

Briefing Note Session 3

IRENA Innovation Week 2020

Session 3: Green hydrogen: electrolysis, ammonia and other e-fuels

6 October 2020 • 8:00 – 11:00 AM CEST • Virtual

Background

CO₂ reduction targets at national and regional levels pose a daunting challenge particularly for the industry and transport sectors. Tackling it effectively requires a dramatic reorientation of these sectors, as there is an increased acknowledgement of the limitation of the direct electrification. This shifts the attention to the importance of indirect electrification via green hydrogen and e-fuels to decarbonise these sectors. Green hydrogen can take renewables from the power sector into sectors for which decarbonization is otherwise difficult. In this respect, hydrogen from renewable power can replace fossil fuel-based hydrogen, fossil fuel-based feedstocks and, eventually, converted into carbon-neutral fuels.

Green hydrogen

According to the IRENA's Transforming Energy Scenario¹, green hydrogen demand will reach around 240 Mt per year by 2050, double today's demand for grey or fossil fuel-based hydrogen. This growing demand needs have been acknowledged in the past couple of years by countries across the globe adopting hydrogen strategies and roadmaps and setting up collaboration platforms including the IRENA's Collaboration Framework on Hydrogen, including looking into different ways to scale-up production of hydrogen either via the electrolysis technologies with a different level of maturity including alkaline and proton exchange membrane (PEM) as well as solid oxide electrolyser cells (SOEC) and anion exchange membrane (AEM). Particularly with falling costs of variable renewable energies, it underlines the attractiveness of widening the application of renewable power and stresses other benefits of green hydrogen such as its suitability in some applications given its higher energy density, good prospects to be transported over large distance, and by providing a relatively low-cost energy storage option.

But the scale of hydrogen production is lagging behind the growing demand prospects with costs being likely a main barrier, whether it is the electrolyser's cost and efficiencies, or renewable power costs and logistical costs (such as transportation and storage infrastructure costs).

E-fuels

E-fuels, whether hydrogen-based fuels obtained from syngas, derived through biomass gasification or by synthesizing green hydrogen with a source of carbon (CO and CO₂ captured from emission streams, biogenic sources or directly from the air) or with nitrogen (in the case of ammonia) represent an attractive direct replacement of their fossil fuel-based counterparts, which is particularly relevant for applications that are hard to electrify e.g. shipping and aviation. E-fuels' storage, distributions and consumption is possible with existing infrastructure without the need to adapt it. But according to the IRENA's analysis, green ammonia, green methanol and synthetic oil products have production costs that are two to three times higher than fossil-based products. To realise benefits of e-fuels, some challenges need to be overcome including high electrolyser's costs and the need for a cheap and clean carbon source.

Objective of the session

By setting the scene for the following sessions that will discuss the use of energy carriers in industry and transport, this session will focus on the supply side particularly on the innovative solutions for the production of (1) **green hydrogen through electrolysis** and (2) **e-fuels**. Experts will discuss the opportunities for their scale-up production

¹ "Transforming Energy Scenario" outlined in IRENA's 2020 "[Global Renewables Outlook: Energy transformation 2050](#)".

and highlight key priorities whilst exploring what is needed to sufficiently accelerate innovation across different dimensions (e.g. technological, political, economic) to produce these energy carriers in a cost-competitive way and in turn help to accomplish the goal of decarbonizing the end-use sectors of industry, transport and buildings by mid-century.

Session Agenda

Green hydrogen: electrolysis, ammonia and other e-fuels

Tuesday, 6 October 2020 (8:00 – 11:00 AM CEST)

Opening and Scene-setting presentations

08:00 – 08:15

Scene-setting presentations

Emanuele Taibi, Programme Officer, IRENA Innovation and Technology Centre

Panel 1 – Electrolysis production

08:15 – 09:30

A diverse panel of experts will discuss the most promising innovative technological pathways, as well as regulatory and market solutions to produce cost-competitive green hydrogen. Panellists will evaluate the potential of different technology options, identify their deployment challenges, weigh their pros and cons, and close the panel discussion with their vision on what solution is more likely to succeed.

Moderator: Tim Karlsson, Executive Director, IPHE

- **Denis Thomas**, EU Regulatory Affairs & Business Development Manager Renewable Hydrogen, Hydrogenics/Cummins
- **Jan-Justus Schmidt**, Co-founder, Enapter
- **Benjamin Schroeder**, Siemens
- **Eiji Ohira**, DG, Fuel Cells and Hydrogen Technology Group, NEDO

09:30 – 09:40

Digital Break

Scene-setting presentations

09:40 – 09:55

Scene-setting presentations

Michele Azalbert, CEO, Hydrogen Business Unit, Engie, Hydrogen Council

Panel 2 – Ammonia and other e-fuels

09:55 – 10:55

A diverse panel of experts will discuss the most promising innovative technological pathways, as well as regulatory and market solutions to produce cost-competitive e-fuels. Panellists will evaluate the potential of different technology options, identify their deployment challenges, weigh their pros and cons, and close the panel with their vision on what solution is more likely to succeed.

Moderator: Fernando Gomez, Head, Chemical and Advanced Materials Industry, World Economic Forum

- **Badr Ikken**, Director General IRESEN
- **Kilian Crone**, Team Lead, International Cooperation Hydrogen and Powerfuels, DENA
- **Karan Bagga**, Chief Engineer Process, ThyssenKrupp
- **Dan Feldman**, Partner, Shearman & Sterling LLP

Closing

10:55 – 11:00

Closing Remarks

Roland Roesch, Deputy Director, IRENA Innovation and Technology Centre

Speaker biographies

Scene-setting Presenters and Moderators

<p>Prof. Dr. Roland Roesch, Deputy Director, IRENA Innovation and Technology Center</p>	
	<p><i>Roland Roesch is the Deputy Director of the IRENA Innovation and Technology Centre in Bonn and brings 25 years of experience in energy markets, energy economics and energy sector transformation strategies, renewable integration management, energy project development and project financing. Before joining IRENA he worked in the Oil & Gas and Utilities Industry and as an Energy Market Consultant for Lahmeyer International and as researcher for renewable energies.</i></p>
<p>Dr. Emanuele Taibi, Power Sector Transformation Strategies, IRENA Innovation and Technology Centre</p>	
	<p><i>Emanuele Taibi joined IRENA in 2013. He is based with the IRENA Innovation and Technology Center in Bonn, Germany. He is responsible for assisting Member Countries in devising strategies for the transformation of the power sector, currently managing the work on power system flexibility, hydrogen and storage as enablers for the integration of variable renewable energy. After his first years working for large energy companies and research institutions, he spent over ten years working as an international civil servant in different countries and institutions, including the United Nations. He has a PhD in Energy Technology, a M.Sc. in Management Engineering (laude) and is a chartered industrial engineer from Italy.</i></p>
<p>Tim Karlsson, Executive Director, IPHE</p>	
	<p><i>Tim Karlsson is Executive Director of the International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE) Secretariat, since 2015. The IPHE is an inter-governmental partnership of 19 countries and the European Commission, working to help facilitate the transition to clean and efficient energy, industry, and mobility systems using hydrogen and fuel cells technologies. Previously, Mr. Karlsson held various positions including Director of Emerging Technologies, and, Director of Environmental and Clean Energy Industries in the government of Canada's Department of Industry. He has worked on numerous policy issues related to energy and the environment including domestic and international climate change as a member of Canada's delegation to the United Nations Framework Convention on Climate Change. Mr. Karlsson has a Bachelors and Masters in Economists from the University of British Columbia.</i></p>
<p>Michele Azalbert, CEO, Hydrogen Business Unit, Engie, Hydrogen Council</p>	
	<p><i>Michèle Azalbert is the Chief Executive Officer of ENGIE's Hydrogen Business Unit dedicated to industrial-scale renewable hydrogen development. Before her current role, Michèle held various responsibilities in treasury, financing and risk management at Elf Aquitaine from 1992 to 1996, at Sanofi from 1996 to 1999, and then at Suez from 1999 to 2005. She became Head of Treasury & Risk Management of the Suez Group in 2005. Then, in 2008 she was appointed Gaselys' Chief Operating Officer. From 2011 to 2013, she was Executive Vice President of ENGIE Global Markets (previously GDF SUEZ Trading), responsible for support functions. From 2013 to 2017, she was the Chief Operating Officer of ENGIE's Global LNG Business Unit, in charge of supply and trading. On January 1, 2018,</i></p>

Michèle assumed her current role as CEO. Michèle holds a computer science engineering degree and an MBA degree from HEC.

Dr. Fernando Gomez, Head, Chemical and Advanced Materials Industry, World Economic Forum



As the Head of the Chemical and Advanced Materials industry program at the World Economic Forum, Fernando oversees the involvement of partners from the chemical and materials industries in the Forum's alliances, programs and activities. Within the Platform for Energy and Materials at the Forum, Fernando provides strategic guidance to initiatives on sustainable energy systems and low-carbon emitting technologies. Before joining the Forum in 2010, Fernando was for eight years at AkzoNobel Chemicals (now Nouryon). Fernando is experienced in structuring and managing partnerships and has performed in areas including technology strategy and management, corporate innovation, new product development and corporate venturing. Fernando received his chemistry degree from Universidad del Valle in Colombia, earned his Ph.D. in polymer chemistry from the University of Florida, and completed his post-doctoral work in organometallic chemistry at Stanford University.

Panel 1: Electrolysis for green hydrogen production

Prof. Dr.-Ing. Armin Schnettler, Siemens Energy



Armin Schnettler is Executive Vice President of the New Energy Business at Siemens Energy as well as president of VDE, the German Association for Electrical, Electronic and Information Technologies. He joined Siemens in 2013 as Senior Vice President of New Technology Fields in Corporate Technology. Before this period, he held several positions at ABB and became member of the management team of ABB's business area "High Voltage Products and Substations". From 2001 till 2018 he held a full professorship and was director of the Institute for High Voltage Technology at RWTH Aachen University. Until joining Siemens, he has additionally been managing director of 'Forschungsgemeinschaft für elektrische Anlagen und Stromwirtschaft e.V. (FGH e.V.)' – Research Association of Power Systems and Power Economics.

Dr. Eiji Ohira, DG, Fuel Cells and Hydrogen Technology Group, NEDO



Eiji Ohira is the Director General of the New Energy and Industrial Technology Development Organization (NEDO)'s Fuel Cell and Hydrogen Group within the Advanced Battery and Hydrogen Technology Department. In this capacity, he is responsible for the overall strategy, execution, and coordination of NEDO's research, development and demonstration projects on fuel cell and hydrogen. He has also coordinated fuel cell and hydrogen activities with international stakeholders, through International Energy Agency's Technology Collaboration Program (IEA TCP: Advanced Fuel Cell & Hydrogen), and International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE). He joined the NEDO in 1992, just after graduation from the Tokyo University of Science. He served as a visiting scholar at the Massachusetts Institute of Technology in 1997-1998. Before taking up his current position in April 2013, he served in several positions, including Representative at NEDO Asian Representative Office, Director of the Energy Storage Technology Division.

Denis Thomas, Global Business Development Leader, Water electrolysis, Hydrogenics Europe N.V. (Cummins)



Denis Thomas is leading the Global Business Development activities for water electrolysis at Cummins, which has acquired the activities of Hydrogenics in 2019.

Denis represents Cummins in several EU associations such as Hydrogen Europe, Wind Europe and CO2 Value Europe. Before joining the company in 2014, Mr. Thomas has worked 8 years in the solar photovoltaic sector in Belgium and at European level within the European Photovoltaic Industry Association. Mr. Thomas holds a Master's Degree in Business Administration and a European Master's Degree in Renewable Energy.

Jan-Justus Schmidt, Co-founder, Enapter



Jan holds a master's degree in aerospace engineering from the University of Sheffield, UK, and an MBA from Hong Kong University of Science and Technology. He was listed in Forbes 30 under 30 in Energy in 2020. Since co-founding Enapter in 2017, Jan leads the technical development and oversees business operations of the company in Germany and Italy. Through further R&D, standardisation and automated mass-production, Enapter aims to make green hydrogen from electrolysis cheaper than fossil fuels.

Thorsten Herbert, Director of Market Development and Public Affairs, Nel ASA



Thorsten Herbert has recently joined Nel ASA as the Director for Market Development and Public Affairs.

Thorsten's main objectives in Nel are to represent the company in relevant European associations, organizations, and forums, as well as to identify and influence funding opportunities supporting Nel's ambitions and strategic positioning.

Well known in the hydrogen industry, Thorsten has spent over 18 years building up the industry in Germany.

With a Mechanical Engineering degree from TU Darmstadt and a Master of Science in Renewable Energy from HAW Hamburg, Thorsten has attained years of experience with hydrogen and fuel cell technology. From his many years with GM, working with fuel cell propulsion systems, and NOW GmbH – the main funding body for alternative fuels in Germany – he has developed a broad network within hydrogen and other alternative fuels.

Page Break

Panel 2: Ammonia and other e-fuels produced from green hydrogen

Dr. Badr Ikken, Director General, IRESEN



Mr. Badr Ikken received an engineer degree in mechanical engineering and industrial production & solar systems from the Berlin Institute of Technology. He wrote a thesis on production technologies of hard materials. During 8 years, he worked in the Department for Machining Technology of the Institute for Machine Tools and Factory Management (IWF) in Berlin, first as a research associate, then as a project manager. In the Institute for Production Systems and Design Technology (Fraunhofer IPK), he served as leader for several industrial projects involving companies such as Siemens Power Generation, INA Schaeffler, Saint-Gobain Diamantwerkzeuge, SGL Carbon,.. Between 2008 and 2010, Badr Ikken served as CTO of the multinational company Lunos-Raumluftsysteme. During this period, he developed and launched two new production lines in Germany. He also expanded the production in China. In September 2010, he joined the Moroccan Agency for Solar Energy (MASEN) as Director of Integrated Development, in charge of Industrial Integration and R&D. He co-founded the Moroccan-based National Institute IRESEN (Institute of Research in Solar Energy and New Energies). He is the Director General of IRESEN since July 2011 and established 2016 the largest solar research platform in Africa, the Green Energy Park and he is currently building a network of applied research centers (Green Energy Park, Green & Smart Building Park, Green H2A,..) Badr Ikken is Vice-President of the green economy commission of the Moroccan Confederation of Enterprises (CGEM), member of the board of the National Center for Scientific Research (CNRS) and represents Morocco in different international commissions.

Kilian Crone, Team Lead, International Cooperation Hydrogen and Powerfuels, DENA, Germany



Kilian Crone leads the team for International Cooperation on Hydrogen and Powerfuels at the German Energy Agency dena. He also coordinates the work of the Global Alliance Powerfuels, an industry-backed initiative founded in 2018 to foster the market development of electricity-based energy carriers internationally. He has written and contributed to several analyses and studies in the field.

Karan Bagga, Chief Engineer, thyssenkrupp Green Hydrogen & Chemicals Technology, Australia



Karan Bagga is the Chief Engineer at thyssenkrupp and heads up Company's Green Hydrogen & Chemicals Technology division in Australia. At thyssenkrupp, he is responsible for furthering and strategic implementation of thyssenkrupp technologies in the field of conventional and green hydrogen and chemical derivatives in Australia and New Zealand region. He holds a Master's degree in chemical engineering and is an accredited chartered engineer with IChemE. His 21 years of experience in the process industry, spans across the energy, hydrocarbons and petrochemicals sectors, including development of renewable power to X applications. A commercially astute and a keen technologist, he has expertise in technology development, design, optimisation and operation of hydrocarbons, hydrogen and ammonia value chain facilities. He is an established front end techno-economic concept development specialist for small and large scale renewable hydrogen projects, especially in sector coupling and "end to end" integration for Power to X facilities, focusing on chemical derivatives, CCU and Industrial Symbiosis.

Dan Feldman, Partner, Shearman & Sterling LLP



Dan Feldman is a Partner at Shearman & Sterling, a global elite law firm. He is based in Abu Dhabi and leads Shearman & Sterling's Global Hydrogen Industry Legal Team, comprising Partners from Europe, the Middle East, Asia, and the Americas. Dan is currently advising NEOM on a joint venture with ACWA Power and Air Products to develop a US\$5 billion green hydrogen-based ammonia production facility in Saudi Arabia, the first green hydrogen megaproject in the world, which will establish the Middle East as a major exporter of renewable energy to the rest of the world.

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