NATURAL HYDROGEN

Prospecting.
Exploration.

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PROPOSAL
«The search for natural hydrogen »

In recent years, more and more countries are paying attention to the use of non-traditional and environmentally friendly, renewable energy sources (solar, wind, thermal, and hydrogen). Moreover, hydrogen is considered as an alternative source of energy to traditional hydrocarbon, as a fuel of the future. It is actively used in different types of transport, energy, and industry (see Appendix).

At the same time the most common and the most energy-intensive approach to hydrogen production involves the following methods:

– separation of hydrogen from produced natural gases;

– production of hydrogen from methane by pyrolysis (without oxygen access) without carbon dioxide emissions with the cost of electricity to obtain 1 cubic meter of hydrogen, according to experts' calculations, at the level of 0.7-3.3 kWh;

– obtaining hydrogen in the process of steam reforming of methane with the collection and disposal of carbon dioxide emissions;

– production of hydrogen from water by electrolysis using renewable (sun, wind, tidal energy, biomass, etc.) and traditional energy sources (hydrocarbons, coal, nuclear and thermonuclear energy). This most energy-intensive method is considered to be one of the most promising. To obtain one mole of hydrogen by electrolysis of water, it is necessary to spend 286 KJ of energy; to obtain one mole of hydrogen from natural gas by pyrolysis of methane, one needs to spend seven and a half times less energy, only 37.5 KJ [https://nat-geo.ru/science/].

By 2050 the global demand for hydrogen will be 80 exajoules per year according to the EU Council for Hydrogen Technologies. To obtain the required volumes of hydrogen using electrolysis plants (this is the only efficient way in which the carbon emissions are zero), volumes of electricity are required so large that they will surpass the entire volume of electricity generated in 2019. And to achieve this goal, it is necessary to build about nine times more wind and solar generators compared to the number that exists today around the world. That is, the transition to hydrogen technologies will require large energy costs for the production of hydrogen, as well as for the utilization and storage of carbon dioxide. At the same time, the costs of searching for and producing natural hydrogen are 3-4 times less than those of natural gas and oil, and in terms of energy efficiency, respectively, 7-8 times.

Another way is the search for "natural" hydrogen.

Another practically inexhaustible resource for producing hydrogen (thanks to the continuous and abundant "gas breathing of the Earth) is the natural gases of the lithosphere and the bowels of our planet. This is the way that does not require large expenditures for the detection of hydrogen, as well as its preparation for use in various spheres of consumption. The potential of natural hydrogen in the bowels of the Earth has not yet been estimated due to the existing prejudice that free hydrogen is rare in nature and low concentrations, as a result of which it did not attract the attention of a wide range of researchers - "if no one expects to find free hydrogen, then nobody tries to find him."

In recent years, there have been cases of the discovery of free, not chemically bound, "natural" hydrogen on the mainland. As a rule, we are talking about hydrogen in the composition of gases found in the form of outlets of free gases in water areas of water bodies (gas griffins, bubble outlets), in gas-liquid inclusions in various rocks, in water-dissolved, oil-dissolved, and other types of gases. In addition, there is a large amount of data on increased hydrogen content in gas jets on the ocean floor [Keir, 2010; Proskurowski, Lilley, Kelley, & Olson, 2006].

At the moment, on the land of the continents, hydrogen degassing of the bowels can be observed everywhere with the naked eye. For example, in Turkey (Chimaera), a gas containing up to 12% hydrogen has been burning on the rocks for several millennia [Etiope, Schoell, & Hosgörmez, 2011]; in the Philippines (Zambales), a gas consisting of 60% hydrogen is constantly burning [Abrajano et al., 1988]; in the reservoirs of the oases of the Sultanate of Oman, jets of bubbles containing 82-99% hydrogen rise from the bottom [Sano, Urabe, Wakita, & Wushiki, 1993].

Elevated concentrations of free hydrogen were found in methane gases of the coal basins of the CIS, which amount to no more than nine percent (on average, 2-4 percent). A high concentration of hydrogen is found in volcanic chambers and explosion tubes (up to 50 percent of the total amount of gases). Increased concentrations and streams of hydrogen degassing are observed in the rift zones of the oceans. According to V. Gavrilov's data, the removal of hydrogen in the rift of Iceland is up to 1,000 m^3/day.

In the Udachnaya kimberlite pipe (in well 42), the hydrogen flow rate reached 100 thousand m^3/day, which is comparable to that in wells in gas fields. On the Siberian platform, geologists have noted the confinement of increased content of natural hydrogen to trap fields and zones of development of kimberlite pipes, deep faults of the crystalline basement, rift zones, and other geological formations. It was also found that outlets (streams) of natural hydrogen are confined to certain "degassing structures", the search for which is a promising direction for future hydrogen exploration [N. Larin et al., 2014; Zgonnik et al., 2015].

In the area of the village of Bourakebougou in the Republic of Mali, while drilling a well to search for water, they accidentally encountered a natural accumulation of hydrogen. The Canadian company Petroma, later renamed Hydroma, took over the production surveys. The gas produced from this well consists of almost 96% hydrogen, which made it possible to set up its combustion in a gas turbine right on the spot and thereby organize the generation of electricity for a small village [https://www.connaissancedesenergies.org/tribune-actualite-energies/].

In the course of work in the area of the Bourakebougou village in 2017-2019, the construction of 24 wells was completed. The total footage of drilled wells was 6953 m. Based on the results of work at depths from 30-135 to 1125-1500 meters, five large productive reservoirs H2 were identified, confined to predominantly carbonate reservoirs overlain by dolerite strata [https://hydroma.ca/en/field- work /].

The first hydrogen well in the world. The village of Bourakebougou, Republic of Mali, 2012 Electricity generation for the village (96% pure hydrogen). Hydroma INC.

In addition to Hydroma INC, the American company Natural Hydrogen Energy LLC drilled the first well in Kansas at the end of 2019 in order to search for hydrogen [http://nh2e.com/].

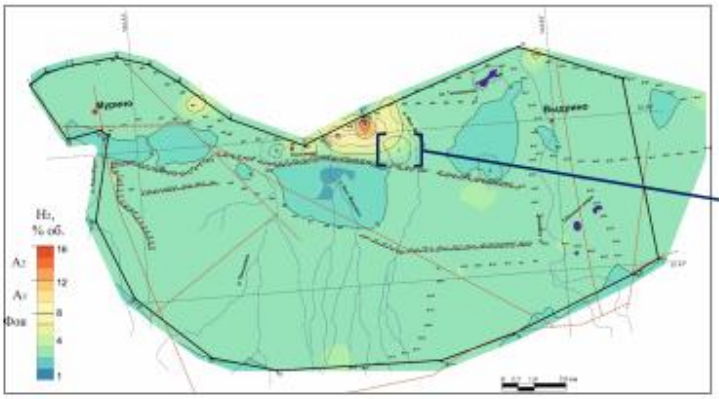
The French company 45-8 Energy is engaged in complex searches for hydrogen and helium, assuming a strong paragenetic connection of these gases in the subsurface [http://www.458energy.com/index.php/en/].

In 2014-2019, the Russian production and geological company Sibgeokom from Irkutsk conducted searches for "natural" hydrogen in the water area of the lake. Baikal, in 2017-2019 within the southern part of the Baikal region. The work included gas-geochemical testing of surface waters and sediments, conducting field hydrogen measurement. As a result of the work, "degassing structures" were identified with an abnormal content of" natural " hydrogen in both free and water-dissolved gases.

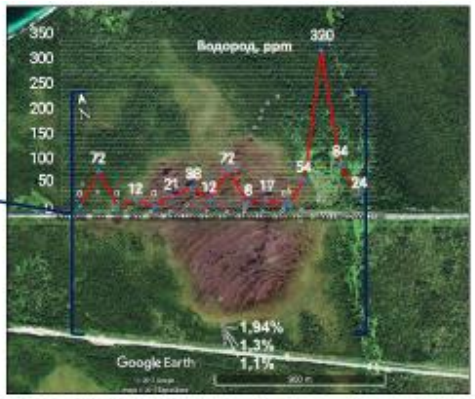
On the territory of Mongolia, Sibgeokom company discovered intense flows of natural hydrogen (the content of molecular hydrogen is 42-67% vol.) in buried riftogenic structures of the Mesozoic age.

The Sibgeokom company has developed and successfully tested technology for searching for unloading centers or structures for degassing deep fluids, incl. natural hydrogen, based on the mapping of active faults of various ranks. The technology includes a search complex of methods for remote sensing of the Earth, geophysical (seismic, electrical, gravitational), and geochemical studies. The leading place in the complex is given to gas-geochemical studies of the composition of fluid flows carrying natural hydrogen. Numerous outlets of natural hydrogen in the form of "hydrogen pipelines" have been established practically over the entire surface of the Earth's land surface, which is well deciphered from space photographs in the form of rounded zones ("circles") with diameters of up to 1-10 km.

At the same time, the latter is manifested in the form of anomalous fields of concentrations of hydrogen, helium, methane, and carbon dioxide in various natural environments - in surface and deep waters, in gases of the underground atmosphere. They are traced to depth in the rocks of the sedimentary cover and crystalline basement according to the materials of microseismic, electromagnetic, and gravity studies.

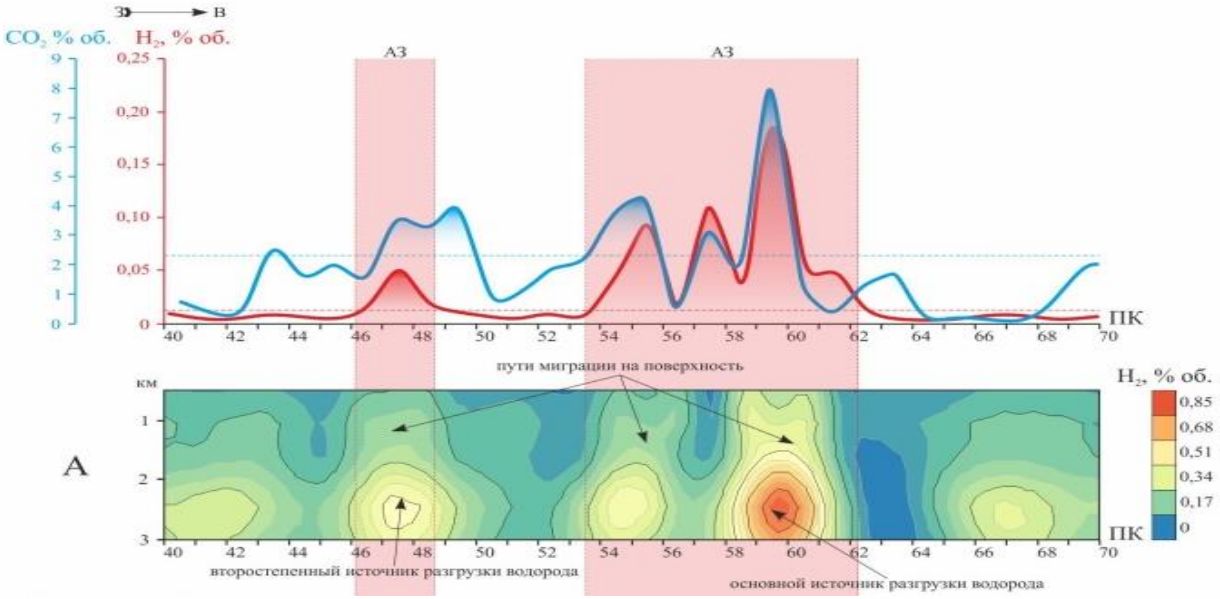


Map of the distribution of hydrogen content in free gases of near-surface sediments at the work site in the interfluve of the Khara-Murin and Snezhnaya rivers. [Sibgeokom PGK LLC]



Results of hydrogenometry of gases of near-surface deposits in the area of a potential ring structure of degassing.
[Sibgeokom PGK LLC, NTANO Center for Hydrogen Technologies]

Distribution of hydrogen concentration in near-surface sediments within the " degassing structure " (Near the village of Murino, Southern Baikal region, Sibgeokom PGK LLC)



Analytical modeling of fields of concentrations of gas fluids (H2, CO2), in the lower half-space to the level of the target horizon (deep reservoir) by the APGP method within the "degassing structure" (the area of the village Murino, Southern Baikal region, Sibgeokom PGK LLC)

On the Earth's surface, deep gas emanations are recorded in the form of macro-and microconcentrations of free hydrogen, determined, in most cases, by highly sensitive methods of gas-liquid chromatography.

The presence of ancient rift zones and extended deep faults within the continents and oceans, accompanied by numerous "degassing structures", suggests the presence of deep fluid outlets in the form of" hydrogen pipelines " containing hydrogen in concentrations sufficient for the needs of alternative renewable energy.

Hydrogen gas has the highest energy per unit mass compared to other fuels. The conversion of hydrogen takes place in fuel cells, which are an electrochemical current source. Currently, the industry in different countries produces a wide range of fuel cells from small compact (automobile type) to high-power stationery. As a result of the direct conversion of hydrogen energy into electrical energy in fuel cells, combustion processes are excluded from the technological chain, and their efficiency increases to 90% with no harmful effect on the environment. Waste from hydrogen engines is considered to be environmentally friendly because it contains only water vapor.

It seems very promising and large-scale application of natural hydrogen for:

– thermal power plants and boiler houses in the entire range of power capacities, including in local energy (small settlements, near oil wells, which is especially important for remote areas);

– environmentally friendly transport, primarily automobile, which is based on direct generation of electricity in fuel cells.

Natural hydrogen
is an environmentally friendly and safe fuel of the future!

We invite interested parties to cooperate in the search, production and development of natural hydrogen energy resources.

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Properties of hydrogen:

– the simplest and most common chemical element in the universe;
- colorless gas, tasteless and odorless, non-toxic;
– each hydrogen molecule consists of two hydrogen atoms;
- hydrogen gas is 14 times lighter than air, in addition, it has the highest energy per unit mass compared to other types of fuel;
- on our planet, hydrogen is widely distributed, but it occurs only in combination with other elements. The compound with oxygen forms water, and the compound with carbon forms hydrocarbons, such as gasoline, diesel fuel, natural gas, propane and many others.
- the best energy carrier for electric vehicles powered by fuel cells or existing cars with internal combustion engines.

Why do we need hydrogen energy?

The peculiarity of hydrogen fuel cells is that they are an electrochemical current source. As a result of the direct conversion of the energy of hydrogen fuel cells into electrical energy, gorenje processes are excluded from the technological chain. Because of this, according to experts, the efficiency increases to 90% and the degree of harmful effects on nature decreases. Waste from hydrogen engines is considered environmentally friendly, since it contains only water.

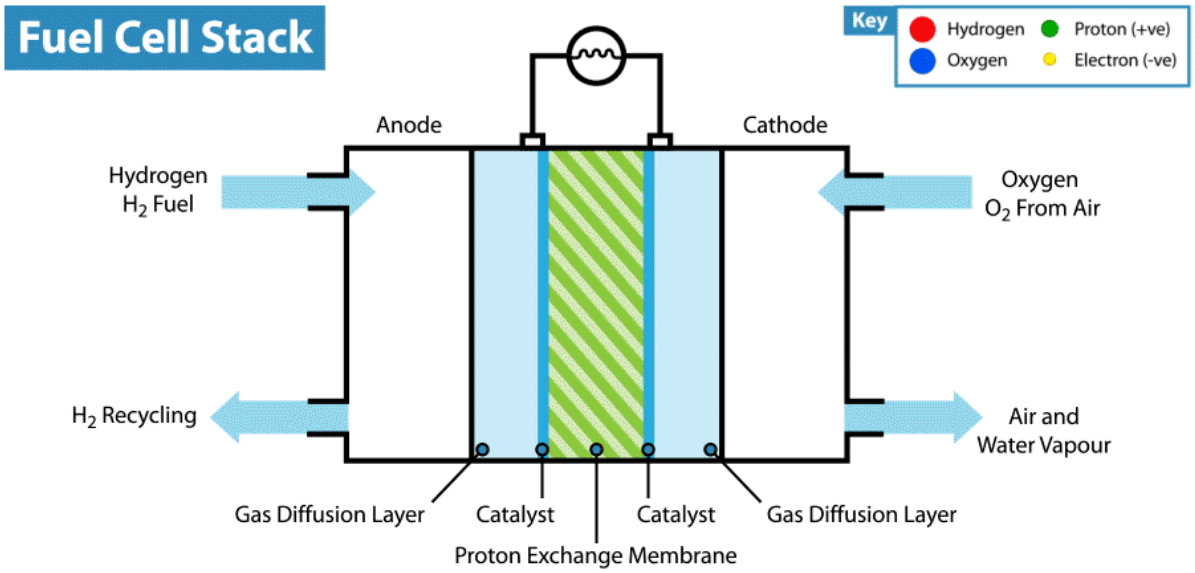

Diagram of a hydrogen fuel cell power plant

Hydrogen - fueled road transport

Tata Motors, the largest manufacturer of commercial vehicles in India, has won a tender for the supply of 15 buses with proton-exchange membrane fuel cells based on hydrogen from the state-owned Indian Petroleum Corporation (IOCL) (July, 2021).

Jaguar Land Rover will develop a prototype of the Defender SUV with a hydrogen engine. This is part of a campaign to reduce air emissions to zero by 2036, the company said (June, 2021).

Citroën has introduced its own version of the hydrogen medium van-Citroën-Jumpy Hydrogen (June, 2021).

NAMI developed the Aurus car on hydrogen. The car was presented during the launch ceremony of the serial production of Aurus (June, 2021).

Toyota has announced that its flagship hydrogen fuel cell vehicle, the second-generation Toyota Mirai, has increased the world record distance for an FCV to more than 1,000 km at a single gas station (June, 2021).

Hyzon will become a public company, agreeing to go public through a reverse merger with SPAC and Decarbonization Plus Acquisition Corp. The estimated capitalization after the transaction will be $ 2.7 billion. The first line of Hyzon cars powered by hydrogen fuel cells with a capacity of 100-200 kW will include trucks from 15 to 40 tons (May, 2021).

Everfuel has teamed up with Cabonline, the largest taxi operator in the Scandinavian region, and Toyota Norge to further develop the hydrogen taxi market in the region - 100 Toyota Mirai hydrogen taxis should appear on the roads of Oslo by the end of 2022 (May, 2021).

Shell has teamed up with the German company Daimler Truck to develop the market for hydrogen-fueled heavy trucks in Europe (by 2030, 150 hydrogen filling stations and about 5,000 Mercedes-Benz heavy trucks) (May, 2021).

Opel introduced the Vivaro - e Hydrogen hydrogen van, which has a main mileage of over 400 km (May, 2021).

Hyundai Nexo covered 887 km on one tank with hydrogen, setting a new world record (May, 2021).

Производитель строительной техники JCB анонсировал поршневой двигатель на водородном топливе, который не выделяет CO2. Босс JCB лорд Энтони Бэмфорд говорит, что поршневой двигатель без выбросов CO2 может быть более дешевым и быстрым способом достижения целей по выбросам (май, 2021 г.).

Российская компания «Эвокарго» объявила о выпуске на рынок своего первого продукта — беспилотного грузовика. Малотоннажник EVO-1 полностью основан на российских разработках, оснащен гибридной системой питания от электрических батарей и водородных топливных элементов, поддерживает технологии взаимодействия с подключенной инфраструктурой «умной» дороги (май, 2021 г.).

Daimler Trucks and Volvo AB intend to jointly reduce the cost of hydrogen fuel cells by five or six times by 2027, as they strive to make the zero-emission technology commercially viable for long-distance freight transportation (April, 2021).

Hizon Motors Inc. has started production of 15 commercial electric vehicles with hydrogen fuel cells for delivery to the municipality of Groningen in the Netherlands. The range of zero-emission vehicles for municipal needs includes a tanker truck, garbage trucks, cranes, trucks and vans (April, 2021).

The number of hydrogen electric vehicles supplied to Korea is the highest in the world, but the charging infrastructure is very poor (April, 2021)/

Three Chinese manufacturers of hydrogen fuel cell trucks Neo, Xpeng, Li Auto plan to attract $ 7.5 billion on the international market to finance their investment programs. The volume of the Chinese government's support program will amount to 34 billion yuan, subsidizing the sales of 40,000 to 60,000 new hydrogen cars in the period from 2020 to 2023 (March, 2021).

The first hydrogen ambulance, called Zero (short for Zero Emission Rapid Response Operations),built by Ulemco, will arrive in London at the end of2021. UIenco is teaming up with Ultra Electronics and Ocado (power and control electronics) and Promech Technologies to produce an electric car with an increased power reserve due to an original hydrogen solution (February, 2021).

At a press conference after the finish of the ninth stage of Dakar - 2021, the organizers presented a plan for the transition of Dakar to environmentally friendly cars by 2030 (January, 2021).

The Chinese company Grove Hydrogen showed promising hydrogen cars (April, 2019).

In June 2019, the China Hydrogen Association (China Hydrogen Alliance) released a White Paper on Chinese hydrogen energy and fuel cells, according to which in the short term (2020-25), the volume of industrial production of the hydrogen industry will reach $148 billion , and the fleet of fuel cell cars in China will be 50,000 with an infrastructure in the form of 200 hydrogen gas stations. In 2026-35, the volume of industrial production in the industry will grow to $740 billion.

Public transport on hydrogen fuel

London has released its first hydrogen double-decker bus. 20 new buses join 500 electric and 3,800 hybrid buses already in operation (June, 2021).

An unmanned hydrogen-fueled shuttle will be launched in the Estonian city of Tartu. The drone was developed by Auve Tech in cooperation with the University of Tartu (June, 2021).

Kerala State Road Transport Corporation (KSRTC) is to receive 10 hydrogen-fueled buses on an experimental basis in cooperation with Indian Oil Corporation Limited (IOCL) and Cochin International Airport Limited (CIAL).

BUS Eireann (Ireland) plans to replace half of its fleet with electric and hydrogen cars over the next nine years as part of a plan to reduce greenhouse gas emissions (May, 2021).

The first 3 out of 12 hydrogen buses for urban transport were presented in Bolzano (Italy). The buses produced by Solaris will be added to the fuel cell prototypes that have already been used in Bolzano since 2013 (May, 2021).

In 2020, more than 11,000 kg of hydrogen was produced at the Rīgas satiksme hydrogen station. 10 Rīgas satiksme trolleybuses powered by hydrogen have covered about 370,000 kilometers using both a hydrogen element and a contact network (April, 2021).

Since 2021. The Ministry of Trade, Industry and Energy of South Korea plans to invest 45 billion won (40.5 million US dollars) in testing hydrogen-powered trams by 2023, before introducing them as South Korea's newest export product (April, 2021).

Hydrogen fuel cell buses (FCEB) from the Canadian Ballard Power Systems, designed and developed by Global Bus Ventures (GBV), have passed road tests in the city of Rolleston (New Zealand), following which it is planned to put them into operation at Auckland Transport (March, 2021).

Prime Minister Boris Johnson has unveiled funding of 3 billion pounds to make buses the country's" preferred transport". As part of the "National Bus Strategy", the government has committed to deliver 4,000 new British electric or hydrogen buses (March, 2021).

In Aberdeen, Scotland, from the summer of 2020, hydrogen-powered double - deck buses will start operating on the main city routes, which First Aberdeen ordered from the British manufacturer Wrightbus, based in Northern Ireland (March, 2020).

The Chinese company GCV introduced the first commercial city bus powered by fuel cells (June, 2019) and turned the electric train into a hydrogen train (June, 2019).

Hydrogen-fueled water transport

Irina Gracheva won the Marie Agnès Péron trophy on a hydrogen-powered sailboat (June, 2021).

Piriou will build a hydrogen fuel cell dredger for Occitania (June, 2021).

Concordia Damen has signed a contract with Lenten Scheepvaart, providing for the construction of the first hydrogen-powered inland water transport vessel in the Netherlands (June, 2021).

The three largest manufacturers of marine engines Kawasaki Heavy Industries (KHI), Yanmar Power Technology and Japan Engine signed an agreement on joint activities for the development of hydrogen-fueled engines for large commercial vessels operating on domestic and international routes (May, 2021).

The California Energy Commission has provided Zero Emissions Industries with a $ 2 million grantfor the development, construction and testing of the first of its kind small high-speed boat powered by hydrogen fuel cells (April, 2021).

Japan's Mitsui OSK has become the first of the major Japanese shipping companies to develop a plan to achieve zero emissions from its fleet by 2050. Nikkei Asia reports that the company has outlined a plan to invest $ 1.8 billion over the next three years as part of an overall plan to reduce carbon emissions and develop new zero-carbon enterprises (April, 2021).

The owner of the tanker flotilla Ardmore joined forces with Maritime Partners LLC and Element 1 Corp. to introduce the use of hydrogen fuel cells in the marine sector. The new company is called E1 Marine-the partners have equal ownership rights (April, 2021).

Royal IHC, a Dutch developer and manufacturer of vessels for dredging and the offshore industry, has received an approval in principle (AiP) from Bureau Verita for the development of a hydrogen dredger with a trailer bunker (TSHD) (April, 2021).

The Japanese shipping company NYK Line, the Eneos oil refinery and the engineering companies Kawasaki Heavy Industries (KHI) and Toshiba Energy Systems and Solutions are creating a hydrogen infrastructure in the largest port city of Japan (March, 2021).

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One of the world's largest shipbuilding companies, Hyundai Heavy Industries Group (HHI Group), has signed an agreement with the state oil company of Saudi Arabia, Saudi Aram co, on cooperation in the production of hydrogen and ammonia. In addition, Hyundai Oilbank plans to create a supply chain for the sale of produced hydrogen, making up to 300 hydrogen charging stations available throughout South Korea by 2040 (March, 2021).

5 commercial vessels powered by hydrogen fuel cells are being built in the EU at the same time (January, 2021).

Hydrogen-fueled air transport

ZeroAvia is expanding its hydrogen-electric aviation program to 19-seat aircraft and is raising an additional $ 13 million in funding for the development of large engines (June, 2021).

Under the contract for 831 million won ($737,000), drones manufactured by Doosan Mobility Innovation on a hydrogen fuel cell will be purchased for the Air Force of the Republic of Korea (May, 2021).

French technology companies Thales, Drones-Center and ZenT have teamed up to test a hydrogen drone (May, 2021).

South Korean Hypower Lab promotes drones based on hydrogen technologies of the IPHF RAS (May, 2021).

Doosan Mobility Innovation, a subsidiary of the Doosan Group, has introduced the first successfully commercialized hydrogen fuel cell for drones and mobile robots (May, 2021).

According to the forecasts of Gediminas Ziemelis, Chairman of the Board of Avia Solutions,the market of hydrogen aircraft will reach about $174 billion by 2040. (April, 2021).

Airbus will create a superconducting power plant for hydrogen-powered aircraft. The Ascend system will become a ground-based prototype, which should be completed within three years. This will be a 500 kW (670 hp) power plant (April, 2021).

As part of the BALIS project, the German Aerospace Center is developing the world's first megawatt-class fuel cell power plant for aircraft. The system should be designed for a power of about 1.5 megawatts, which makes it possible to equip small-sized jet aircraft for 40-60 passengers with a power reserve of about 1000 kilometers with zero emissions (February, 2021).

The first flight of a 6-seat Piper Malibu aircraft powered by hydrogen fuel cells took place in October 2020 from Cranfield University Airport north of London (March, 2021).

The MetaVista drone with a hydrogen "gas tank" and an FCPM engine produced by Intelligent Energy spent 10 hours and 50 minutes in the sky. For drones with lithium-ion batteries, half an hour of flight is already an achievement (February, 2019).

Rrailway transport on hydrogen fuel

A fleet of 27 trains will be used in the Rhine-Main region of Germany from December 2022. The necessary hydrogen comes from the Frankfurt-Hoechst industrial park, where gas is produced in large quantities as waste from chemical processes (July, 2021).

Alstom debuted its Coradia iLint hydrogen train on the test track of the Railway Research Institute to highlight the potential of sustainable transport in Poland (June, 2021).

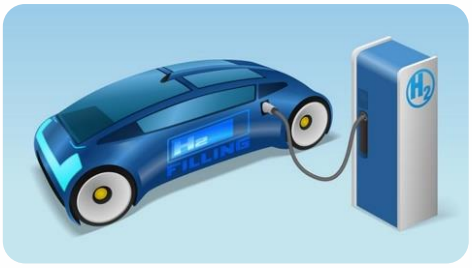
General Motors Co will supply electric batteries and hydrogen fuel cell systems for Wabtec railway locomotives, which is headquartered in Pittsburgh. The company is developing locomotives powered by electric batteries and hydrogen fuel cells, in response to the demand of the railway industry to eliminate carbon emissions (June, 2021).

Ballard Power Systems has announced that it will supply Sierra Northern Railway with fuel cell modules to power a zero-emission locomotive (April, 2021).

In the city of Datong, North China's Shanxi Province, the first hydrogen fuel cell locomotive developed in China rolled off the assembly line at the CRRC Datong Co. plant. The locomotive is designed to operate at a speed of 80 km/h with a constant power of 700 kW for 24.5 hours. The maximum traction load on a straight track exceeds 5 thousand tons (February, 2021).

Rhein Main GmbH (fahma), a subsidiary of Rhein–Main–Verkehrsverbund (RMV), held a tender worth 500 million euros for the supply of 27 regional hydrogen-fueled trains and the creation of the necessary infrastructure to replace diesel-poweredtrains in the federal state of Hesse. Siemens and Alstom participated in the tender. The Coradia lint train, developed by aFrench corporation, was recognized as the winner .Alstom will receive 360 million euros for the rolling stock, operationwill begin in 2022. (January, 2021).

By the end of 2021, the non-electrified railway line in the north-west of Germany in the federal state of Lower Saxony will completely abandon diesel locomotives. 14 hydrogen-powered electric trains will be launched on the one-hundred-kilometer route between the cities of Bremerhaven, Cuxhaven, Buxtehude and Bremerferde (March, 2020).



Gas stations

The Port of Antwerp and the local shipping company Compagnie Maritime Belge (CMB) have opened the first of a series of hydrogen filling stations to serve areas with industrial complexes, such as ports. According to CMB CEO Alexander Saveris(pictured, inset), the gas stations will serve various types of transport, and the company has plans to open new stations in Japan, three in the UK and one each in the Netherlands and France (June, 2021).

The Japanese government will include 1,000 hydrogen gas stations for fuel cell vehicles deployed throughout the country by 2030 in the draft of its growth strategy (May, 2021).

The state of Washington (USA) has allocated more than $ 4 million for the construction of the first two gas stations for hydrogen vehicles in the state (May, 2021).

Industrial gas giant Air Liquide said that Daimler Truck was selected to work on the development of a new refueling system based on existing technologies. The truck manufacturer will place the system on its test sites. The supplied liquid hydrogen will be produced at one of the Air Liquide gas liquefaction plants (May, 2021).

PKN ORLEN has announced the start of the process of selecting a contractor for the construction of its first hydrogen filling stations in Poland. According to the company's press release, two filling terminals will be located at the existing ORLEN filling stations in Poznań Katowice, and should serve buses and passenger cars. PKN ORLEN is in the final stage of deploying three hydrogen stations in the Czech Republic .Two stations, in Prague and Litvinov, should start commercial operation by the end of 2021, and other stations on the D10 motorway in Prague, Brno and Pilsen will open in 2022 (May, 2021).

Shell, Vattenfall, Mitsubishi, Airbus, ArcelorMittal, HADAG and 6 other companies have joined together to create a hydrogen hub in Hamburg, where one of the largest transport hubs in Europe is located (April, 2021).

Toyota Australia has commissioned the first facility of the future hydrogen center in Altona. An electrolysis plant with a capacity of 200 kW, as well as equipment for compression and storage of hydrogen in two pressure ranges, will provide refueling of forklifts and cars powered by hydrogen fuel cells (April, 2021).

The new 5 MW electrolytic hydrogen plant will support the HTEC network of hydrogen fueling stations and decarbonize the use of the local gas network in British Columbia. The project is being implemented as part of HTEC cooperation with the Canadian subsidiary Mitsui (April, 2021).

Haskel has developed, installed and launched new equipment for hydrogen refueling of trucks and passenger cars in Arnhem, at the Total Nederland enterprise (April, 2021).

Air Products & Chemicals, a world leader in industrial gas production technologies, has introduced a new hydrogen gas station at its plant in Ulsan, South Korea (April, 2021).

The Canadian company Hydro Energy has signed a long-term contract with the chemical company Chemtrade Logistics Income Fund for the supply of environmentally friendly hydrogen for commercial trucks at a fixed price 5% lower than diesel fuel (March, 2021).

Sinopec plans to build 1,000 hydrogen stations in China by 2025 (March, 2021).

The hydrogen refueling station in Saudi Arabia will be the first in the country (January, 2019).

In Germany, 24 hydrogen filling stations were launched in 2017 (April, 2018).

In June 2018. Toyota has teamed up with the Japanese company Seven-Eleven Japan to work on a project to build hydrogen energy storage devices.

The first mobile Hydrogen gas station (July, 2018).The South Korean company Helium Industries Inc., has released the world's first hydrogen mobile gas station.

Hydrogen energy

The Hydrogen House project in Gateshead, led by Northern Gas Networks and supported by BEIS, is the first public demonstration of a hydrogen house in the UK (June, 2021).

South of Tokyo, at the foot of Mount Fuji, Toyota is leading a project called "Woven City". Plans for the futuristic prototype city were presented at CES in 2020, and construction began in February of this year. This week, Toyota announced a partnership with the Japanese oil company ENEOS to create a hydrogen fuel cell system that will become an energy source for the city (May, 2021).

Norway plans to double to 20 million euros the financing of hydrogen in the revised budget for 2021 (May, 2021).

Singapore-based SAN Group is investing about 3 million euros in a new hydrogen production plant in Herzogenburg, Austria. The plant uses a fully renewable energy (April, 2021г.).

Hexagon bought Ebony Energy for the production of blue hydrogen in the Pedirka project in Northern Australia (April 2021).

The French and the Russian state nuclear energy giants EDF and Rosatom have teamed up to develop a low-carbon hydrogen projects in Russia and Europe with the goal of decarbonization of the transport and industrial sectors (April, 2021г.).

Total Ceran and Providence Resources are planning an 8 Kw green hydrogen production project in Australia (April, 2021).

Kawasaki Heavy Industries, J-POWER, Iwatani, Marubeni, AGL and Sumitomo, with the support of the governments of Victoria, Australia and Japan, have launched the pilot stage of a giant project to gasify brown coal in Australia for hydrogen production and transport it to Japan.The CO2 from the reforming process is planned to be captured and buried.In Japan, the Kawasaki vessel, equipped for the transportation of liquefied hydrogen for the first time in the history of shipping, is waiting for its first flight (March, 2021).

Poland plans to invest 2 billion euros in the production of green hydrogen (April, 2021).

Norwegian Equinox and the British energy company SSE have agreed to develop the world's first 100% hydrogen power plant in the UK (April, 2021).

The French nuclear operator enters the hydrogen energy market (April, 2019). Ballard Power Systems Europe is providing technology for the H2Ports project, thanks to which the port of Valencia in Spain will become the first in Europe to use hydrogen energy in its operations (April, 2019).

Many well-known manufacturers of power equipment have engaged in the development of hydrogen gas turbines (May, 2019).

In the first seven months of 2019, the installed capacity of hydrogen fuel cells in China increased by 642.6% compared to the same period in 2018 (to 45.9 MW).

The project of a floating plant for the production of hydrogen (January, 2018).The use of hydrogen for heat supply (February, 2018). A large hydrogen production plant (March, 2018).

The French government highlights the development of the hydrogen economy as a priority area (June, 2018). Hydrogen fuel can be used for power supply of space stations (July, 2018).

In December 2018, Rosatom State Corporation decided to include hydrogen energy in the list of priority areas.