Methodology for Determining the GHG Emissions Associated with the Production, Conversion/Conditioning and Transport of Hydrogen

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THE CREATION OF A GLOBAL MARKET
Key Drivers: based on unique National Circumstances

- **Environmental Benefits – Climate Change**
  - Climate Change, Clean Air/Local Air Quality, Noise Pollution

- **Energy Security**
  - Security of Supply and Resource Diversity

- **Energy System Resiliency and Stability**
  - Effective Use of Variable Generation – grid services, storage at scale, and sector coupling
  - Distributed Generation Option

- **Economic Growth: Innovation & Technology Leadership**
  - Strength of the industry
  - Capacity of innovation
  - Skilled Jobs and Manufacturing Opportunities
Key Challenges: Need to Get to a Global Scale

1. **Innovation**
   - *Must get low-carbon hydrogen cost competitive*
   - *Skilled workforces from engineers to operators: initial cursus and lifelong trainings*

2. **Infrastructure Investment**
   - Installation of the massive production capacities
   - Efficient Transmission/Transportation

3. **Policy and Regulatory Framework**
   - *Stable and strong Policy Signals*
   - Regulatory Certainty
   - Market Transparency
THE ROLE OF INTERNATIONAL MULTILATERAL COLLABORATIONS
International collaborations and coordination are essential

### International Hydrogen Initiatives

#### Public-sector-led global Hydrogen Initiatives
- **IPHE**
- **CEM Hydrogen Initiative**
- **MI’s Clean Hydrogen Mission**
- **G7’s Hydrogen Action Pool**
- **UNDP’s Hydrogen Initiative**

#### Private-sector-led Global Hydrogen Initiatives
- **Hydrogen Council**
- **Green Hydrogen Organization**
- **First Movers Coalition**
- **Green Hydrogen Catapult**

#### Public & Private-sector Global Hydrogen Initiatives
- **RNA’s Collaborative Framework on Green Hydrogen**
- **WEF’s Accelerating Clean Hydrogen Initiative**
- **Breakthrough Energy Catalyst**

#### Country-led International Initiatives
- **H2Global (DE)**
- **Quad Clean Hydrogen Partnerships (US, JP, AU, IN)**
- [Others to be added]

#### Regional Hydrogen Initiatives
- **African Green Hydrogen Alliance**
- **Hydrogen Europe**
- **H2 LAC**
- **MENA Hydrogen Alliance**
- [Others to be added]

#### Global Initiatives working on related topics
- **CEM Investment and Finance Initiative**
- **Mission Possible Partnership**
- **Green Grids Initiative**
- **Breakthrough Energy Catalyst**
- **Development Bank**

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*Not an Exhaustive List*

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Group of Experts on REn - UNECE, 12 September 2023, Geneva, Switzerland

Priorities:
1. Share Information on Latest Developments
2. Inform Future Government Policy
3. Foster Collaboration

The IPHE addresses these Priorities by,
- Coordinating and Sharing Information
- Regular Country Updates – Country Profiles at www.iphe.net
- Working Groups:
  1. Regulations, Codes, Standards & Safety (RCSS) – TFs: Maritime & Bulk Storage
  2. Education & Outreach (E&O) – Early Career Network
- Task Forces:
  1. H₂ Production Analysis – Working Paper Ver 3 Published
  2. H₂ Trade Rules – Paper Published, Potential new work
  3. H₂ Certification Mechanisms
  4. Skills – Terms of Reference under Development

And coordinate with other International initiatives including IRENA, IEA, CEM/MI, WEF, H₂ Council, and the Breakthrough Agenda
Implementing international regulations, codes and standards
IPHE Hydrogen Production Analysis Task Force
What does “Clean Hydrogen” mean?

‘Quantification Methodology’ Working Paper Version 3 Co-leads France, EU, USA
- Published Methodology for Determining the GHG Emissions Associated with the Production of Hydrogen Working Paper Version 3 July 2023

Schematic of “Well-to-Gate” system boundary adopted

Handed over to ISO TC197/SC1/WG1 Convener France, Project leader Brazil

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- Hydrogen Production Pathways:
  - Electrolysis
  - Steam Methane Reforming with CCS
  - Industrial By-Product
  - Coal Gasification with CCS
  - Biomass
  - Auto-Thermal Reforming with CCS

- Conditioning and Carriers of $\text{H}_2$
  - Liquefaction
  - Ammonia
  - Liquid Organic Hydrogen Carriers

- Transportation of $\text{H}_2$
  - Marine; Pipeline; Mobility – Train, Truck

*Three main types of electrolyzers include alkaline, polymer electrolyte membrane (PEM) and solid oxide (SOEC)*
The GHG Emissions associated with the Production of Hydrogen depend on:

- the primary energy

AND

- the production pathway
• GHG Emission link to the transportation of Hydrogen and Hydrogen carriers

Principles of Quantification of GHG Emissions Related to Transport Chains (TC), Transport Chain Elements (TCE), Transport Operation Categories (TOC) and Hub Operation Categories (HOC)

Illustrative example of a multi-element freight transport chain [modified from ISO 14083:2023]

Diagrammatic relationship between operations and TCEs for an example freight transport chain (modified from ISO 14083:2023)
Global hydrogen trade currently blocked by lack of mutual recognition of standards and risk of regulatory fragmentation

Multiple certification schemes are emerging across jurisdictions, with more under development…

…however standards are being developed independently, with no mutual recognition / interpretability…

…which causes a risk of regulatory fragmentation, limiting global and cross-border hydrogen value chains and trade
Conclusions: Hydrogen, the energy for today!

International collaboration and coordination are key.

Business-as-Usual is not sufficient given energy, climate and societal drivers. Crucial for governments to facilitate efficient and effective international hydrogen markets.

Robust, stable and transparent regulations, codes and standards are key.

Continuous and strong involvement of public and private stakeholders is welcome.
Thank you