Development of hydrogen energy in the Russian Federation

March 2022
Hydrogen energy sector in Russia. Short-term roadmaps

<table>
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<th>Short-term planning</th>
<th>Status</th>
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<td>Energy strategies</td>
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<td>Russian Energy strategy 2035</td>
<td>Approved by RF Government Decree No. 1523-p of 09.06.2020</td>
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<td>Roadmap for the development of Russian hydrogen energy sector to 2024</td>
<td>Approved by RF Government Decree No. 2634-r of 12.10.2020</td>
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<td>The concept of hydrogen energy development</td>
<td>Approved by RF Government Decree No. 2162-p of 05.08.2021</td>
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<td>Russian low-carbon hydrogen strategy</td>
<td>In development since Sept 2021, Expected by 2Q 2022</td>
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Organization activities

| Creation of a project office for implementing the Program for the development of the Russian energy sector | The project office has been established at the Russian Energy agency (Energy ministry of RF) |
| Creation of the Joint government working group and R&D Committee on hydrogen technology | 3Q 2021 |
| Creation of «Hydrogen infrastructure developers and equipment manufacturers» (non-profit organization) | 2Q 2022 |

Investors

- Oil and gas complex - "blue" hydrogen
- Nuclear power plants – "yellow" hydrogen
- RES – "green" hydrogen

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<tr>
<td>GAZPROM</td>
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<td>NOVATEK</td>
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<td>ROSATOM</td>
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<td>Other oil&amp;gas companies</td>
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Hydrogen production KPIs, Mt

- Baseline scenario
- Optimistic scenario
The cost of hydrogen production in the Russian Federation using various technologies

- **SMR**: $2.2/kg H₂, 1.0 kg CO₂/kg H₂
- **SMR+CCS**: $2.3/kg H₂, 1.9 kg CO₂/kg H₂
- **CH₄ pyrolysis**: $1.8/kg H₂, 1.4 kg CO₂/kg H₂
- **Coal Gasification**: $1.9/kg H₂, 1.0 kg CO₂/kg H₂
- **Coal Gasification +CCS**: $2.7/kg H₂, 2.2 kg CO₂/kg H₂
- **Biomass Gasification**: $3.0/kg H₂, 1.5 kg CO₂/kg H₂
- **Biomass Gasification +CCS**: $3.2/kg H₂
- **Nuclear Electrolysis**: $8.2/kg H₂, 5.0 kg CO₂/kg H₂
- **Wind Electrolysis**: $10.0/kg H₂, 4.6 kg CO₂/kg H₂
- **Solar Electrolysis**: $14.9/kg H₂, 7.1 kg CO₂/kg H₂

- **EU Taxonomy** = 5.8 kg CO₂ per kg H₂
- **CertifHy** = 4.4 kg CO₂ per kg H₂

Taking into account the decrease in LCOE of RES in Russia: Wind – to 0.06 $/kWh, PV – to 0.08 $/kWh.
Traditional and prospective areas of hydrogen usage

### Traditional areas
- **Industry**
  - Chemical industry (ammonia, methanol)
  - Metallurgy
  - Glass industry
  - Electronic industry
  - Food processing industry
  - The pharmaceutical industry

- **Oil refinery**
  - Hydrotreating of fuels and lubricants
  - Hydrocracking
  - Preparation of catalytic cracking raw materials

### Prospective areas of hydrogen use as an energy carrier
- **Transport**
  - Fuel cell electric vehicle (FCEV):
    - Passenger cars
    - Buses and trucks
    - Warehouse transport
    - Railway transport
    - Ships and air transport
  - In internal combustion engines:
    - Methane-hydrogen mixtures
    - In the form of ammonia

- **Energy sector**
  - Application today:
    - Cooling of turbo generators
  - Prospective application:
    - Energy carrier, electric power storage systems
    - Balancing of power systems
    - Methane-hydrogen mixtures
    - Gas turbines

- **Buildings**
  - Electricity supply (hydrogen power plants)
  - Heat supply
  - Local power supply systems
  - Household fuel cells

### Consumption
- **Traditional areas**
  - Consumption today **90 million tons per year**

- **Prospective areas**
  - Consumption today **less than 0.01 million tons per year**

*for pure hydrogen*
## Initiatives and policies to develop hydrogen economy

| 1 | Creation of hydrogen clusters | • Deployment of infrastructural hydrogen solutions  
• Adoption of best international industrial practices in hydrogen economy  
• Gaining hydrogen engineering and industrial expertise  
• Boosting demand for Russian science-intensive hydrogen energy technologies  
• Export-oriented hydrogen production |
| --- | --- | --- |
| 2 | Scientific and technological infrastructure | • Fundamental and applied research in hydrogen energy technologies,  
• Opening Russian scientific research to global competition  
• Creating business and legal framework for intellectual property in hydrogen economy  
• Establishing connection between public and corporate R&D in hydrogen technology |
| 3 | State support mechanisms | • Investment incentives for new production facilities  
• Roadmap for cutting the cost of hydrogen production to outperform global rivals  
• R&D incentives in hydrogen energy  
• Promotion of hydrogen as a prospective energy carriers for the Russian market  
• Regulatory and legal framework for hydrogen economy and management of GHG emissions |
| 4 | Deployment of RES | • Increasing the share of RES in national energy mix  
• Cutting the cost of CapEx and OpEx in renewable energy sources  
• Reducing the cost of renewable electricity  
• Achieving synergy between hydrogen technology and renewable power generation |
| 5 | Promotion of international hydrogen trade cooperation | • Building cooperation with future hydrogen importers to eliminate the barriers slowing the development of hydrogen economy  
• Cooperating on the development international hydrogen economy and technology standards  
• Establishing international organizations and alliances in hydrogen economy  
• Initiating and promoting international scientific and educational activities hydrogen economy |