



Security of supply II: Electric Transmission System Reliability

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The Energy Agency of the Republic of Serbia &
The Pennsylvania Public Utility Commission**

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Content proposed by PA PUC

- Overview, characteristics and performance of the bulk transmission power system in Serbia
- Rules to ensure reliable power grid operation
- Reliability institutions
- Role of AERS in ensuring transmission system adequacy
- Compliance with reliability policies and standards
- Resolution of disputes
- Reliability system cost recovery and distribution
- Transmission system planning and siting (investment and research)

Serbian Transmission Power System

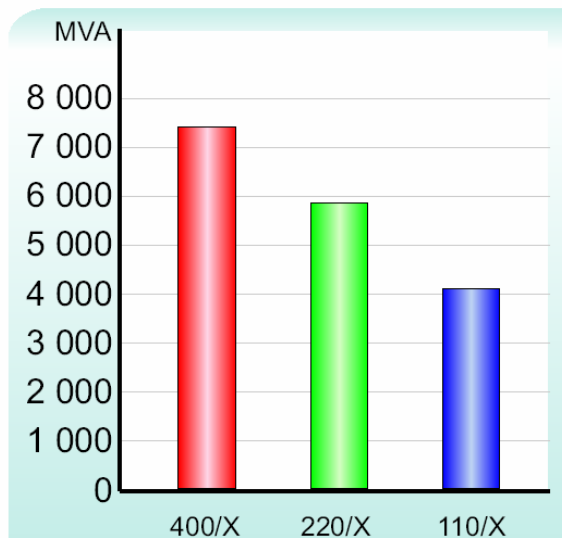
- infrastructure -

End of 2007

Installed capacity – 17,381.5 MVA

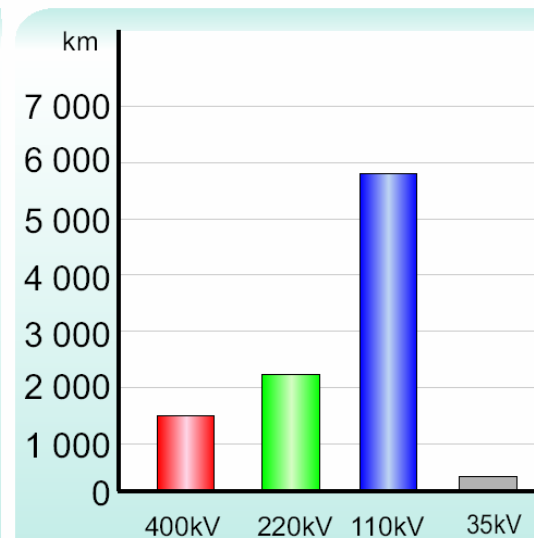
Length of lines – 9,898.7 km

Transformers



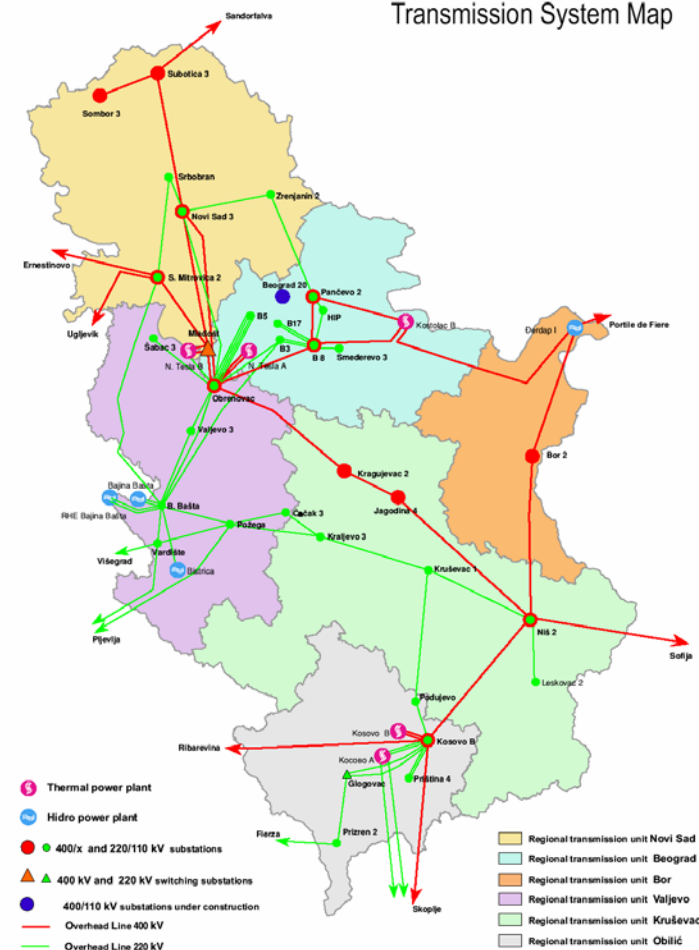
400/x kV	220/x kV	110/x kV
MVA	MVA	MVA
7 450	5 881,5	4 050

Overhead Lines



400 kV	220 kV	110 kV	35 kV
km	km	km	km
1 649,7	2 169,5	5 829,0	250,5

Transmission System Map



Serbian Electric Transmission System

- power flow -

Electricity transmission in 2007:

Input: 47,884 GWh

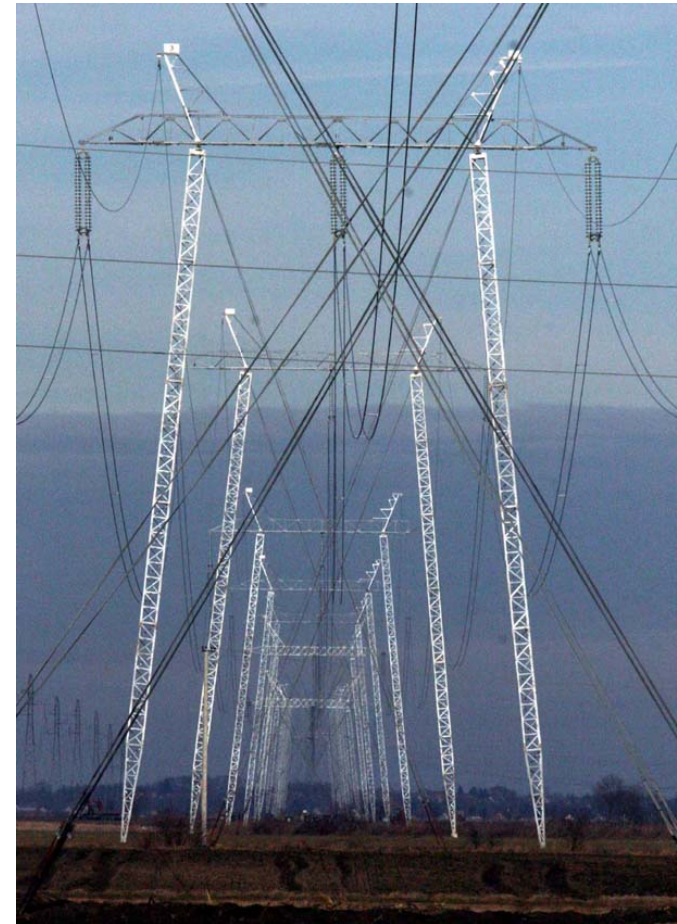
Output : 46,597 GWh

Losses: 1,287 GWh

Losses rate: 2,69%

**Withdrawal from
the neighboring systems: 8,905 GWh**

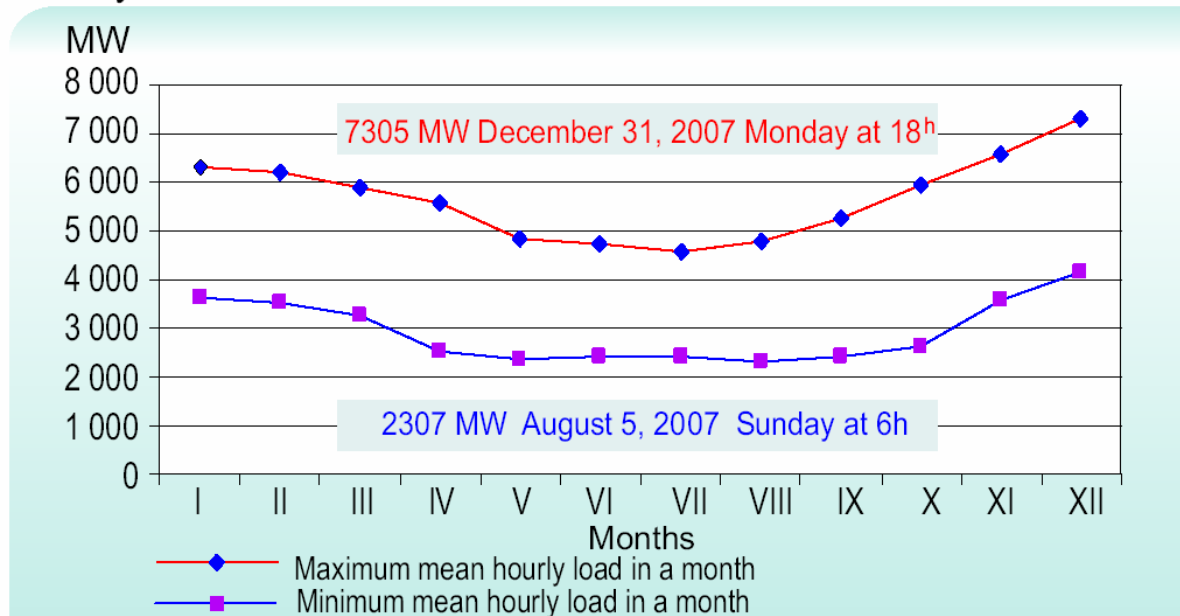
**Injection into
the neighboring systems: 8,658 GWh**



Serbian Electric Transmission System

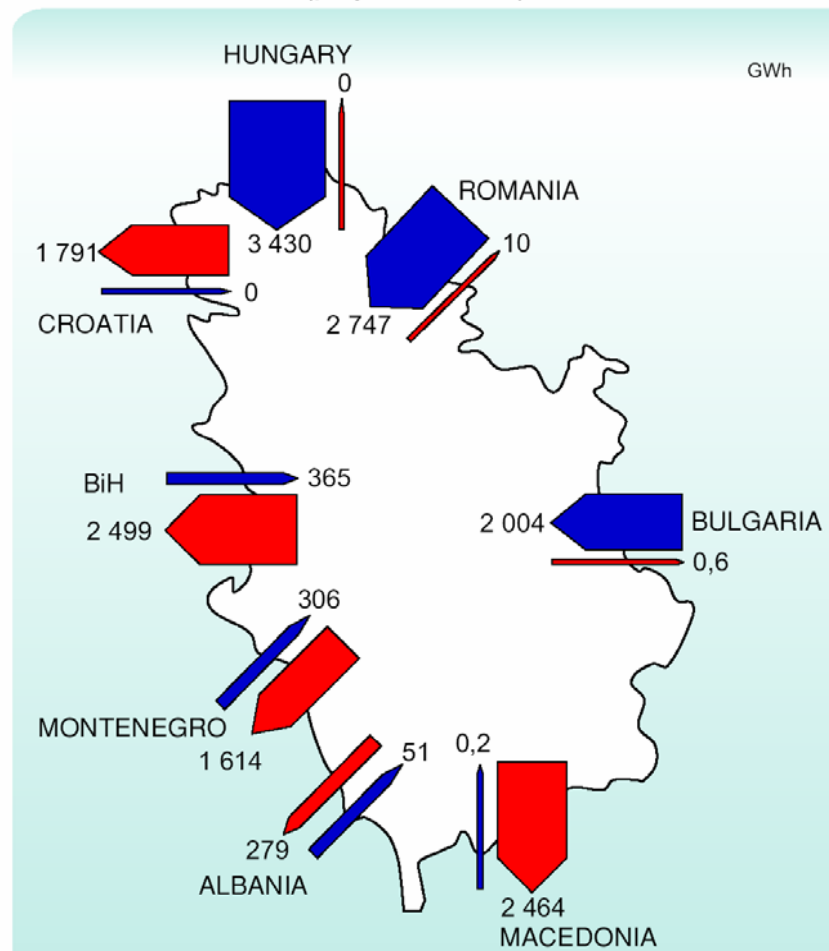
- peak load -

Hourly Load



Serbian Electric Transmission System Position in South East Europe

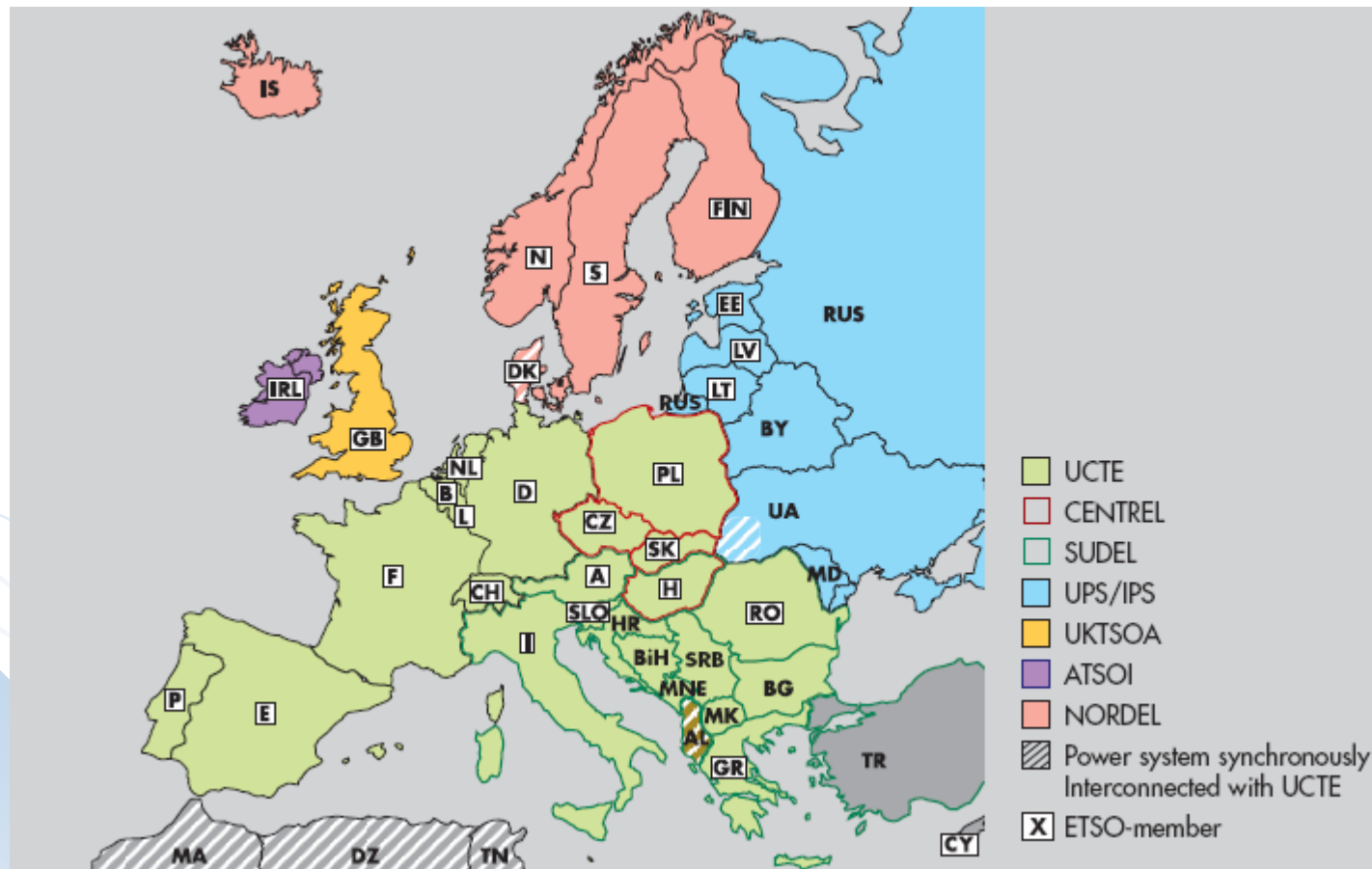
Electricity Exchange on Tie Lines
(physical flow)



Neighboring countries:

1. Albania
2. Bosnia and Herzegovina
3. Bulgaria
4. Croatia
5. Hungary
6. Macedonia
7. Montenegro
8. Romania

Serbian Electric Transmission System Position in Europe



Serbian TSO - ID

PU EMS¹ - Serbian Transmission System and Market Operator (TSMO)



- Established on the 1st of July 2005
- Independent company
- 100% state-owned by the Republic of Serbia
- Transmission asset owner
- Number of employees: 1,331
- Licensed for:
 - Transmission of electricity
 - System Operation
 - Organization of Electricity Market

¹ Public Utility ELEKTROMREŽA SRBIJE

Serbian TSO - Tasks

EMS obligations under:

- **Transmission License**

- Maintaining the transmission system and tie-lines
- Ensuring continuous availability and functioning of the system
- Undertaking safety measures when using transmission system
- Undertaking measures for environmental protection
- Development of the transmission system in compliance with the 5-year development plans

- **System operation license**

- Ensuring security of power system operation
- Determining technical conditions for connection to the transmission system
- Providing ancillary services
- Operating the transmission system
- Balancing
- Maintenance coordination
- Synchronize operation of Serbian power system with neighboring systems
- Monitoring of generation, transmission and distribution facilities
- Cooperation with Market Operator in operational planning and settlement

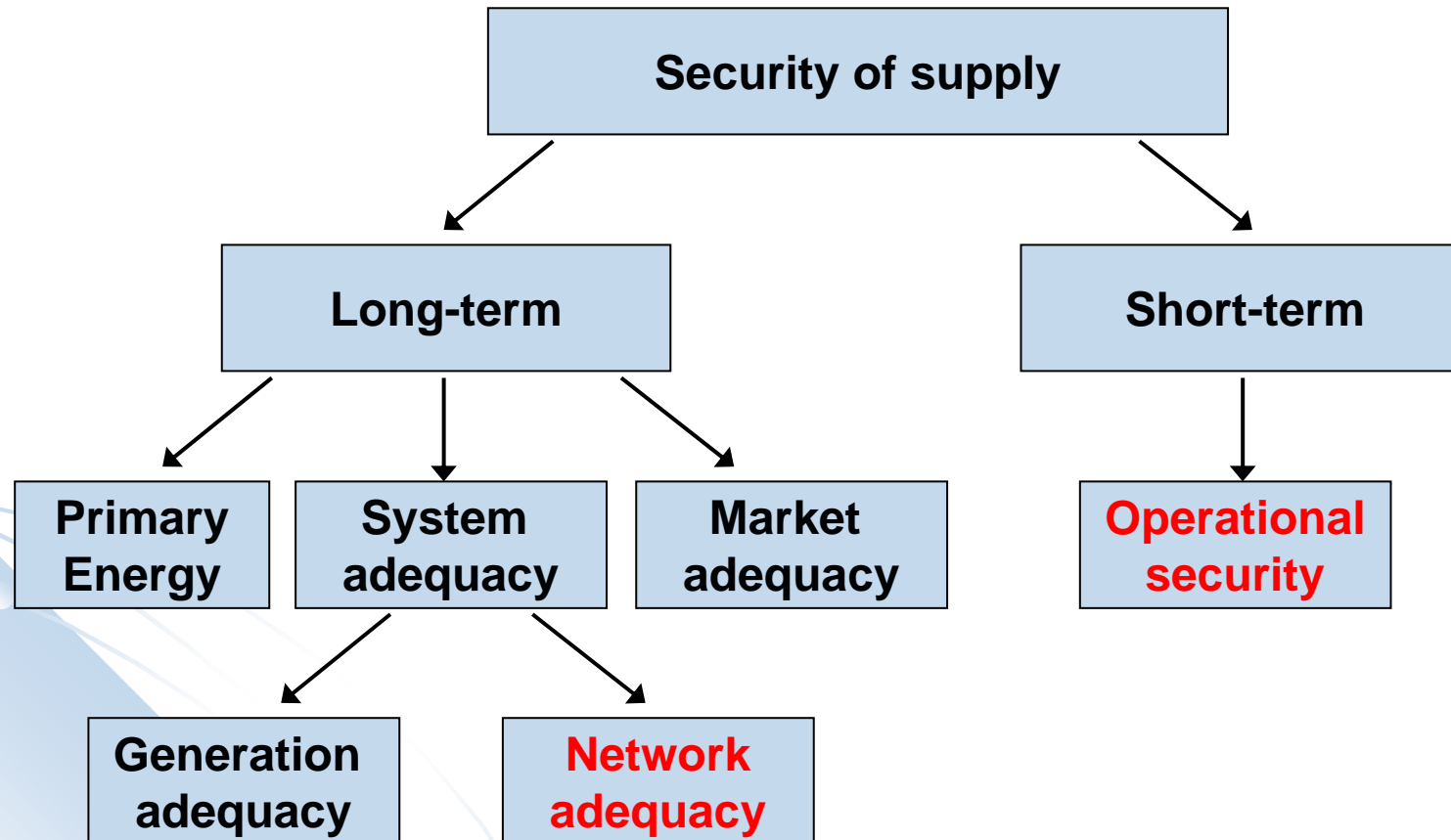
Security of supply - Definition

Security of supply is the ability of the power system to supply final customers with electricity under specified level of:

- **Continuity** (end-user have electricity),
- **Reliability** (end-user will have electricity),
- **Quality** (end-user have/will have “good” electricity),
- **Liability** (if end-user don't have electricity he'll get compensation),

relating to the existing standards at the points of delivery.

Security of supply - Scope



Network adequacy

Availability of:

- transmission network
 - distribution network and
 - cross-border interconnections
- infrastructure to meet demand.

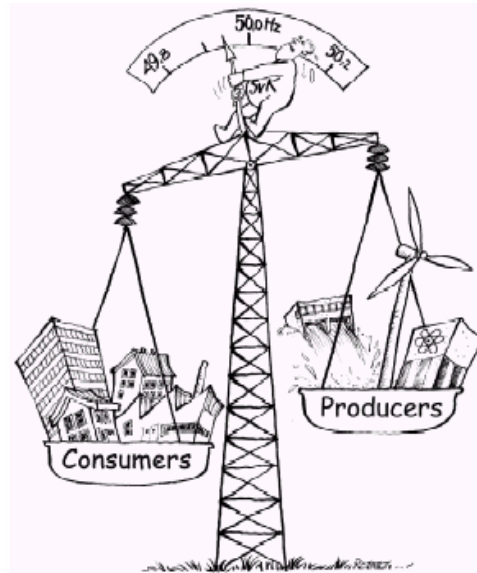


Operational security

Operational network security

+

Maintaining balance between supply and demand



SoS – WHO?

Bodies:

- Government/Ministry
- AERS
- DSOs
- Market players
- TSO



SoS – HOW? (I)

Government/Ministry:

- Ensuring harmonized energy policy and energy development planning through the:
 - Energy Sector Development Strategy (ESDS)
 - Implementation Program of ESDS
 - Energy Balance
- Ensuring compliance with EU legislation through the activities in MC-EnC
 - ⇒ On 18.12.2007. MC-EnC adopted decision under which Serbia has to implement Directive 2005/89/EC concerning measures to safeguard security of electricity supply and infrastructure investment before 31 December 2009
- Providing proper economic incentive for the investments in the process of giving approval on prices for use of the network

SoS – HOW? (II)

AERS:

- Issuing methodologies and tariff systems for transmission and distribution network use
- Issuing methodologies for connection charges
- Giving opinion on the prices of electricity and network use
- Giving approval on the Grid/Distribution/Market Code
- Market Monitoring process
 - Infrastructure development planning follow-up
 - Connection procedure
 - Ancillary Services provision
 - Congestion management
 - Quality of supply

SoS – HOW? (II)

Market Players:

- Compliance with legislation/license/connection/codes
- Providing ancillary services
- Providing necessary data to TSO



SoS – HOW? (III)

DSOs:

- Issuing Distribution Code
- Development, maintenance and operation of the distribution network
- Cooperation with TSOs on operation, maintenance and development of the networks
- Monitoring and reporting

SoS – HOW? (III)

TSO:

- Issuing Grid Code
- Development, maintenance and operation of the transmission system in compliance with legislation/codes
- Cooperation with connected customers, DSOs and neighboring TSOs on operation, maintenance and development of the networks
- Monitoring and reporting

Grid Code

Grid Code legally establishes technical rules for the:

- Transmission System Planning
- Connection to the Transmission System
- Transmission System Access
- Power System Operation
- Metering

in order to ensure secure power system operation.

First official version of the Grid Code is expected to be approved by AERS and issued by the TSO this month.

Grid Code

Transmission System Planning

TSO responsibilities:

- 5-year Transmission System Development Plan with respect to:
 - Voltage
 - Frequency
 - Short-Circuit Currents
 - “N-1” Security Criteria
 - Stability
 - Generation adequacy
 - Transmission System Adequacy and
 - Ancillary Services provisions
- Cooperation with DSOs and other TSOs on regional and UCTE level on the Development Plans harmonization



Network users responsibilities:

- Providing data needed for Development Plan preparation

Grid Code

Connection to the Transmission System

Technical conditions to be fulfilled by the TSO and network user prior to the connection:

- Technical criteria regarding
 - Voltage (harmonics, overvoltages, unbalances)
 - Frequency
 - Short-Circuit Currents
 - “N-1” Security Criteria
 - Stabilityhave to be preserved when the new user gets connected.
- Additional requirements imposed to the generator regarding
 - Ancillary services capability (primary, secondary, tertiary reserve, voltage control, black start)
 - Synchronizing to the network
 - Disconnecting from the network



Grid Code

Transmission System Operation

TSO responsibilities:

- Operational planning – yearly, monthly, weekly, daily
- Maintenance planning – yearly, quarterly, weekly
- Ancillary services
 - Primary
 - Secondary
 - Tertiary
 - Voltage control
 - Black start
 - Inadvertent interchange
 - Technical losses
- System operation
 - Balancing
 - Congestion management
- Emergency planning
 - Contingency planning
 - Demand control



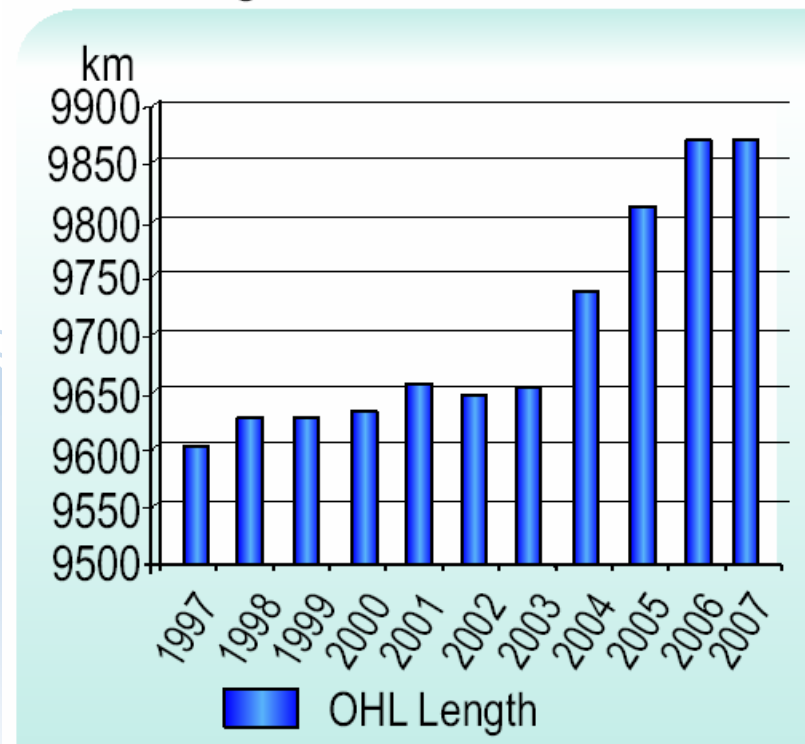
Serbian Transmission Power System - 1990-2000 development -

- Delay in investments due to international sanctions and low electricity prices
- Destruction of the network during NATO airstrikes in 1999

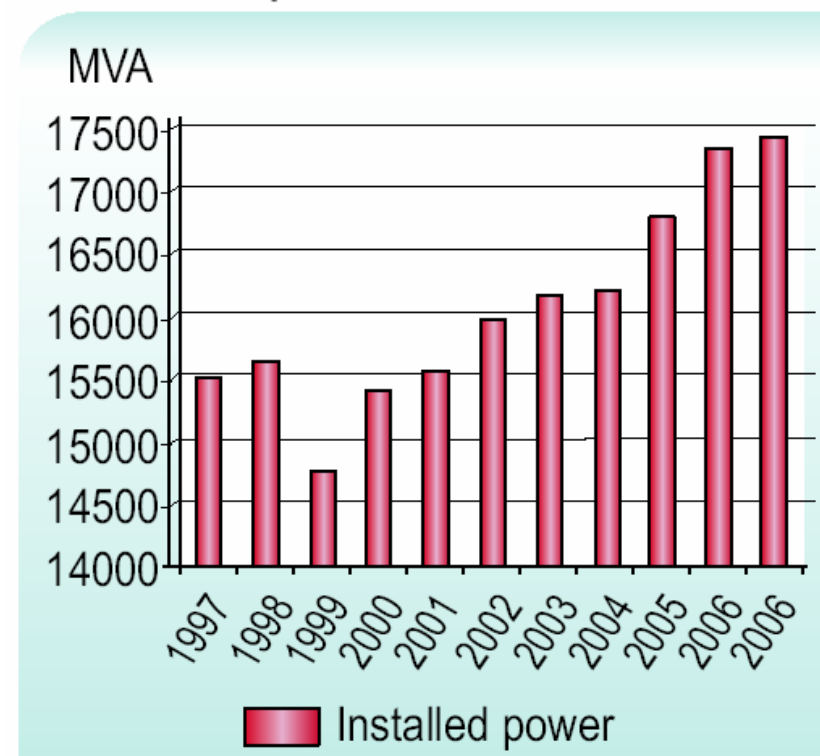


Serbian Transmission Power System - 1997-2007 development dynamic-

OHL Length

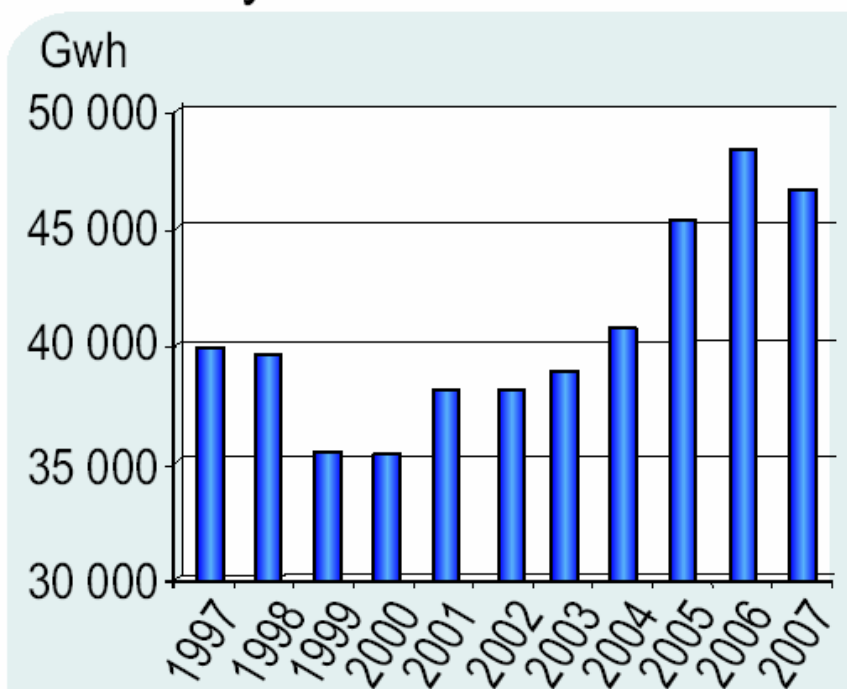


Installed power

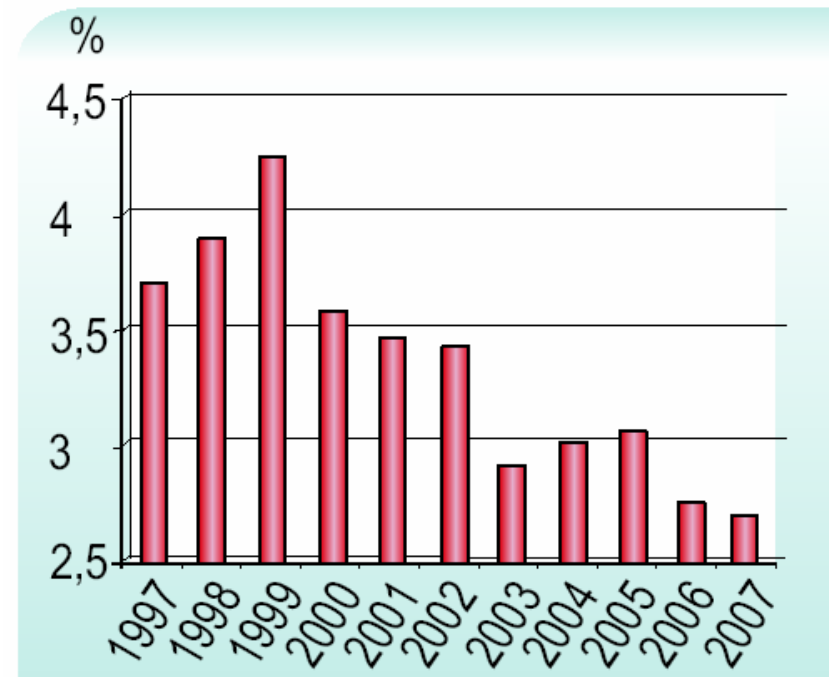


Serbian Transmission Power System - 1997-2007 development dynamic-

Electricity delivered



Transmission Network Losses



Serbian Transmission Power System - development plan until 2015-

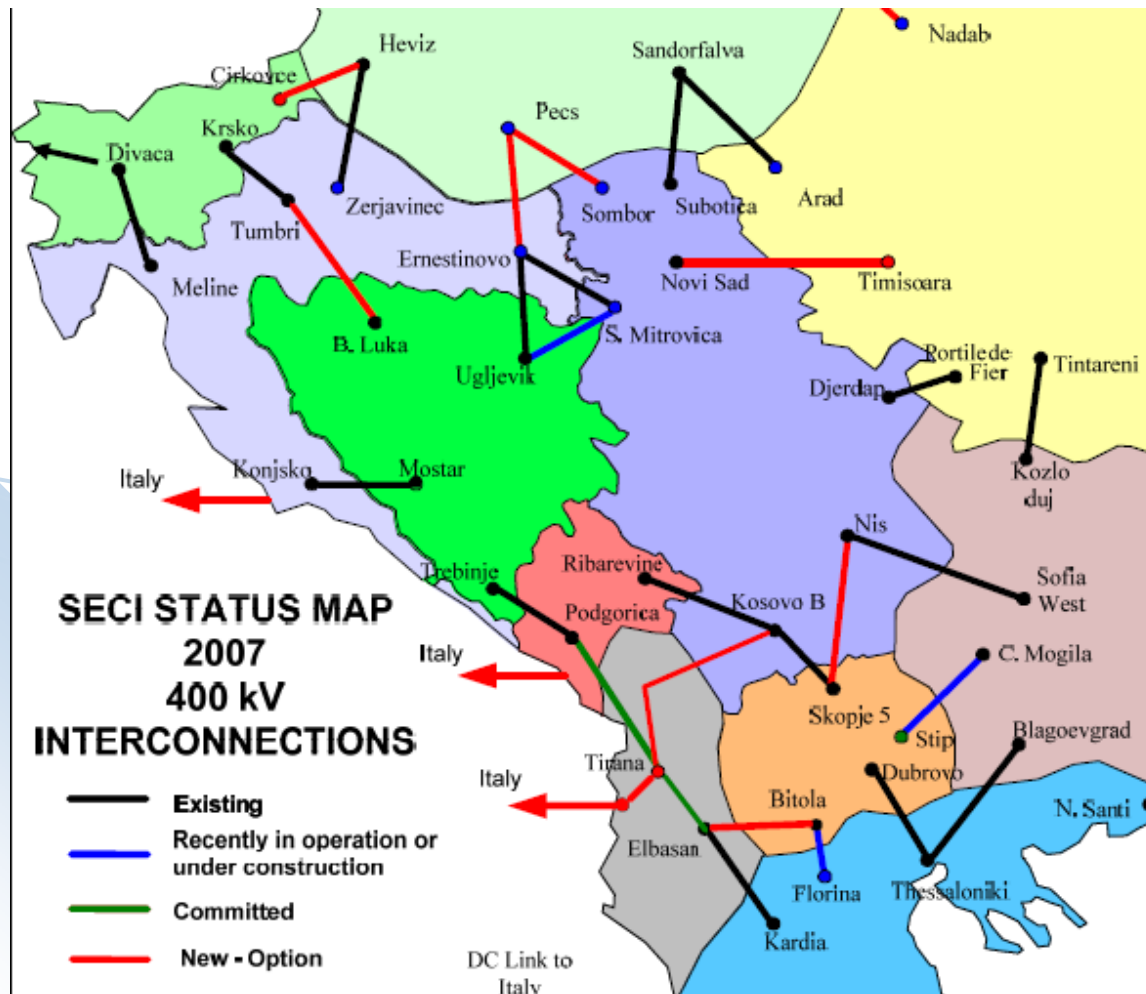
The main areas of EMS Investment and Development plan

- Transmission system
- IT
- Telecommunications
- Other investments

Investments of 400 m € are planned until 2015!

Serbian Transmission Power System

- interconnection development -



- **Serbia-Macedonia**
 - 400 kV OHTL
 - Under construction
- **Serbia-Romania**
 - 400 kV OHTL
 - Feasibility study under way
 - 128 km in total
 - 84 km in Serbia
 - 44 km Romania

Resume

Maintenance, renewal and development of transmission power network is one of major prerequisites for improving security of supply in Serbia.



Thank you for your attention!

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