

# Security of supply I: Generation adequacy in Serbia and SEE

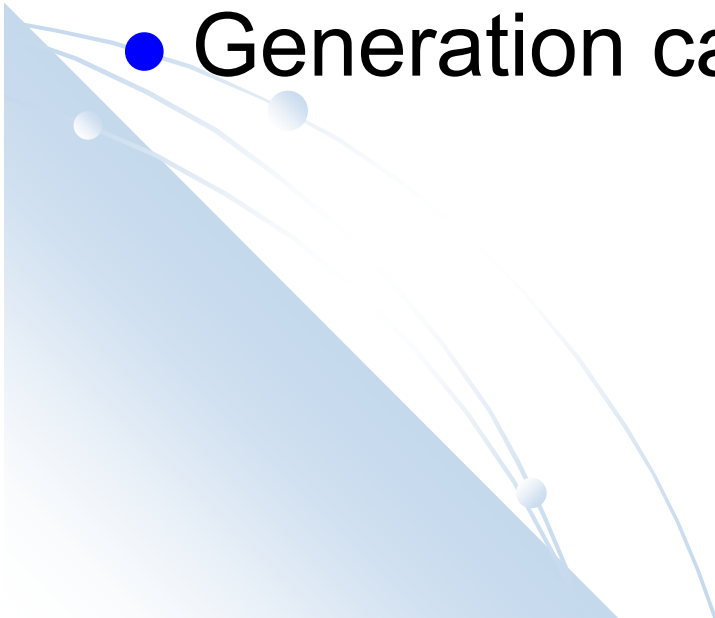


Harrisburg, 31 March 2008

# Main Purpose of the presentation

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- Describe elements for Generation Adequacy in Serbia and SEE
- How to fulfill requests for Security of supply
- Generation capacity production forecast



# Contents

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- Objectives and overview of power system planning in Serbia and SEE
- Compliance with EU legislation
- Forecasting electricity demand (annual, varying, peak)
- Capacity mechanisms to stabilize the generation volumes
- Power production capacity reporting by generators, interface with the transmission grid
- Generation plant availability (scheduled maintenance, forced outages)
  - Basic modeling approaches
  - Special modeling for variable (wind) generation
  - Process of commissioning new generation capacity

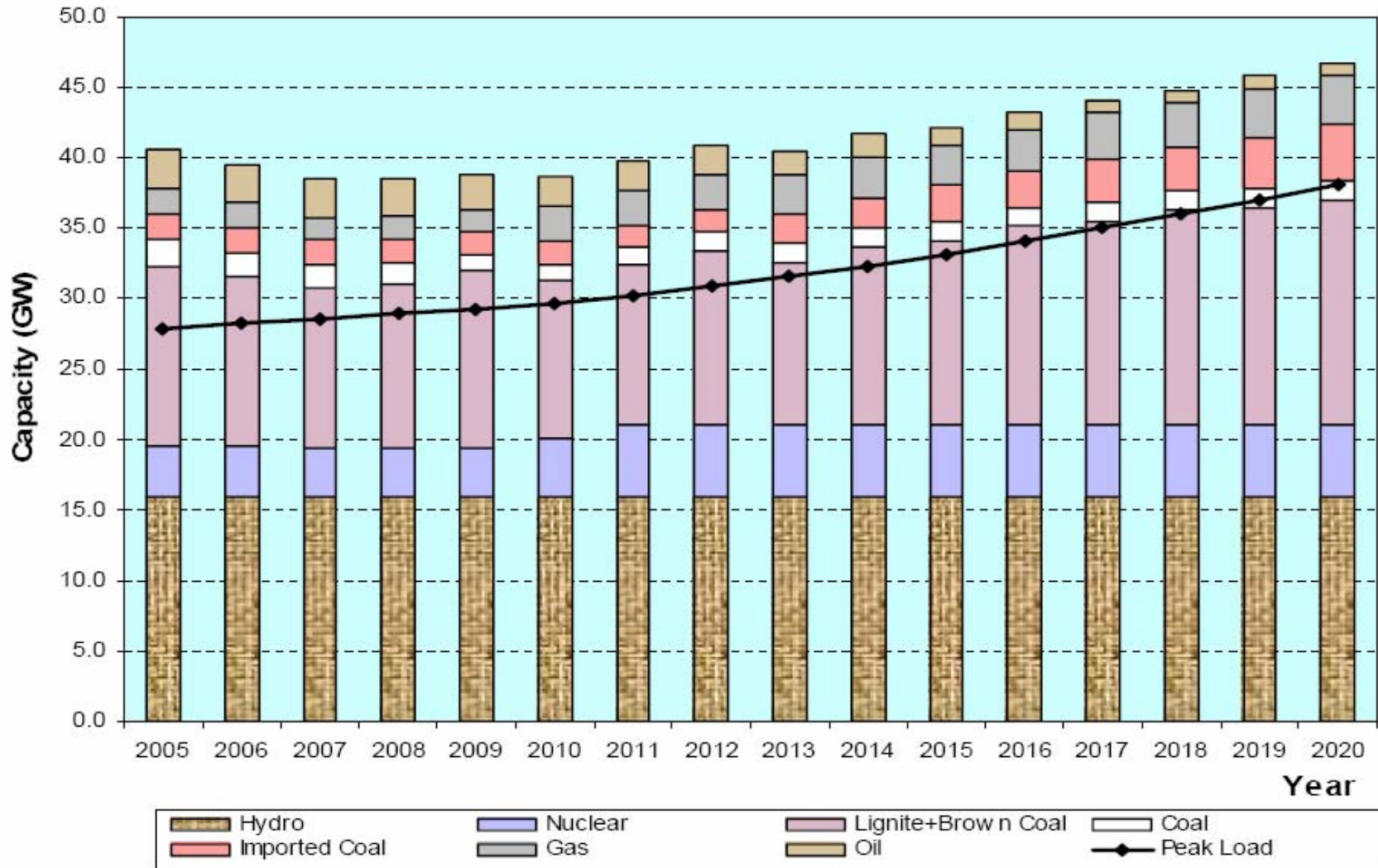
# Objectives and overview of power system planning in Serbia and SEE



# SEE Generating Sources - 2005

Source	Total	42.8 GW	167 TWh	100 %
Hydro	HPP+PS	18.2	47.6	28.5
TPP	Lignite + Brown coal	12.8	74.6	44.7
	Coal domestic and imported	3.7	18.4	11.0
	Oil	2.7	0.2	0.1
	Gas	1.8	2.8	1.7
Nuclear		3.5	23.4	14.0

# SEE Peak demand and sources: 2005-2020

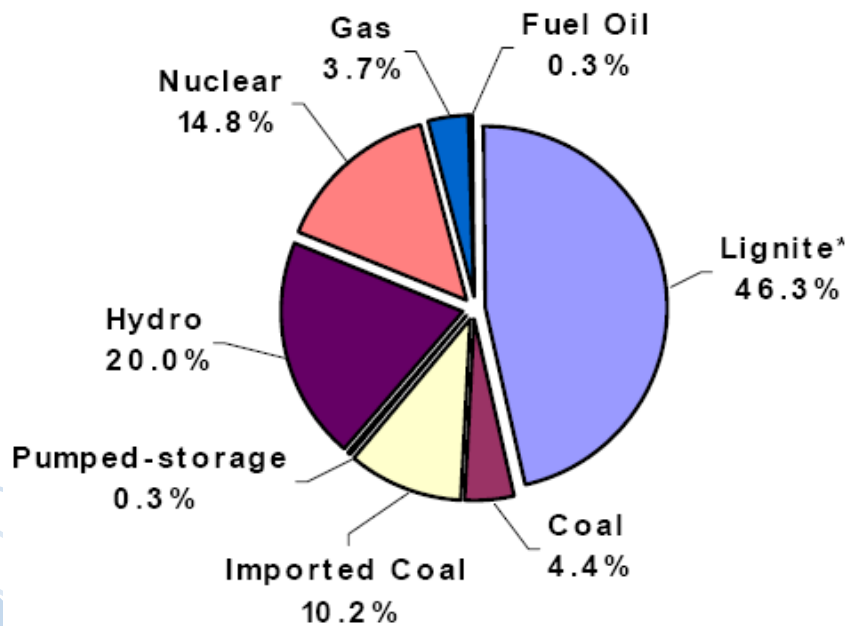


# Results of GIS Update

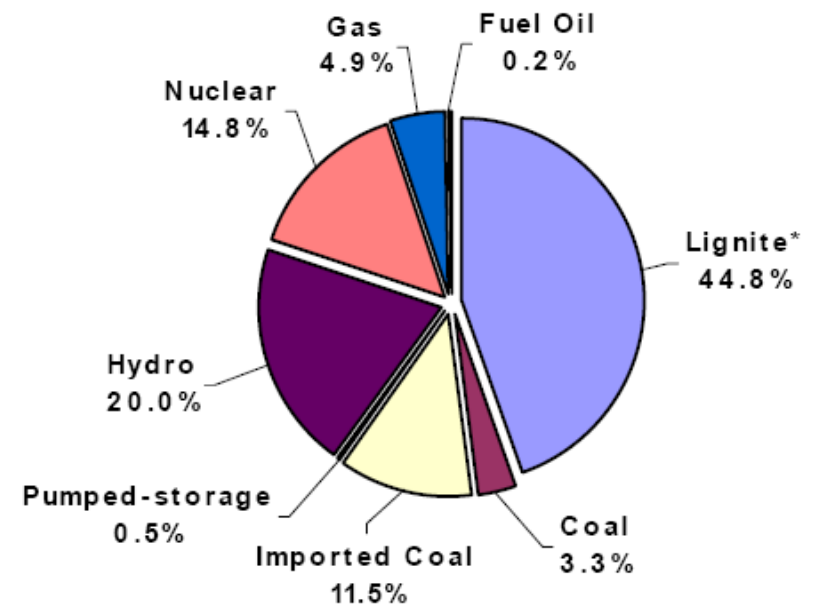
<u>Scenario</u>	<u>Rehab</u> (MW)	<u>New</u> (MW)
■ Official plan:	11,574	11,000
■ Baseline Justified:	9,361	12,696
■ High electricity imports	9,361	6,936
■ High oil/gas prices:	10,061	12,494
■ Low oil/gas prices:	6,814	14,712
■ €20/ton of CO2:	4,573	16,634
■ €30/ton of CO2:	Zero	21,259
■ High gas/CO2 prices	10,061	13,926

# SEE Generation mix in 2020

**Official Rehabilitation**



**Justified Rehabilitation**





# Key Results of GIS Update (1)

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- **Local lignite:** most scenarios indicate the need for 4,000-4,800 MW; high CO<sub>2</sub> prices may limit its use
- **Imported coal:** up to 3,000 MW selected; relatively stable price; plentiful and secure supply; but lack of infrastructure (ports; railroads)
- **Natural gas:** up to 8,000 MW selected; cleanest fuel, but highly volatile price; multiple supply sources could enhance diversification and competition, but require significant investments
- **Nuclear:** Competitive at €30/ton CO<sub>2</sub>, but serious obstacles remain (siting and financing)

# Key Results of GIS Update (2)

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- **Hydro:** 2,112 MW competitive under high gas prices or high CO2 prices; higher potential exists but more comprehensive assessment is needed
- **Renewables:** Renewables may be competitive at high gas or CO2 prices; more review needed
- **CHP:** District Heating could be modernized and expanded to generate electricity, too; high efficiency and small increments which are easier to finance are attractive features; more detail assessment is needed
- **Electricity Imports:** from Ukraine and Russia; Viable option; depends on pricing (break-even costs is €32.6/MWh) and strengthening of transmission

# State of play on Generation in SEE

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- There is a lack of electricity in SEE region (present generation vs. consumption growth)
- South of SEE is facing the greatest energy deficit (Albania, Greece, Montenegro, FYROM, UNMIK)
- Clear indicatives for consumption/energy demand growth from 2005-2020

## **Clear conclusions:**

- There is an urgent need for generation capacities investments in SEE region
- Deficit of electricity in SEE is provided through electricity import (present and in near future)
- High Electricity Import prices (40-45 €/MWh vs. 70-80 €/MWh in SEE)

# Serbia: Development and Investments (1)

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REBIS: GIS Study, (WB, 2004)  
Data on South East Europe, 2005 - 2020:

SEE region will require

- 12,700 MW of new capacity
- 9,400 MW of rehabilitated capacity  
(to extend life time)

• Serbia will require

- 640 MW of new capacity
- 2,800 MW of rehabilitated capacity  
(to extend life time - partly accomplished)

# Serbia: Development and Investment (2)

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## Demand Forecast :

Anticipated yearly increase (without KiM)

- REBIS-GIS Study (WB, '04): 1.6% -1.1%
- LCIP for Serbia (EAR, '05): 1%
- Serbian Energy Strategy ('05): 1.9%
- EPS ('07): 1.3 - 0.6%

## EPS's Assumptions:

- Economic electricity price
- Development of district heating systems
- Development of gas sector
- Effects of rationalisation

# Serbia: Development and Investment (3)

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- Rehabilitation and modernization of existing facilities
- Construction of new capacities

## **Domestic resources**

- Lignite
- Hydro potential
- Renewable sources

## **Imported resources**

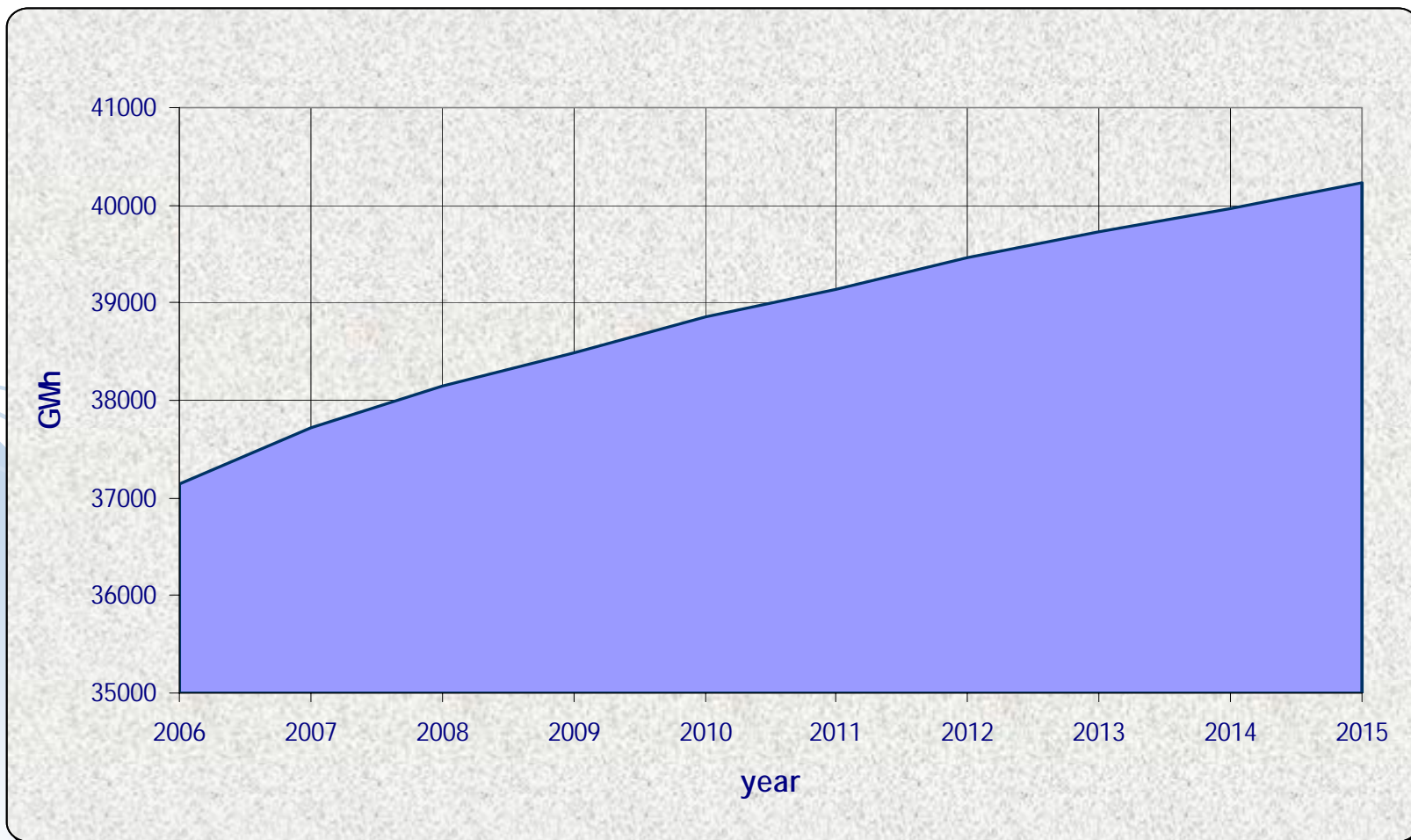
- Natural Gas

The most important rehabilitation projects:

- HPP Đerdap, 6\*176 MW
- HPP Bajina Bašta, 4\*91 MW

# Electricity demand in Serbia

- Projected demand increase (EPS projection) of 9% for the period 2006-2015



# Electricity Generation priority projects

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- EPS projects supported by the Government of RS

## **I. TPP Kolubara B**

700 MW (2x350 MW) lignite fired power plant

## **II. TPP Nikola Tesla B3 (TENT B3)**

700 MW lignite fired supercritical power plant

## **III. Reconstruction/ Extension of CHPP Novi Sad**

Optimization of existing plant and new unit – up to 450 MW gas-fired

combined heat and power plant with combined cycle gas turbine



# I. TPP Kolubara B

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- **Country and location within country:**
  - Serbia, Lazarevac/Ub
- **Type of project:**
  - Construction completion
  - Joint investment into turnkey construction and operation of TPP Kolubara B
- **Description of the project:**
  - 700 MW (2x350 MW) lignite-fired power plants with closed cooling system and environmentally optimized design according to BAT on the site of Kolubara B
- **Origin of funding:**
  - IPP - Private
- **Overall project value:**
  - Approximately EUR 750 million

## II. TPP Nikola Tesla B3

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- **Country and location within country:**
  - Serbia, Obrenovac
- **Type of project:**
  - Greenfield/expansion of TPP Nikola Tesla B
  - Joint investment into construction and operation of TENT B3
- **Description of the project:**
  - 700MW lignite-fired supercritical power plant with open cooling system and environmentally optimized design according to BAT on the site of TENT B
- **Origin of funding:**
  - IPP - Private
- **Overall project value:**
  - Approximately EUR 900 million

### III. Reconstruction / Extension of CHPP Novi Sad

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- **Country and location within country:**
  - Serbia, Novi Sad
- **Type of project:**
  - Rehabilitation/expansion
- **Description of the project:**
  - Optimization of existing plant and new unit – up to 450 MW gas-fired combined-heat-and-power plant with combined cycle gas turbine
  - Beside PE EPS and its local partner, the City of Novi Sad, project requires involvement of the strategic partner (preferably foreign investor)
- **Origin of funding:**
  - PPP – partially soft loans
- **Overall project value:**
  - Approximately EUR 120 – 160 million

# Contribution to the energy market

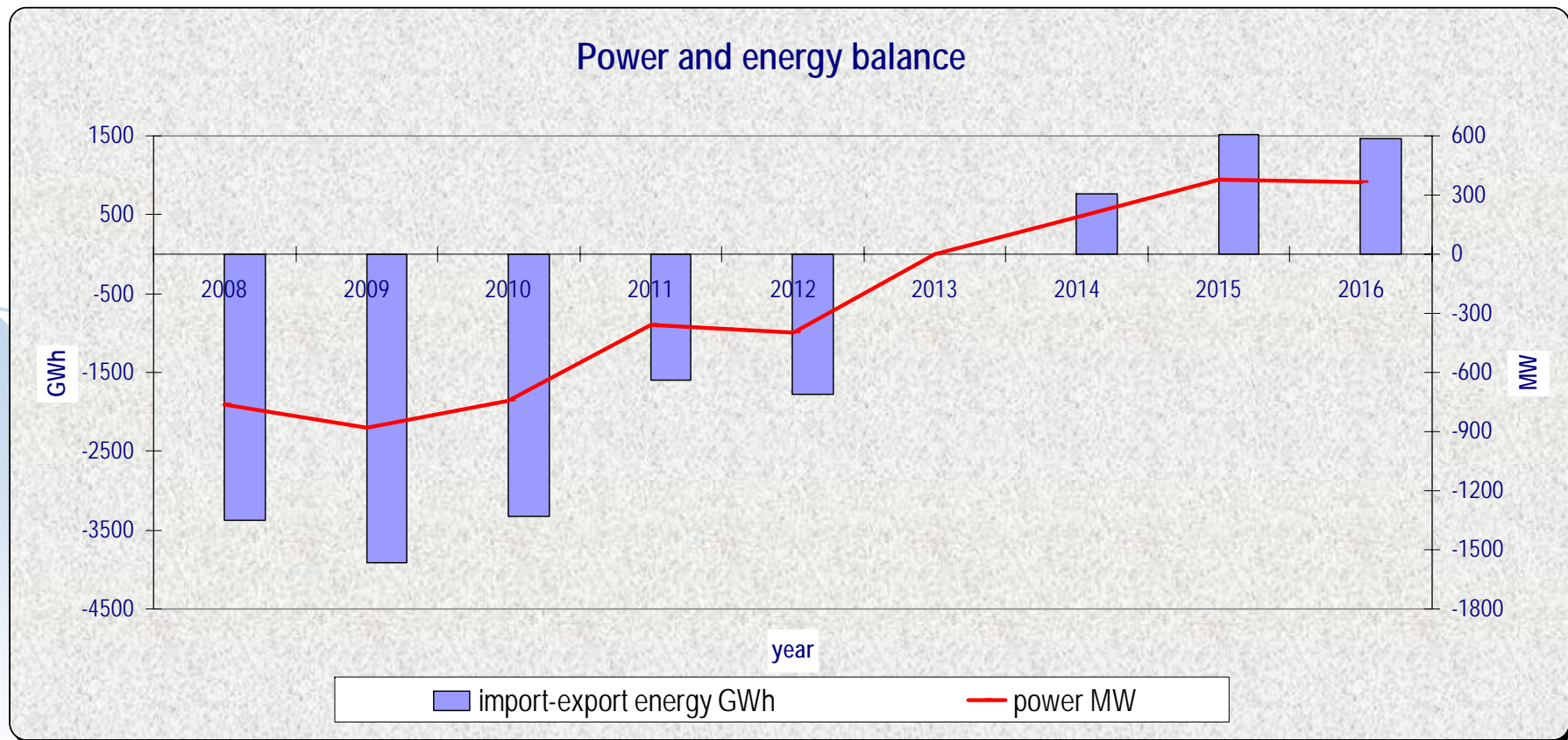
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- **National & Regional**

- Replacement and expansion of pool of generation assets prepares the grounds for meeting the projected higher energy demands
- New thermal capacities up to 1,850 MW (Kolubara B, TENT B3 and CHP CCGT Novi Sad) will not only secure supply on the Serbian market but have significant impact on electricity imbalances on the regional level
- New technologies ensures substantial environmental advantages compared to existing old, low efficiency plant which will be shut down

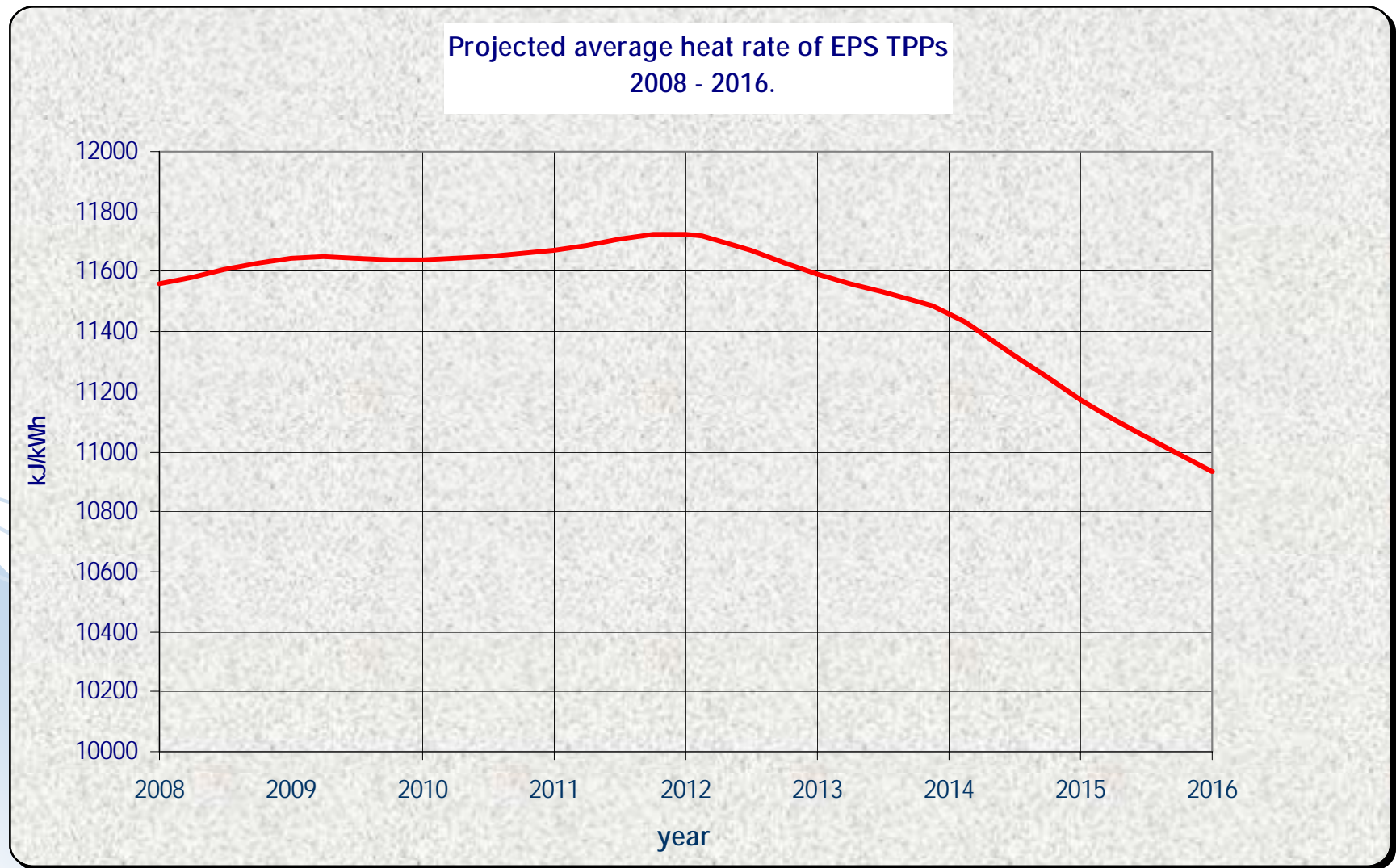
# Electricity supply in Serbia

- New generation capacities securing energy balance after 2013





# Environmental and efficiency advantages



# Renewable sources - Potential Assessment

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- **Small Hydro PP**

- CADAstre of Small PP's ('87)
- 850 Sites
- 450 MW
- 1,500 GWh/year

- **Biomass**

- **Wind power plants - farms**

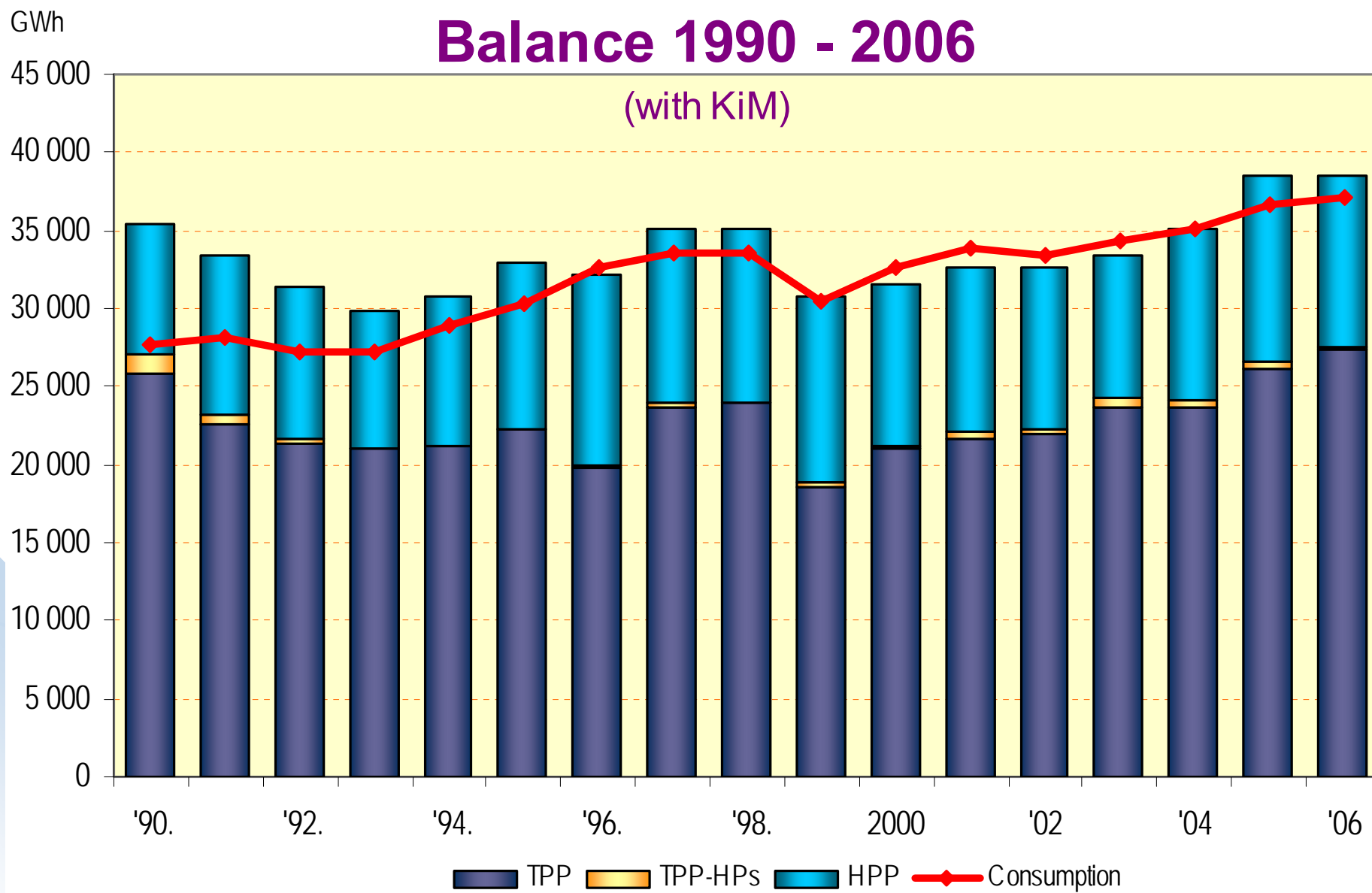
- **Waste incineration**

- **Other**

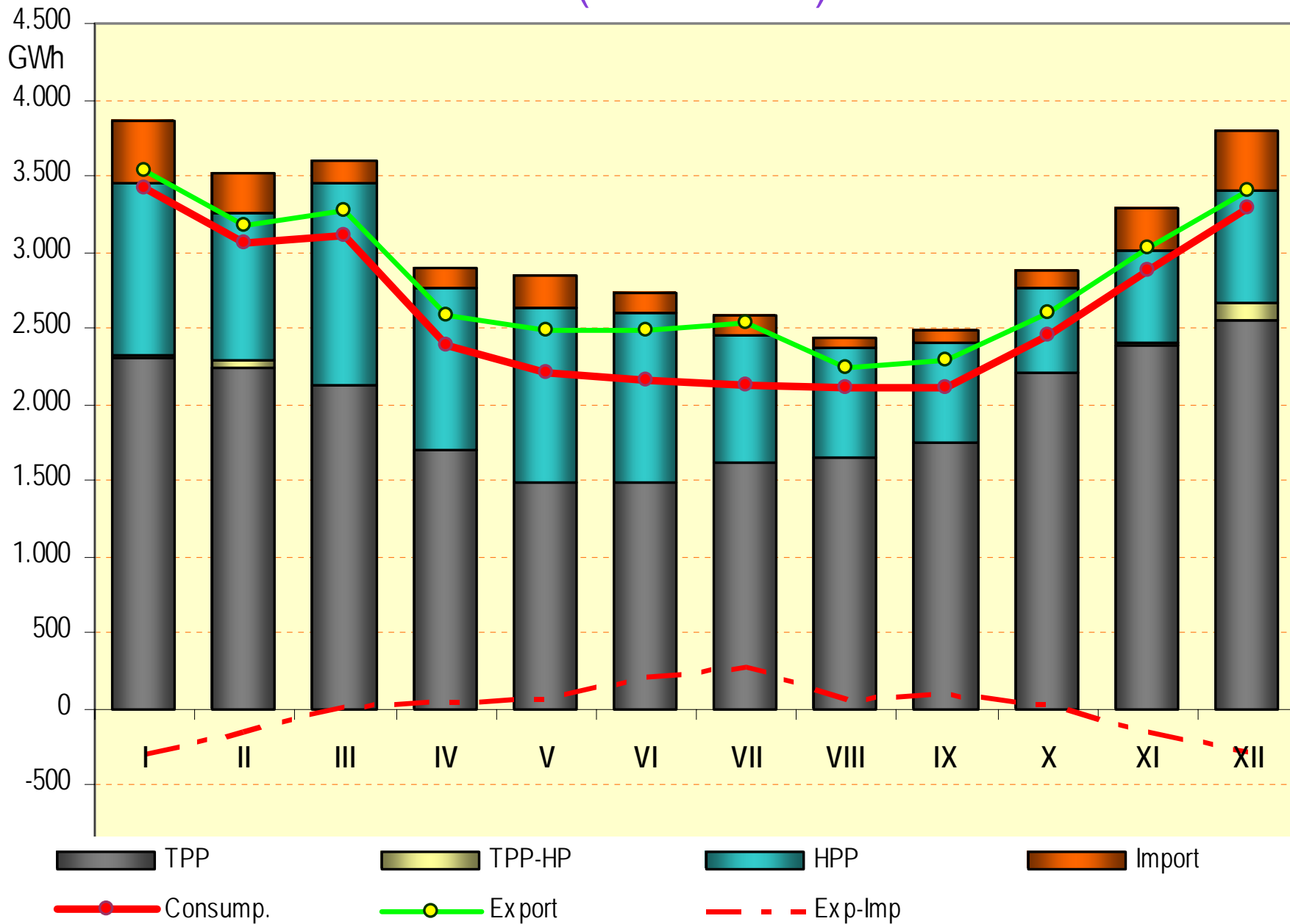
# Forecasting electricity demand (annual, varying, peak)



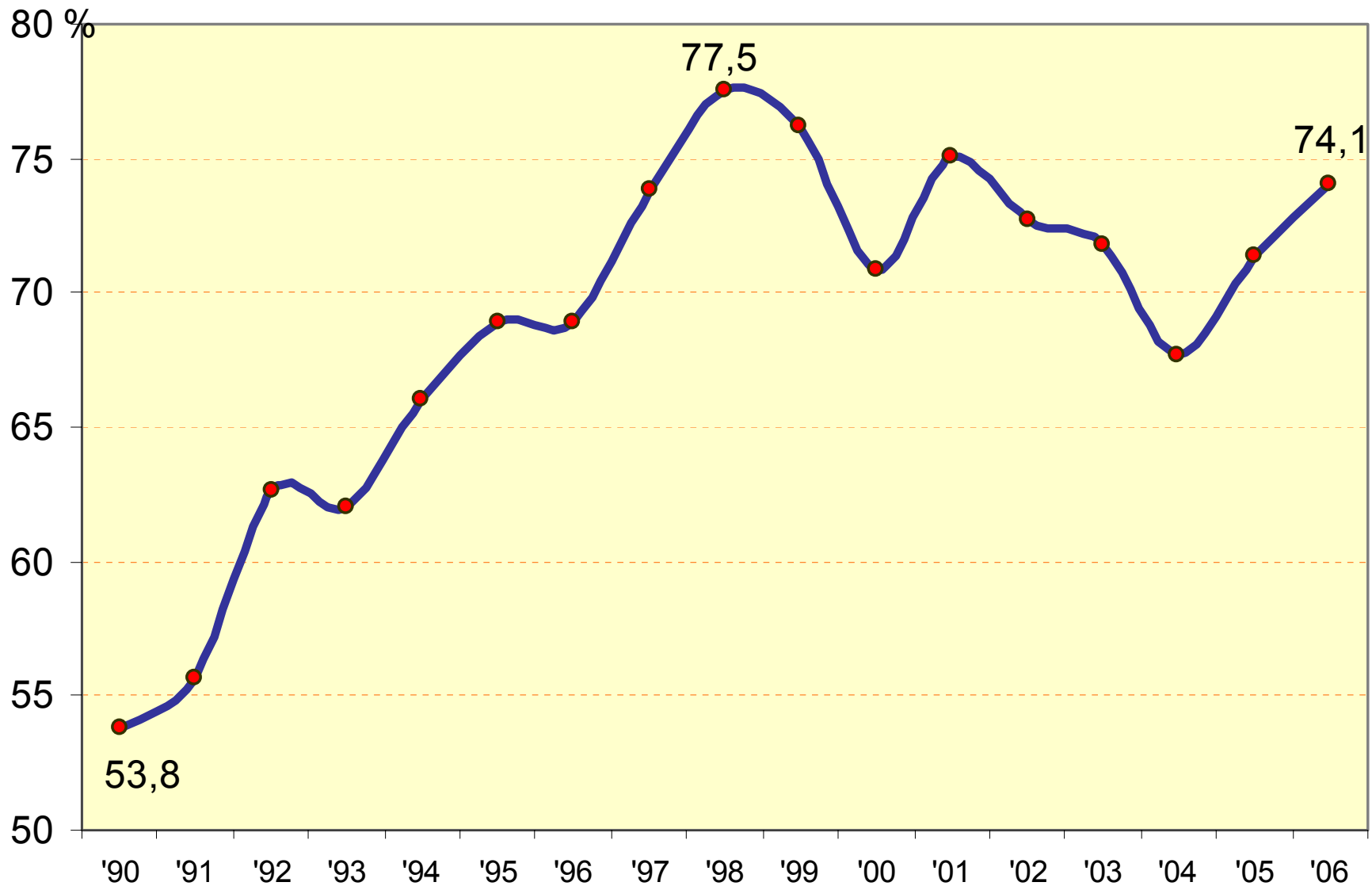




## Balance 2006 (without KiM)



# Max Peak Load / Generation Capacity



# Power System of Serbia



# Serbia's Power System

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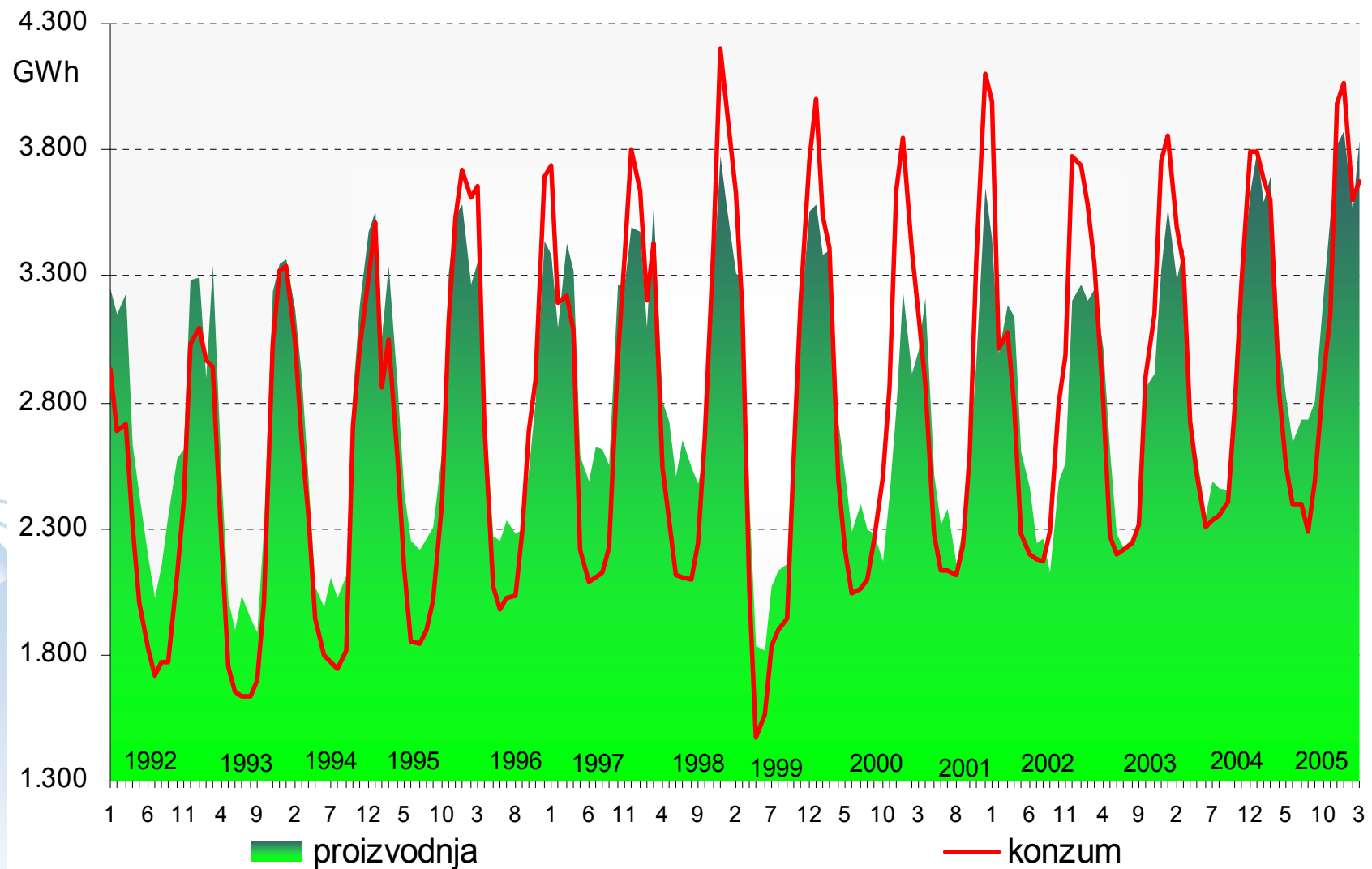
- **Advantages**

- Favourable position in the Region
- Significant share of HPPs (40%)

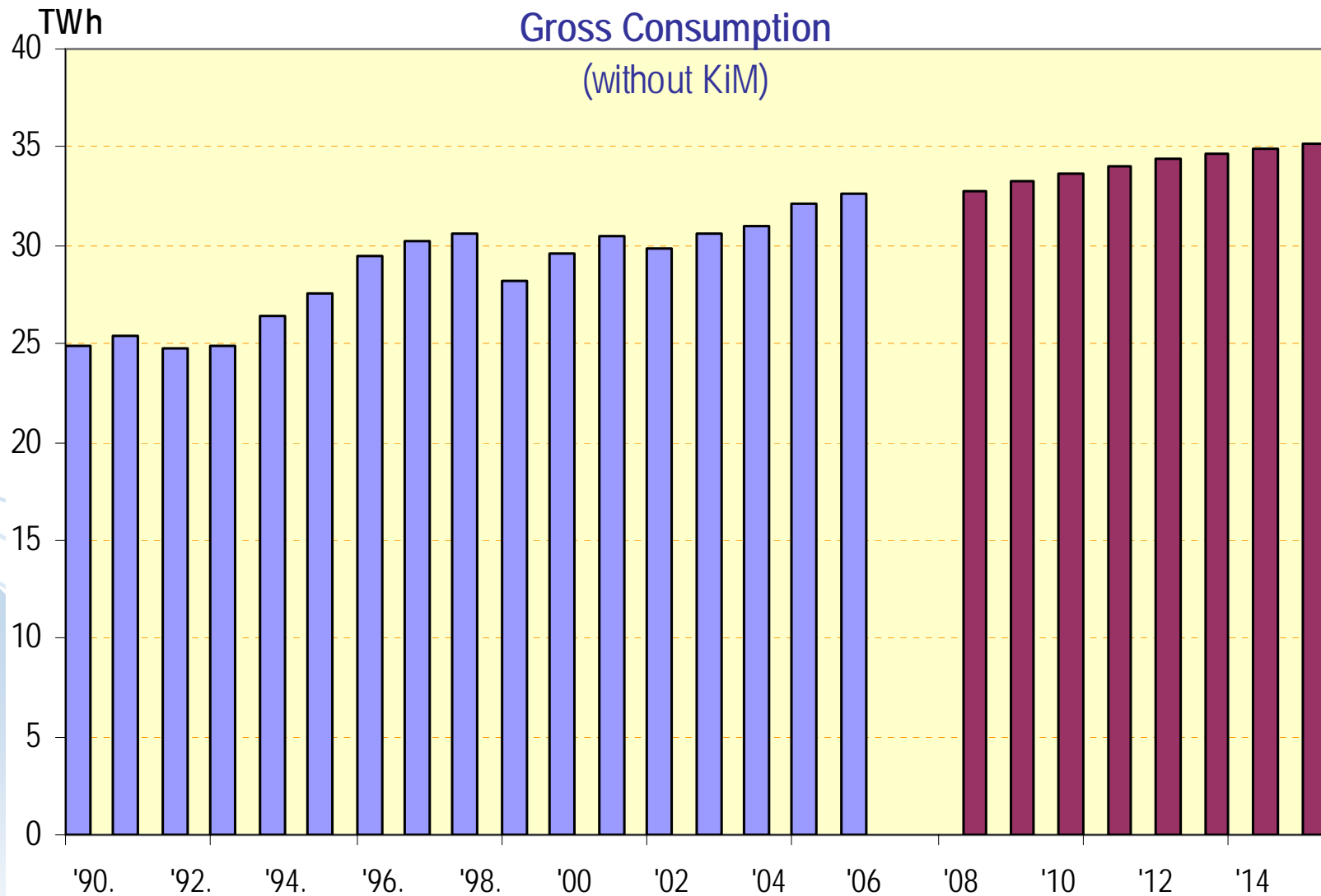
- **Problems**

- Big seasonal difference in consumption
- Delay with:
  - New generation capacity construction and
  - Revitalization and modernization of existing generation facilities

# The range of the monthly production and consumption



# Demand forecast by EPS



# EPS Yearly Forecast

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According to the EPS yearly plan for next year there is:

- Plan of Electricity deliveries
- Plan of External deliveries
- Plan of Generation
- Plan of Import of electricity (deficit)
- Plan of production of coal
- Plan of thermal energy and technological steam



# EPS Plan of Generation: 2008

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- 34,503 GWh will be provided from domestic generation sources (3% more than realization in 2007, and makes 94.9% of needed available energy)
- Run-of-river HPP production plan is 9,397 GWh (15% more than last year, due to bad hydro circumstances in 2007)
- Reservoir and Pump Storage HPP plan is 927 GWh (73% of realization in 2007) → Planned production is in line with power system needs for providing peak energy and with assumption that the accumulation level at the beginning and end of 2008 remains the same
- Thermal Power Plants (coal) plan is 23,649 GWh (1% more than realization in 2007. TPP Generation abilities are bigger than planned generation at amount of 1,564 GWh, but limited by production of coal)
- CHP (liquid and gas) plan is 530 GWh, in line with needs for heating power and electricity, respecting possibilities for electricity import and price, import of oil and gas

# Grid Codes provisions

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Transmission grid development plan:

- Contains data on total consumption and generation forecast
- Investigate generation adequacy and preconditions for normal power system functioning
- Monitoring of actual and forecast of future conditions in power system according to consumption, generation, taking into consideration sufficient amount of reserve

# Capacity mechanisms to stabilize the generation volumes



# Electricity Market Structures in Energy Community

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- Very little free market wholesale activity within most of the SEE
- Distribution companies (suppliers) are either still integrated with the generation company or are not eligible
- Suppliers are obliged to buy from a wholesale supplier, usually attached to the TSO, at regulated prices or there are still integrated generation-supply businesses
- Only Romania and partially Bulgaria have broken the generation sector to allow for some amount of national competition in generation
- In Albania, Croatia and Montenegro, there is, for the time being, integrated generation and supply companies - thus no wholesale market
- In FYROM the soon to be privatized distribution company (supplier) will not be eligible and thus will have to buy its electricity from the wholesale supplier attached to the TSO

# Outcomes...

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- Generation Investment Study (GIS), have identified the need for considerable investments in SEE in generation capacity (new power plants and re-powering of existing ones) until 2020
- How to provide appropriate incentives to prospective private investors and financing institutions to commit funds for such long term projects, while at the same time avoiding excessive tariff increases, since electricity tariff affordability is a major issue for SEE region
- The introduction of competition in generation fundamentally changes the planning dynamics for new investments
- Under a monopoly regime the “capacity market” is administered by the vertically integrated company through a central planning process determining, by an engineering related criterion, the type and size of new generating capacity and the associated transmission facilities required

# Capacity Support Mechanisms in EnC

- Italy (still hasn't finalized its permanent scheme ) and Greece are the only that have implemented a capacity mechanism, both of which are currently running the transitional phases of their respective mechanisms
- Romania and UNMIK are still in the planning process
- The rest haven't planned or implemented any kind of capacity mechanism, excluding the renewable energy sources support mechanisms
- Hungary, FYROM, Turkey still have in place long term Power Purchase Agreements (PPAs) in order to guarantee the funding of generation units
- In Serbia, Bosnia-Herzegovina and Montenegro the generation investments are still planned centrally
- In Austria the interconnection capacities in conjunction with the existing hydro resources are considered adequate to cover the expected demand in the future

# General Information regarding capacity support mechanisms

	Romania	UNMIK	Hungary	Serbia	Bosnia- Herze govina	Turkey	FYROM	Austria	Montenegro	Greece
Capacity Support Mechanism in place	No (under planni ng)	No (under plan ning)	No	No	No	No	No	No	No	Yes
Secured Contracts (PPAs)	No	Yes	Yes	No	No	Yes	Yes	No	No	No

## Synopsis of Capacity Support Mechanism implementation

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- Currently there is a range of views from EnC as to whether capacity mechanisms are needed and which type of mechanism should be implemented
- The most important reasons for not supporting the introduction of a capacity support mechanism are:
  - Existence of adequate generation capacity (currently and as foreseen in the coming years)
  - Existence of PPAs providing adequate financial support to the generators
  - Decisions regarding capacity expansion are (still) taken centrally
  - Trust in the energy-only market model



# Capacity Support Mechanisms in EnC...

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- Greece's and UNMIK's capacity support mechanisms are based on the bilateral trading of Capacity Contracts between generators and suppliers
- Romania's and Italy's (originally proposed) mechanisms involve the conclusion of Capacity Contracts with embedded call options, concluded between the generators and the TSO. This type of mechanism connects the capacity and the energy markets, reducing the price volatility of the energy markets through the employment of the call options
- There is no experience yet on the actual implementation of any capacity support mechanism in the EnC and, consequently, conclusions can not be drawn on the actual efficiency of any of the proposed capacity support mechanisms

# Harmonization of production in Serbia

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In order to harmonize production in Serbia the following production capacities have been used:

- For reducing production
  - Pump Storage Hydro Power Plants (PS Bajina Bašta 624 MW and PS Lisina 28 MW)
- For supporting production
  - Reservoir HPP (PS Bajina Bašta 614 MW, Bistrica 102 MW, Kokin Brod 22 MW, Vrla I-IV 129 MW, Uvac 36, Pirot 80 MW)

Power production capacity  
reporting by generators,  
interface with the  
transmission grid



# Grid Codes provisions <sup>(1)</sup>

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- Yearly, monthly and daily planning is performed by EMS (TSMO)
- Strong cooperation on data exchange between EMS and generation sector:
  - Plan of consumption, generation and electricity exchange
  - Plan of providing electricity for covering technical losses in transmission network including electricity for transmission objects self-consumption needs
  - Plan of consumption, production and exchange in the hour of maximum load
- Goal is to investigate if basic conditions for normal functioning of power system is fulfilled, evaluate if any problems could occur in providing ancillary services, or problems in realization of energy plan of Republic of Serbia

# Grid Codes provisions (2)

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In order to define power system plan, Responsible parties, on behalf of transmission grid users, are obliged to submit to EMS the following data:

- Plan of total active power consumption
- Plan of individual objects active power consumption (upon EMS request)
- Plan of active power consumption for electricity generation needs
- Plan of active power consumption for pumping needs
- Plan of active power production (separately for TPP and HPP) in objects connected to transmission grid
- Plan of active power exchange (separately import and export)
- Plan of work for the hour of maximum load in characteristic day
- Plan of available generation capacities for contracted ancillary services

# Grid Codes provisions (3)

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Plan of work for the hour of maximum load in characteristic day envisages the following data collection:

- Plan of summary active power consumption
- Plan of available active power for generation, for each HPP and TPP unit
- Plan of active power exchange (separately for import and export)
- Plans of available generation capacities for realization of contracted ancillary services  
→ EMS is obliged to inform transmission grid users about the dates which will be considered as characteristic days, at least 30 days before the deadline for data submission

# Grid Codes provisions (3)

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Additionally request submission of the following information for Yearly, Monthly and Daily Plan:

- Plan of unavailability of generation units for each day and hour with reasons
- Plans of total electricity consumption for certain objects upon EMS request
- Plan of total electricity generation
- Plans of electricity generation for each HPP and TPP
- Plans of Pump Storage units in pumping regime
- Specified generation units which are envisaged to provide contracted primary, secondary and tertiary reserve (including all available generation units merit order)
- Consumption amount which was agreed as tertiary reserve

# Generation plant availability (scheduled maintenance, forced outages)





# Basic modeling approaches

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While planning generation, the following information regarding each generation units availability is taken into consideration within EPS Yearly Plan:

## **Thermal Power Plants**

- Rehabilitation (duration)
- Capital maintenance (duration)
- Extended Maintenance (duration)

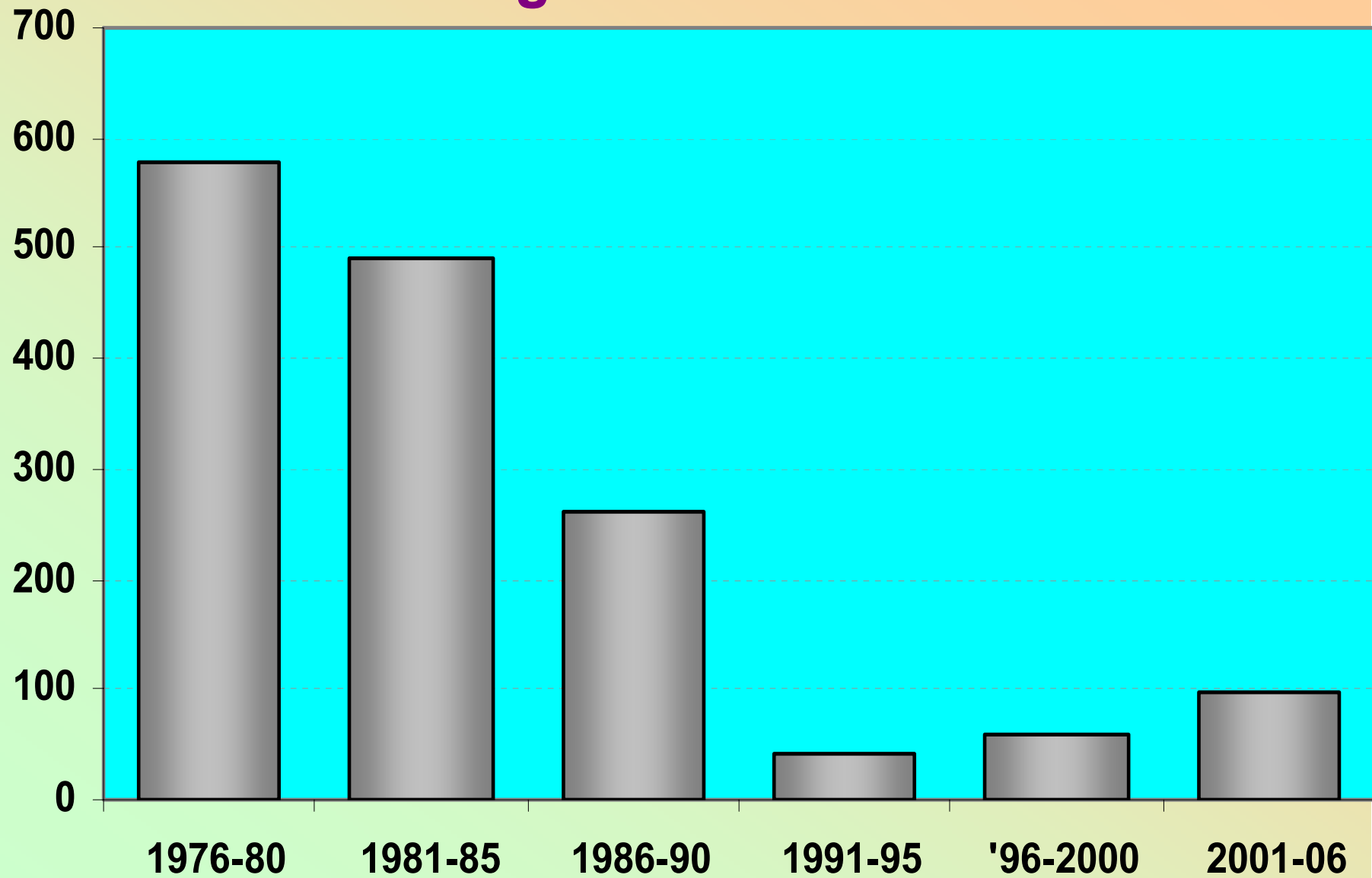
## **Hydro Power Plants**

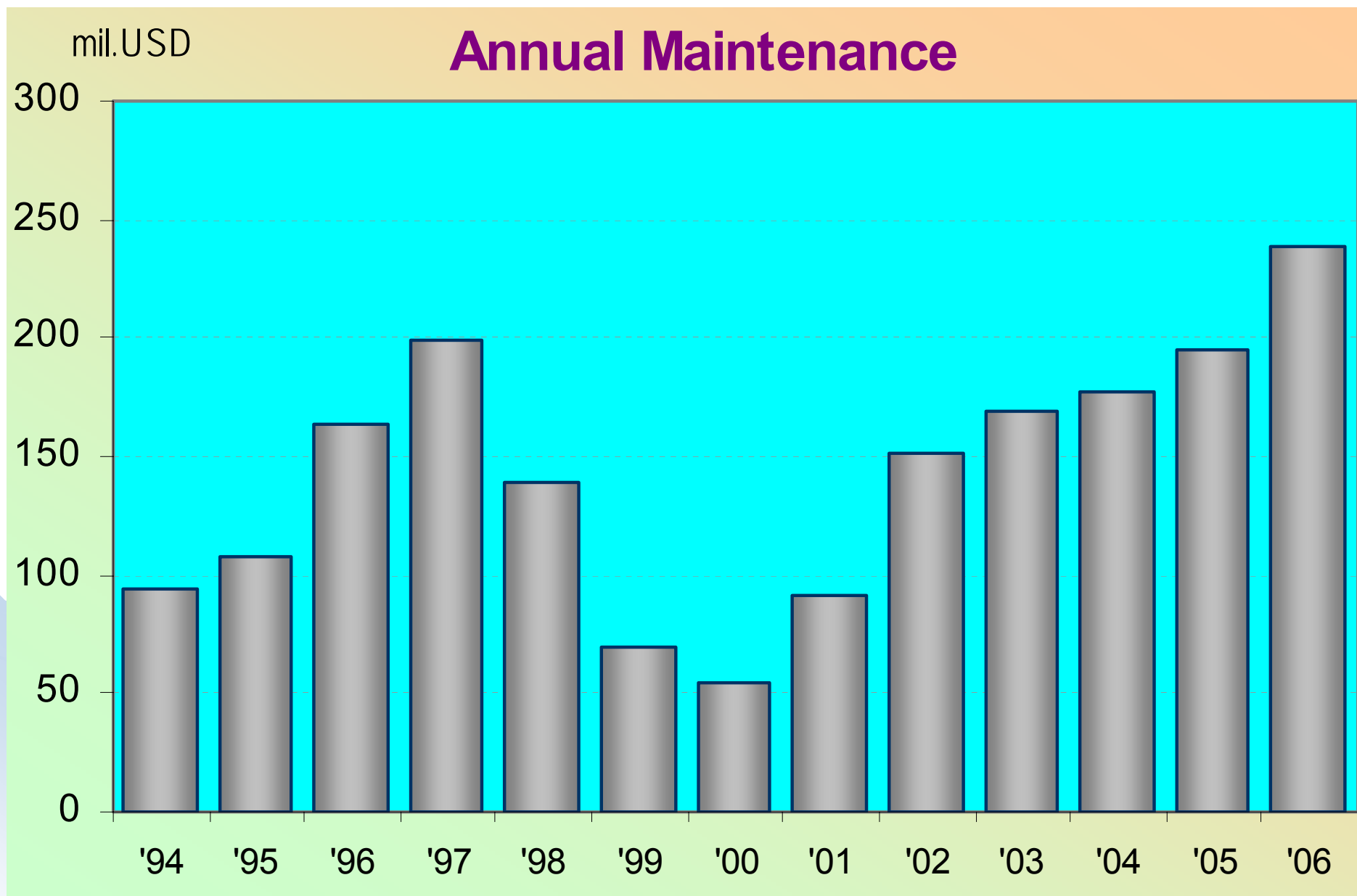
- Revitalization (duration)
- Capital maintenance (duration)

→ Time planned for generation units maintenance will enable to perform planned works, fix actual technical condition and improve continuous operation availability

mil.USD

## Average Annual Investment





# Key Policy Goals after October 2000

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- Security of supply
- Electricity sector restructuring
- Market opening and development
- Incentives for private capital investments
- To reach the important role in the regional electricity market
- Internal efficiency increase
- Improved environmental protection
- Reduction of losses (technical and non-technical)

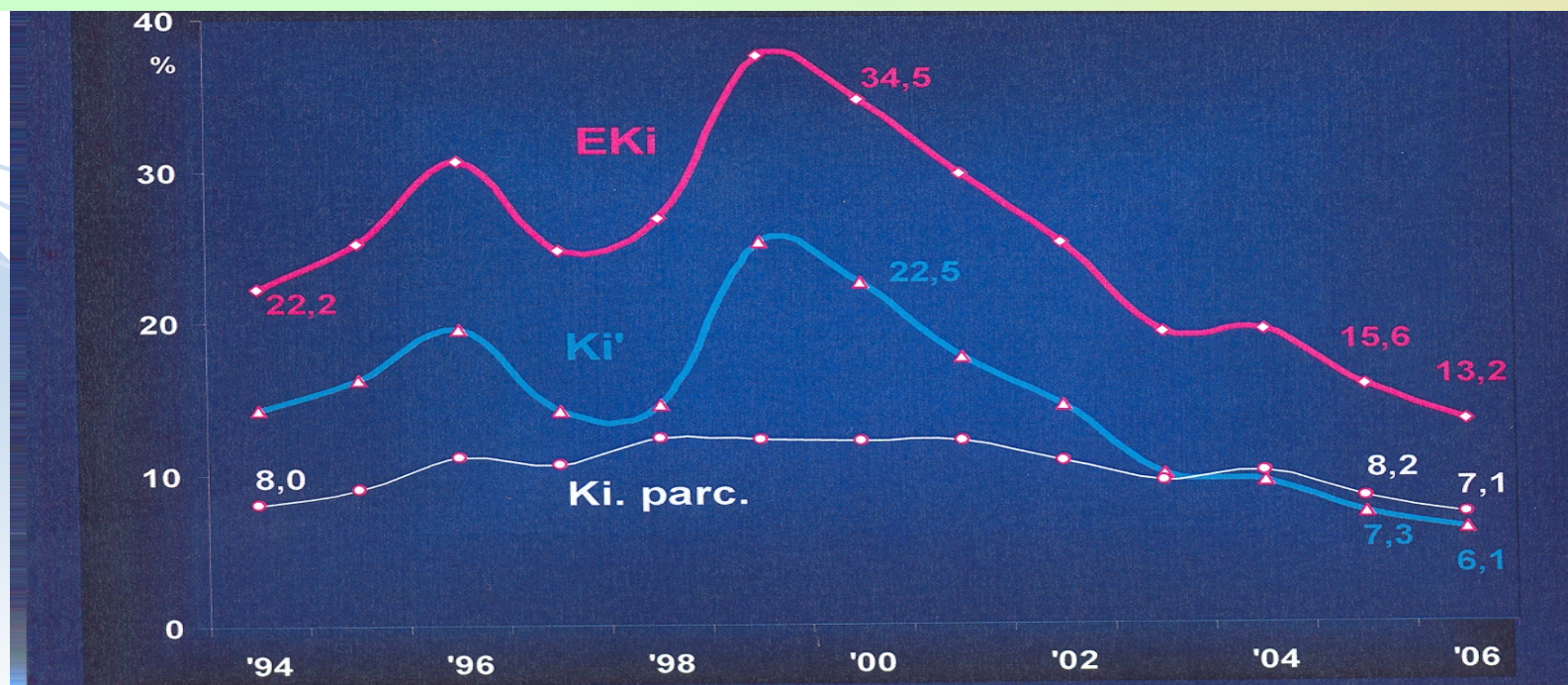
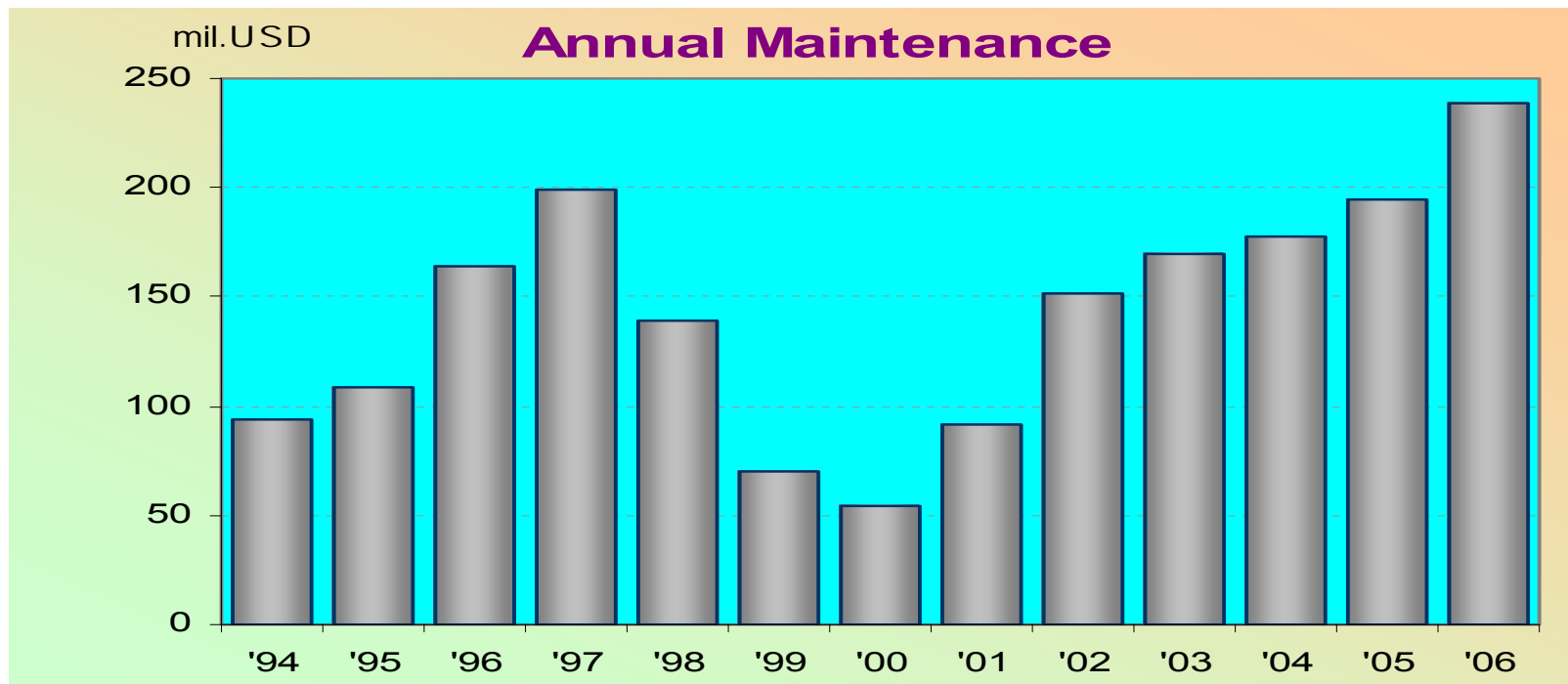
# International Community Assistance

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450 mil € donations - mostly from EU through EAR

Main areas of assistance:

- Electricity imports
- Fuel for heating
- Spare parts and equipment for PP's and open-pit mines
- Overhauls of TPP's
- District heating systems of Belgrade, Novi Sad and Niš
- Reforms, capacity building and technical assistance



# Special modeling for variable (wind) generation

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- There is no special modeling for variable generation
- Incentives for renewable generation is not under Regulator's responsibilities in Serbia
- Ministry of mining and energy has this obligation
- Energy policy of the Republic of Serbia includes measures and actions to be taken for achieving long-term objectives in the energy sector as creation of conditions for stimulating use of renewable energy sources and combined heat and power generation
- Energy Sector Development Strategy of the Republic of Serbia defines incentive measures for financial investments in energy facilities in which renewable energy sources will be used



# Process of commissioning new generation capacity

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- Commissioning is organized in presence of equipment manufacturer
- Special protocols for testing operation
- Generation capacity is connected to the transmission grid in compliance with connection permission and connection contract
- EMS (TSMO) verifies if all technical conditions for generation capacity connection, defined within the Grid Codes, are fulfilled in order to issue connection permission, also evaluating influence to the power system functioning according to technical criteria



# Decision on Generation capacity Connection

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- Capacity Data
- Installed capacity power and contracted power
- Kind, manner and site of line connection, transformer stations, metering, protection and control equipment for generation capacity (including telecommunication connections for control purposes, metering and protection, characteristics of local equipment for secondary regulation (if predicted), earthing, over voltage protection, coordination with existing protection and isolation in transmission grid and generation capacity and additional equipment according to the generation capacity stability study
- Expiring date of the Decision
- Connection expenses
- Transmission quality and conditions, including frequency ranges and voltages in order to provide permanent, or temporary functioning of capacity to the transmission grid, influence of capacity to the voltage quality in transmission grid, conditions for synchronization of capacity



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