

Global Trends in Clean H₂ Production & Utilization: Strategies for Supply-Demand Matching

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Global Water Electrolysis Demonstration Trends

As of end of 2025, global water electrolysis operational capacity is 4.1 GW, with 5.2–6.3 GW under construction

Operational Capacity — Total 4.1 GW		
Region	Capacity (GW)	Share
China	2.8~3.0	~70%
Europe	0.50~0.60	13~14%
Japan	0.04~0.06	~1%
Korea	0.03~0.05	~1%
Middle East	0.02~0.04	<1%
Africa	0.02~0.04	<1%
North America	0.25~0.30	6~7%
Australia/NZ	0.07~0.10	~2%
SE Asia+India	0.15~0.20	~4%
South America	0.07~0.10	~2%
World Total	≈ 4.1 GW	100%



*Under Construction: projects where EPC, civil works, and electrolyzer installation are actively underway on-site.

FID-only or not-yet-broken-ground projects are excluded, as are ammonia/alkaline electrolyzers and planning/MOU/FEED-stage projects.

Under Construction Capacity* — Total 5.2~6.3 GW		
Region	Capacity (GW)	Share
China	0.5~0.8	8~13%
Europe	1.8~2.0	28~32%
Japan	0.01~0.03	<1%
Korea	0.03~0.05	~1%
Middle East	2.2~2.3	35~40%
Africa	<0.1	<1%
North America	0.2~0.3	3~6%
Australia/NZ	0.05~0.15	1~2%
SE Asia+India	0.3~0.5	5~9%
South America	0.05~0.10	1~2%
World Total	≈ 5.2~6.3 GW	100%



Key Points

- End-'25 global operational WE capacity: ~4.1 GW, with China at ~70%
- Under-construction capacity: ~5.2~6.3 GW, led by EU & ME (NEOM 2.2 GW)
- From '26, the global market is expected to expand significantly

Source; IEA Hydrogen Projects Database, 2026.

WE Demonstration Trends_China

As of 2026, 2.8 GW of WE is operational in China, with 7.8 GW under construction; over 80% Alkaline WE, over 65% linked to solar power

Project	Capacity (Type)	Features
Envision Chifeng Green H2 & Ammonia	500 MW (ALK)	Trial run in '24, normal operation from '25, World's largest scale, wind/solar power 320,000 tons/year of Green NH3 production, offtake agreement with Marubeni
Sinopec Kuqa Green H2 Project	260 MW (ALK)	Resolved operational stability and load-fluctuation issues in '23–'25, now operating Solar power, Green H2 production for refining process
Shenneng Otog Banner project	240 MW (ALK)	Operational from '26, wind/solar power 100,000 tons/year of Green NH3 production
China Energy Engineering Group Songyuan Phase I	320 MW (ALK)	Phase 1 operational in '25, integrated Green H2/NH3/MeOH project CMB.Tech mentioned as Green NH3 offtaker
Datang Duolun Coal-to-Chemicals + Green Hydrogen	70 MW (ALK)	150 MW wind/solar power, 6,400 tons/year H2 production Green H2 integrated into coal chemical process

WE Demonstration_China



Envision Energy 500 MW WE Plant

World's largest scale, Chifeng, Inner Mongolia, China

320,000 tons/year of Green NH₃ produced from Green H₂

Green NH₃ exports to Korea and Japan starting '26

<https://www.hydrogeninsight.com/production/pepsico-buys-certificates-from-world-s-largest-green-hydrogen-and-ammonia-project-to-claim-avoided-emissions/2-1-2023313>

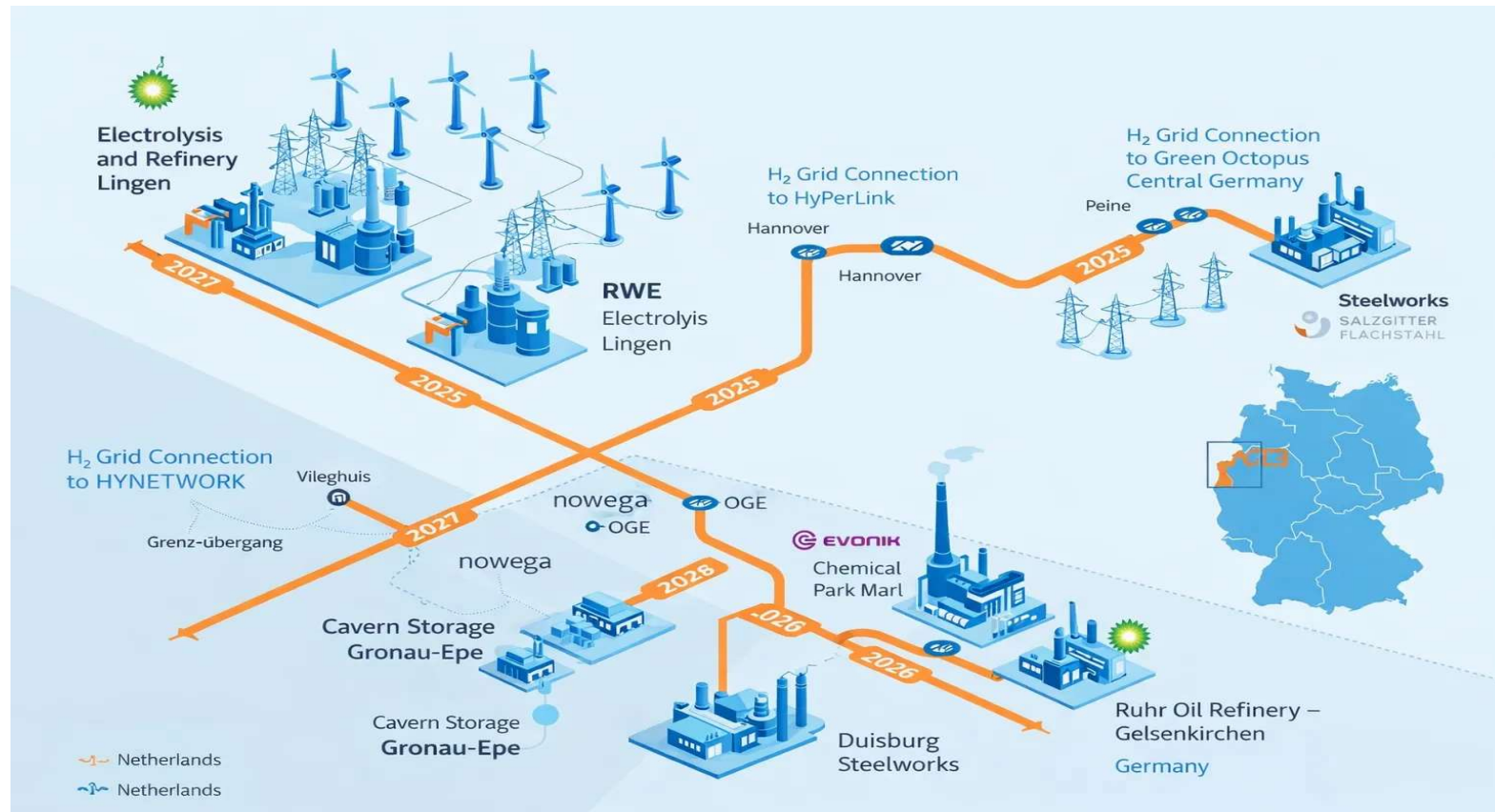
WE Demonstration Trends_Europe/US

As of 2025, 1 GW of water electrolysis is operational, with 2.8 GW under construction

Country	Project	Capacity (Type)	Features
Netherlands	Shell Holland H2 I	200 MW (PEM)	Targeting operation in '26, offshore wind power Rotterdam Maasvlakte. For Pernis refining process
Netherlands	Air Liquide ELYgator, Maasvlakte	200 MW (PEM)	Targeting operation in '27. 23,000 tons/year H2, supplied to industrial/heavy-duty mobility and TotalEnergies' Antwerp platform
Germany	RWE GET H2 Nukleus, Lingen	100 → 300 MW (PEM+ALK)	100 MW operational in '26. 300 MW target for '27. wind power 120 km pipeline to Evonik's Marl chemical complex, salt-cavern storage
Germany	VNG Bad Lauchstädt Energy Park	30 MW (PEM)	Trial run in Q3 '25, wind power Supplies Leuna chemical/refining complex. 2,700 tons/year H2 production
Germany	Hamburg Green H2 Hub, Moorburg	100 MW (PEM)	Targeting operation in '27, wind power, 10,000 tons/year H2 Converts former coal-fired power plant site, supplies Hamburg steel/chemical complex
France	Air Liquide Normand'Hy	200 MW (PEM)	Targeting operation in '26, Port-Jérôme Decarbonization of Normandy industrial complex
Sweden	Stegra Boden Green Steel	700 MW (ALK+PEM)	Targeting operation in '27, clean power 2.5 million tons/year steel production, Europe's largest green steel project
Denmark	Kassø e-Methanol	52~52.5 MW (PEM)	Operational in '25, solar power 42,000 tons/year e-MeOH production, customers including Maersk & Lego
Austria	OMV Schwechat Green H2 Plant	10 MW (PEM)	Operational in '25, renewable energy power, 1,500 tons/year H2 production Austria's largest Green H2 plant, decarbonizing refining process
US	ACES Delta, Utah	220 MW (ALK)	Operational in '26, wind/solar power, salt-cavern storage Utilizing 30% H2 co-firing gas turbine power generation

WE Demonstration_Germany

Germany's RWE GET H2 Nukleus, Lingen project



https://www.valveworldexpo.com/en/Media_News/News/Topics/GET_H2_Nucleus_Hydrogen_for_the_chemical_industry

WE Demonstration_US

ACES Delta, Utah 220 MW Water Electrolysis Plant



Operations began in Q2 '26, producing 100 tons/day H2
Long-duration storage of 9,000 tons of H2 in salt- caverns
30% H2 → 840 MW gas turbine power plant
Conversion to 100% H2-fired turbine power plant by '45

<https://decarbonfuse.com/posts/aces-delta-hits-220mw-milestone-in-utah>

WE Demonstration Trends_M.E., Japan, Asia, South America

Country	Project Name	Capacity (Type)	Features
Saudi Arabia	NEOM Green H2 Complex	2.2 GW (ALK)	Targeting operation in '27, 4 GW solar/wind power Green NH3 production, Air Products offtake
Oman	ACME Duqm Green Ammonia	300~320 MW (ALK)	Targeting operation in '27, Chinese electrolyzer equipment Green NH3 production, Yara offtake
Japan	Fukushima H2 Energy Research Field	10 MW (ALK)	Operational since Mar. '20, solar+grid power connection Electrolyzer by Asahi Kasei (Japan), used for research
Japan	Yamanashi Komekurayama P2G	2.3 MW (PEM)	Operational since June '26, solar power Japan's representative MW-class P2G demonstration case
Japan	Suntory Hakushu Green H2 Park	16 MW (PEM)	Production and use began in '25 Plant heat source, hydrogen boiler use
India	AM Green Kakinada	1.3 GW (ALK)	Targeting operation in '27, targeting 2 million tons/year of Green NH3; long-term offtake agreements including Uniper
Vietnam	Tra Vinh Green H2/ Ammonia	240 MW (ALK)	Trial run in '26, targeting commercial operation in '27 Linked to 600 MW-class renewable power and ESS Targeting 182,500 tons/year of Green NH3
Chile	Haru Oni e-Fuels	1.2 MW (PEM)	Operational since Oct. '22, wind power E-fuel production demonstration, supplied to Porsche and others
Colombia	Ecopetrol Cartagena Refinery Green H2	5 MW (PEM)	Targeting operation in '26, 22 MW solar power Targeting 800 tons/year H2, replacing gray H2 at refinery

WE Demonstration_Saudi Arabia

Saudi Arabia's 2.2 GW NEOM Green H2 Complex

Targeting operation in '27, area of 300 km²
2.2 GW WE (600 tons/day H₂)
4 GW solar/wind power generation, port
1.2 million tons/year of Green NH₃ production



WE Demonstration_Japan

Configuration of Japan's Suntory Hakushu Green H2 Park (16 MW)



https://x.com/TEPCO_English/status/1984174885237555226

Status of Domestic WE Demonstrations-1

Category	Operation Period	Power Scenario	Demonstration Site	Facility Scale	Annual H2 Production
Jeju Haengwon 3.3 MW Water Electrolysis Demo.	Sep. '24	Wind-based + ESS linkage	Haengwon Wind Farm, Gujwa-eup, Jeju	3.3 MW (ALK, PEM)	70~80 ton-H2/yr (200 kg/day)
Jeju Bukchon 10.9 MW Water Electrolysis Demo.	From '27	Solar + wind + expected grid linkage	Bukchon-ri site, Jocheon-eup, Jeju	9.7 MW (ALK, PEM, AEM)	1,000 ton-H2/yr (60% utilization rate)
Jeju RE100 Hydrogen Pilot Complex	Jun. '26	Wind-centered + ESS + partial grid linkage	Haengwon-ri site, Gujwa-eup, Jeju	1 MW (ALK)	146 ton-H2/yr (400 kg/day)
Jeju 5 MW PEM Water Electrolysis Demo.	'29	100% wind-based	Gimnyeong Wind Farm site, Gujwa-eup, Jeju	5 MW (PEM)	730 ton-H2/yr (2 ton/day)
Gimcheon Solar Green Hydrogen Production Facility	Mar. '26	100% solar (8.3 MW) direct-connected, off-grid	Gimcheon, Gyeongbuk	10 MW (ALK)	230 ton-H2/yr
Nuclear-linked Clean H2 Production Demo.	'27	Nuclear power + partial grid power	Ulju-gun, Ulsan Saeul Nuclear Power Plant	10 MW (ALK)	1,300 ton-H2/yr (4 ton/day)

Status of Domestic WE Demonstrations-2

Category	Operation Period	Power Scenario	Demonstration Site	Facility Scale	Annual H2 Production
WE H2 Production Base–Buan	'25	Solar-centered + grid mix	Buan, Jeonbuk	2.5 MW (PEM)	330 ton-H2/yr (1 ton/day)
WE H2 Production Base–Pyeongchang	'25	Wind-centered + grid support	Pyeongchang, Gangwon	2.5 MW (PEM)	330 ton-H2/yr (1 ton/day)
WE H2 Production Base–Donghae	Planned '26	Wind + solar + grid	Donghae, Gangwon	2.5 MW (ALK)	330 ton-H2/yr (1 ton/day)
WE H2 Production Base–Boryeong	Planned '26	Solar + grid linkage	Boryeong, Chungnam	2.5 MW (PEM)	330 ton-H2/yr (1 ton/day)
Seongnam Regional Water Treatment Plant Green H2 Demo.	Jul. '25 H2 supply begins	Small hydropower generation (0.7 MW)	Bokjeong Water Treatment Plant site, Seongnam, Gyeonggi	0.6 MW (ALK)	62 ton-H2/yr (188 kg/day)
Miryang Dam WE Pilot Project	Nov. '26	Small hydropower generation (1.3 MW)	Miryang Dam site, Miryang, Gyeongnam	1.5 MW (PEM)	140 ton-H2/yr (429 kg/day)
Chungju Dam WE Pilot Project	Apr. '28	Small hydropower generation (1.5 MW)	Chungju Regulation Dam site, Chungju, Chungbuk	1.5 MW (PEM)	210 ton-H2/yr (640 kg/day)

Clean H2 Certification Issues

Clean H2 from WE must satisfy additionality, geographical correlation, and hourly matching

■ **Additionality**

- To produce clean hydrogen via WE, new carbon-free power sources must be built and used, rather than existing ones
- EU: Until Jan. 1, '28, carbon-free power sources built within the past 36 months may be linked
- US: Carbon-free power sources built within the past 36 months may be linked

■ **Geographical correlation**

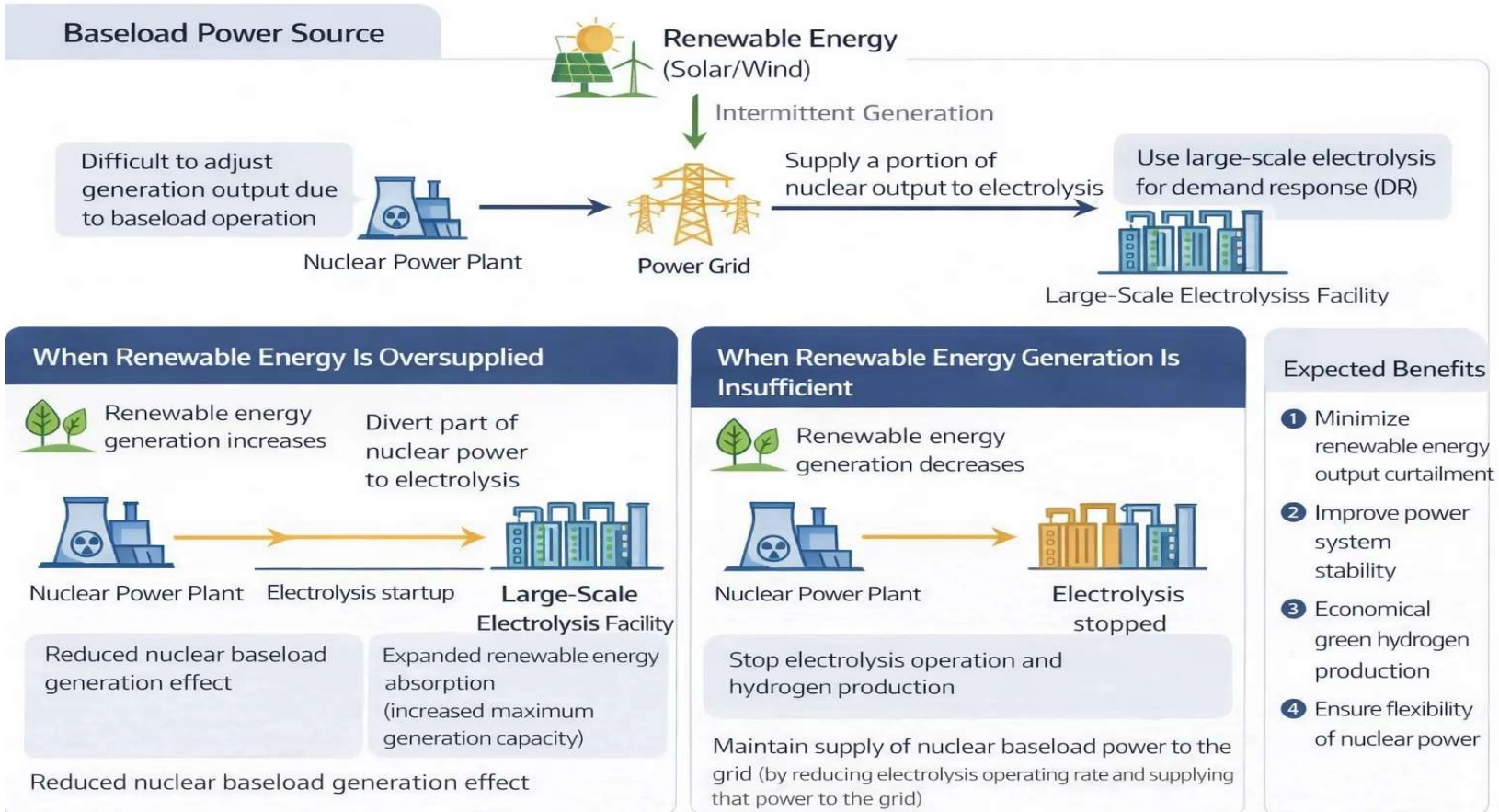
- The carbon-free power source and the electrolysis facility must be connected via the grid within the same region
- EU: Same power bidding zone; adjacent zones are recognized to a limited extent considering power market price flows
- US: Must be located within the same power grid operating body (eGRID region)
- Korea: Recognized if connected within the KEPCO grid or under a direct PPA (Power Purchase Agreement)

■ **Hourly matching**

- The time period of carbon-free power generation must match the time period of power use for water electrolysis
- EU: A time gap of up to 1 month is recognized until Jan. 1, 2030, after which up to 1 hour is recognized
- US: A time gap of up to 1 year is recognized until Jan. 1, 2028, after which up to 1 hour is recognized
- Korea: A time gap of up to 1 month is currently recognized, to shift to an hourly basis in the future

Securing Power Grid Flexibility through Nuclear–WE Linkage

Using WE facilities can secure power grid flexibility and maximize renewable energy generation



"Gemini AI." Google DeepMind(2026)

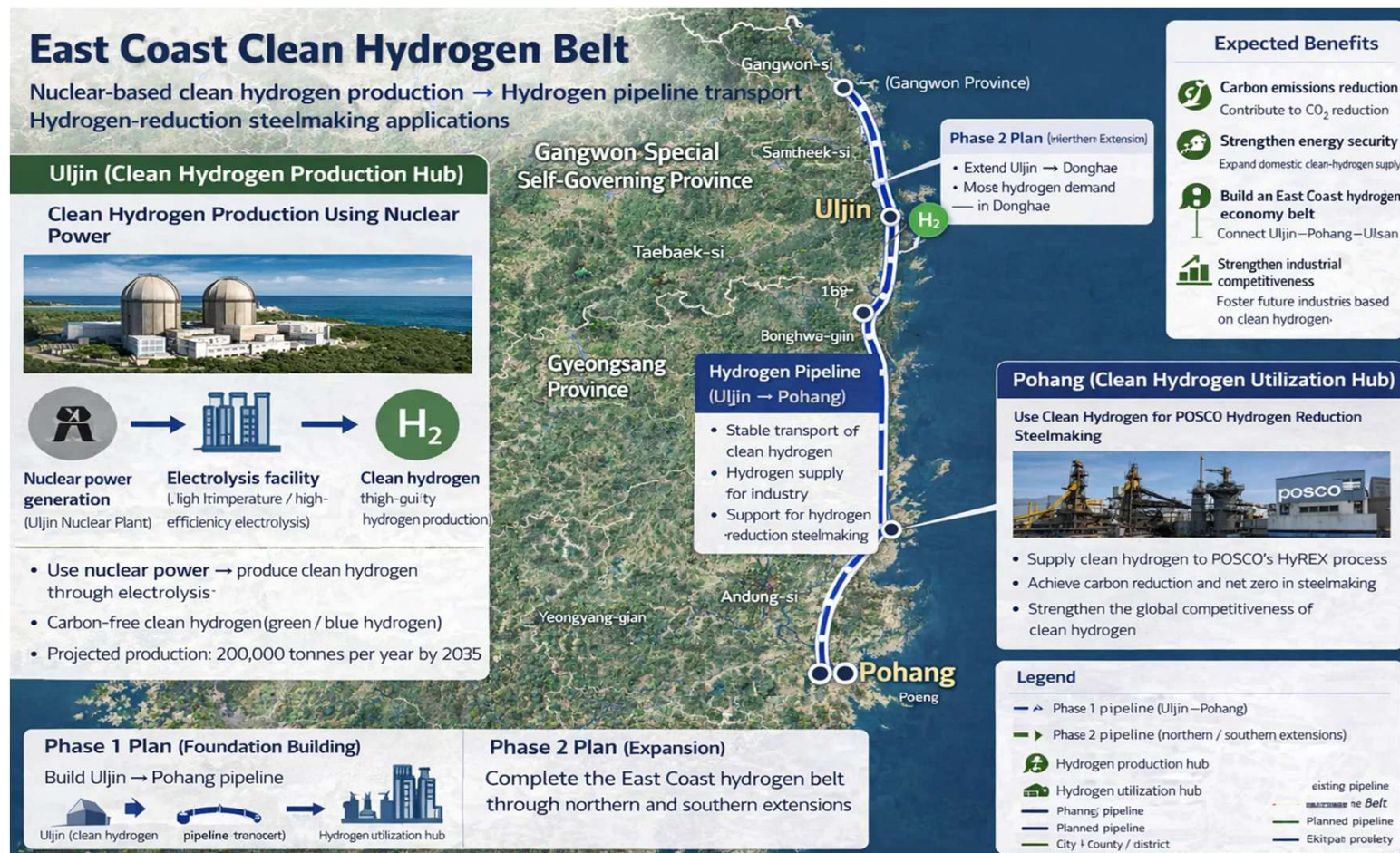
Nuclear-linked WE Demonstration Trends

Currently at the demonstration stage; conditions for clean H2 production via WE are excellent, but full-scale deployment has not yet begun

Country	Project	Capacity (Type)	Features
US	Nine Mile Point	1.25 MW (PEM)	Operational since '23, world's first nuclear-linked WE Supplies cooling process inside the nuclear plant, Operates fuel cells within the nuclear plant
UK	Nuclear Hydrogen Project	1 MW (PEM)	Operational since '23 Supplies nearby HRS
US	Davis–Besse Project	2 MW (PEM)	Scheduled to operate in '26, verifying commercial viability of nuclear H2 For processing at nearby manufacturing plants (glass, steel, etc.) and sales to HRS
Korea	10 MW-class nuclear-linked water electrolysis demonstration	10 MW (ALK)	Scheduled to operate in '28, world's largest nuclear-linked WE Supplies HRS and nearby industrial complexes

East Coast Clean H2 Belt (draft)

Building H2 transport and storage infrastructure along the East coast to promote clean H2 industry



"ChatGpt AI." (2026)

East Coast Clean H2 Belt Roadmap (draft)

Prioritizing the establishment of a hydrogen industry foundation, followed by full-scale hydrogen industry development

Short-term

- Uljin: Establish H2 industry foundation through small-scale nuclear-linked WE (tens of MW-class) demonstration
 - Water electrolysis hydrogen production, attracting hydrogen-utilizing industries
 - Parallel deployment of hydrogen electric vehicles and hydrogen refueling stations
 - Gyeongbuk: Build Uljin–Pohang H2 pipeline network
 - Build long-distance pipeline network and attract H2 storage base demonstration projects
 - Expand FCEV deployment and HRS
 - Pohang: Build H2 demand base
 - POSCO's H2 reduction ironmaking demonstration (using byproduct H2, blue H2, etc.)
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Long-term

- Uljin: Develop H2 industry through large-scale nuclear-linked WE (hundreds of MW-class) demonstration
 - East coast clean H2 supply base
 - Production of clean methanol and clean ammonia using clean H2
 - Gyeongbuk: Utilize and extend the built H2 pipeline network (Gangwon, Ulsan)
 - Expand pipeline-linked H2 storage bases, green H2 production bases, and HRS
 - Pohang: Expand POSCO's H2 reduction ironmaking
 - Use clean H2 supplied from Uljin
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Thank You !

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