# Regional Insights on National Hydrogen Strategies


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# Power Technology Research Inc.

**Founded in 2016**

Owned and operated by researchers, analysts, and power engineers

**Objective:**

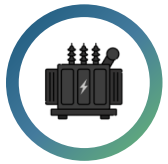
To understand the recent and upcoming changes to our electric infrastructure while identifying and communicating the best technologies and associated business models applied by industry leaders.

**COVERAGE**

**Power Grid**

**New Energy**

# Specialized Power Grid & New Energy Market Research



**Transformers**
(Dist., Power)

**Substation Automation**
(Dist. vs Cent.)

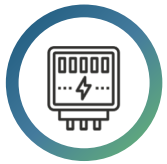
**EV Charging Infrastructure**
(Public, Private, Passenger/Comm.)

**Switchgear**
(HV, MV)

**Port Electrification**
(Shore-to-Ship, Microgrid)

**Energy Storage Value Chain**
(Utility Scale, C&I)

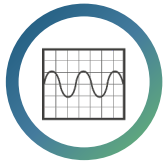
**Flexible AC Trans. Systems**
(SVCs, STATCOMs)



**Smart Meters**
(Power Quality, AMI)


**Hydrogen in Power Sector**
(Tech., Demand, Value Chain)

**HVDC Market Analysis**
(VSC, LCC, Cables)



**Power Factor Correction**
(Active, Passive)

**AI in Power Grid**
(Projects, Corp. Strategy, Policy )

**Synchronous Condensers**
(4-Pole, 6-Pole,...)

**Grid Communication**
(Private LTE, 5G)

**Impact of EVs on Power Grid**
(Quantitative, Trafo., Switchgear)

**Industrial Motors & Drives**
(MV/LV - Custom)

**Comm. & Off-Highway Vehicles**
(BEVs, PHEVs, ICEs)

# Agenda

1. **Introduction**
2. **Global Overview**
3. **APAC** – The Epicenter of Hydrogen Movement
4. **Africa** – Huge Potential, Little Infrastructure
5. **Europe** – Leading the Clean Energy Transition
6. **Middle East** – Setting Foot in a Decarbonized World
7. **Americas** – Increasing Self Sufficiency & Regional Coopoeration
8. **Q&A**

# Hydrogen: A Promising fuel for the Future

***Hydrogen is a versatile fuel which presents untapped potential as a clean energy source as it can be produced from different energy sources.***

## Hydrogen as an Energy Vector. Why Now?

**Most Abundant and Naturally Occurring Element**


**Essential in Achieving Net-Zero Emissions**

**Widespread Applications in Power Generation, Mobility, Ammonia, Methanol, Iron & steel Industries**

**Hydrogen**

**A potential game changer for global emission reductions**

## Challenges with Hydrogen as a Clean Fuel

**Green Hydrogen Production is a costly method**

**Low Volumetric Density**

**To overcome the challenges associated with hydrogen and to better utilize this clean energy source, leaders around the globe have come up with policy frameworks termed as "National Hydrogen Strategies" to promote the development and adoption of hydrogen.**

# Hydrogen: A Promising fuel for the Future

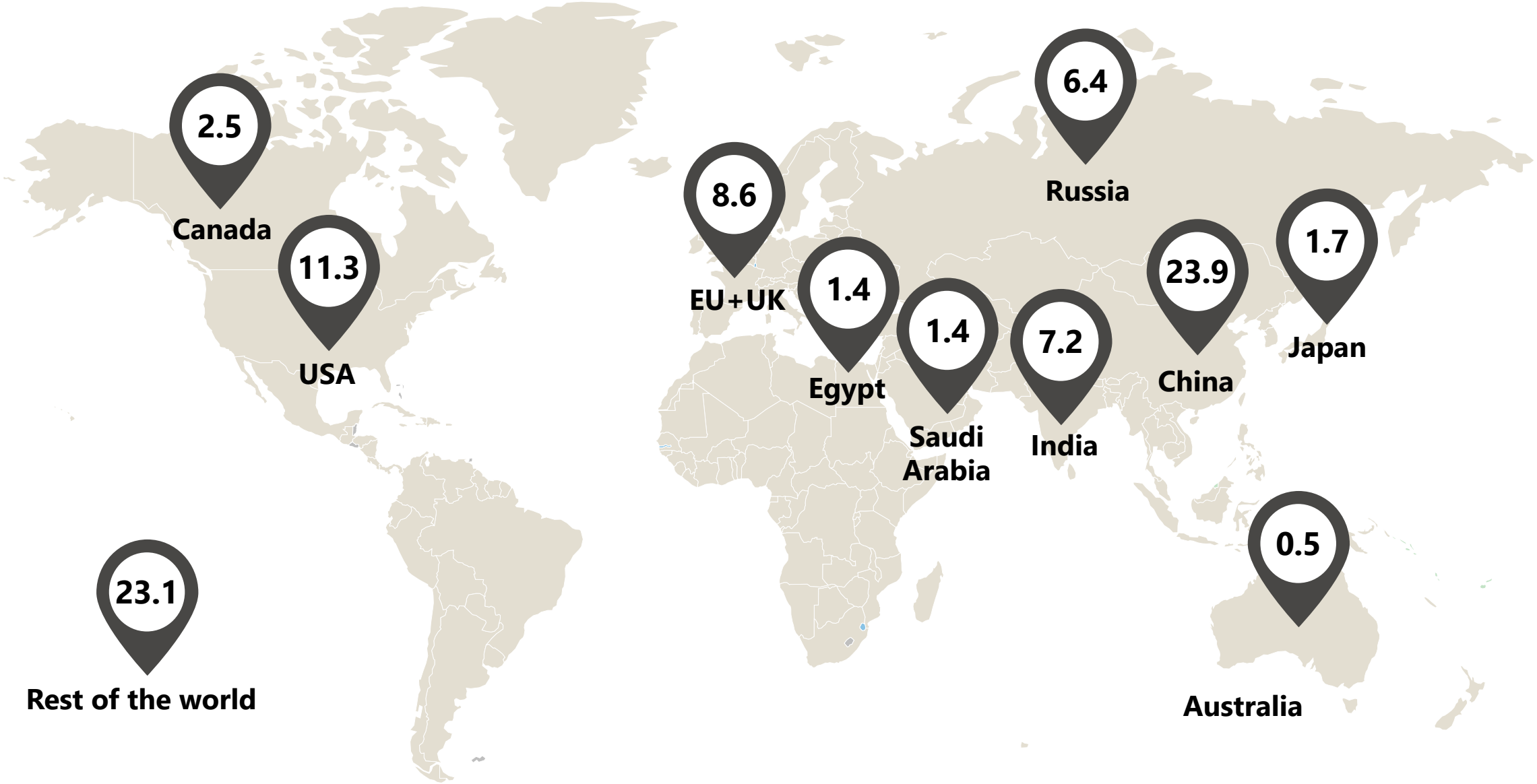
## What are the key factors that enables the development of National Hydrogen Strategies?

- Decarbonization
- Fostering Economic Growth
- Integration of renewable energy
- Energy Security especially after Russia-Ukraine Crisis

## Key tools within strategies to establish hydrogen economy

- Direct Financial Support
- Financial Incentives (Subsidies & Tax Policies)
- Public Private Partnerships (PPPs)

# Global Hydrogen Consumption - 2020




Consumption Unit: Million tonnes/year

Source: IEA, Statista

# National Hydrogen Strategies: A Global Overview

**USA**
- **Bipartisan Infrastructure Law ($9.5 B):** R&D & Hydrogen hubs
- US Inflation Reduction Act: $3/kg in tax credits for low-carbon hydrogen production

**France**
- NHS 2020: 1-10 MW of Power to Gas Installations by 2023 and 6.5 GW of electrolyzer capacity by 2030.

**Netherlands**
- Government Strategy on Hydrogen 2020: 500 MW of electrolyzer capacity by 2025 and 3-4 GW of electrolyzer capacity by 2030.

**Japan**
- Japan Basic Hydrogen Strategy 2017: 3 million t/year hydrogen production by 2030 and 20 million t/y hydrogen production by 2050
- 5.3 million residential fuel cells and 900 HRS with around 800k FCEV

**UK**
- UK NHS revised targets 2022: 2 GW low carbon hydrogen production by 2025 & 10 GW by 2030 out of this 10 GW 5 GW will be entirely green hydrogen.

**South Korea**
- Hydrogen Economy Roadmap 2019: expands consumption from 130k tons at present to 5.26 Mt by 2040
- 6.2 million FCEV and 1200 HRS by 2040.

**China**
- No hydrogen strategy in place however 16 provinces and cities have published 5-year plans that feature hydrogen
- 2021-2035 China long term plan for hydrogen: Green hydrogen production in the range of 100k-200k tonnes by 2025

**Chile**
- **Hydrogen strategy** targets cheapest hydrogen production $1.5/kg
- Install 25 GW electrolysis capacity by 2030

**Spain**
- **Spanish Hydrogen Roadmap 2020** targets installation of 300-600 MW electrolyzer plants by 2024
- Installation of 4 GW electrolyzer plants

**Germany**
- **NHS 2020: 5GW by 2030**
- **Till 2023 Phase-1,** Start market ramp-up, Harness opportunities & **by 2030 Phase-2,** Strengthen market ramp-up Nationally & Internationally

**Australia**
- **Target hydrogen production cost to fall below 2 AUD/kg**
- Become one of the largest global hydrogen suppliers

**24** National hydrogen strategies available

**26** National hydrogen strategies in preparation

**35** National hydrogen strategies in initial policy discussions phase

# APAC

Asia-Pacific

# Asia-Pacific: The Epicenter of Hydrogen Movement

*Overview*

## Tremendous Potential to Produce Low-Carbon Hydrogen:

**Australia has the greatest hydrogen production potential from low-rank coal and renewables especially solar.**

**65 PJ** Malaysia has the highest hydrogen production potential from flared gas

**2,901 PJ** China has the greatest hydrogen production potential from hydropower

**Renewable energy accounts for 20% of Asia's total energy generation**

## Market Opportunities

- Iron & Steel Industry
- Ammonia & Methanol
- Mobility
- Refineries
- Power Generation
- Heating

**China**

**World's largest producer and consumer of hydrogen**

**South Korea, China and Japan among top 4 largest markets for FCEVs globally**

## Key Challenges

- High Cost of Production
- Developing new infrastructure
- Lack of clear application priorities

# APAC's Vision of a Hydrogen Future

***According to PTR, the pioneer of hydrogen strategies, Japan, and the surging renewable hub, Australia, are the most notable countries in terms of hydrogen development in the Asian continent.***

## Japan: First country around the globe to publish a national hydrogen strategy in 2017

Power generation using hydrogen at ¥ 17/kWh

**2030**

3 million t/y hydrogen production

26% GHG emission reduction

**2050**

20 million t/y hydrogen production

80% GHG emission reduction

**800,000** FCEVs

**10,000** Forklifts

**1,200** FC Buses

**900** HRS

## Key Players

Australia, Japan, China, India, New Zealand, South Korea, Singapore

## Australia: To become a Hydrogen Powerhouse by 2030

- To become one of the top 3 exporters of hydrogen to the Asian markets.
- Investment of 1.3 billion AUD committed.
- To bring the cost of clean hydrogen below $2/kg.

11% of Australia is suitable for renewable H2 production

# Africa

# Africa: Huge Potential, Little Infrastructure

*Overview*

60% of world's best solar resources

**Tremendous Potential to Produce Low-Carbon Hydrogen:**

| | | | | | |
|---|---|---|---|---|---|
| **10** | TW Solar | **110** | GW Wind | **148.6** | Trillion m3 of gas reserves |
| **10** | GW Geothermal | **350** | GW Hydropower | **7%** | Of global gas reserves |

## Market Opportunities

- Ammonia Production
- Methanol
- Refineries
- Export to EU

## Key Challenges

- Lack of Infrastructure
- Lack of Skilled Workforce
- Availability of Capital for Investments

## Mali

1st country in the world to produce electricity from natural hydrogen

# African Hydrogen Game Plan

***According to PTR, the early mover, Morocco, and the emerging player, Egypt, are the most notable countries in terms of hydrogen development in the African continent.***

## Morocco's Green Hydrogen Roadmap – Vision 2050

**2030**

8 GW Electrolyzer Capacity
1 Mt $CO_2e$ emission reduction

**2040**

37 GW Electrolyzer Capacity
6 Mt $CO_2e$ emission reduction

**2040**

78 GW Electrolyzer Capacity
11 Mt $CO_2e$ emission reduction

**10** kt/y hydrogen production starting from 2025

**4** % of Global Green Hydrogen Demand Fulfilment by 2030

Morocco's installed renewable capacity: 3950 MW

**Key Players**

Morocco, South Africa, Namibia, Egypt, Mauritania, Kenya

## Egypt: An Emerging Player in the Continent

- The Egyptian Government is expected to announce a $40 billion hydrogen strategy this year.
- The strategy aims to develop a production capacity of 1,400 MW by 2030.
- 1 GW LOHC Hub is also planned at Egypt's East Port.

5 green hydrogen projects are under development in Egypt

# Europe and Middle East

# Europe Leading the Clean Energy Transition

***According to PTR, Europe is leading the Green Revolution with a great number of projects under development, a huge investment plan and several published strategies.***

## EU-27 Hydrogen Strategy for a Climate Neutral Europe


**To boost clean hydrogen production in Europe**

**60 million tonnes H2 demand in Europe by 2050**

**2024**

**6 GW electrolysis capacity**

**1 million tonnes of renewable hydrogen**

**2030**

**40 GW electrolysis capacity**

**10 million tonnes of renewable hydrogen**

**2030 onwards: To deploy renewable hydrogen at a large scale across all hard-to-abate sectors**

## Key Players

**Germany, Netherlands, Hungary, Portugal, France, Spain, Slovakia, Denmark**

## RePower EU Plan

**10** million tonnes of domestic renewable hydrogen production by 2030

**10** million tonnes of renewable hydrogen imports by 2030

## European Hydrogen Backbone Initiative

**€80-143 bn investment in H2 infrastructure by 2040**

**5** Pan-European H2 Supply & Import Corridors

**53,000** km H2 pipeline by 2040

# UK's Ambition for a Thriving Hydrogen Economy

***Hydrogen is a promising solution for the UK to achieve its world-leading emission reduction targets for Carbon Budget Six (CB6) and net zero by 2050.***

## United Kingdom seizing the hydrogen opportunity

**41 Mt CO2e emission reduction**

**10** GW of low-carbon hydrogen production target

**50** % hydrogen production from renewables and the rest from other sources

**55** Euros million investment to convert industrial machinery to run on hydrogen

**40** Euros million investment to convert heavy machinery to run on hydrogen

**20** % hydrogen injection in natural gas networks

**H2 Teesside:** UK's largest blue hydrogen production facility to produce 1 GW H2 by 2030

## Key Challenges

- High Cost of Clean H2
- Lack of Infrastructure
- Green hydrogen production unproven at scale
- Policy and regulatory uncertainty

# Middle East Setting Foot in a Decarbonized World

***Although the Middle Eastern region does not have a published national hydrogen strategy yet, there is a huge potential for clean hydrogen production in the region with Saudi Arabia and the UAE leading the hydrogen movement in the region.***

## Saudi Arabia: To become the top supplier of hydrogen in the world

**2.9** million tons of clean hydrogen production by 2030

**4** million tons of clean hydrogen production by 2035

**36** billion USD investment envisioned

Focused on gaining a large market share in blue hydrogen

Hydrogen usage in mobility under exploration

World's largest renewable hydrogen-to-ammonia facility

### Neom Hydrogen Project

4 GW renewable capacity
1.2 million tons hydrogen/year

### Dubai's Mohammed bin Rashid Al-Maktoum Solar Park

Country's 1st green hydrogen project: 1.2 MW pilot facility was commissioned in 2021

## United Arab Emirates: To conquer 25% of the global low-carbon hydrogen market by 2030

**500,000** million tons/year hydrogen production envisioned

To establish the country as a leading hydrogen exporter

Targeted markets:
Germany, Japan, South Korea

1st Middle Eastern country to commit to a net-zero emissions target

# Americas

North and South America

# Americas: Increasing Self-Sufficiency & Regional Cooperation

*Overview*

## Tremendous Potential to Produce Low-Carbon Hydrogen:

**678** Mt of Green Hydrogen Production Potential in USA

**1800+** GW of renewable energy potential in Chile

**670** MW potential of electrolysis capacity by 2030 in Mexico with the right policies

## Market Opportunities

- Iron & Steel Industry
- Petrochemical
- Mobility
- Refineries
- Export
- Agriculture

Chile's Hydrogen Green, H2V CAP and Antofagasta Mining Energy Renewable Projects expected to double the current global electrolysis capacity

## Key Challenges

- Legal uncertainties
- Lack of a clear regulatory framework
- Domestic transport of hydrogen

**USA, Canada**

Leading blue hydrogen production with more than 80% of global production capacity

# American Hydrogen Roadmap

***According to PTR, Chile and USA are the most notable countries in terms of hydrogen development in the North and South American continents.***

## Key Players

Chile, Canada, Colombia, USA, Uruguay, Mexico

By 2030,13.5 GW green H2 projects to be online

**111 Goal:** Cost of clean hydrogen to be $1 per 1 kg in 1 decade

## Chile: A clean energy provider for a carbon neutral planet

**2025**

5 GW electrolysis capacity

200 k tonnes hydrogen production/year in 2 hydrogen valleys

**2030**

25 GW electrolysis capacity

Provide the cheapest green hydrogen on the planet at <1.5 USD/kg

**5** Billion USD investment

**2.5** Billion USD/year export of hydrogen

Targeted Market: To lead in green hydrogen production and hydrogen export

## United States of America

USA has an installed electrolysis capacity of 17 MW whereas 1.4 GW of projects are in the pipeline.

**8** billion USD allocated for Regional Clean Hydrogen Hubs.

**1** billion USD allocated for H2 Electrolysis Program

**500** million USD allocated for Clean H2 Manufacturing & Recycling

# Audience Q&A

## PTR's Hydrogen Market Intelligence

Research on the use of Hydrogen as an energy transition fuel around the world

### Global Hydrogen Projects Database

- This is a database style service containing over 700 Hydrogen projects. The database includes project specific information of Hydrogen projects delivered around the globe. Additionally, announced projects are added into the database which gives an overview of Hydrogen pipeline globally.

### National Hydrogen Strategies Analysis

- The NHS database consists of a detailed description of the published hydrogen strategies of 21 countries. These countries have been segregated into three regions: Americas, APAC and EMEA. Key points have been extracted from these strategies that include the targeted hydrogen type and sectors, the defined goals and the pillars of action on which these strategies are based.

### Hydrogen Value Chain Analysis Report

- This report covers global analysis of hydrogen market through its entire value chain. It gives a comparative overview of different hydrogen production technologies and green hydrogen production cost comparison in different regions across the globe.

Scan me!

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