

ENERGY ICEBERG

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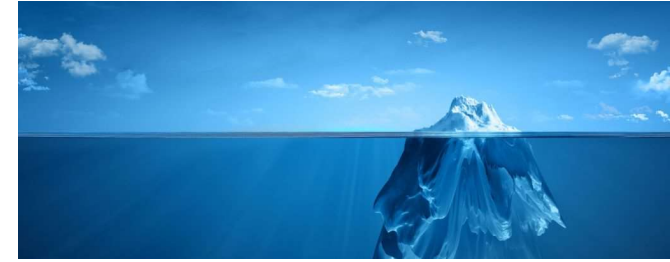


UNDERSTAND CHINA'S ENERGY INDUSTRY

		Production	Storage Infrastructure/ Charging Stations	Fuel Cell & Vehicle	Business Entities / Strategies
1st Tier Power Developer	SEIC (Shenhua)	<ul style="list-style-type: none"> - 2005 developed China's first coal-to-hydrogen unit in Erdos - joint research with Tsinghua and DTU on wind-to-gas 2019 - is leading a national demonstration of large-scale wind/solar and hydrogen storage hybrid project for 2022 Beijing Winter Olympic 	<ul style="list-style-type: none"> - 2016 developed a charging station (Rufu of Jiangsu) - looking to build hydrogen charging network in two cities (Xianyang of Shaanxi, Baotou of Inner Mongolia) 	<ul style="list-style-type: none"> - 2018 joint research with Weichai to develop fuel-cell hydrogen truck (>200 tonnage) 	<ul style="list-style-type: none"> - initiator of China's National Alliance of Hydrogen and Fuel Cell - 2019 published white paper (joint research) of China's fuel cell and hydrogen energy
	SPIC	<ul style="list-style-type: none"> - 2017 integrated hydrogen production base project at Liaoning initiated wind-to-gas research and demonstration - is developing two local industry bases (Ningbo, Yanqing) - 2019 announced to develop an integrated wind-to-gas and hydrogen demonstration in Baicheng (Jilin) 	<ul style="list-style-type: none"> - initiated R&Ds in hydrogen and natural gas blending technology - teamed with local firm Juhua to develop storage technology and equipment 	<ul style="list-style-type: none"> - SPIC Central Research Institute has a lab for fuel cell and advanced storage research - 2019 announced to have "fully" developed its own technology of the fuel cell value chain - teamed with Beiqi Foton Motor and Sinohytec to develop a fuel cell battery prototype, apply it on a bus prototype and develop 1000 buses by 2022 	<ul style="list-style-type: none"> - 2017 set up hydrogen technology subsidiary - set up ¥1Bn industry investment fund - 2018 set up group-level executive hydrogen task force led by president Qian Zhimin - 2018 MoU with Linde on renewable-to-gas cooperation - 2019 MoU with CSIC

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1st Tier Power Developer	Huaneng	- is developing an integrated wind-to-gas and hydrogen charging demo project at Zhangjiakou (Hebei)			- 2017 MoU with Beijing government and 16 other to develop hydrogen innovation center
2nd Tier Power Developer	CTG	- 2018 inked agreement with Proton Energy System to cooperate on hydrogen production, charging and storage equipment; planned to set up joint venture in Weifang (Shandong)			- teamed with Chengdu government and Dongfang Electric to develop Dongfang-CTG Fund and Dongfang hydrogen fund
	CGN	- capital investor in a MCFC fuel cell station in Korea			- 2017 set up ¥3Bn hydrogen industry fund (first phase ¥1Bn) at Shenzhen - 2018 teamed with Narada Power to set up ¥1Bn hydrogen fund
	CNNC				- signed framework agreement within Tsinghua and Baosteel to develop nuclear-to-gas and nuclear for steel demonstration
Power Grid	SGCC	- a plan announced to develop a hydrogen storage power plant			

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1st Tier Manufacturer	Dongfang Electric			- 2019 developed China's first fuel cell battery production line in Chengdu (1000sets/year)	- teamed with China Three Gorges to develop hydrogen industry fund - initiator of Chengdu hydrogen energy industry development platform
	CSIC	- CSIC 718 Research Institute has been conducting R&D in power-to-gas, hydrogen storage, transportation and processing; it is the key provider of water electrolysis equipment in China (>65%) - 2019 announced to provide hydrogen equipment to SPIC's Baicheng (Jiliin) integrated hydrogen project	- developed two charging stations: Yutong project in Zhengzhou (Henan), Nanhai project in Foshan (Guangdong)		- 718 Institute has set up a Hebei Hydrogen Engineering Application Center specialist in wind-to-gas - 2019 signed a cooperation agreement with SPIC - 2019 participated in Handan's (Hebei) hydrogen industry development base project
NOCs (Oil Majors)	Sinopec		- 2019 built the first oil and hydrogen blending charging station at Foshan - plans to add hydrogen charging to tis fueling stations in Inner Mogolia province and in Guangdong(Yunfu and Foshan)		- MoU with Japan JXTG to cooperate and develop hydrogen charging stations in China and abroad

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NOCs (Oil Majors)	CNPC		<ul style="list-style-type: none"> - 2018 built the first hydrogen charging station in Hubei - an agreement signed to develop hydrogen charging stations in Beijing and Zhangjiakou (Hebei) 		
	SinoChem			- teamed with Tianjin University to develop fuel cell technology	- Set up Sinochem International Hydrogen Energy& Fuel Cell Innovation Center
Coal Miners	JAMG				<ul style="list-style-type: none"> -2019 MoU with AF Energy to explore hydrogen energy - in talk with Areva Hydrogen, Framatome on hydrogen blending and distributed fuel cell power technology
	Yankuang				<ul style="list-style-type: none"> - MoU with Air Liquide of France - initiate a Shandong provincial hydrogen industry alliance - look into coal-to-gas option
	Datong Coal Mine	- 2018 started to construct at 5000ton/y coal-to-gas hydrogen production project			- initiator of Datong's (of Shanxi) clean coal alliance to develop new strategy for coal application (e.g. hydrogen production)

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Coal Miners	China Luan	- agreement with Aspens of Germany to cooperate in hydrogen production and processing		- agreement with Aspens to develop fuel cell production - agreement with AP of the U.S. for its charging station development - teamed with Jiangling Heavy Motors to develop hydrogen trucks in Xian (Shaanxi)	
Automotive Manufacturer	Weichai			- framework agreement with Bosch - Ballard Power Systems announced to provide a mix of fuel cell products and components for the assembly of models to power FCEVs in China	- 2019 acquired 19.9% of Canada's Ballard Power Systems and become the largest shareholder; the two then set up a joint venture in Shandong to produce LCS fuel cell stacks and power modules

This table was made by Yuki of Energyiceberg.com

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