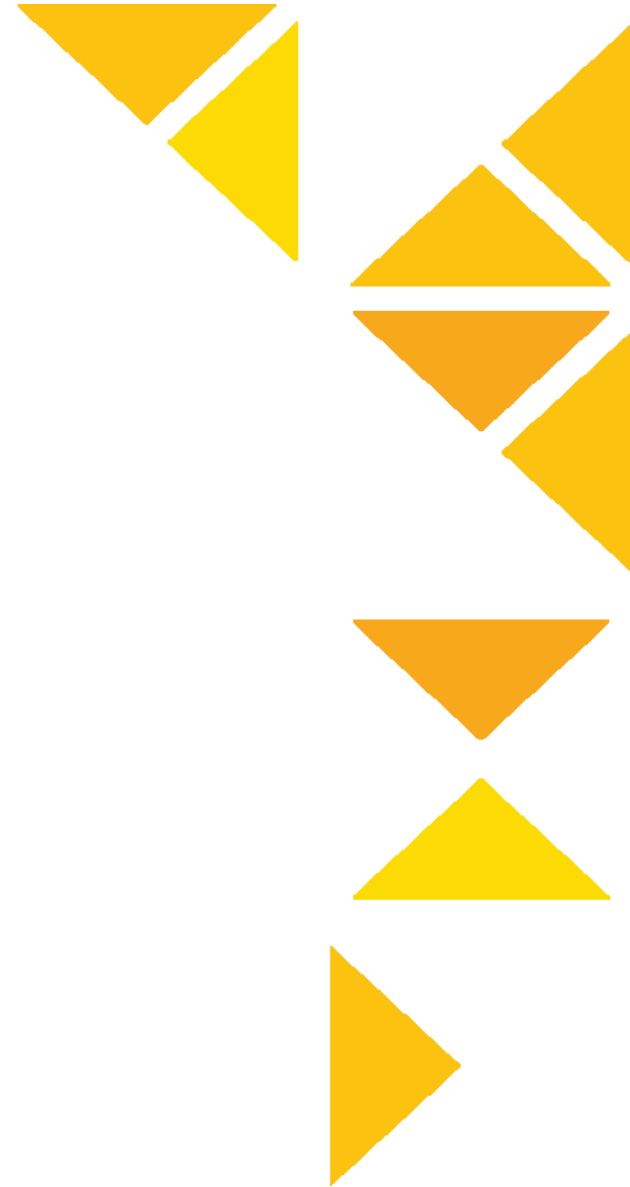


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# Adaptive protection pilot

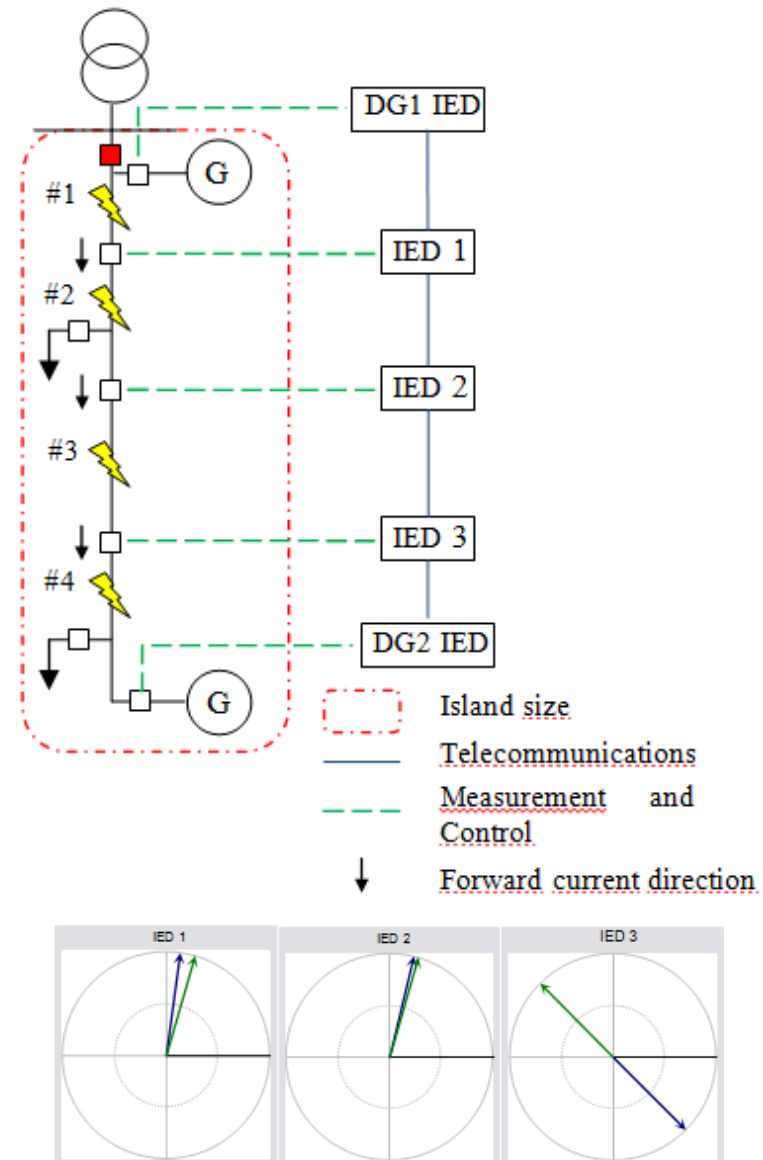
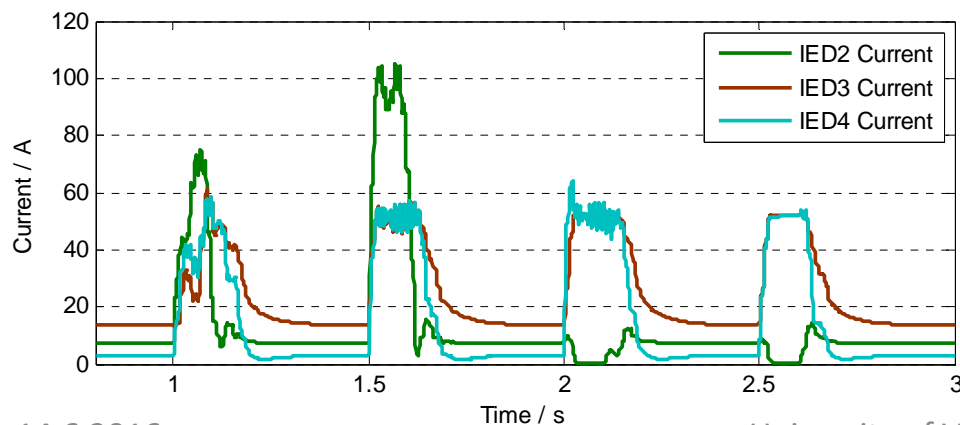
# Background

- Little of who I am
- My PhD thesis
  - Protection requirements for future Smart Grids
- Past research
- What is going on now – Adaptive protection pilot
  - Sundom Smart Grid



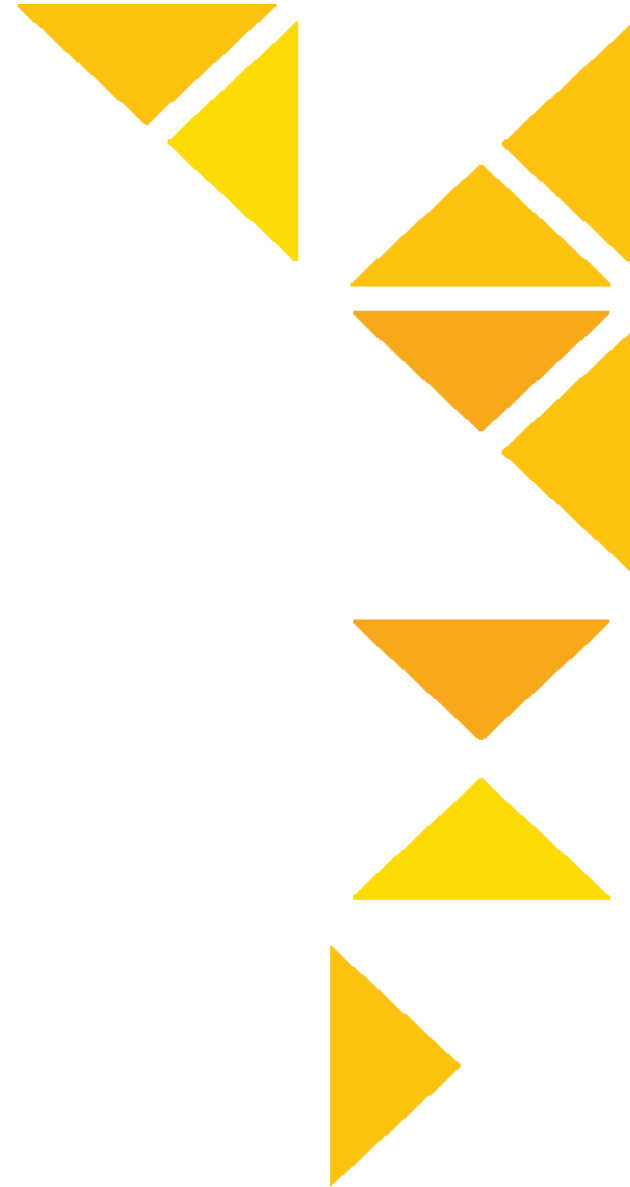
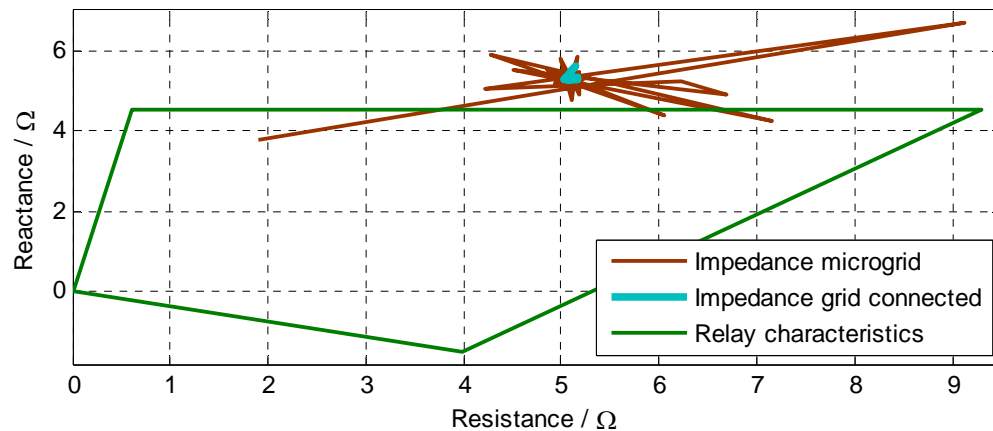
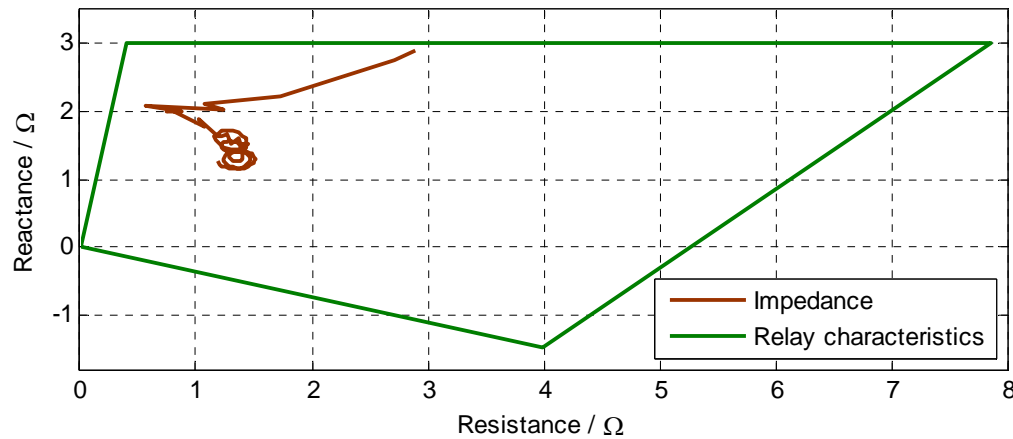
# Microgrid protection

- Telecommunication based protection approach for MV microgrid
- Distinguishing between LV and MV faults



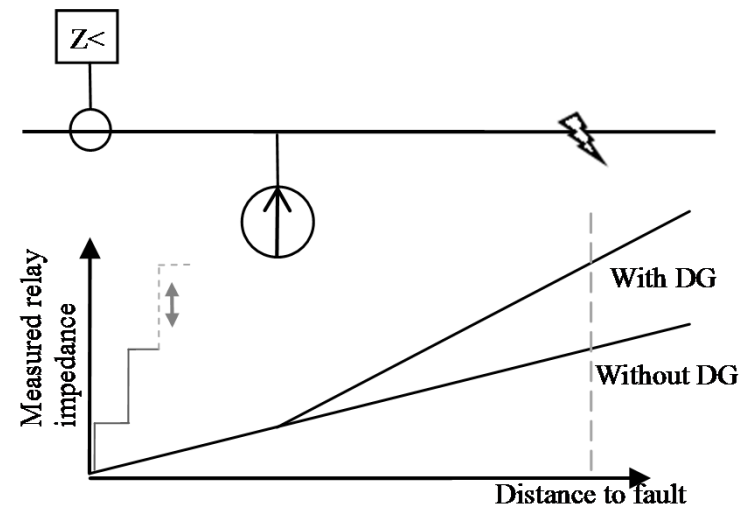
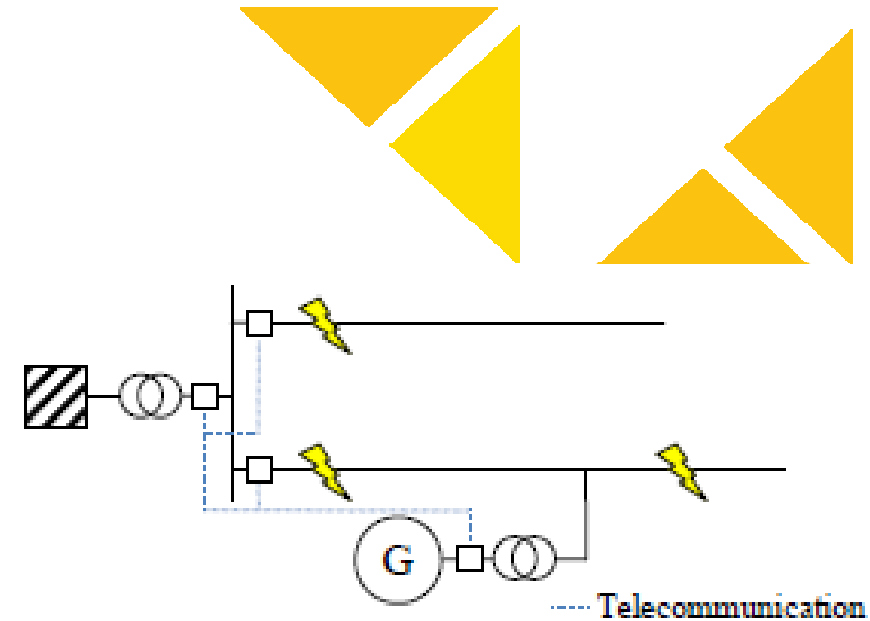
# Microgrid protection

- Distance protection



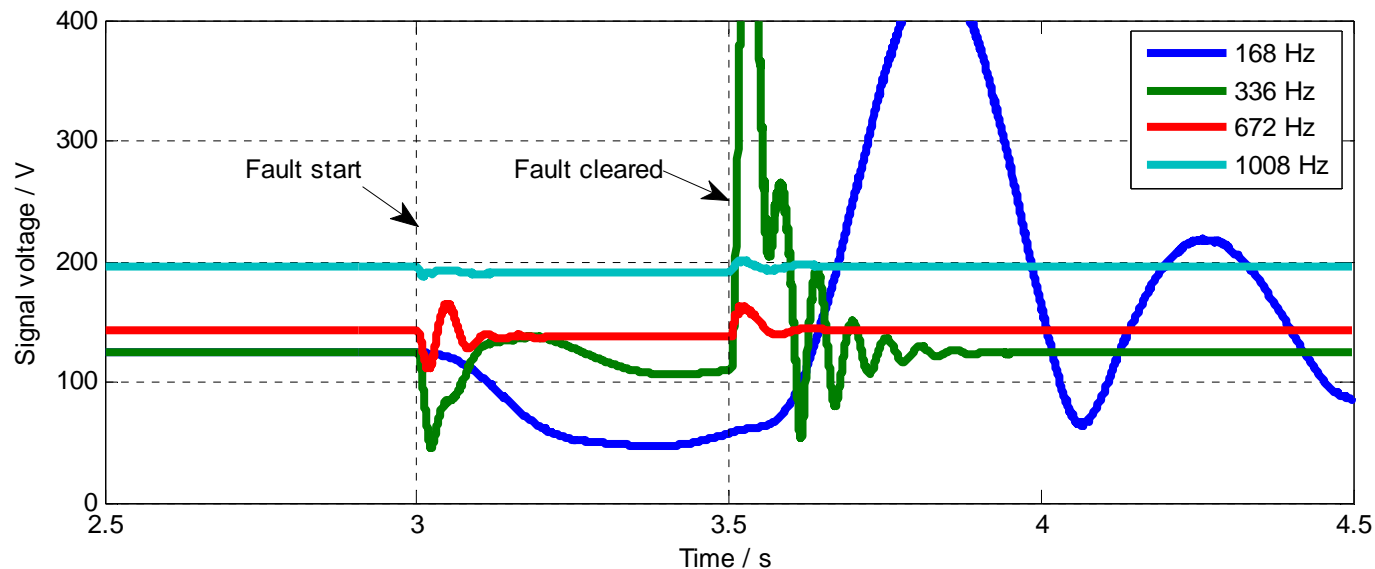
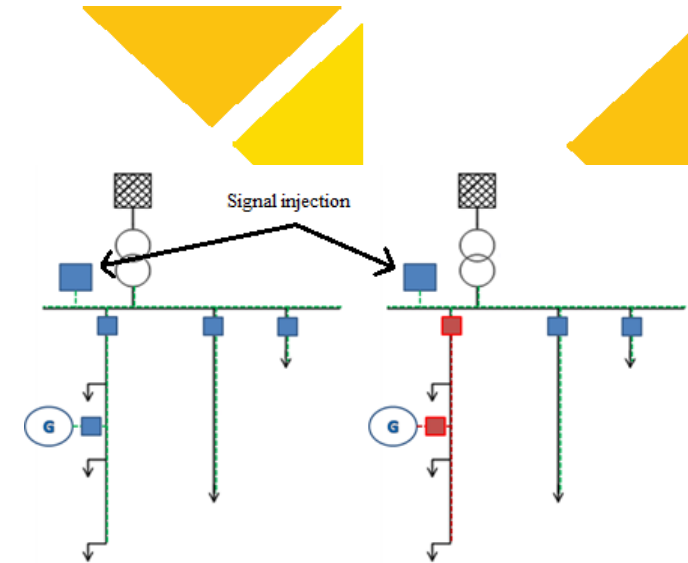
# DG protection

- Benefits of using telecommunication based protection with DG
  - Prevent false and nuisance tripping
- Distance protection as an alternative
  - Intermediate in-feed
  - Microgrids

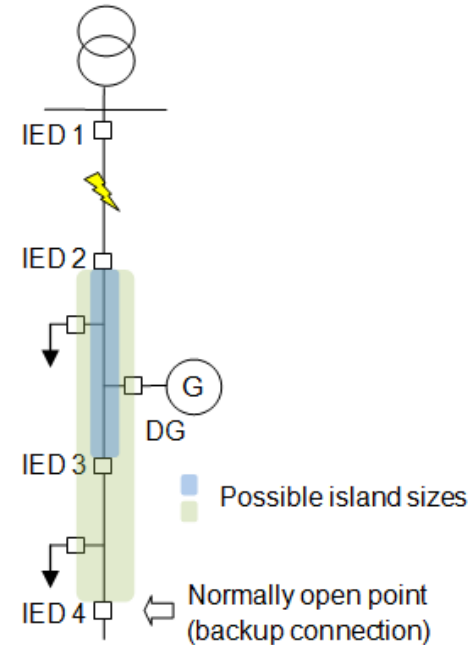
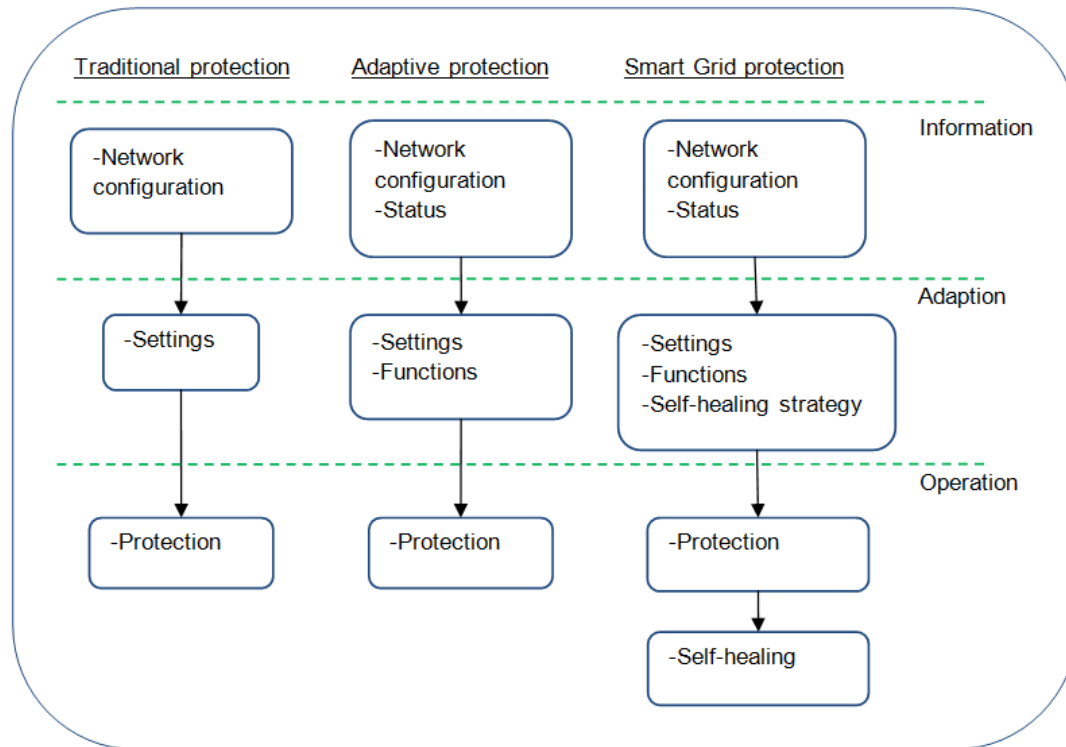


# DG protection

- Power Line Carrier based LOM
  - Simulations with PSCAD
  - LOM detected in 20 ms at best
  - PLC signal during voltage disturbance

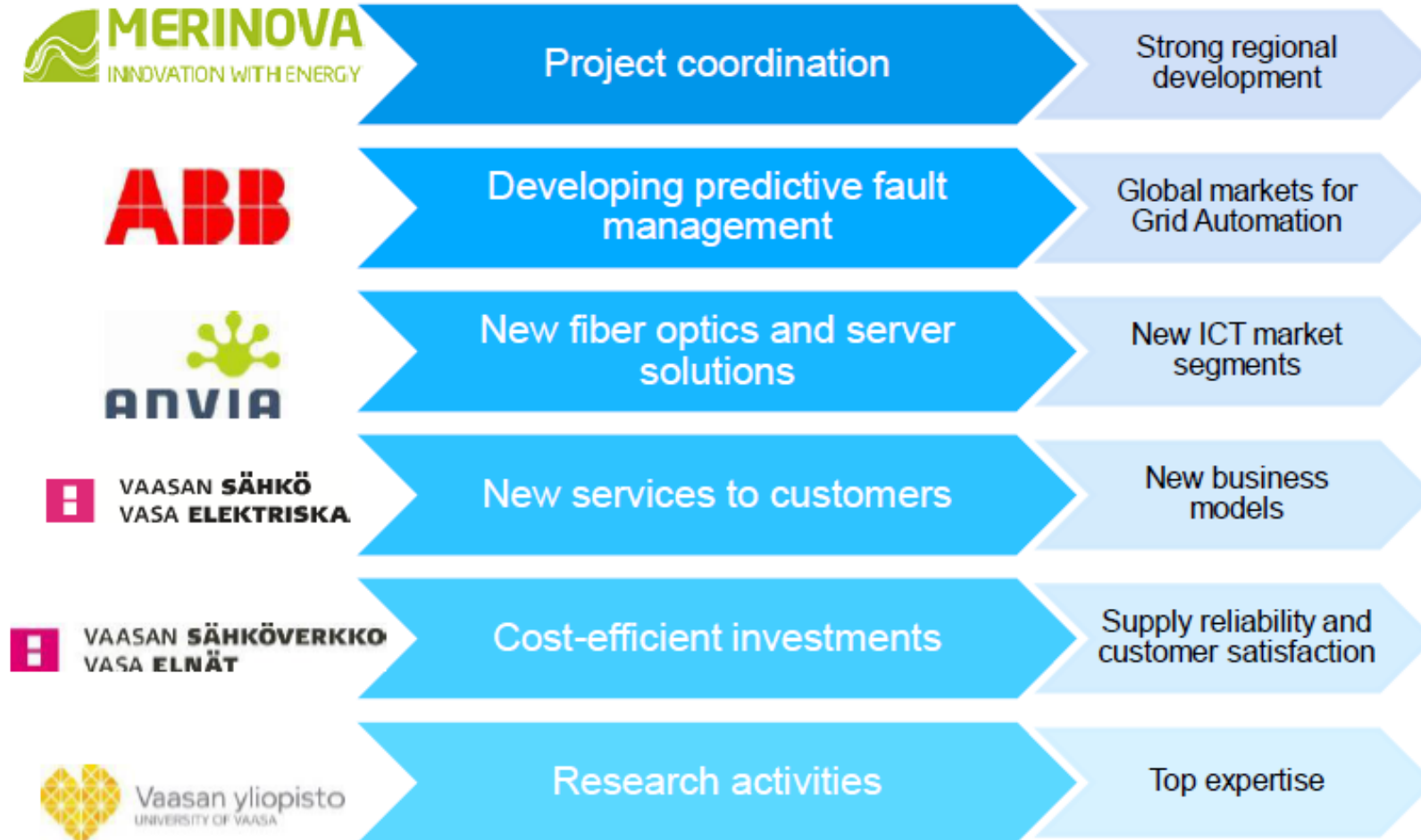


# Adaptive protection



- Restructuring the network after fault
  - Dividing the power system to protection zones
- Enabling different functions or settings according to network state

# Sundom Smart Grid



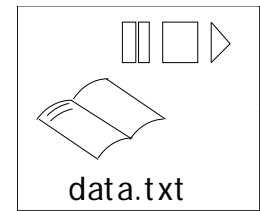
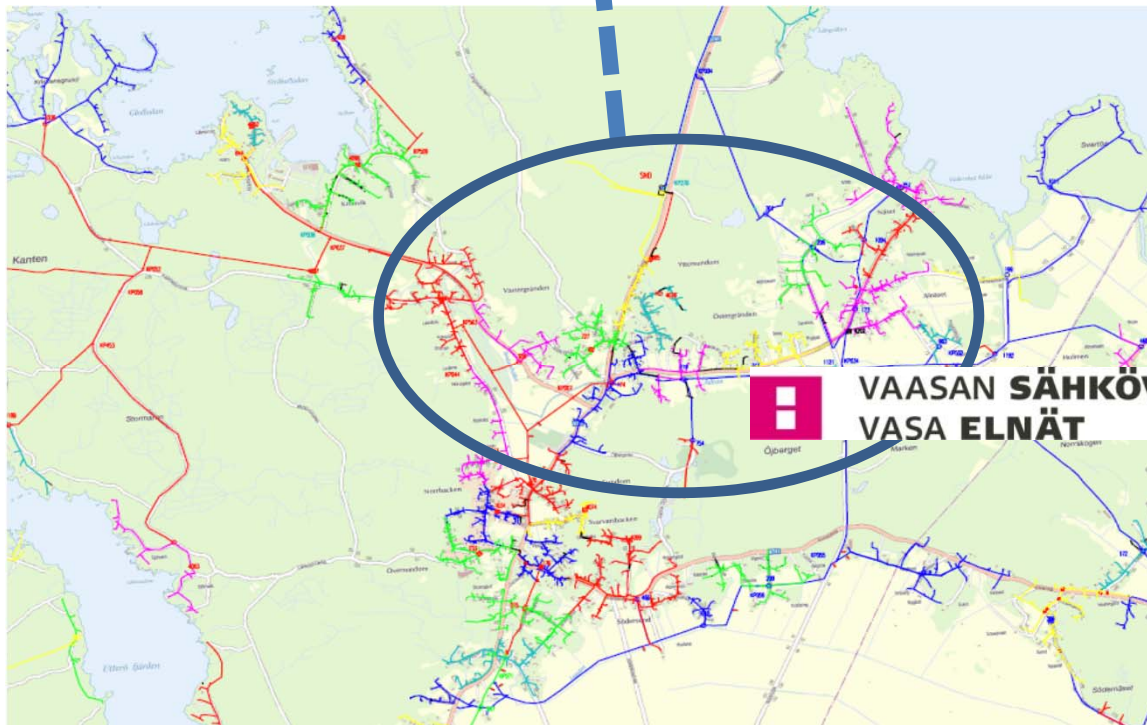


# Research themes

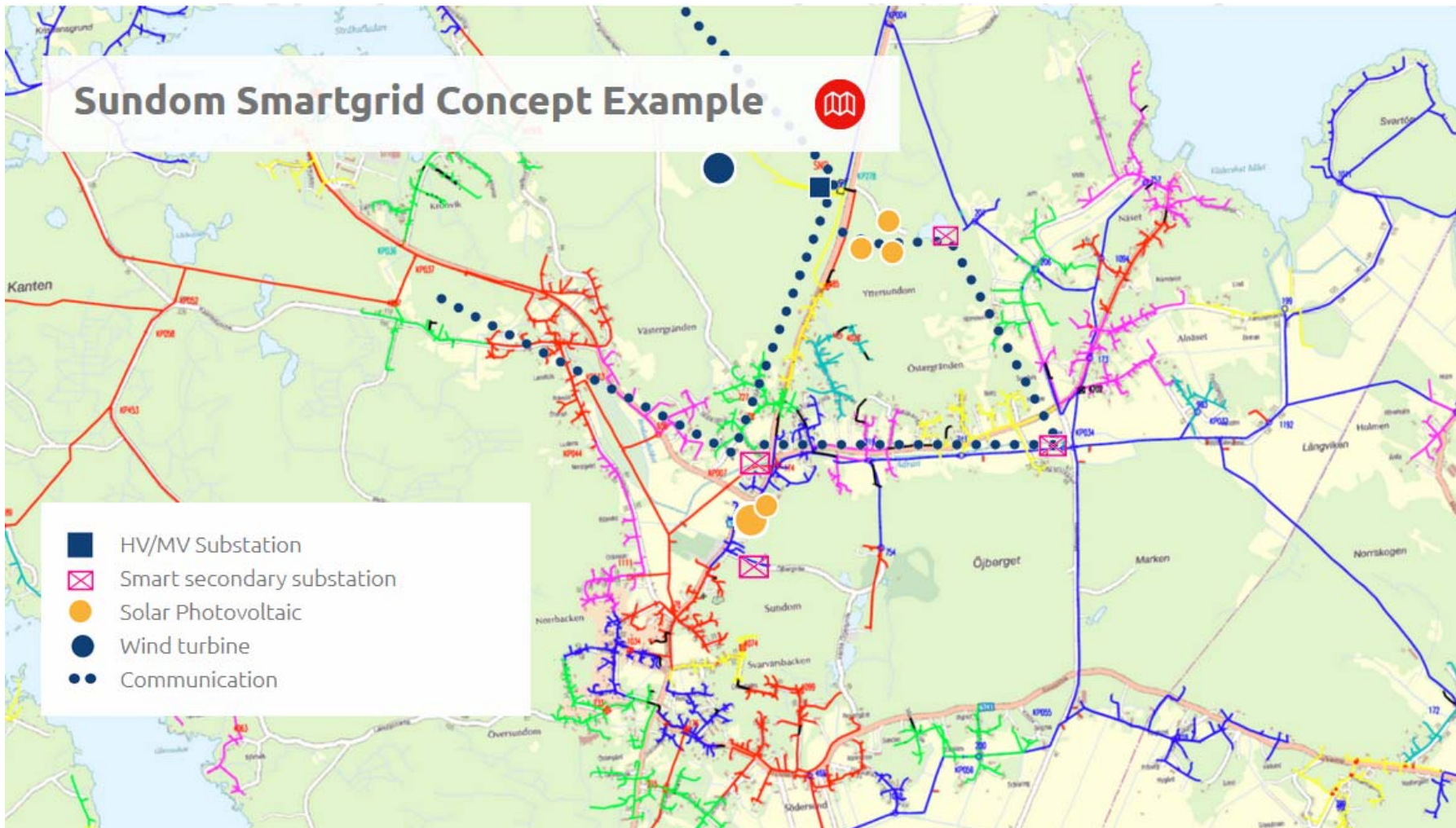
- **Piloting Smart Grid technologies with modern IEDs and fast telecommunication**
- **Grid technologies for better reliability – effects of regulation models**
- **Integration of distributed generation**
- **Active customer participation - prosumers**



# Sundom Smart Grid

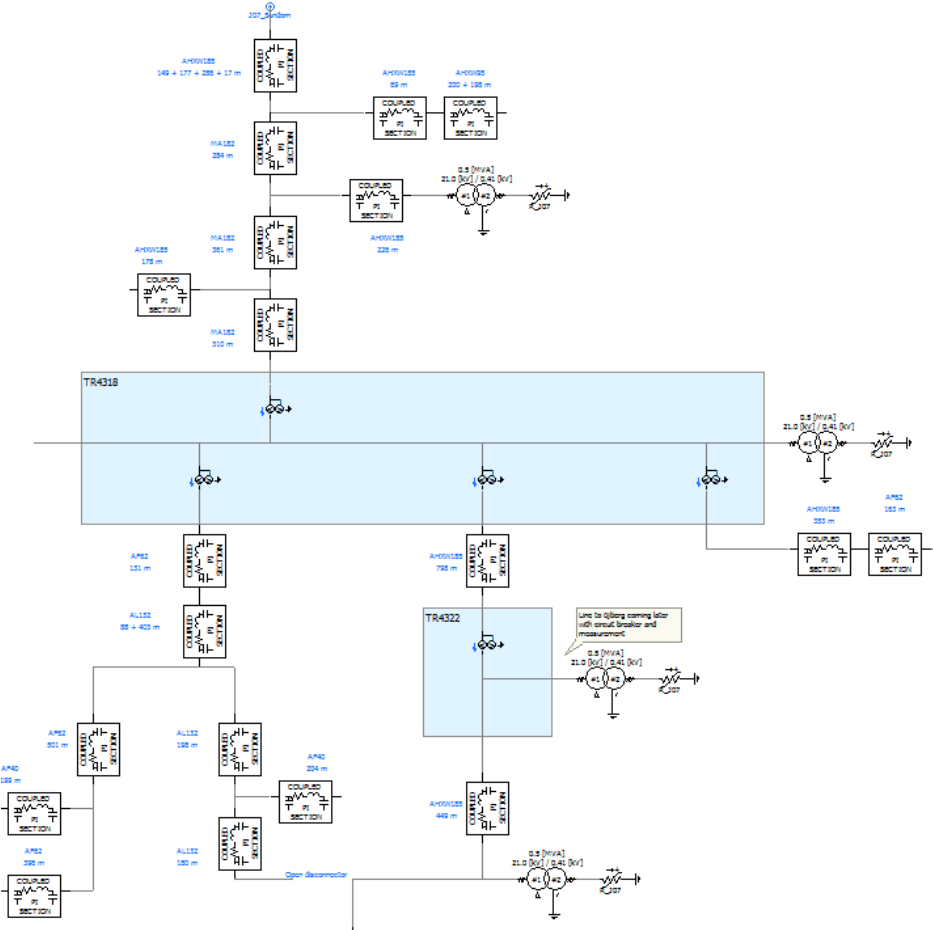


# Sundom Smart Grid



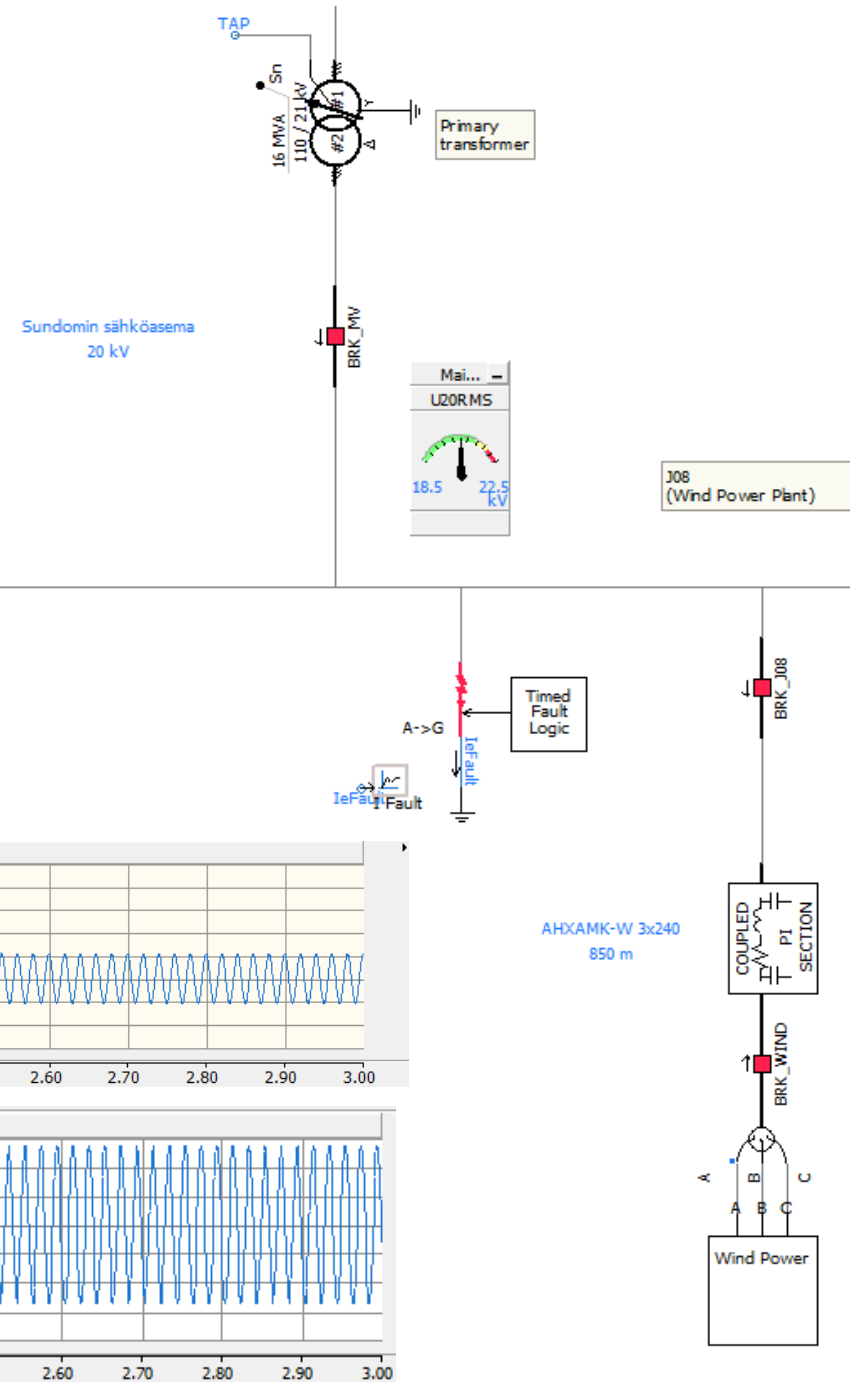
# Sundom Smart Grid

- PSCAD model of the network



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# Sundom Smart Grid

- Field tests
  - Continuous and permanent earth faults
  - Intermittent earth faults
  - Fault resistance 0 – 10000  $\Omega$
  - Test the operation of primary and secondary substations

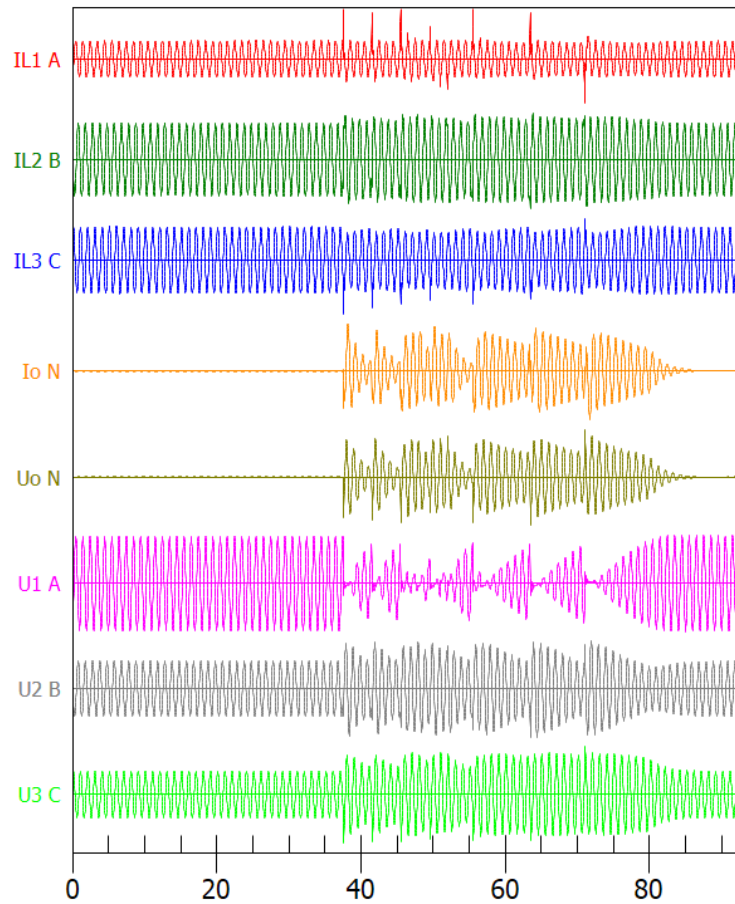
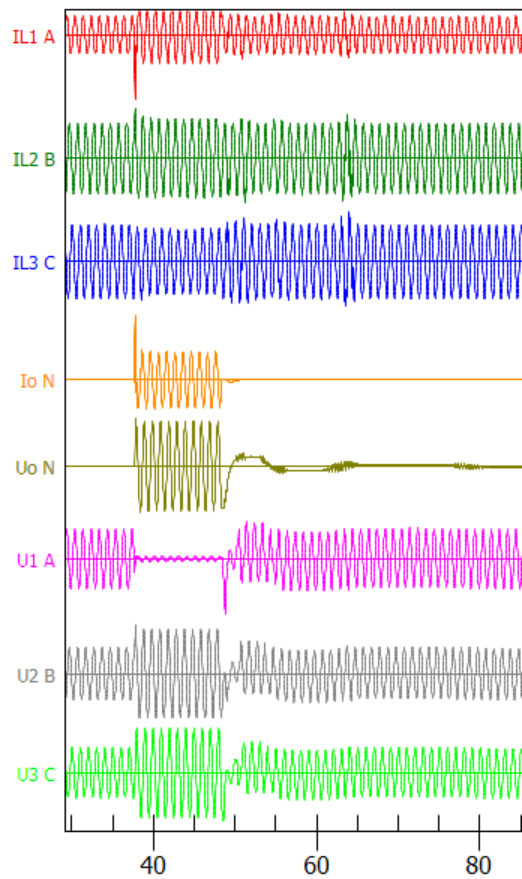


Pictures: Jukka Rinta-Luoma



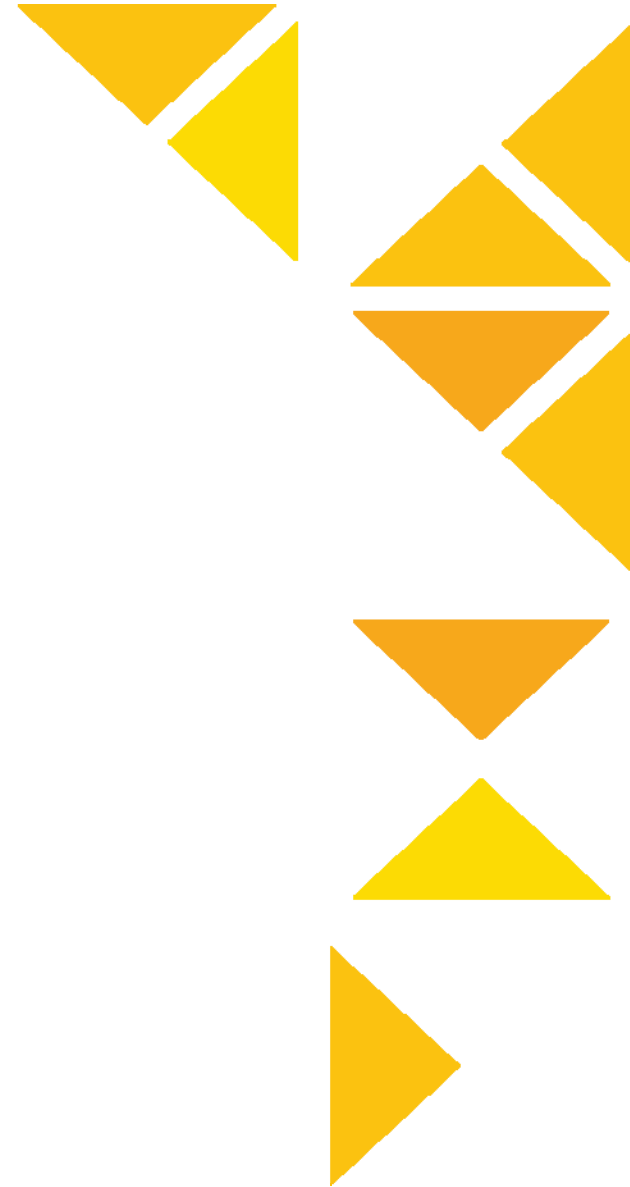
# Sundom Smart Grid

- **Field tests**



# Sundom Smart Grid

- What else has been done in the project
  - Prosumers
  - Cost-efficiency of cabling
  - Real time measurement
- What possibilities are there
  - Infrastructure has been built
  - More field tests
  - Implementation and effects of DG units
  - Protection verification
  - Microgrid simulation or tests
  - Living lab
    - Real time measurement



Thank you!

Questions?



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