



International Partnership for Hydrogen and Fuel Cells in the Economy



20th Steering Committee Meeting, City of Fukuoka, Japan, 20-21 November 2013

Country Update Russia



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State Policy

Among 8 top priority science and technology development directions the following, dealing with hydrogen economy, were declared by the President's Decree: ***“Energy efficiency and energy saving”*** and ***“Transportation and space systems”***, which correspond to Critical Technologies: ***“Novel and renewable energy sources, including hydrogen energy”***, ***“Next generation transport technologies”***.

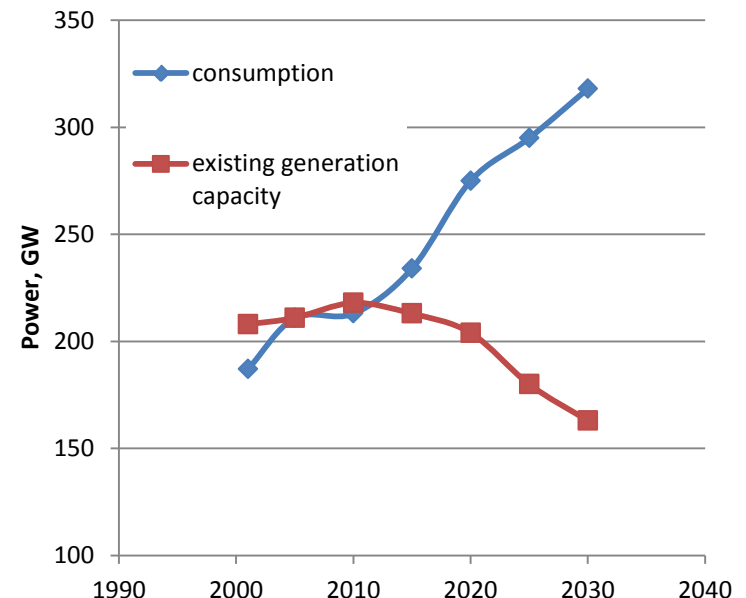
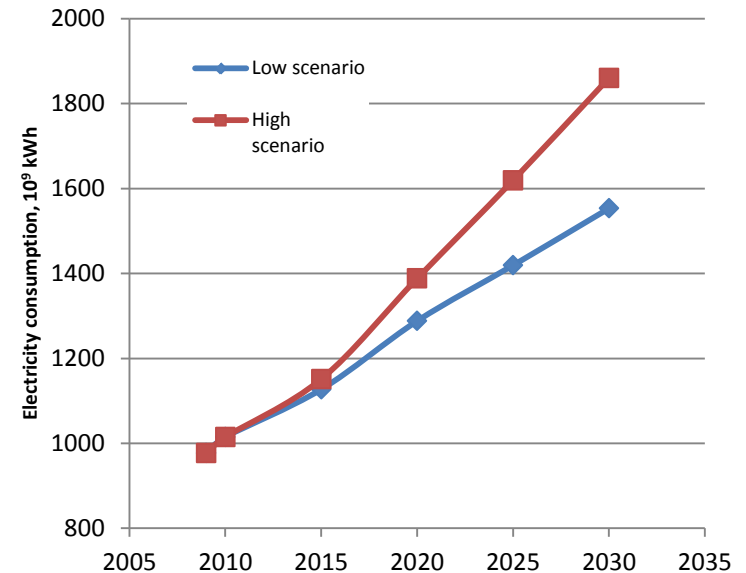
The government also adopted ***“The Basis of Russian Federation Policy in the Field of Science and Technology till 2020 and after”*** and ***“Russian Federation Innovative Development Strategy till 2020”***.

State Policy

To cover electricity consumption demands in 2030 Russia needs 318 GW of available power station capacity. New 164 GW are needed!

Priorities in Hydrogen Energy

- New technologies for hydrogen production incl. renewables
- Hydrogen systems for electricity accumulation in power industry
- Hydrogen for distributed power production
- Superconductive and liquid hydrogen hybrid systems for energy transportation
- Hydrogen current sources
- Metal hydride systems
- Aluminum-hydrogen technologies for energy production and transportation
- Hydrogen safety



A.N. Shishkin "Current state, problems and perspectives of power industry development", 2011

State Policy

Technological platforms (TP) are tools for modernization and innovative development of Russian economy acting by combining efforts of the state, business and science for implementation of long-term strategic research.

Platform title	Issue addressed dealing with hydrogen	Host organization
BioTech2030	Biohydrogen	JSC “Biotechprom”, MSU
Deep refining of fossil fuels	Hydrogen production processes and catalysts	JSC “Vnipineft”
Distributed power	Fuel cells	JSC “Agency on the Balances in Power Generation”
Perspective Technologies of Renewable Energy	Hydrogen energy storage	JSC “RusGidro”
High-efficient Ecologically Clean Thermal Power Production	Fuel cells	JSC “VTI”
Green Car	Fuel cells	State Research Enterprise “Nami”, State Technical University “MADI”

Financing

Russian Ministry of Education and Science supports basic and applied research and development and innovation activity in the field of hydrogen and fuel cells within the framework of Federal Target Program

“Research and Development in Priority Directions of science and technology development in Russia for 2007-2013”

Increase of state financing of R&D for the past 3 years in 30% every year. For R&D in the field of hydrogen and fuel cells it is 80% increase compared to 2010. From 2011 till now 20 projects were supported, including 3 big projects.

Funding 2011-2013: **1 072.45 mln Rub** including financing attracted from non-budgetary sources (**462,35 mln Rub**).

In Addition:

30% of the budget financing : the programs of **Russian Academy of Sciences**.

5% comes from various foundations, including **Russian Foundation for Basic Research**.





Energy system based on solar voltaic array with electricity and heat accumulation systems based on hydrogen co-generation systems

electricity production



hydrogen production



hydrogen storage



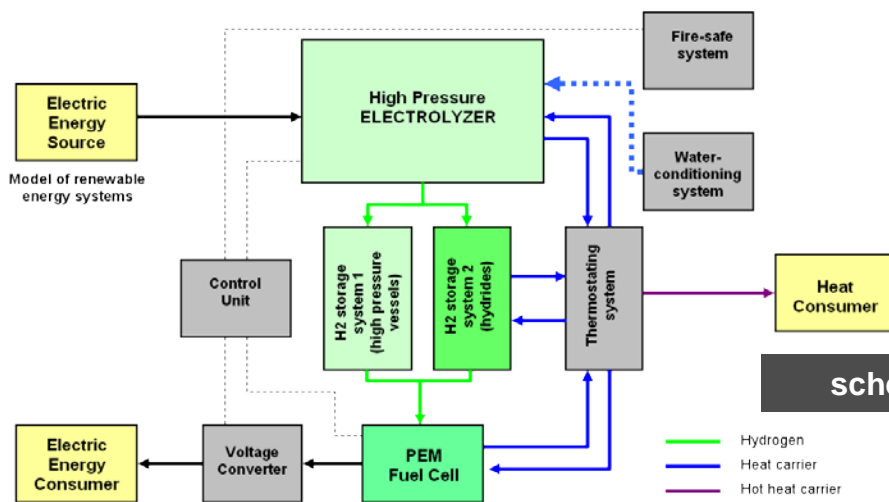
Energy system based on fuel cells, water electrolyzers and hydrogen accumulators for local energetic

electricity production





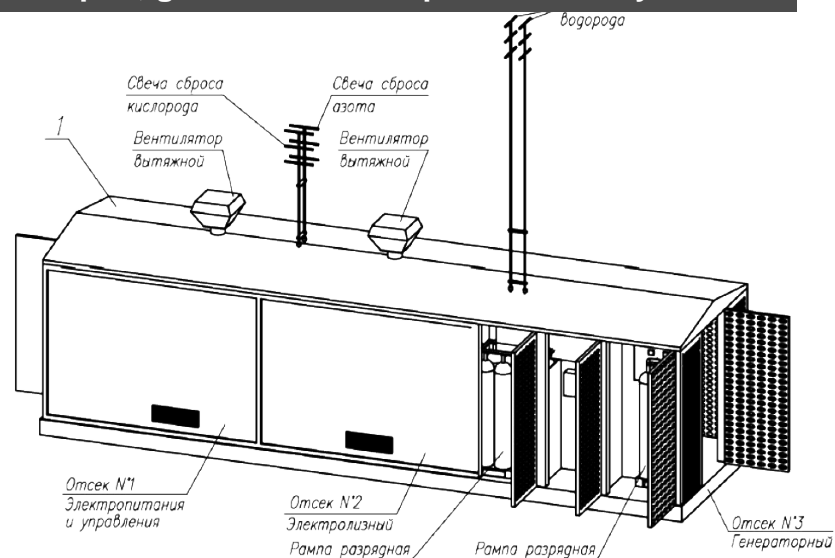
Pilot energy accumulation system based on hydrogen technologies



Key elements of the system:

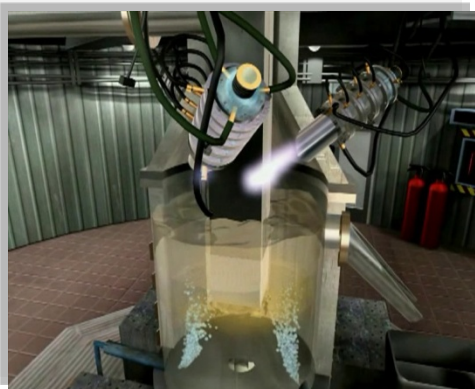
- High Pressure Electrolyzer (10 m³/h, 130 bar)
- H₂ storage system #1 (high pressure vessels, 130 bar, up to 70 m³)
- H₂ storage system #2 (metal hydrides)
- PEM Fuel Cell (10 kW)

schematic plot, general view and photo of the system





Hydrogen production from hydrogen sulfide to be used for oil and gas processing and hydrofining (plasma technology)



Hydrogen (syn-gas) production from waste of oil processing (plasma-melt technology)

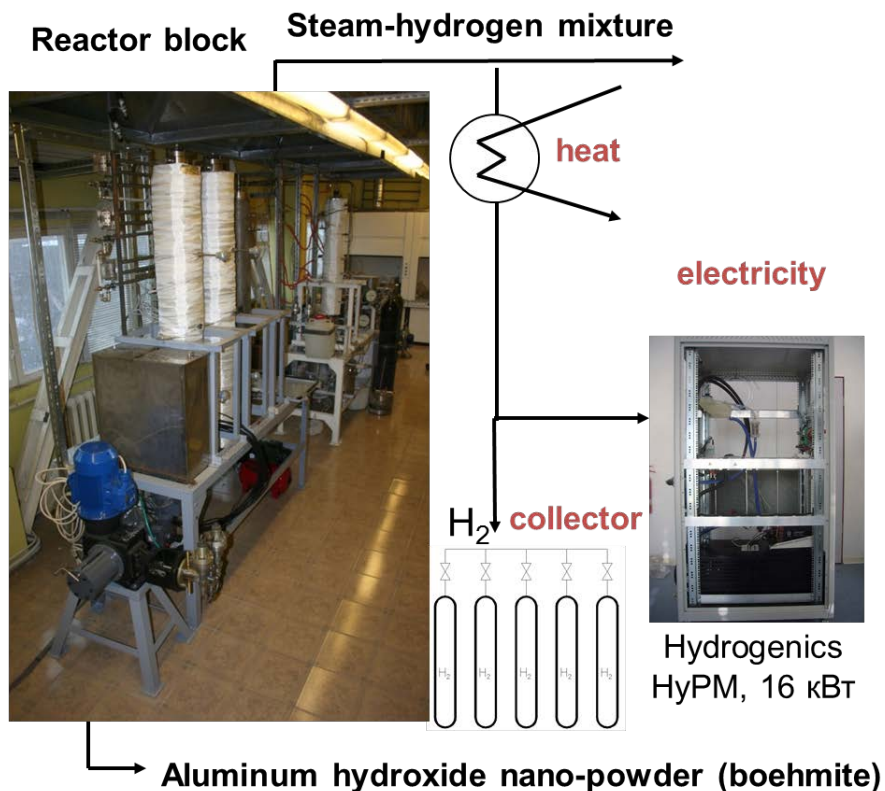


Experimental facility for:

- MeH hydrogen storage and purification
- kW scale combined heat and power with hydrogen energy storage
- FC back-up power systems development
- biohydrogen purification
- solid state hydrogen storage fundamental studies

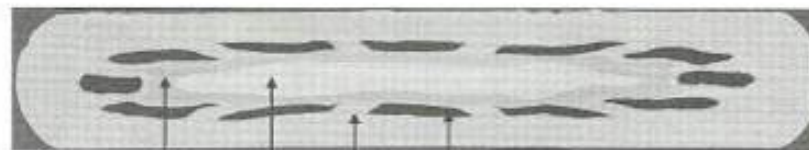
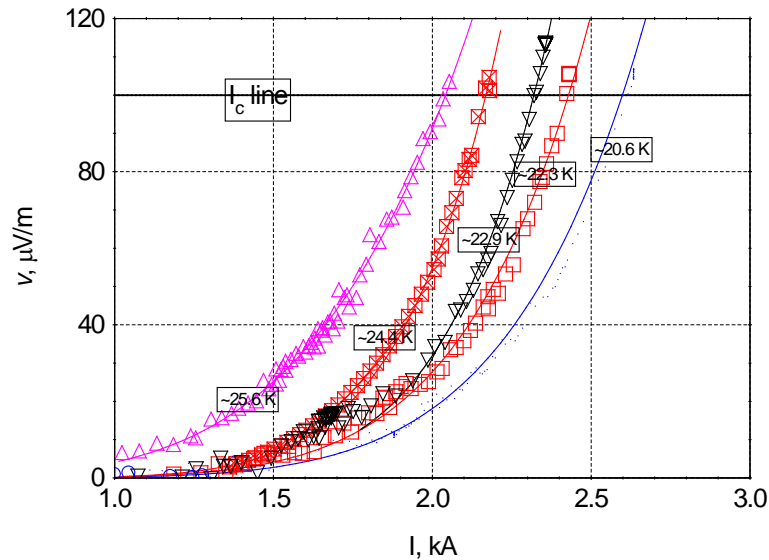
H2Lab JIHT RAS





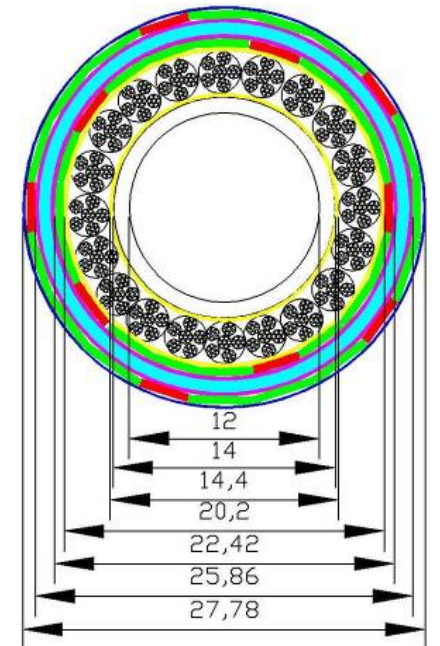
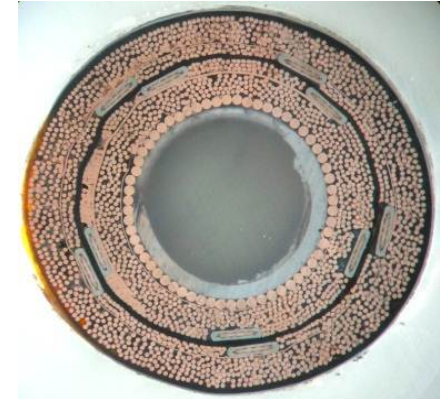
<i>Parameter</i>	<i>Value</i>
Aluminum consumption, kg	9.4
Aluminum hydroxide production, kg	19
Heat power, kWh	37
Hydrogen production, nm ³	12
Hydrogen consumption by Fuel Cell, nm ³	10
Fuel cell output, kWh	14
Auxiliary, kWh	4.3
Total efficiency (to aluminum enthalpy), %	72

First superconductive/hydrogen hybrid energy transportation line



Fe Cu Ni MgB_2

Dimensions: 3.65 mm x 0.65 mm
 I_c @ 20K, 1T > 400A
 Cost << 10 €/kAm \rightarrow << 13\$/kAm
 Minimum bending radius: 65 mm
 Single-piece length: Up to 1.7 km



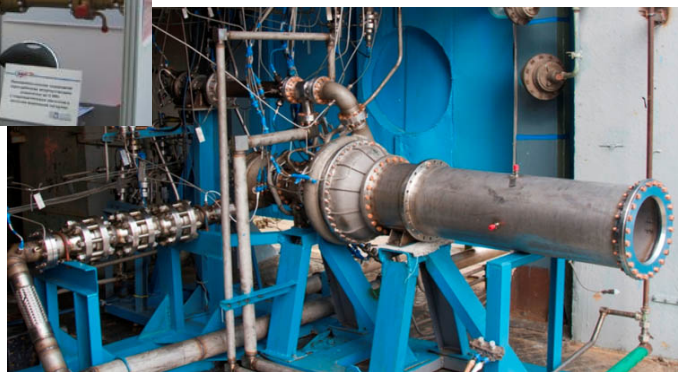
Demonstration

Hydrogen-oxygen units for autonomous and back-up power production



Application:

- electric energy production at enterprises having hydrogen as side product;
- fire fighting systems;
- back-up and peak power.



Advantages:

- High specific power;
- Minimal start-up time (less than 10 sec.);
- Ecologically clean;
- Efficiency (more than 30 %).
- Simple design and low specific cost (less than 300 \$/kW).

RCS activity

“Hydrogen technologies” Technical Committee at **Federal Agency on Technical Regulation and Metrology** implemented several national standards corresponding with ISO and IEC:

- “Hydrogen generators basing on the fuel processing technology”
- “Road vehicles using fuel cells”
- “Connecting devices for multiple charging of ground vehicles by compressed hydrogen”
- “Movable devices and systems for hydrogen storage on the base of metal hydride technology”
- “Gaseous hydrogen – Fuelling stations”

**National Association of Hydrogen Energy is initiator of technical policy in hydrogen
RCS – 10 year Anniversary !**



Hydrogen Safety



Organizations involved in hydrogen safety R&D:

- **Joint Institute for High Temperatures, RAS**
- **Institute of Physics and Power Engineering**
- **Institute of Structural Macrokinetics, RAS**
- **All-Russia Thermal Engineering Institute**
- **NRC “Kurchatov Institute”**



Explosive chamber 13R3

Education



All-Russian competition of research projects “Energy of Youth” for young scientists is held annually, more than 20% of the proposals from young scientists deal with hydrogen and fuel cells.

More than 30 scientific and educational centers in the field of hydrogen and fuel cells, among them:

- Boreskov Institute of Catalysis (Novosibirsk)
- Moscow State University
- Moscow Power Engineering Institute



Perspectives

New Federal Target Program adopted

***“Research and Development in Priority Directions
of science and technology development in Russia for
2014-2020”***

with total funding: **239 023.77 Mln. Rub (≈ 7.5 bln. USD)**