



HYDROGEN AMERICAS 2023 SUMMIT & EXHIBITION

2-3 OCTOBER 2023

RONALD REAGAN INT. TRADE CENTER WASHINGTON D.C

2023

EXECUTIVE SUMMARY

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SUMMIT DAY ONE



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Sustainable Energy Council

 U.S. DEPARTMENT OF
ENERGY

 **HYDROGEN
AMERICAS
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SUMMIT & EXHIBITION

OPENING KEYNOTE ADDRESSES

Sunita Satyapal of the U.S. Department of Energy delivered a welcome address, stressing the critical moment at which the hydrogen industry finds itself. Bringing participants from all parts of the value chain together will be key to make sure that hydrogen can deliver on its promises, she said. While Satyapal noted the complexity in developing production, infrastructure and demand capacities, she highlighted the benefits that hydrogen can deliver not only in emissions reductions but also regarding energy security and job creation.

In the following opening keynote, Air Liquide's Katie Ellet reiterated these prospects for hydrogen with regard to decarbonisation, energy security and job creation. She noted that "a fully developed hydrogen market could meet one-fifth of the global energy demand by 2050". For a hydrogen market to develop, accessibility will be key, Ellet said, noting "it is vital that hydrogen provides the same affordability and reliability as traditional energy sources". With regard to the path forward it will be critical for the private sector to demonstrate "leadership through investment," Ellet said. "Simply put, we need more of it to continue developing healthy market dynamics." In order to facilitate this, government incentives such as those foreseen under the Inflation Reduction Act are crucial, Ellet noted. Air Liquide itself is involved in several low-carbon hydrogen projects, including as part of the U.S.' hydrogen hubs. The company has committed to spending \$10bn on low-carbon hydrogen until 2035.

Dr Sunita Satyapal

Hydrogen and Fuel Cell Technologies Office
Director and Hydrogen Program Coordinator
at [U.S. Department Of Energy](#)

Katie Ellet

President, Hydrogen Energy & Mobility,
North America at [Air Liquide](#)

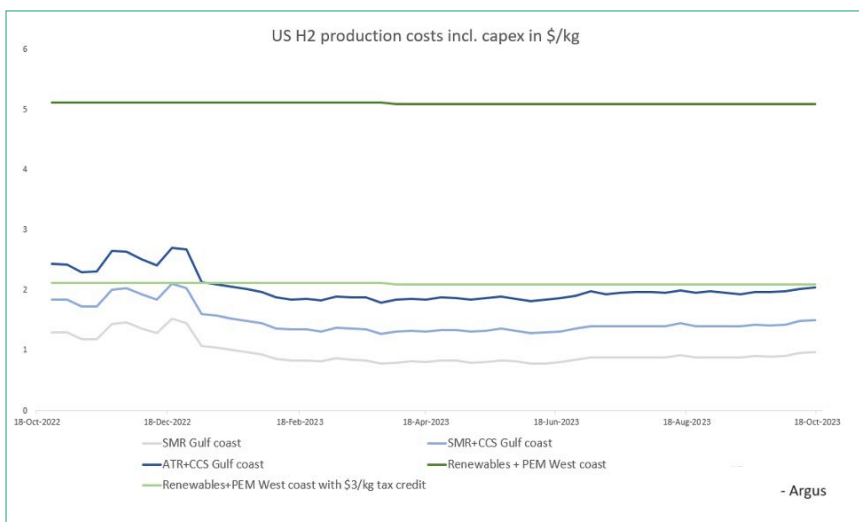


FIRESIDE CHAT: VISION FOR A HYDROGEN ECONOMY IN THE AMERICAS

Air Products' Seifi Ghasemi highlighted the need for companies to take the risk and move ahead with investments even if the scale of demand for clean hydrogen is still unclear. "Somebody has to take that risk to demonstrate to the world that we have the technologies" and "that the product can be used at industrial scale," Ghasemi said. The largest demand for hydrogen will come from steelmaking, shipping and refineries, he noted. Ghasemi called the Inflation Reduction Act "one of the greatest pieces of climate legislation that anybody has ever passed". On the hydrogen side, the bill will provide production tax credits of up to \$3/kg, with the exact amount of support to depend on the product's lifecycle emissions. But Ghasemi also noted that demand-side incentives will be important too. The best incentive would be a global CO2 tax, he said, adding that he expects a CO2 tax to be introduced in the U.S. in the future.

Annie Hills
Senior Advisor, Clean Energy & Innovation, Special Presidential Envoy for Climate John Kerry at U.S. Department of State (Moderator)

Seifi Ghasemi
Chairman, President and CEO at Air Products



SPOTLIGHT: GETTING IT RIGHT: DELIVERING ON HYDROGEN'S DECARBONIZATION POTENTIAL

During the following spotlight discussion, Steven Hamburg of the Environmental Defense Fund stressed the importance of getting decisions in the hydrogen space right from a decarbonisation perspective. “We’ve seen too many opportunities to decarbonise where we’ve taken a path either ineffective or simply not doing anything good,” he said. Hamburg placed a special emphasis on cutting methane leaks in U.S. gas production as this will be crucial for blue hydrogen production to provide benefits in terms of emissions reductions. Similarly, for electrolytic hydrogen production it will be key to ensure that the power supply comes from renewable sources – of which there currently are not “nearly enough,” Hamburg said. Technology will have a key role to play in ensuring that hydrogen can deliver environmental benefits – with measurement technology for methane leakage being of particular importance – while focusing on the right end uses will also be essential, Hamburg said.

Annie Hills

Senior Advisor, Clean Energy & Innovation,
Special Presidential Envoy for Climate
John Kerry at [U.S. Department of State](#)
(Moderator)

Steven Hamburg

Chief Scientist & Senior Vice President at
[Environmental Defense Fund \(EDF\)](#)



SESSION 1: CLEAN HYDROGEN LEADERS IN THE AMERICAS: PROJECTS, POLICIES & INVESTMENTS

The first panel discussion of the day focused on project plans by some major companies and key challenges that still need to be overcome. bp's Tomeka McLeod stressed her company's ambitions to first decarbonise hydrogen used at its own refineries before moving on to other demand opportunities. Regarding incentives, McLeod noted that the U.S. is "blessed to have the Inflation Reduction Act" but that this will still not be enough to bridge the gap between production costs for clean hydrogen and hydrogen made from conventional sources. In line with comments by previous speakers, she highlighted the need for more demand side incentives. The DOE's plan to set aside an initial \$1bn in funding support for offtakers – which was first announced in July this year – is a "good step in the right direction", McLeod said, even though these subsidies will be limited to demand linked to the hydrogen hubs. Eventually "we need something that we can have across the board that's going to help to underpin that," she said.

Linde's David Burns agreed that there is still a cost gap to conventional fuels, although this is much smaller for blue hydrogen made from gas with carbon capture and storage or utilisation than it is for green hydrogen. Blue ammonia that fertiliser producer OCI will make on the U.S. Gulf coast with hydrogen supplied by Linde will be cost-competitive with grey hydrogen in Europe, thereby opening up export opportunities, Burns noted.

Intersect Power's Sheldon Kimber voiced concerns about the U.S. electricity grid which will need to grow rapidly to meet decarbonisation goals. The grid will need to grow by 60pc by 2030 and triple in size by 2050 to meet decarbonisation targets, Kimber said, who thinks that "that's not going to happen". The U.S. has "deep systemic issues in the transmission grid" that were due to be fixed long ago but have not been, he said. Because of this, Kimber is doubtful that the grid will be able to support all the green hydrogen projects. Only a few companies will be able to deliver the large behind-the-meter hydrogen production facilities that they have announced, he said.

Meanwhile, Brady Ericson of Phinia called for a less "nitpicky" and more pragmatic approach to trying to achieve carbon reductions. While there are a lot of discussions around exactly how much CO2 emissions need to be cut this can hold back attempts to actually achieve any reductions at all. Burns agreed with this, saying that "sometimes we let the perfect be the enemy of the good".

Tom Baker
Managing Director & Partner
Boston Consulting Group (Moderator)

Laura Parkan
Vice President, Hydrogen Energy Americas
Air Liquide

Brady D. Ericson
President and Chief Executive Officer
PHINIA Inc.

Tomeka McLeod
VP Hydrogen, U.S.
bp

David Burns
VP Clean Energy
Linde

Sheldon Kimber
Founder and CEO
Intersect Power



SPOTLIGHT: U.S. DEPARTMENT OF ENERGY AND FEDERAL AGENCIES ACROSS THE U.S. GOVERNMENT CREATING OPPORTUNITIES FOR HYDROGEN

Secretary of Energy Jennifer M. Granholm delivered the event’s keynote address, stressing the urgency, opportunities and the outstanding challenges for the hydrogen industry. She noted that there recently were several major investments in electrolyser factories in the U.S. and that the country is keen to bring down costs for the equipment. Various U.S. companies have pushed forward with plans for electrolyser manufacturing facilities recently, while there have also been multiple manufacturers from abroad that have indicated an increased focus on the U.S., including Norway’s Nel and Hystar and the UK’s ITM. Granholm noted that the government was “very close” to announcing the selected hydrogen hubs at the time that the event took place. And the White House has indeed since named seven hubs that will each get a share of the overall \$7bn public funds allocated under the scheme. Granholm also reiterated the U.S.’ goals for clean hydrogen production – 10mn t/yr by 2030, 20mn t/yr by 2040 and 40mn t/yr by 2050.

The DOE’s Sunita Satyapal subsequently outlined the key pillars of the U.S.’ national hydrogen strategy, in particular highlighting three key components. The first is a focus on hydrogen application in “strategic high impact end uses”, which are hard to decarbonise sectors such as certain industry segments, heavy-duty transport and energy storage. The second component is a “laser focus” on bringing down costs, as hydrogen will have to become competitive to trigger uptake. The third element is centered around regional networks such as the hydrogen hubs which co-locate large-scale production and end use. Satyapal also noted that the DOE is now tracking 3.7GW of electrolyser capacity that is either deployed, under construction or backed by concrete plans. This constituted a 5-fold increase compared with 2022, she said.

In the subsequent panel discussion, Grant T. Harris highlighted that a key aspect of the U.S. Department of Commerce’s hydrogen-related work is focused on contributing to the creation of resilient and secure supply chains. “We’re going to need to make sure that industry is able to have secure and diverse supply chains to draw on,” he said. “That includes anything from critical minerals that might go into it, iridium, platinum, nickel and the like” to questions around demand, he said. The department aims to “write a playbook” on how to secure supply chains “for emerging technologies where there are so many questions to be answered,” Harris said. It also aims to connect suppliers with potential offtakers abroad.

Diversifying energy supply is a key priority for the Department of Defense and hydrogen may have a role in that, for example through deployment of a fuel cell in a light combat platform, or through hydrogen use in fixed military bases, Michael McGhee said. Using hydrogen-powered fuel cells could help “operate a mobile platform without a heat signature, without an emissions tail, without a noise signature,” McGhee said. Another priority for the department is to “facilitate the resilience” of a hydrogen supply chain, drawing on experience from other commodities, he said.

The Hon. Jennifer M. Granholm
Secretary of Energy at
U.S. Department of Energy

Dr Sunita Satyapal
Hydrogen and Fuel Cell Technologies Office
Director and Hydrogen Program Coordinator at
U.S. Department of Energy

Michael McGhee
Acting Deputy Assistant Secretary of Defense
for Environment & Energy Resilience at
U.S. Department of Defense

Jeff Marootian
Principal Deputy Assistant Secretary, Office of
Energy Efficiency and Renewable Energy
U.S. Department of Energy

Grant T. Harris
Assistant Secretary of Commerce for
Industry & Analysis at
U.S. Department of Commerce



SPOTLIGHT: CANADA'S HYDROGEN STRATEGY

Amandeep Garcha

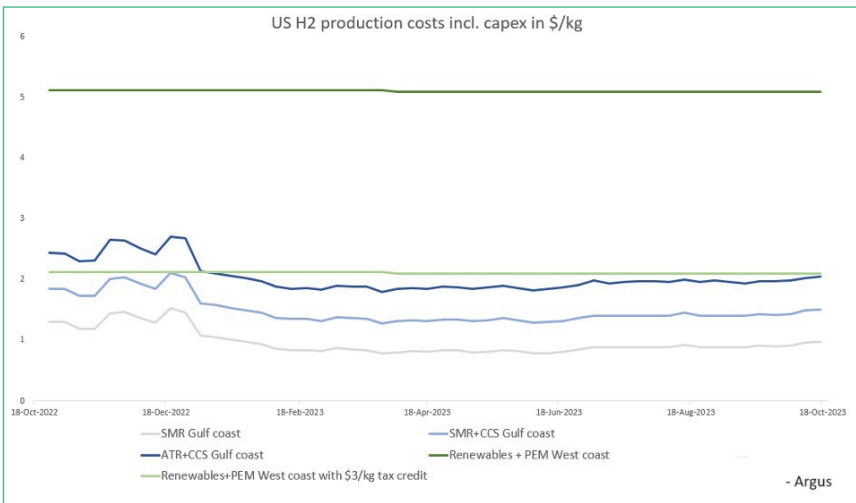
Deputy Director | Fuels Sector, [Natural Resources Canada](#)

Amandeep Garcha, who leads the implementation of Canada's Hydrogen Strategy, spoke about the country's ambitions in the space, noting that "Canada sees a significant opportunity for hydrogen". He pointed to Canada's long history and prominent position in hydrogen production and research as well as to ample prospects for both gas-based and electrolytic hydrogen output.

Several measures could help stimulate cleaner production going forward, including Canada's CO2 tax which is due to rise to C\$170/t of CO2 equivalent (CO2e) by 2030 from the current C\$65/t of CO2e. Argus calculations suggest that the rising CO2 tax alone would make production from new low-carbon hydrogen projects using steam methane reforming and CCUS more competitive than output from existing grey hydrogen projects with unabated emissions. In March, Canada announced investment tax credits for up to 40pc of capital costs for hydrogen projects, with the exact support depending on carbon intensity. For now, the policy covers

production from renewable power using electrolysis and natural gas reforming with carbon capture and storage, but it could in future be broadened to include other pathways, including methane pyrolysis and biomass gasification, Garcha said. The investment tax credit measure could in total provide an estimated C17bn for clean hydrogen production, he noted. Other incentives will include support for manufacturing clean technologies such as electrolyzers and separate support for carbon capture and storage, renewable energy installations and ammonia production.

So far, 75 clean hydrogen projects have been either announced or are under construction in Canada, with announced investments of over C\$90bn, Garcha said. Some 17 projects are targeting exports, primarily to Europe and Asia, he noted. Canada's windswept east coast in particular has attracted many project developers which are looking to send supply to Europe.



Hydrogen Policy Development

- ✓ **Hydrogen Strategy for Canada**
- ✓ **Federal Carbon Pricing**—rising price on carbon (\$170/tonne in 2030)
- ✓ **Net-zero Emissions by 2050**
- ✓ **Clean Fuel Regulations**—including credits for hydrogen feedstock/transportation fuel
- ✓ **Clean Electricity Standard**
- ✓ **Codes & standards**
- ✓ **Cross-border alignment**
- ✓ **Streamlining regulatory assessments**

The pyramid diagram consists of four levels from top to bottom: Targeted Programming, Strategic Finance, Investment Tax Credits, and Pollution Pricing & Regulatory Framework.



SESSION 2: SCALING UP ELECTROLYSIS FOR LARGE SCALE END-USE

Panellists at this session debated recent increases in costs for hydrogen production projects and associated equipment. They agreed that inflation, high material costs and rising borrowing rates have driven up costs, while the industry's ramp-up has not materialised as quickly as some had hoped. The panellists also shared the view that bringing down costs going forward will by no means be easy. Some costs are in fact bound to rise further, including labour costs for engineering, procurement and construction, Bechtel's Gunn said. Similarly, demand for specific equipment needed in energy transition projects, such as transformers, will grow as more projects are realised, which could drive up costs, Gunn said.

Panellists largely agreed that standardising equipment and production plants could be instrumental in bringing down costs going forward. Standardising electrolyzers and associated equipment will allow manufacturers to procure more material in bulk, thereby increasing their bargaining power, thyssenkrupp nucera's Stadtler said. Moreover, it will help increase electrolyser sizes, which in turn will reduce the overall material needed and cut shipping costs, he said. thyssenkrupp nucera is one of several electrolyser manufacturers which recently released or announced new, larger modules with 20MW capacity to cater to increasing project sizes.

A more standardised approach will also be key to bringing down costs for designing and implementing actual production projects, according to SMA Altenso's Voll. In his view, standardising projects is preferable to finding the optimal solution for each individual project. Currently all hydrogen projects are customised, but "we need to get away from our attempt to constantly for every project find the best solution," Voll said. He called for "a little less engineering," arguing that a standardised approach would ultimately lead to much larger cost reductions than finding the best possible compressors and rectifiers for each individual project. Widespread standardisation would not only make implementation easier, but would also unlock more financing by reducing the risks for banks and other financiers, Voll said.

Tim Hard
SVP Energy Transition
Argus Media (Moderator)

Bernhard Voll
Senior Technical Expert
SMA Altenso GmbH

John Oyen
Manager of Business Development
ABB

Alex Savelli
Managing Director of Electrolyzers – Americas,
Accelera by Cummins

Thilo Städtler
Head of Strategy and M&A
thyssenkrupp nucera

John Gunn
Global Manager of Operations, Energy
TransitionBechtel

Tony Cochrane
Chief Commercial Officer
Ceres



SESSION 3: REGIONAL TO GLOBAL SUPPLY CHAINS: LINKING THE AMERICAS WITH GLOBAL PARTNERS

The session covered a wide range of topics around hydrogen value chains, including transport and associated infrastructure. Dutch government representative Michel Heijdra provided The Hague's perspective on some of the related issues and stressed the different approaches taken by the EU and the U.S. for stimulating investment. Europe's focus is primarily on carbon pricing and obligations for use of cleaner fuels, including renewable hydrogen, while the U.S. is opting for a broad sweep of subsidies for production projects. It will be important to learn from each other in the long run, while it will be equally key not to contradict one another on matters such as certification and standards, Heijdra said.

From a port perspective, it is essential to think about which infrastructure additions are necessary and what infrastructure could be shared between companies, said Jeff Pollack of the Port of Corpus Christi. Beyond that, the aim is to create "a truly integrated ecosystem that's more than the sum of its parts," Pollack said. This approach influences aspects such as the port's land acquisition and land use strategies, he said. David Hart of ERM noted that projects creating "locally co-located" supply and demand should have priority because these can be built quickest, while involving least complexity. Building such ecosystems near ports can yield particular advantages because it also opens opportunities for future imports, Hart said, referring to developments in the Netherlands as a positive example for this. "Act local, think global," could hence serve as a "simple mantra," he noted. Hart also stressed the importance of standards and certifications, referring to the biofuels market as a negative example where these have not been implemented particularly well and where it is "quite easy to game markets".

In terms of potential hydrogen carriers, panellists largely agreed that ammonia will be an obvious starting point in the short term, but that other transport options such as liquid hydrogen and liquid organic hydrogen carriers will have a role to play as well. For Mitsubishi Power's Michael Ducker, synthetic natural gas – made by combining hydrogen with CO₂ – may in fact be the most viable option in the short term. This would allow for the existing gas infrastructure, including LNG import and export terminals, to be used, Ducker noted. But Ducker noted that major policy questions need to be answered around this, including on the source of CO₂ and emissions accounting.

Meanwhile, Avangrid's Adolfo Rivera pointed to the fact that recent sharp decreases in grey ammonia prices mean that cleaner alternatives are now a lot less competitive than they were a year ago. Such swings "completely mess up your financial model" and make long-term commitments much harder to reach, Rivera said. Ducker agreed that this volatility means that either the offtaker or producer would have to take sizable risks. Rounding off the panel, the speakers agreed that regulatory and policy clarity is the top priority for the sector at the moment.

Marcel Van de Kar
Global Director New Energies
VOPAK (Moderator)

Dr. Michel Heijdra
Vice Minister for Climate & Energy
Ministry of Economic Affairs and Climate Policy,
Government of The Netherlands

Jeff Pollack
Chief Strategy & Sustainability Officer
Port of Corpus Christi

David Hart
Partner
ERM

Michael Ducker
Senior Vice President, Hydrogen Infrastructure
Mitsubishi Power

Austin Knight
Vice President, Hydrogen
Chevron New Energies

Adolfo Rivera
Sr. Director, Green Hydrogen
Avangrid Renewables



SESSION 4: DECARBONISING HYDROGEN PRODUCTION WITH CCUS FOR THE ENERGY TRANSITION

The session kicked off with discussions on the prospects for hydrogen production with carbon capture and storage or utilisation (CCUS) in different areas and outstanding challenges. bp’s Rushabh Shah highlighted the large scale, the capital efficiencies and the continuous supply that give hydrogen produced from gas with CCUS an edge compared with other pathways, especially electrolytic hydrogen. Focusing on the U.S., Shah noted that states have taken very different approaches to CCUS regulation and are at different levels of development. He singled out Indiana as a state with a clear framework that has helped “large-scale CCS projects to progress”.

CF’s Linda Dempsey said that in her company CCS is seen as “the best and quickest way” to cutting emissions and pointed to the firm’s joint project with ExxonMobil in Louisiana. The 45Q provisions in the Inflation Reduction Act will make the capturing process commercially feasible, Dempsey said. Under the rules, firms will get \$85 for each tonne of CO2 they capture and store. But there is still work to be done on a technology and policy level, Dempsey noted. Svante’s Brett Henkel agreed, adding that technology developments for capturing CO2 in the flue gas, i.e. post combustion, will be key as these will allow for the highest capture rate. Svante focuses on technology developments for the sector and Henkel noted that the firm has raised some \$500mn so far which it will partly use to build a manufacturing facility for equipment in Canada. On the policy side, Dempsey pointed to permitting of sequestration wells, clear pipeline regulations and a global price on carbon as the most pressing issues.

Nathalia Weber of Brazil’s CCS industry body highlighted that her country is open to all different hydrogen production pathways and that hydrogen production from gas with CCUS could play a major role. The state of Rio de Janeiro could be a hotspot for this given its existing natural gas production and state-owned oil company Petrobras is getting involved, Weber said. A regulatory framework for hydrogen production in Brazil is currently debated by the country’s congress and could help move the industry along, she added. Additionally, a Brazilian emissions trading system could further pave the way for low-carbon hydrogen production, according to Weber.

Selim Cevikel
Principal Consultant Finance
Global CCS Institute (Moderator)

Rushabh Shah
Director, Midwest Hydrogen and CCS
bp

Brett Henkel
Co-Founder & VP, Strategic Accounts & Gov’t Affairs
Svante

Nathalia Weber
Co-Founder and Director
CCS Brasil

Linda Dempsey
Vice President, Public Affairs
CF Industries



SESSION 5: DECARBONISING HARD TO ABATE SECTORS THROUGH HYDROGEN APPLICATIONS

Several company representatives explained how hydrogen fits into their respective sectors as a route to decarbonisation. Anglo American’s Jan Klawitter highlighted the use of hydrogen in mining vehicles, pointing to pilots that the firm is doing for on-site electrolysers and refuelling stations to power trucks. Electrification is not really an option for these operations because of the required battery sizes, Klawitter said.

Jenny Molvin explained H2 Green Steel’s plans to produce low-carbon steel in Sweden. The firm is building a plant for direct reduced iron (DRI) and steel production that is due to start in 2026 and could eventually produce 5mn t/yr of green steel. It involves a 760MW electrolyser for which the firm has struck a deal with Germany’s thyssenkrupp nucera. The plant’s costs are estimated at around \$6bn and H2 Green Steel has first offtake deals in place and is already considering DRI production facilities in other geographies, Molvin said.

On the hydrogen production site, Matti Malkamäki presented Hycamite’s technology which is focused on “methane splitting” into hydrogen and carbon nano products, with the latter having potential use cases in products such as lithium ion batteries, supercapacitors and conductive polymers. Hycamite is looking to set up production facilities in Oregon through a cooperation with utility NW Natural which is looking to decarbonise its supply. The firm is hoping to build plants that could eventually deliver some 500,000t/yr of hydrogen with low or even negative emissions. The panellists agreed that collaboration with companies across the value chain is key to achieve decarbonisation goals, especially as a lot of the technology involved in projects is still at an early stage.

Annie Hills
Senior Advisor, Clean Energy & Innovation, Special Presidential Envoy for Climate John Kerry
U.S. Department of State (Moderator)

Matti Malkamäki
Chairman of the Board and Founder
Hycamite TCD Technologies

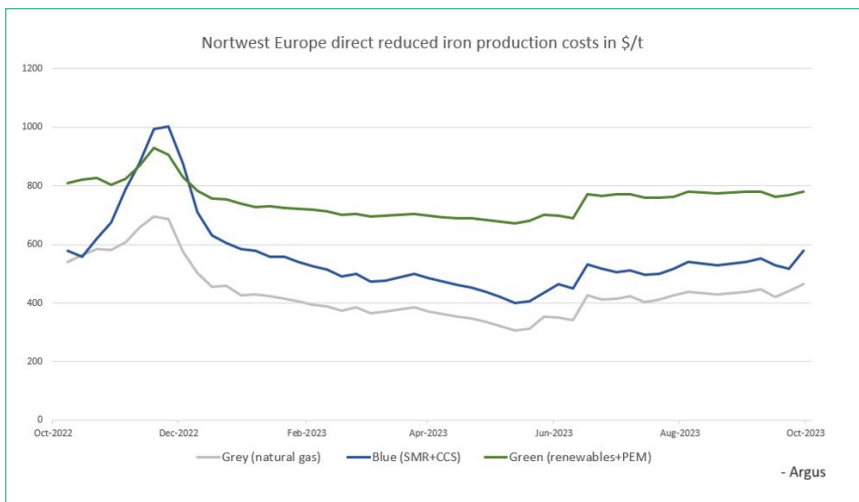
Andy Walker
Technology Market Insights Director
Johnson Matthey

Claus Nussgruber
CEO
Utility Global

Yusuke Hongo
General Manager of Corporate Marketing Division
Mitsui O.S.K. Lines, Ltd.

Jenny Molvin
Director Global Growth & Hydrogen Business
H2 Green Steel

Jan Klawitter
Head of International Policy
Anglo American



SUMMIT DAY TWO



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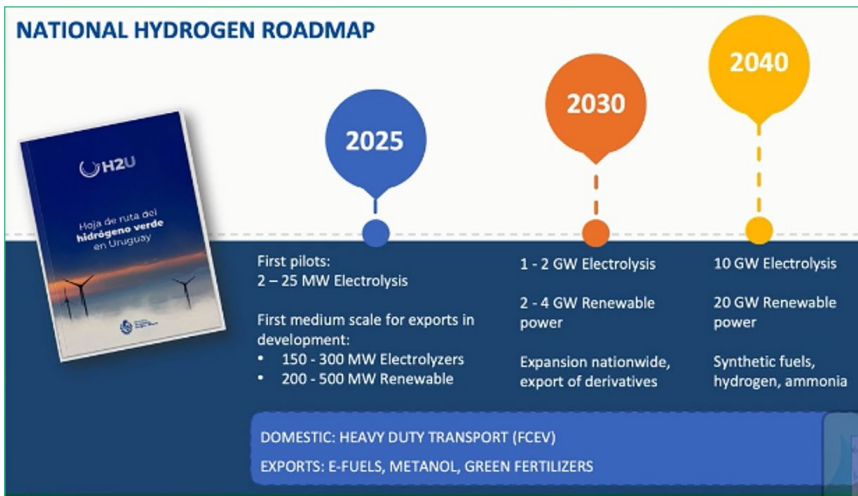
**HYDROGEN
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MINISTERIAL KEYNOTES

Omar Paganini

Minister of Industry, Energy and Mining
Government of the Republic of Uruguay

Uruguay's Omar Paganini opened by highlighting how Uruguay's departure from fossil fuel dependency positions it to become a hydrogen export power. Uruguay aims to have 1-2GW of electrolysis capacity in 2030, scaling to 10GW in 2040. Renewable energy sources, including wind, hydro and biomass, have accounted for over 90pc of the country's electricity generation for the last five years, in tandem with moving to a more distributed power generation system. Uruguay's political stability, Atlantic coast access and water and availability of biogenic CO2 all make it a prime location for hydrogen and derivative projects, the minister said. The country has 60GW of high quality solar potential and 30GW of wind potential with high average speeds, as well as offshore wind potential. Bit must pursue energy exports – which could primarily be made as e-fuels thanks to the availability of biogenic CO2 – because its generation will exceed its domestic needs, the minister said. That said, a recent drought in the region – the worst in over 70 years – sparked water scarcity concerns among residents which could bolster resistance to hydrogen projects. The government will need to keep citizens informed on how much water will be used in the projects and where it will come from, although there is overall enough water to support the country's hydrogen production goals, the minister said. "We have a lot [of water]. It is not a problem of abundance, it's a problem of managing," the minister said.



FIRESIDE CHAT: HYDROGEN'S REGULATORY ROADMAP

FERC's Allison Clements urged the audience to participate in dialogues around the federal regulation of hydrogen pipelines, saying she has previously requested that Congress create clarity around the topic. The Natural Gas Act somewhat streamlines the process of building interstate pipelines by giving oversight to FERC. But hydrogen is not included in the law, so its regulation falls to individual state and federal agencies. A national hydrogen economy will need interstate pipeline connections, meaning there is a need to clarify who can greenlight hydrogen pipelines, Clements said.

If the regulatory regime fails to encourage the development of a coordinated pipeline system, the hydrogen network risks the same fate of the offshore wind projects developed in the northeast. "There had been no common planning for the grid underneath those offshore wind projects," she said. "Now what's happening is the individual states are procuring transmission as part of the individual projects that are getting awarded. While that might be an okay way to go in the near-term, over the long-term, it's going to be significantly more expensive."

Gurpreet Hayre
Event Director
Sustainable Energy

Allison Clements
Commissioner
Federal Energy Regulatory
Commission (FERC)



SOUTH AUSTRALIA: CLEAN ENERGY POWER HOUSE

South Australia's Edit Mucsi provided an overview of South Australia's decarbonization pathway. It aims to have 100pc renewable energy generation in 2030, but may reach this goal already by 2028, Mucsi said.

The region is rich in copper, graphite, zircon, cobalt and magnetite, which puts it in a favourable position to supply minerals needed for energy transition technologies. It has several renewable hydrogen projects planned, including the government-owned 250MW Whyalla hub, which the government has furnished with a total A\$593mn (\$376.08mn). The Whyalla hub is to be developed by a company selected through a tender, although the winner was yet to be announced at the time of the conference.

"Investing in a different country sometimes is scary, and we don't know what regulatory environment is waiting for us," Mucsi said. But South Australia has introduced regulations like the Hydrogen and Renewable Energy Act to streamline approval processes so that projects can be deployed quickly, she said. As part of the bill, South Australia will also introduce a new competitive system to grant access and licences for projects on pastoral land and state waters under the laws, opening some of the largely arid state's best prospective regions for renewable energy development.

Chris Wood

Executive Director of Invest SA,
Department for Trade and Investment
Government of South Australia

Hon Nick Champion MP

Minister for Trade and Investment,
Minister for Housing and Urban Development,
Minister for Planning
Government of South Australia

Edit Mucsi

Director, Minerals and Energy, Invest SA,
Department for Trade and Investment
Government of South Australia



South Australia - green hydrogen superpower

- Developing Hydrogen and Industrial hubs
 - ✓ Government owned: **Whyalla Hub - Hydrogen Jobs Plan**
 - 250MWe electrolyser, 200MWe Power Plant by Q4 2025
 - ✓ Government led: **Port Bonython Hydrogen Export Hub**
 - 6 shortlisted Project Partners, Up to 1.8m tonne H2 /annum capacity
 - ✓ Industry led: **Cape Hardy Industrial Hub**
 - Up to 5GWe electrolyser capacity, green iron potential (DRI)

Logos for SOUTH AUSTRALIA, Government of South Australia, and SEC are visible at the bottom of the slide.



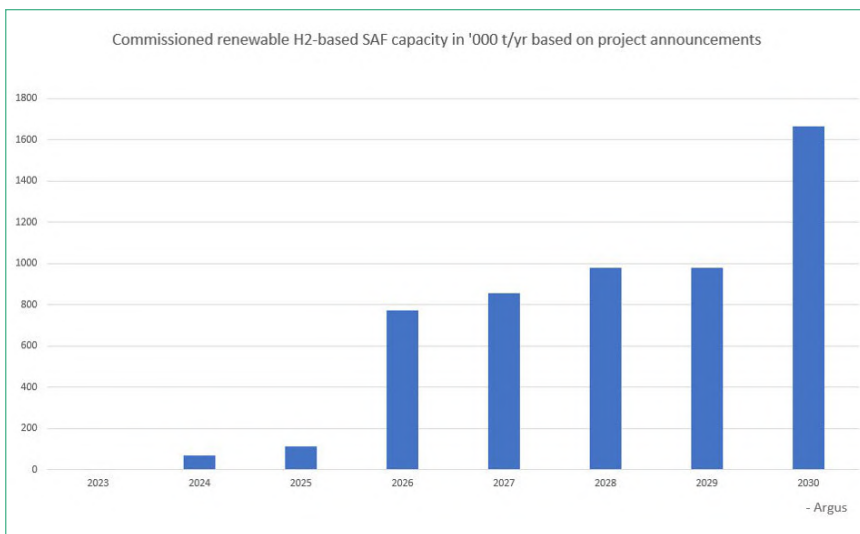
SESSION 6: HYDROGEN MOBILITY APPLICATIONS AND SOLUTIONS

Panelists discussed how hydrogen will be used across various mobility applications. Although BMW has yet to decide if it will mass produce fuel cell vehicles, 100pc vehicle electrification would place immense demand on the grid and require €1.5 trillion (\$1.58 trillion) in investment until 2050, the company’s Thiemo Schalk said. Fuel cell vehicles would ease the strain on the grid and present customers with options, he said. Governments have recently taken steps to drive forward the adoption of fuel cell vehicles, although there appears to be growing consensus that hydrogen adoption in road transport may be primarily focused on heavy-duty good transport and base-to-base vehicles. The EU recently adopted its alternative fuel infrastructure regulations under which hydrogen refuelling stations – for trucks as well as passenger vehicles – will have to be built by 2030 at every 100km along the bloc’s main roads and at all urban nodes.

In aviation, hydrogen is the only long-term solution, according to Airbus’ Amanda Simpson. Airbus expects all its aircraft to be compatible with sustainable aviation fuel (SAF) by the end of the decade, and sees SAF as an interim solution. But ultimately, hydrogen is the only zero-emission option, Simpson said. “This is not something that needs to be done in the next five years. This is something that needs to be done over the next five or so decades, but we have to start down that path, identifying what our goal is, and make the right choices now so that we can get there,” Simpson said.

There are too many barriers to deploying batteries in large aircraft, and ammonia is too dangerous for aviation, while the combustion of SAF and other e-fuels still produces emissions. Work must begin now to bring hydrogen to airports, in order to have sufficient infrastructure in later decades once aircraft have been engineered to run on hydrogen, Simpson said. The initial rollout of hydrogen aircraft will be along hydrogen corridors, in places with substantial hydrogen infrastructure, she added. First pilot projects are underway to trial options for hydrogen supply to airports. And similar to the road transport sector, the EU has introduced regulations to stimulate hydrogen use in aviation, with the ReFuelEU Aviation package setting specific targets for use of hydrogen-based fuels in aircraft.

The number of hydrogen production projects eyeing SAF production is rising at a quick pace. Argus is currently tracking 34 planned or operational SAF production plants that will use renewable hydrogen as a feedstock, with the vast majority of these located in Europe.



Mike McGowan
Specialist Executive
Deloitte (Moderator)

Ehab Zabaneh
Vice President New Energy
U.S., Woodside Energy

Thiemo Schalk
BMW Group Representative
BMW of North America

Dr. Richard Mackay
R&D, Manager
Molecular Products

Amanda Simpson
Vice President for Research and Technology
Airbus Americas

Bill Elrick
Executive Director
Hydrogen Fuel Cell Partnership



SESSION 7: FINANCING HYDROGEN PROJECTS

Panelists discussed the challenges of financing hydrogen projects, and measures governments can take to help put projects in the ground. While many renewable and low-carbon hydrogen projects have been announced around the world, few have progressed to final investment decisions (FIDs), let alone construction or operations. Regulatory uncertainties, lack of offtake and increasing financing costs have been key reasons for little progress towards moving more projects closer to realisation. Moreover, hydrogen and derivative projects have unique requirements and while they will utilise technologies that have in principle been proven, these have not been demonstrated at scale, thereby adding further uncertainties, said the Bank of America's Michael Mudd.

Once the U.S. Treasury releases its guidance on the 45V hydrogen production tax credit, many companies will likely take final investment decisions on projects that have been on hold – but it may be the most complex tax credit industry has ever seen, Citi's Leopoldo Gomez said. 45V will require multi-layered analysis of lifecycle emissions, exposing producers to risks if there are variations in the emissions from hydrogen projects, he added.

The tax equity market is unlikely to be able to supply sufficient capital to all the projects seeking financing, but the tax credit could be monetised using transferability, Mudd said.

If Treasury takes restrictive measures on the implementation of 45V, such as strict time matching and co-location requirements for electricity, operating costs rise – which could affect private sector investment in the sector, the Clean Hydrogen Future Coalition's Shannon Angielski said.

“But at the end of the day, we do want to make sure that it [45V] is achieving the policy objective of making sure that, if we're going to be producing hydrogen, that it really is hydrogen that is low-carbon intensity,” Gomez said. There have been heated debates in recent months around the form that the exact 45V requirements should take. While many hydrogen industry participants are warning that restrictive measures could drive up costs and limit the sector's development, environmental groups have warned that lax rules would open the door for heavily-polluting hydrogen production drawing government funds.

Frank Wolak
President & CEO
FCHEA (Moderator)

Amandeep Garcha
Deputy Director, Fuels Sector,
Natural Resources Canada

Shannon Angielski
Principal, Van Ness Feldman, President
Clean Hydrogen Future Coalition

Leopoldo Gomez
Vice President, Global Infrastructure Finance
Citi

Pierre Audinet
Lead Energy Specialist
World Bank Group

Michael Mudd
Director, Global Sustainable Finance
Group (GSFG)
Bank of America



SESSION 8: AN OUTLOOK FOR HYDROGEN'S FUTURE

Panelists urged industry to take greater risks and move ahead with investments in hydrogen infrastructure today, rather than waiting for costs to fall. Although market participants typically prefer to let competitors take on the risks of being a first mover, it is riskier in an exponentially changing market like hydrogen to wait on investments, as it will be harder later to catch up, Deloitte's Geoff Tuff said.

Air Products' Eric Guter was not optimistic that hydrogen equipment costs will fall in the next five to 10 years as many stakeholders hope. Industry members need to move today – even if that means moving from traditional feedstocks to grey hydrogen, to facilitate the implementation of downstream hydrogen infrastructure in anticipation of future low-carbon supply, Guter said.

A global carbon tax would be the fairest and fastest way to drive an energy transition – but it has almost no chance of being implemented, so industry is left to juggle a patchwork of policies, according to Guter. California has led the way in the U.S. with policies meant to support demand, with around 12 other states following suit. That may be enough to create demand among U.S. customers which will be vital to ensure domestic use of renewable or low-carbon hydrogen, he said.

If such demand incentives are not provided, “a lot of what we do in the U.S. may be poised to an export market because those are where the strong demand signals are being created,” Guter said. The EU recently introduced legislation that will require 42pc of all hydrogen consumed in industry to come from renewable sources by 2030, with the share to rise to 60pc by 2035. Meanwhile, Japan and South Korea are also betting heavily on domestic hydrogen use and are developing initiatives to stimulate demand.

Wesport's Gage Garner said he expects most equipment manufacturers in the heavy-duty truck market to offer hydrogen solutions between 2027-2030, either in the form of fuel cells or hydrogen internal combustion engines. The off-road sector, especially the mining industry, will need to commit to decarbonisation decisions soon because of the sheer amount of capital equipment installations that are needed, Garner added.

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EU renewable hydrogen targets set under REDIII and ReFuelEU Aviation

INDUSTRY

42pc of all hydrogen or derivatives used in industry to come from renewables by **2030**

60pc of all hydrogen or derivatives used in industry to come from renewables by **2035**

Hydrogen is not factored into the calculations if it:

- is used in production of conventional transport fuels and biofuels
- is produced by decarbonising industrial residual gases and used to reduce these specific gases from which it is produced
- produced as a by-product in industrial installations

A target reduction by 20pc is possible if

- The member state is on track towards its expected national contributions to the overall EU target on the share of renewables in gross energy consumption

AND

- The share of hydrogen or derivatives from fossil fuels consumed in the member state is not more than 23pc in 2030 and 20pc in 2035

MARITIME

1.2pc of all energy supplied to the maritime sector to be renewable hydrogen or derivatives in member states with maritime ports by **2030**

TRANSPORT

1pc combined share for biofuels, biogas and renewable hydrogen and derivatives in fuels supplied to the transport sector by **2025**

5.5pc combined share for biofuels, biogas and renewable hydrogen and derivatives in fuels supplied to the transport sector by **2030**

including a 1pc share of hydrogen and derivatives in fuels supplied to the transport sector by **2030**

AVIATION

Synthetic aviation fuels, such as renewable hydrogen and e-kerosene to make up the following shares of aviation fuel:

2030	1.2pc
2032	2pc
2035	5pc
2050	35pc

SESSION 9: HYDROGEN INFRASTRUCTURE: ADVANCEMENTS IN STORAGE, TRANSPORTATION AND DISTRIBUTION

This session provided a deep-dive on topics centred around future hydrogen infrastructure.

Marco Alvera's TES is focusing on what it calls electric natural gas (e-NG) which is made from renewable hydrogen and CO₂. The supply could be moved around using existing infrastructure for natural gas, according to Alvera, who is upbeat on the potential for renewable hydrogen production costs to fall. Electrolytic hydrogen can be cheaper than oil if electrolyser prices fall from around \$800-\$1000/kW to \$200/kW, the going rate in China, Alvera said. This is also dependent on having a source of low-cost renewable electricity – but hydrogen and its derivatives will be a useful medium to move energy from rural areas with high wind speeds or solar penetration to demand centers, without putting additional strain on already overloaded grids, he said.

But in line with views voiced by speakers across many of the panels, Alvera noted that there is a lot of work left to do when it comes to regulations and certification schemes. "How do we treat carbon captured in the U.S. to create a product that's used in Japan, with Japan subsidies? Is that an avoided emission in Japan or in the U.S.? All that complexity has to absolutely dealt with. The certificates have to be in place," he said.

Moreover, many banks have not yet figured out how to finance hydrogen projects and insurance companies do not yet have a roadmap for insuring hydrogen projects, Alvera said, adding that this is a key hurdle preventing stakeholders from taking final investment decisions. Governments will need to play a big role by establishing frameworks and certification standards, but also providing guarantees to lower the cost of capital and make projects more bankable, he said.

EDP's Antonio Fayad reiterated the view from previous speakers that the initial focus will have to be on production and demand projects which are located closely to one another. It will take time and investment to establish expansive infrastructure like a pipeline system for hydrogen, Fayad said. In the near-term companies like EDP can focus on projects that co-locate production and consumption and help consumers convert processes to be compatible with hydrogen, he said.

Tony Lindsay

P.E., Managing Director – Energy Delivery
GTI Energy (Moderator)

Prof. Dr. Klaus Bonhoff

Director General Policy Issues
German Federal Ministry for Digital
and Transport

Pierre Poulain

President & CEO
Powertech Labs

Marco Alvera

Co-Founder, Zhero, CEO
TES

Antonio Fayad

Senior Manager for H2
EDP Renewables North America



SPOTLIGHT: HARNESSING LATIN AMERICA'S POTENTIAL FOR CLEAN HYDROGEN PRODUCTION

This spotlight session shifted the focus southward by focusing on Latin America's potential. Many Latin American countries are hoping to not only use renewable or low-carbon hydrogen to decarbonise their own economies but could also become key exporters.

But Latin America cannot be regarded as a monolith with one hydrogen solution for all its countries, White Martins' Guilherme Ricci said. The Vaca Muerta field in Argentina can produce natural gas at competitive prices, making it well-suited for low-carbon hydrogen production with CCUS – but many other regions boast substantial renewable power capacity. The Patagonia region has ample potential for wind power production that could be used for hydrogen production geared towards domestic consumption, for instance in Chile's large mining industry, and for exports. Uruguay is positioned to move on hydrogen with its renewable power policies and capacity, while Brazil has strong renewable potential and a mostly decarbonized grid, as well as significant domestic demand, including for fertiliser production. Indeed, Brazil's domestic demand for hydrogen could be 2-3 times greater than its potential to export hydrogen, Ricci said.

In Costa Rica, electrolytic hydrogen is the only option, Ad Astra's Franklin Chang Diaz said. The country has no plans to explore oil and gas, but it has an excellent electric grid that is "virtually" 100pc renewable, he said. Costa Rica lacks the technicians that will be needed to develop hydrogen, but has started a hydrogen school to initiate training. But rather than building extensive hydrogen infrastructure, Costa Rica will likely move renewable energy as electrons and produce hydrogen on-site, he said.

"One of my concerns right now when I see the hydrogen economy developing into gigantic mega systems is leaving the little ones behind," Diaz said. It will be important to develop smaller projects in tandem with large-scale export projects, Diaz said. Costa Rica has a small energy system and has struggled to find electrolyzers at a size that would meet its needs, he added. A 1MW electrolyzer could produce hydrogen for mobility purposes that would be competitive with diesel, as long as the cost of electricity was around \$0.05-\$0.06/kWh, he said. Such a system would cost about \$5mn, with half the cost covered by investment and the other half by debt, he said. This would provide a 15pc return on investment, without requiring government subsidies.

There is room for governments and multilateral organizations to help the market develop in South America. Political instability creates risk for large export-oriented projects requiring large amounts of capital investment, and support from sustainable finance systems and governments can help ease the amount of risk placed on private investors, Uruguay's Maria Jose Gonzalez said.

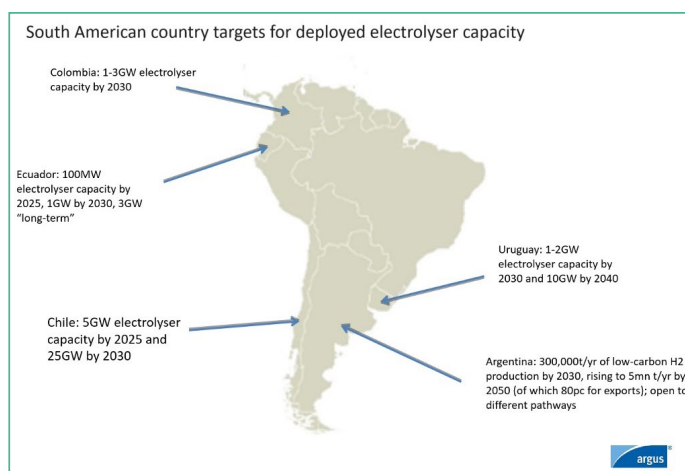
Juan-Pablo Zúñiga
Country Manager
HINICIO (Moderator)

María José Gonzalez
H2U Program Coordinator and
Advisor Ministry of Industry,
Energy and Mining,
Government of the Republic
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Guilherme Ricci
Business Director
White Martins
(a Linde Company)

Franklin Chang Díaz
CEO
Ad Astra Rocket Company

Andre Magalhães
Commercial Director
Pecém Complex (Brazil)



SESSION 10: AMMONIA'S POTENTIAL IN DIFFERENT INDUSTRIAL AND ECONOMIC SECTORS

The U.S. already produces about 17mn t/yr of ammonia – which would theoretically be sufficient to power the country for three and a half days, Mainspring's Shannon Miller said. No other storage medium is at a similar scale today that could compare with oil and gas to provide firm capacity for increasing renewable energy generation, she said. But the fuel is complex and today mostly attractive to “big and sophisticated customers” like data centers and utilities.

Today half of LSB's ammonia is used for industrial applications, while the other half is used for agriculture, Jakob Krummenacher said. Recent legislation has been credited with driving decarbonisation, but Krummenacher argued that policies like those included in the Inflation Reduction Act are only accelerating decarbonisation trends that are happening regardless, he said.

Fertiliser usage is expected to increase by about 44mn t/yr by 2050, and zero- or low-carbon ammonia could fill the gap created by that growth, IHI's Glenn Lansford said. But fertiliser producers are not willing to pay the green premium on a decarbonized product today, meaning the government will need to incentivise the switch with penalties or subsidies, he added. The U.S. is not as “clear cut” as Japan, for instance, in its hydrogen and ammonia goals, which leaves companies to their own devices without an overarching plan, IHI's Glenn Lansford said.

But if consumer-facing organizations set goals to introduce low-carbon fertilisers, demand will drive the transformation of the supply chain, rather than forcing farmers to pay a premium, the Ammonia Energy Association's Trevor Brown said.

More than half of all hydrogen production projects announced globally are ultimately aimed at making ammonia, Amogy's Seonghoon Woo said. U.S. hydrogen policies are serving to help the ammonia economy take off, even though demand is coming from Japan, Asia and Korea. Amogy is initially targeting European and Singaporean shipping sectors, but its discussions with U.S. partners are “rapidly evolving” on the back of the Inflation Reduction Act, he said.

Trevor Brown
Executive Director
Ammonia Energy Association
(Moderator)

Glenn Lansford
CEO
IHI Energy Solutions

Shannon Miller
CEO
Mainspring Energy

Seonghoon Woo
CEO
Amogy

Jakob Krummenacher
Vice President of Clean Energy
LSB Industries



SESSION 11: INTERNATIONAL STANDARDS, CERTIFICATION & REGULATIONS TO FACILITATE TRADE

Paul Durrant of the Breakthrough Agenda opened the discussion by pointing out that while some progress has been made in terms of international collaboration on hydrogen, including on standards and certification, a lot more work lies ahead. An assessment by IEA, Irena and others showed that the coordination and resourcing of efforts in the area fall short of what is needed Durrant. While many different initiatives are involved, there was “no place in which that all came together,” he said. On the resourcing side, “the people working on this are diligent, hardworking experts, but they are often national experts seconded to an international panel” and are “doing this in addition to their day job”. For what could be a multi-billion dollar industry, “having such a critical enabler of this relying on such a thin layer of resources [is] clearly a high risk,” Durrant said. According to him, resourcing will be key, while content-wise the focus will need to be not only on emissions standards, but also on safety and operational standards and on mutual recognition of these.

IPHE is working on some of these aspects on a government level and Laurent Antoni stressed the importance to build “stable, robust regulations in order to create confidence” for suppliers, offtakers and for the investors that will have to provide a lot of the money to move projects forward. It will be critical that “we speak a common language” with regard to hydrogen definitions, Antoni said. IPHE is developing guidelines which could help in setting up a common approach. Certification will have to go beyond emissions standards and also focus on environmental criteria like land use and water stress as well as social considerations such as labour availability, Antoni said.

Rich Gottwald of the Compressed Gas Association underlined the necessity to focus on safety matters, noting that a single incident could set back the entire industry. Meanwhile, the EDF’s focus is primarily on emissions and Beth Trask highlighted the need to use the best data available on upstream methane emissions and hydrogen emissions when making policy decisions.

Oleksiy Tatarenko
Senior Principal
RMI (Moderator)

Beth Trask
Associate Vice President, Energy Transition
Environmental Defense Fund

Rich Gottwald
President & CEO
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Laurent Antoni
Executive Director
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Paul Durrant
Joint Head of the Breakthrough
Agenda Secretariat
Breakthrough Agenda





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