THE WORLD'S 20 LARGEST GREEN HYDROGEN PROJECTS

INVESTING IN GREEN HYDROGEN 2023

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INTRODUCTION:

The increasing demand for hydrogen in 2022 is being primarily supplied by hydrogen produced from fossil fuels. Only a small amount, less than 1 million tons, of low-carbon hydrogen production will be green hydrogen, and most of it will be from blue hydrogen. However, there is a growing global interest in green hydrogen, and several countries have introduced policies to promote its development. As of the end of 2022, there are more than 250GW of green hydrogen projects in the concept stage worldwide. This paper examines the top 20 green hydrogen projects around the world, their status, and their potential impact on the green hydrogen market.

TOP 20 GREEN HYDROGEN PROJECTS:

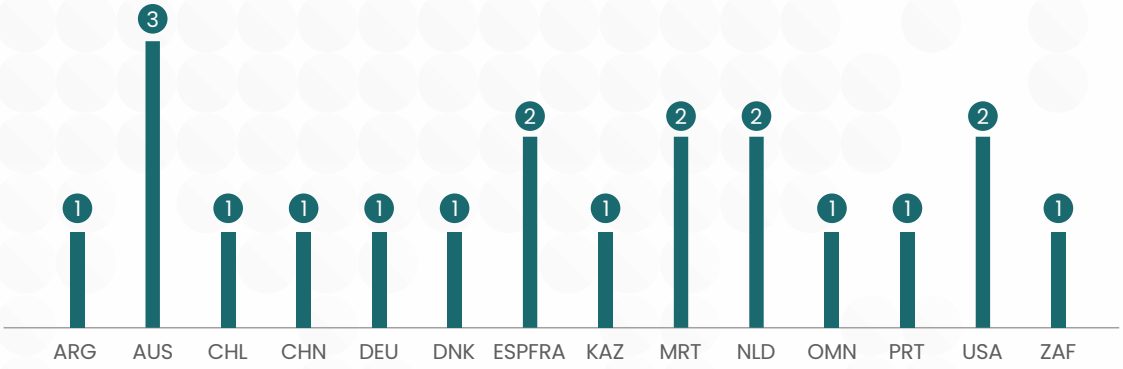
Among the currently disclosed global green hydrogen database, the top 20 green hydrogen projects are located in **15 countries**, with Australia having the most significant number of projects. The other countries with multiple projects in the top 20 are the United States, the Netherlands, Mauritania, France, and Spain. These projects vary in size, with the **largest** having a potential annual capacity of **3.6 million tons** of green hydrogen, and the smallest producing 750,000 tons per year. Large-scale projects are beneficial in achieving economies of scale and reducing production costs, but they require the development of the entire green hydrogen ecosystem, including production, transportation, and use of green hydrogen. Some projects even include the energy supply of entire cities.

If these top 20 projects are divided by continent, **Europe** has the most, with seven projects. It is followed by Asia, Oceania, and Africa, each with three projects. At the bottom of the list are North America and South America, each with two projects.

All 20 of these projects are in the early stages of development, with **13** in the concept stage and 7 in the feasibility study stage. Most of them are expected to begin commercial operation during 2030-2040, with only a small number of projects expected to achieve commercial operation during 2026-2028. The combined capacity of these projects when completed is expected to exceed **32.4 million tons** of green hydrogen per year.

Figure 1 and 2 display the top 20 green hydrogen projects by country and continent, while Figure 3 shows the projects' status.

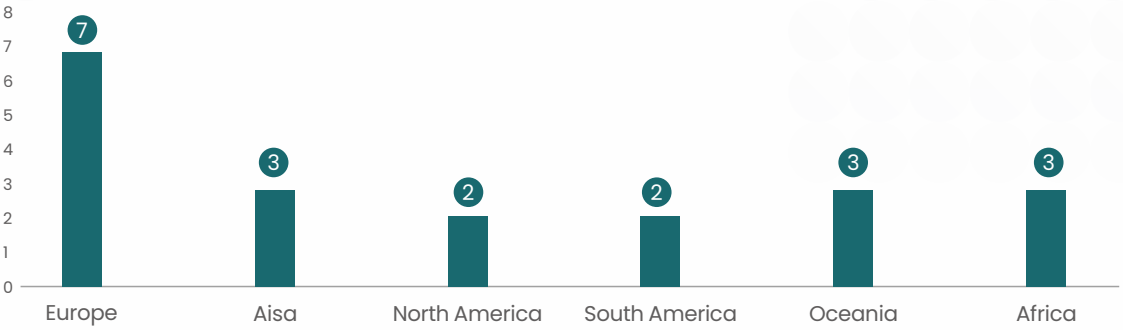
FIGURE 1: TOP 20 GREEN HYDROGEN PROJECTS BY COUNTRY



ARG: Argentina
AUS: Australia
CHL: Chile
CHN: China
DEU: Germany
DNK: Denmark
ESPFRA: Spain & France
KAZ: Kazakhstan
MRT: Mauritania
NLD: Netherlands
OMN: Oman
PRT: Portugal
ZAF: South Africa

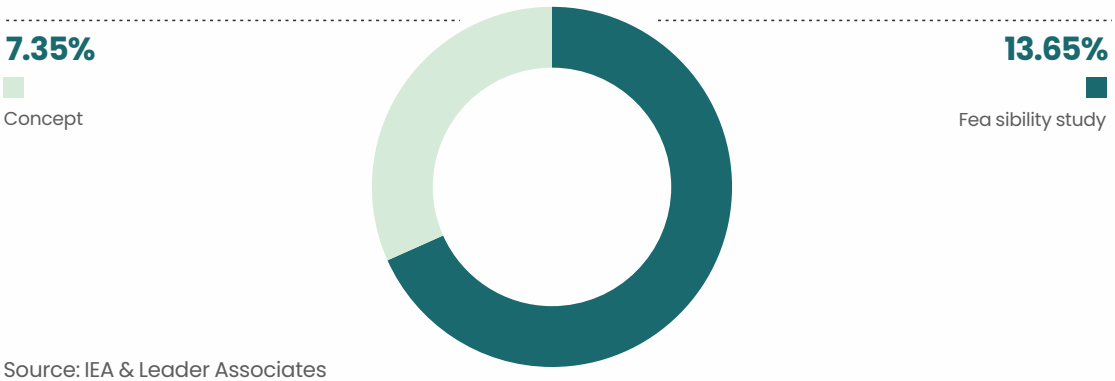
Source: IEA & Leader Associates

FIGURE 2: TOP 20 GREEN HYDROGEN PROJECTS BY CONTINENT



Source: IEA & Leader Associates

FIGURE 3: TOP 20 GREEN HYDROGEN PROJECTS BY STATUS



Source: IEA & Leader Associates

As of date, the **largest** green hydrogen project worldwide is **HyDeal Ambition**, launched by Soladvent in 2020. The project aims to provide 3.6 million tons of green hydrogen per year to Spain, France, and Germany's hydrogen energy ecosystem by 2030. The project involves 30 companies covering the complete green hydrogen value chain from upstream to midstream, downstream, and finance. The project includes 95GW of photovoltaic capacity and a 67GW electrolyzer. The green hydrogen produced will mainly be used in industrial applications in the steel, chemical, and power sectors.

The **Western Green Energy Hub**, jointly developed by InterContinental Energy, CWP Global, and Mirning Traditional Lands Aboriginal Corporation, is the world's second-largest green hydrogen project. The plant will cost approximately $70 billion and is expected to be completed by 2028. The project includes 50GW of wind and photovoltaic installed capacity and 28GW of electrolyzers and is expected to produce 3.5 million tons of green hydrogen per year.

Tied for third place are the **Kazakhstan green hydrogen project** and **Hydrogen City**, both aiming to produce 3 million tons of hydrogen per year. The Kazakhstan project is jointly developed by German company Svevind Energy and KazakhInvest, with approximately 45GW of wind and photovoltaic installed capacity, scheduled for completion in 2028. Hydrogen City, developed by GHI, is located in Texas, USA, with approximately 60GW of photovoltaic and wind energy installed capacity. The project's first phase of construction is expected to be completed in 2026, and the green hydrogen produced will be exported, used for producing green ammonia, generating electricity, and as rocket fuel.

Exhibit 1 provides detailed information on the top 20 green hydrogen projects worldwide.

EXHIBIT 1: THE WORLD'S 20 LARGEST GREEN HYDROGEN PROJECTS

No.	Project name	Country	Status	Announced Size	Normalized capacity (kt H2/y)	Date online	Developer / Owner
1	HyDeal Ambition	ESP, FRA	Concept	67GW	3600	2030	30 energy players / Soladvent / Snam / Enagas / OGE/ McPhy
2	Western Green Energy Hub	AUS	Concept	3.5Mt H2/y	3500	2028	InterContinental Energy/ CWP/ Mirning
3	Kazakhstan green hydrogen project	KAZ	Concept	30GW	3000	2032	Svevind Energy/ KazakhInvest
4	Hydrogen City	USA	Concept	3 Mt H2/y	3000	2026 phase 1	GHI
5	Fortescue Metals - Rio Negro	ARG	Concept	15GW	2200	2030	Fortescue
6	Oman-Al Wusta green H2 project	OMN	Feasibility study	14GW	1800	2038	OQ/ ICE/ Enertech
7	Aman - Green Hydrogen Project	MRT	Feasibility study	16-20GW	1700	2030	CWP
8	Asian Renewable Energy Hub	AUS	Feasibility study	14GW	1600	2028	BP/ ICE/ CWP/ Macquarie Capital
9	Secunda SAF Project	ZAF	Concept	2.5 Mt synfuels/y	1284	2040	
10	Project Nour	MRT	Feasibility study	10GW	1200	2030	Chariot
11	H2 Magallanes	CHL	Feasibility study	8GW	1000	2027	Total Eren
12	NortH2	NLD	Concept	10GW	1000	2040	Equinor/ Gasunie/ Groningen Seaports/ RWE/ Shell Netherlands
13	Baicheng, Jilin wind-solar project	CHN	Concept	1 Mt H2/y	1000	2035	JEPC/ CSIC/ Goldwind
14	Lacq Hydrogen	ESP, FRA	Concept	1000 kt H2/y	1000	2030	Enagás/ Teréga/ DH2/ GazelEnergie
15	BrintØ - Hydrogen Island	DNK	Concept	1Mt H2/y	1000	2030	COWI/ CIP
16	AquaVentus	DEU	Concept	10GW	1000	2035	RWE
17	MoU Shell - Mitsubishi	NLD	Concept	1Mt H2/y	1000	2043	Mitsubishi/ Shell
18	HIF USA	USA	Feasibility study	900kt H2/y	900	2026	HIF USA
19	IPCEI New Green Flamingo	PRT	Concept	5GW	866		Resilient Group
20	Murchison	AUS	Feasibility study	5GW	750	2028	CIP

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