FAKULTÄT FÜR ELEKTROTECHNIK UND INFORMATIONSTECHNIK
Faculty of Electrical Engineering and Information Technology

The New Electricity Age

Albana Ilo
University of Technology of Vienna
Institute for Energy Systems and Electrical Drives

Open Future Day,
24. September 2015

Impact of the new age in the actual electricity industry

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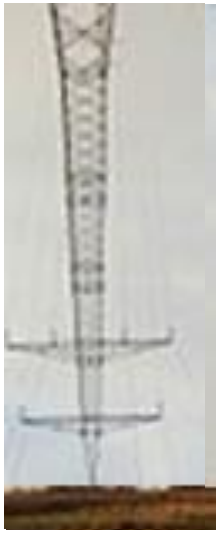
Evolution or **revolution?**



The word **Evolution** synonymous with gradual and continuous, natural or planned progression of events.

The word, **Revolution**, implies planned and deliberate changes more or less sudden in their action, taken to change the order of things.

Impact of the new age in the actual electricity industry

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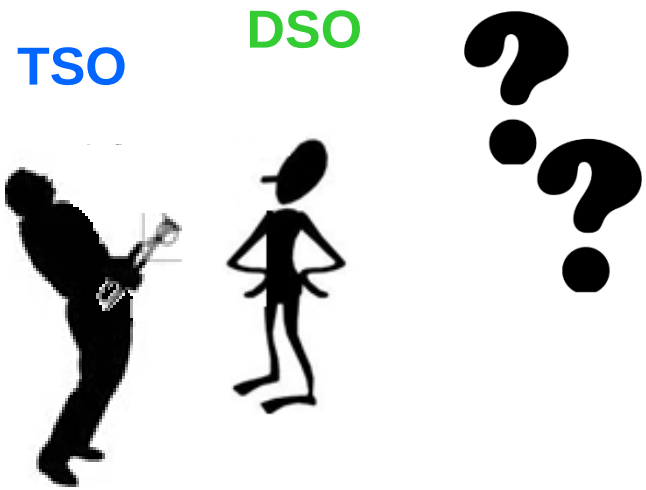
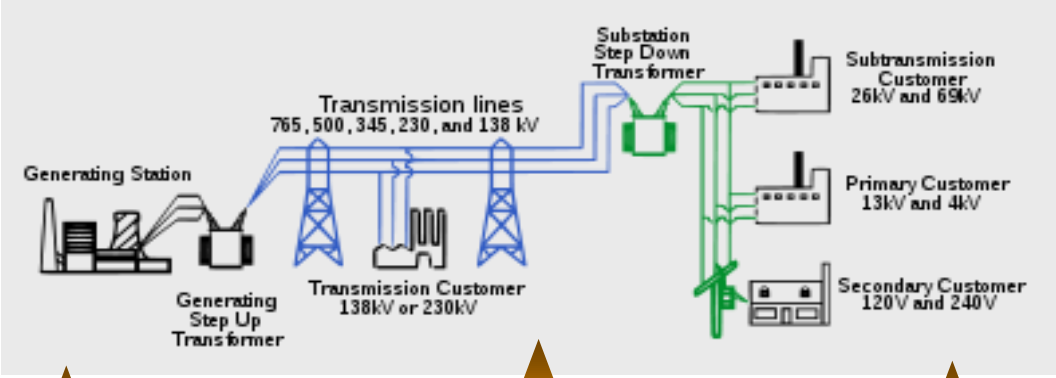
Power grid operation

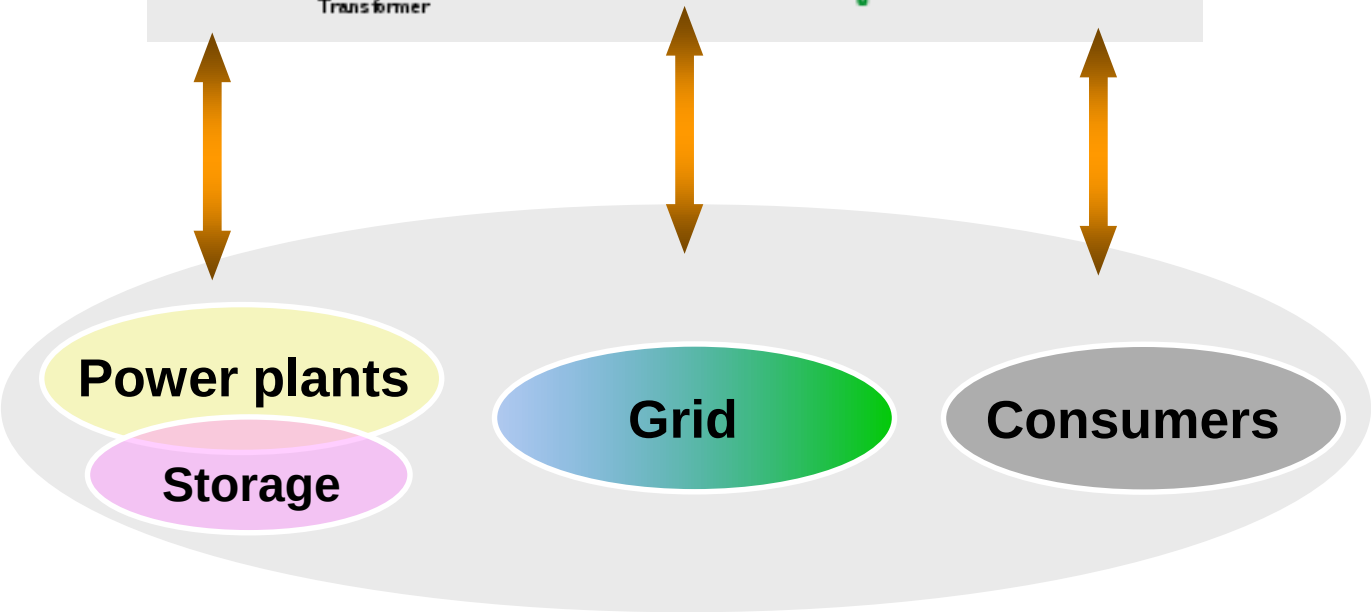
Past

New electricity age



Principal elements of power systems





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Principal elements of power systems
Power plants/Storage

- Peaking plants
- Gas turbine
- Diesel
- Reservoir hydro

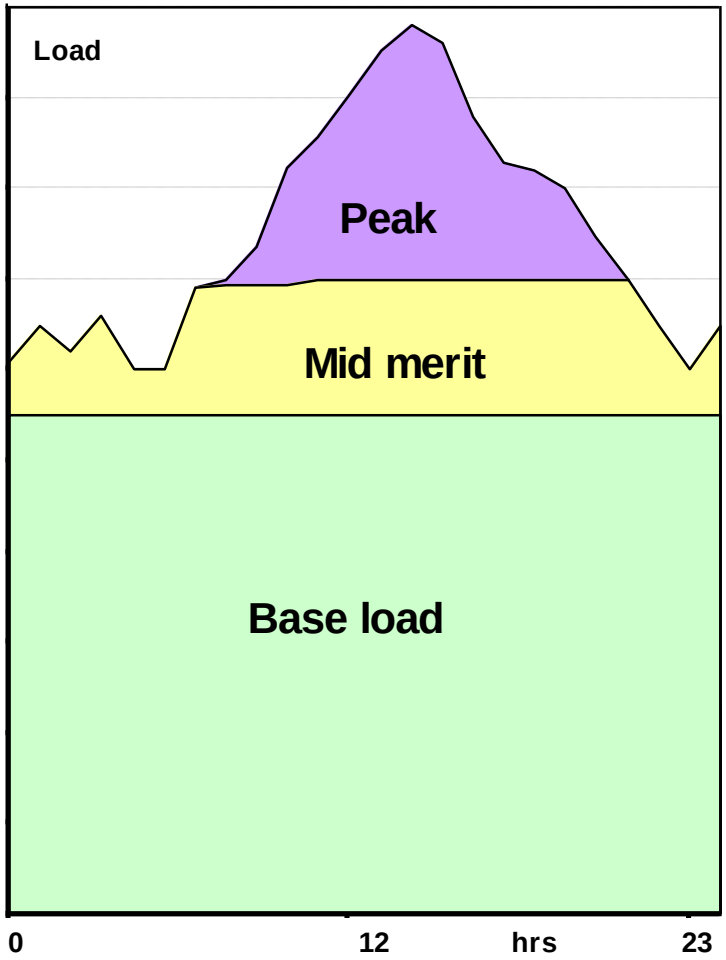
- Pumped storage hydro

- Storage

- Mid-merit plants
- Hydro
- Coal, Combined cycle
- Biomass

-Base load plants
- Nuclear
- Geothermal
- Coal
- Run of river

- Volatile

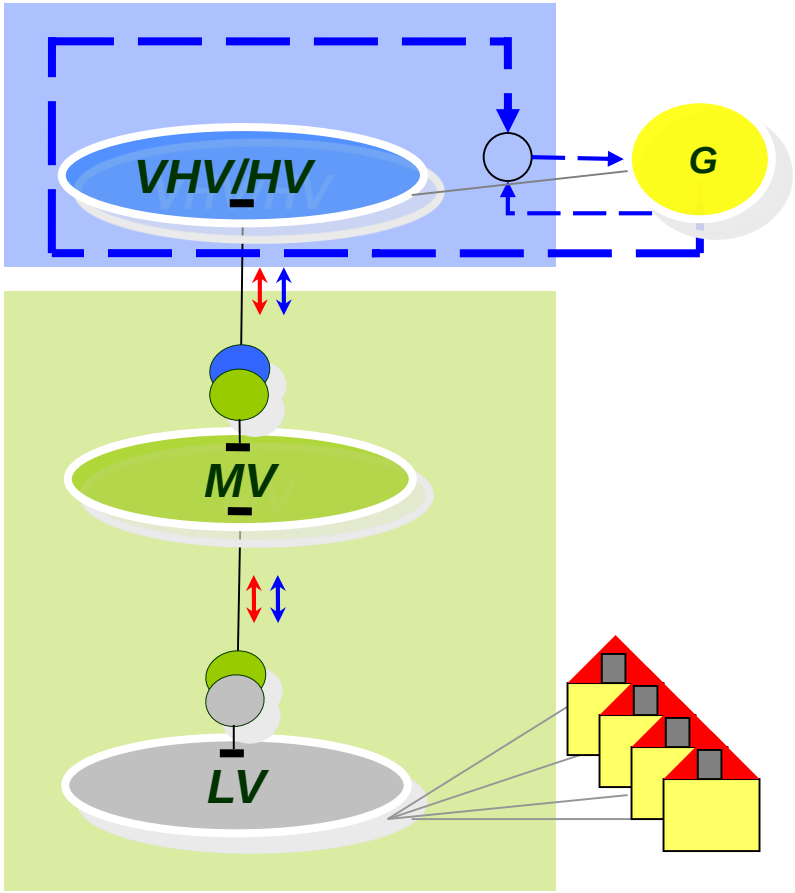


Principal elements of power systems Grid

-Transmission (VHV,HV)
- Remotely controlled
- Redundant measurements
- Intelligent software

- Distribution MV
- Almost manually updated
- Marginal measurements
- Little intelligent software

- Distribution LV
- Manually updated
- No measurements
- No intelligent software



Principal elements of power systems
Consumers

-Consume energy

•*No automation*

New electricity age

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The new electricity age is penetrating through

”Smart Grid”

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Northeast blackout of 2003

Black out begin August 14th, 4:10 p.m.
Partly restoration by 11:00 p.m.
Full restoration after 2 days

2003

Black out affected people:
about 10 million in Ontario and
about 45 million in 8 US States

States and provinces that experienced power outages

Reliability demands will drive automation investments.

Michael T. Burr

Fortnightly Magazine - November 1 2003

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TECHNOLOGY CORRIDOR

Reliability demands will drive automation investments.

In the days and weeks following Aug. 14, 2003, politicians scrambled to assess blame for the blackouts that plagued the United States and Canada.

Even today, as the blame game proceeds, the precise cause of the grid's collapse remains uncertain. But Republicans, Democrats, and the utility industry alike seem to agree on one thing: the U.S. power grid needs major investment.

"We need between $50 billion and $100 billion over several years to upgrade the nation's transmission system," said Kurt Yeager, president and CEO of the Electric Power Research Institute (EPRI) in Palo Alto, Calif.

Despite pressures to enhance grid reliability, mobilizing $50 billion to $100 billion for transmission system investment seems like a Herculean task. Faced with regulatory uncertainty and economic malaise, utilities are not well positioned to make such colossal infrastructure investments.

"I suspect I'll have a lot of questions from our clients, saying, 'They want us to invest money in technology to increase reliability, but nobody is giving us the money to do it,'" says Jill Feblowitz, research director with Boston-based AMR Research.

Policy questions aside, the big challenge for the industry in the coming months and years will be figuring out how to improve grid reliability and survivability-without accumulating a Herculean tab.

Smart Grid

Weaknesses in the power grid can be narrowed to two general areas-transmission capacity and network control systems. Both of these areas will likely see increased investment in the years to come, but the precise focus of such investments remains to be determined.

What are *"Smart Grids"*?

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The term "***Smart Grid***" refers to a modernization of the electricity delivery system so it monitors, protects and automatically optimizes the operation of its interconnected elements – from the central and distributed generator through the high-voltage transmission network and the distribution system, to industrial users and building automation systems, to energy storage installations and to end-use consumers and their thermostats, electric vehicles, appliances and other household devices. (**Electric Power Research Institute 2009**)

A *"**Smart Grid**"* should:

- Provide quality, reliability and efficiency by dynamic optimization
- Accommodate all generation and storage options
- Enable electricity market to flourish
- Motivate consumers to actively participate in operation of the grid

Principal elements in the new electricity age: Power plants

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- Peaking plants
- Gas turbine
- Diesel
- Reservoir hydro
- Pumped storage hydro
- ***E-cars, large batteries***

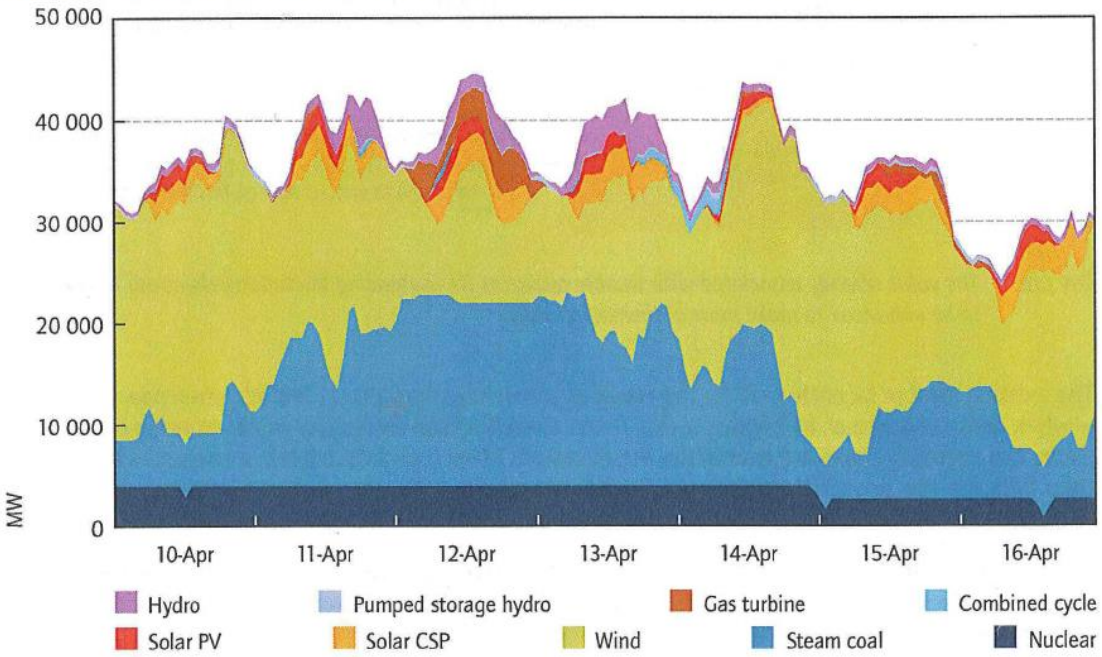
- Storage

- Mid-merit plants
- Hydro
- Coal, Combined cycle
- Biomass

- Volatile
- Run of river
- ***Wind, Solar***

-Base load plants
- Nuclear
- Geothermal
- Coal

Figure 23 • Effect of 35% variable renewables in the West Connect area of the United States



Principal elements in the new age: Grid

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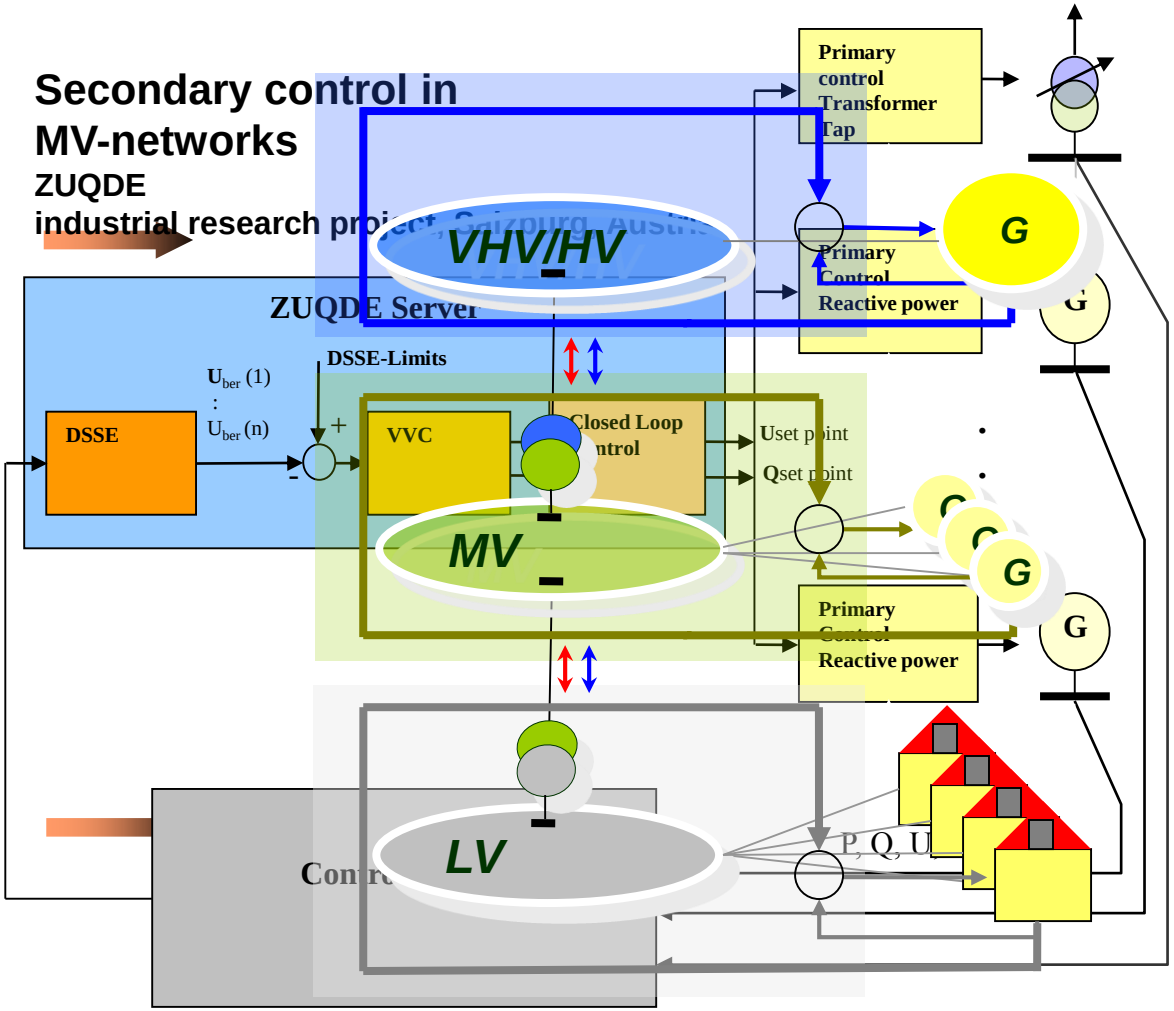
-Transmission (VHV,HV)
- Remotely controlled
- Redundant measurements
- *Higher automation degree*

-Distribution MV
- *Almost remotely controlled*
- *Rich on measurements*
- *High automation degree*

-Distribution LV
- *Almost remotely controlled*
- *Smart meters*
- *High automation degree*



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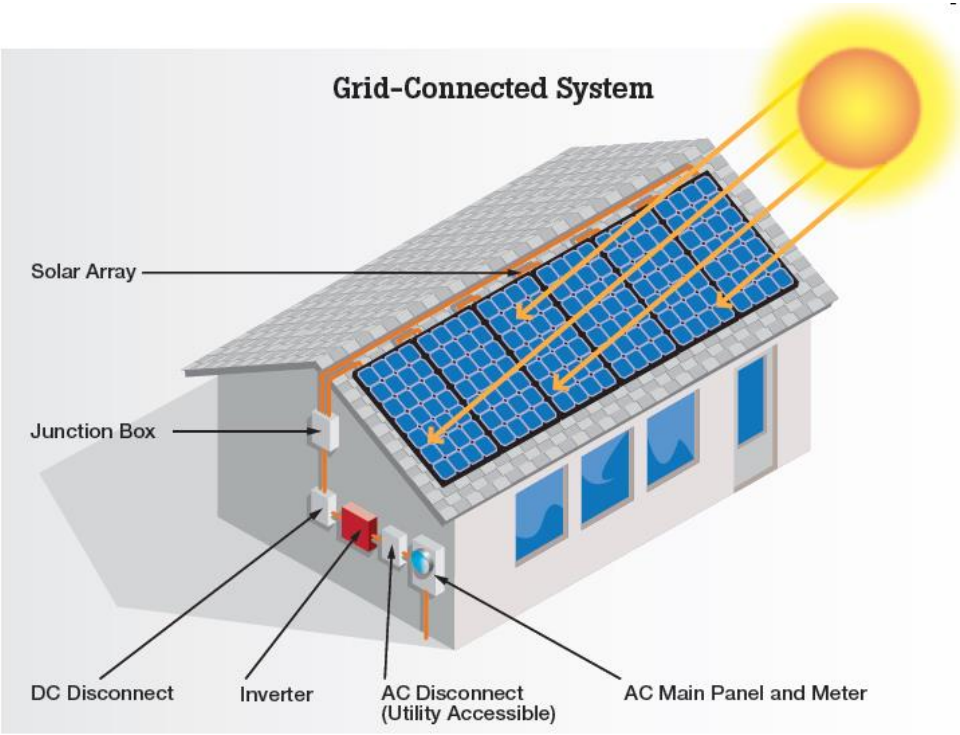
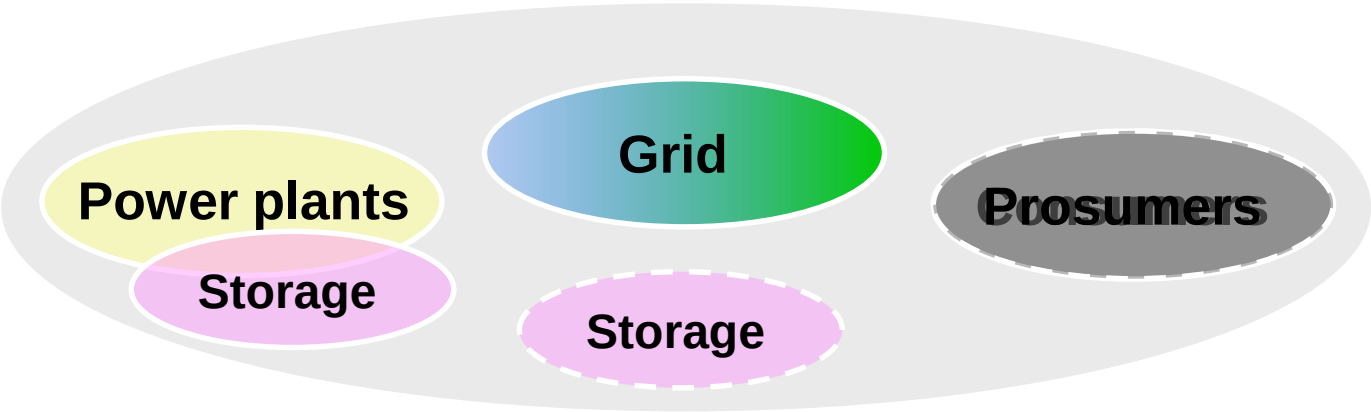
Principal elements the new age: Prosumers

-Consume energy
•Full automation

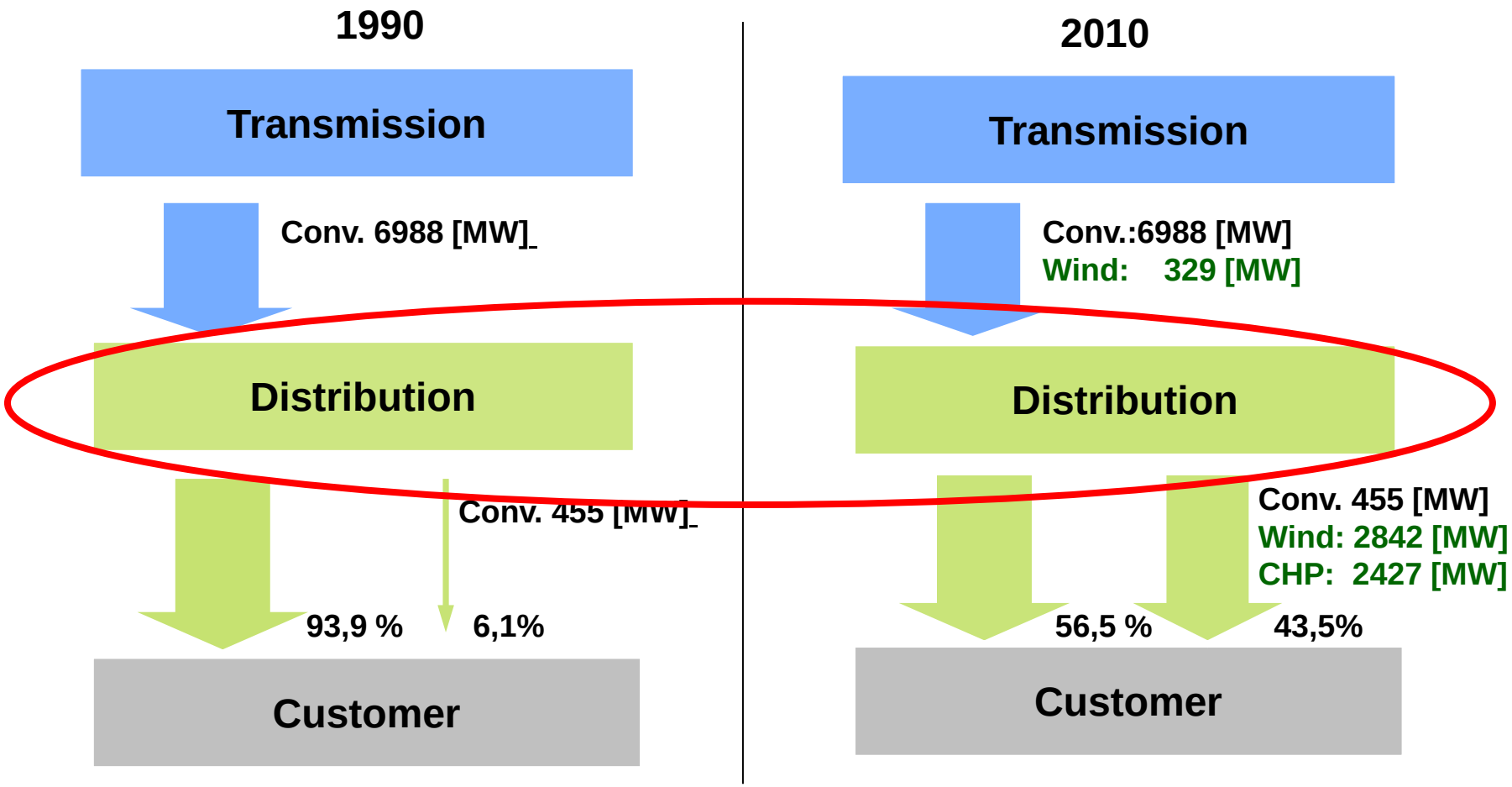
-Produce energy
•Full automation



Principal elements of power systems in the new electricity age



The structure of power systems is actually changing very fast



Nowadays good weather may create serious problems in transmission system operation

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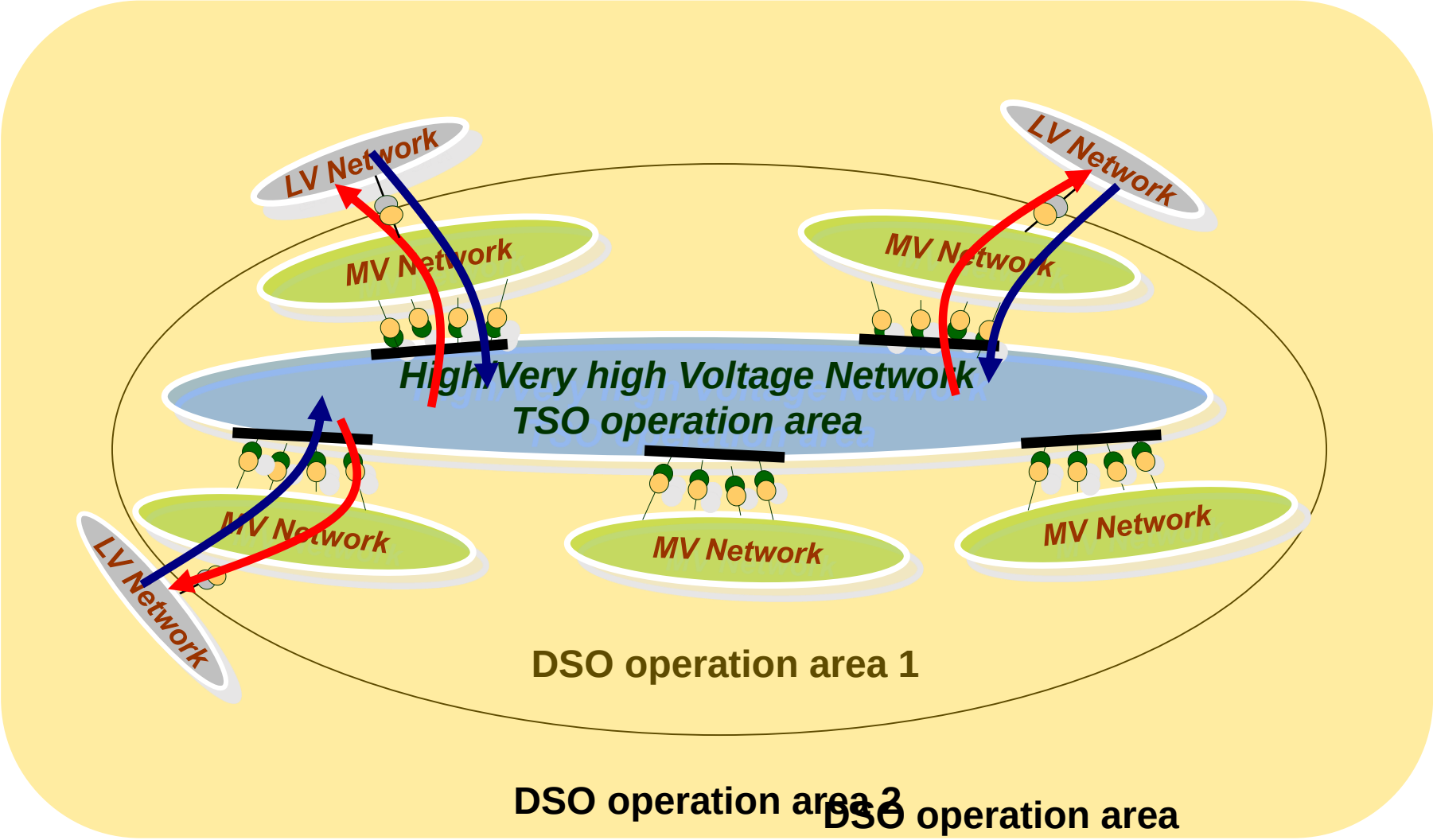
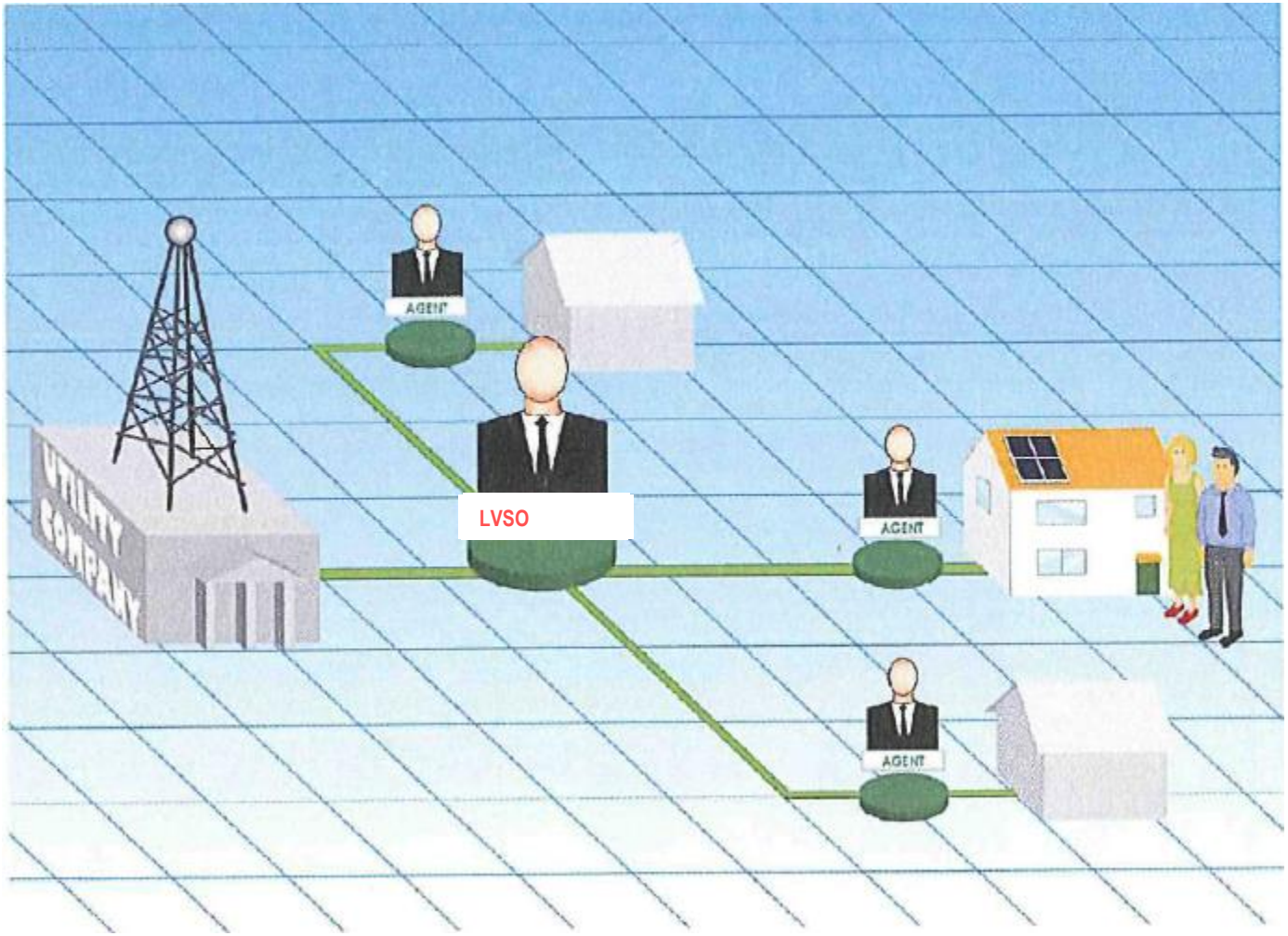
Power grid in the new electricity age

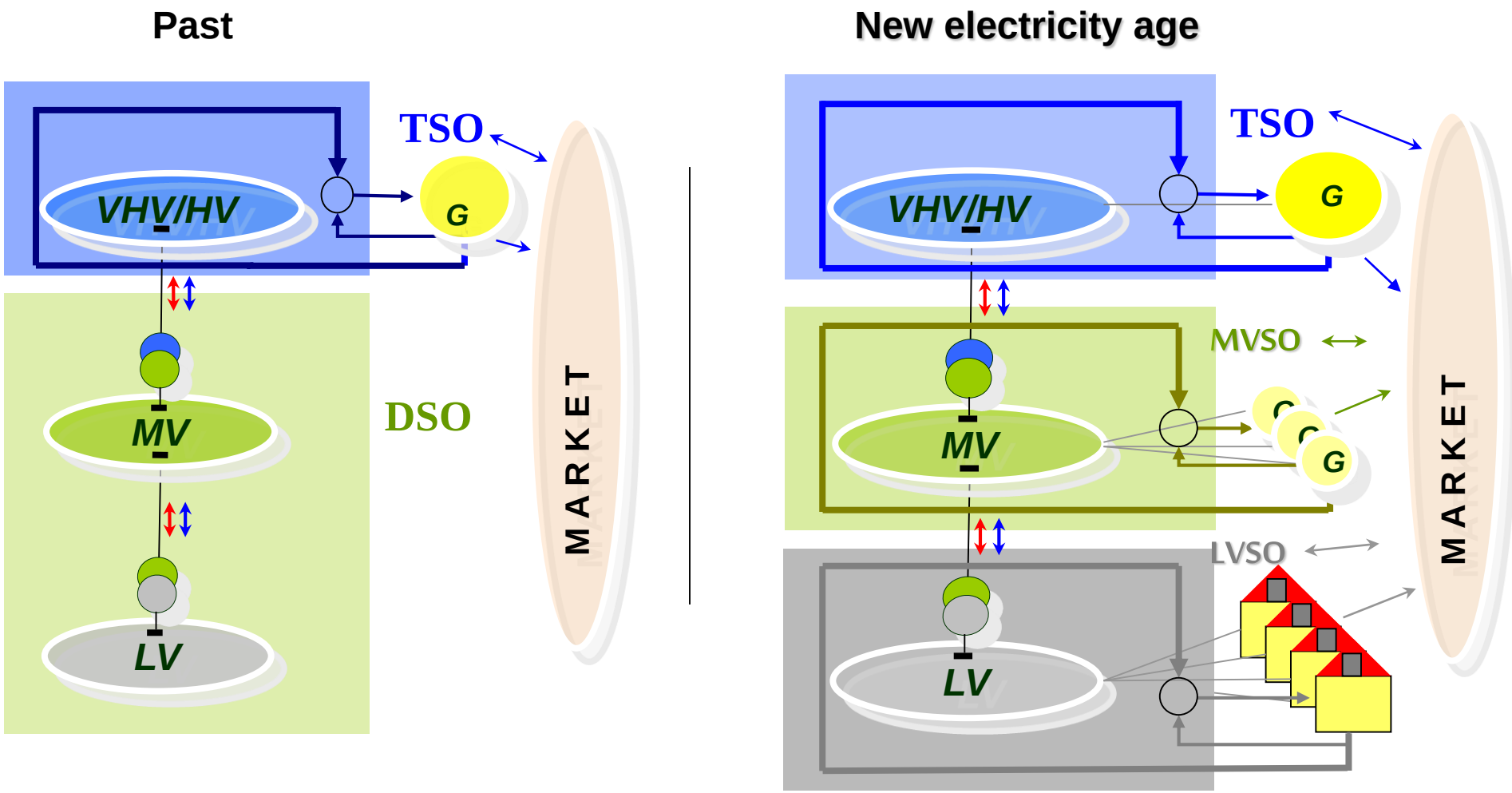


Research projects: the need of a new actor in LV area



Source: EU research project BeyWatch

Power grid in the new electricity age



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Power grid operation in the new electricity era

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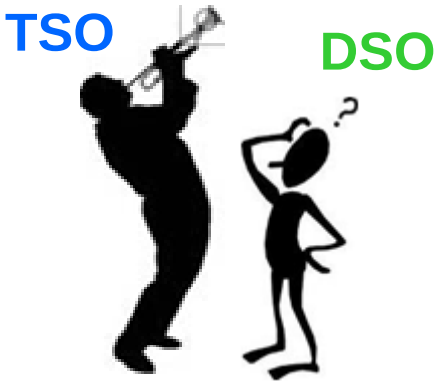
Past



The new electricity age

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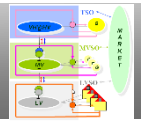
Conclusions

The new electricity age is characterised by:

- evolution process in all principal elements of power systems

- reinforcement and full automation of power grid



- responsibility changes and new actors in grid operation