Overview of JP "Elektromreža Srbije" main activities aimed to improve power system control

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"JP Elektromreža Srbije" – JP EMS
Serbian Transmission System and Market Operator

DEMSEE
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Presentation Map

- **Introduction – Basic data about "JP Elektromreža Srbije" – JP EMS**
- JP EMS main activities aimed to improve power system control
- Operational challenges in the future

Basic data about Serbian power system

Installed Generation Capacity

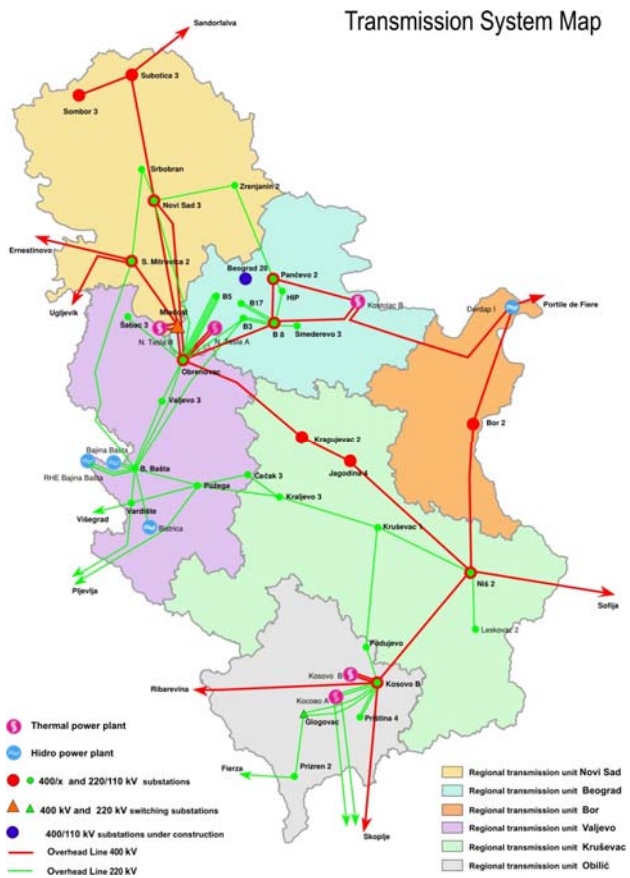
- thermal 5507 MW
- hydro 2866 MW
  Total 8373 MW

Overhead Power Lines

- 400 kV – 1649.7 km
- 220 kV – 2169.5 km
- 110 kV – 5832.6 km
  Total 9651.8 km

Installed Transformer Capacity:

- substations 400/x κV – 7500 MVA
- substations 220/x κV – 5881.5 MVA
- substations 110/x kV – 4093 MVA

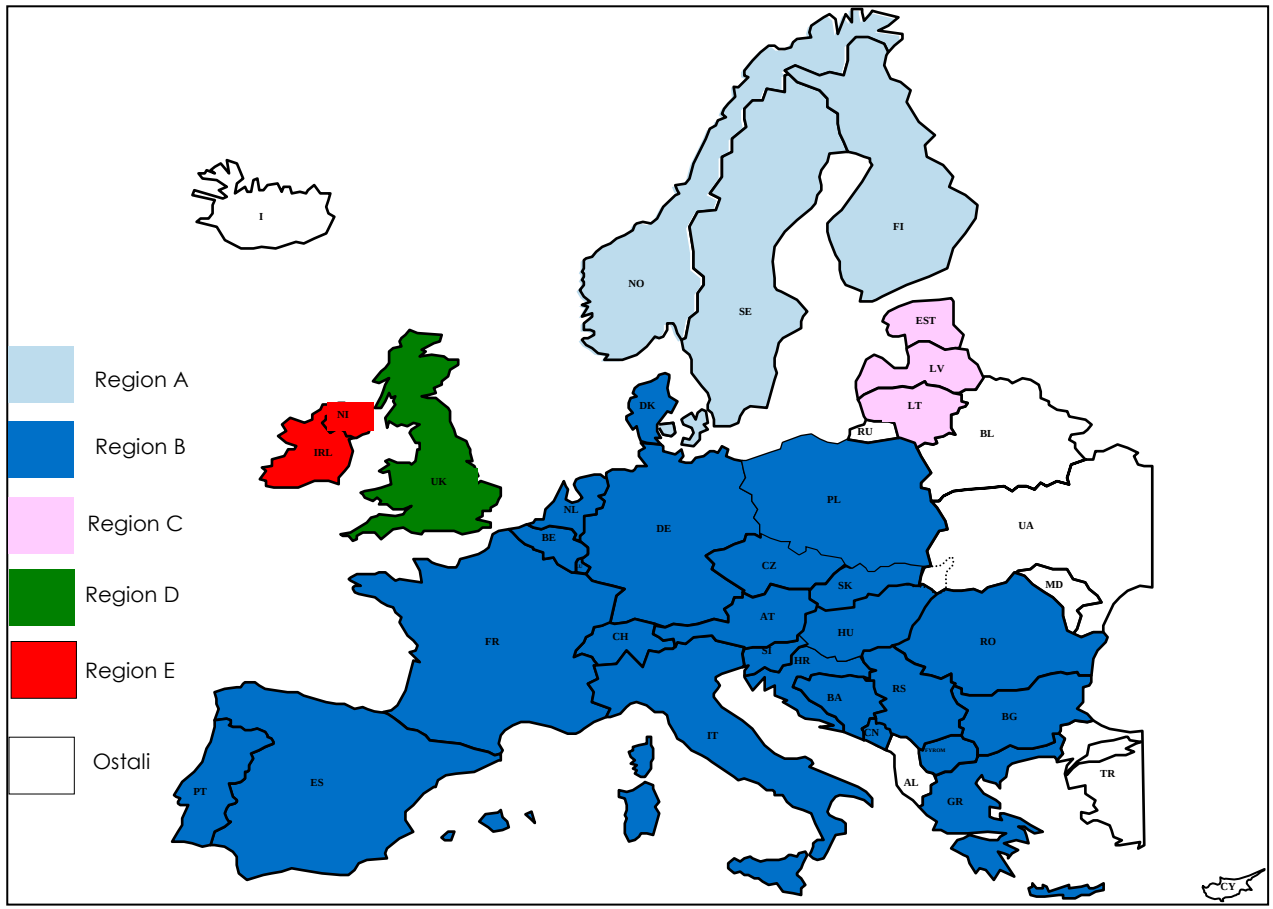


JP EMS - Foundation and core activities

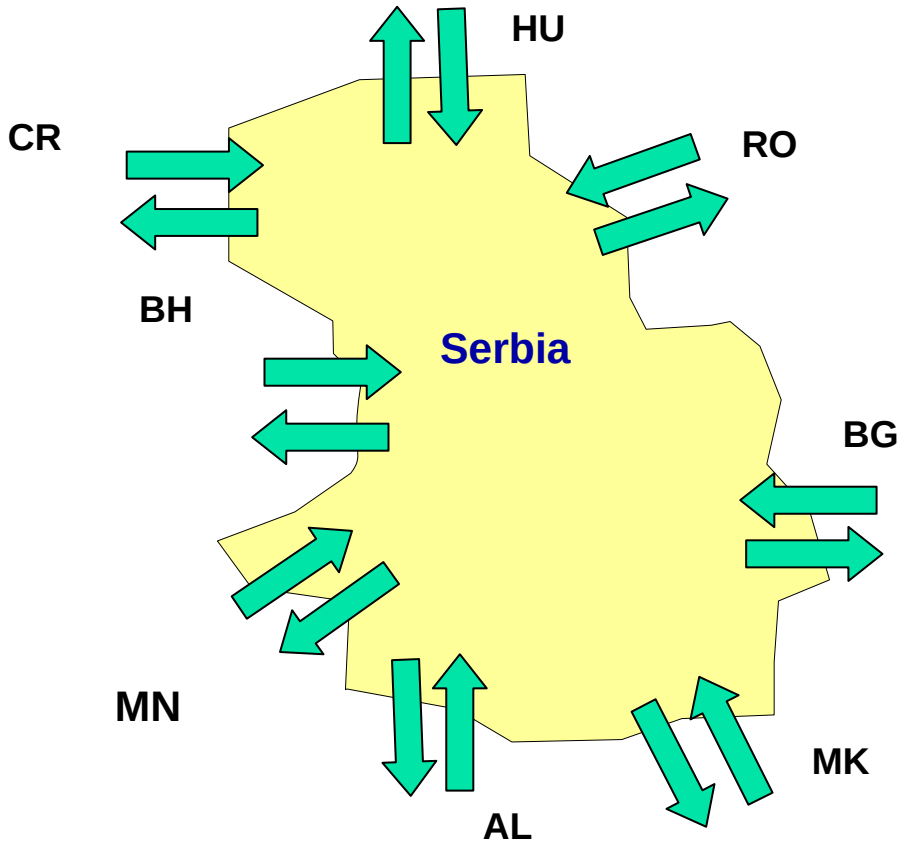
- Based upon the Decision of the Government of the Republic of Serbia and according to the Energy Law, the Public Enterprise "Elektromreža Srbije" (Serbian Transmission System and Market Operator) has started to work on 1st of July, 2005
- 100% owned by the Republic of Serbia
- Three core activities of JP "Elektromreža Srbije" and coresponding divisions are:

1. Transmission
2. System operation
3. Market operation

Synchronous areas in Europe



Central position in the region



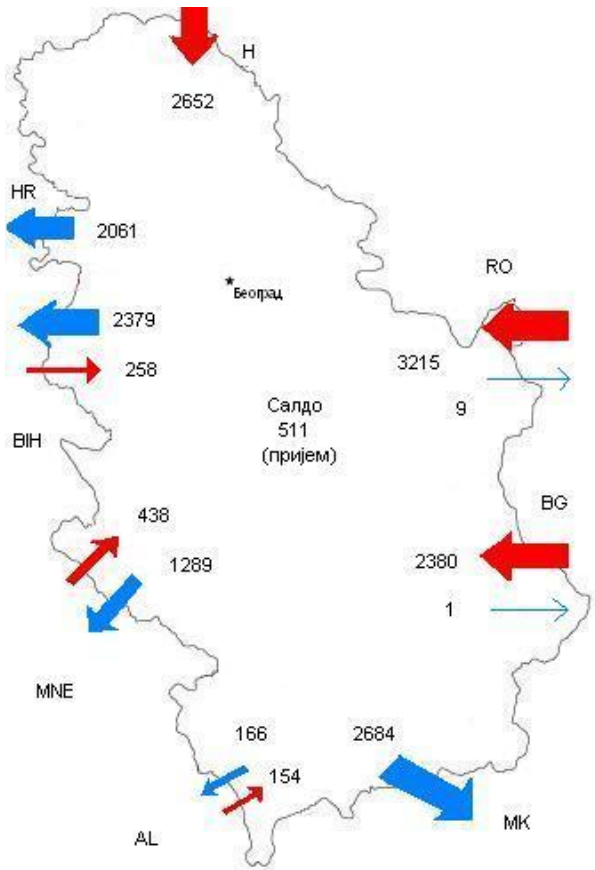
Serbian transmission system is connected with all neghbouring systems (except Albenian) by 400kV lines.

Secure system operation – prerequisite for the functioning of both internal market and the regional market in South East Europe

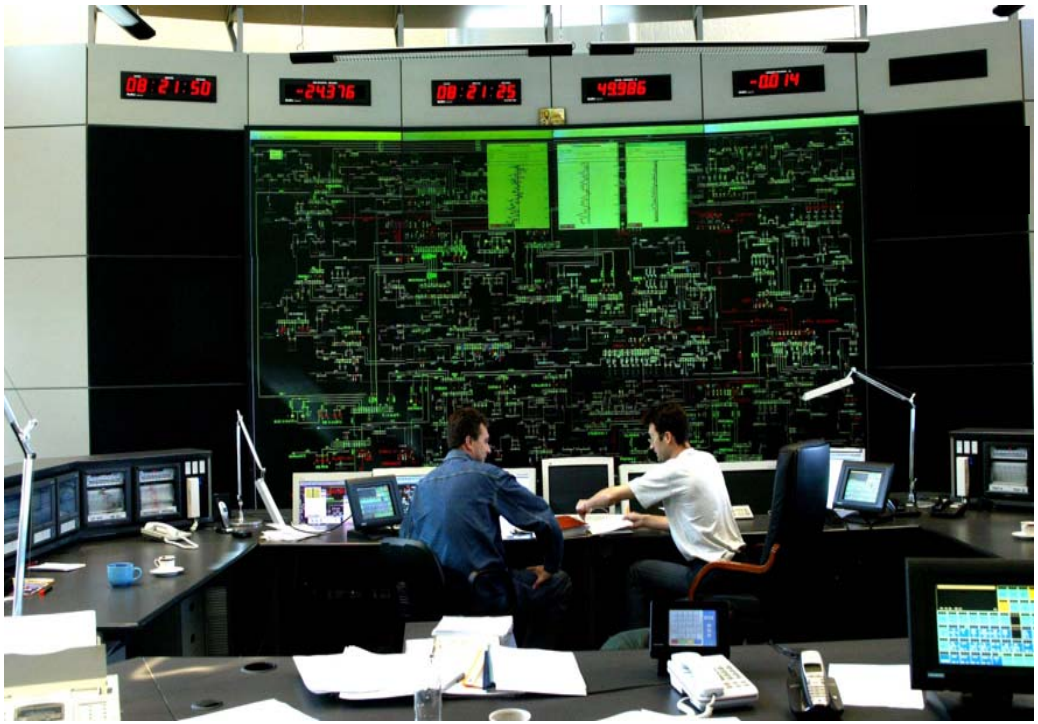
Energy Flows

Two main directions:

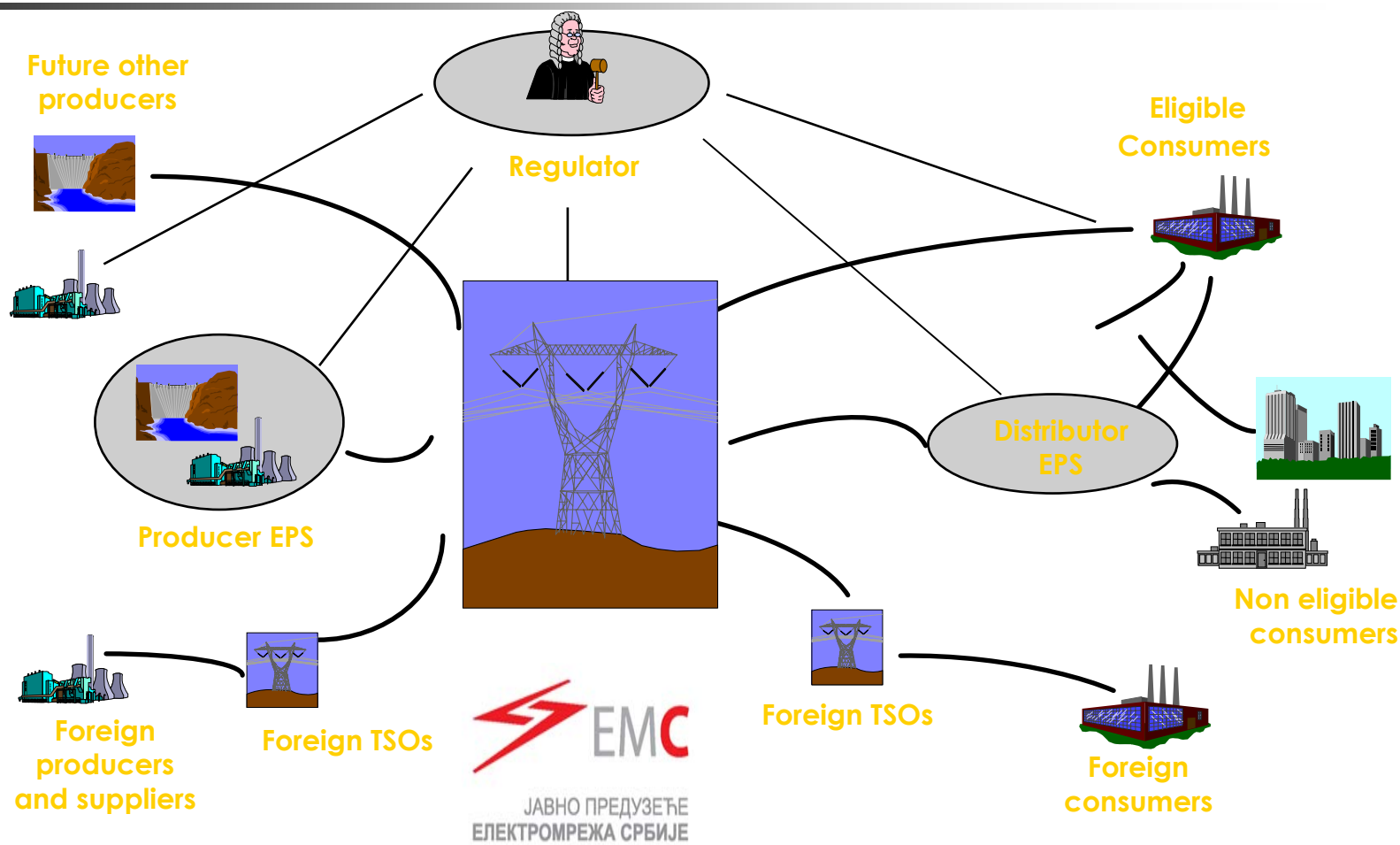
- From East to West
- From North to South



System Operation Division



Market Division



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- Introduction – Basic data about "JP Elektromreža Srbije" – JP EMS
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Introduction

- Serbian transmission system has a central place in the South-East Europe and it is connected to eight neighboring transmission systems
- Secure operation of Serbian transmission system is necessary not only for satisfying the required power supply quality for Serbian consumers but also for establishment and operation of a Regional Electricity Market in South-East Europe (SEE) as a part of Pan-European Electricity Market

Introduction (2)

In paper the following JP EMS projects, which have been realized in order to improve power system control, are described:

- infrastructure strengthening (transmission network and telecommunication)
- state-of-the-art SCADA/EMS
- new ETSO Scheduling System (ESS)
- implementation of the control block function for Serbia, Macedonia and Montenegro (SMM) Control Block.

Basic acts

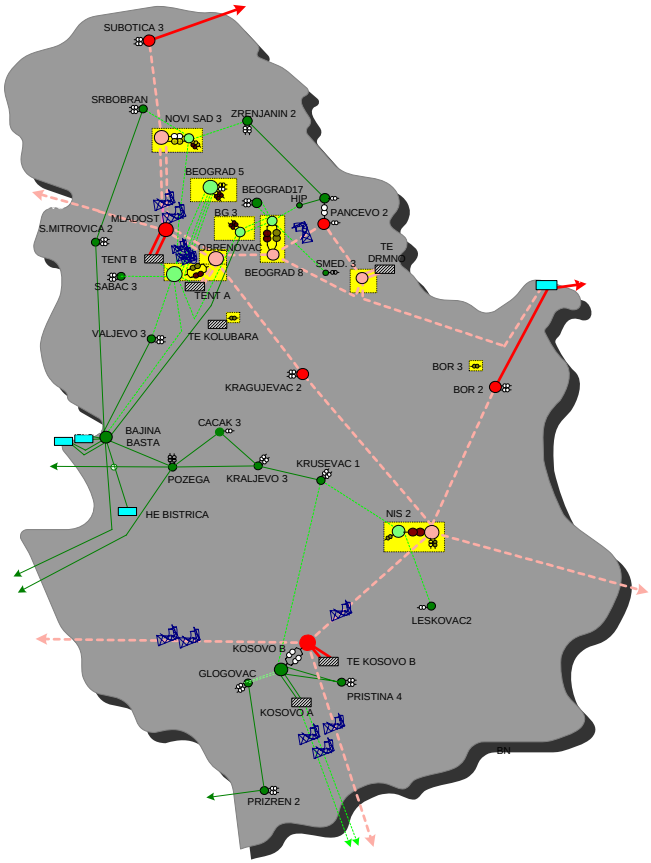
Basic acts that determine obligations of JP EMS as entity responsible for transmission and system operation in the Republic of Serbia and in Continental Europe synchronous area are:

- UCTE Multilateral Agreement and UCTE Operation Handbook, Policy 1-8, 2004-2009
- Serbian Energy Law (August, 2004)
- Serbian Transmission Grid Code (May, 2008)

Infrastructure strengthening - transmission network

Transmission network in June 1999.

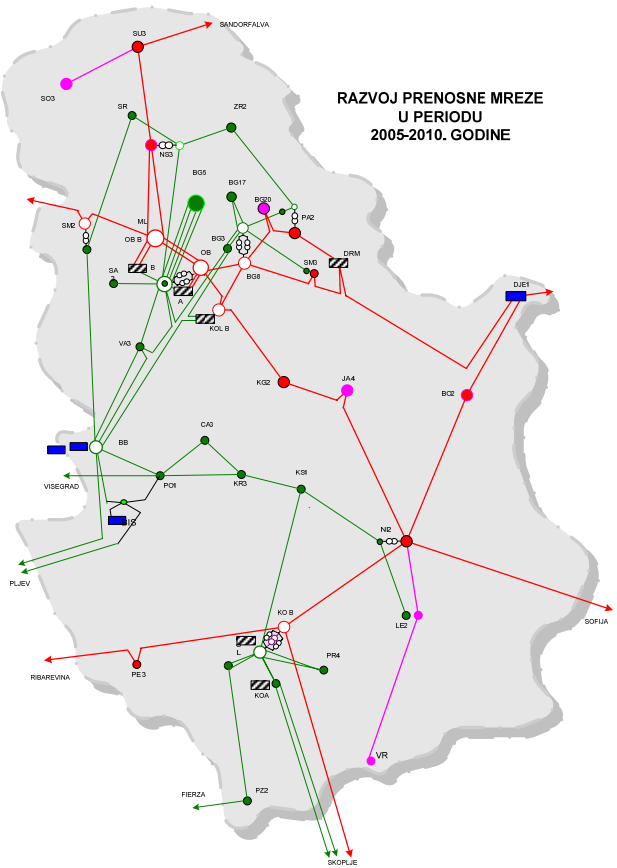
- 32 power transformers of total 4135 MVA capacity were destroyed or damaged during NATO bombing
- After the phase of urgent remedy of the consequences of bombing, the transmission system had been under an intense reconstruction.



Infrastructure strengthening - transmission network (2)

EIB Loan is used for rehabilitation of the following substations:

- 400/220 kV Beograd 8
- 400/220/110 kV N.Sad 3
- 400/220/110 kV Niš 2
- 220/110 kV Beograd 5
- 220/110 kV Beograd 3
- 220/110 kV Leskovac 2
- 220/110 kV Kruševac 1
- 220/110 kV Srbobran



Infrastructure strengthening - transmission network (3)

EBRD Loan has used for following projects:

Construction of new substations 400/110 kV:

- Sombor 3
- Jagodina 4
- Beograd 20

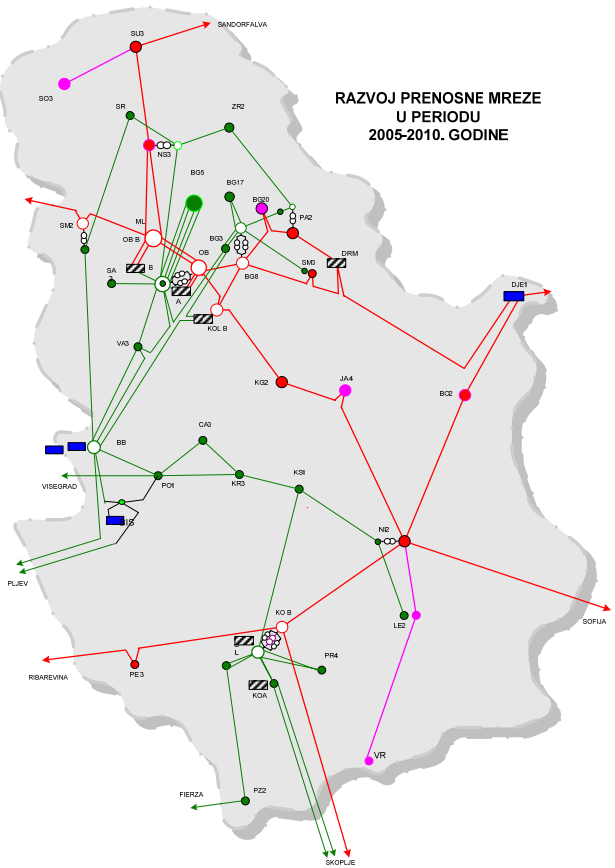
Upgrade of existing substations:

- Sremska Mitrovica 2
- Subotica 3

Construction of new OHL 400 kV:

- Sombor 3 – Subotica 3
- Sremska Mitrovica 2 – Ugljevik (BiH)
- OHL for connection of substation 400/110 kV Jagodina 4

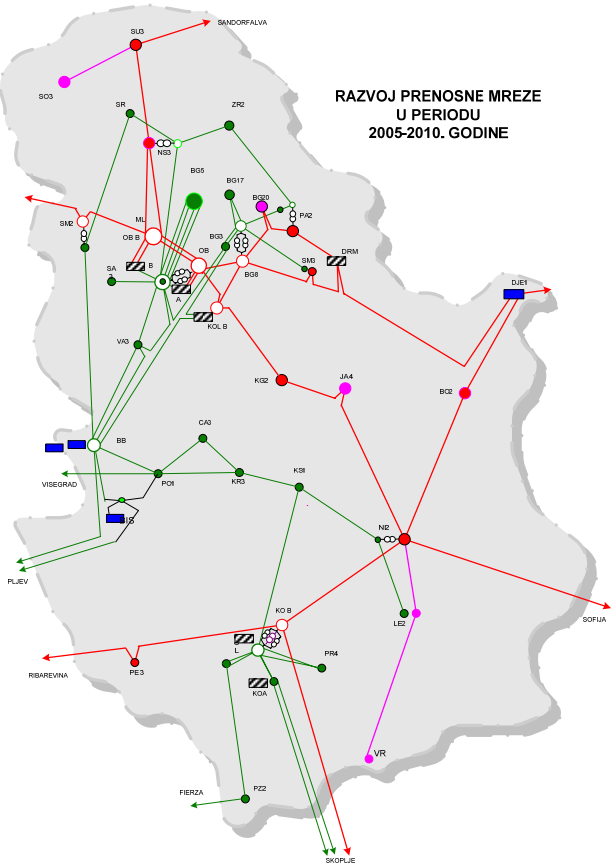
Rehabilitation of 110 kV power lines in total length of 170 km



Infrastructure strengthening - transmission network (4)

New tie line 400kV
Nis 2 – Leskovac –
- Vranje - Stip
(Macedonia)
is under construction

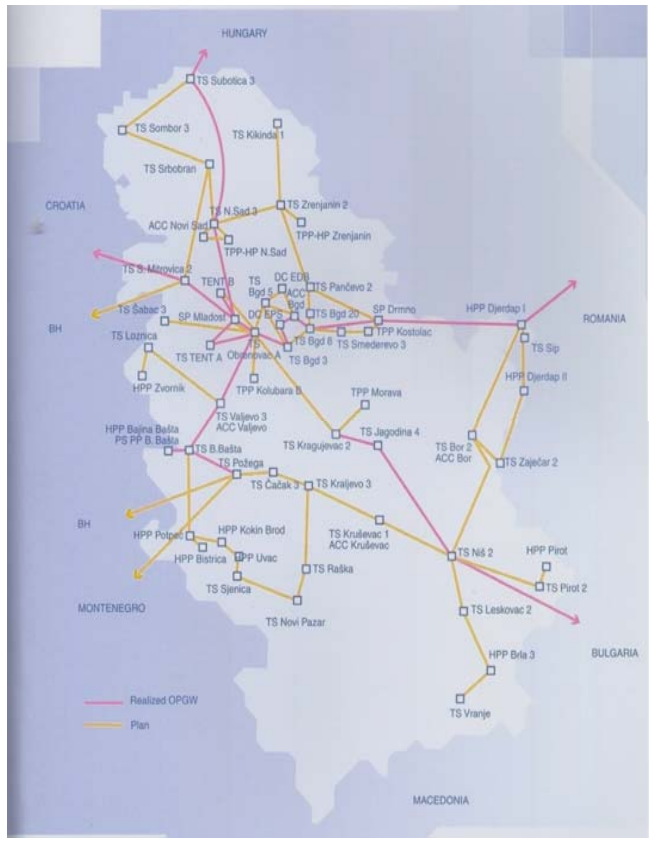
EAR (European Agency for Reconstruction) grant



Infrastructure strengthening - Telecommunication network

Modernization of Telecommunication system

- The aim of the project has been a provision of telecommunication infrastructure and necessary software required for technical and company business system of the Serbian power industry, as well as establishment of telecommunication links to neighboring TSOs
- Installation of optical network of OPGW wires of about 3000 km on overhead lines on main directions, as well as installation of new, state-of-the-art SDH terminal equipment
- The network is of mesh structure with STM 16 capacity over main links, STM 4 is used on important directions, and on the less demanding directions STM 1. STM 4 is meant for directions to neighboring transmission systems.



IT system for power System control and Market

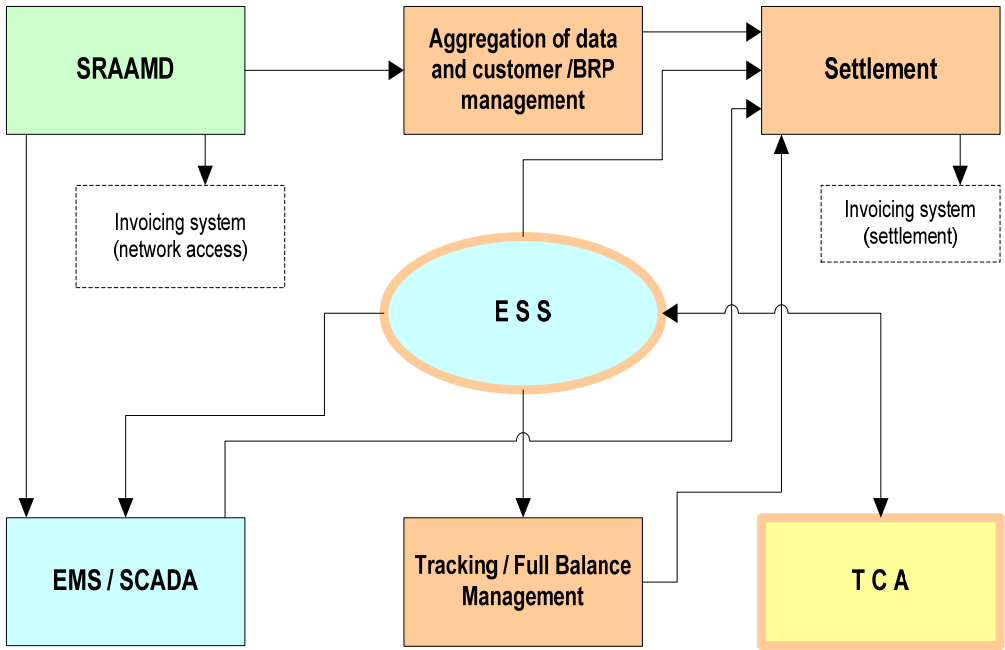


Figure 1 – Common Block Diagram of integrated IT system of JP EMS (the implementation will follow the mid 2009)

Electronic Highway (EH) links

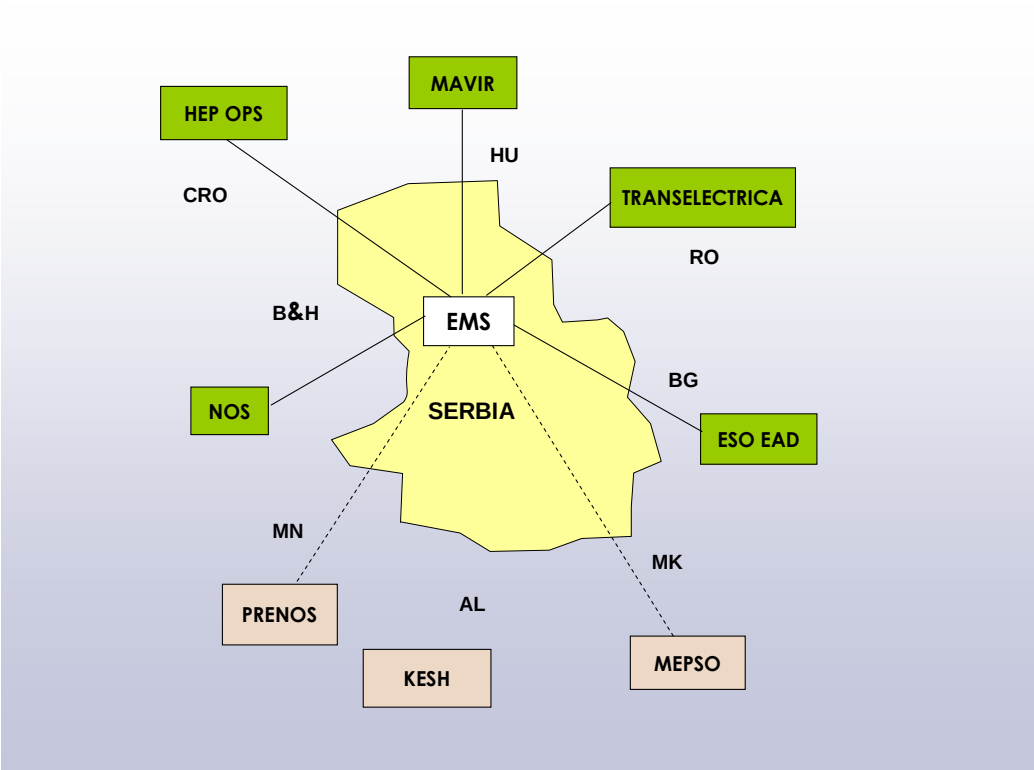


Figure 2 – EH links of NDC in Belgrade with the dispatching centers of neighboring transmission system operators (status in the mid 2009)

Serbia, Macedonia and Montenegro (SMM) UCTE control block

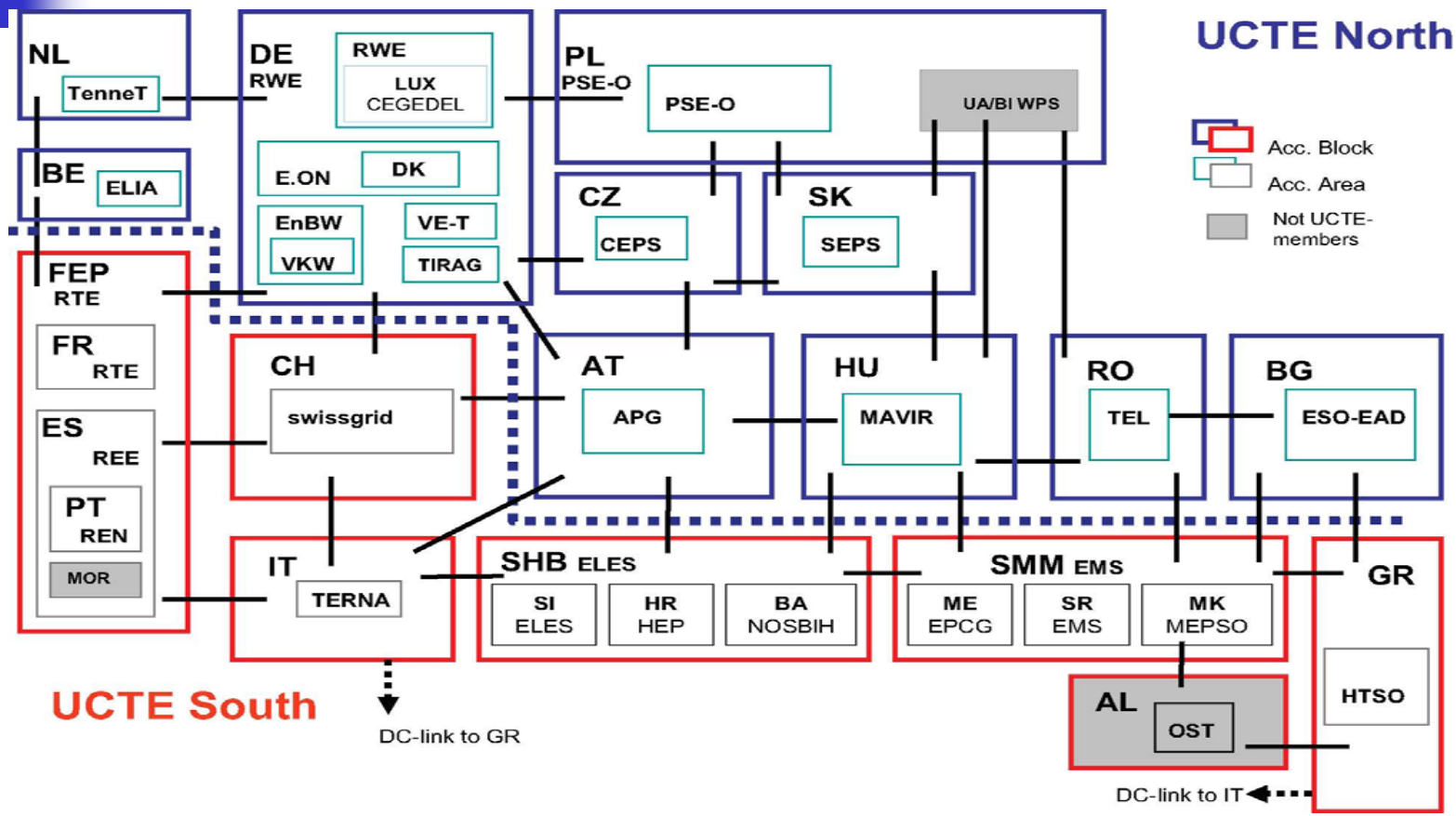


Figure 3 - Structure and organization of the control blocks and areas in countries belonging to the UCTE synchronous area (status in the mid 2009)

Serbia, Macedonia and Montenegro (SMM) UCTE control block

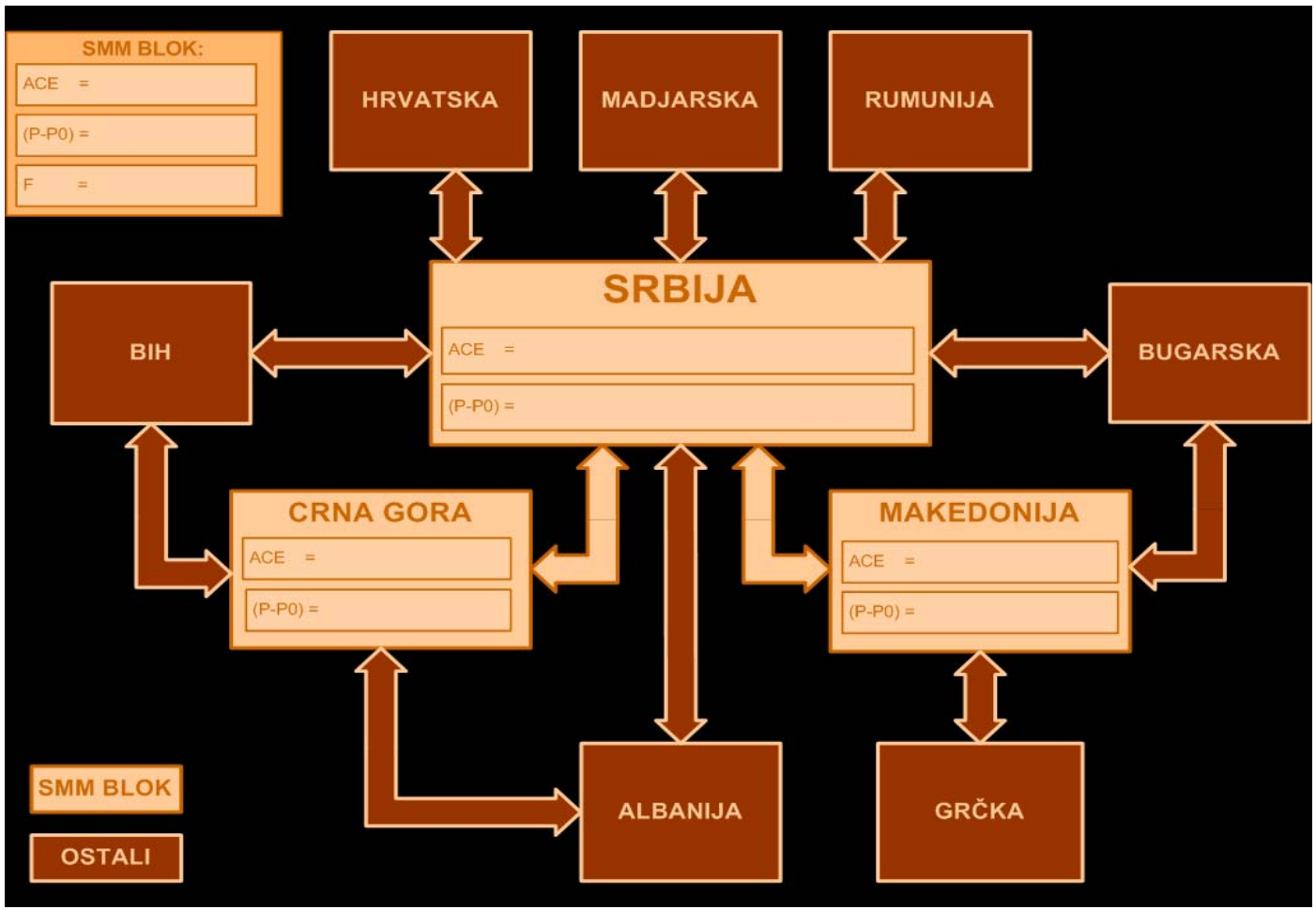


Figure 4 - Structure and organization of the SMM control block

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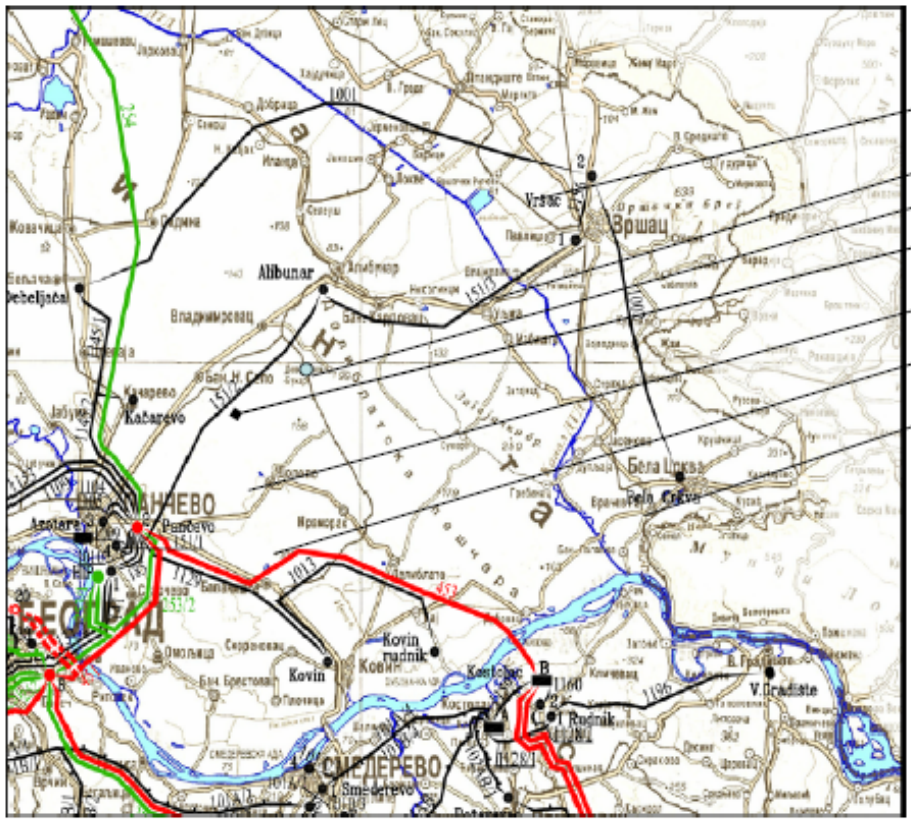
Main future activities

- The completion of the 400kV overhead line Niš 2 – Leskovac 2 – Vranje 4 – Štip (Macedonia)
- Increase exchange of real-time data with neighboring systems
- Construction of back-up National Dispatching Center
- Direct links from JP EMS EH node to all other neighboring TSOs using the private optical telecommunication infrastructure
- Integration of future Serbian wind generators into transmission system is a bigest domestic challenge either from transmission system planning aspect as well as from operational and market point of view

Integration of wind generators into transmission system (2)



- WP Vrsac(50)
- WP Nikolinci(60)
- WP Pancevo BA(120)
- WP Dolovo(300)
- WP Dol. Cibuk (300)
- WP Kovin(188)
- WP Bela Crkva(187.5)

Integration of wind generators into transmission system (3)

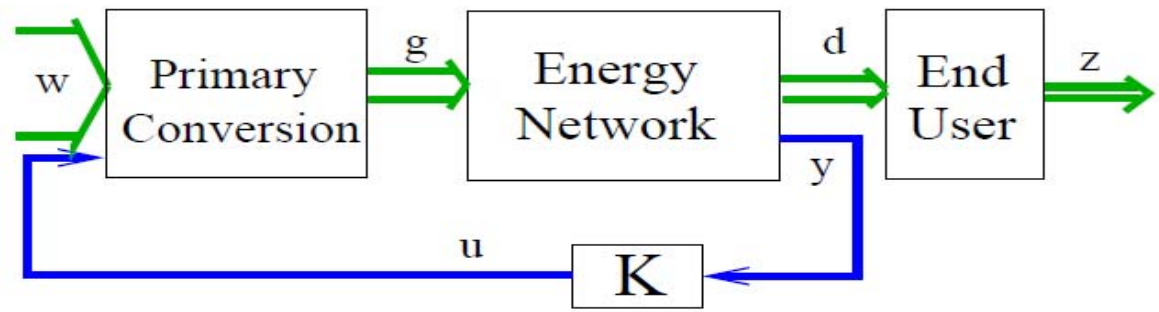
- The general objective is to increase the share or renewable energy, and especially wind energy in Serbia
- Determination of the appropriate levels of wind power capacity which may be connected to the national grid and operational measures and technical improvements for management of such connected capacity
- Identification of necessary investment for transmission network strengthening
- Create market rules for integration of wind generators

Existing Electric Energy Systems

Alex M. Stanković, Northeastern University, Boston, USA

Some performances of existing electric energy systems are:

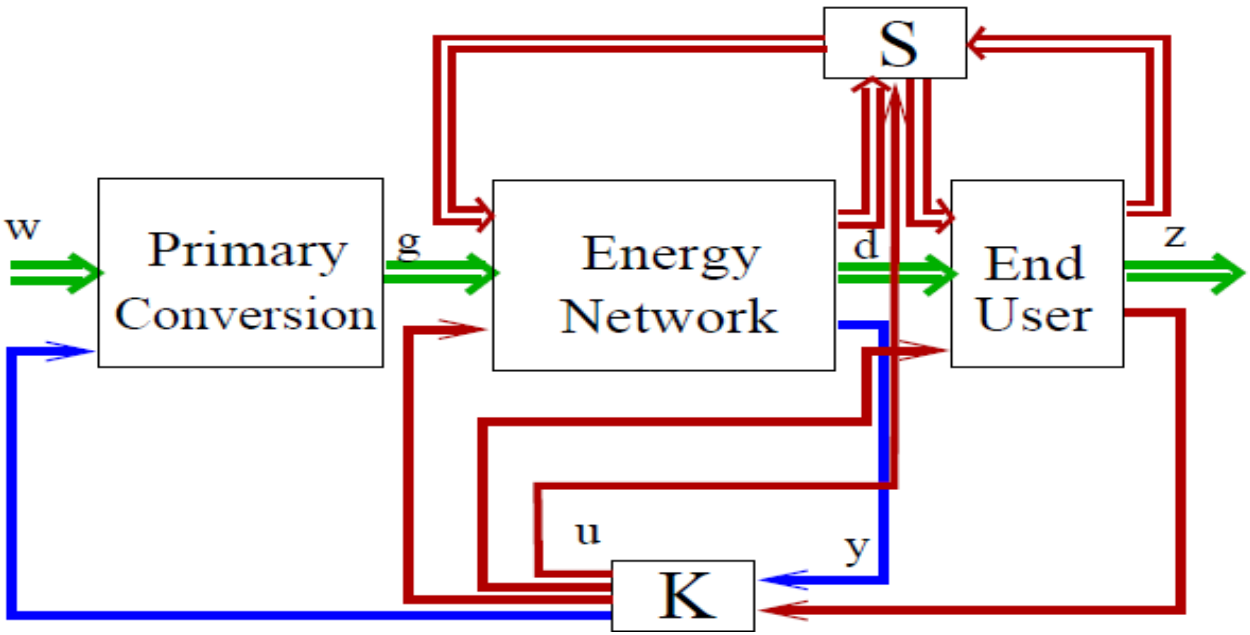
- **w** too large, little from renewables,
- Significant variations in the part of **w** from renewables
- Large variations in **z** (and **w**) - cyclic and stochastic,
- No storage of electric energy
- Over-designed components – due to variations in **z** as well as due to fault accommodation
- Control is too local.



Future Electric Energy Systems

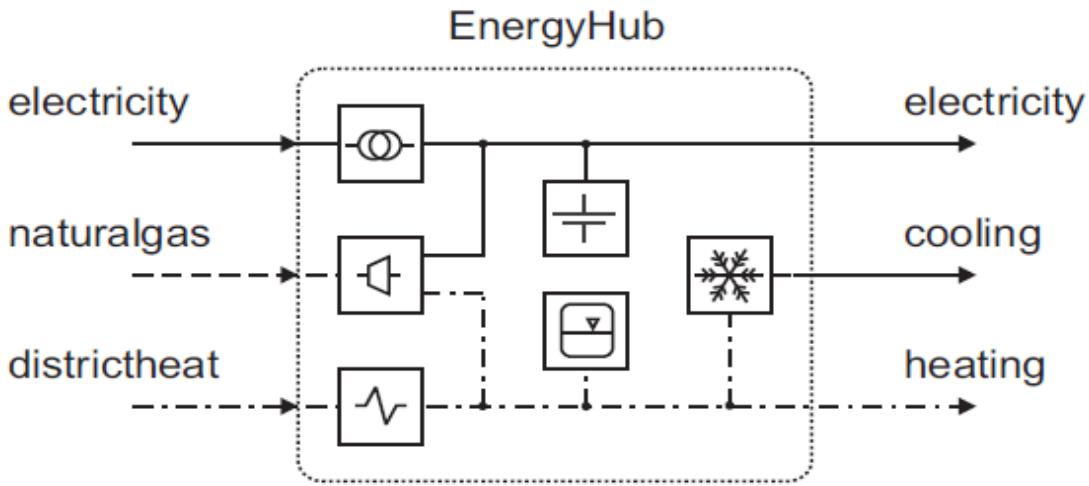
Some of performances of future electric energy systems are:

- More **w** from renewables,
- Information layer (sensors, coordinated K = local + global context, loads inside)
- Flatter control – decoupling from above and below, faster, more authority via storage and routing



Future Electric Energy Systems (2)

- Networked multi-carrier energy hubs - by connecting and coordinating different single-carrier systems in cyber-physical networks (i.e., at the energy and the information flow layers) overall performance can be dramatically improved.



Thank you for your attention!