

Global Action Agenda Progress Report
The Hydrogen Energy Ministerial 2020
On-line Special Event

October 14, 2020

This report was prepared to report to the Hydrogen Energy Ministerial Special Event held on October 14, 2020, supported by the International Energy Agency and International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE).

1. *Introduction*

In June 2019, “The Future of Hydrogen” the first comprehensive report on hydrogen published in the occasion of G20 by the International Energy Agency (IEA) stated that hydrogen enjoys “unprecedented momentum.” One year later, this still holds and even more so, even under the Covid-19 situation. Last year in October, 35 representatives from countries/regions/international organizations gathered in the 2nd Hydrogen Energy Ministerial Meeting, where the Global Action Agenda¹ – a principle that guides actions towards a hydrogen-based society and mobilizes global efforts to expand RDD&D of hydrogen – was launched, and since the Meeting, more and more countries and regions are considering the potential of hydrogen as a clean, secure and affordable source of energy. Many countries – Australia, European Commission, France, Germany, Korea, the Netherlands, New Zealand, Norway, Portugal and Spain – unveiled national strategies or visions to expand the use of hydrogen, and more countries are lined up to develop such nationwide policies. In July this year, at the IEA’s Clean Energy Transitions Summit, Ministers representing 80% of global carbon dioxide emissions convened and many of them reaffirmed their commitment to hydrogen despite the outbreak of Covid19. There is also growing momentum and concrete actions being taken to unlock the potential of hydrogen in the private sector. The Hydrogen Council, a global industrial body actively exploring the use of hydrogen in the world, was established in 2018 with 13 global companies, the member of which increased to 92, enjoying an impressive seven-fold increase in the number of member companies. Much research and analysis done by international organizations, for example by the International Energy Agency, has shown that hydrogen is an essential element towards the path to carbon neutrality and decarbonization. In addition, at the 2nd Hydrogen Energy Ministerial, the International Renewable Energy Agency (IRENA) launched a report on hydrogen, which highlights the key role of hydrogen as an enabler to integrate renewables in global energy systems. All these developments means that hydrogen has now established a very strong status as a crucial component that enables clean energy transition. With this perception of hydrogen in the global energy landscape in mind, this report summarizes major recent developments in the hydrogen space that are in line with the Global Action Agenda².

2. *Progress made along the line of the Global Action Agenda*

¹ <https://www.meti.go.jp/press/2019/09/20190927003/20190927003-5.pdf>

² The developments in summarized in this report are by no means exhaustive, especially for those done by private companies.

The Global Action Agenda is composed of the following six pillars of items concerning hydrogen:

- ✓ Formulating strategies and roadmaps
- ✓ FC mobility across applications
- ✓ Hydrogen Supply Chains
- ✓ Sector Integration
- ✓ Study and evaluations of hydrogen's potential
- ✓ Communication, education and outreach

The major developments in countries, international organizations and regions are summarized along these six pillars below³. These are by no means exhaustive, especially as there are many developments made in the private sector, which are outside of the scope of this report. Nonetheless, these actions listed provide evidence of hydrogen being globally acknowledged as a critical element in the clean energy transition.

I. Formulating strategies and roadmaps

- Australia published a national hydrogen strategy, with a goal to be in the global top 3 exporters of hydrogen to Asian markets. This was followed by the release of a low emissions technology statement, which identifies hydrogen as a priority technology for Australia, along with an economic goal to produce hydrogen at under AUD\$2 per kilogram. Australia has also announced a AUD\$1.9 billion investment package for future technologies to lower emissions, including hydrogen. This builds on over AUD\$500 million funding already committed to support hydrogen industry growth.
- Canada also published their “2019 Hydrogen Pathways” with 10 recommended actions such as forming an advisory council involving a range of stakeholders and identifying and resourcing research priorities.
- National Energy Administration in China released an announcement on public solicitation on "Energy Law of the People's Republic of China (Draft for Comment)", in which hydrogen energy was classified as an energy category. This is the first legal confirmation of hydrogen energy in China.
- The European Commission also published a region-wide strategy for hydrogen, with an ambitious target of having 40GW of installed

³ Many developments listed in this report are sourced from Country Updates in the IPHE website, and contribution from the governments and international organizations, as well as from publicly available governments' home page and news sources.

electrolysers by 2030, together with an economy recovery package that includes the support for hydrogen. In addition, Clean Hydrogen Alliance was launched to foster the deployment of hydrogen technologies.

- France published its national hydrogen strategy, with an ambitious numerical target of 6.5 GW for the capacity of electrolysers by 2030. Under the strategy, 7 billion euros are invested for low carbon hydrogen production through electrolysis as well as for commercial mobility focusing on heavy duty vehicles and fleets and research, innovation, training and education.
- Germany published its national hydrogen strategy, with an ambitious numerical target of 5 GW for the capacity of electrolysers by 2030. The strategy also states that 9 billion euros will be invested, of which 2 billion euros will be allocated for international cooperation.
- Korea has released their H2 roadmap, including targets on FCEV, HRS, stationary FC and power generation
- Ministry of Economy, Trade and Industry in Japan made a hydrogen-related budget request of around USD 800 million for fiscal year 2021.
- The Netherlands has launched its national hydrogen strategy, with an ambition of 3 – 4 GW of electrolysis capacities by 2030.
- New Zealand published a vision for hydrogen, Green Paper, looking at the potential of hydrogen in the country based on the abundant renewable resources.
- Norway also presented the government's hydrogen strategy that announces an explicit goal of increasing the amount of pilot- and demonstration projects in Norway. On May 29 the Norwegian Government announced NOK 120 million (USD 13 million) to innovation projects including hydrogen technologies through the ENERGIX-programme under the Norwegian Research Council, as well as NOK 2 billion (USD 220 million) to the state enterprise Enova to support technology development in industry, including technology development for hydrogen. The Norwegian Government is also developing a roadmap for hydrogen focusing on the development of infrastructure and supply-chains where collaboration across sectors and users of hydrogen is possible.
- Poland, since joining the Tokyo Declaration on Hydrogen in 2018, has focused on creating instruments to support new hydrogen technologies. During the meeting on July 7th 2020, representatives of the Ministry of Climate together with the most important energy and transport sector

companies signed the Letter of intent on establishing a partnership for the creation of a hydrogen economy and the sectoral hydrogen agreement. Poland also intends to publish a draft of Polish Hydrogen Strategy by the end of October 2020.

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- Portugal also published a national hydrogen strategy, with various objectives such as 5% share of hydrogen in final energy consumption, 50 to 100 hydrogen stations and 2 GW of installed electrolyzers by 2030.
- Spain has published a H2 Strategy, with targets for FCEV electrolysis (4GW), FCVs, HRS and in percentage of electrolytic H2 in industrial uses
- Joint political declaration of the pentilateral energy forum, consisting of Austria, Belgium, France, Germany, Luxembourg, the Netherlands and Switzerland was published to affirm their commitment to strengthen their cooperation on hydrogen produced in a CO₂ reducing manner with the aim of contributing to the full decarbonization of the energy system.
- In the United States, the Office of Fossil Energy in the DOE published a hydrogen strategy for fossil fuels that includes a variety of initiatives such as those for carbon neutral hydrogen production.
- The 2020 budget for the U.S. Department of Energy (DOE) Hydrogen and Fuel Cell Technologies (HFTO) Office is USD 150 million (compared to USD 120 million for 2019) covering hydrogen and fuel cells R&D infrastructure, technology acceleration, systems analysis and safety, codes & standards activities. Stakeholder feedback through a Request for Information is underway to update the DOE strategic program plan on hydrogen.
- Other countries, including U.K., Chile, and South Africa are also in preparation of national hydrogen policies.

II. FC mobility across applications

- ✓ Mobility infrastructure development and market expansion

- In terms of the “10, 10, 10” target, around 370,000 fuel cell stacks, including those for stationary fuel cell systems and for fuel cell powered forklifts, have been installed and 470 hydrogen stations are installed. Over 25,000 fuel cell vehicles deployed, with the sales in 2019 doubled compared to the previous year.
- Two hydrogen trains have started operation in 2019 and another 14 are expected by 2021. Spain, Italy, the UK and France have also announced plans to deploy H₂ trains.
- JHyM (Japan H₂ Mobility, LLC) has been leading the development of 157 hydrogen stations, with support from Ministry of Economy, Trade and Industry in Japan.
- H₂ Mobility in Germany has led the development of 85 hydrogen stations.
- The total number of fuel cell-powered forklifts installed in the U.S. has reached 35 thousand units, along with 100 fueling stations specifically for forklifts, and another 45 FCV fueling stations in the U.S.
- New Zealand announced a plan to invest in emerging technology including hydrogen, and support for a nationwide hydrogen station network.
- The Japan Bank for International Cooperation (JBIC) signed on June 16 a shareholders' agreement for a joint investment with a Japanese company, of up to approximately USD23 million in the United States.
- Three hydrogen buses are introduced in Denmark.
- The first hydrogen tram in China started commercial service in Foshan, Guangdong Province.
- ✓ Harmonization of regulations, codes, and standards (RCS) in FC mobility
 - The IPHE Regulations, Codes, Standards, and Safety Working Group (RCSS WG) is compiling a database from IPHE member and, where possible, non-member countries with national and regional technical regulations related to:
 - Hydrogen Infrastructure including injection in natural gas streams (permitting, limits, gas quality, safety, and payment/remuneration mechanisms), hydrogen refueling station regulations (land and use plan, permitting requirements/process, safety requirements and process), and maritime rules for landing and bunkering, and on- and off-shore refueling of hydrogen and hydrogen-based fueled vessels
 - Hydrogen Mobility including regulations for broad deployment of fuel cell mobility units (tunnels, bridges, underground parking), for

fuel cell heavy duty mobility units not covered by UNECE GTR 13 (ships, trains, aircrafts, trucks) and rules for approval of hydrogen and hydrogen-based fuels vessels (ships, boats, utility vessels)

With the compilation of these regulations, the RCSS WG will identify gaps and make recommendations on standards work necessary for the safe and effective handling of hydrogen in these areas.

- The Hydrogen Council has collected members' insights into safety-related and other critical regulatory gaps and engaged an expert consultant to assess and prioritize these gaps as well as make specific recommendation on how to improve regulatory alignment. Results are expected to be available towards the end of 2020/ early 2021. With regards to safety regulatory gaps, the Hydrogen Council also hosted a dedicated digital workshop with key partner organisations in March 2020.
- New Energy and industrial Technology Development Organization (NEDO) in Japan has begun the development of a high-speed hydrogen refueling protocol for heavy-duty vehicles.
- International Hydrogen Infrastructure Workshop, held in Tokyo in February, shared experiences, best practices and progress on key issues facing hydrogen infrastructure deployment for fuel cell electric vehicles in the United States, Europe, Germany and Japan.
- The Sub-Committee on Carriage of Cargoes and Containers (CCC) of the IMO is working on interim guidelines for ships using fuel cells.
- The Emirates Authority for Standardization and Metrology (ESMA) has completed the first technical regulation of hydrogen-powered vehicles in the UAE, making the UAE a pioneer in the MENA region to establish such a regulation.
- ✓ Research and development (R&D) for next generation FC systems
 - NEDO has launched a new R&D project to dramatically expand the use of fuel cells for FCVs, stationary business and industrial use. (Japan)
 - The Fuel Cells and Hydrogen Joint Undertaking (FCH JU) launched its Fuel Cells and Hydrogen Observatory which aims at providing users with data and information on the hydrogen sector.
 - In November 2019, comprised of senior experts from IEA member governments, the IEA Committee on Energy Research and Technology (CERT) held a thematic discussion on hydrogen, a topic on which many members have expressed a strong interest. This session offered delegates the opportunity to learn more about recent activities in the hydrogen space, including IEA analytical work, government strategies

and RD&D priorities from a selection of countries, engagement activities in various fora, and the outcome from other recent Ministerial-level meetings.

- ✓ Ensuring hydrogen safety
 - IPHE continues to collaborate with many organizations to keep the Safety topics a key priority, specific actions include:
 - IPHE agreement on a priority list of safety topics to be tackled in the following years (2018)
 - A Memorandum of Understanding with the International Association on Hydrogen Safety (IA HySafe) is in place and collaboration through the Center for Hydrogen Safety (CHS).
 - Publication of a Report from the Hydrogen Fuel Cell Vehicles in Tunnels Workshop (April 2020), from a joint IPHE – HySafe Research Priorities Workshop 2018
 - Engaging with the Hydrogen Council on Safety (first meeting March 2020)
 - Organisation of a specific session on hydrogen safety for maritime applications at the next HySafe Research Priorities Workshop October 22 and 23, 2020
 - Presentations by CHS and industry including lessons learned from incidents in Norway, Korea, and the United States at IPHE meetings
 - Complementing its work on safety-related regulatory gaps (as outlined above), the Hydrogen Council has also taken specific steps to equip and train members with regards to safety-related crisis communications, including detailed protocols, FAQs, simulation workshops etc.

III. Hydrogen Supply Chains

- ✓ Research and development and sharing information
 - Australia announced an energy investment plan for new and emerging technologies including hydrogen, and set up a hydrogen export hub worth \$70.2 million to scale-up demand and take advantage of the advancements in this low emissions, high powered source of energy.
 - Australia and Germany signed a joint declaration of intent to carry out a supply chain feasibility study on hydrogen produced from renewable energy.
 - Portugal and The Netherlands commit themselves in the MOU signed to affirm their intentions to develop a strategic export-import value chain

to ensure production and transport of renewable-based hydrogen from Portugal to the Netherlands and its hinterland.

- ✓ Promoting investment and demonstration projects that work as models for hydrogen deployment and scale-up, and help prepare the regulatory environment
 - The world's first liquefied hydrogen carrier “SUISEI FRONTIER” was launched, which was equipped with the world's first liquefied hydrogen storage tank for marine transportation.
 - The Advanced Hydrogen Energy Chain Association for Technology Development (AHEAD) in Japan has achieved the world's first hydrogen supply chain demonstration project that consists of a series of processes from the production of methylcyclohexane (MCH) in Brunei to ocean transport to the separation of hydrogen from MCH in Japan, as the use of hydrogen shipped from abroad as fuel for power generation.
 - CCS is a prerequisite for blue hydrogen, and the Norwegian Government recently announced to appropriate NOK 16.8 billion in the 2021 budget to the full-scale CCS project "Longship" with a total cost estimate of NOK 25.1 billion. The project will demonstrate carbon capture technologies at the cement factory in Brevik as well as the waste incineration facility in Oslo on the condition that this project secures sufficient own funding and funding from the EU or other sources. Both projects the amount of CO₂ captured for each project to be around 400 000 ton per annum, Longship also comprises funding for the transport and storage project Northern Lights, a joint project between oil companies that will transport liquid CO₂ from capture facilities to a terminal at Øygarden in Vestland County. From there, CO₂ will be pumped through pipelines to a reservoir beneath the sea bottom.
 - Saudi Aramco and the Institute of Energy Economics, Japan (IEEJ), in partnership with SABIC, have successfully demonstrated the production and shipment of blue ammonia from Saudi Arabia to Japan with support from the METI in Japan.
 - The Hydrogen Council is building a new digital investment platform to enable exchange on key projects and match start-ups and project developers with potential investors. The platform is expected to be fully operational in the course of 2021.
- ✓ Support the development of effective hydrogen trading markets
 - In Japan, Hydrogen Utilization Study Group was launched in the Chubu region as well as in Kobe and Kansai region for the purpose of

creating demand for hydrogen and building a supply chain for the stable use of hydrogen.

- The IPHE created a new Hydrogen Production Analysis Task Force whose objective is to develop a mutually agreed methodology for determining the greenhouse gas (GHG) and other emissions associated with the production of a unit of hydrogen. Application of this methodology, e.g. in an ISO international standard, will help facilitate international trade in 'clean' hydrogen by recommending a common approach, while its adoption is not mandatory and is subject to each member's discretion, depending on each member's circumstance.
- Australia is undertaking consultation via an online survey on the design of a Hydrogen Certification Scheme.
- New Zealand is proposing a project on a Low-carbon Hydrogen International Standard for APEC 2021.
- The Hydrogen Council is developing a study to outline industry perspectives on hydrogen production pathways. Preliminary results are expected before the end of the year. The official publication of the report is foreseen for January 2021.

IV. Sector Integration

✓ Research and development

- As part of the H2@Scale program, the U.S. DOE announced funding for 18 research and development projects totaling USD 64 million in fiscal year 2020. The funds will support innovative research and development that will drive market expansion and scale up the production, storage, transportation and use of hydrogen. Projects will include research and development on electrolyzers, new carbon fibers, steelmaking processes, the first marine barge and data center projects using hydrogen and fuel cells, and more.
- The Hydrogen Valley Platform was launched on 21 April 2020 as a Global Information Sharing Platform, developed by the FCH 2 JU to support the Mission Innovation IC8 Member States, aiming at promoting the emergence and implementation of hydrogen flagship projects ("Hydrogen Valleys").

✓ Demonstration

- Fukushima Hydrogen Energy Research Field (FH2R) in Japan was constructed with a renewable energy-powered 10MW-class hydrogen production unit, the largest-class in the world. The produced hydrogen is being used to power stationary fuel cells in the region. The FH2R will

adjust to supply and demand in the power grid in order to maximize utilization of this energy while establishing hydrogen production technology with low cost.

- The European industry association Hydrogen Europe is undertaking 2 x 40 GW Green Hydrogen Initiatives, where a number of projects to produce hydrogen with massive scale of electrolyser is planned.
 - The first megawatt-scale green hydrogen pilot project in MENA to produce hydrogen by solar power generation is being conducted in Dubai by the Dubai Electricity and Water Authority
 - The hydrogen production plant with 6 MW electrolyser started operation in Austria.
 - The French government-supported GRHYD project, which began blending 6% hydrogen into the natural gas grid in 2018, already reached 20% on a volumetric basis in 2019, demonstrating the technical feasibility of this approach for domestic use.
 - The Gigastack feasibility study was funded by the BEIS in U.K. to demonstrate the delivery of bulk, low-cost renewable hydrogen through Gigawatt scale polymer electrolyte membrane (PEM) electrolysis, manufactured in the UK.
- ✓ Expanding the use of hydrogen in various sectors
- The Netherlands started research on how to repurpose part of its current natural gas infrastructure for the transport of hydrogen, including a so called hydrogen backbone, which connects the major industrial clusters in The Netherlands and possibly in Northwestern Europe.
 - The Korean government is implementing the “Hydrogen Model City Project” to build hydrogen model cities in Ulsan, Ansan and the Wanju-Jeonju area by 2022.
 - The world's first hydrogen based steel plant in Sweden began operations, which can reduce CO₂ emissions in the steel industry by replacing coal with hydrogen in the steelmaking process.
 - Over 300,000 stationary fuel cells are installed in Japan to provide heat and power to households.

V. Study and evaluations of hydrogen's potential

- Energy Technology Perspectives 2020, a major new IEA publication focused on the technology needs and opportunities for reaching international climate and sustainable energy goals. This report highlighted the crucial role of hydrogen for reaching net-zero emissions

globally in 2050 as well as 2070. Hydrogen plays a key role in decarbonizing long-distance transport and heavy industry, including to produce hydrogen-derived fuels, with global demand growing by up to 7-fold. Such increase in demand means that hydrogen would meet over 10% of final energy consumption by the time of net-zero emissions. At that point, hydrogen production is low-carbon based on electrolysis using low-carbon electricity, or fossil fuels coupled with carbon capture and utilization or storage (CCUS), depending on each country's own circumstances.

- The IRENA published the report “Producing Competitive Green Hydrogen: Scaling up Electrolysers and Reducing the Cost of Green Hydrogen” presented today, 14 October 2020, at the Third Hydrogen Energy Ministerial, to contribute to the discussion on the need to evolve and scale up electrolyser technologies, as one of the common points of countries’ roadmaps/strategies.
- IRENA's Global Renewables Outlook: Energy Transformation 2050 provides an ambitious, yet technically and economically feasible roadmap to meet climate goals and place countries on the path towards net-zero emissions by 2060. To produce the amount of green hydrogen required, a significant scale-up of electrolysers translated into 1700 GW by 2050 is necessary, in addition to at least 4 TW of dedicated renewable capacity. In addition, in September 2020, IRENA released the report “Reaching Zero with Renewables” which outlines pathways to achieve net-zero emissions in industry and transport by 2060, and for all of which carbon-free hydrogen will have an important role.
- In January 2020, the Hydrogen Council published a report on the economic prospects for hydrogen technologies in the report "Path To Hydrogen Competitiveness: A Cost Perspective".

VI. Communication, education and outreach

- The IPHE actions related to Education & Outreach includes:
 - ✓ Planned, managed and executed the communications and outreach campaign around IPHE’s first virtual Global Hydrogen Forum with nearly 2,000 attendees, increasing the visibility of the role of hydrogen in the economy on the web and social media platforms including 3,000 new IPHE Website users, a 3-fold increase in LinkedIn followers and a 60% increase in IPHE twitter followers after the event.

- ✓ Publishing the IPHE Newsletter in March 2020 providing information on latest developments in member countries, the IPHE Policy Forum, the Yonsei University Student event and Student Award, and visit to Korea Gas Safety test facility.
 - ✓ Publishing the IPHE Brochure, hosting a series of Webinars, launched a Student Infographic Challenge, and launched an IPHE Early Career/Youth Chapter Network.
 - ✓ Developing Member Country Profiles identifying the latest information on Policies, programs, initiatives, deployments, and National Statements and Roadmaps.
- The IEA, CEM Hydrogen Initiative, IPHE, and the Clingendael International Energy Programme (CIEP) held a joint event ‘Scaling up Clean Hydrogen Around the North Sea’ on 3 July 2020, which is a starting point for potential international cooperation in the North Sea region.
 - As part of the 11th Clean Energy Ministerial Meeting (CEM) Pre-event, the CEM Hydrogen Energy Initiative organized an event titled “Opportunities for clean hydrogen to drive the sustainable recovery and clean energy transitions in a post-COVID world.
 - The Hydrogen Council has launched the first-ever global hydrogen consumer campaign to help grow awareness of hydrogen solutions among the broader public. The fully digital CLIMATE CH2AMPION campaign went live on 15 September 2020.
 - A Ministerial Roundtable on Green Hydrogen held during the IRENA’s Assembly brought together Country Members and the private sector who debated the relevance of hydrogen under distinct national energy contexts.
 - IRENA has established a Collaborative Framework on Green Hydrogen which aims at serving as an effective vehicle for dialogue, co-operation and coordinated action to ensure the continued deployment of hydrogen. IPHE and the Hydrogen Council have discussed with IRENA on how they can contribute to, and benefit from, the Collaborative Framework.