CICED 2016

Xi'an, China

Distribution Grids
The active link between generation and consumption
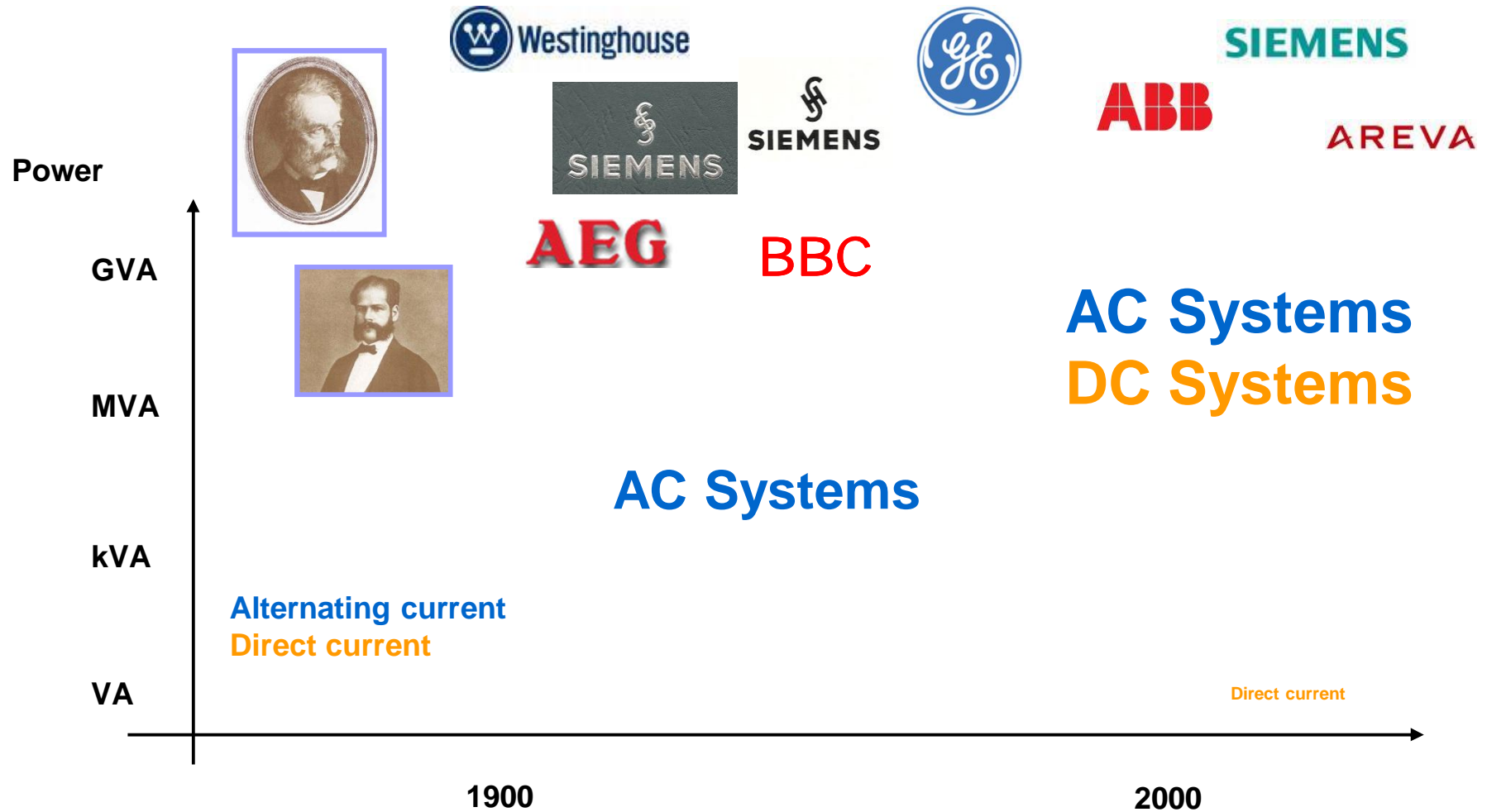
Theodor Connor
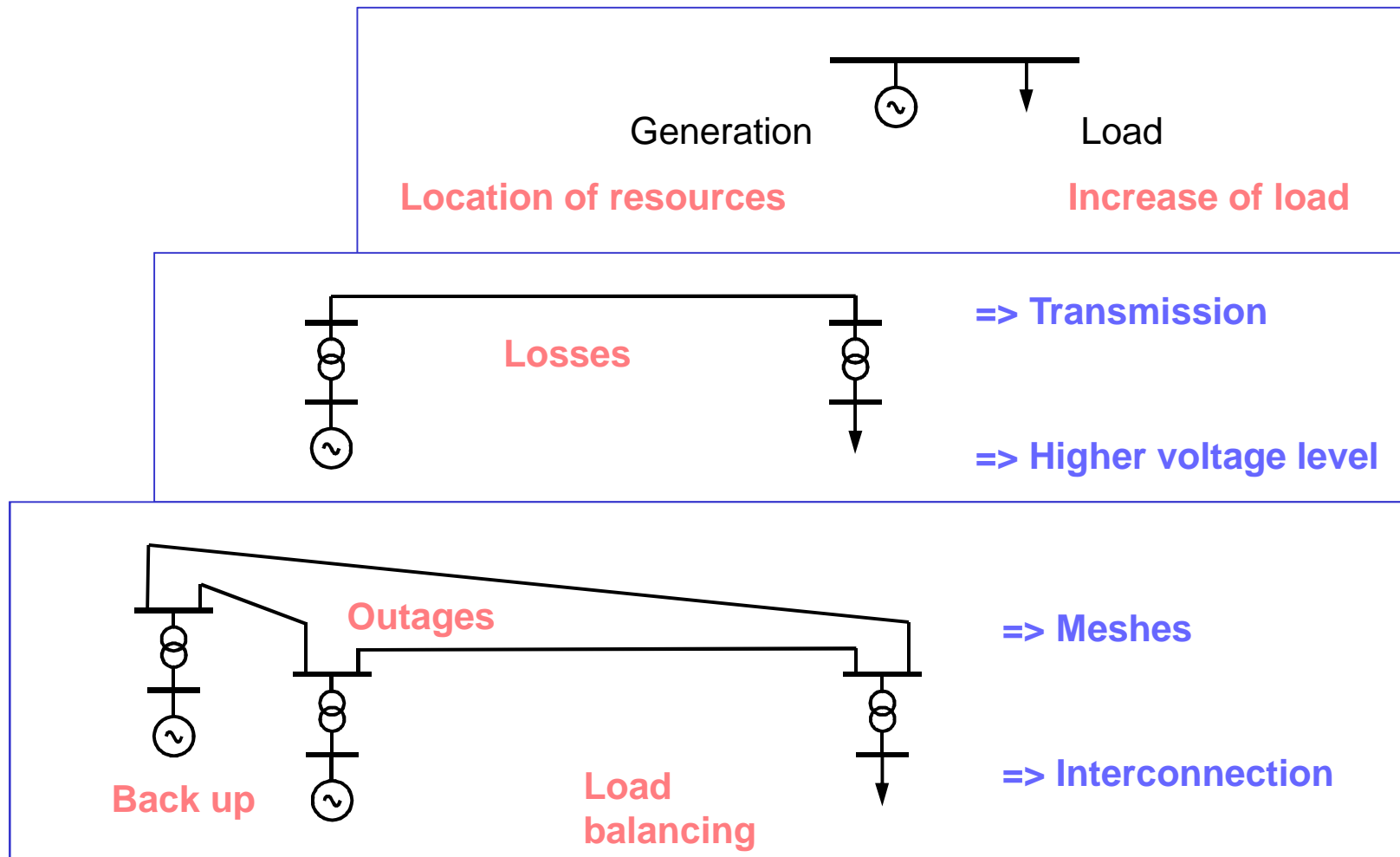
Siemens AG

Erlangen, Germany

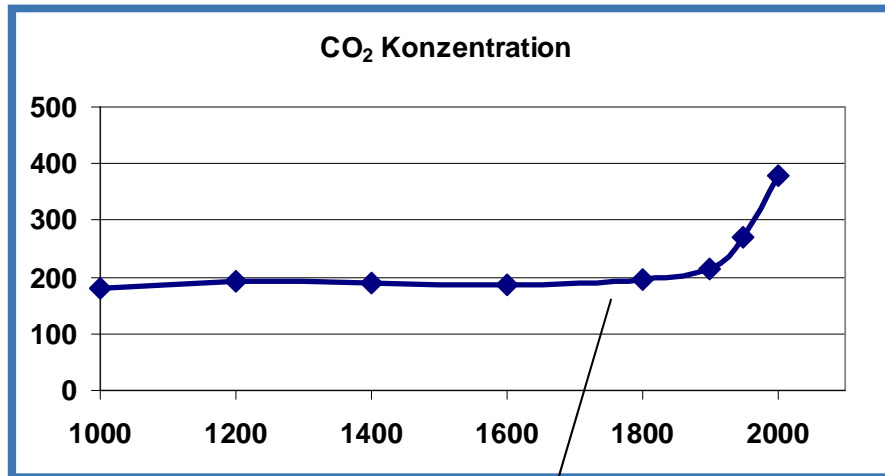CIRED Chairman of the Directing Committee
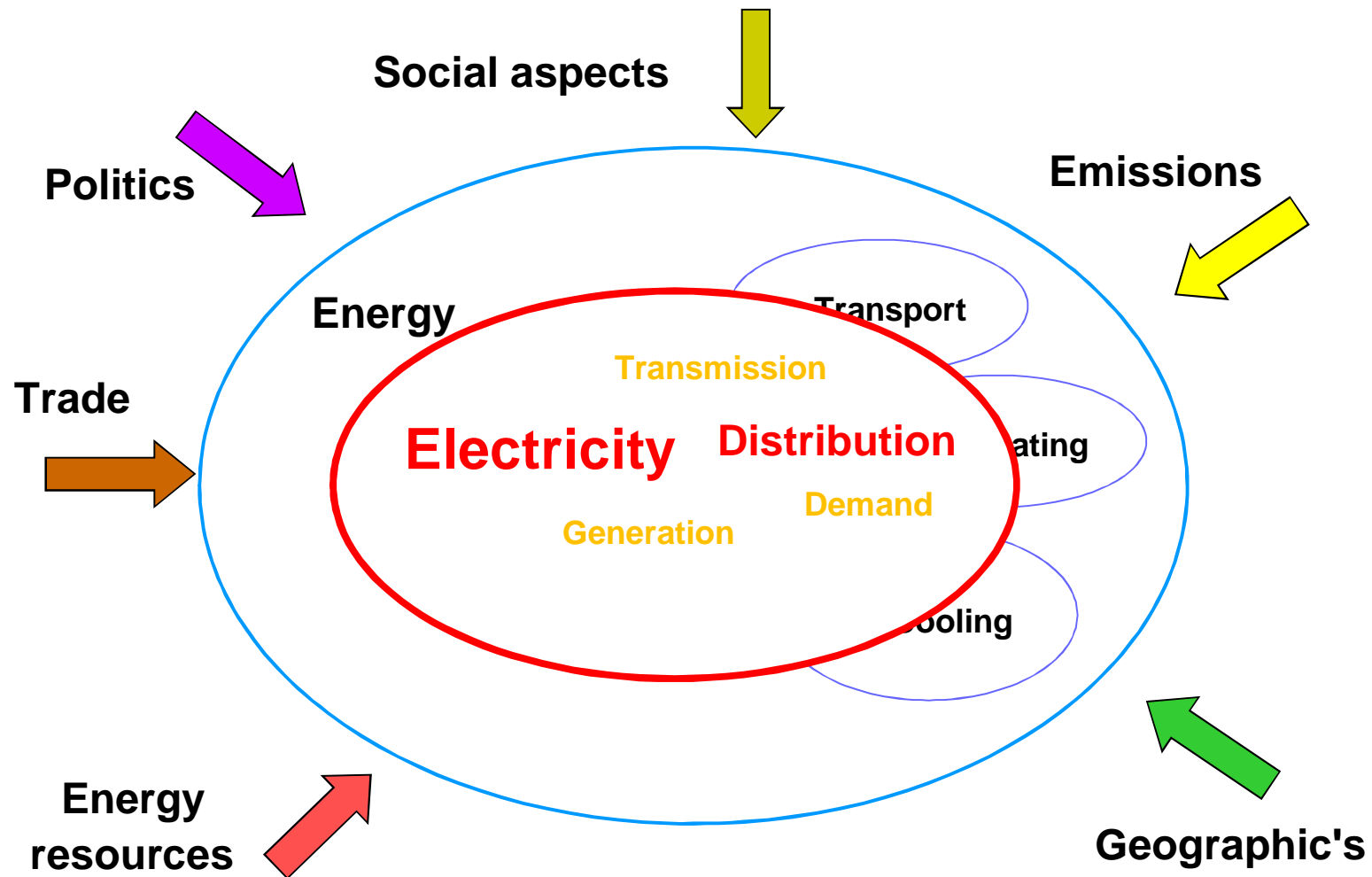
History of power supply systems

Power

GVA

MVA

kVA

VA

Alternating current
Direct current

AC Systems

AC Systems
DC Systems

BBC

Direct current

1900   2000

From island supply to interconnection

Generation   Load

Location of resources   **Increase of load**

Losses   **=> Transmission**

=> Higher voltage level

Outages   **=> Meshes**

Back up   **Load balancing**   **=> Interconnection**

Carbon dioxide concentration in the air

CO$_2$ Konzentration

Industrial revolution

Think in "Energy"

Social aspects

Politics

Emissions

Energy

Trade

Transport

Transmission

Electricity **Distribution**

ating

Demand

Generation

ooling

Energy resources

Geographic's

Physics of electricity supply

Up to now no large scale storage of electricity is not possible !

Transmission

Excitation => U, Q

Revolution => f

Steam => P

Generation

Schedule

Distribution

Load

Stochastical Load

=> Predictable Load
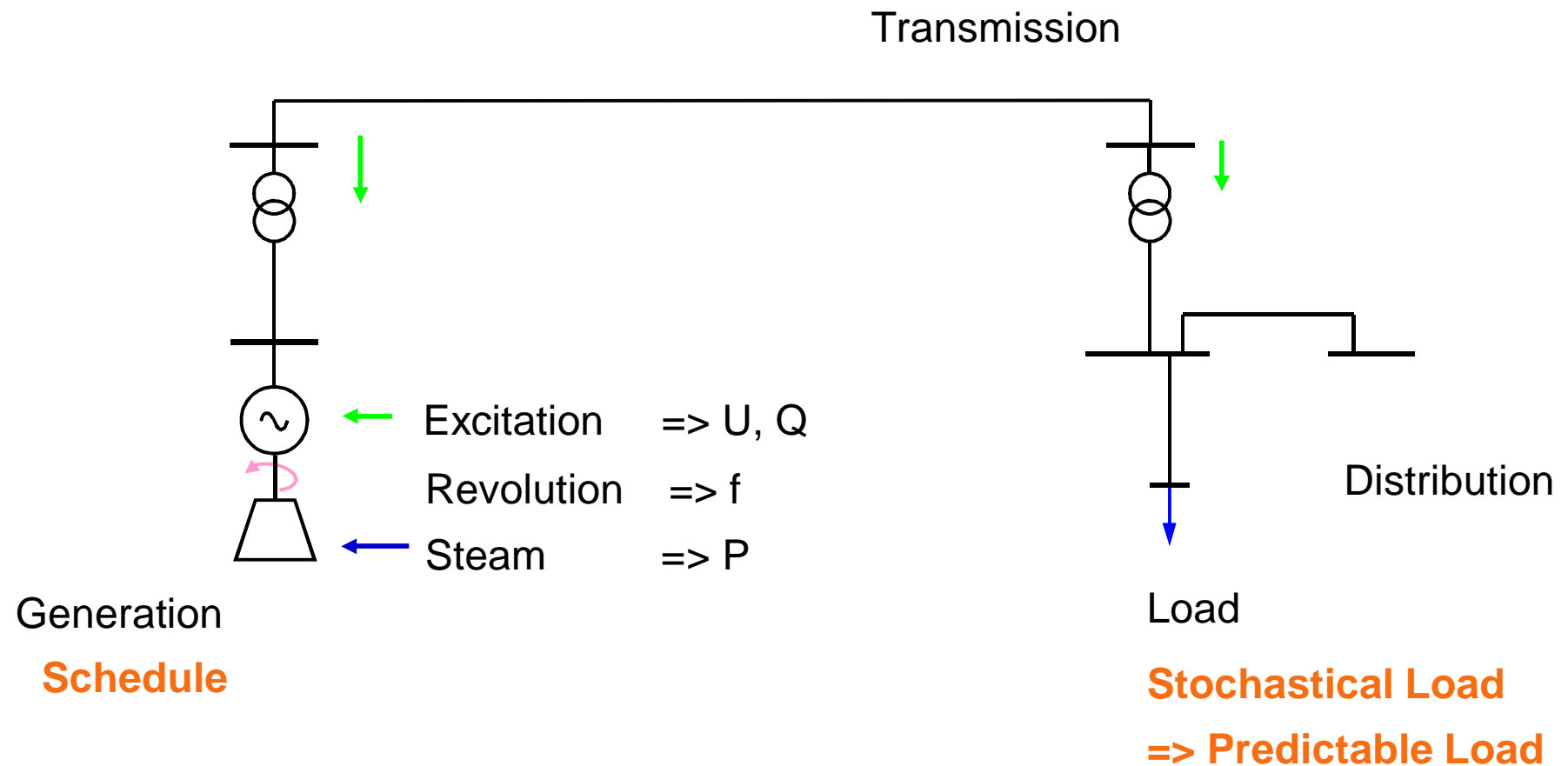
Challenges of future grids
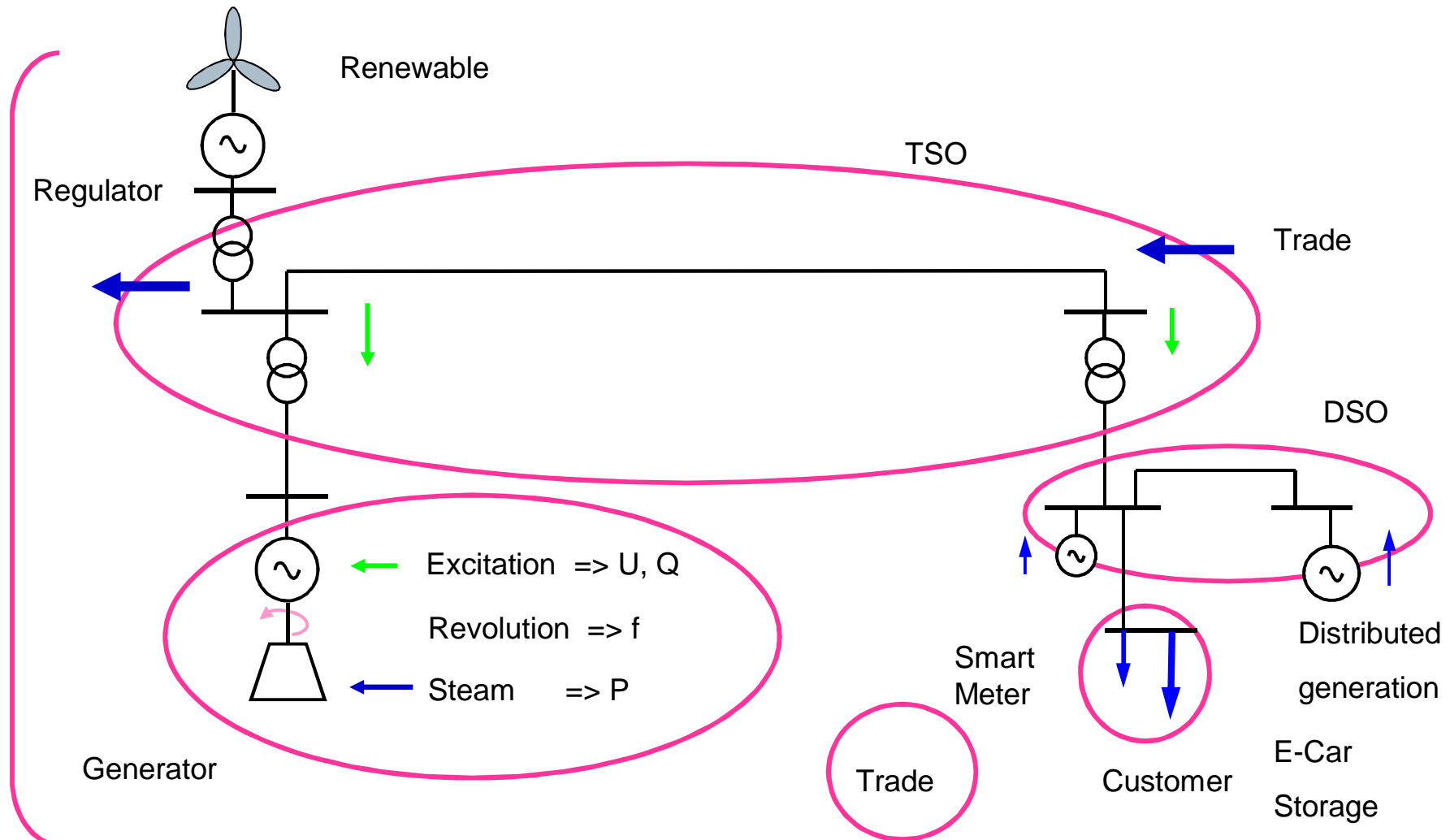
Concept of today's distribution

Control center
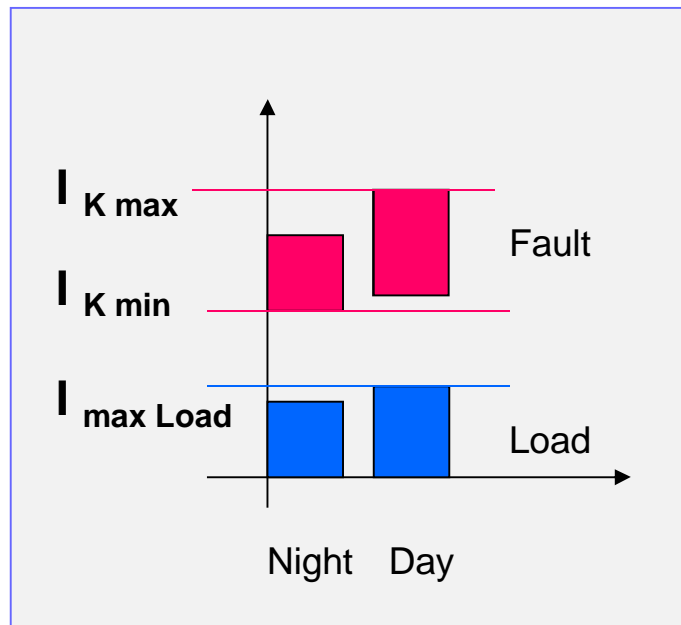
Circuit breaker

Load breaker
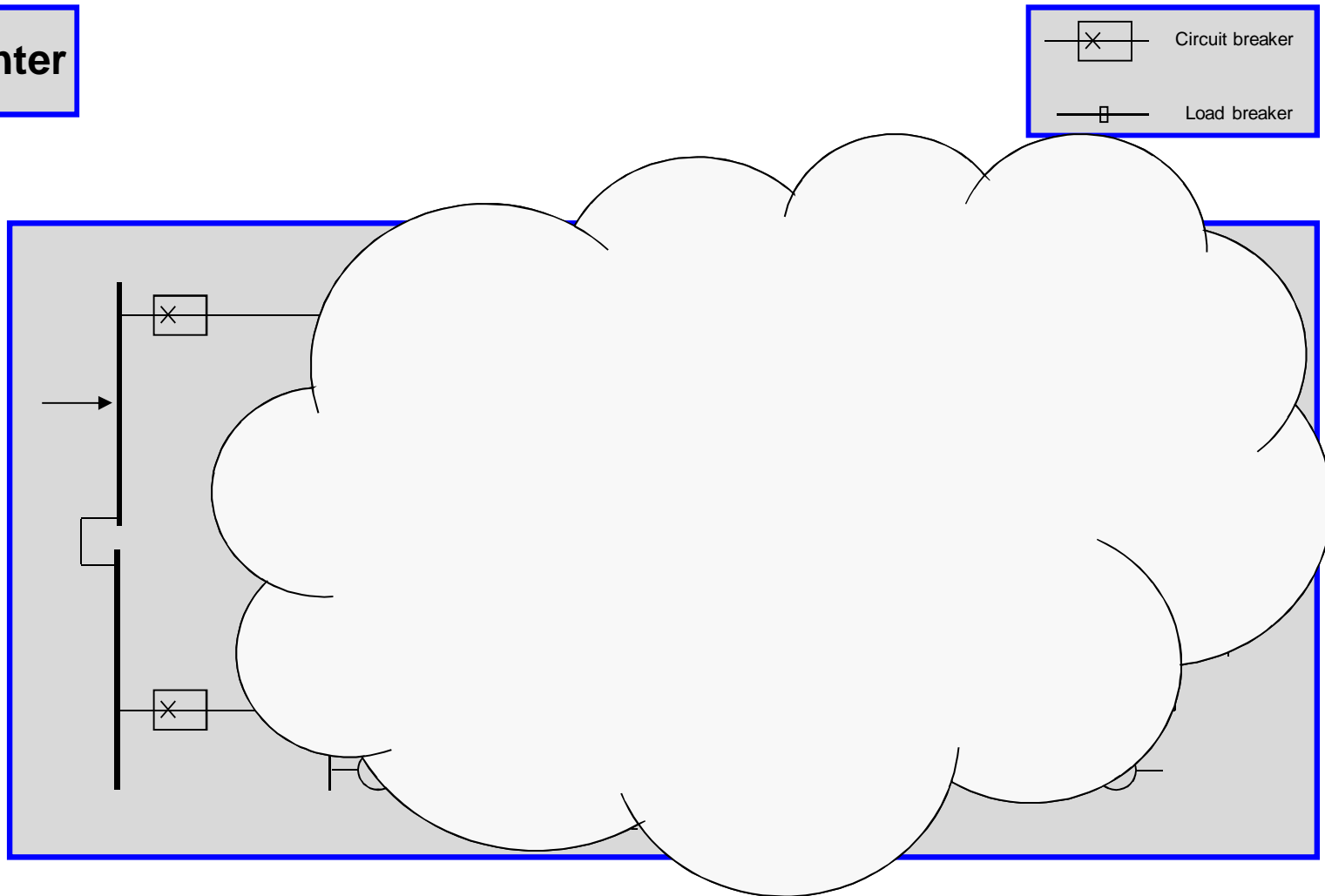
Integration of distributed generation
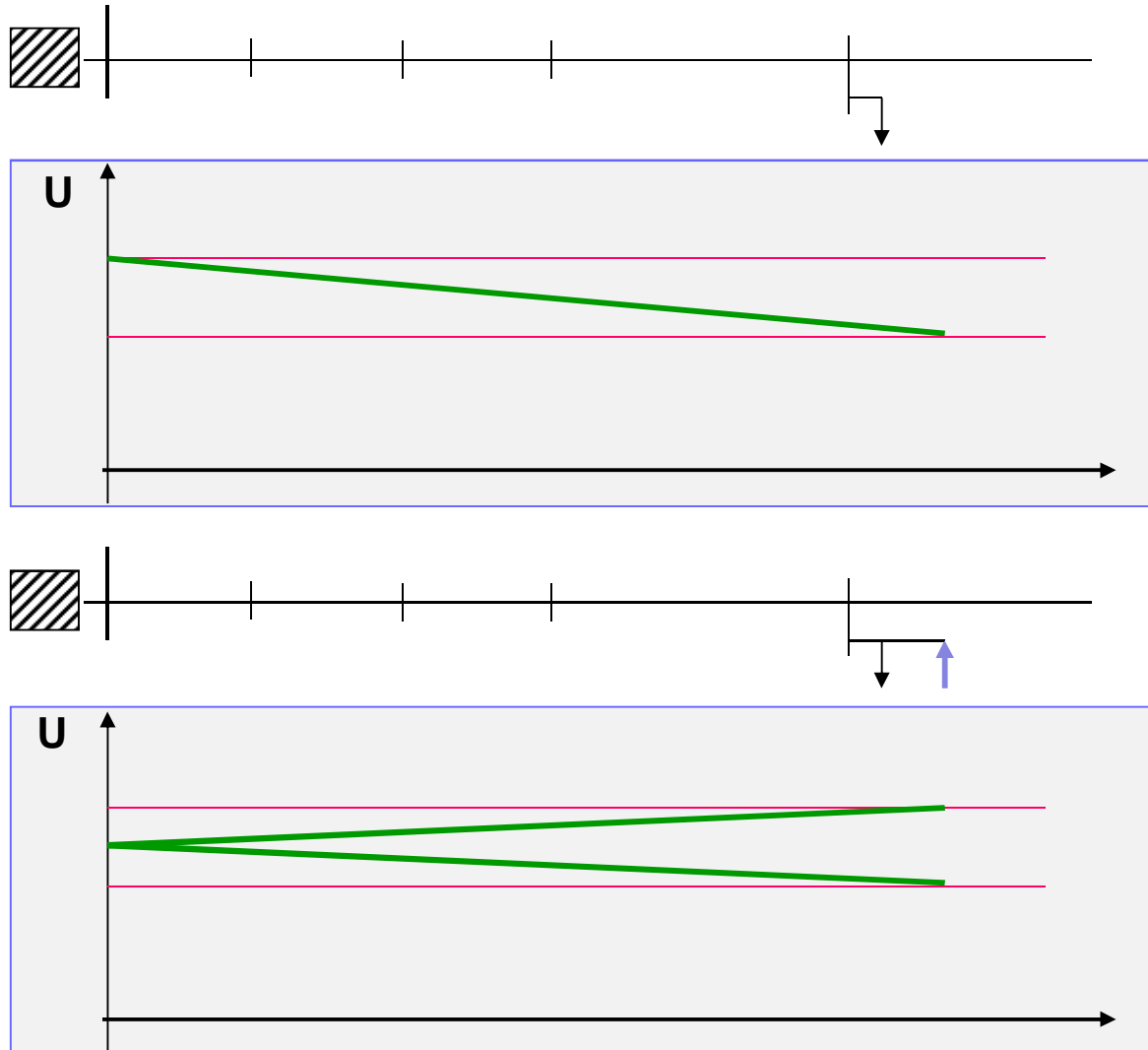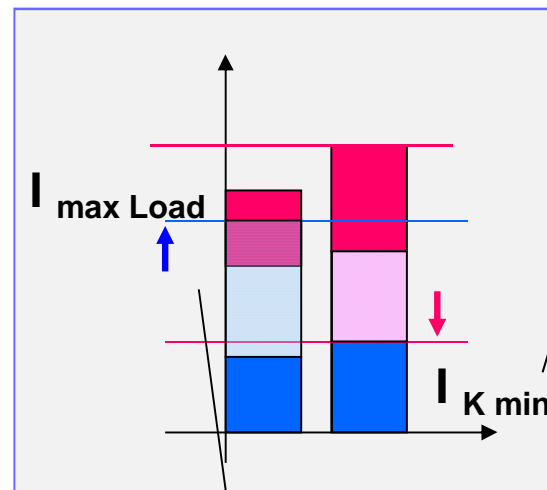

Voltage band

Selective protection

Fault current level

Voltage quality

Operational details

Development of load and fault currents

$I_{K\,max}$

$I_{K\,min}$

$I_{max\,Load}$

Fault

Load

Night   Day

Past

Future

$I_{max\,Load}$

$I_{K\,min}$

Flexible network
configuration
e.g. Islanding

Flexible loading
within tolerable limits

Components and functions of future grids

Micro Grid

Power Quality

Energy Storage

Supply Reliability

Integration of E-car

Virtual Power Plant

Distribution Automation

Demand Side Management

Energy Efficiency and Energy Management

Smart Metering and Meter Data Management

Components and functions of future grids

Micro Grid

Power Quality

Energy Storage

Supply Reliability
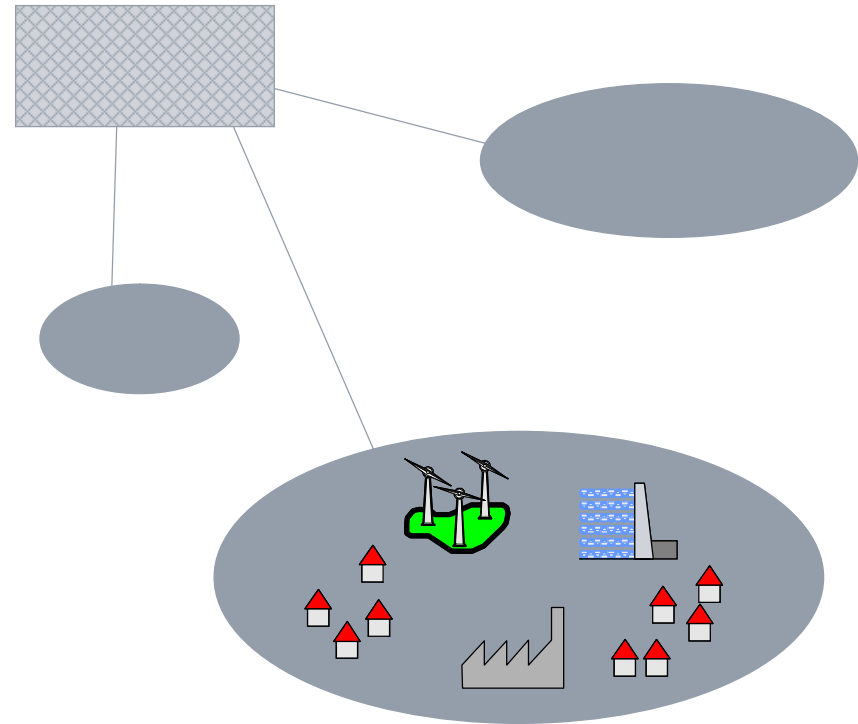
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Control Centre

Wind park

PV

Co-Gen

Load

Fuel cell

Battery

Industry

Components and functions of future grids

Micro Grid

Power Quality

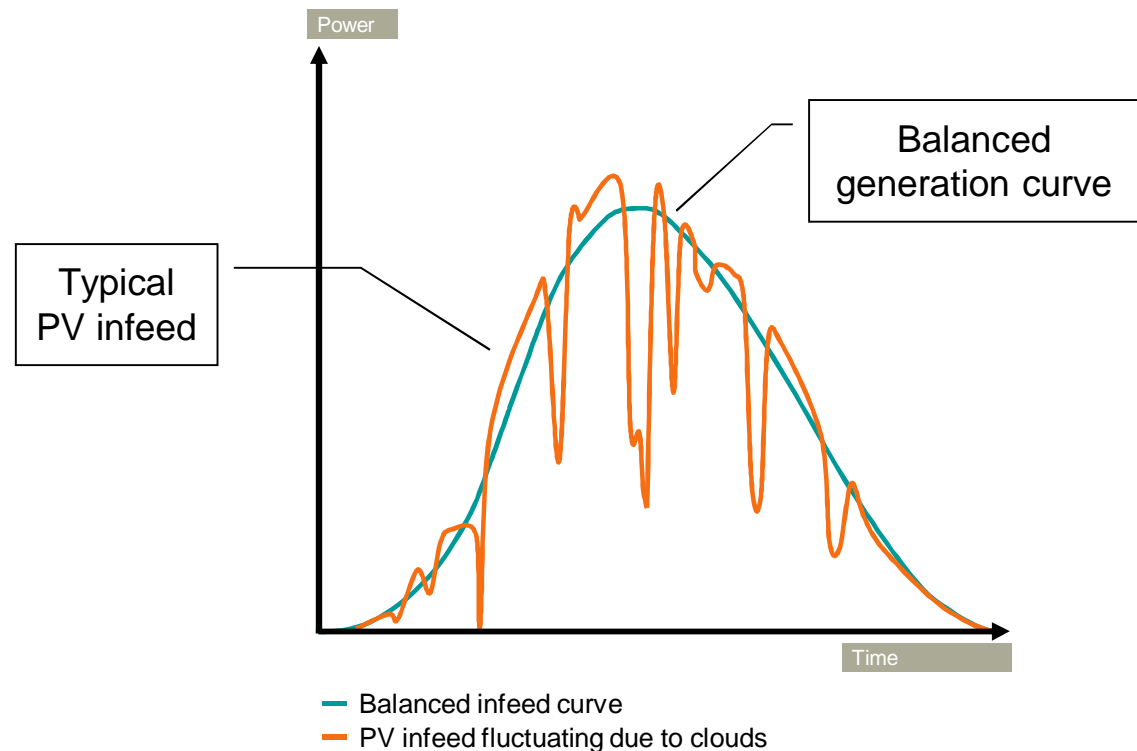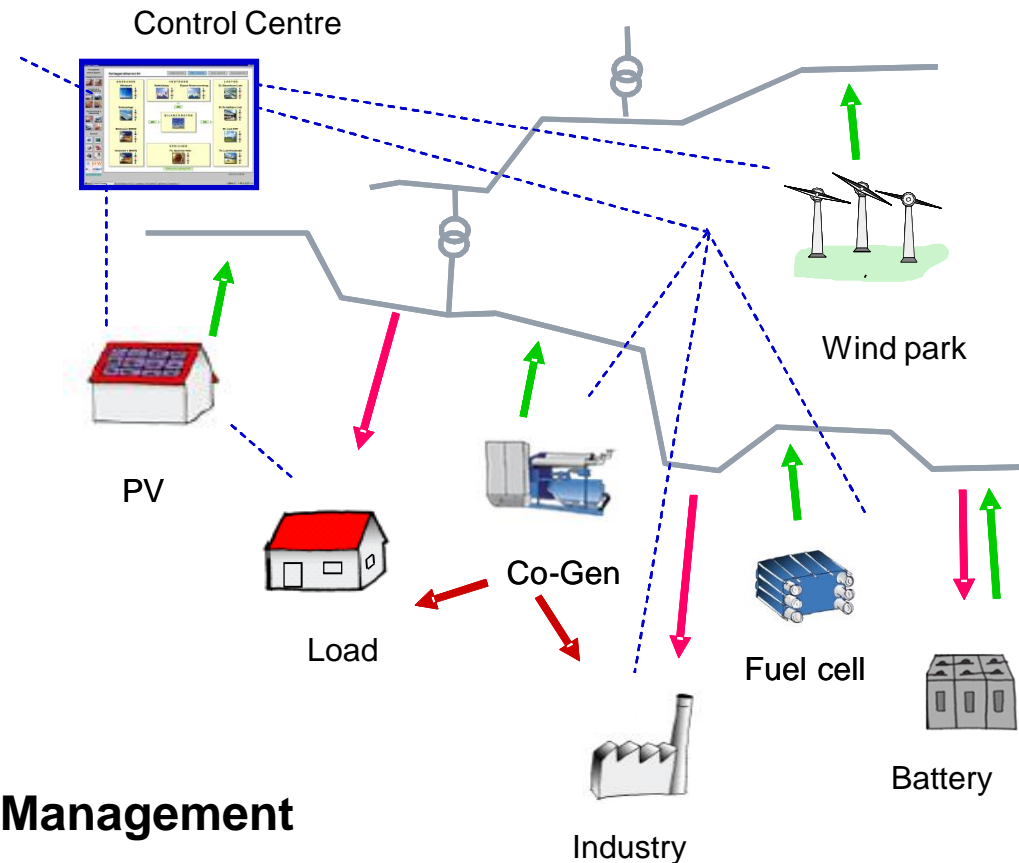Energy Storage

Supply Reliability
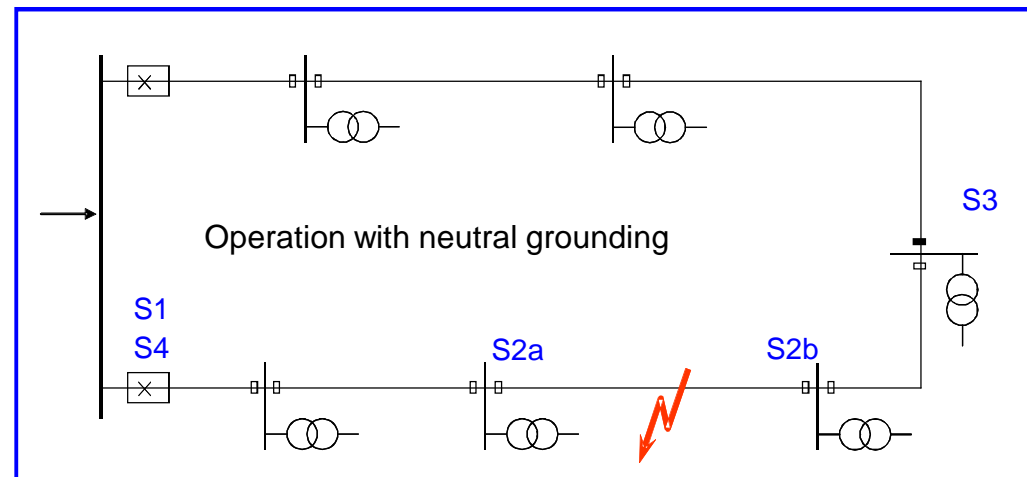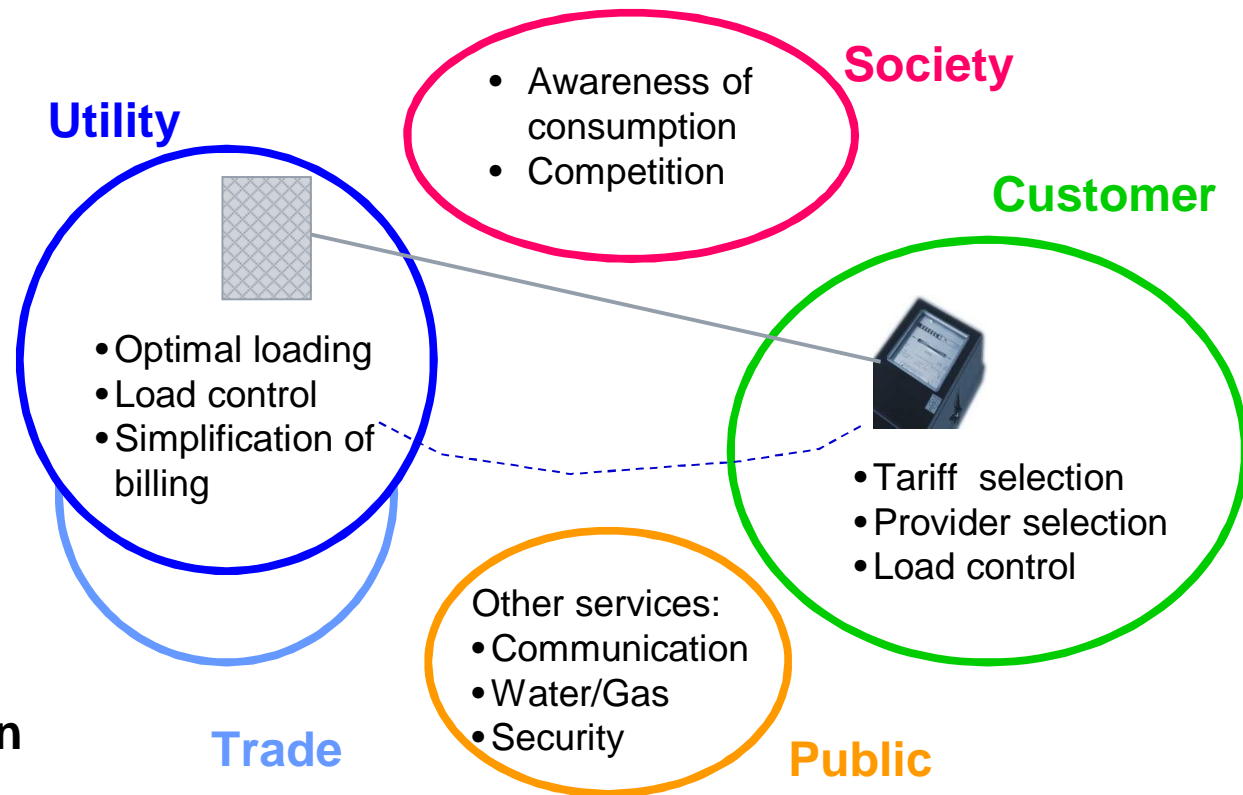
Integration of E-car

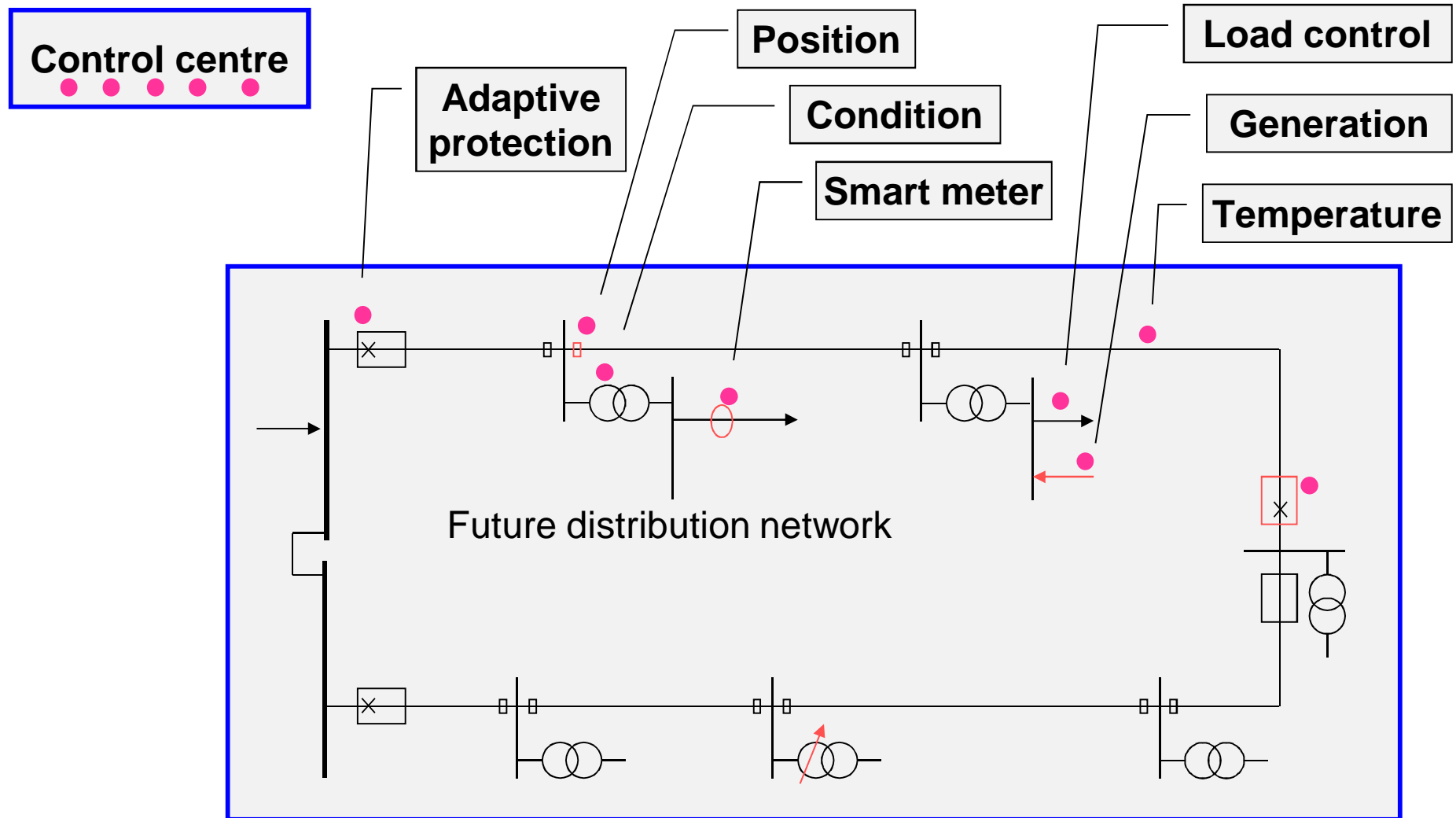Virtual Power Plant

Distribution Automation

Demand Side Management

Energy Efficiency and Energy Management

Smart Metering and Meter Data Management

Operation with neutral grounding

Components and functions of future grids

Micro Grid

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Energy Storage

Supply Reliability

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Smart Metering and Meter Data Management

Utility

- Optimal loading
- Load control
- Simplification of billing

Society
- Awareness of consumption
- Competition

Customer
- Tariff selection
- Provider selection
- Load control

Trade

Other services:
- Communication
- Water/Gas
- Security

Public

Vision of intelligent electricity grid

Control centre

Adaptive protection

Position

Condition

Smart meter

Load control

Generation

Temperature

Future distribution network

Grid components as foundation of business

Digitalization — Grid control – grid applications – planning and simulation – data analytics

Automation — Smart communication – self healing – smart metering – grid protection – SCADA - grid automation – power quality,

Electrification —
Generators
Transformers
Breaker, Switchgear, Fuses
High voltage direct current transmission, FACTS
Overhead lines, cables, compact transmission lines
Isolator, Bushings, Surge Arrestor, Instrument transformer

Modelling of hybrid systems
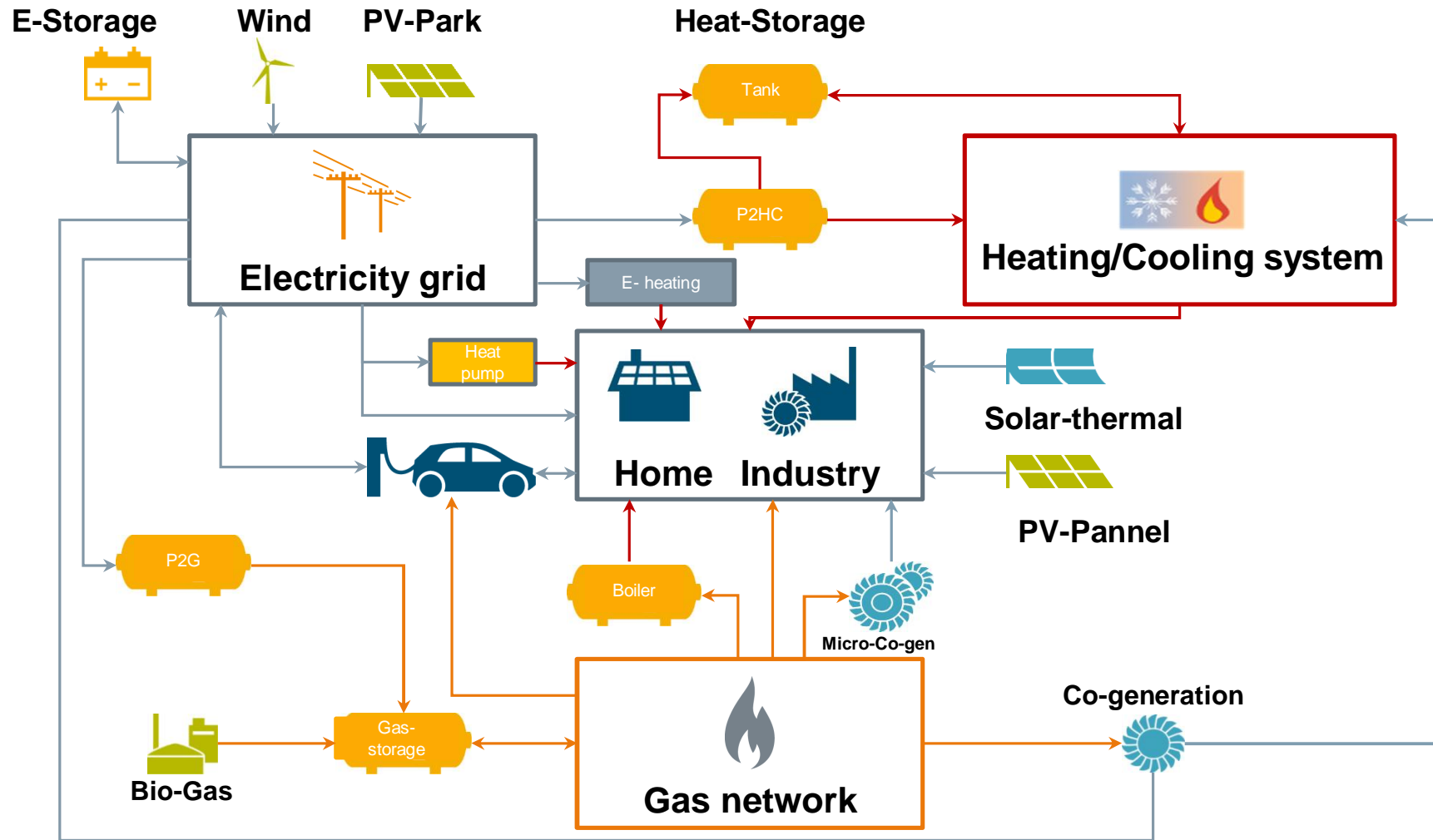
Final statement

Thank You for the attention.

Sorry for my limited Chinese language skills

and

have a successful conference