

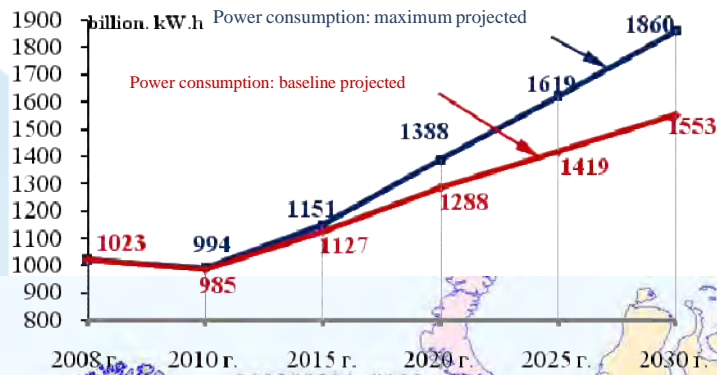
Developing a Unified Smart Energy System based on Russia's Unified Energy System

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Unified Energy Systems of Russia (UESR): Key Features

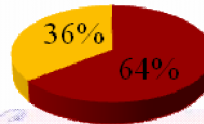


Projected power consumption in Russia through 2030



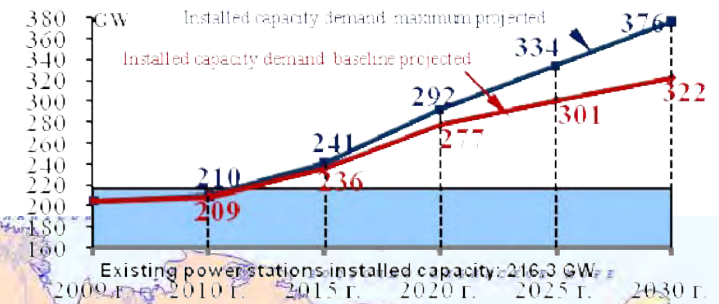
Investment required for UESR development through 2030

$\Sigma = 1.4$ trillion \$



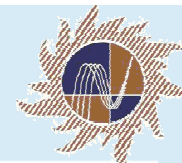
- Power station development
- Construction of power grid facilities

Installed power station capacity demand in Russia through 2030



Existing power stations installed capacity: 216.3 GW

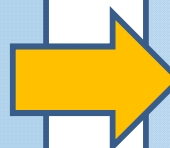
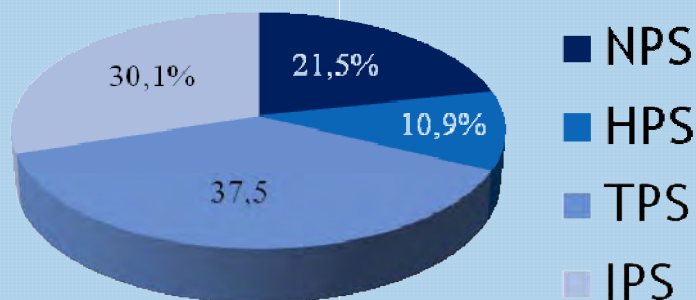




UESR: Key Features

2009 - current indicators

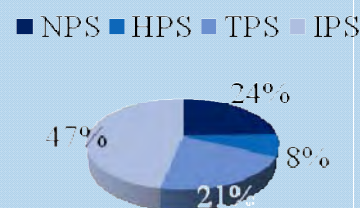
- Power station installed capacity– 211845,7 MW
- Power generation output– 957,1 billion kW h
- Power consumption– 942,8 billion kW h
- Existing infrastructure of installed capacity within UESR



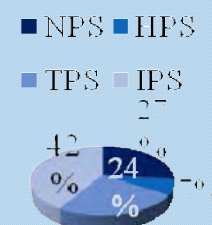
2030 estimate

- Power station installed capacity– 410 000 MW
- Power generation output– 2080 billion kW h
- Power consumption– 1553 billion kW h
- Additional power generating facilities - 204,8 GW (159.3 GW under baseline projected)

Maximum projected



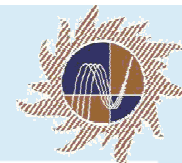
Baseline projected



UESR: Key Features:

- ✓ Uneven power consumption trends across the country.
- ✓ Long high voltage AC power lines
- ✓ Uneven infrastructure of power generation across the country
- ✓ Highly centralized, multilevel control system

New Challenges for the Energy Sector

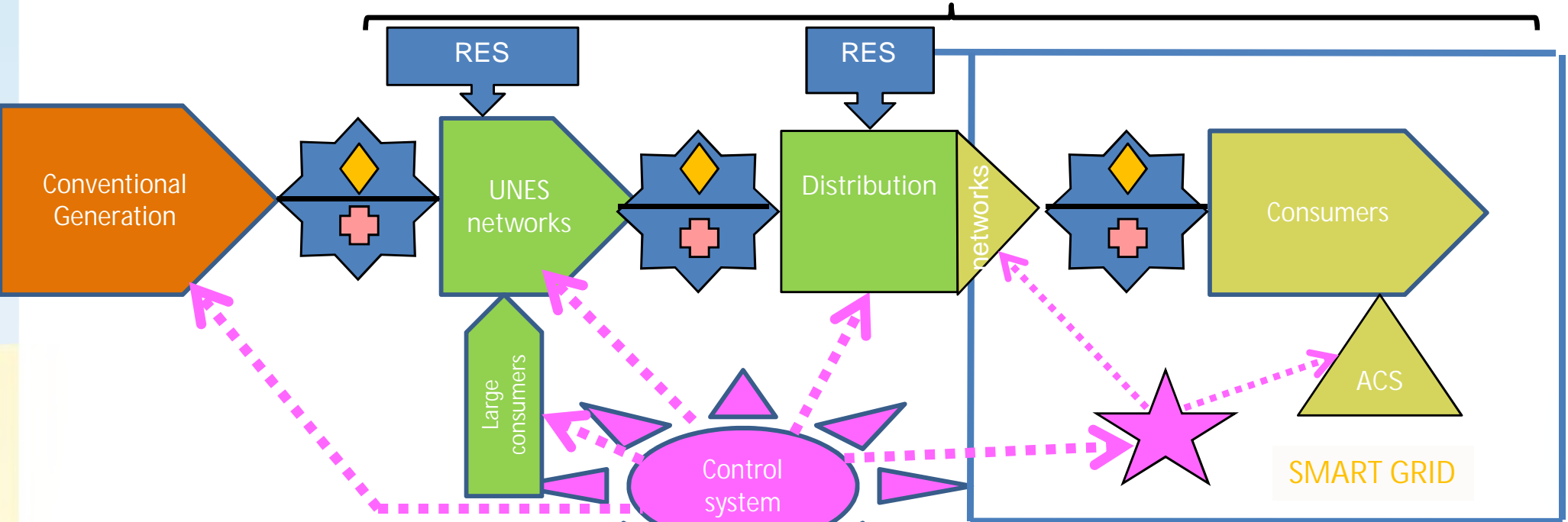


- ✓ Ensuring energy efficiency of the infrastructure's operation and development
- ✓ Changes in the organizational chart of the energy industry driven by restructuring
- ✓ Changing consumption patterns in discrete section of the energy system. Concentration of power consumption and production.
- ✓ Growing decentralization of power supply due to expanded use of small size generator sources
- ✓ Lack of certainty with regard to location of new energy consumers across the country.
- ✓ Obsolescence and tear & wear of equipment and control means.

Infrastructure of Energy Systems



PROCESS INFRASTRUCTURE—ACTIVE/ADAPTIVE NETWORKS



System parameters control systems:

- frequency
- voltage

Regulators of:

- Network resistance
- Voltage modules
- Voltage phases
- Energy stores
- Information systems
- Control systems

Smart Grid: Key parameters:

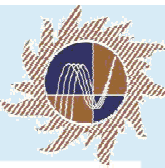
- Sophisticated metering and measurement systems
- Adaptable consumption control systems (ACS)
- Self-regulation systems for local power sources (inc. renewables)
- Coordination implemented by the common control system



Measurement systems



Metering systems



Smart Energy System (SES) is a new generation electric energy system designed to ensure:

- Accessibility in use of resources;
- Reliability;
- Quality;
- Cost efficiency;
- Flexible coordination of all consumers served by generation and power systems.

The key element of SES is the active/adaptive network serving as foundation of process infrastructure of electric energy generation.



Government Action:

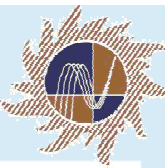
1. Russian Federation Energy Strategy through 2030 – approved by government decree #1715-r of 11.13.20090
2. Federal Law #261 “On Saving Energy and Increased Energy Efficiency and Amendments to Certain Russian Federal Laws” of 11/23/2009
3. The list of presidential instructions of 01/04/2010 #PR-22 based on the results of the presidential commission for modernization and technological development of Russia’s economy in June-December 2010.
4. Minutes of the meeting of the Council of general and chief designers, leading scientists and experts in high-tech economy sectors chaired by Prime Minister Putin of 12.07.2009 #4.
5. Government directive # CC-P7-7170 dated 12.7.20090 on developing an Action plan to stimulate corporate innovation based on implementation of key activities of the Russian government in 2010 - 2011
6. Minutes of the meeting of Presidential commission for modernization and technological development of Russia’s economy through December 25th, 2009, #37.

«FGS UES» and «R&D Center of power engineering» : Bringing the Action Plan to Life :

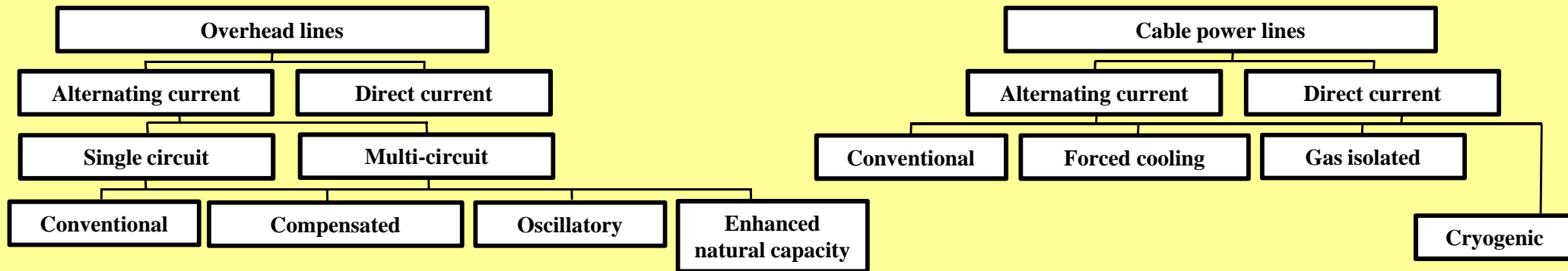
February 2010 – the concept of the smart energy system featuring active/adaptive network (SES/AAN) has been developed. The methods for its development have been reviewed and approved by the Strategic Committee of the Board of Directors of FGS UES as well as the science and technology council of Russia’s academy of sciences.

April 2010 -As a next step, a task force including experts from Russia’s academy of sciences, FGS UES, Holding IDGC, SO UES, Inter RAO UES, Russian Energy Agency, R&D Center for power engineering, Energy Strategy Institute, National Institute of Energy Security, Independent Energy Alliance, etc. has been formed. R&D Center for power engineering is coordinating the project.

August 2010 – Key Provisions of the concept for developing a smart energy system with active/adaptive network are currently being reviewed by FGS UES, SO UES, Holding IDGC, Russia’s academy of sciences, Russia’s Energy Agency and the Ministry of Energy



Key innovative technologies required for A/A N



- New devices for control (compensation) of reactive capacity and voltage with parallel network connection: STATCOM and asynchronized compensator (ASC)
- STATCOM-driven insertion of direct current
- Controlled series compensation devices (CSCD)
- Phase-shifting devices (PSD)
- Short circuit current restrictors (SCCR)
- New generation power lines with enhanced throughput capacity combined with FACTS class devices
- Energy stores

Turbo-hydrogenerators.

- Asynchronized turbo- and hydro power generators
- Asynchronized compensator (ASC).
- Hydro power generators with alternating revolution frequency
- Turbo- and hydro power generators combined with FACTS class devices
- Turbo- and hydro power generators combined with energy stores.



Thank you for attention

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