

Национальная
технологическая инициатива

Пространство возможного

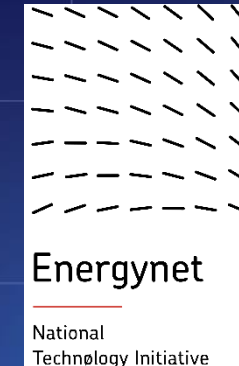
Russian capabilities on hydrogen fuel global market

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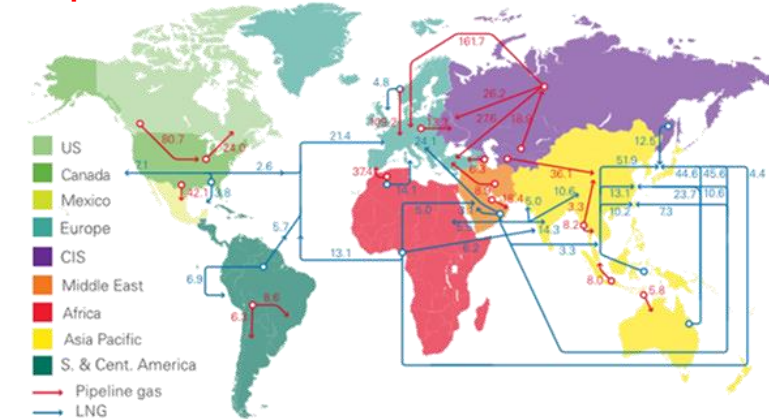
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Why hydrogen energy is important for Russia:

1. Russian power system has abundant generation with low capacity factor and possibility to construct new generation on the base of RES
2. There are huge part of remote territories in Russia
3. There are a lot of territories with high ecological requirements (e.g. Arctic region)

Hydrogen is the new export product for Russian economy and driver for electricity consumption



Hydrogen is the clean fuel for Arctic region

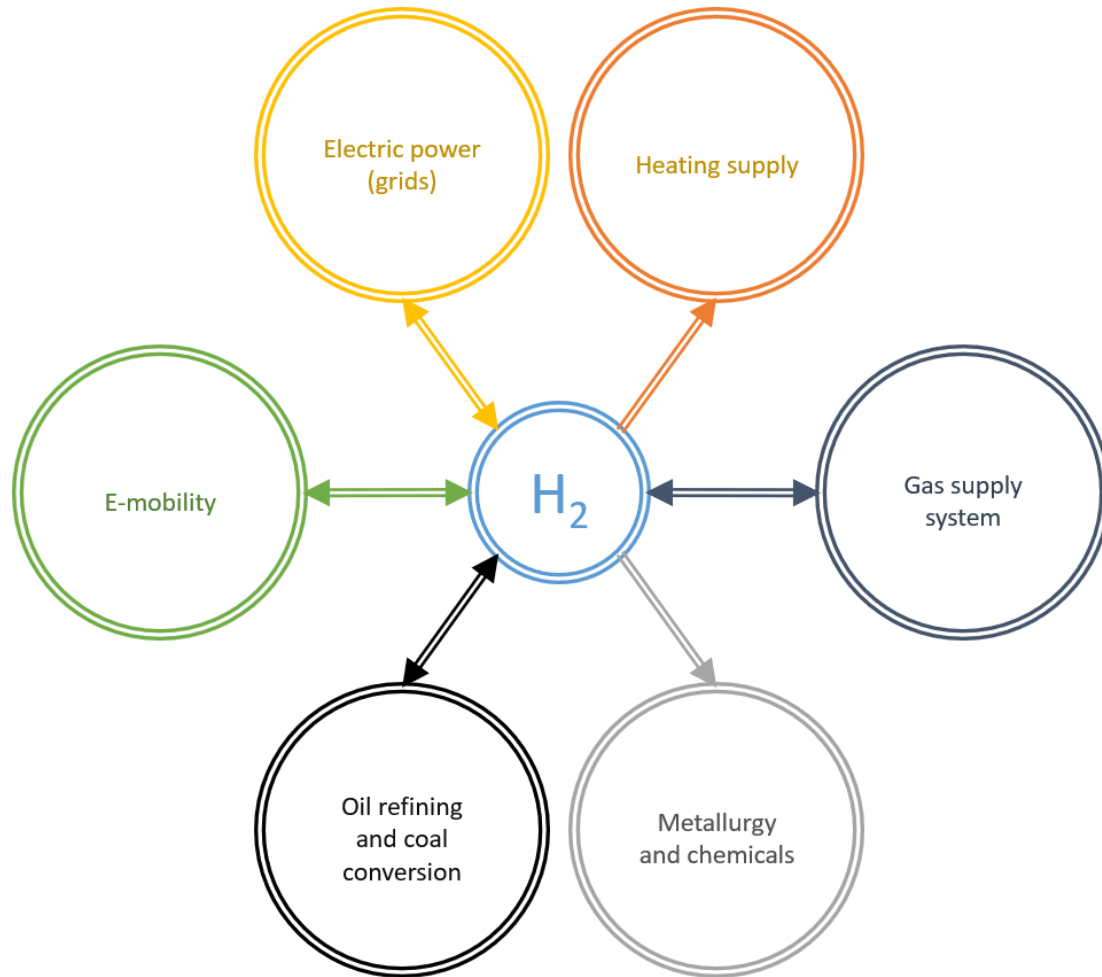


Hydrogen energy is effective way for remote territories energy supply



GLOBAL MARKET HYDROGEN DEMAND AND REQUIREMENTS

Hydrogen is the universal mediator for multi-infrastructural interconnection



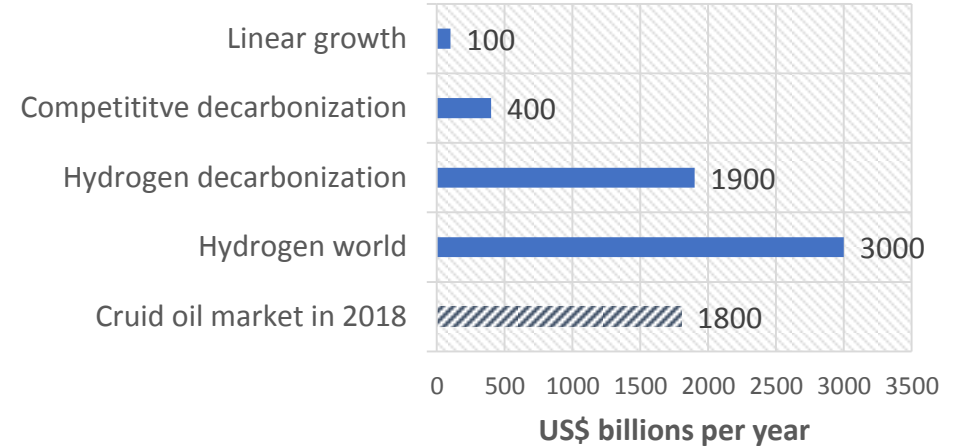
Hydrogen production cost
<\$1,5 per kg

Water electrolysis efficiency
<48,2 kWh/kg

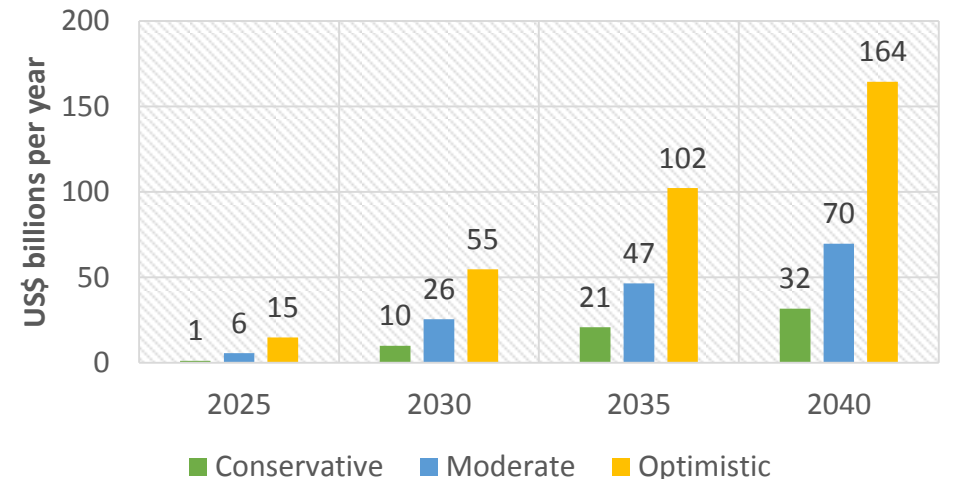
Hydrogen storage and transportation efficiency
<6 kWh/kg

Hydrogen fuel cell LCOE
<0,17 \$/kWh

Estimated hydrogen global trading, US\$ bln per year



Estimated hydrogen fuel demand, US\$ bln per year



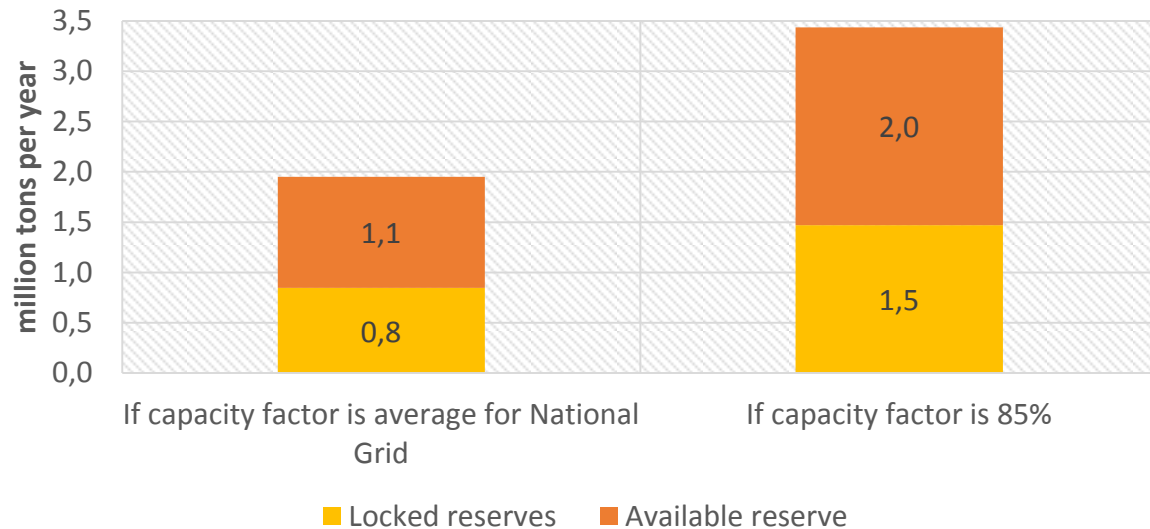
RUSSIAN HYDROGEN SUPPLY CAPABILITIES

Russian hydrogen supply capabilities is **3,5 million tons per year** on the base of existing power generation only by capacity factor increase.

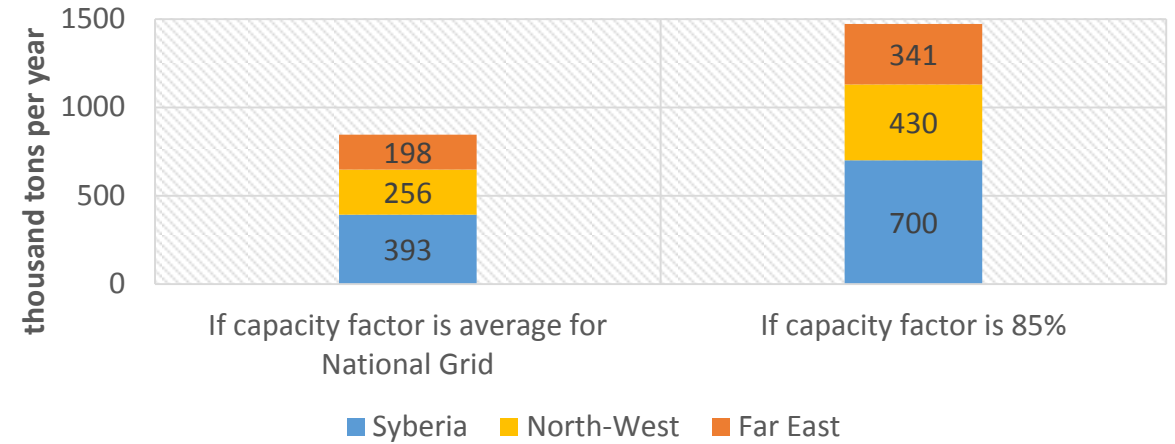
Priority generation for hydrogen production are:

- **Locked reserves** use as an alternative of grid construction for capacity factor increase,
- **Zero-carbon generation** (NPP, HPP) to produce “green” hydrogen.

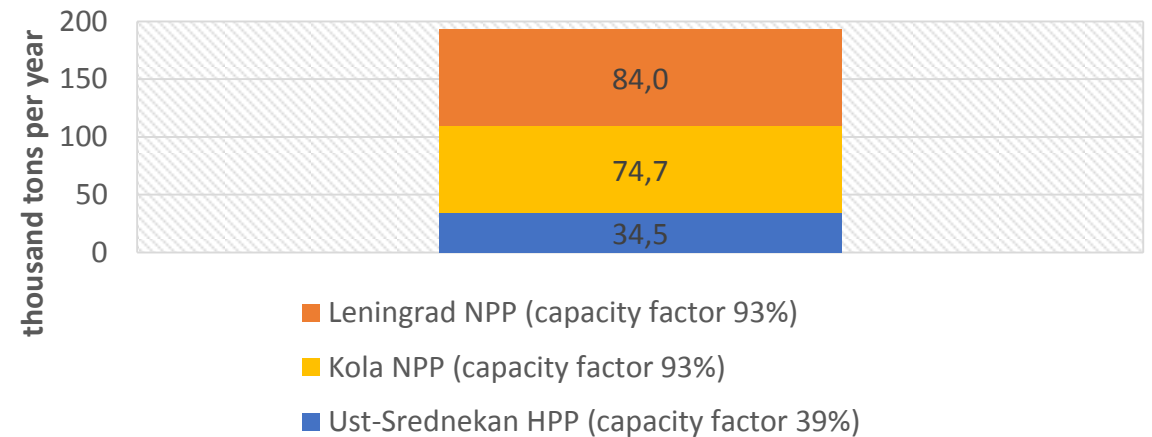
Hydrogen production capabilities on the base of power reserves in Russia, thousands tons per year

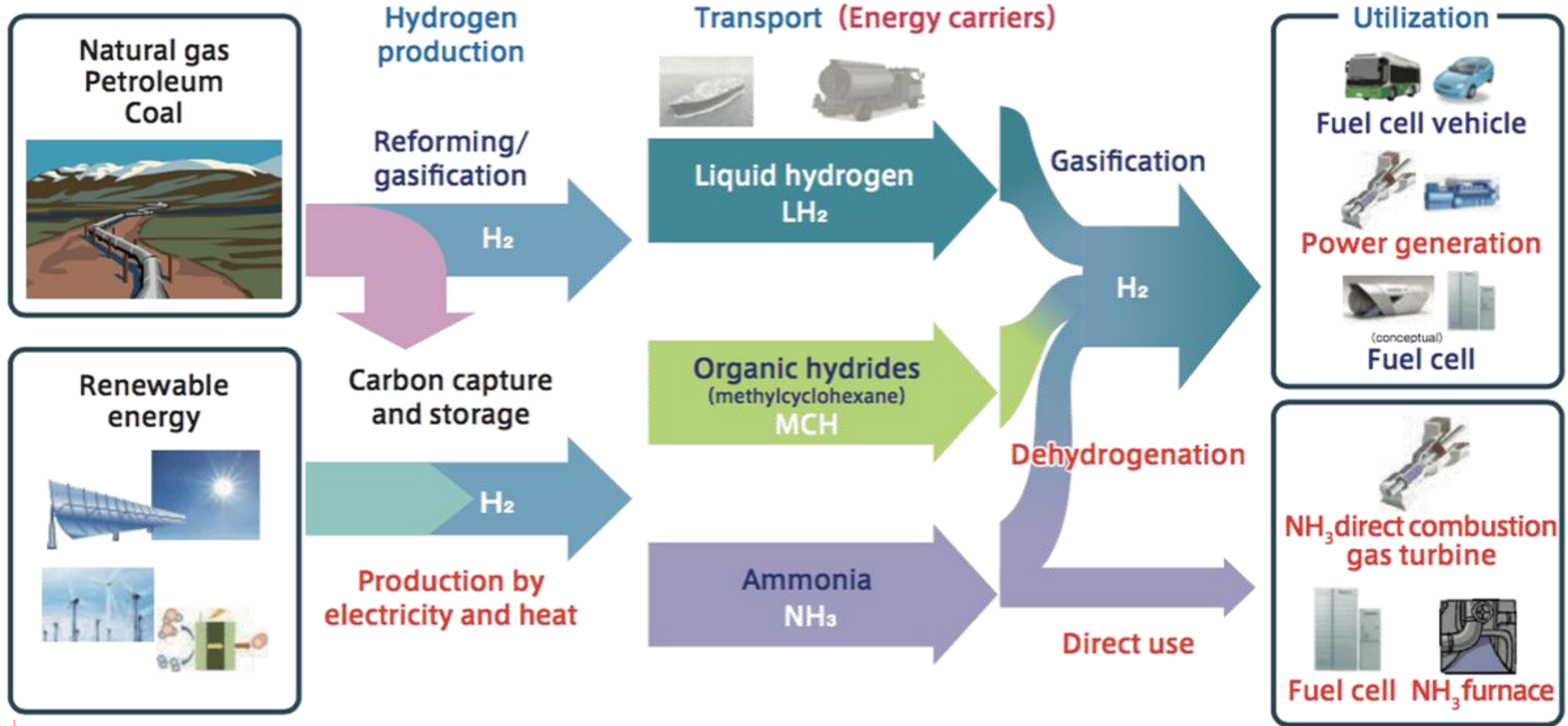


Hydrogen production capabilities on the base of locked reserves in Russia, thousands tons per year



Hydrogen production capabilities on the base of some NPP and HPP, thousands tons per year



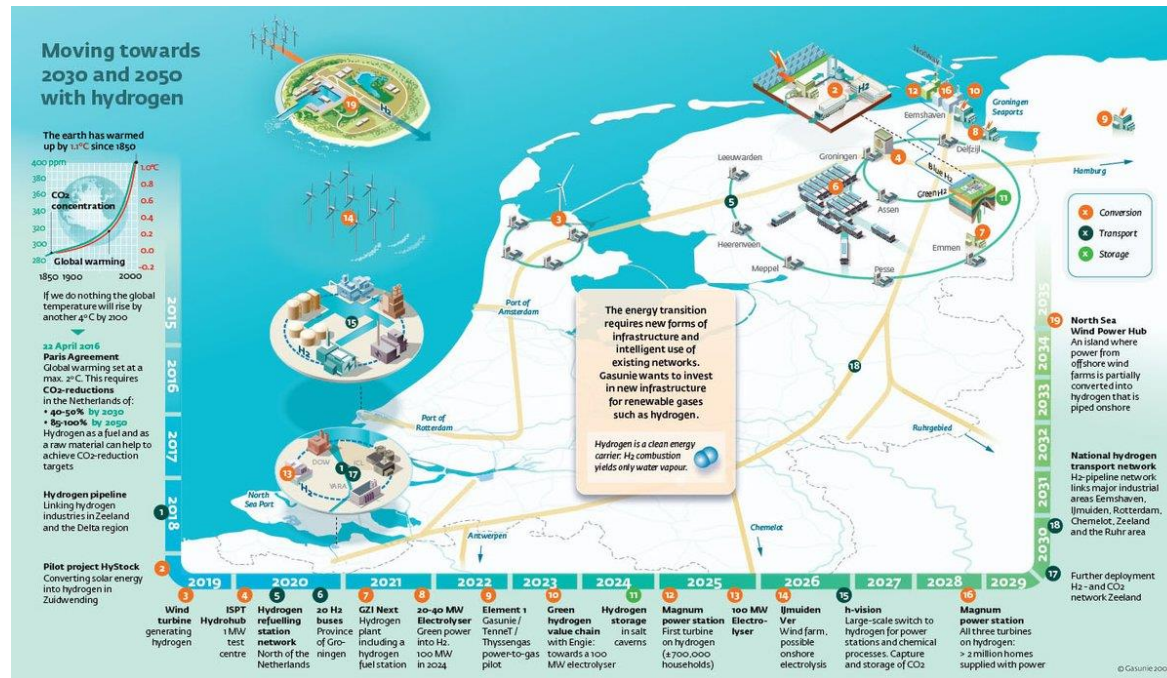


POSSIBILITY FOR INTERNATIONAL COOPERATION

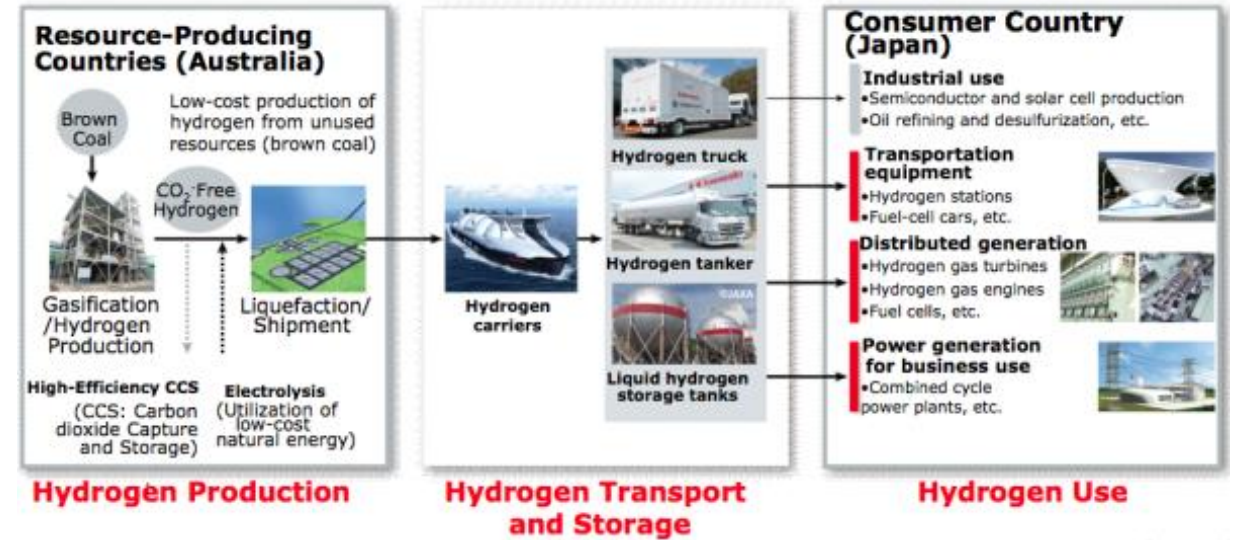
Russia has great capabilities to meet global hydrogen demand and to cooperate on the field of pilot projects with EU, Japan, South Korea and China as a hydrogen shipper:

1. Interconnection with Europe P2G initiatives via hydrogen hubs
2. Making new hydrogen supply chain pilots

Power-to-gas hydrogen hub in North Netherlands



Australia to Japan hydrogen supply chain by Kawasaki

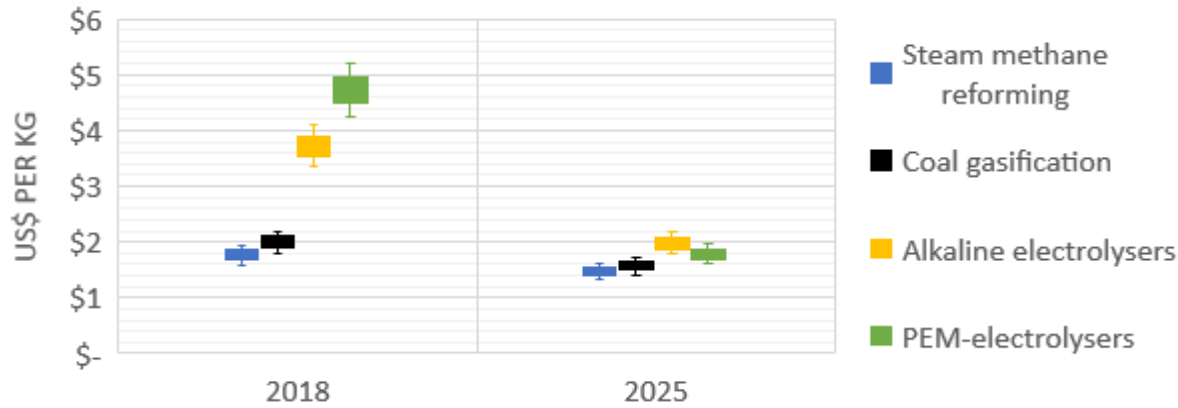


Brunei to Japan hydrogen supply chain by Chiyoda

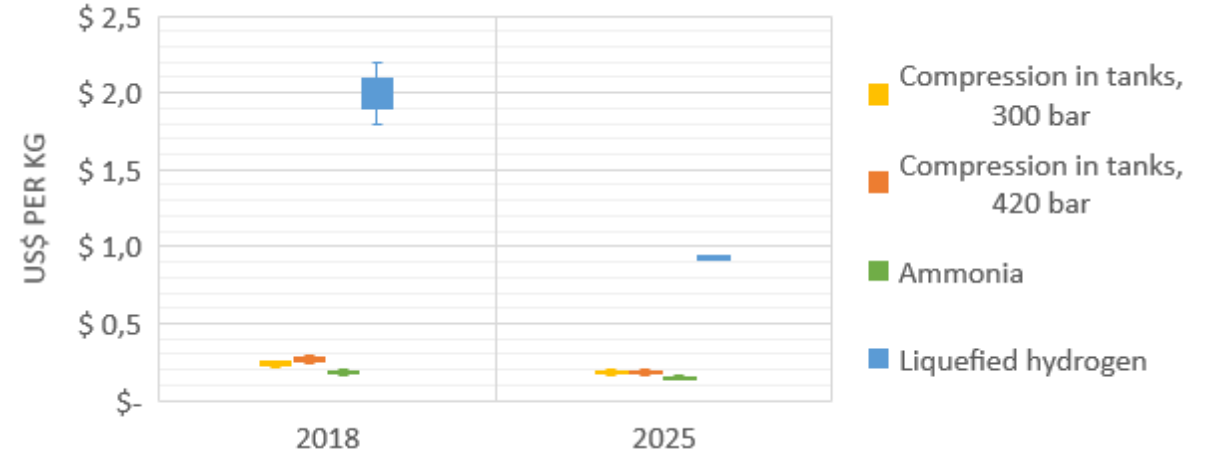


KEY TECHNOLOGY CHALLENGES: TO GO CHEAPER

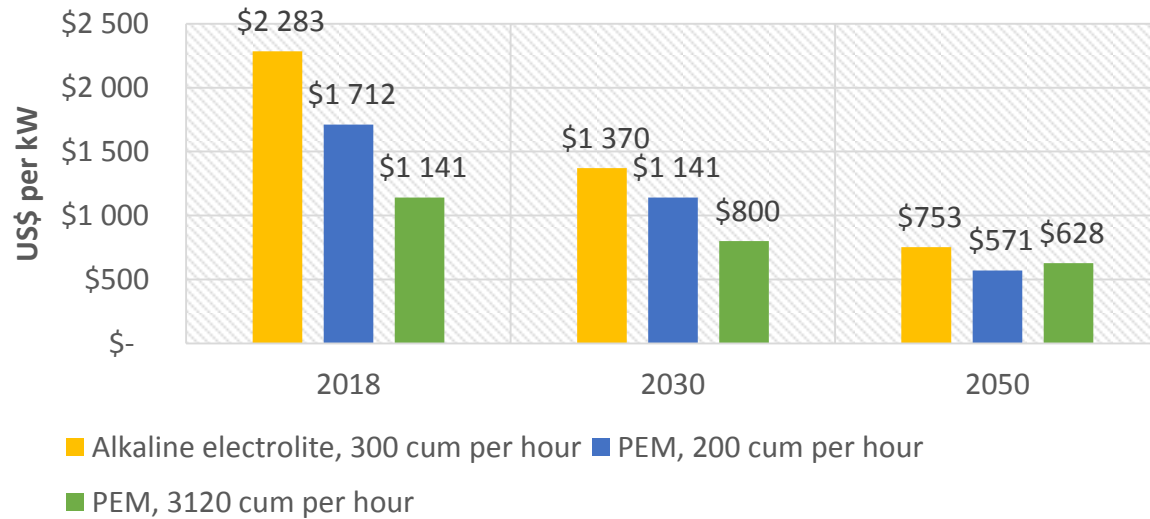
Levelized cost of hydrogen (LCOH), US\$ per kg



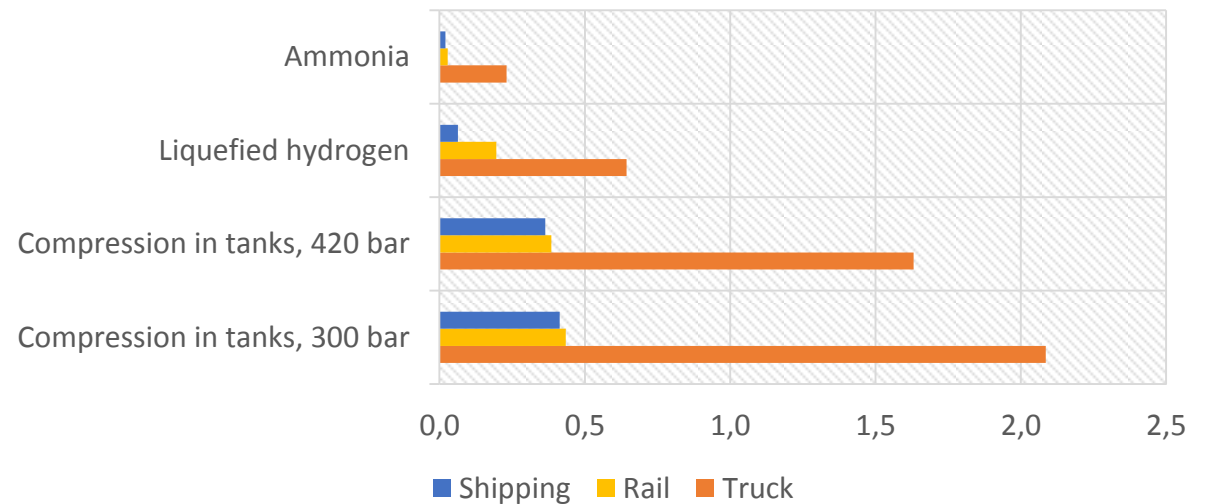
Hydrogen storage costs, US\$ per kg



Water electrolyser costs, US\$ per kW

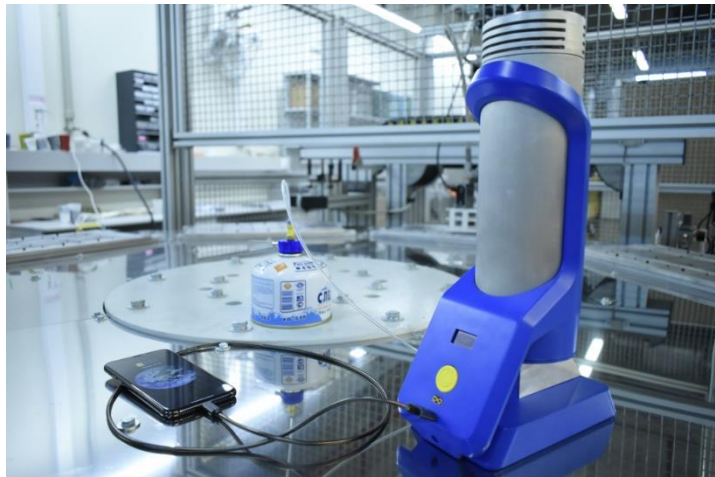


Hydrogen transportation costs, US\$ per tkm

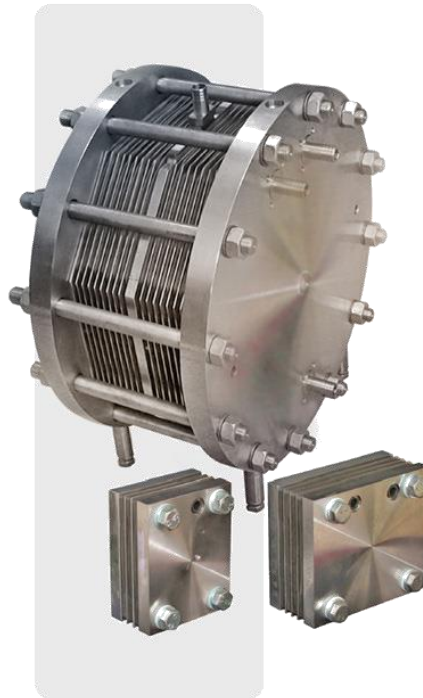


Russia has its own technologies and technology competence in the fields of:

- Alkaline and PEM water electrolyser,
- Hydrogen storage in hydrides of intermetallic,
- Hydrogenation and dehydrogenation of aromatic and ammonia,
- PEMFC, SOFC and middle-temperature PEMFC.



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NTI competence center for new and mobile power sources projects

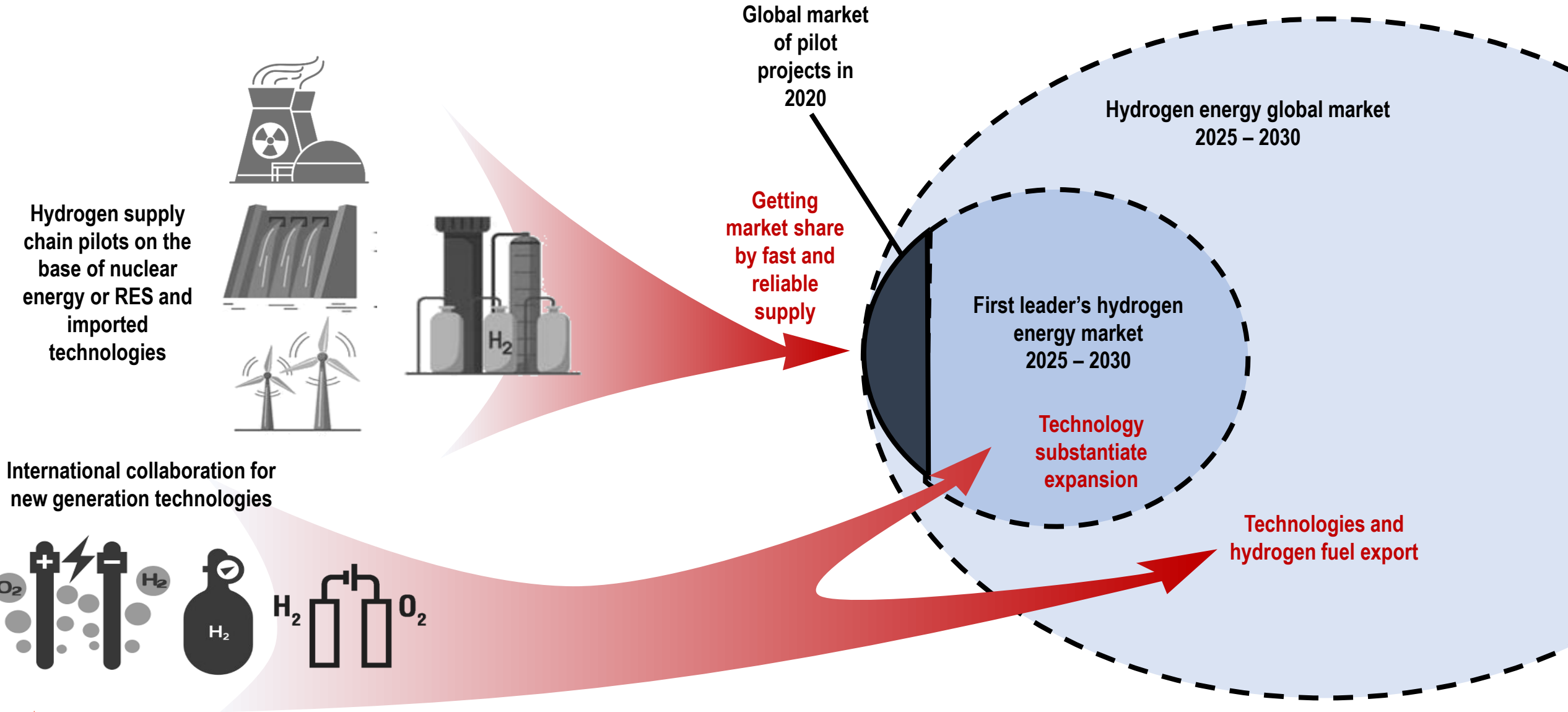


Mobile generator on microtubular hydrogen fuel cells

Functional materials for hydrogen producing from inorganic fuels

Electrocatalysts for alcohols direct oxidation

Inorganic electrolytes for middle-temperature fuel cells



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