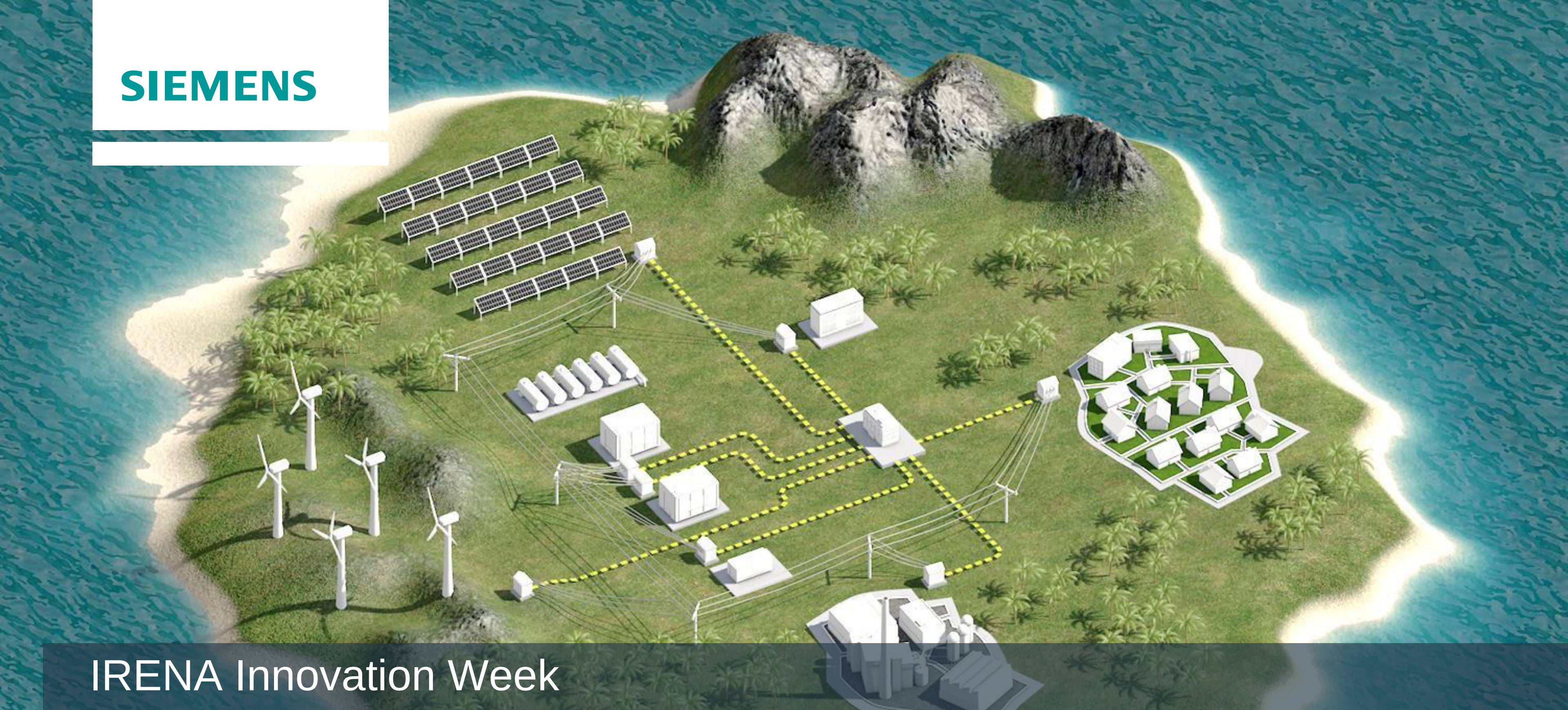
SIEMENS



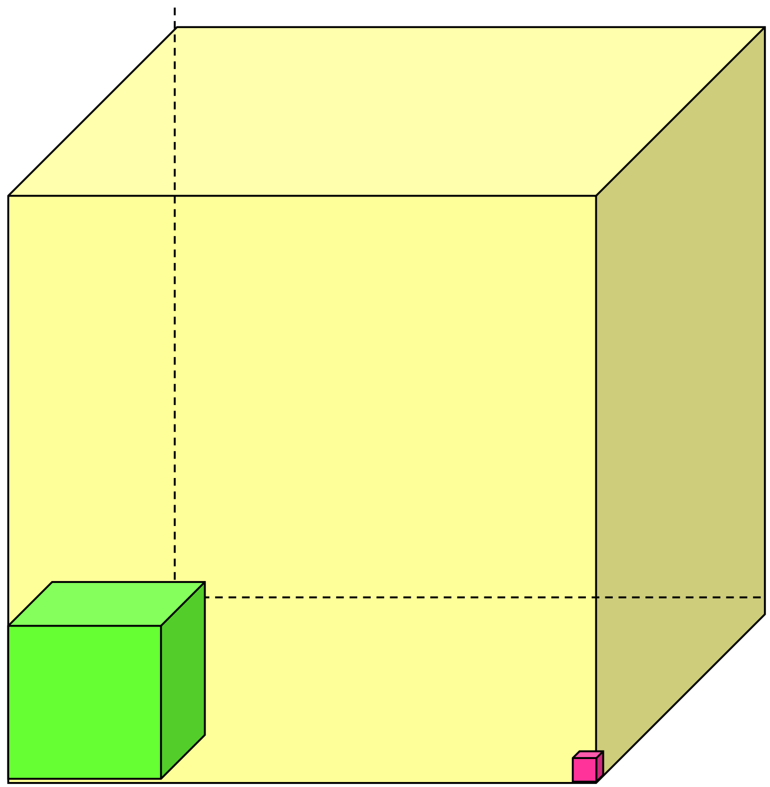
IRENA Innovation Week

Energy system modelling and planning

Availability of renewable energy

Energy input from sun

1 500 000 PWh



Wind energy

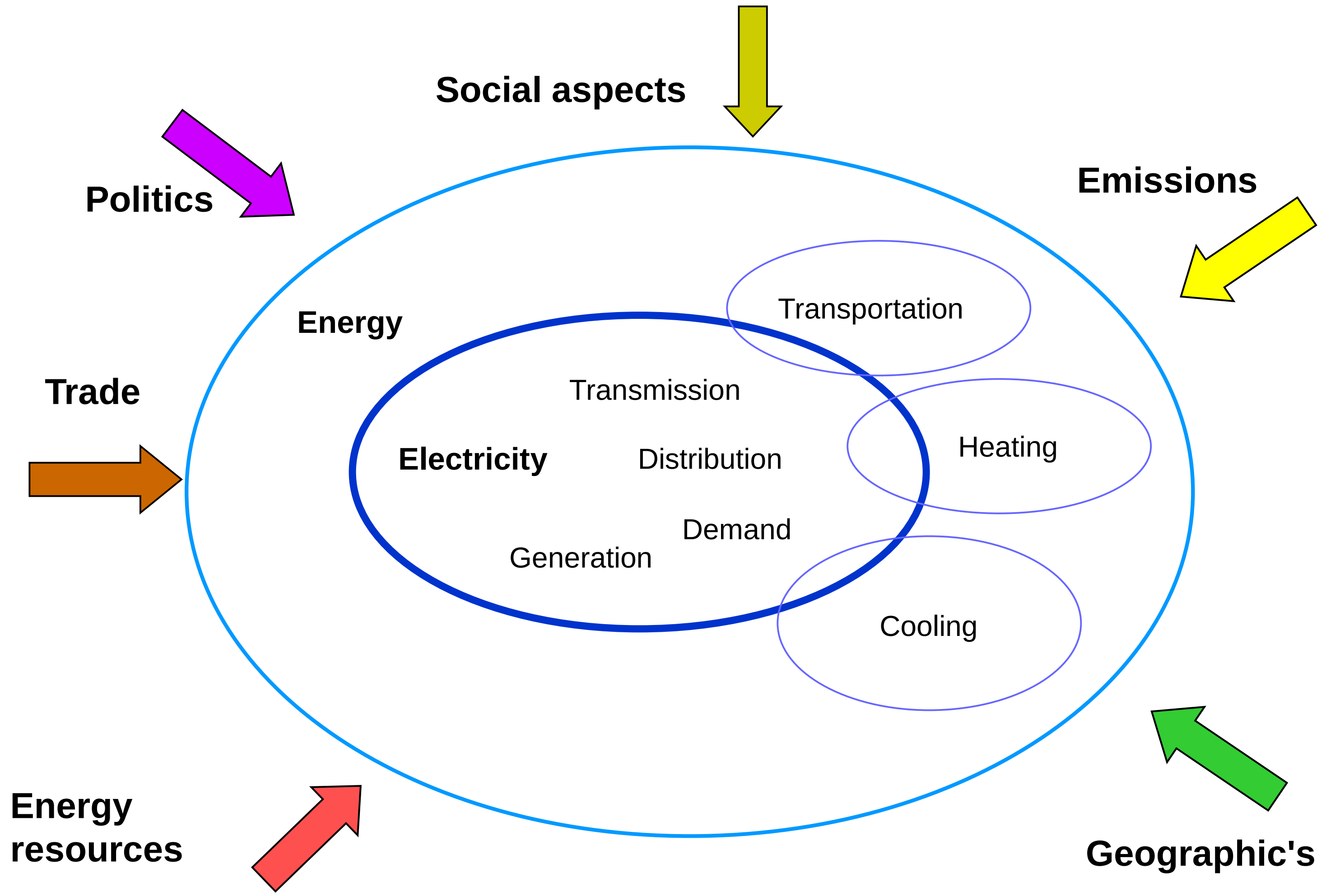
30 000 PWh

Energy demand world wide 2010

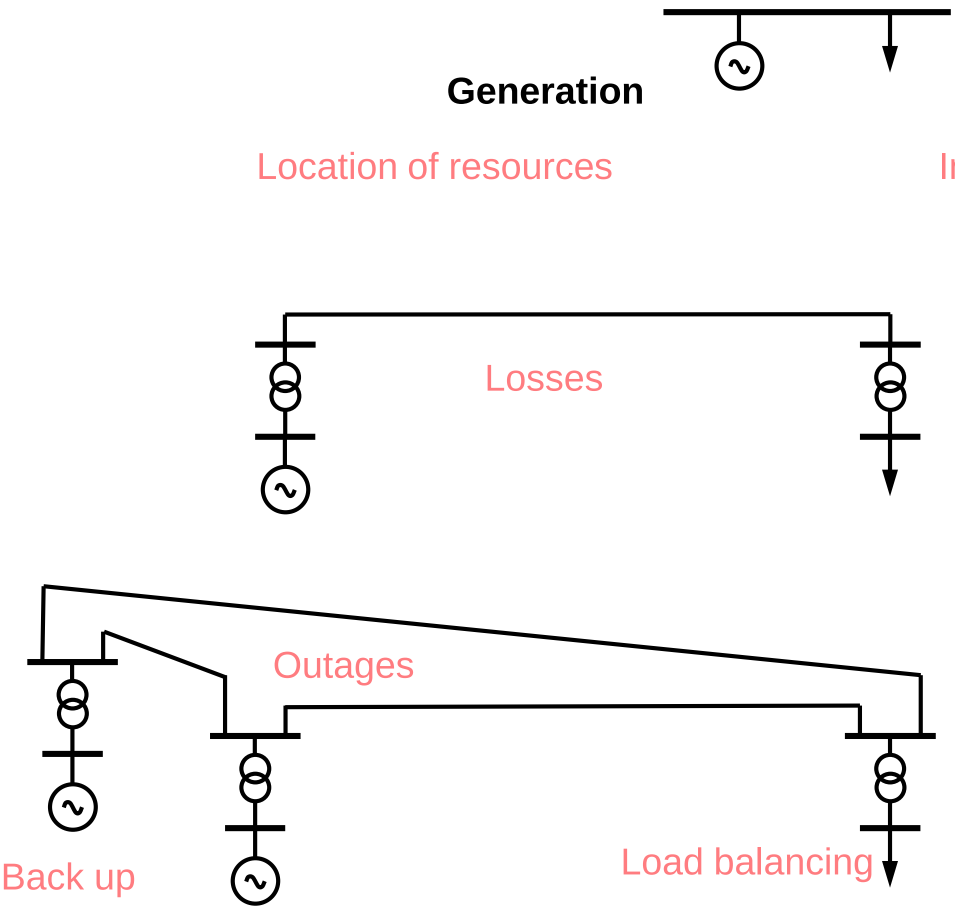
140 PWh

Quelle: BEE

Electricity in the energy focus



From island supply to interconnection



=> Transmission

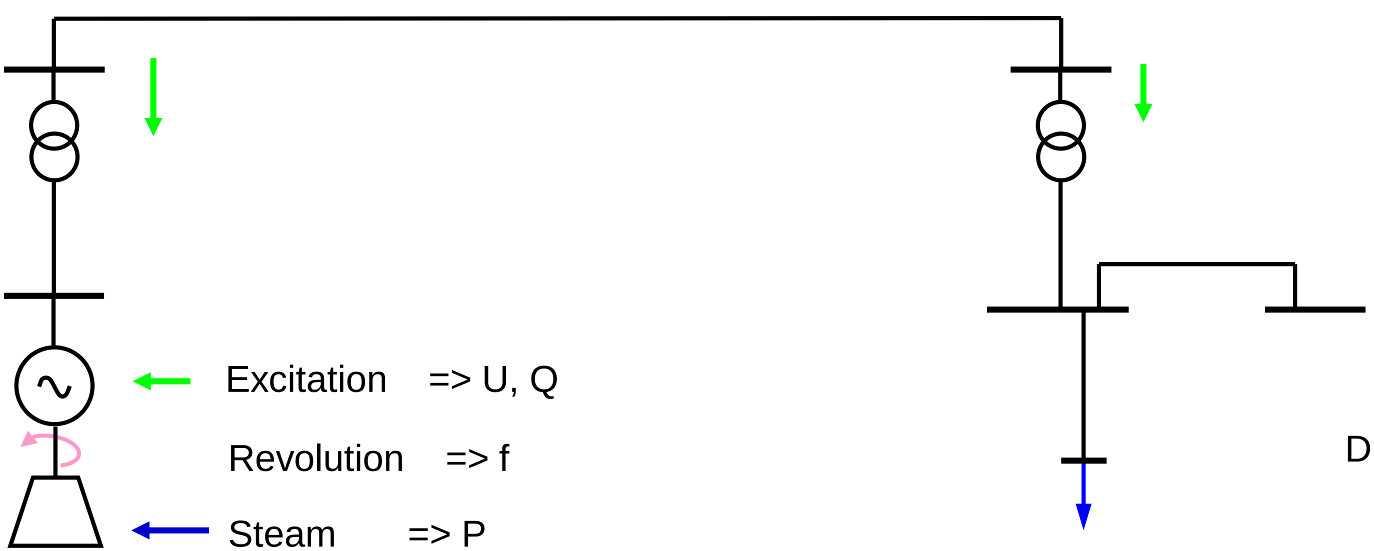
=> Higher voltage level

=> Meshes

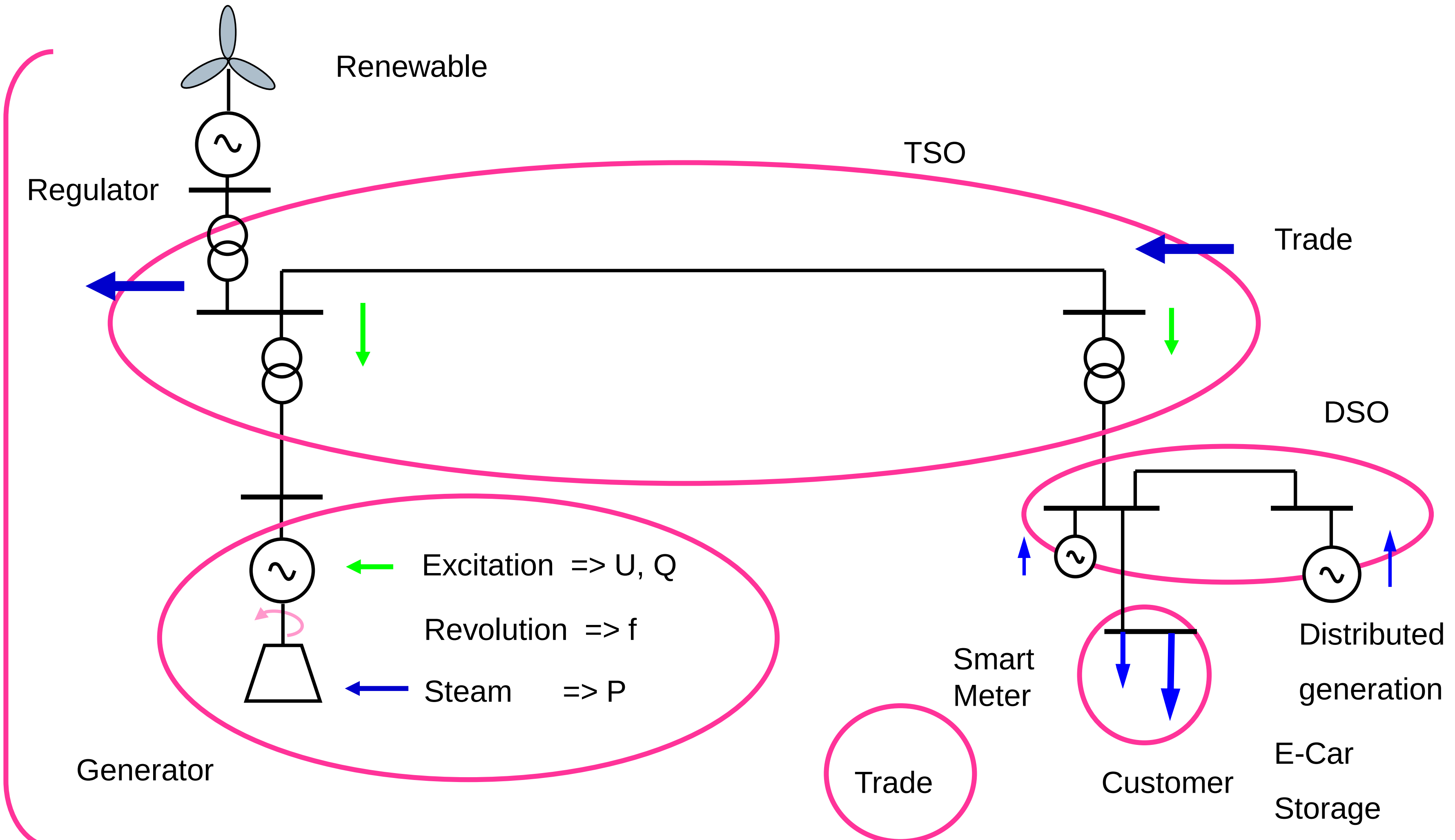
=> Interconnection

Principle of electricity supply

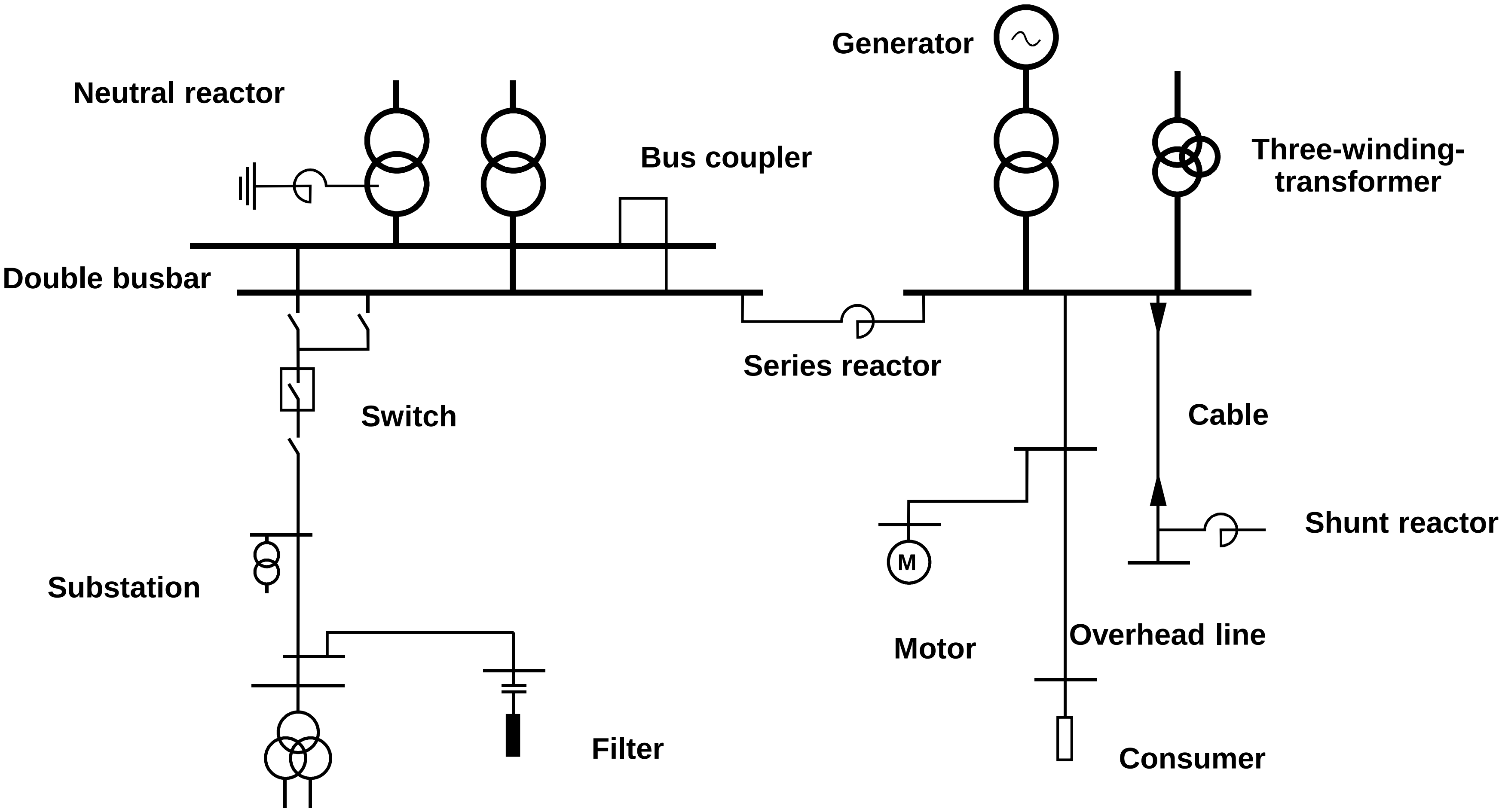
Up to now no large scale storage of electricity possible !



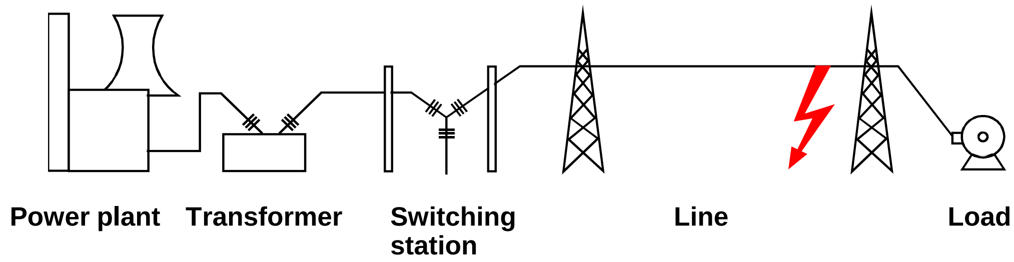
Challenges of future grids

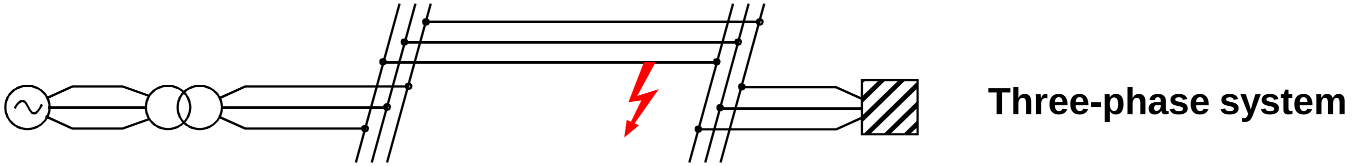


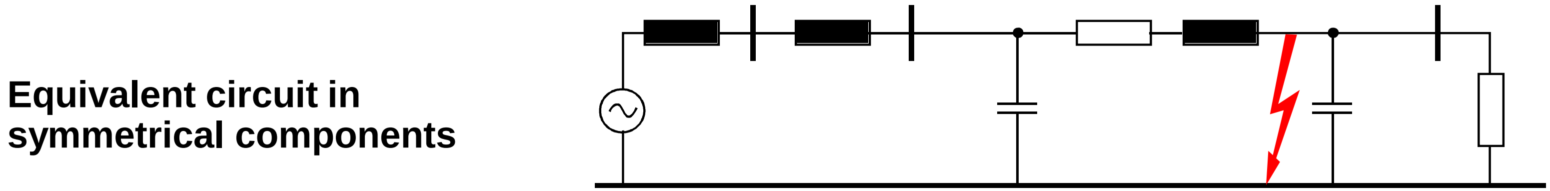
Typical network elements



Grid modelling







Subjects of network analysis

Load flow

Short circuit

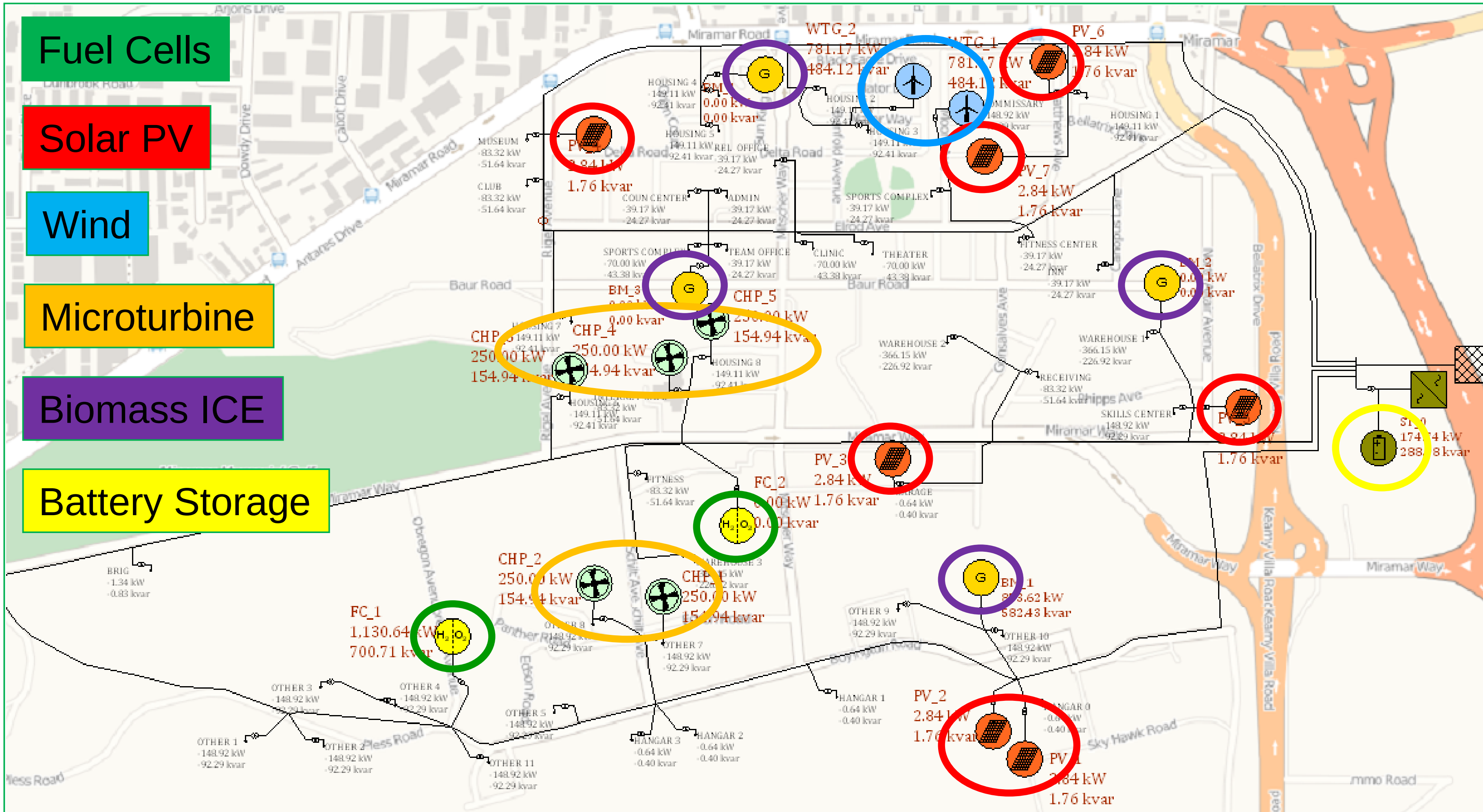
Dynamic

Transient

Operation

- Fault current contribution (max / min)
- Reactive power control
- Voltage profile (steady state / dynamic)
- Element loading (normal operation / contingency)
- Losses
- Protection concept
- Harmonic distortion
- Supply reliability
- Switching operation
- Insulation coordination
- Start up procedure

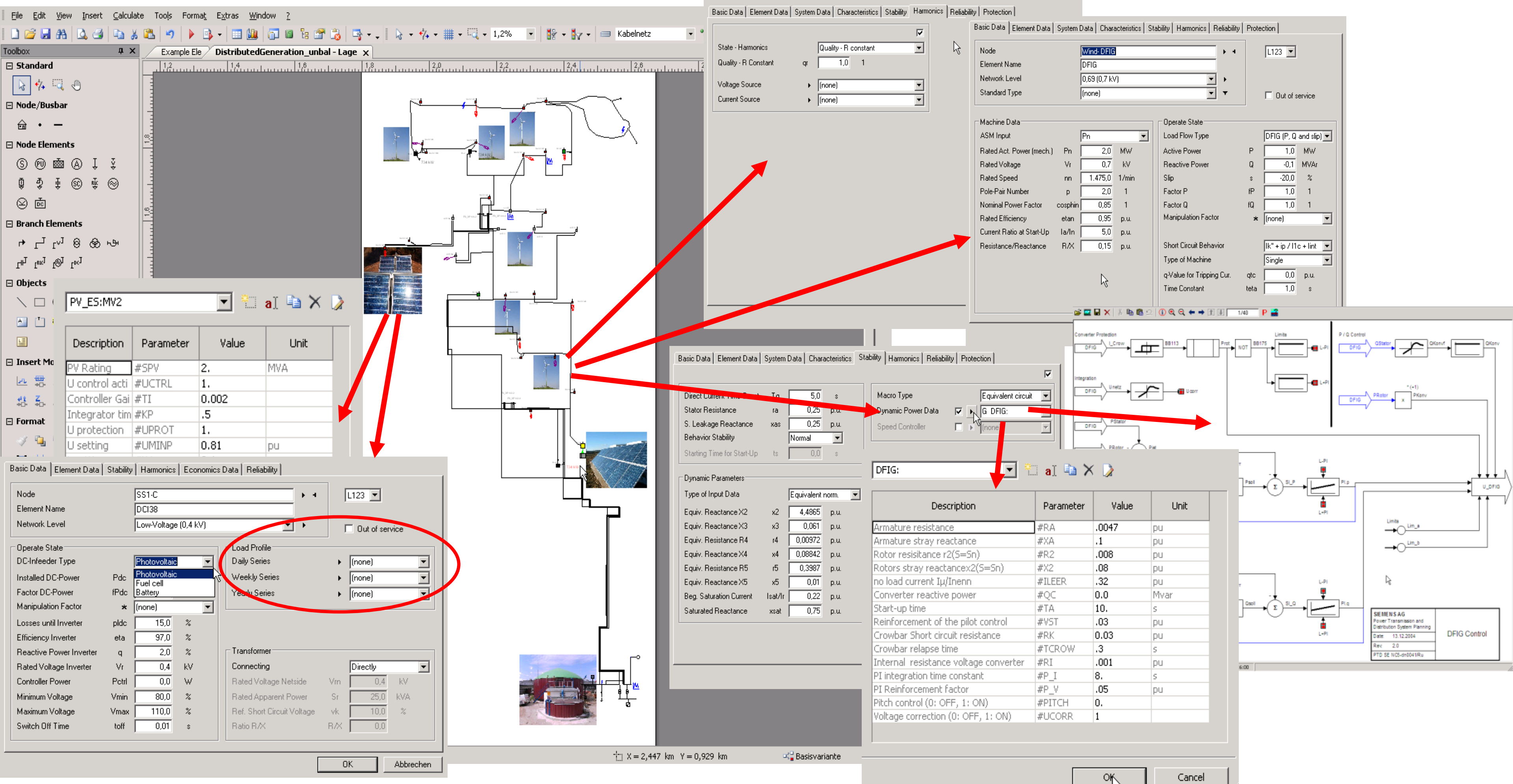
Grid modelling



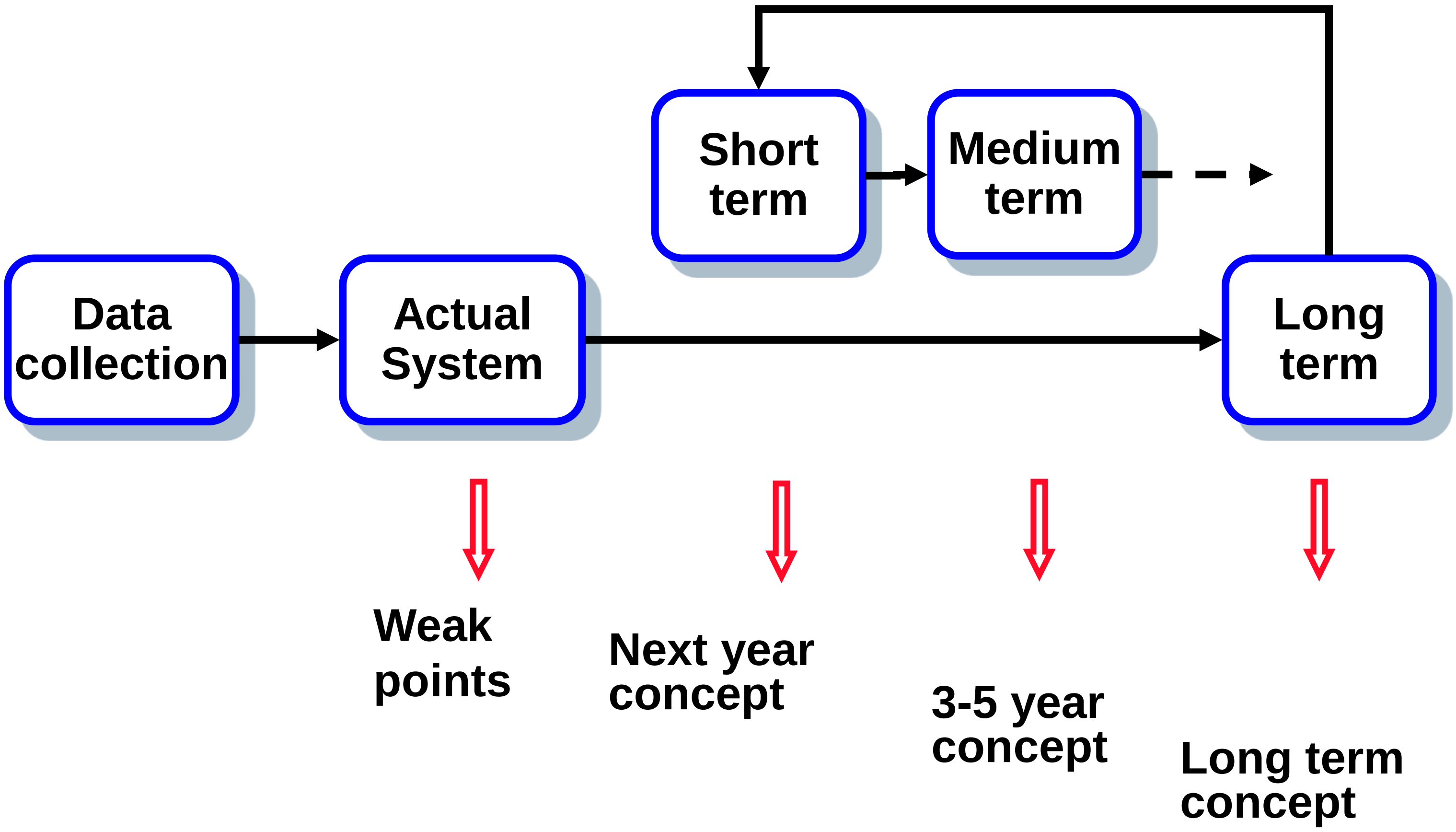
PSS®SINCAL Element Models for all tasks

SIEMENS

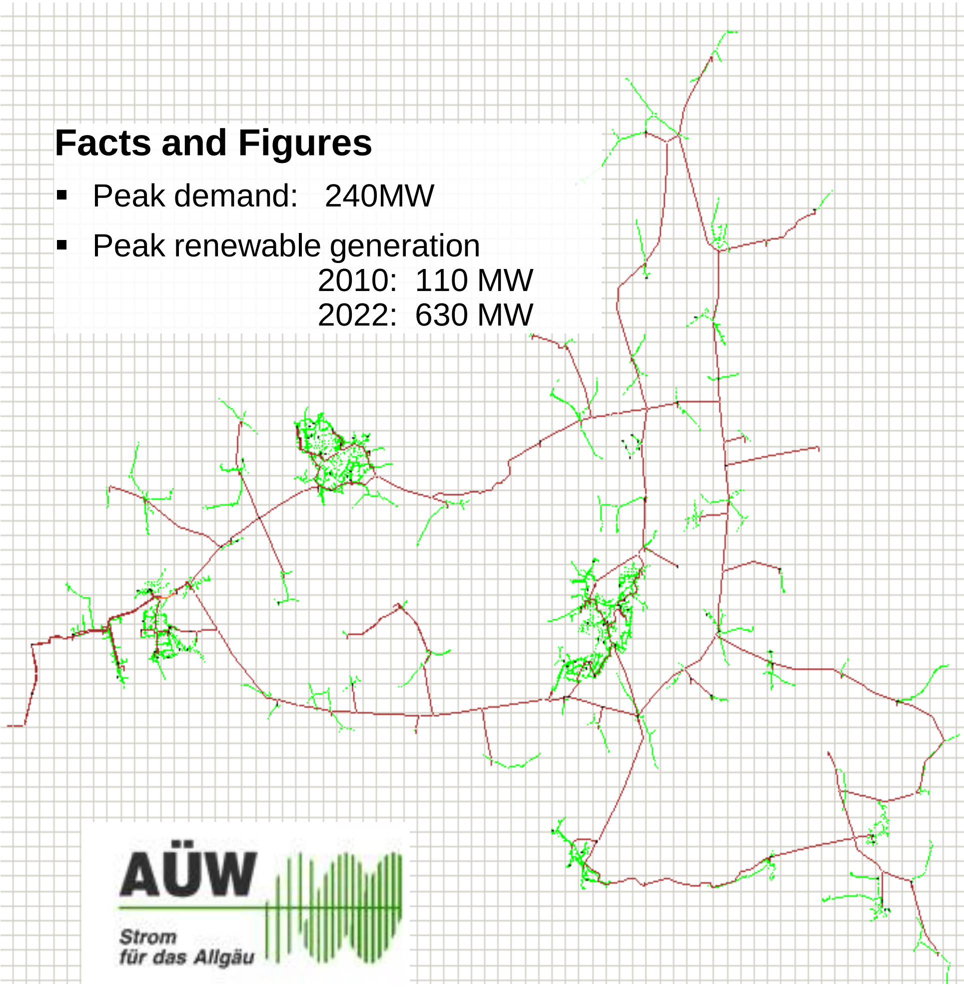
The model complexity varies from simple (short circuit) to normal (load flow) and expert (dynamics, control systems)



Planning Loop



Example of renewable integration



Facts and Figures

- Peak demand: 240MW
- Peak renewable generation
  2010: 110 MW
  2022: 630 MW

Challenges

- Integration of large amount of renewable generation (PV, Wind) in existing network structures
- Minimization of costs in grid extension

Siemens solutions

- Determination of minimum required grid extension by comparison of DER integration in various voltage levels:
  - LV (0.4 kV), MV (20 kV), HV (110 kV)
- Comparison of conventional versus smart grid extension measures in terms of costs:
  - Storage, Load Management, Regulated Distribution Transformers, Controllable Converters

Customer benefits

- Maximum renewable generation integration
- Effectiveness of smart grid components for reducing grid extension costs
- Determination of costs of energy transition

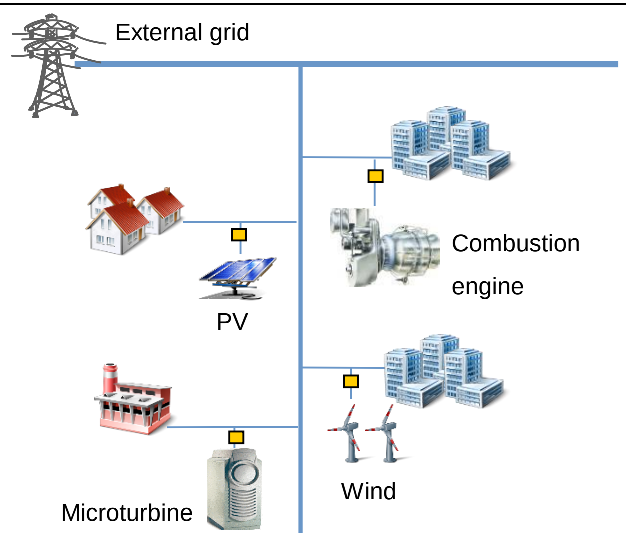
Source: Siemens AG, EM DG PTI

Micro Grid

Comparison between distributed generation and Micro Grid

Conventional distributed generations

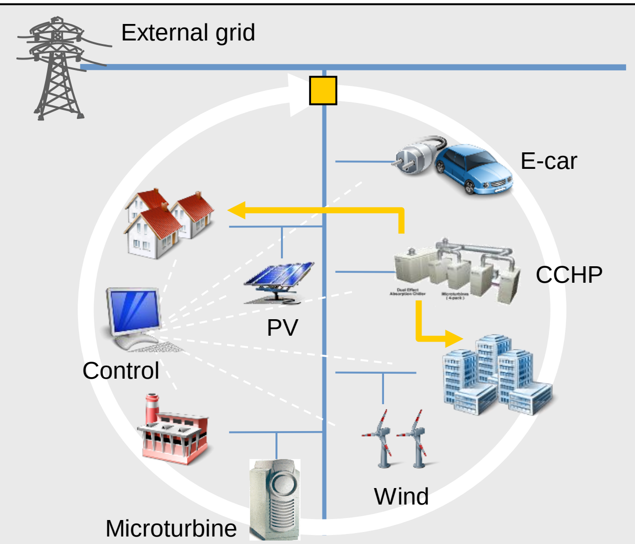
- Several points of coupling
- Generation sources are not coordinated / optimized
- Adverse impact on main grid



Uncoordinated

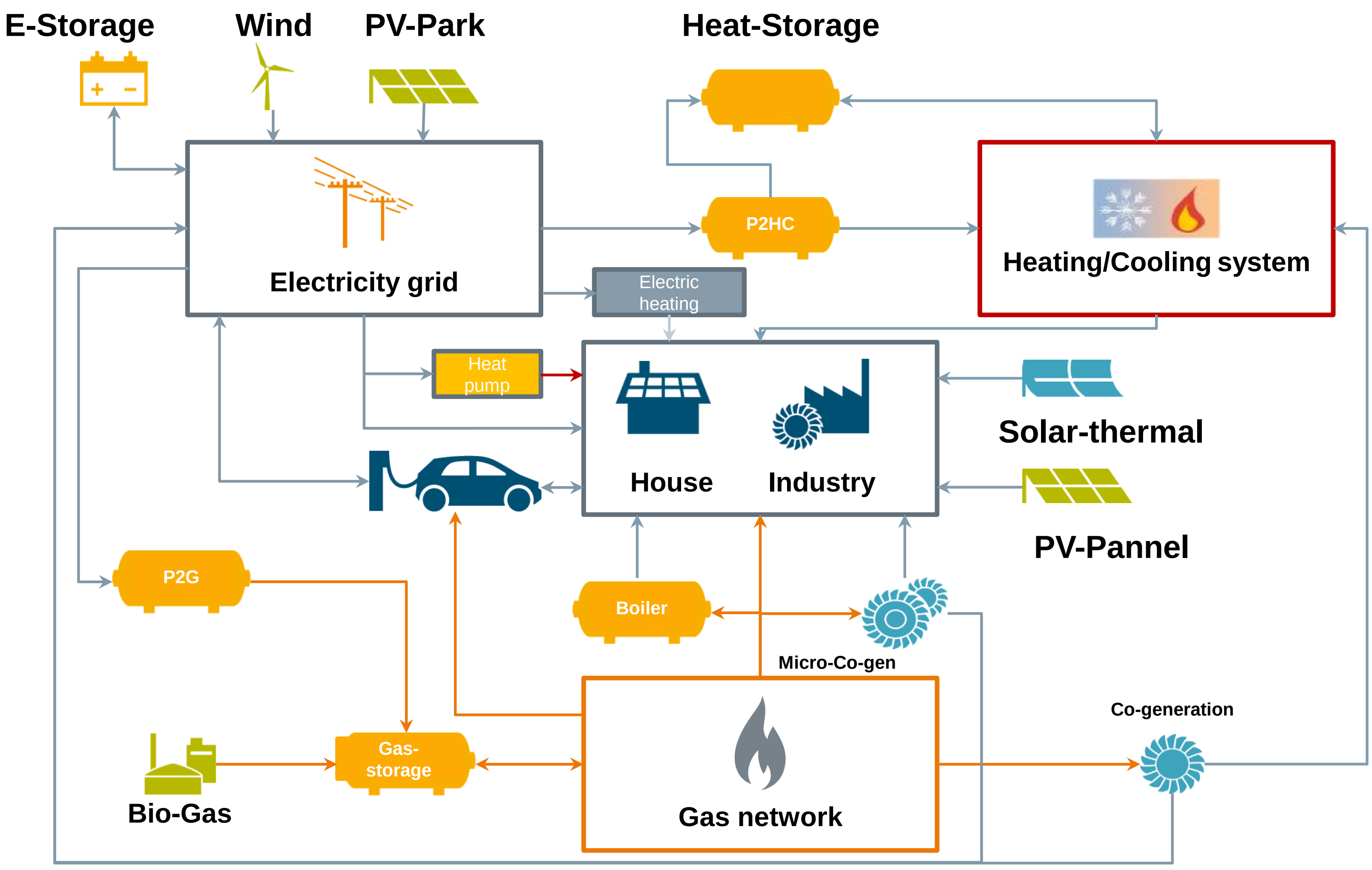
Micro Grid

- Common point of coupling
- Presents to grid as an aggregated load / energy source
- Energy sources including thermal are coordinated / optimized



Coordinated and optimized

Hybrid system



Thank you for your attention

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