Summary of Technical Parallel Sessions – Day 2

INTERNATIONAL CONFERENCE ON GREEN HYDROGEN 2023

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Day – 2 Program: 6 July 2023

0930 – 1015 hrs **Plenary Session – 3: Japanese Perspective**

Dr. Eiji Ohira, Director General, Fuel Cell & Hydrogen, NEDO, Japan

1015 – 1100 hrs **Plenary Session – 4: Australia Perspective**

Ms. Sarah Storey , Deputy Head of Mission to India, Australian High Commission

1130 – 1300 hrs **Technical Sessions – III**

Session 3A:	**Hydrogen Infrastructure & Compatibility**	**(4 speakers)**
Session 3B:	**Hydrogen Economy – Logistics and Infrastructure**	**(4 speakers)**
Session 3C:	**Codes, Standards & Regulations**	**(4 speakers)**
Session 3D:	**Hydrogen Valleys / Hubs / Clusters**	**(4 speakers)**

1400 – 1445 hrs **Plenary Session 5 – Perspective of the International Energy Agency**

Mr. Uwe Remme, Head – Hydrogen & Alternative Fuels Unit, IEA

1450 – 1620 hrs **Technical Sessions – IV**

Session 4A:	**Start-ups in Hydrogen**	**(5 speakers)**
Session 4B:	**Hydrogen Strategies & Policies**	**(5 speakers)**
Session 4C:	**Green Financing**	**(5 speakers)**
Session 4D:	**Strengthening R&D Ecosystem**	**(3 speakers)**

Day-2 : Highlights in numbers….

Sessions	No. of Sessions	No of Speakers
Plenary Session	03	03
Parallel sessions	08	34

Plenary Sessions

Day-2

Plenary Session – 3: Japanese Perspective

Chair: Mr. Atul Kumar Tiwari, Secretary, Ministry of Skill Development and Entrepreneurship

Speaker : Dr. Eiji Ohira, Director General, Fuel Cell & Hydrogen, NEDO, Japan

- Japan's 2021 primary energy supply & energy related CO2emissions – Oil & gas still predominant
- Japan's net zero target is by 2050
- Basic Hydrogen Strategy 2017 in place with 2050 target. Aims to make H2 affordable (@ 3 USD/kg by 2030 and 2 USD /kg by 2050)
- Revised the strategy in 2023
  - Target H_2 production - 12 MMT by 2040
  - Definition of low carbon H2 → < 3.4 kg CO2e / kg H2
  - Plans in place to promote H2 – supply side & demand side
- Current Status against the targets 2030: Refueling stations 167 now (1000 nos. by 2030); Mobility (~8000 vehicles against 8 lakhs) Fuel Cell stationery Power (~5 lakh against 3 million)
- Demonstrations across sectors: H2 technology centres, H2 Trucks, H2 off-road vehicles, H2 refueling (, H2 gas turbines & MW scale combustor, Liquefied H2 tankers,
- MW scale electrolysis demonstration (10 MW alkaline & 1.5 MW PEM), H2 Valley at Fukhushima

Plenary Session – 4: Australia Perspective

Chair: Mr. Pankaj Agrawal, Secretary, Ministry of Power, Government of India

Speaker : Ms. Sarah Storey, Deputy Head of Mission to India, Australian High Commission

- Strong strategy relationship in place between India & Australia - Green H2 Task force formed
- Australia's Climate Change Framework 2022
  - Net Zero by 2050, AUSD 20 billion to rewire the nations' electricity grid
  - GHG reduction by 43% of 2005 levels by 2030
- Australia's national hydrogen strategy 2019
- Land resources will be leveraged for H2 infra augmentation
- Budget 2023-24 → H2 head-start programs (AUSD 2 billion)and H2 hubs initiatives (AUSD 5.6 billion)
- Australia's Hydrogen Projects
  - 100+ announced Green H2 & Green methanol and ammonia projects
  - 15+ projects reached final invetment decisions
  - AUSD 230-300 billion investments are in pipeline
- Global collaborations – with Japan, Korea, Singapore,UK, US, India, Germany…..

Plenary Session – 5: Perspective of the IEA

Chair: Mr. Rajat Kumar Mishra, Secretary, Department of Fertilizer, Govt.of India

Speaker : Dr. Uwe Remme, Head – Hydrogen & Alternative Fuels Unit, IEA

- Hydrogen demand to jump fivefold by 2050, expanding beyond refineries and the chemical industry
- By 2050, electrolysers accounting for ~70% of global production, and NG with CCUS for ~30%.
- Low-emission hydrogen could reach 20-36 MMT per year by 2030 with major contribution by rise in electrolyser manufacturing capacity to 125 GW per year.
- Renewable hydrogen could become cost competitive (solar PV, wind and electrolysers will also bring down the cost of hydrogen)
- Annual exports could reach 12 MMT of hydrogen by 2030, but some challenges remain in regulation, infrastructure, demand creation, value for exporters and trade rules
- Existing and planned certification systems and regulatory frameworks in the countries like Canada, US, UK, France, china and Australia can enable certain interoperability and minimise market fragmentation.
- Collaborations will Intensify international cooperation for hydrogen trade and to accelerate the development of hydrogen infrastructure.

Technical Sessions – III

1130 – 1300 hrs

Technical Session – 3A

Hydrogen Infrastructure & Compatibility

TS 3A: Hydrogen Infrastructure & Compatibility

- Green hydrogen infrastructure development in India can be categorized into four major verticals belonging to following stakeholders –
  - **Government** – To promote the industry and to implement policies
  - **OEM** – Manufacturing and to cut overall costs through economies of scale
  - **EPC Suppliers** – Installation, turnkey solutions
  - **End Consumers** – Refineries, Fertilizers, Steel & Cement industries
- The session covered the need to develop Infrastructure for green hydrogen and how to address the dilemma of transportation of electrons versus molecule
- Solar story is different from GH2 as the existing grid acts as a backbone for RE transmission.
- For longer distances, pipelines are the most efficient and cost effective way of transporting hydrogen. Cryogenic tankers can be used for transportation of hydrogen through road for mid-distances.

TS 3A: Hydrogen Infrastructure & Compatibility

- Highlighted main concerns or gaps for the transportation of pure hydrogen through pipelines, such as suitability of existing equipment, materials required for construction, development of gas turbines for pure hydrogen, leak detection systems and the standard codes & regulations.
- The session further discussed damage mechanisms of hydrogen in metals at high & low temperatures, trapping due to diffusion, blistering, embrittlement, cracking, fissures due to reaction at high temperatures.
- Studies by IOC R&D highlighted the interplay between environmental variables, materials & stress mechanisms in understanding hydrogen embrittlement
- Screening methodology for the evaluation of in-service pipelines is the need of the hour
- Studies in Germany proposes transport of hydrogen in existing CNG pipelines with mixing ratio from 15% to 25% to utilize existing infrastructure to save capital costs.
- Need of professional tools like ‘Computational Pipeline Monitoring’ for monitoring of in-service pipelines based on specific algorithms & conventional measuring devices for flow, temperature and pressure was also raised.

Technical Session – 3B

Hydrogen Economy – Logistics and Infrastructure

TS 3B: Hydrogen Economy – Logistics & Infrastructure

- Transport holds 70% of diesel consumption. Blending of hydrogen derived derivatives with diesel have great potential.
- Presented need for indigenous component manufacturing and H2 generation (upstream), Conversion and distribution (mid stream) and end use (down stream).
- For long range transport cryogenic tanks may be considered.
- To ensure round the clock renewable electricity availability pumped storage hydro power, batteries with different chemistry to be considered.
- Methanol and DME are good carriers for hydrogen transport in view of cost associated in transport of gaseous hydrogen or liquid hydrogen.
- Indigenous development/manufacturing of components present in hydrogen value chain is essential.
- To increase hydrogen demand, in addition to refining fertilizer sectors, use of hydrogen for power generation may also be considered.
- India centric Life cycle assessment of different transport modes of hydrogen to be carried out.

TS 3B: Hydrogen Economy – Logistics & Infrastructure

- The session also discussed H2 characteristics, risks during H2 logistics & transportation and strategies for risk mitigation.
- Due to wider LEL-HEL band compared to natural gas (NG), probability of fire is ~6 times higher than NG.
- Although probability of hydrogen leak is less but severity is high.
- **Central Electricity Authority highlighted**
  - Government is taking steps to ensure the availability of green power to all green hydrogen and ammonia production plants
  - To tackle the intermittent nature of renewable energy (RE), pumped hydro storage and nuclear may need to be focused.
  - Open access to RE to be given to ensure connectivity on supply side.
- Taking steps to waive off license requirement for laying dedicated interstate transmission lines.
- Focus on SEZ development to balance supply and demand.

Technical Session – 3C

Codes, Standards & Regulations

TS 3C: Codes, Standards & Regulations

Safety aspects of Hydrogen – Production, Transport and Storage

- Session highlighted the physical and chemical attributes, safety of Hydrogen and misconceptions pertaining to use of hydrogen.
- Risk and prevention of accidents from Hydrogen Hazards
- Institutes like OISD / PESO are engaged standard formulation for GH2 value chain. Faster assessment and clearance is the need of the hour.
- ISO 19880 Series, SAE J 2601, IEC 60079 standards were considered by PESO in granting approvals to H2 facilitates at IOC R&D, IOC Guj. Refinery (350 bar) , Reliance Jamnagar (180 bar) & UPES Gurgaon. etc
- Current approvals for Hydrogen Tanks are limited to 350 bar. Guidelines for 700 Bar h2 storage is under development.
- Formulation of standards for Composite cylinders based on EC-79, ECER 134, ISO 19981 etc. for Type IV cylinder EN-12245

Hydrogen Utilization

- H2 identified as fuel for automotive applications | IS 16061 : 2021
- Key codes developed for H2: AIS codes for Hydrogen fuel cell vehicles (AIS 157), AIS 195 (H2ICE engines)
- For hydrogen automotive applications , critical components for codes development are identified as Fuel Quality, Fuel system components, Storage & Hydrogen Dispensers
- For on board storage & tank valves, PESO is the nodal agency for guidelines

International Perspective - Switzerland

The Green Hydrogen Standard

- Renewable hydrogen is the only option strictly aligned with reliably 1.5 Deg C energy sector pathway
- Process of GH2 production – presents complex scenario of Carbon footprint accounting (Carbon emissions in manufacturing of RE systems like SPV panels, wind turbines)
- Green Hydrogen Standards to cover three aspects: Safety, Emissions & wider environmental and social perspectives
- Brief on EU pathways for producing renewable green hydrogen | Direct RE, Grid Connected 90 % RE share | Grid connection with emission intensity in bidding zone is less 18gCo2eq/MJ | Renewable PPA with contacted asset built within 36 months before electrolyser.
- Methods for hydrogen production pathway (upcoming regulations by IPHE, iREC, ISO), standards, Project testing, project accreditations & certifications,
- Role of rapid assessment tools for accreditations & certifications

Technical Session – 3D

Hydrogen Valleys / Hubs / Clusters

TS 3D: Hydrogen Valleys / Hubs / Clusters

Hydrogen Valleys/ Hubs in India -

- Cost effective technologies for CCUS along with Carbon Credits and incentives for CCUS projects will make Blue Hydrogen to compliment Green Hydrogen usage
- Management of Hydrogen Valley/ Hubs require
  - ✓ unique type of efforts including operations, maintenance, consulting services,

International Perspective -

- Case study of Germany- Project Clean Hydrogen Coastline to create a hub, with an electrolyser capacity of upto 400 MW by 2026
  - 60 km H2 pipeline - replace existing NG consumption by 1/3rd (570 million m3 of NG p.a)
  - Challenges for Hydrogen valleys:
    - Offtake for Mobility, Offtake for Green Ammonia for shipping and power
  - Australian perspective for green hydrogen with public private partenrship based on various incentives to reduce the cost of GH2 to <$2.80/kg was also covered

Policy Interventions for GH2 project -

- regulatory support and finances and subsidy on hydrogen production cost
- Reducing the indirect taxes on equipment/utilities/assets of GH2 project
- Provision of land: GoI to make revenue land accessible to GH2 project

Technical Sessions – IV

1450 – 1620 hrs

Technical Session – 4A

Start-ups in Hydrogen

TS 4A: Start-ups in Hydrogen

- New market opportunities promote developments in hydrogen energy value chain
- Startups are imperative for translating the solutions to applications at an expeditious rate
- MNRE | SIGHT (STRATEGIC INTERVENTIONS FOR GREEN HYDROGEN TRANSITION) for indigenous development of electrolyser and other Gh2 production pathways is a welcome step
- **Key startup strategies / developments include:**
  - Indigenization of stack and system technology for electrolyzes and fuel cells
  - Indigenization of fuel cell drones
  - Production of bio-hydrogen from waste water

Recommendations

- Need of in house manufacturing of key Component in India for GH2 ecosystem : **cell/stack, electrolysers, compressor, BOP.**
- Highlighted need of proactive support of Banking Finances to startups
- Recommended a special cell to facilitate & support to Startups by means of PLI schemes, State sponsored initiatives
- Assistance in hand holding and risk mitigation for startups
- Public sector companies may fund aggressively the startups in the area of hydrogen

Technical Session – 4B

Hydrogen Strategies & Policies

TS 4B: Hydrogen Strategies & Polices

India - Goals of GH2 mission

- 5MMT GH2, 60-100 GW Electrolyser capacity, 125 GW RE capacity of GH2 generation and associated transmission network
- USD 100 billion investments
- 600,000 jobs
- 50 MMT CO2 emissions averted

Pilot projects nation wide:

- Shipping: retrofitted ships with GH2/derived fuels by 2027
- Transport: heavy duty buses and trucks
- Green steel: Injection of GH2 in 2 leading steel plants
- 19 projects announced for electrolyser manufacturing

Regulatory action plan:

- PESO to facilitate amendment of relevant policies/rules like Gas cylinder rules and Static & Mobile Pressure vessel rules for Hydrogen
- FAME like benefits & tax incentives should be extended to hydrogen ICE & Fuel Cell vehicles in order to pave path for the faster deployment of hydrogen for mobility

TS 4B: Hydrogen Strategies & Polices

Global H2 momentum:

- Financial investment decision (FID) for about USD 29 bn, expected investment 320 bn by 2030
- Investment commitment in JPN, South Korea and rest of Asia USD 17 bn
- 700 MW electrolysis capacity deployed by 2022

Hydrogen Strategies & Polices in EU

5 areas for policy framework in EU:

- Financing and investment
- GH2 definition
- Creation of markets
- R&D and pilot project
- International co-operation

- H_2 generation target of 7 MT/yr by 2030: RE investment $ 200-300 billion
- 22% solar and wind contribution in primary energy mix of EU in 2022 expected to grow to 40-50% by 2030

Technical Session – 4C

Green Financing

TS 4C: Green Financing

- India needs ~US $80-100 Bn investment for the set targets of green hydrogen ecosystem by 2030.
- Additional investment would be required for supporting infrastructure for storage and transportation.
- Cash flow is an important aspect in the next 2-3 years for accelerated development.
- Green hydrogen will play an important role in rural electrification.
- Green H2 main financing challenges include cost parity with grey hydrogen, managing multiple projects, limited global manufacturing capacity, project completion risk, performance risk and policy challenges.
- Possible mitigation mechanisms suggested – managing interdependencies and ownership of infrastructure across the value chain, selection of reliable technology, performance guarantee from EPC contractors, long term agreement with stable tariff, harmonization of policies across the value chain.
- Large shift in the responsibilities of lenders for financing into green hydrogen projects as it requires cash flow after commissioning as well.

TS 4C: Green Financing

- It is absolutely necessary to form a consortium amongst financial institutions for sustainable funding of GH2 and RE projects
- Supportive taxation policy, green infrastructure investment board and necessary regulatory changes in the operation of banks are some of the important steps in increasing green financing.
- **World Bank** has already disbursed US $1.5 Bn loan to the government towards fulfilling regulatory frameworks targets and guidelines.
- Additional development policy loan of US $1.5 Bn has been approved for India.
- Loan is mainly oriented towards the development of Policy regulatory system for the deployment of renewable energy technologies including green hydrogen.

Technical Session – 4D

Strengthening R&D Ecosystem

TS 4D: Strengthening R&D Ecosystem

Strategies for Hydrogen safety

- The session covered unique properties of hydrogen and associated challenges to handle it safely.
- Quantitative risk assessment (QRA) is an integral part of hydrogen system safety analysis.
- R&D in QRA is required to identify gaps in hydrogen safety.
- There is a need to undertake consortium based approach with different countries to accelerate hydrogen safety studies, protocols and standards

R&D, scale and speed for green hydrogen- strengthening ecosystem

- **Need to drive down the production cost through target based approach**
- **Harmonization in targets for Efficiency, durability and performance need to be aligned globally**
- **AEM, Sea Water electrolysis and biomass pathways need to rigorously pursued**
- The session also covered the inter-relation of electrolysis pathway considering all variables- capex, electricity price, plant efficiency and plant load factor.

THANK YOU

for your kind attention !!!