



**Instytut Energetyki Oddział Gdańsk**

**Institute of Power Engineering  
Gdansk Division**

**Concept of  
Smart Grid solutions implementation**

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# Goal of the project

- ❖ Energa Operator (DSO) and the Institute mutual project
- ❖ Implementation of an experimental smart grid in the operator area
  - observable and controllable
  - with specific smart grid elements and solutions
- ❖ Concept and feasibility study of Smart Grid on Hel Peninsula (currently performed)

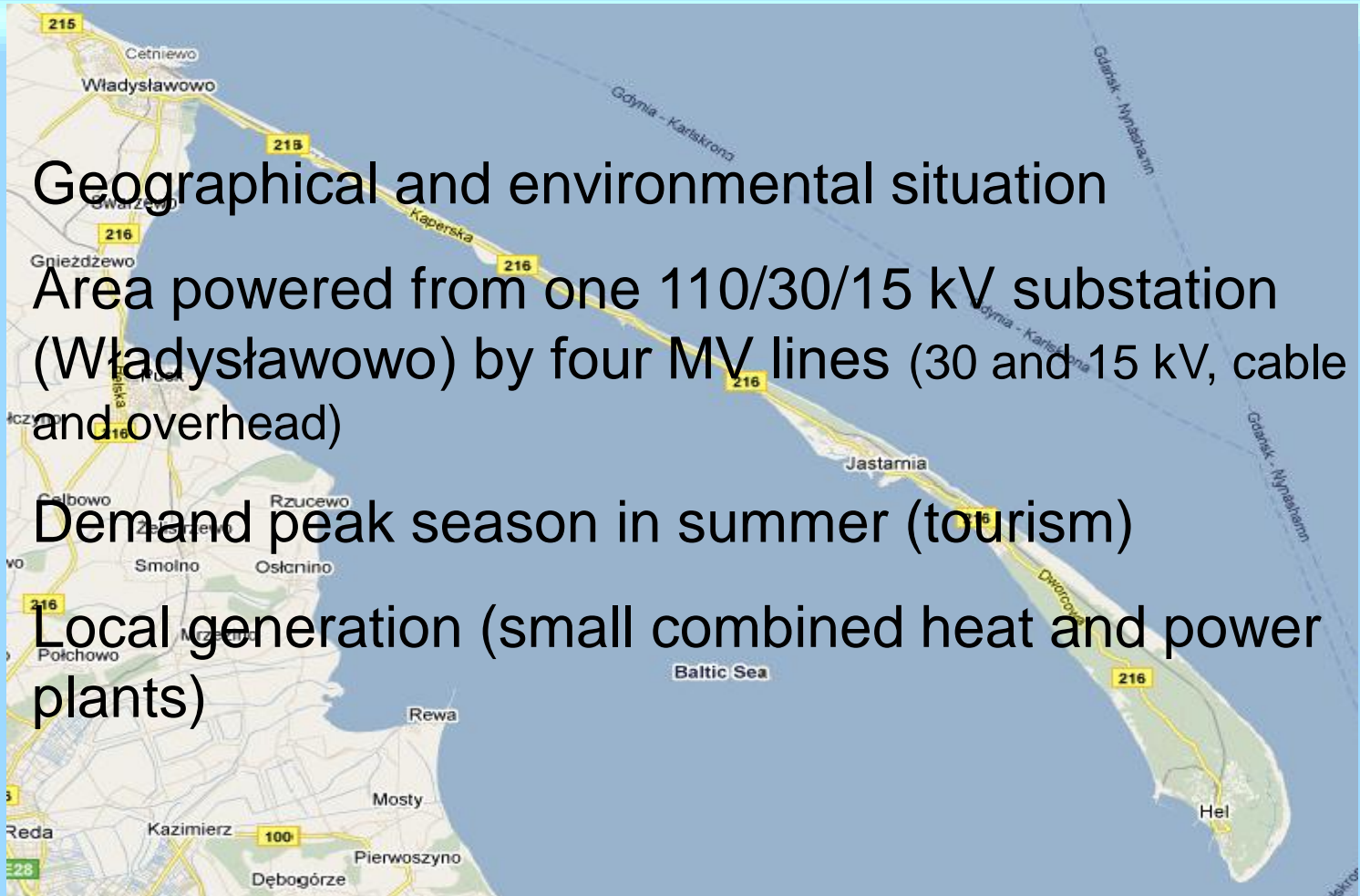


# Scope of the concept project

- ❖ Existing network infrastructure inventory
- ❖ Smart Grid functions, structure
- ❖ MV and LV network simulation study
- ❖ Control algorithms development
- ❖ Feasibility Study of the Smart Grid

# Hel Peninsula grid characteristics

- ❖ Geographical and environmental situation
- ❖ Area powered from one 110/30/15 kV substation (Władysławowo) by four MV lines (30 and 15 kV, cable and overhead)
- ❖ Demand peak season in summer (tourism)
- ❖ Local generation (small combined heat and power plants)





## Existing infrastructure (scope of inventory)

- ❖ MV and LV power lines, substations, transformers
- ❖ Generation – conventional and renewable
- ❖ Network protection and automation
- ❖ Measuring infrastructure
- ❖ Telecommunication infrastructure
- ❖ Analysis of measuring data from HV station  
Władysławowo
- ❖ Demand analysis (characteristics of load)



# Simulation study of grid operation

## Control algorithms development

- ❖ Development of digital model of existing infrastructure elements, generation sources, switching devices, automation
- ❖ Development of digital model of new elements proposed to be installed in the project
- ❖ Study of grid elements co-operation
- ❖ Development of generation and demand profiles
- ❖ Development of control algorithms
- ❖ Study of grid operation with developed algorithms
- ❖ Analysis of island mode operation



# Concept of Smart Grid - basic topics

- ❖ Smart Grid functions
- ❖ Smart Grid structure
- ❖ Telecommunication infrastructure
- ❖ Monitoring and control
- ❖ Guidelines for SCADA system
- ❖ Implementation and integration of AMI (Advanced Metering Infrastructure)
- ❖ Improvement of energy quality and reliability
- ❖ Other (DSM/DR, Smart Buildings, energy storage...)

# Basic functions of the Smart Grid

## Substation control



- ❖ Remote measurements reading of operation and failure parameters
- ❖ Substation switch control
- ❖ Voltage regulation
- ❖ Goal: energy quality and reliability

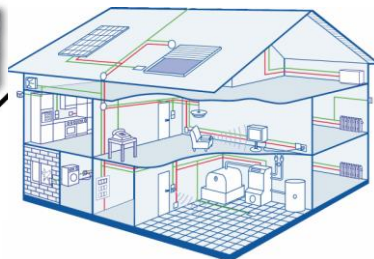
## Energy management



- ❖ Generation and demand prediction
- ❖ Distributed generation management
- ❖ DG and grid save co-operation

## Smart metering / AMI

Home terminal

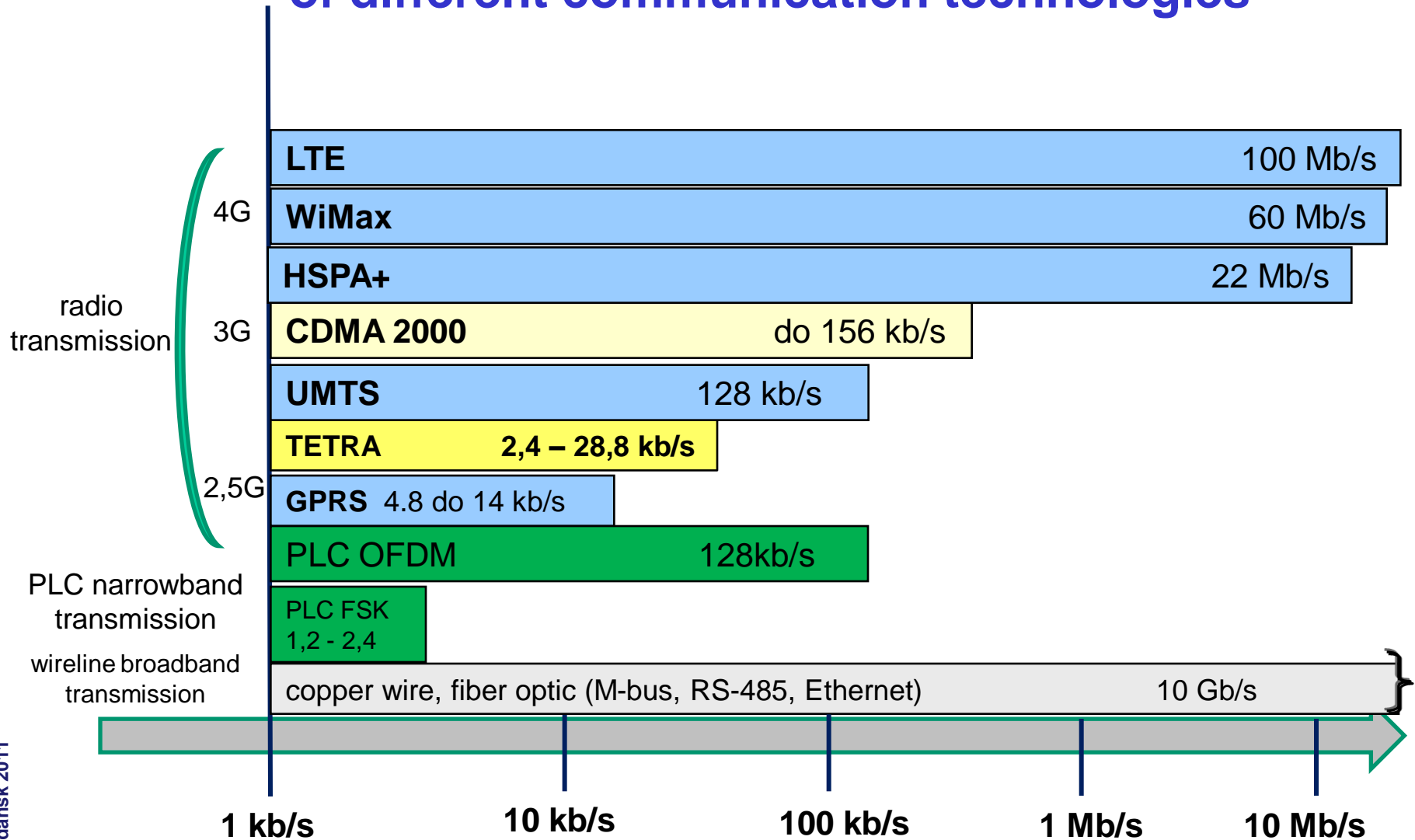


- ❖ Efficiency improvement of energy measurement
- ❖ Energy users education and motivation to change their habits of energy use



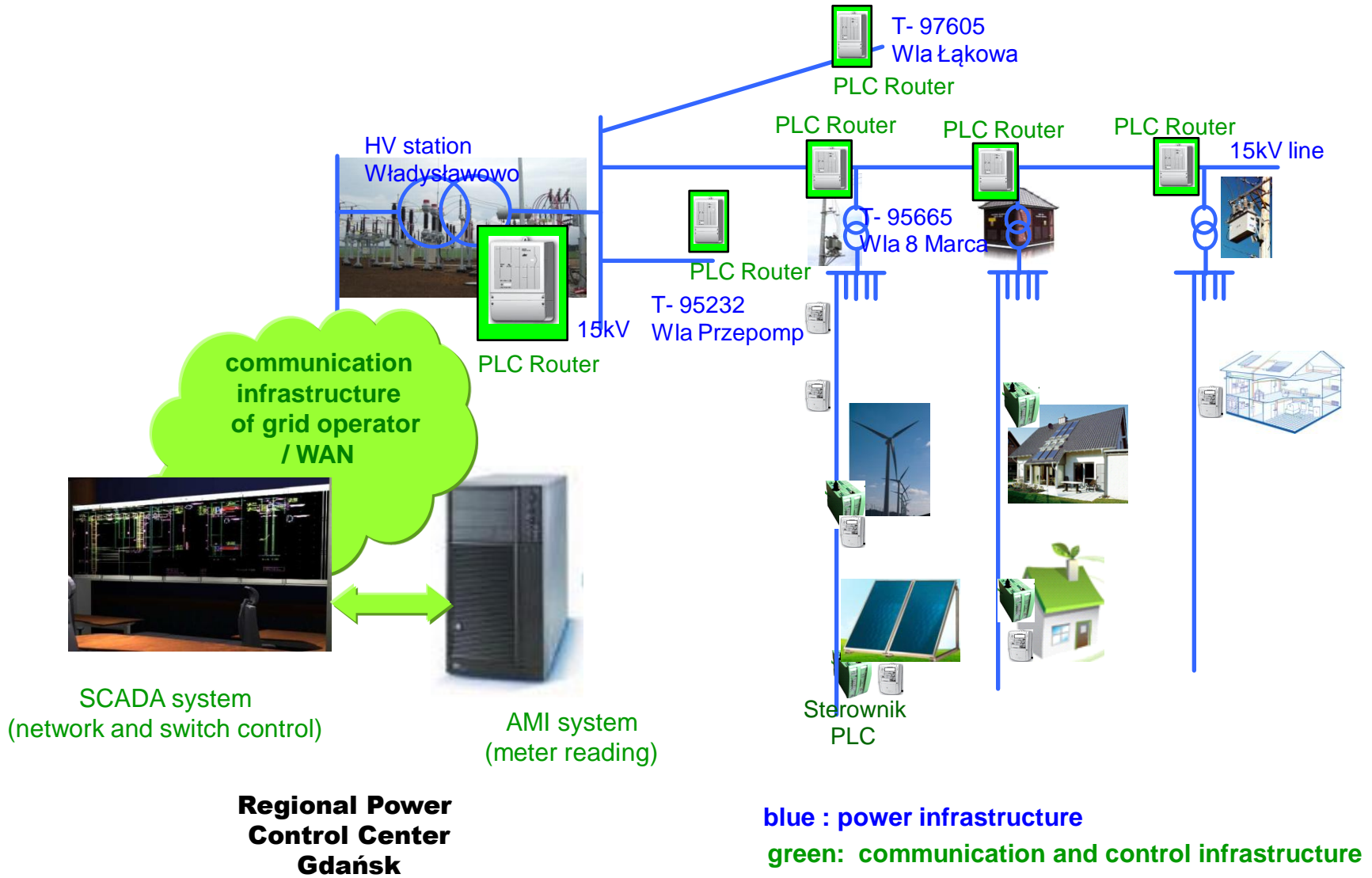


# Communication infrastructure Throughput of different communication technologies





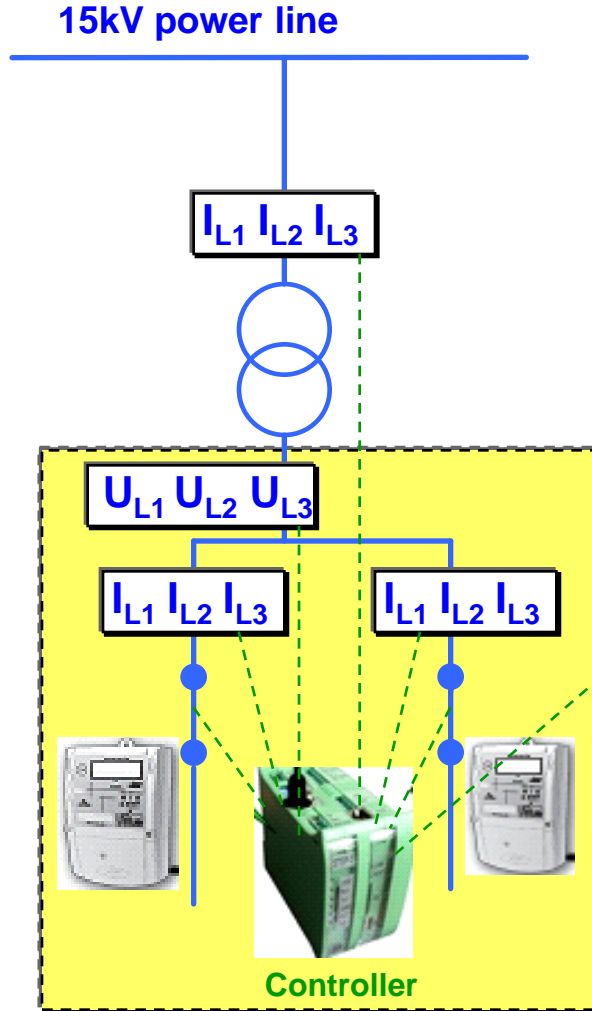
# Basic Smart Grid structure



blue : power infrastructure  
 green: communication and control infrastructure

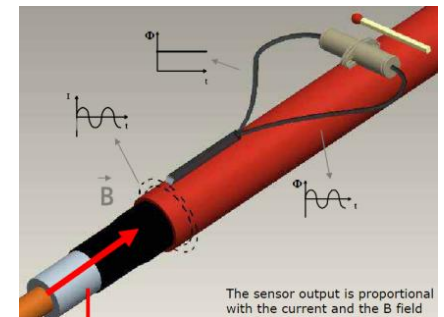


# MV/LV substation measurements concept



Fault indicator

Current sensor



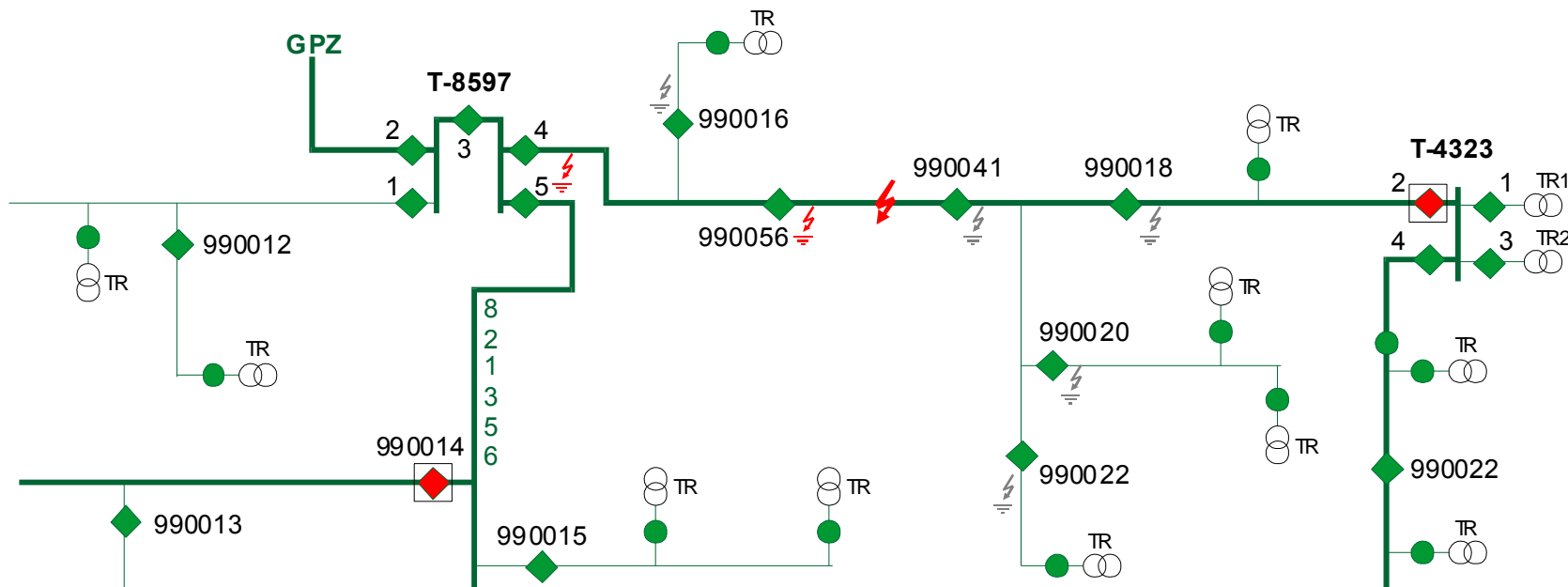
measurements and communication box



# MV Network automation

## separation of damaged MV line section

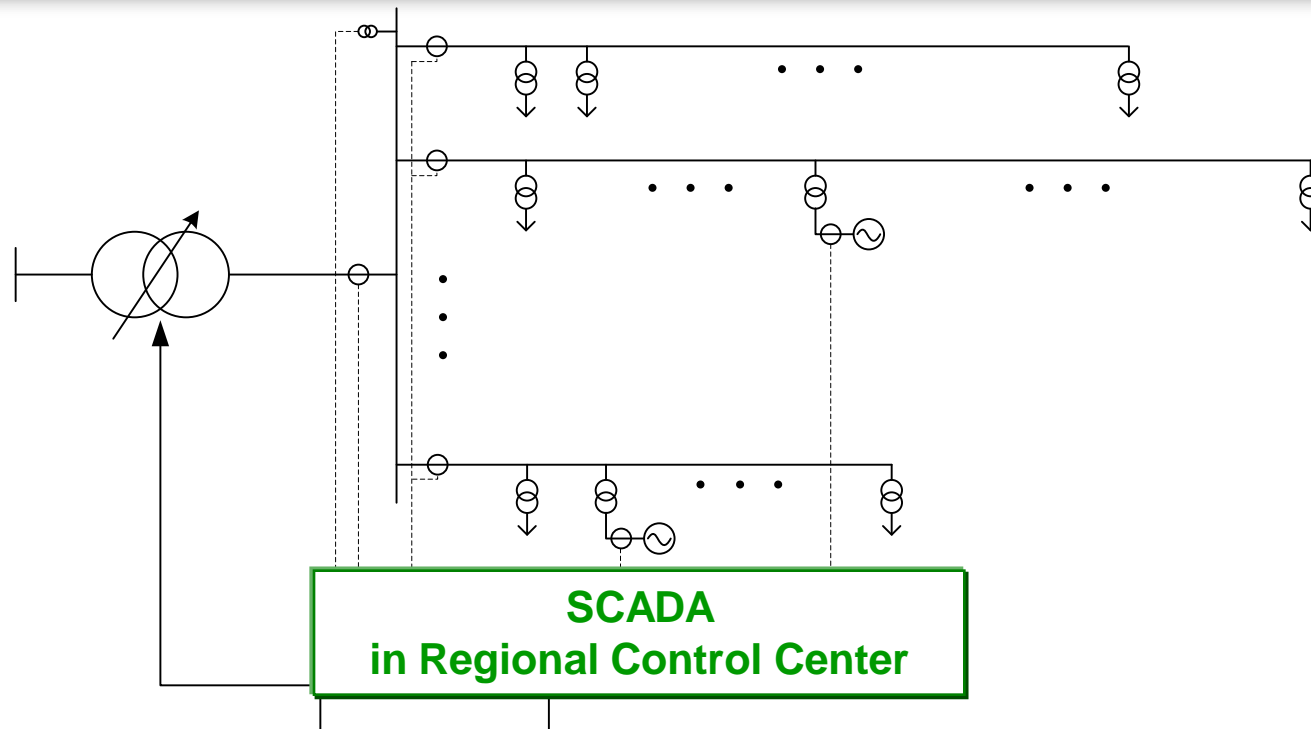
- ❖ goal: shortening of power failures time
- ❖ switching automation
- ❖ determining the remote controlled switches location





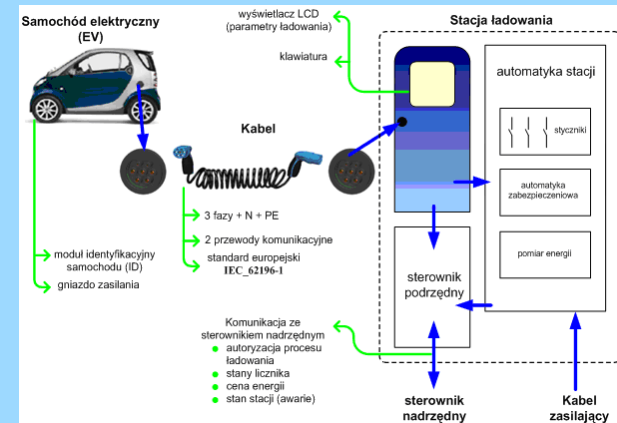
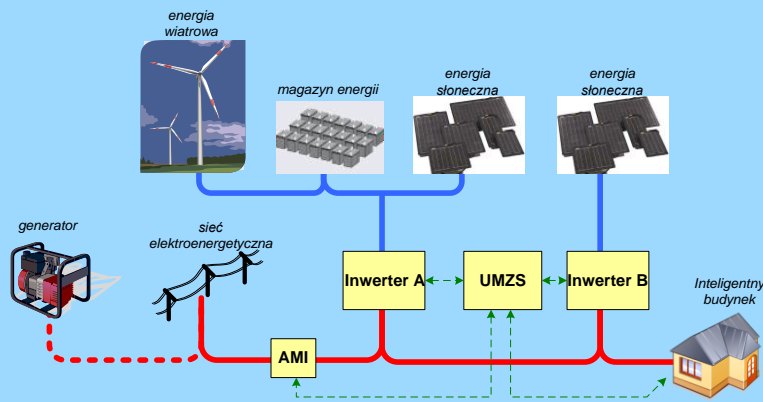
# Concept of Smart Transformer Regulation

- ❖ Compensation of voltage reductions on MV power lines – better energy quality
- ❖ Utilization of measurements:
  - power line currents ,
  - active and reactive power of distributed generation (DG),
  - measurements from MV/LV transformers



# Other topics of the Smart Grid concept

- ❖ Technical solutions of DSM and DR
- ❖ Smart Building with micro-generation - concept and implementation of monitoring and control



- ❖ Plug-In (Hybrid) Electric Vehicles – concept of charging station, energy storage



# Concept of Smart Grid solutions implementation

**Thank you for your attention**

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