SMART GRID TECHNOLOGIES POTENTIAL FOR STRENGTHENING OF THE BELARUS ENERGY SECURITY

Dzianis Rymko

State Enterprise "Institute of Power Engineering of the National academy of sciences of Belarus"

Energy security threats

- **Low provision of own fuel and energy resources - 25%;**
- **High share of imported natural gas in fuel end energy balance - 72%;**
- **Import fuel and energy resources mainly from one country (Russia) - 75%.**
- **Insufficient volumes of strategic reserves of FER for ensuring uninterrupted functioning of energy industry in the conditions of realization of threats of energy security;**
- **High wear degree of the main production facilities in fuel and energy system - 52%;**

Energy security indicators

Energy independence

1 . Relation of primary energy output (production) to gross consumption of fuel and energy resources (FER), %

2 . Self-reliance of the country fuel and energy resources for transport, %

Diversification of suppliers and types of energy resources

3 . Share of the dominating supplier of energy resources in the general import of FER, %

4 . Share of a dominating type of fuel in gross consumption of FER, %

Reliability of deliveries, reservation, processing and FER distribution

5 . The relation of total installed capacity of power plants to the maximum actual loading in a power supply system (reservation), %

6 . Tear of the fixed assets of the energy industries enterprises, %

7 . The relation of the volume of investment into the fixed capital, the energy industries enclosed in development, to the initial cost of fixed assets of the energy industries enterprises, %

8 . Share of dominant energy resources in heat and electricity production,%

9 . The relation of average daily number of violations of power supply of settlements in a year to total of settlements, %

Energy efficiency of final consumption of FER and economic sustainability of energy sector of Belarus

10 . Energy intensity of gross domestic product.

11 . The relation of cost of imported FER to gross domestic product, %

Installed capacity of the Belarusian power supply system and industrial power plants on 1.01.2013

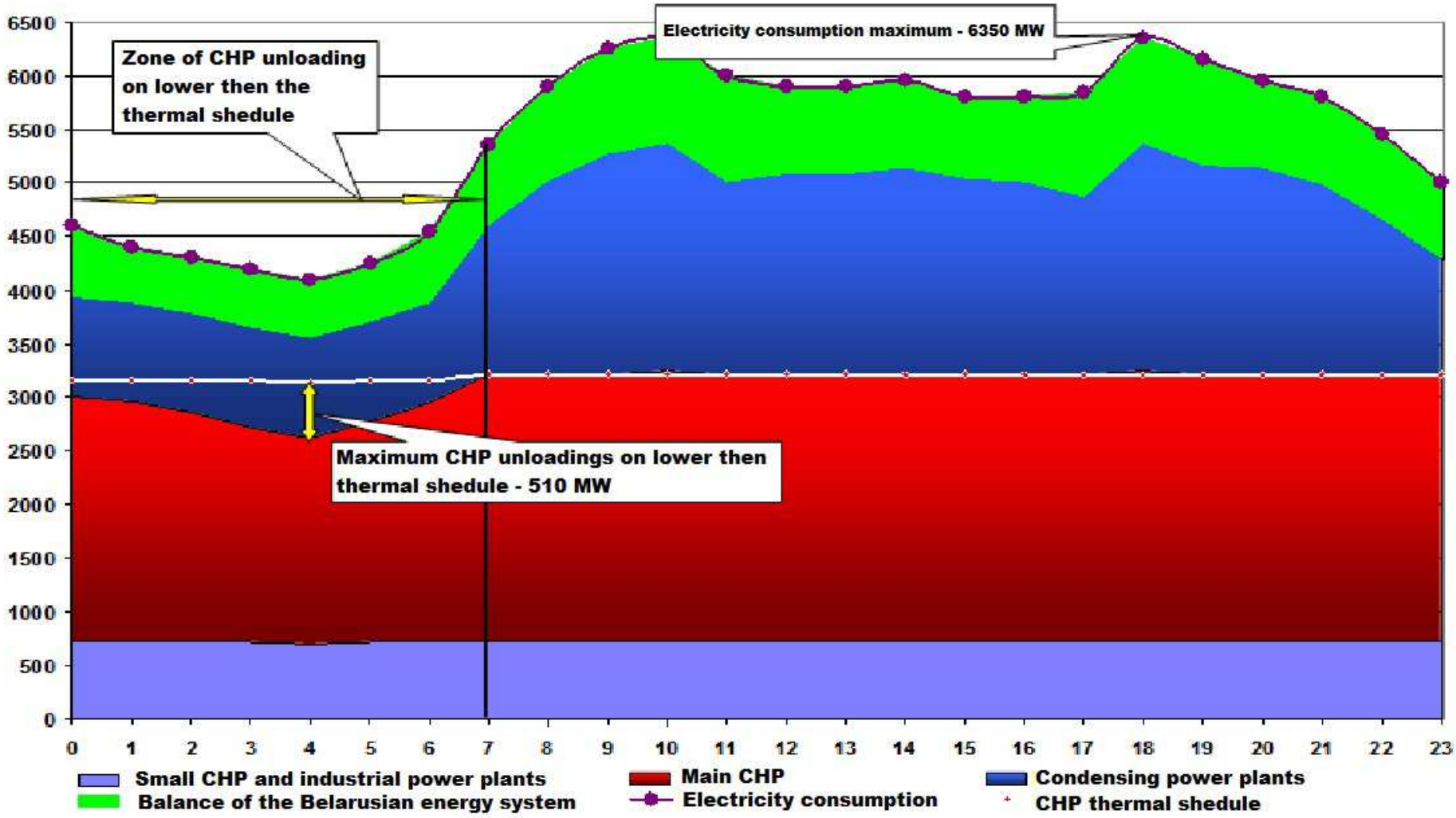
Power plants	Number	MW	%
Condensing power plants (CPP)	3	4140,6	46,4
Combined heat and power plants (CHP)	34	4199	47,0
Wind-and hydroelectric power stations	24	27,7	0,3
Industrial power plants	162	558	6,3
Total installed capacity of the Belarusian power supply system and industrial power plants	-	8925,6	100,0

The maximum peak load in 2012 was 6354 MW.
Ratio of electricity installed capacities to maximal electricity consumption -140,5%.
Threshold value of a normal zone - 120%.

Specifics of BPS generating capacities

1. High unevenness of electricity and heat consumption.
   - Coefficient of unevenness of the production schedule is 0,64
   - Coefficient of filling of the daily production schedule is 0,84
   - the thermal schedule of combined heat and power plant was 2856 MW in the winter of 2012, but was only 864 MW in the summer of this year
2. High share of CHP – 47,0%.

Daily schedule of a electricity consumption in Belarusian energy system



Classification of reserves

- **The included (hot) reserve:**
  - Reserve of primary regulation (during the work in BRELL) – 27 MW
  - Secondary reserve (not less than a rated capacity of the largest put into operation power unit). 400 MW (2012), after NPP input - not less than 1170 MW.
  - The tertiary reserve depends on a maximum of loading of a power supply system and now makes no more than 140 MW, and by 2020 is predicted at the level of 160 MW.
- In 2020 taking into account input of power units of the nuclear power plant the total size of the included reserve of power has to make about 1300 - 1350 MW (now it is 567 MW).
- **The disconnect reserve** of power takes place on the disconnected units of thermal power plant and the nuclear power plant and is entered according to instructions of the dispatcher the ODE for restoration of secondary and tertiary reserves of power at their exhaustion in emergencies, and also in modes with unforeseen and significant growth in loading. The size of a disconnect reserve shouldn't be less than a power of a secondary reserve.
  - 2012 - 400 MWt;
  - 2020 – 1170 MWt.

Scenarios of demand for peak capacity

1 . **The maximum scenario** - maximum consumption by 2020 will be **7560** MW.

2 . **The Smart Grid scenario** - maximum consumption by 2020 will be **7106** MW.

- At active introduction by 2020 of technologies of demand management on the electric power (one of elements of the Smart Grid technologies) the coefficient of unevenness of the production schedule will make 0,7, and the coefficient of filling of the daily production schedule will make 0,9.
- In this case the maximum peak loading will be 6% less, than in the maximum scenario and will make 7106 MW.

№	Parameters	Value, MW		
		2012 year	Smart Grid	Maximal scenario
1	Maximum of electricity consumption	6354	7106	7560
2	The included (hot) capacity reserve	400	1350	1350
3	The disconnect capacity reserve	400	1170	1170
4	The restrictions connected with technology	948	400	400
5	Repair decrease in power	827	900	900
6	Electricity import	978	0	0
7	Necessary installed capacity (1+2+3+4+5-6)	7951	10926	11380

№	Parameters	Value, MW		
		2012 год	Smart Grid	Maximal scenario
8	Input of new steam-gas capacities	-	1440	1440
9	NPP capacity		2340	2340
10	Withdrawal from operation of inefficient capacities		1820	1820
11	The actual installed capacity (the forecast for 2020) (capacity of 2012 +8+9-10)	8420	10380	10380
12	Excess (+) or deficiency (-) installed capacity (11-7)	+ 469	-546	-1000
13	The relation of necessary installed capacity of Belarus energy system to the maximum actual loading in a power supply system, %	125	154	151

Smart grid technologies

- **Demand response:**
  - intellectual accounting of the electric power and management of a power consumption;
  - forecasting and intellectual analysis of emergencies;
  - management and regulation of active and jet power with use of power electronics;
  - electric power accumulation;
- **Reliability:**
  - restriction of short circuit currents;
  - support of operational decisions, issues of recommendations and operating influences on localization and an accident elimination;
  - control and analysis of a technical condition and residual resource of processing equipment.

Influence a Smart Grid technologies on a power supply system

- Introduction of the Smart Grid technologies, allowing to limit a gain of peak loading and to level the schedule of daily consumption with use, first of all organizational actions (multizonal tariffs and so forth) and doesn't demand considerable capital investments in comparison with construction of new power plants.
  - At implementation of the scenario Smart Grid it will be possible to provide quality of economic development (power consumption directly connected with level) maximum scenario with low expenses for implementation of the minimum scenario of a gain of a power consumption.
- For effective use of the nuclear power plant it is necessary to develop and apply beforehand a package of measures to alignment of the production schedule of consumers, and also to electricity consumption growth.
  - At construction of new capacities it is necessary to make a choice for the greatest maneuverability.
- Thanks to intellectual management of a power supply system there will be an opportunity to integrate more capacities on renewable sources of energy.

Energy security indicators and Smart Grid technologies

- Direct influence:
  - The relation of total installed capacity of power plants to the maximum actual loading in a power supply system (reservation).
  - The relation of average daily number of violations of power supply of settlements in a year to total of settlements.
  - Energy intensity of gross domestic product.
- Influence thru increasing of renewable energy sources:
  - Relation of primary energy output (production) to gross consumption of fuel and energy resources (FER).
  - Share of dominant energy resources in heat and electricity production.
  - Share of a dominating type of fuel in gross consumption of FER.
- The main directions of development of the smart grid technologies in Republic of Belarus are developing scientific studies at the National academy of Sciences of Belarus within the state program of the scientific researches "Energy security, energy efficiency and energy saving, nuclear power".

Thanks for attention!