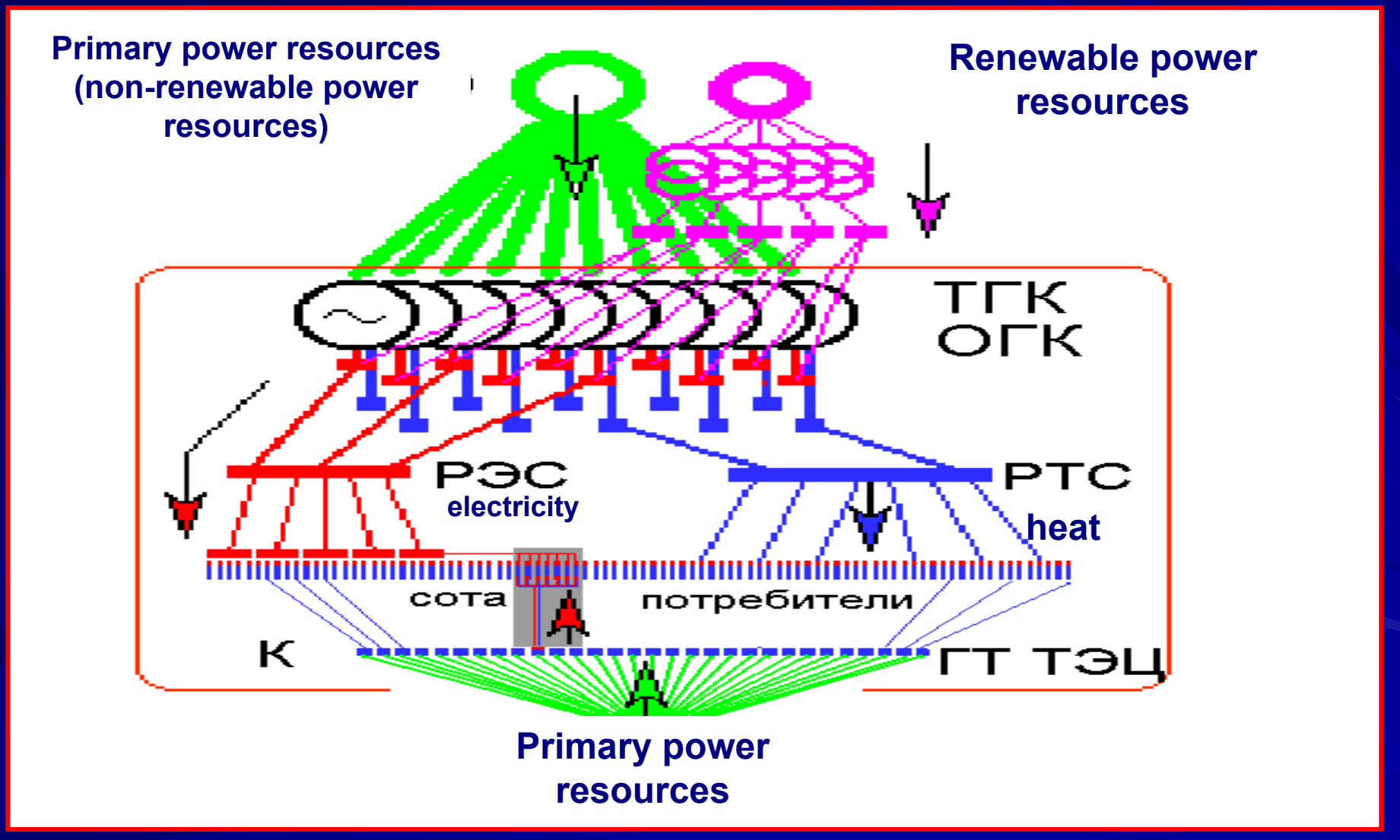
State research center
Lenin Electrical Engineering Institute of Russia

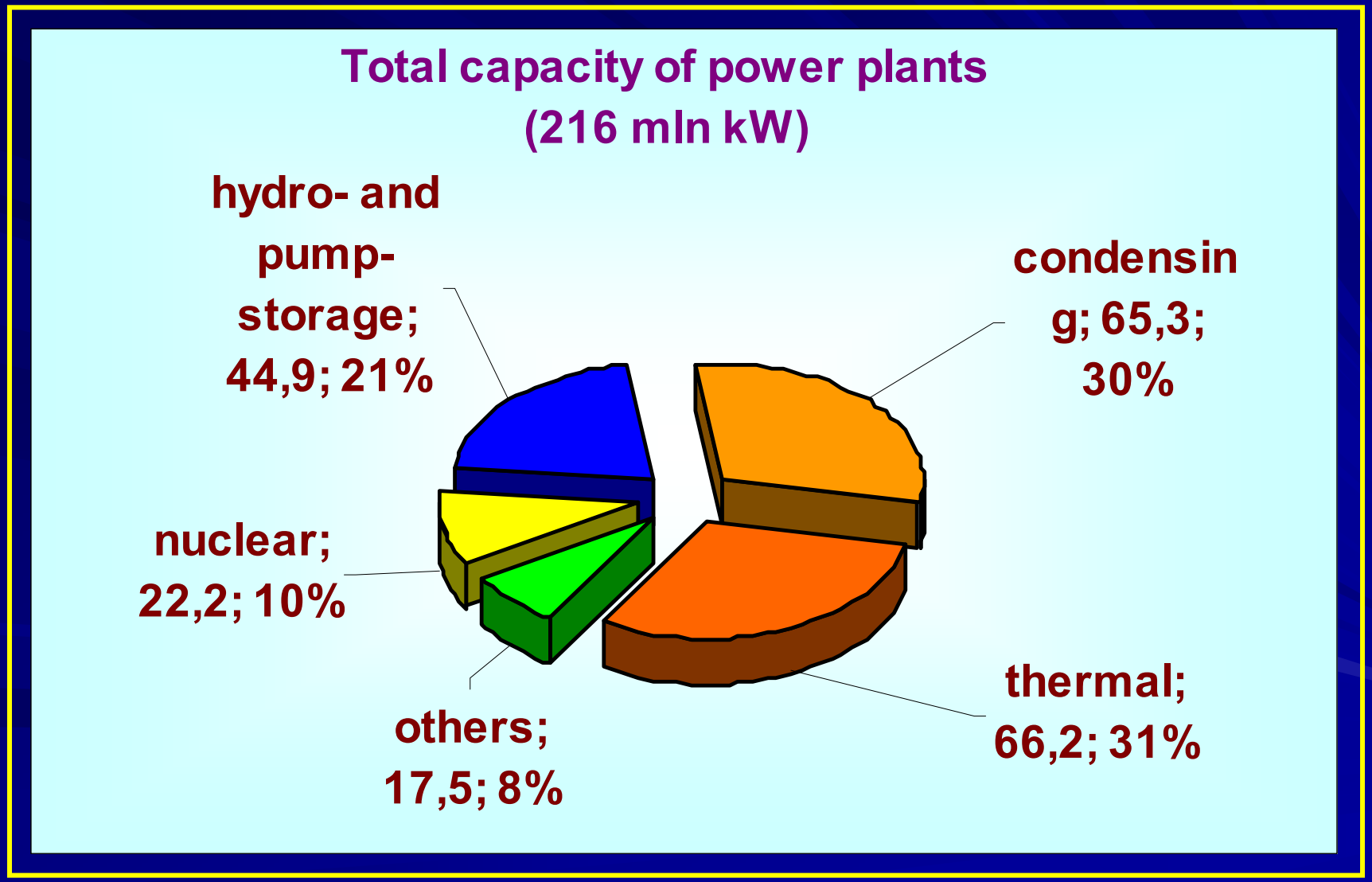
New energy-efficiency technologies in electric power industry

General director of GUP VEI
Kovalev V. D., doctor of engineering

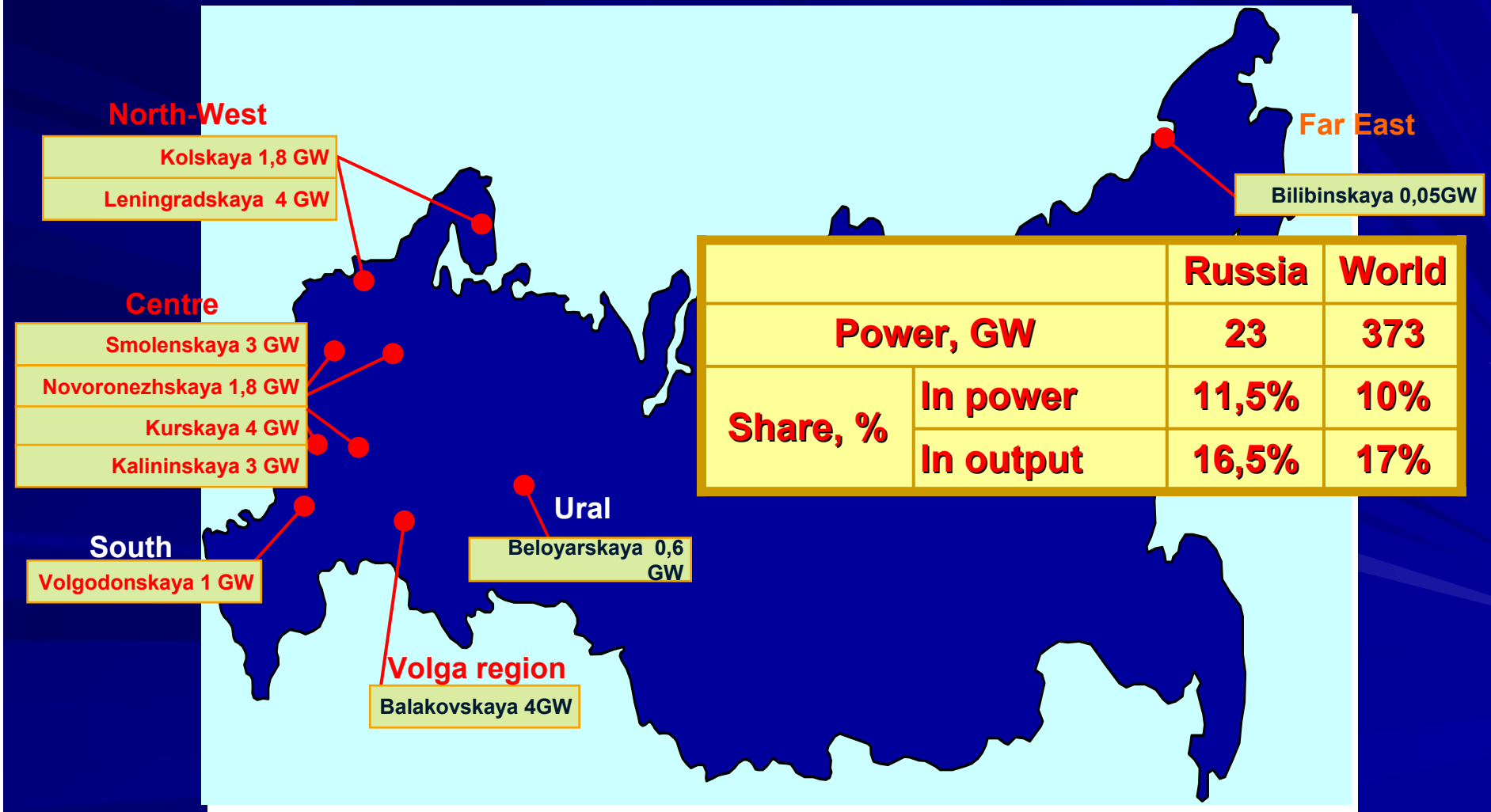
The structure of power resources of Russia



The structure of electric power industry in Russia

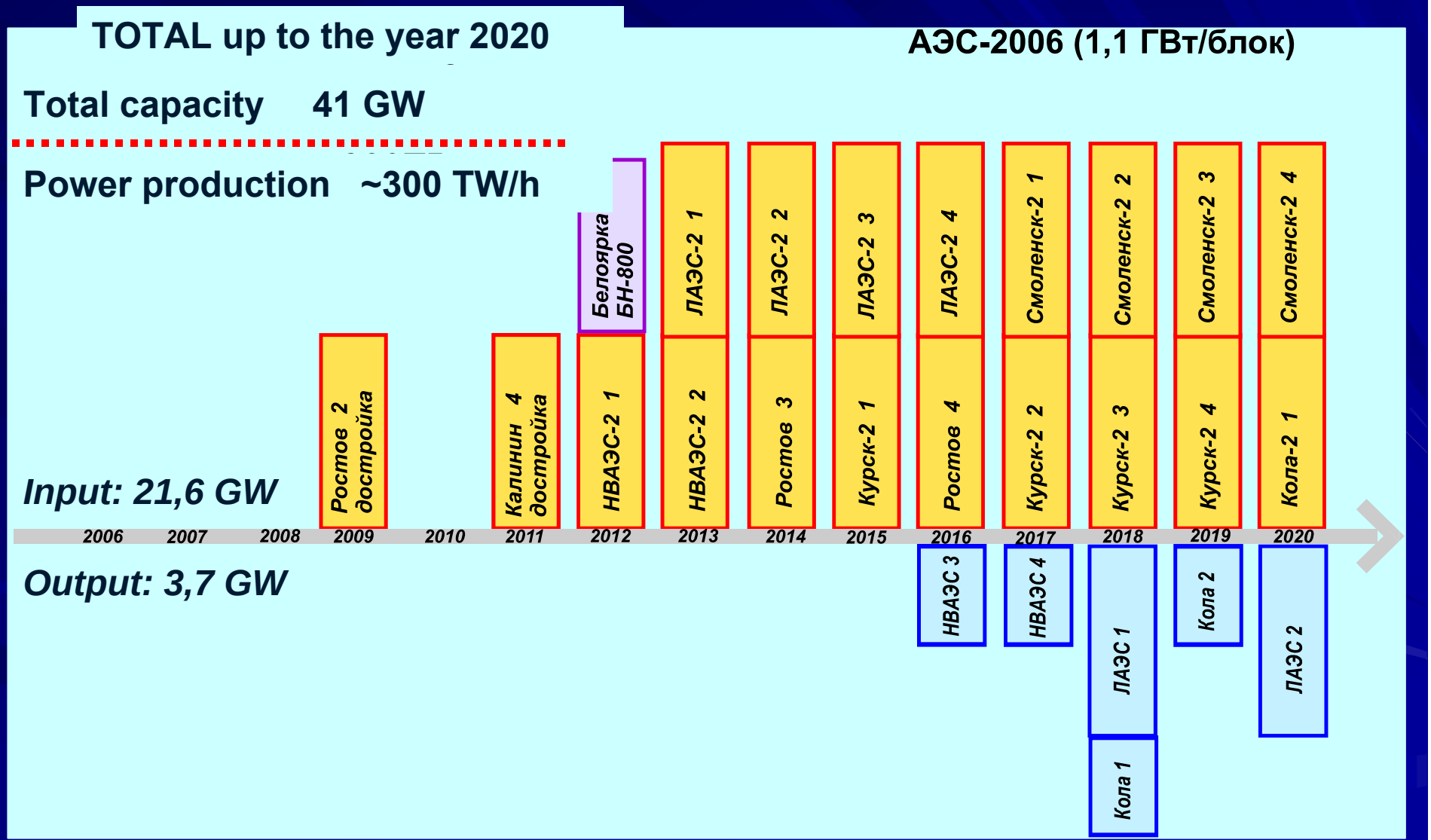


Nuclear power industry of Russia at the beginning of the 21-st century

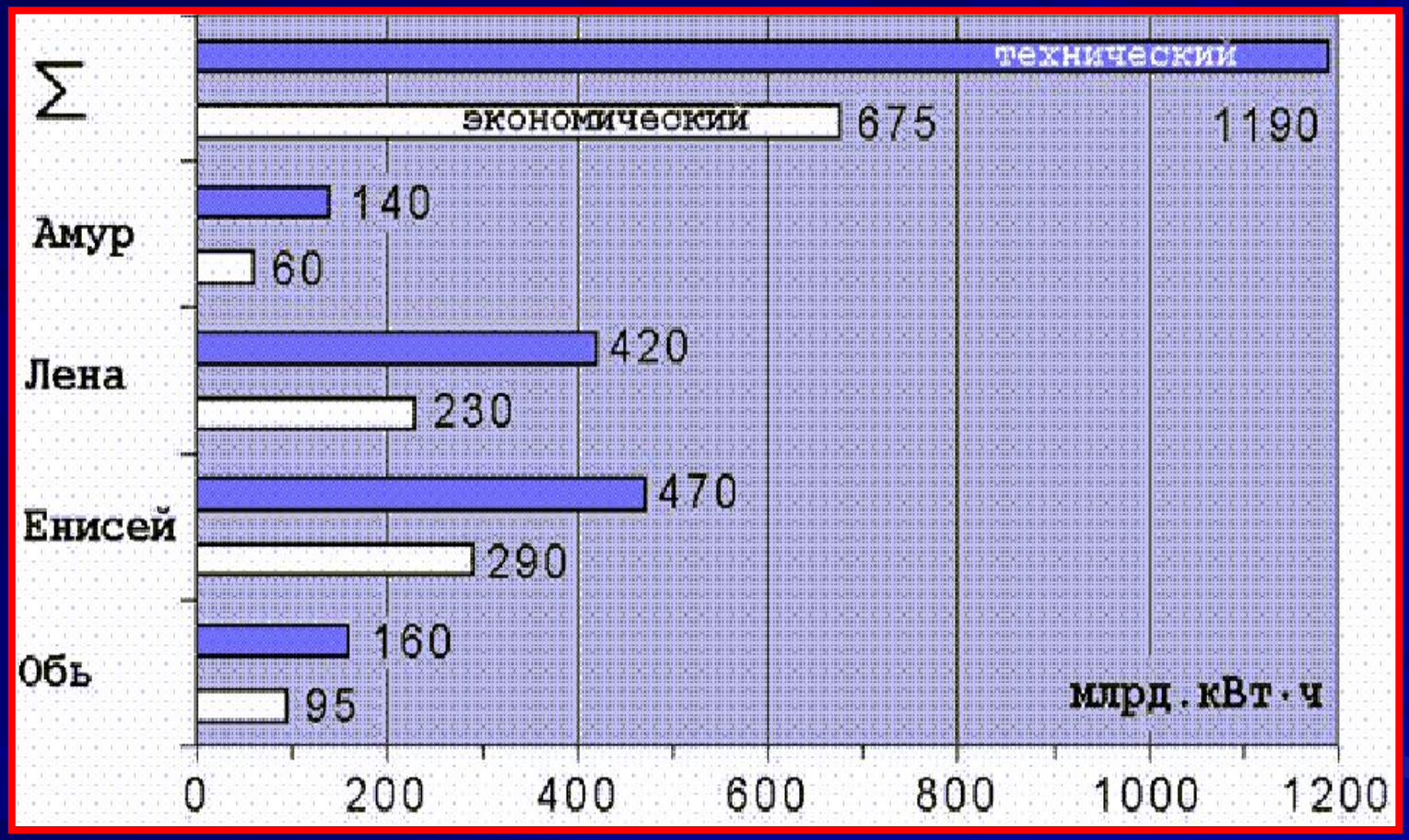


		Russia	World
Power, GW		23	373
Share, %	In power	11,5%	10%
	In output	16,5%	17%

«Roadmap» FCP— RAEPK



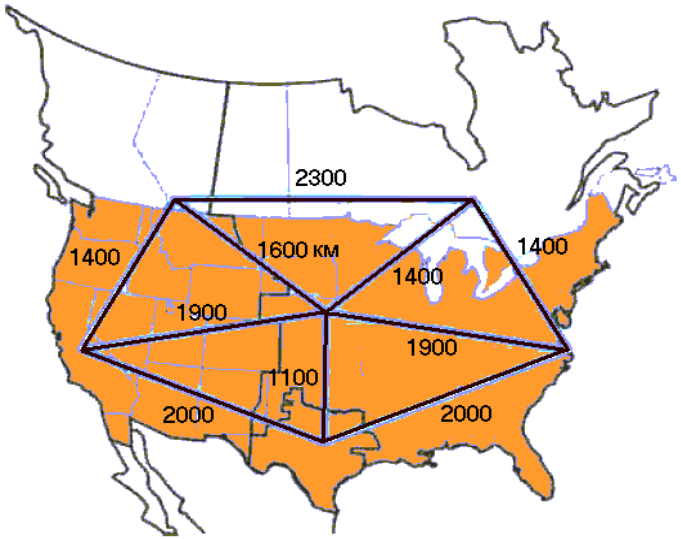
Hydropower resources in Russia



- Total output of electric power- 900 bln kWh
- Total capacity – 216 000 MW

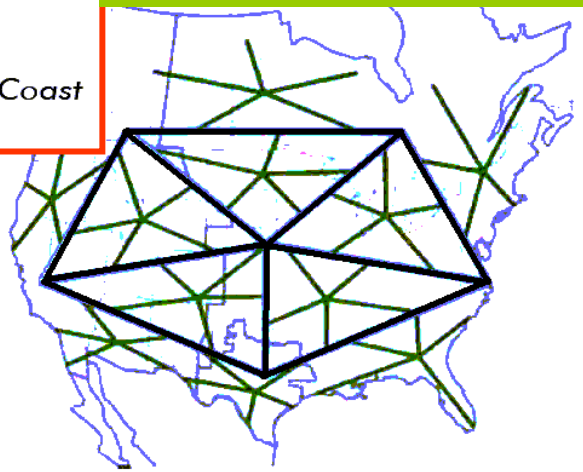
The concept of national power industry development of USA up to the year 2030

Interconnection



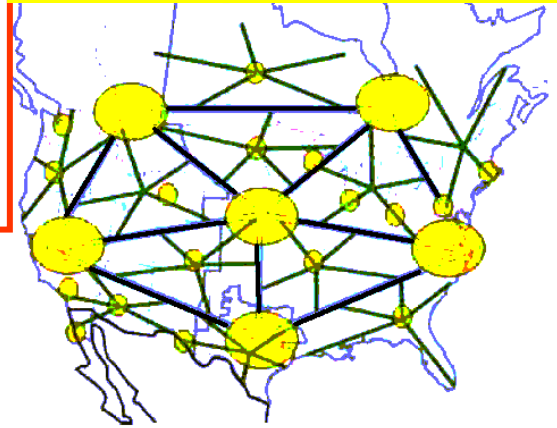
National Electricity Backbone for Coast-to-Coast Power Exchange

Regional connections



Electricity Backbone Plus Regional Interconnection

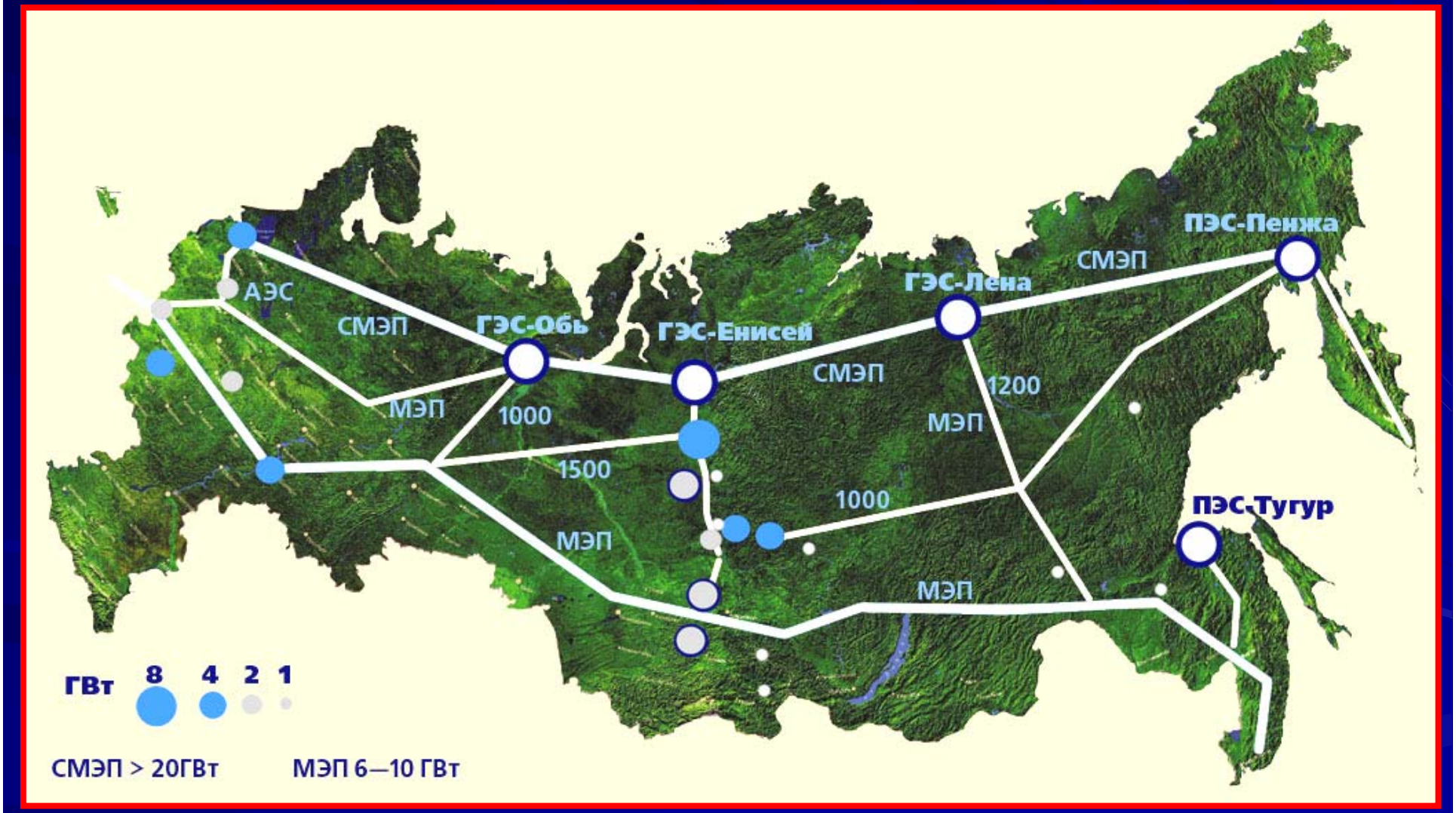
Local connections



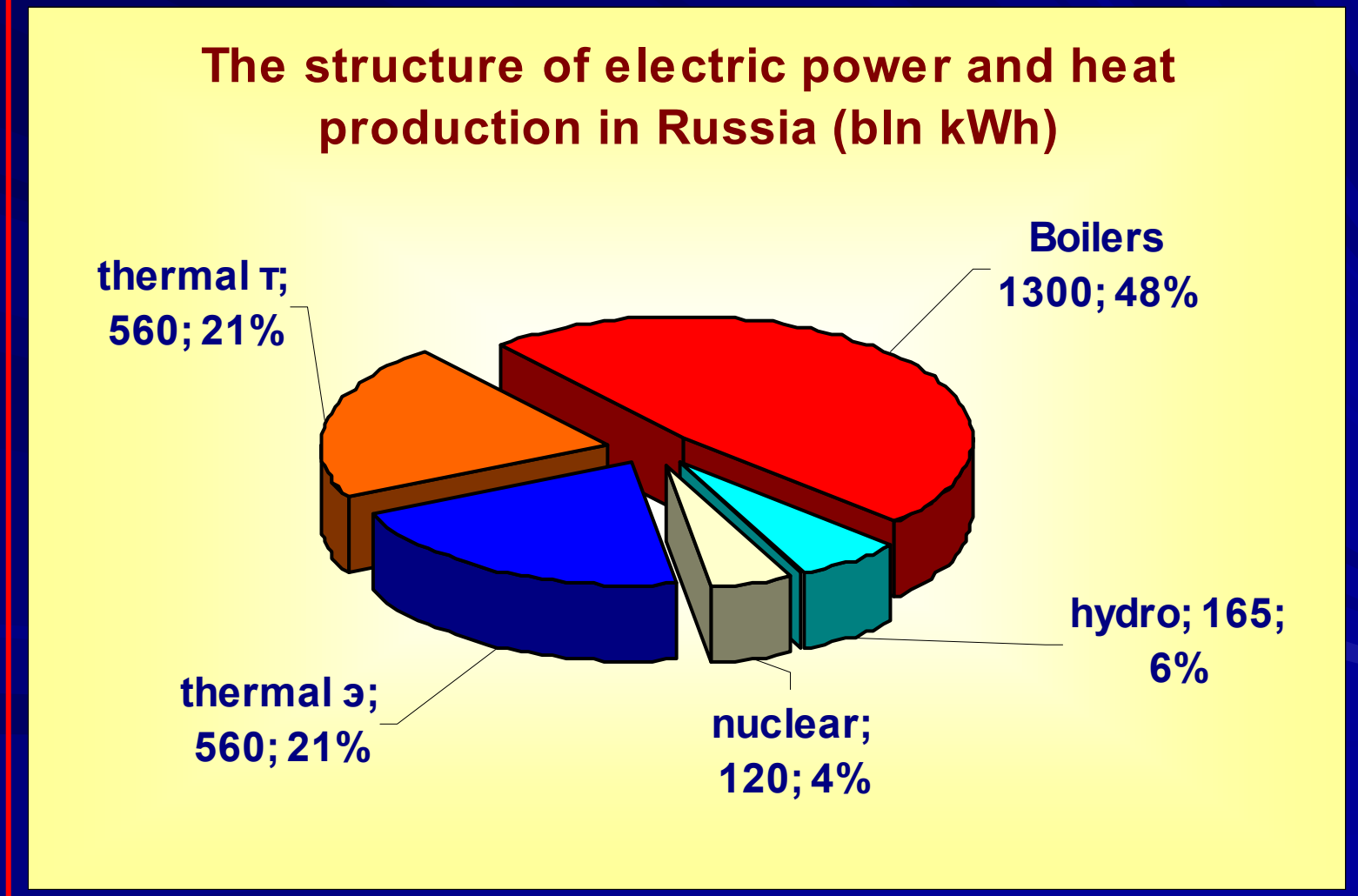
Electricity Backbone, Regional Interconnection, Plus Local Distribution, Mini- and Micro-Grids

The concept of power industry development in Russia

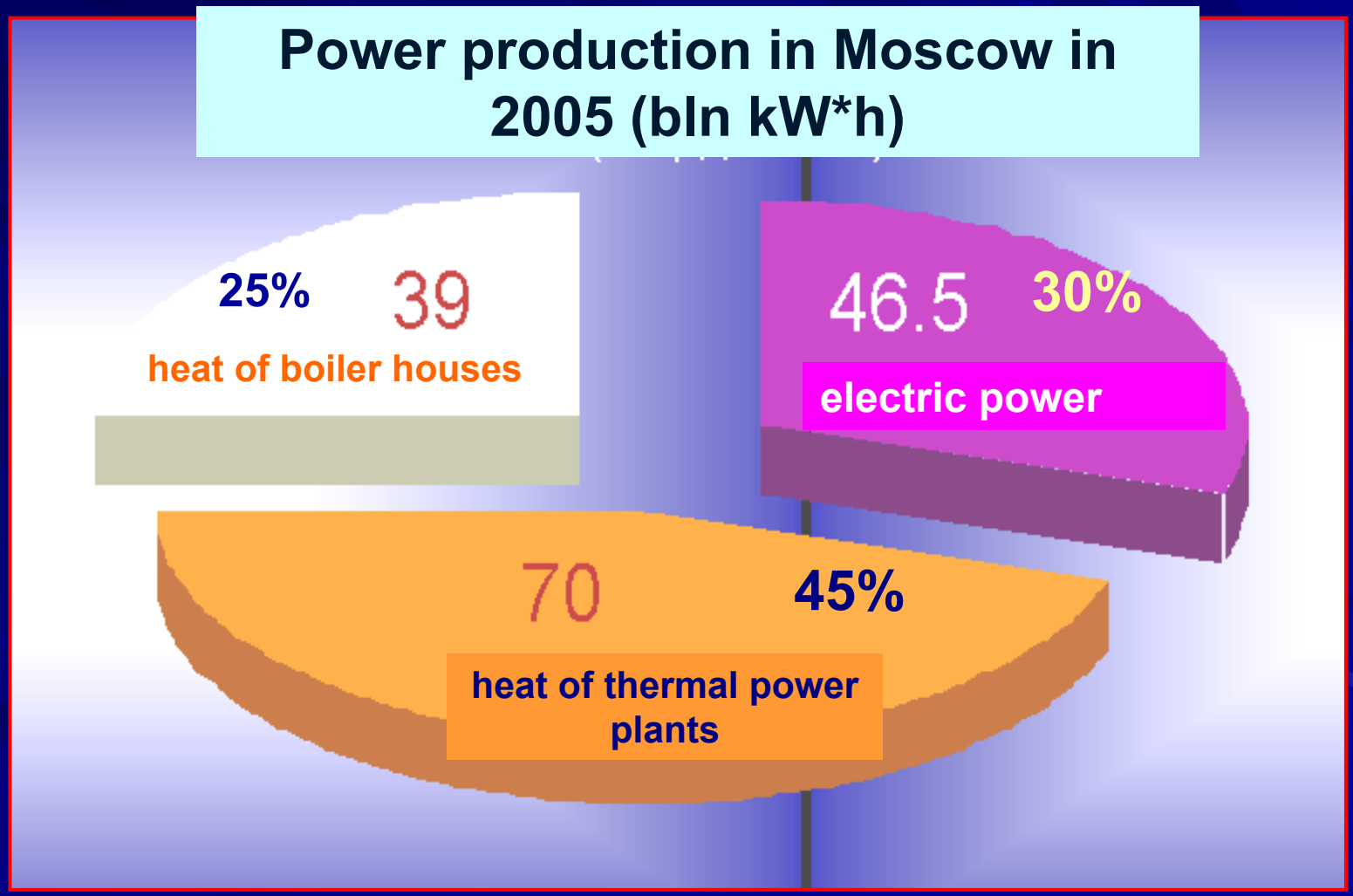
(suggestion of GUP VEI)



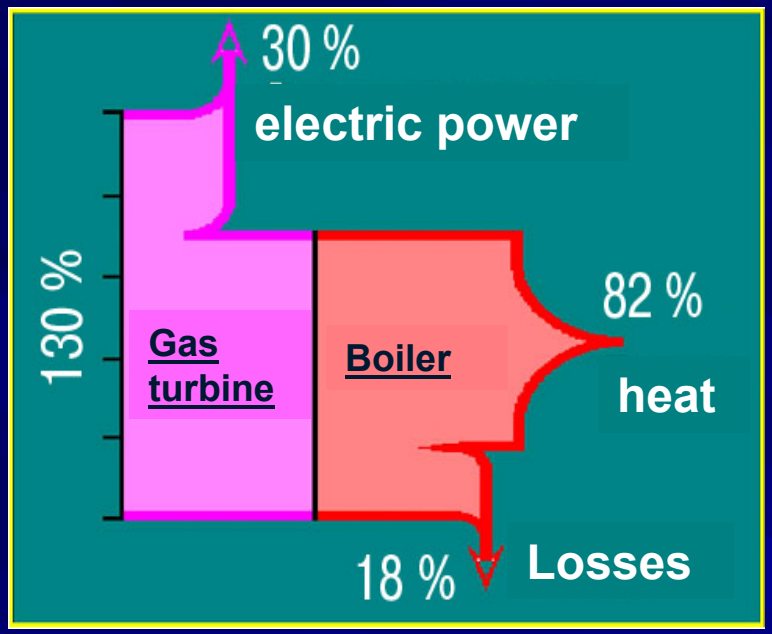
The structure of electric power and heat production in Russia



The structure of electric power and heat production in Moscow



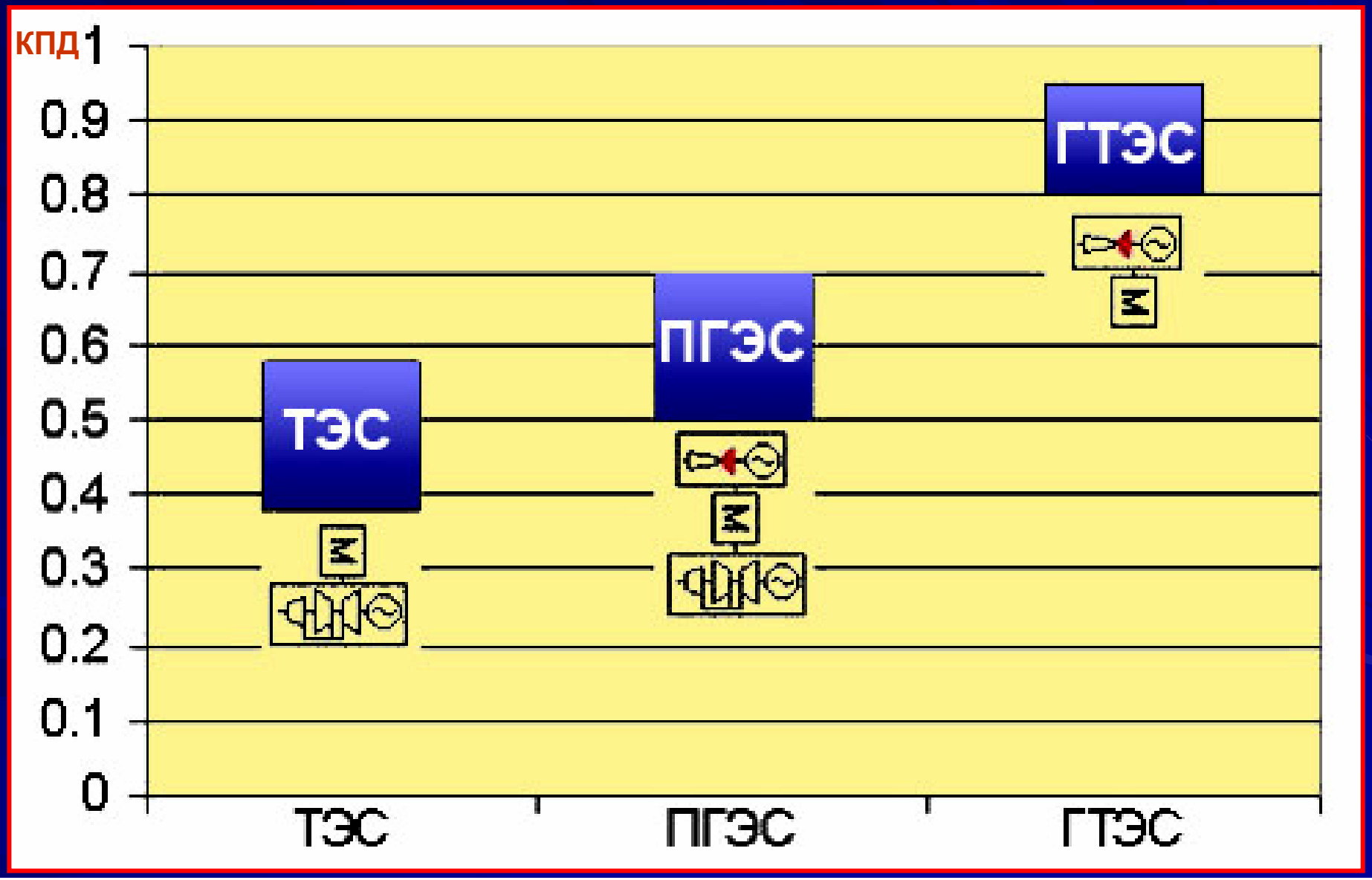
Development of pilot project of electrified 10-20 MW boiler house



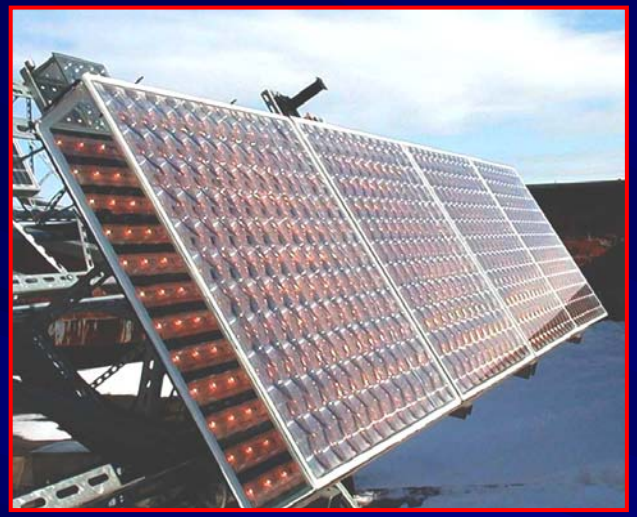
VEI suggests the electrification of the existing boiler-houses by way of their interconnection with the gas turbine and creation of the single energetic complex on the basis of the boiler houses, which will allow to generate about 1 to 3 GW more thermal electric power.

The project does not suggest the installation of any additional boilers, which will allow to minimize the expenses and the area required for the gas-turbine thermal power plant.

Technologies of electric power production



Non-traditional sources of low-power



Ground solar photoconverters and photo-energetic systems based on multi-layered structures with concentrators.

- ***Efficiency>30%***
- ***Power output>250 W/m2***
- ***Service life>25 years***
- ***Reduction of electric power cost to 2 roubles (0,08$) for 1 kW/h***

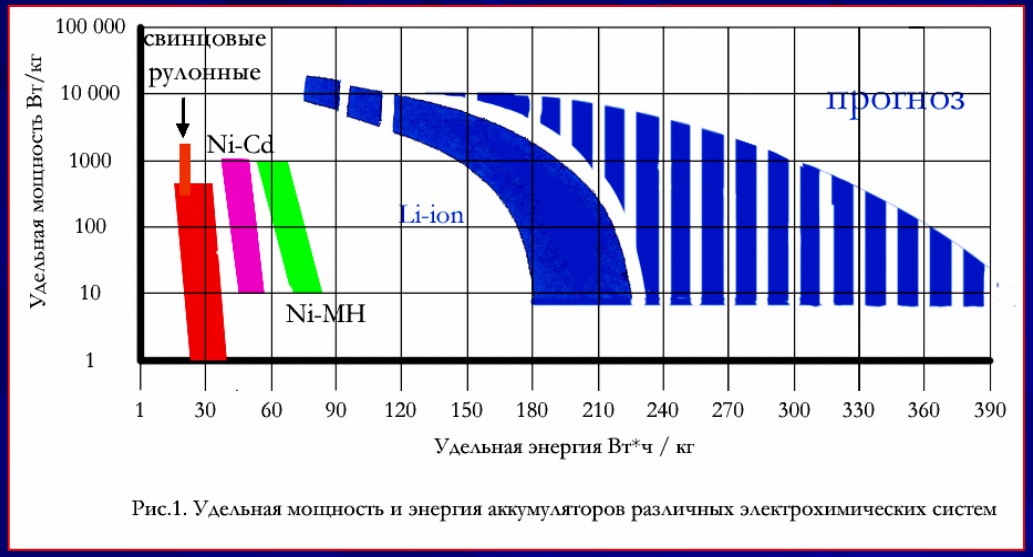
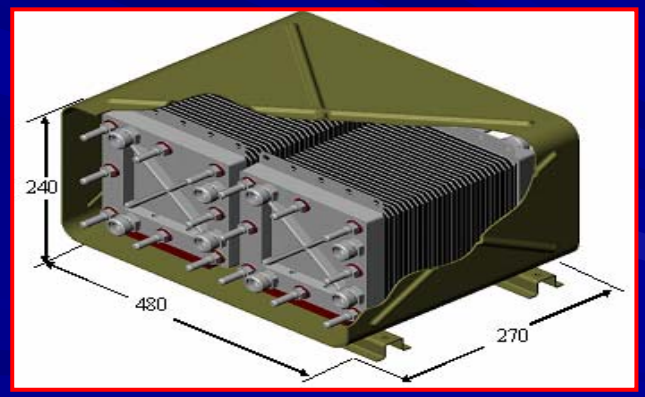


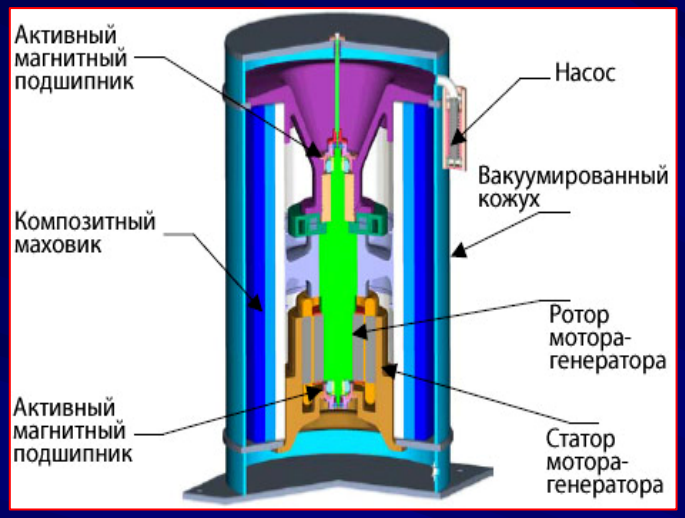
Рис.1. Удельная мощность и энергия аккумуляторов различных электрохимических систем

Specific power rating of lithium-ion rechargeable batteries

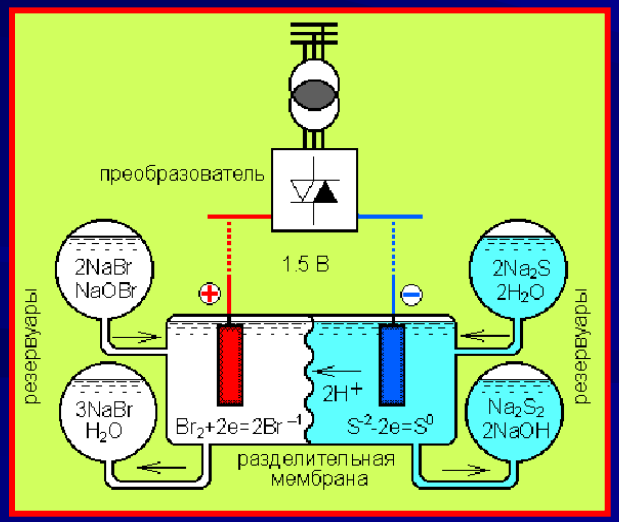


Hydrogen-aerial battery of fuel-cell unit

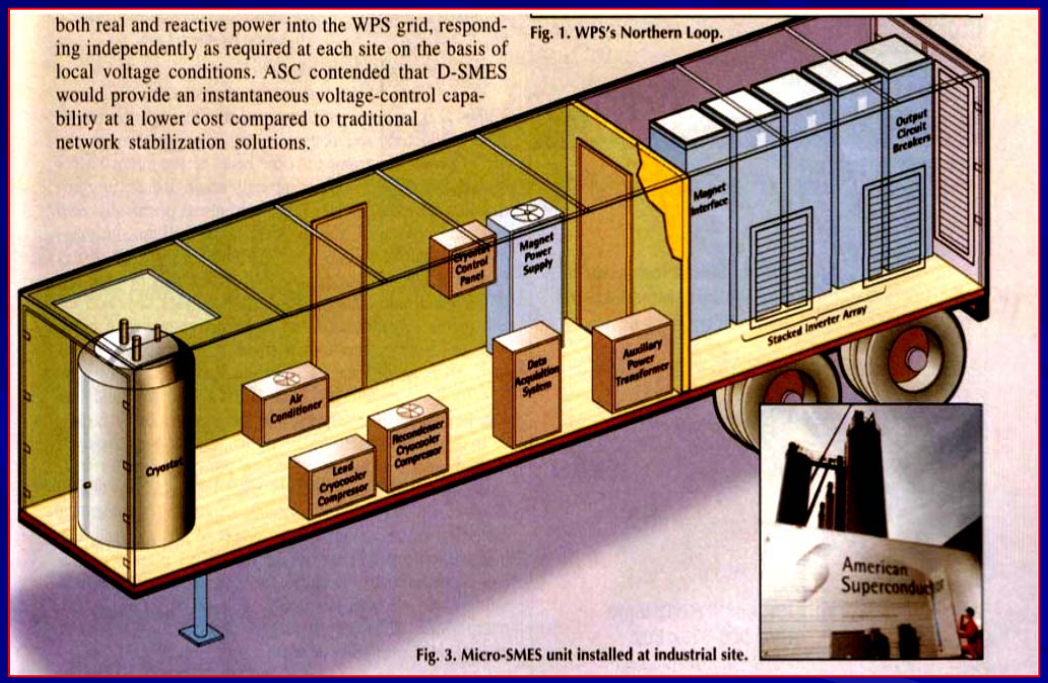
Non-traditional storages of electric power



Flywheel storage (up to 25 kW/h)

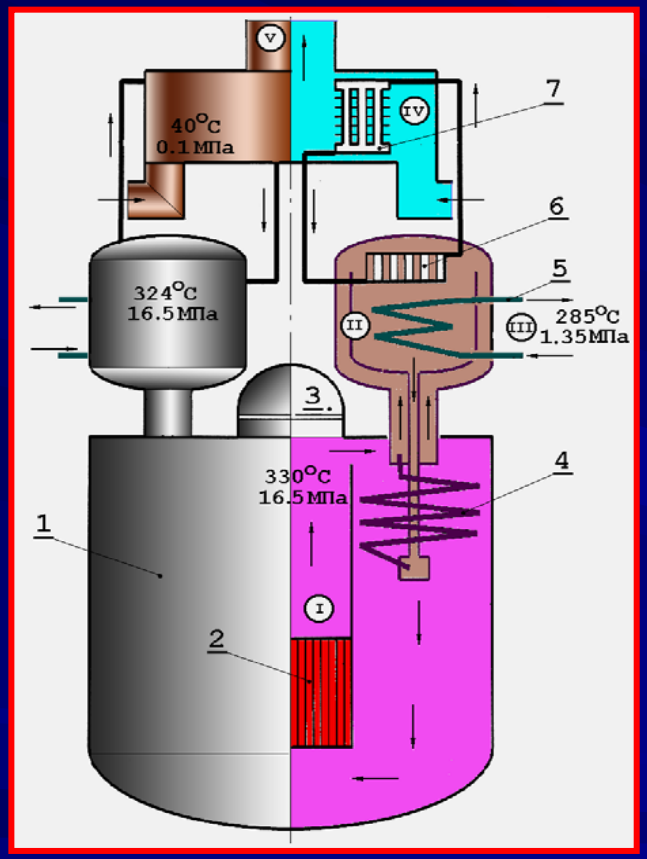


Storage with circulating electrolyte



Superconductive storage (up to 10 MJ)

Development and creation of the series of highly reliable, compact and capsular low power nuclear stations (NSLP, 10-50MW, NIKIET-VEI project)



- 1 - Reactor
- 2 – Active zone
- 3 – Pressure compensator
- 4 – Intermediate heat-exchanger
- 5 – Steam generator
- 6 и 7 – Heat-exchanger- vaporizer and the radiator of autonomous contour of power take-off
- I – First contour of natural circulation
- II – Intermediate contour of natural circulation
- III – Contour of thermal power consumers
- IV – Autonomous contour of power take-off with natural circulation
- V – Naturally circulating open-circuit air contour of reactor cooling

Along with maintaining natural security in conditions of natural circulation the NSLP technologies provide:

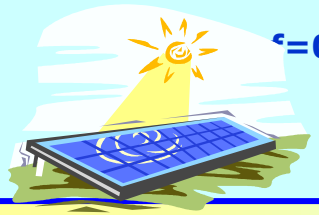
- 25 years of operation without recharging of the core region and major repairs
- long-term and stable work at any level of productivity within 20-100 % without the limitations of power changes ;
- automatic switch to hot reserve mode in case of any heat-consumption termination and absense of its own requirements.

Innovational product allowing to solve the problem of electric and thermal power deficit.

Significantly increases the reliability of electric power supply system of the city.

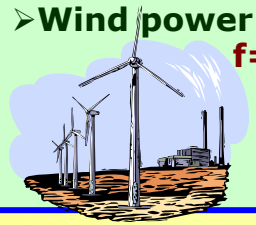
The system of integration of sources in power complex of the power supply facility

The sources of DC-current
- Storages
- Photocells
- Fuel element



The sources of AC-current:
- Gas-turbine installations
- Mini water power plants and nuclear power plants
- Wind power plant

f= var



DC to AC converters

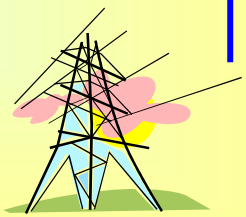
Frequency converters

Converter of communication with external electric power network

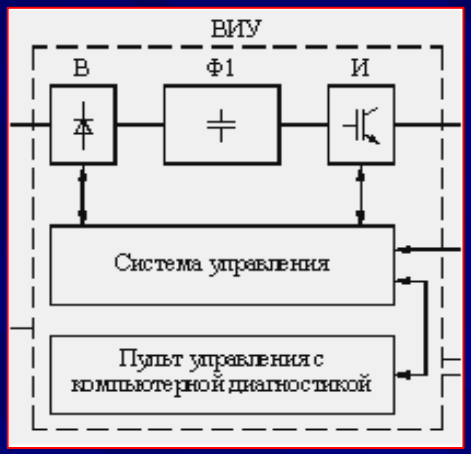
The system of automatic complex control

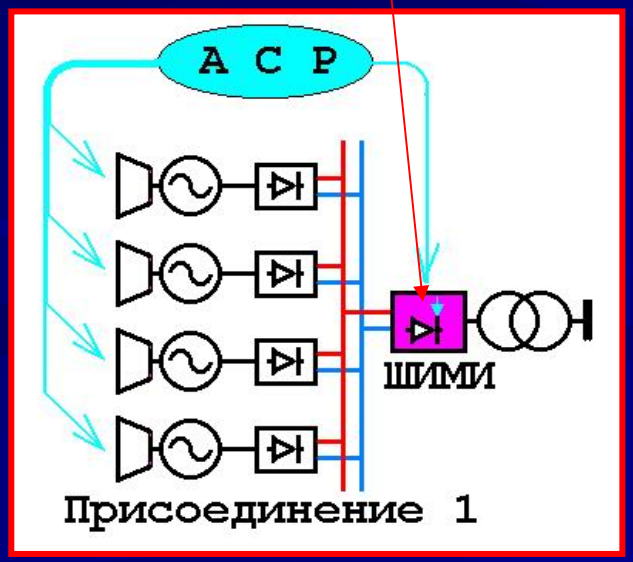
ЭЭС

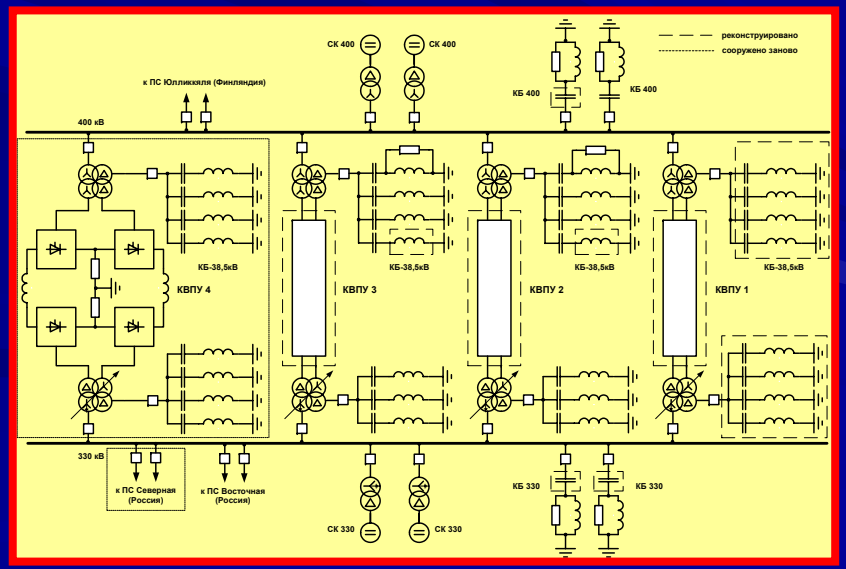
AC network of power supply facility



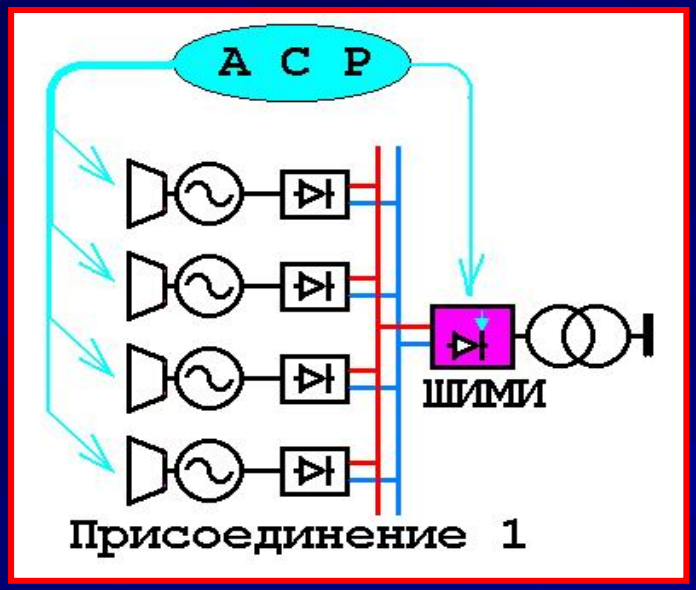
Principles of construction and diagram of sources interconnection

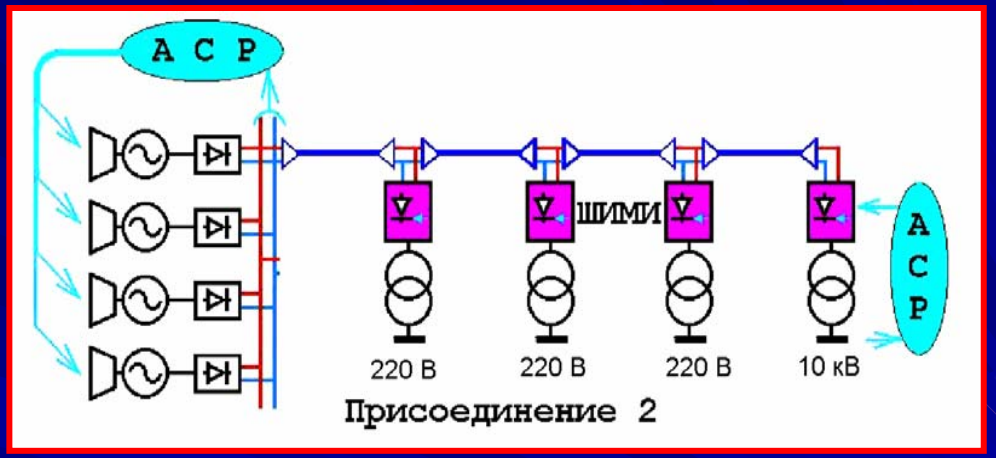






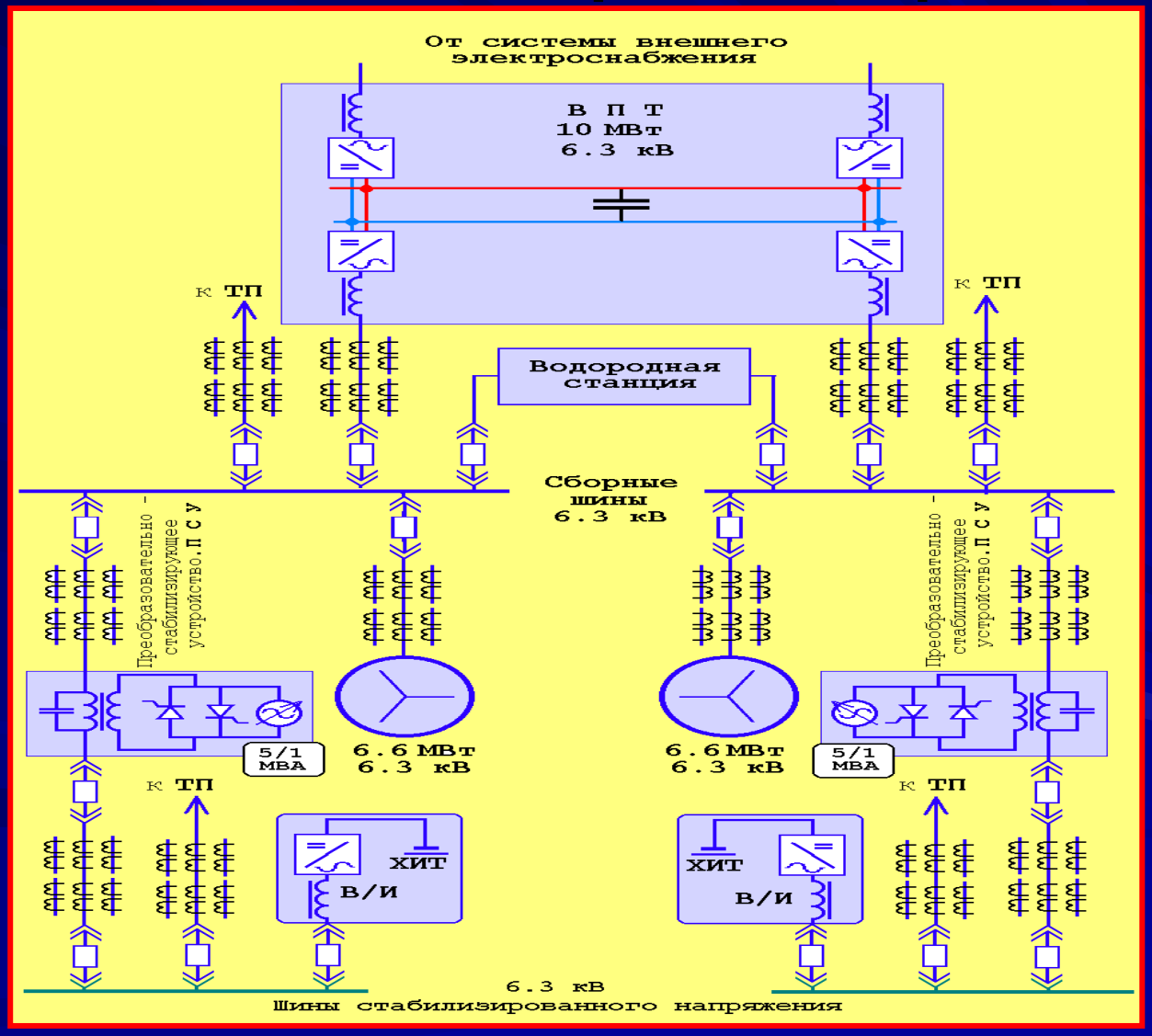
The development of technology and principles of construction of the integrated electric network with sources of small-scale power generation of different type.





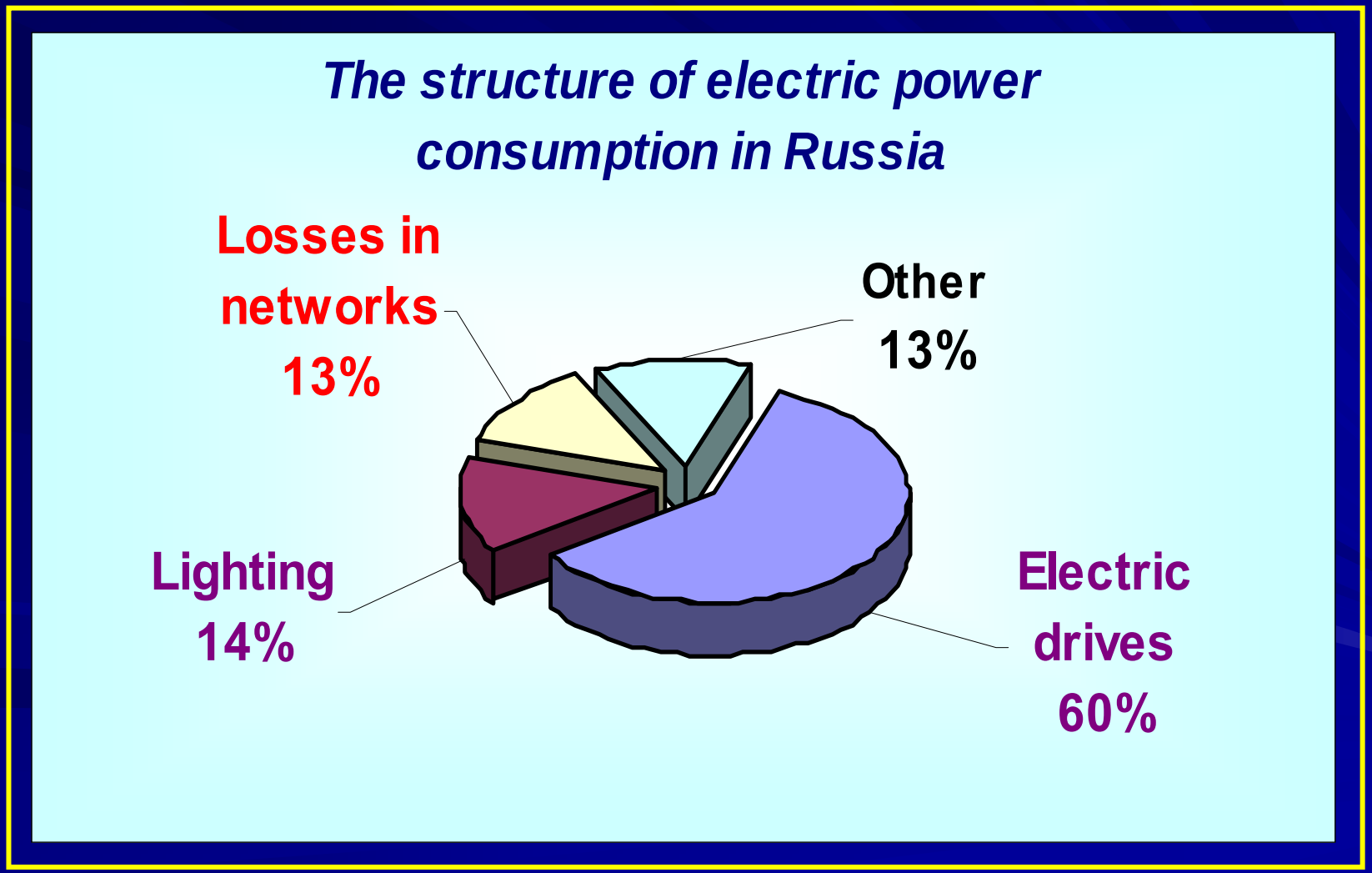
The suggested power grid is built with the broad use of modern converters, providing high quality of voltage for consumers and high controllability of system mode. A cellular principle of power grid construction unites small power-producers owning power generation businesses into a common system of electric power consumers.

The diagram of power output of small nuclear power plants



Energy-efficient technologies of power industry

The structure of electric power consumption in Russia



In 1980-ies for the first time ever in the world 1150kV power transmission line was put into operation and the equipment was made for such a line. These jobs were done under the supervision of VEI.

VVK 1150kV

Super high voltages such as 1150 kV of AC-current and 1500 kV of DC-current allow to create the most effective power transmission lines

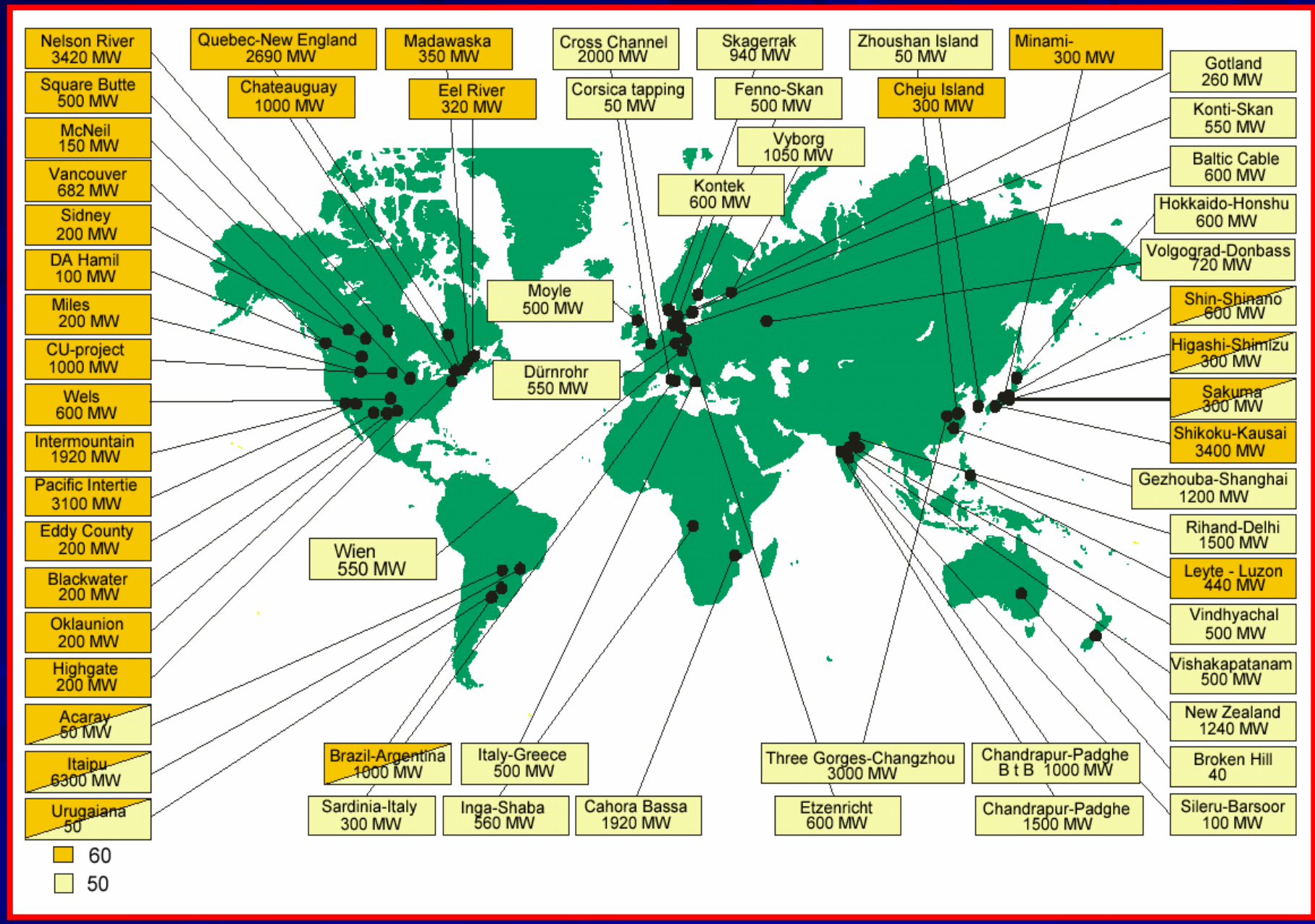
Autotransformer for 1150kV

GIS 1150kV

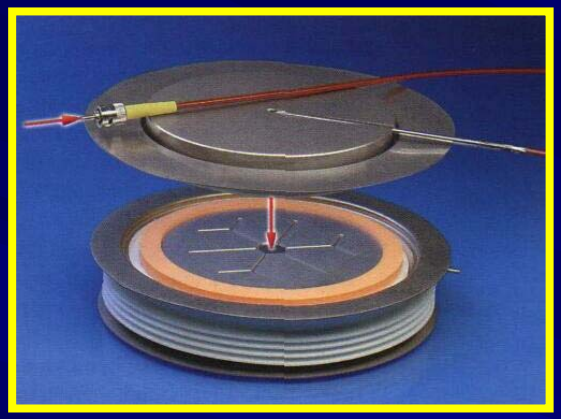
VEI has a unique experience in construction of power UHV DC transmission line (Ekibastuz-centre)

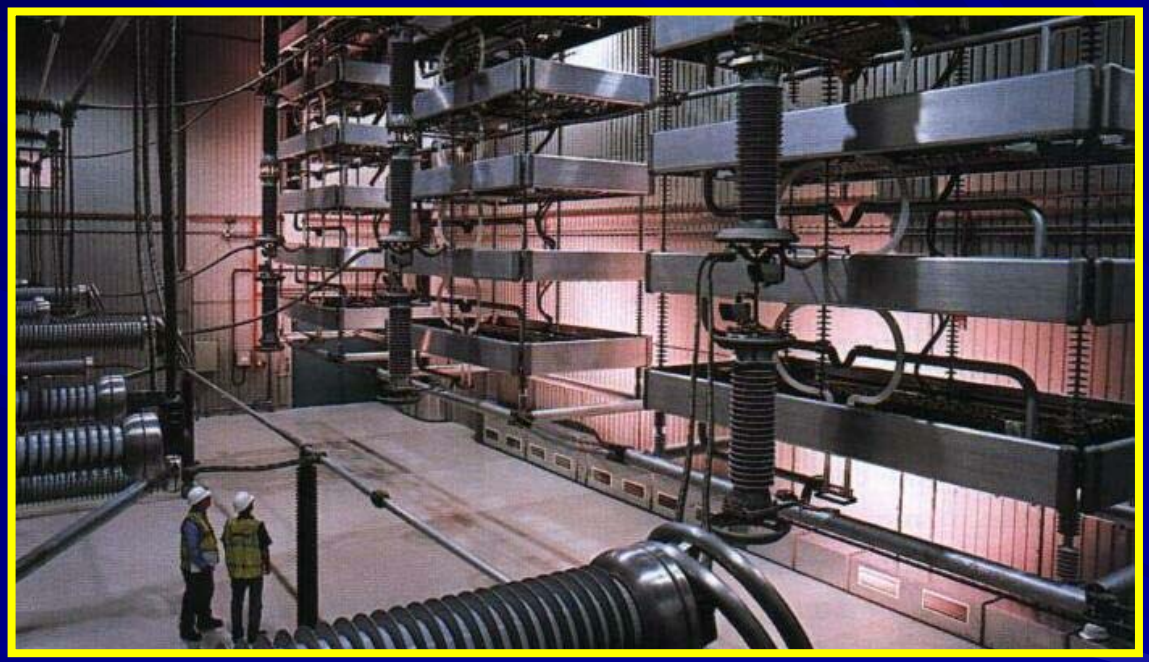
The equipment designed by VEI is in operation at Vyborg back-to-back DC system

World's converting substations and DC back-to-back installations



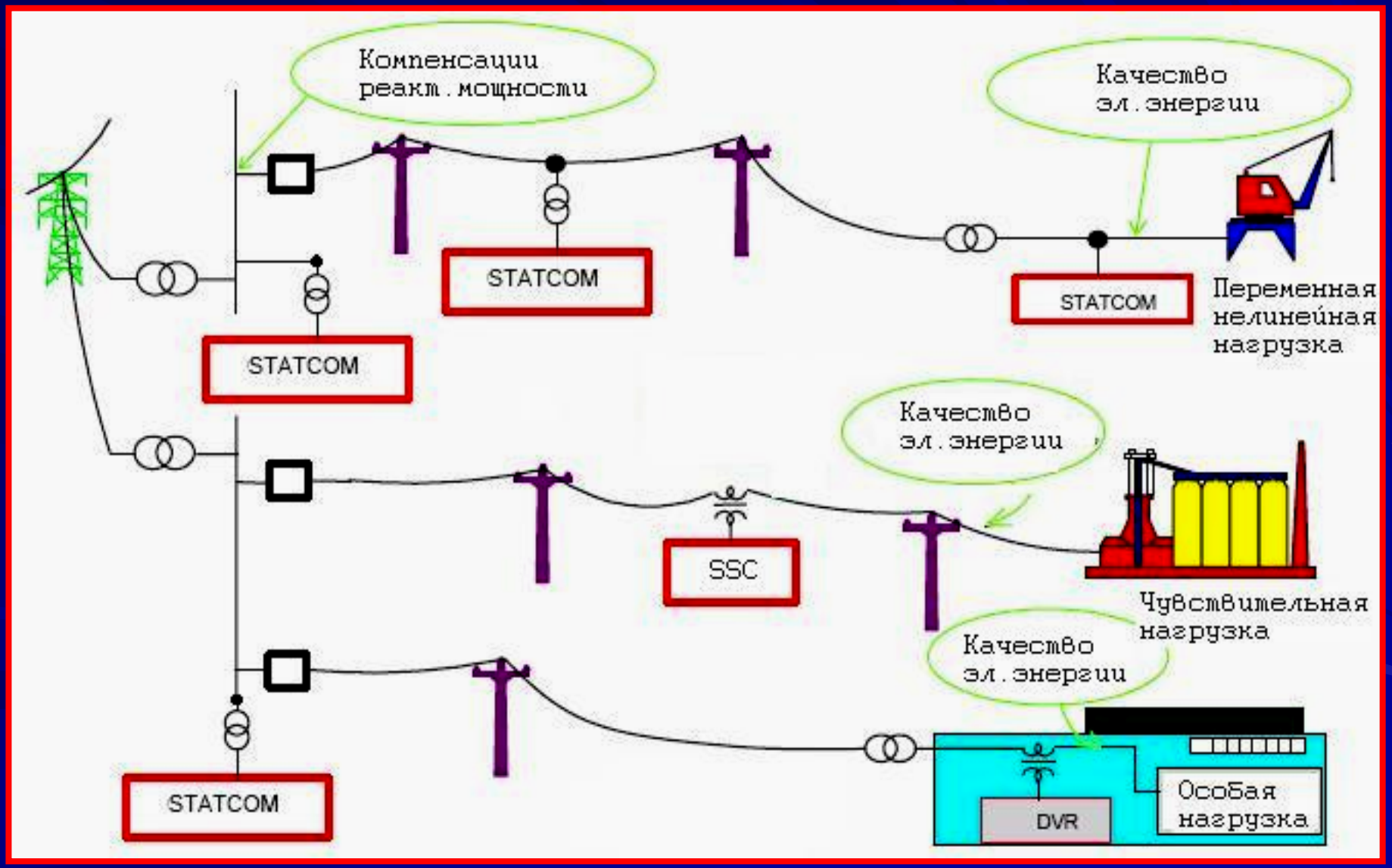
Valves based on photothyristors





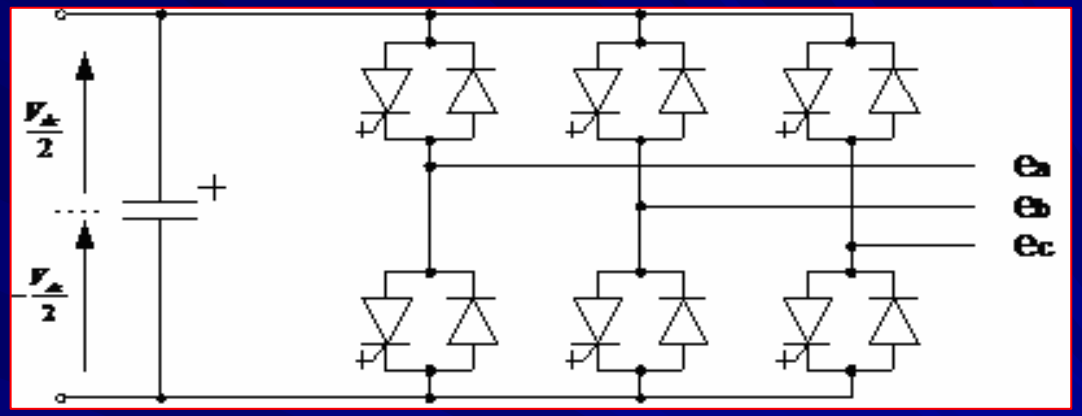
- Gated hall of 250 kV, 1000 A Moyle converting substation

FACTS device in electrical network

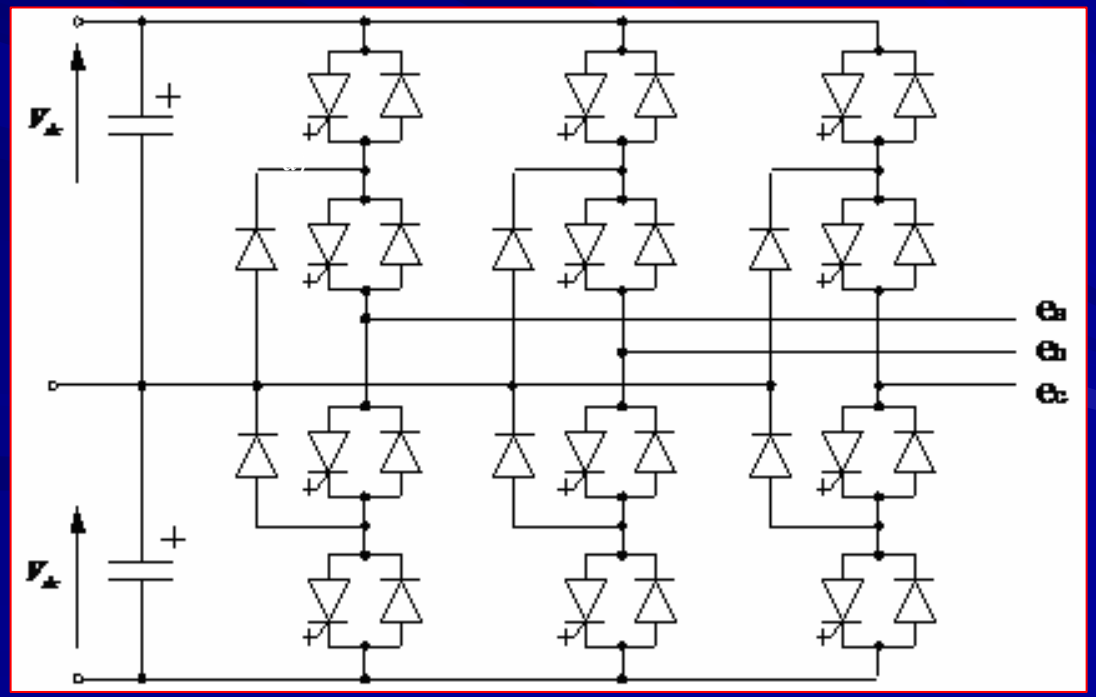


STATCOM voltage converters

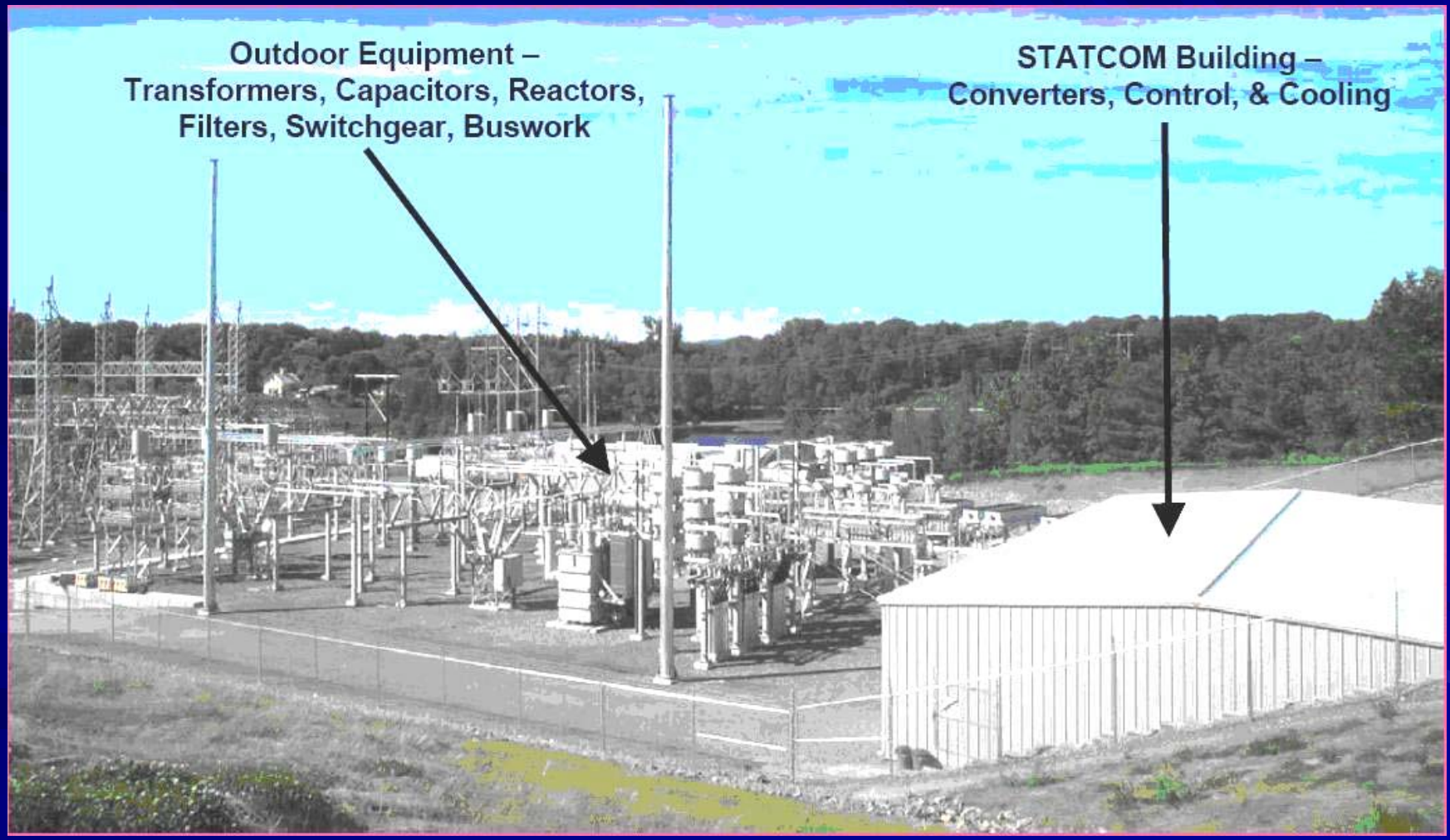
- 2-level



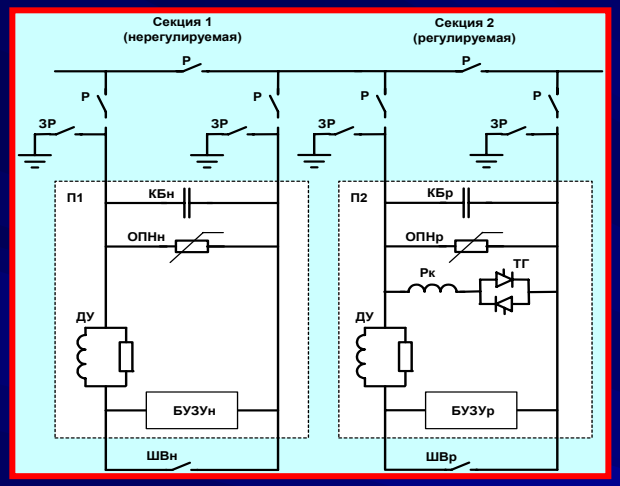
- 3-level



STATCOM at Essex substation (USA)

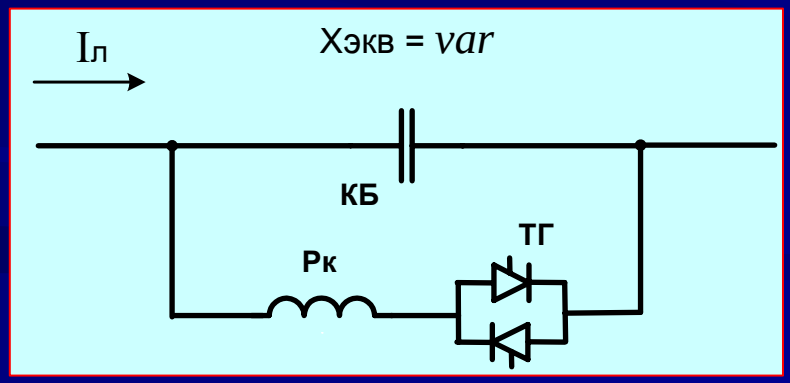


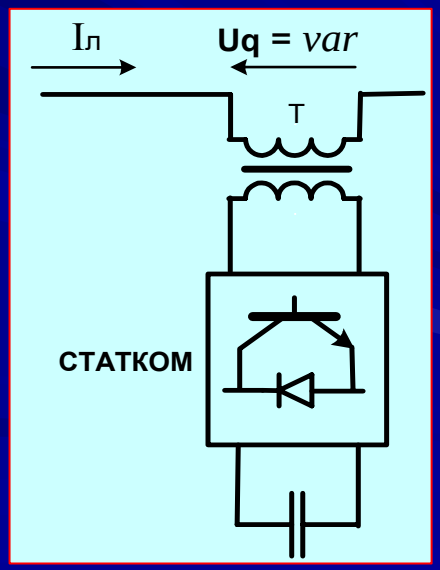
Units featuring controlled series compensation with thyristor control



- Р – disconnectors;
- ЗР – grounding disconnectors;
- П1, П2 – insulating platforms;
- КБн, КБр – capacitor banks;
- ОПНн, ОПНр – surge arresters;
- ТГ – thyristor group;
- Рк – reactor;
- ДУ – damping device ;
- БУЗУн, БУЗУр – quick-response controlled protective device;
- ШВн, ШВр – shunting switch.

Units featuring controlled series compensation with thyristor control





STATCOM-based units

180 MVAr, 330 kV magnetically controlled shunt reactor

VEI carries out a number of works developing power-efficient technologies and electrical equipment.

Controlled electric drive (CED)

LV CED

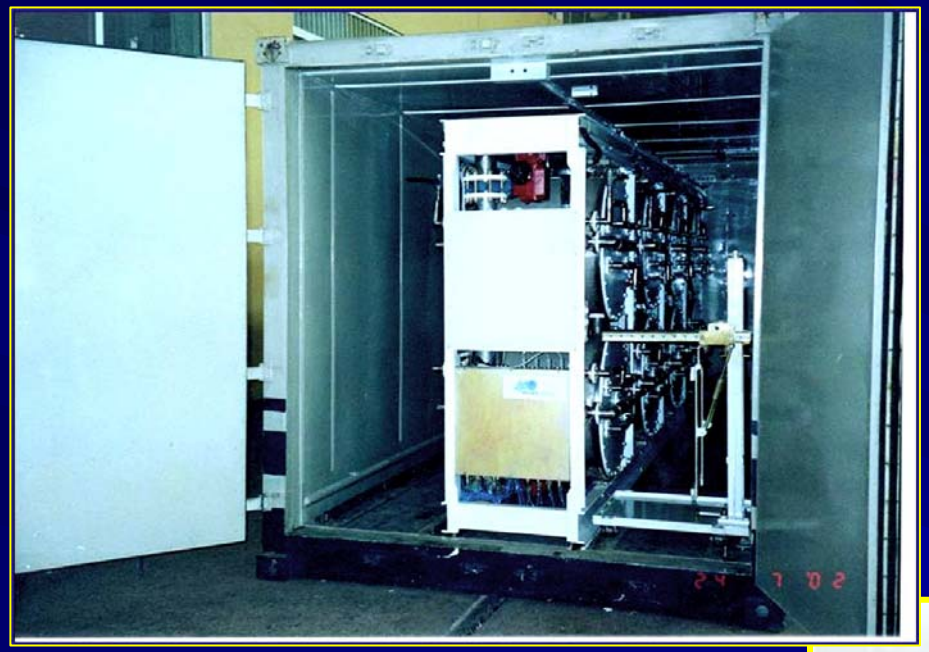
HV CED

The use of frequency-controlled electric drive for electric motors allows to save 15 to 50 percent of consumed power.

The higher the share of converted electric power, the higher the energy-efficiency of the country.

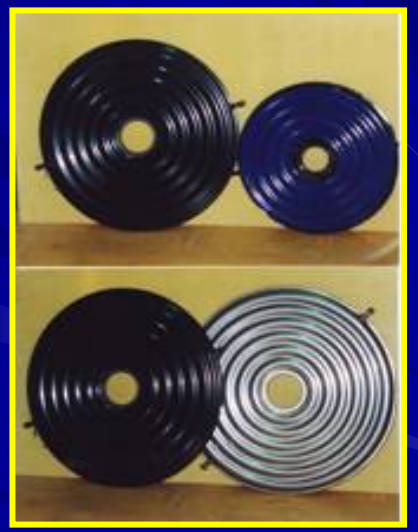
High-output plate ozonizer

(awarded gold medal at
"High technologies of the 21-st century" exhibition)



Ozonizer block of VEI mounted on the eastern water power supply of Moscow

- Plate ozone generator
- Generator module for 3 kg of ozone per an hour



VEI's SHF lamp ("SVETON")

Based on pollution-free non-electrode SHF gas-discharge lamp "SVETON" light source of high intensity features quasi-solar radiation spectrum. Light-emitting SHF discharge is maintained in gas-filled quartz sphere of the lamp, placed in translucent resonator excited with a magnetron.

Features:

-More than 75 % of optical energy radiation with normal colour-reproduction is in the visible spectrum.

-The lamp features a spot luminous element.

-Low level of UV and IR-radiation.

-Service life is 50000 hours.

Thank you for your attention