INCREASE YOUR H_2IQ

The #H2IQ Hour

Today's Topic:

How IPHE is Fostering Global Hydrogen and Fuel Cells Collaboration

This presentation is part of the monthly H2IQ hour to highlight research and development activities funded by U.S. Department of Energy's Fuel Cell Technologies Office (FCTO) within the Office of Energy Efficiency and Renewable Energy (EERE).

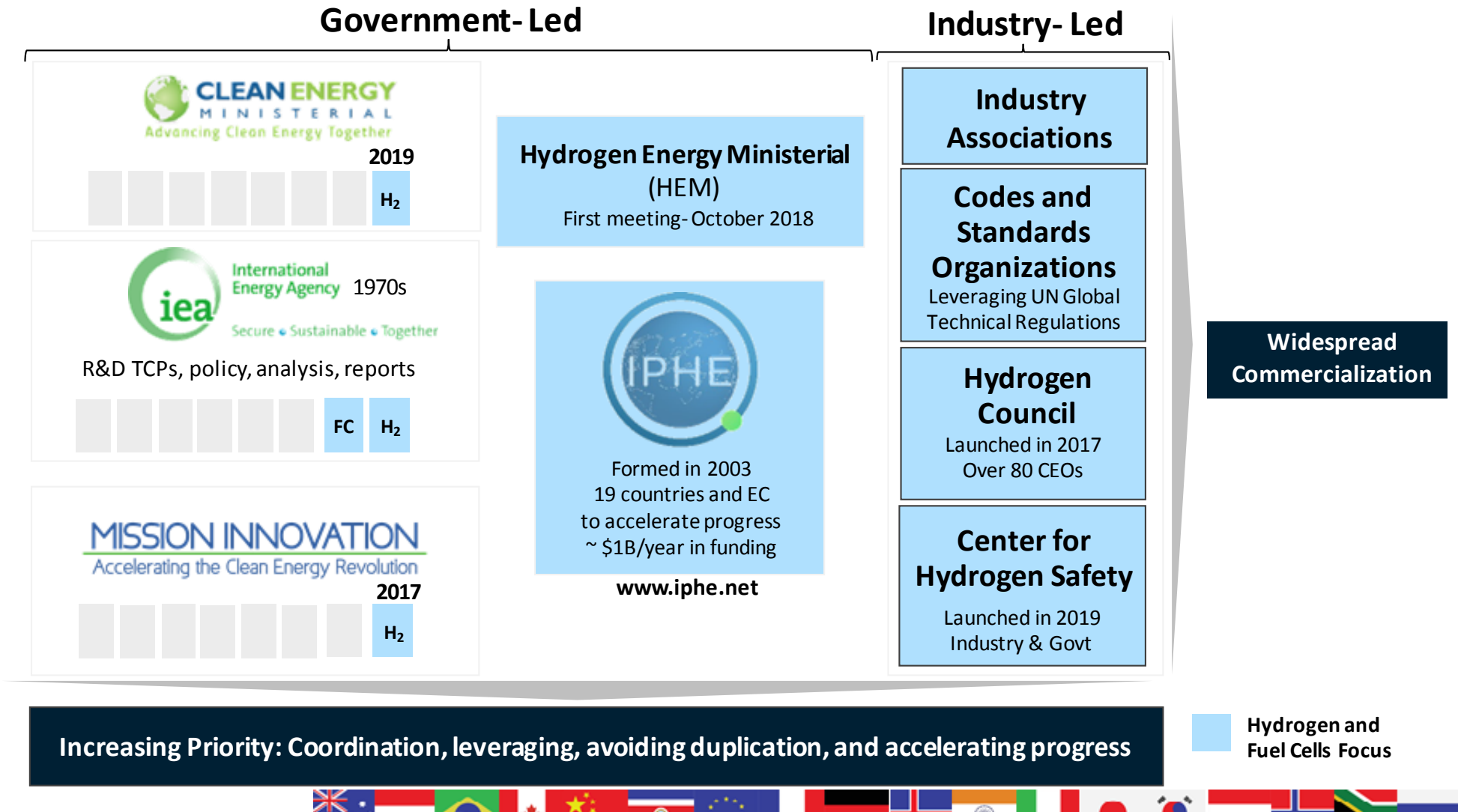
International Partnership for Hydrogen and Fuel Cells in the Economy

How IPHE is Fostering Global Hydrogen and Fuel Cells Collaboration

Tim Karlsson – Executive Director, IPHE Secretariat
Sunita Satyapal – IPHE Chair
Toshiyuki Shirai – IPHE Vice Chair

April 28, 2020

Strengthening coordination among global hydrogen initiatives and organizations – key examples for hydrogen



International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE)

Formed in 2003

Elected Chair and Vice-Chair, 2018

Past Chairs include Canada, Germany, Japan, France

Global Government Partnership to Accelerate Progress on Hydrogen and Fuel Cells

Enabling the adoption of hydrogen and fuel cells in the economy

- **Coordinates and shares information** among members and global and regional partnerships
- **Develops country updates** on initiatives, policies, status, shares best practices
- **Working Groups on** Regulations, Codes, Standards & Safety; Education & Outreach
- **Task Force on H_2 Production Analysis** methodology to facilitate international trade

19 Countries and EC

www.iphe.net

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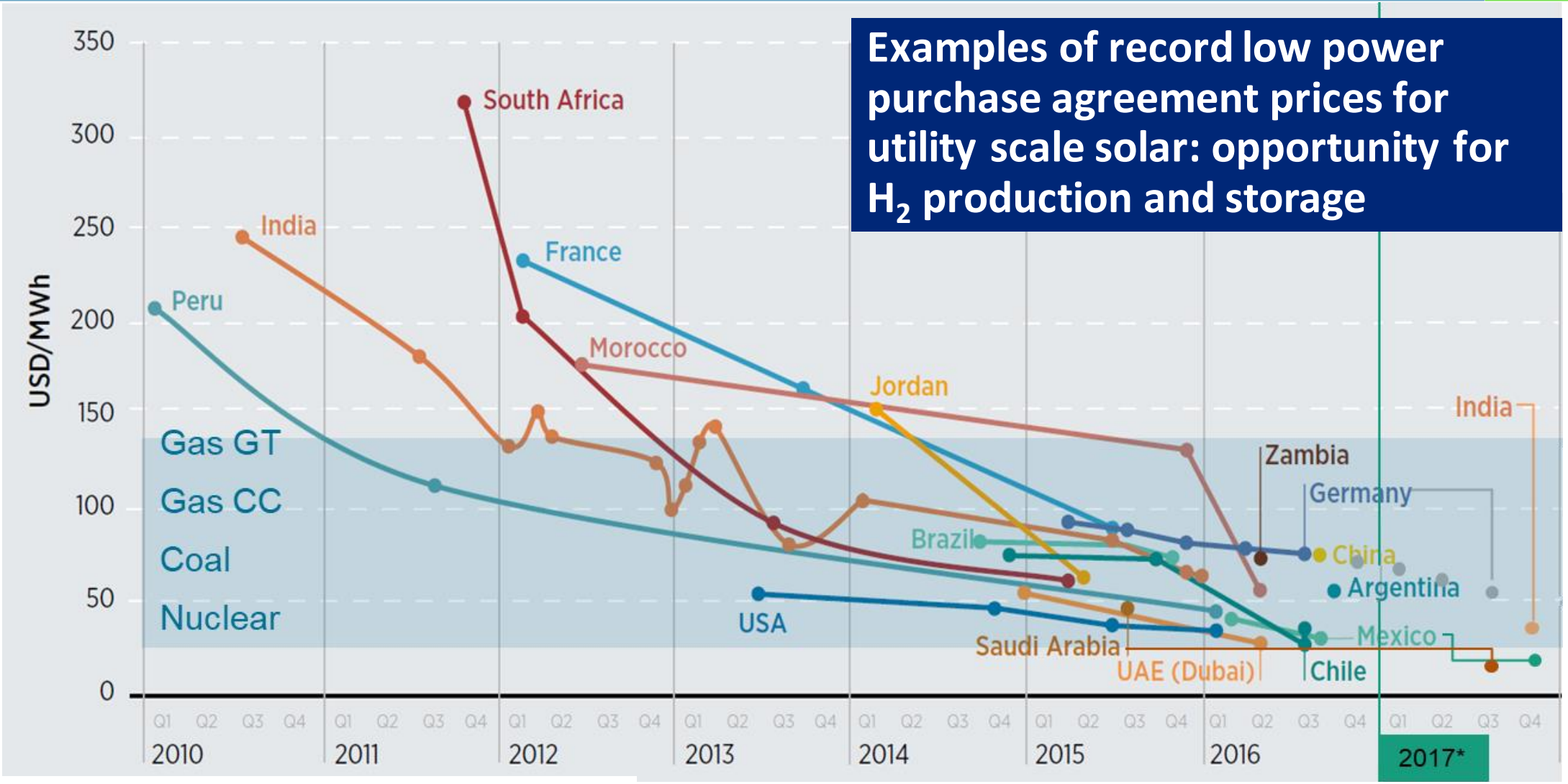
Key Drivers: Based on National Circumstances

- **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**
  - New Products and Supply Chains across Sectors
  - Skilled Jobs and Manufacturing Opportunities
  - Impact on Transportation (marine, rail, vehicles, trucks, air), Industry (e.g. steel, ammonia), Stationary power, and Energy Storage
- **Environmental Benefits**
  - Clean Air/Local Air Quality, Climate Change, Noise Pollution

What is different now?

Unprecedented Reduction in the Cost Of Solar PV

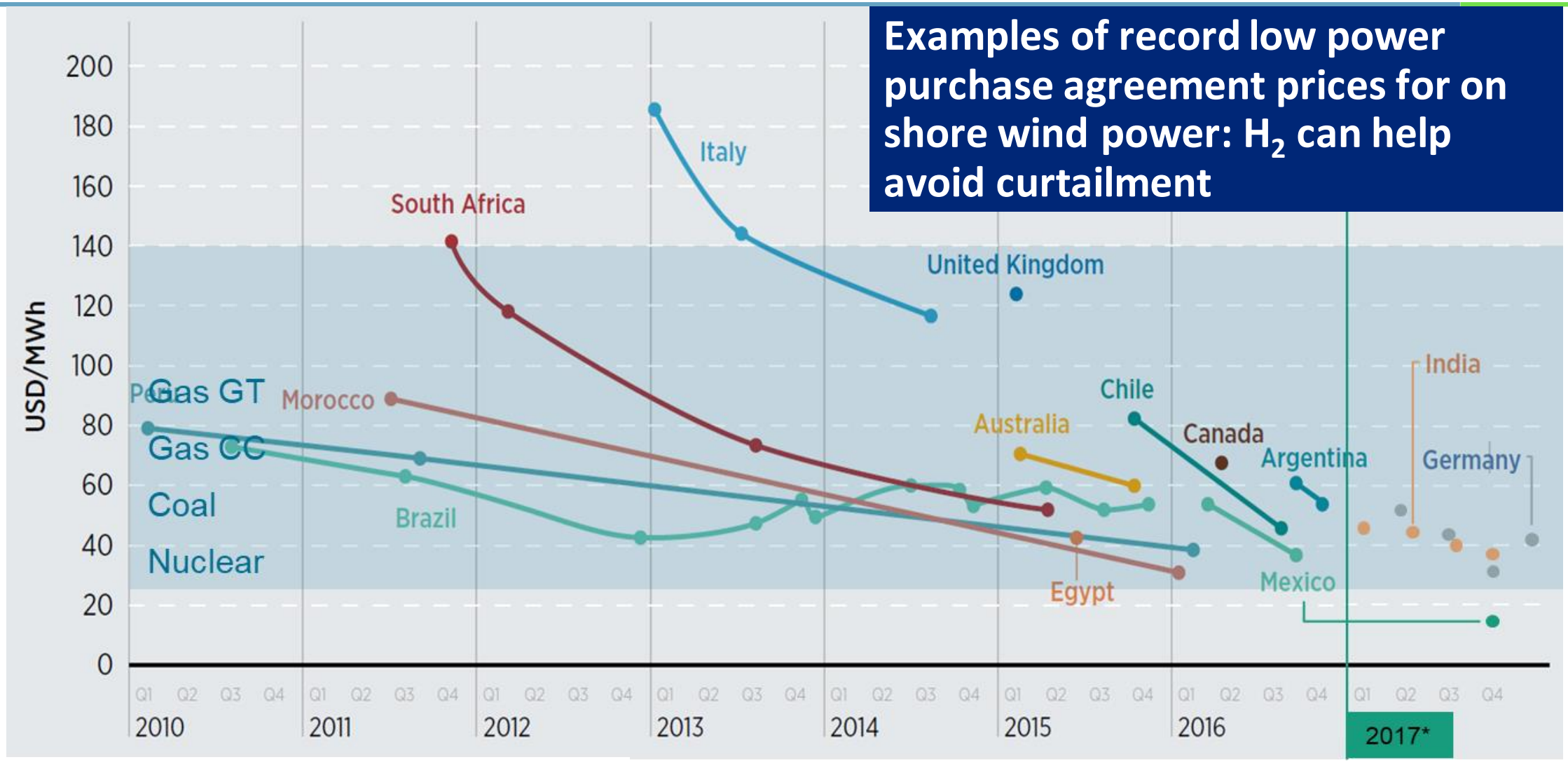


Source: Renewable Energy Auctions 2016, IRENA

Adapted from C Hebling, Fraunhofer

Unprecedented Reduction in the Cost Of Onshore Wind Power

Examples of record low power purchase agreement prices for on shore wind power: H_2 can help avoid curtailment

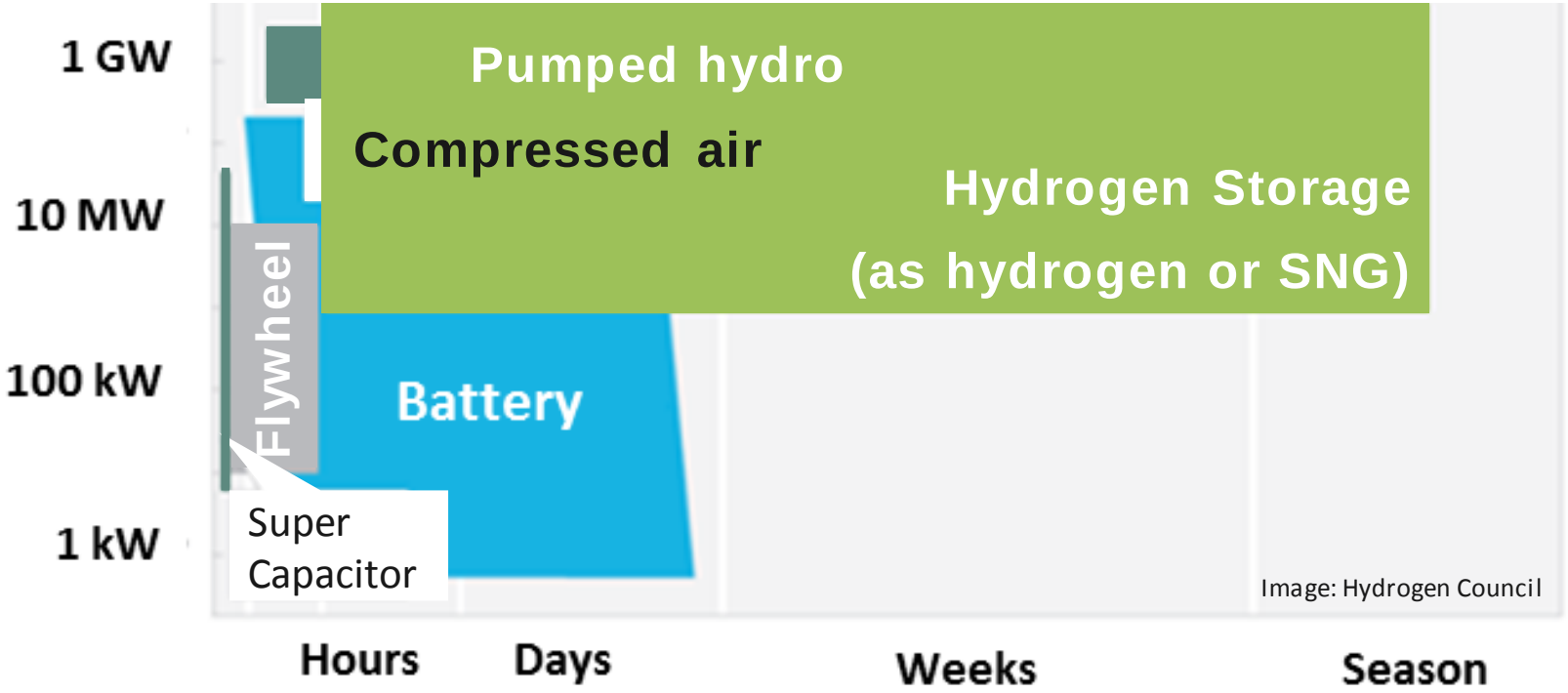


Source: Renewable Energy Auctions 2016, IRENA

Adapted from C Hebling, Fraunhofer

Hydrogen Can Enable Long Term Energy Storage and Grid Services

Overview of Energy Storage Technologies in Power and Time



One Hydrogen Cavern
Could Provide
~ 100 Gwh Energy Storage

Hydrogen can be used to monetize surplus electricity from the grid, or remote, off-grid energy feedstock (e.g. solar, wind) for days to months.

Commercial Hydrogen and Fuel Cell Technologies are now Available in Multiple Sectors of the Global Economy

Value Proposition? Examples of Hydrogen Projects Worldwide and Across Multiple Industries

Germany 2016: 6-MW wind-to-H2 plant using electrolyzers commissioned

Austria 2017: 6-MW electrolyzer for steel plant

Japan 2019: World's first liquid hydrogen carrier to ship hydrogen Australia's south coast to Kobe

New applications underway: Rail, marine, aviation, energy storage, industry (steel, ammonia), heating

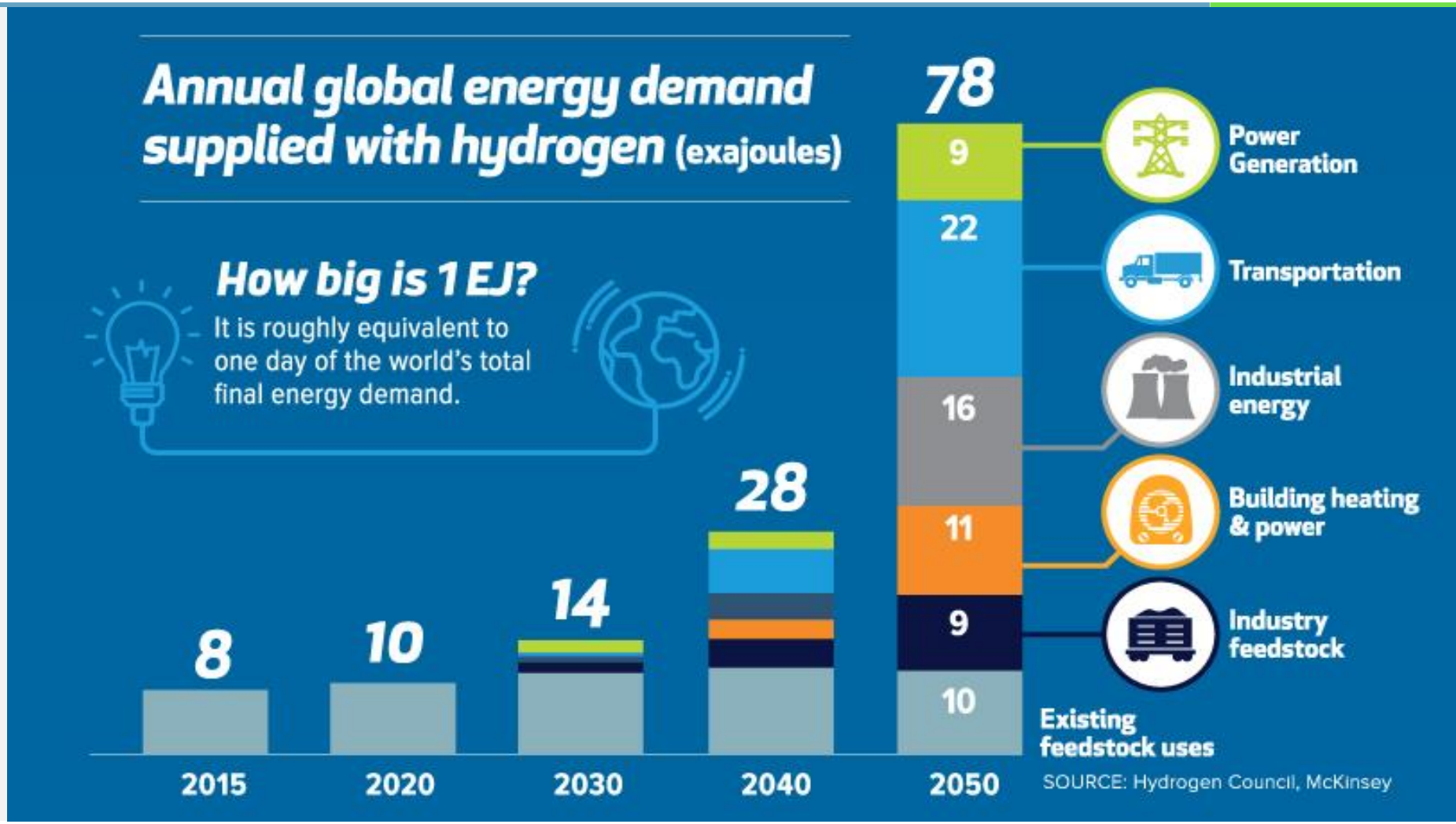
60-MW fuel cell park in South Korea- world's largest!

Netherlands 2020: NortH2 project to develop 10 GW wind-to-H2

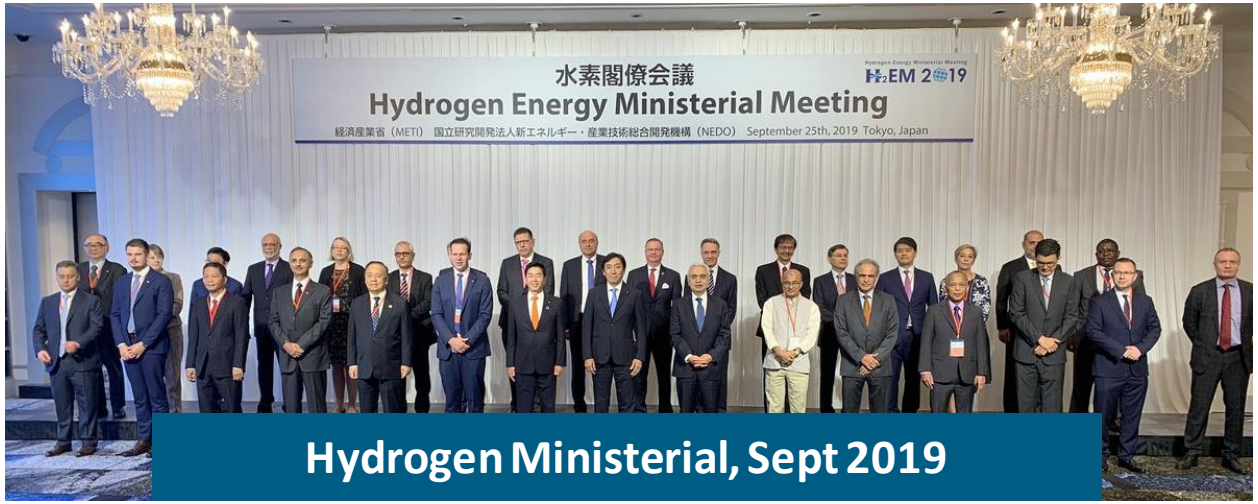
World's largest salt cavern for hydrogen storage commissioned in TX in 2017

Industry Estimates for Hydrogen Global Demand

Potential for **10-fold increase** in hydrogen demand by 2050



Hydrogen: A Discussion Topic in Global Ministerial Roundtables and Engagements



Hydrogen Ministerial, Sept 2019

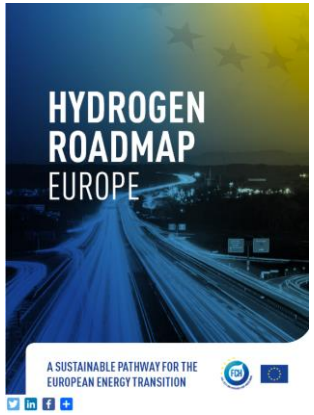
G20 Ministerial, June 2019

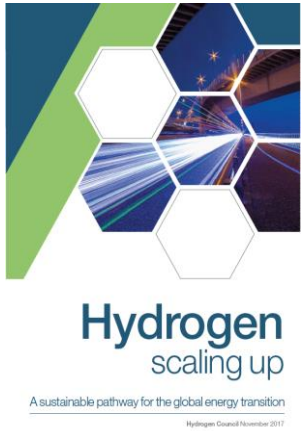
CEM, May 2019

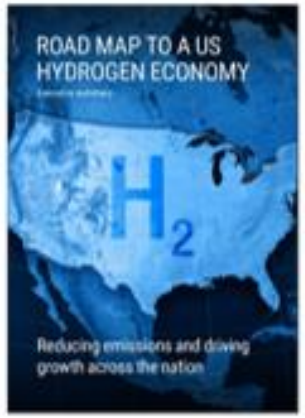
Hydrogen Ministerial, Oct 2018

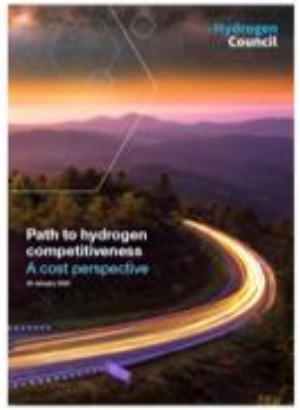
Unique National and Regional Circumstances Drives Actions

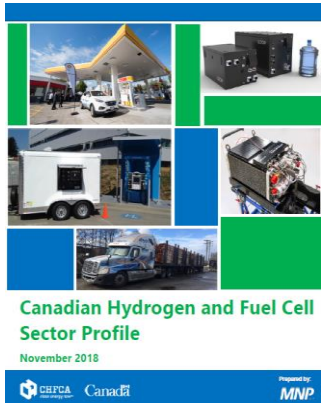
A Common Vision in Hydrogen Roadmaps Around the World

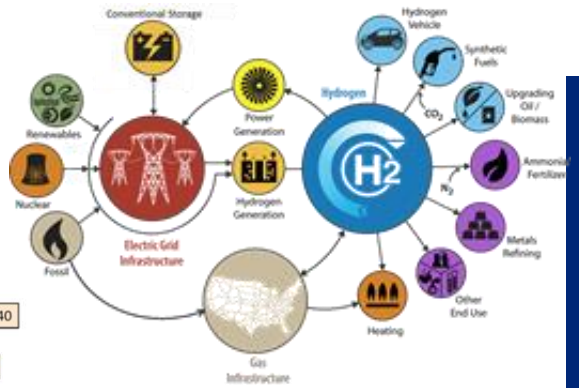












Global Action Agenda
Aspirational Targets:
"10, 10, 10"
10M systems,
10K stations, 10 years

Global Action Agenda (GAA) released at HEM on Oct 2019
Example of Priorities

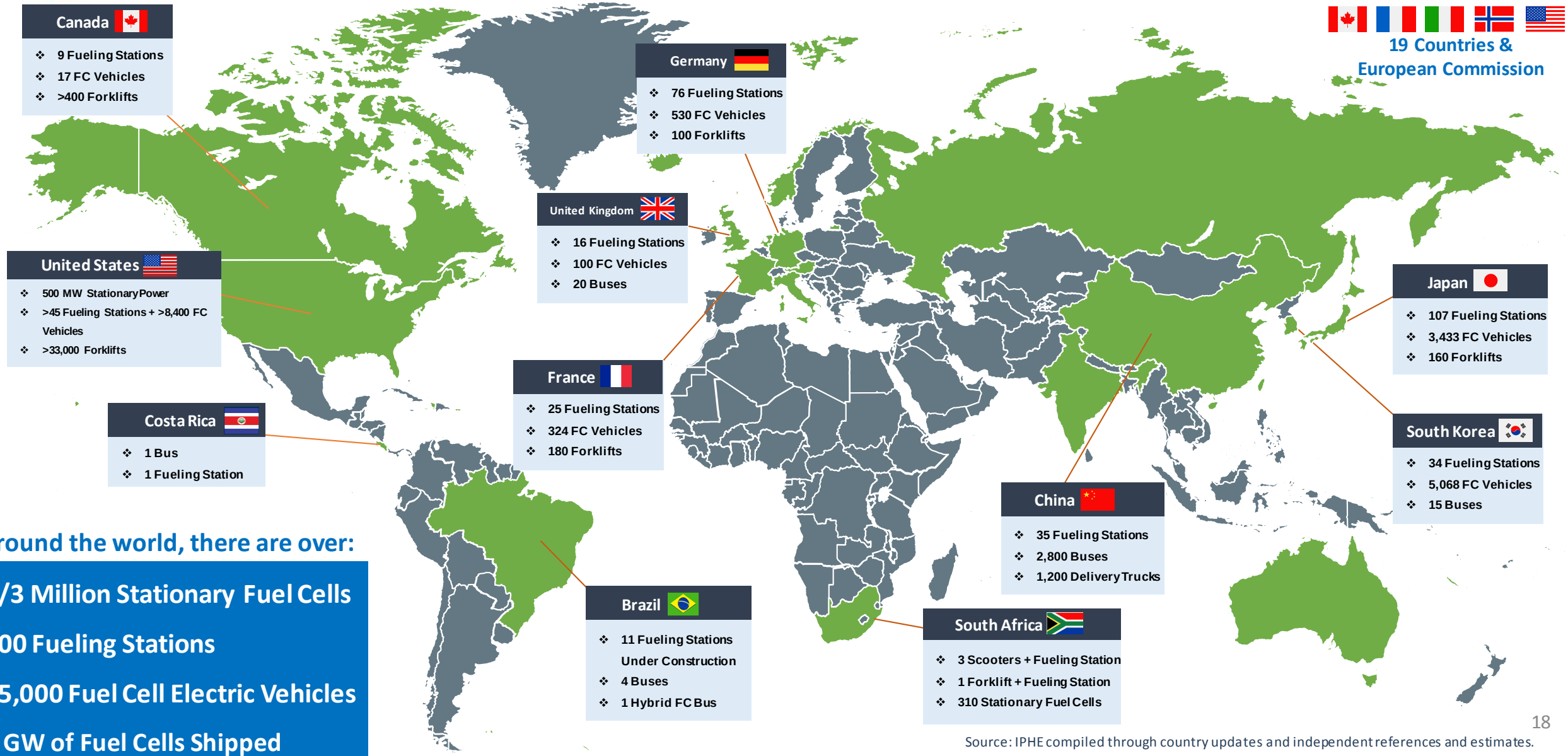
High Level Areas	Sub-areas
1. Across Mobility Applications	1.1 Mobility Infrastructure Development & Market Expansion 1.2 Harmonization of Regulations, Codes, and Standards (RCS) 1.3 Research & Development (R&D) for Next Gen FC Systems 1.4 Ensuring H2 Safety
2. Hydrogen Supply Chains	2.1 R&D and Sharing Information 2.2 Promote investment & demos as models for H2 deploy& scale up 2.3 Support the development of effective hydrogen trading markets
3. Sector Integration	3.1 R&D 3.2 Demonstration 3.3 Expand H2 Use in Various Sectors
4. Study & Evaluation of H2's Potential across Sectors Including Potential for Reducing CO2 & other Pollutants	4.1 Further analysis and study 4.2 Develop projection/scenarios on the demand for clean H2 4.3 Share experiences of relevant projects 4.4 Develop international standards for LCA
5. Communication, Education and Outreach	5.1 Disseminate info 5.2 Conduct outreach campaigns 5.3 Increase global awareness of the H2 5.4 Share info

IPHE Focus

The International Partnership for Hydrogen and Fuel Cells in the Economy

Enabling the global adoption of hydrogen and fuel cells

19 Countries & European Commission



Canada
- 9 Fueling Stations
- 17 FC Vehicles
- >400 Forklifts

United States
- 500 MW Stationary Power
- >45 Fueling Stations + >8,400 FC Vehicles
- >33,000 Forklifts

Costa Rica
- 1 Bus
- 1 Fueling Station

Germany
- 76 Fueling Stations
- 530 FC Vehicles
- 100 Forklifts

United Kingdom
- 16 Fueling Stations
- 100 FC Vehicles
- 20 Buses

France
- 25 Fueling Stations
- 324 FC Vehicles
- 180 Forklifts

Brazil
- 11 Fueling Stations Under Construction
- 4 Buses
- 1 Hybrid FC Bus

China
- 35 Fueling Stations
- 2,800 Buses
- 1,200 Delivery Trucks

South Africa
- 3 Scooters + Fueling Station
- 1 Forklift + Fueling Station
- 310 Stationary Fuel Cells

Japan
- 107 Fueling Stations
- 3,433 FC Vehicles
- 160 Forklifts

South Korea
- 34 Fueling Stations
- 5,068 FC Vehicles
- 15 Buses

Around the world, there are over:

1/3 Million Stationary Fuel Cells

400 Fueling Stations

15,000 Fuel Cell Electric Vehicles

1 GW of Fuel Cells Shipped

Source: IPHE compiled through country updates and independent references and estimates.

IPHE Activities and Accomplishments: Some Examples

IPHE Secretariat coordination across partnerships: Clean Energy Ministerial, Hydrogen Energy Ministerial, Hydrogen Council, Mission Innovation, IEA, IRENA, WEF, and more

Regulations, Codes, Standards, Safety

- ✓ **Developing Codes & Standards Compendium on gaps** for harmonization across multiple countries
- ✓ **Promoting safety information sharing, lessons learned, best practices through comprehensive engagement** (ICHS, Center for Hydrogen Safety, HySafe, Hydrogen Safety Panels (EU, US), HIAD, H2Tools, etc.)
- ✓ **Supported Research Priorities Workshop**
- ✓ **Supporting development of key reports (Tunnels, Research Priorities, etc.)**

Education and Outreach

- ✓ **Biennial update of country profiles on deployments, initiatives, policies, programs**
- ✓ **Policy forums and briefs for policy makers**
- ✓ **Newsletters and outreach through social media and web platforms reaching thousands**
- ✓ **Webinars on country updates available on web**
- ✓ **Student outreach and poster awards** at IPHE host countries
- ✓ **Student infographic competition worldwide** (launched on Earth Day 2020)
- ✓ **IPHE student/postdoc pilot fellowship program**

Hydrogen Production Analysis Task Force (H2PA TF)

Addressing Priority from Industry and Governments

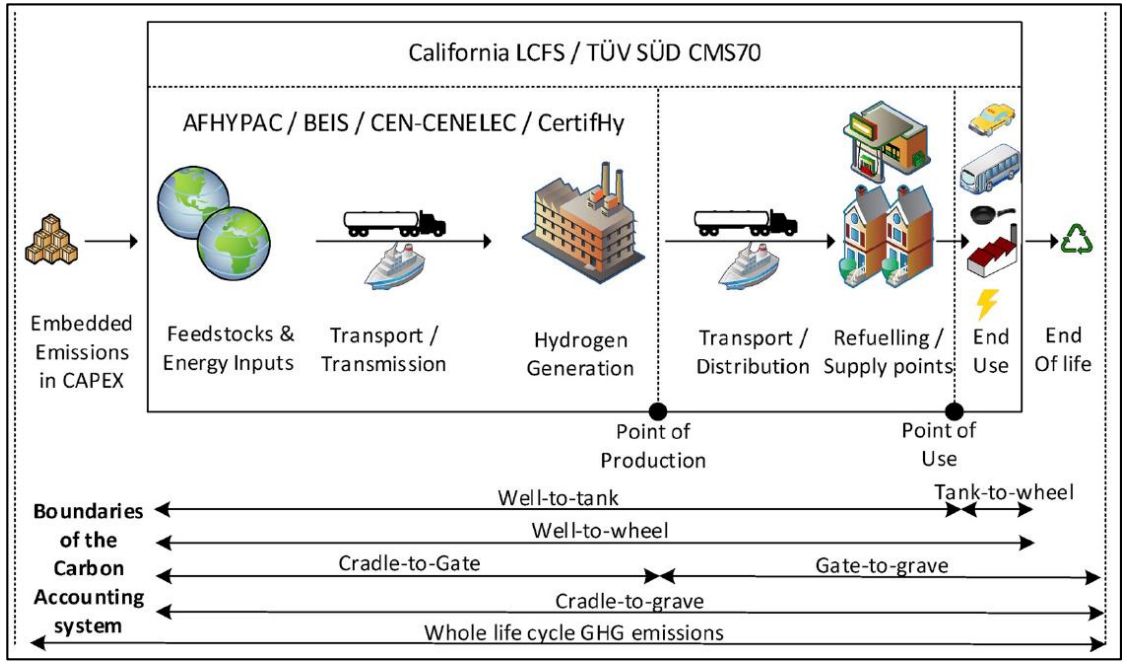
- Harmonize approach and develop framework to facilitate global trade of hydrogen

Scope

- Develop a mutually agreed upon analytical methodology for determining greenhouse gas (GHG) and other emissions associated with H2 production.

Next Steps and Engagement

- Engage key stakeholders, industry and experts to develop framework for methodology



(Source: Abad et al., Energy policy 138 (2020) 111300)

Application of methodology will help facilitate market valuation and global trade in 'clean' hydrogen by recommending a common approach with adoption not mandatory and subject to each member's discretion and circumstance.

20

Collaboration on Safety

IPHE Steering Committee action: Increase awareness of safety partnership.
Promotes safe operation, handling and use of hydrogen across all applications.

Includes over 40 partners from industry, government and academia

Access to >110 countries, 60,000 members

CENTER FOR Hydrogen SAFETY
Connecting a Global Community

HYDROGEN Safety Panel

HYDROGEN Emergency Response Training Resources

CENTER FOR 水素安全センター Hydrogen SAFETY
Connecting a Global Community

水素は、石油、風力、太陽光、その他のエネルギー資源から作られている。水素はエネルギーキャリアーとして注目されている。

化学工業 石油精製 電子工業 医薬品業界

年間7千万トン*

世界中では毎年7,000万トンの水素が産業用途として生産されている。

輸送分野の水素利用:

汚染物質、炭素排出量、騒音の削減手段として、トラックや船舶にゼロエミッションの燃料電池活用への関心が急速に高まっている。

60 輌 燃料電池電車

Fact Sheet Translated into Japanese

European Hydrogen Safety Panel

hySafe INTERNATIONAL ASSOCIATION FOR HYDROGEN SAFETY

www.aiche.org/CHS

Resources and How to Engage

Biannual IPHE Newsletter Released in March

Highlights and Updates

- **Country updates** for Brazil, Canada, China, Costa Rica, Europe, Germany, Japan, South Korea, Netherlands, South Africa, and the United States
- **Events**: IPHE Economy Forum with more than 200 attendees, Yonsei University Student Project event and student award event, IPHE delegates' tour of Korea Institute of Science and Technology's (KIST) Clean Energy Institute; IPHE visit to Korea Gas Safety test facility
- **Updates** from working groups

Find this and other newsletters at IPHE.net/newsletter

NEWSLETTERS

[October 2019 – March 2020 Newsletter]

[Read our Letter Celebrating Global Hydrogen and Fuel Cell Day]

Go to IPHE.net and Click on

Subscribe

Put on your Creative Hat and Participate in the IPHE Infographic Challenge

Opportunity to apply research and creative skills to share with others hydrogen and fuel cells information, connect with other students and professionals, be highlighted on IPHE social media and win a cash prize!

Who can Enter

- Students (secondary and university) ages 13-18 yrs. from IPHE member countries

Two Chances to Submit

- Entries due **July 31, 2020** - winners announced in late September
- **Entries due October 8, 2020** - winners announced in late November

Prizes

- $250.00 cash prize, t-shirts with IPHE logo, and certificates of recognition
- Prizes available for runner up (t-shirt and certificate)
- Opportunity to get your work highlighted on IPHE social media

Active on Linkedin? Join the IPHE Youth Group for updates about the #IPHEInfographicChallenge

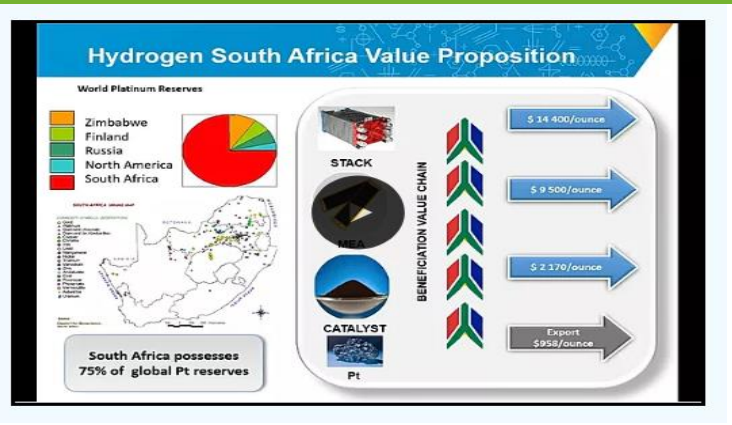
Submit your entry by July 31 to **media@iphe.net**
Learn more **IPHE.net/challenge**

Ways to Engage with the IPHE

Visit Our Website at IPHE.net

Learn About Our Work

Watch Our Webinars



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International Partnership for Hydrogen and Fuel Cells in the Economy

Acknowledgements

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