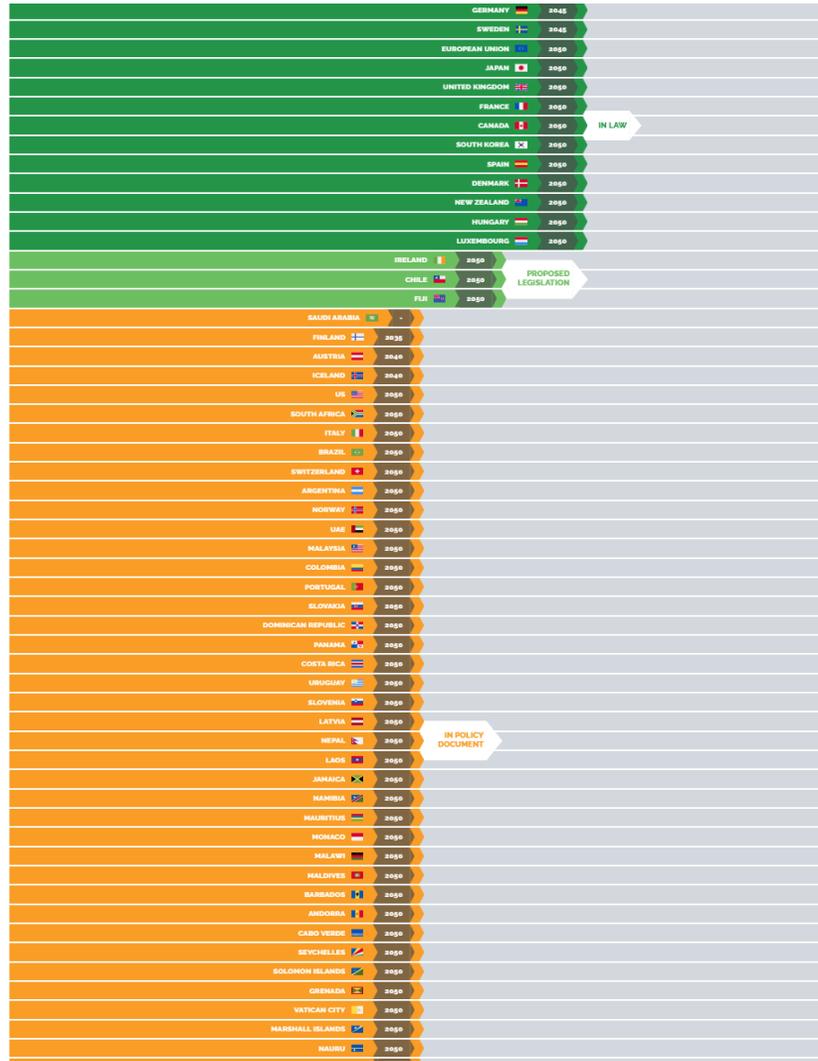


Status & Prospects of Hydrogen Industry in China

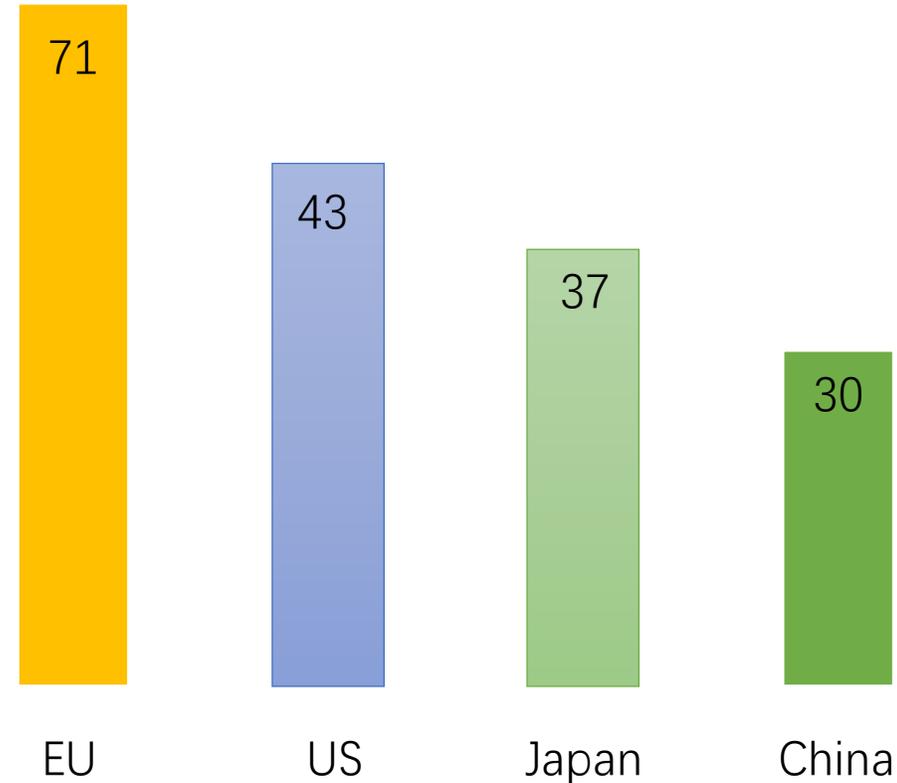
Shiyang Shao

2021-10-28

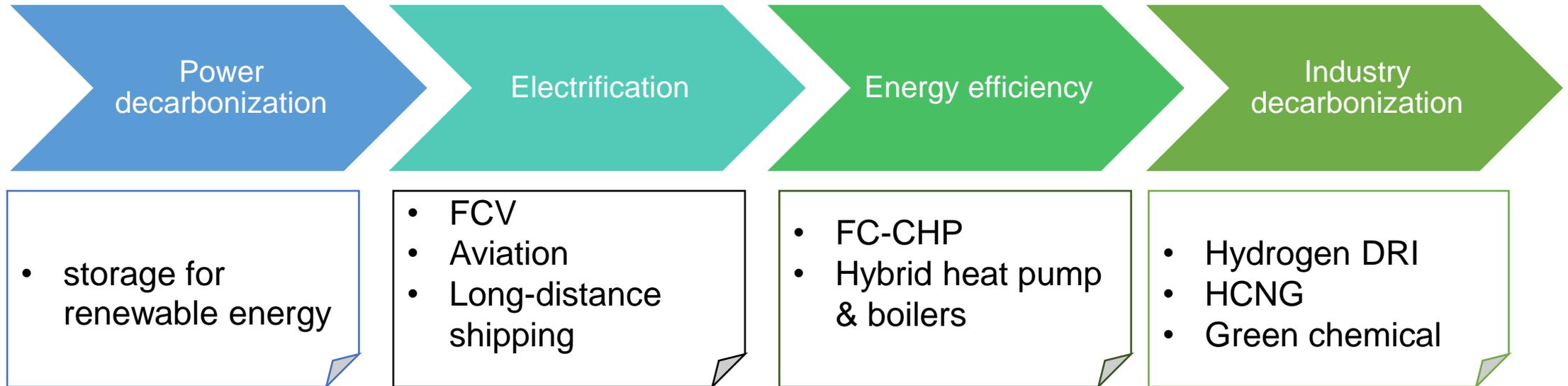
China's "30-60" goal



From Peaking to Neutrality



Where does hydrogen fit into China's carbon neutrality roadmap?



A hydrogen hype



SOEs

Listed Companies

	制氢				储运氢		加氢	
上游	<ul style="list-style-type: none"> 中国石化 中国神华 华昌化工 卫星石化 溴化股份 	<ul style="list-style-type: none"> 嘉化能源 美锦能源 宝钢股份 东华能源 阳煤化工 	<ul style="list-style-type: none"> 凯美特气 鸿达兴业 亿利洁能 佛燃能源 金发科技 	<ul style="list-style-type: none"> 隆基股份 天合光能 明阳智能 阳光电源 宜丰能源 	<ul style="list-style-type: none"> 中材科技 中集集团 深冷股份 京城股份 丰能股份 	<ul style="list-style-type: none"> 长城汽车 巨化股份 鸿达兴业 富瑞特装 航天晨光 	<ul style="list-style-type: none"> 中国石化 中国石油 美锦能源 厚普股份 雪人股份 	<ul style="list-style-type: none"> 安泰科技 富瑞特装 科融环境 冰轮环境 金通灵
中游	燃料电池电堆及零部件				燃料电池系统及零部件			
	<ul style="list-style-type: none"> 潍柴动力 上汽集团 美锦能源 亿华通 雄韬股份 	<ul style="list-style-type: none"> 东风汽车 首航节能 长城汽车 腾龙股份 龙蟠科技 	<ul style="list-style-type: none"> 威孚高科 丰能股份 贵研铂业 华道集团 巨化股份 	<ul style="list-style-type: none"> 东岳集团 道氏技术 上海电气 东方电气 安泰科技 	<ul style="list-style-type: none"> 潍柴动力 上汽集团 美锦能源 亿华通 雄韬股份 	<ul style="list-style-type: none"> 长城汽车 东风汽车 广汽集团 长安汽车 金柴动力 	<ul style="list-style-type: none"> 东方电气 上柴股份 大洋电机 雪人股份 冰轮股份 	<ul style="list-style-type: none"> 欣锐科技 动力源 正泰电器 合康新能 天能股份
下游	燃料电池汽车				工程机械	热电联供	氢冶金	绿色化工
	<ul style="list-style-type: none"> 上汽集团 长城汽车 长安汽车 广汽集团 宇通客车 	<ul style="list-style-type: none"> 中通客车 三一重工 福田汽车 华菱星马 力帆科技 	<ul style="list-style-type: none"> 中通客车 三一重工 福田汽车 华菱星马 力帆科技 	<ul style="list-style-type: none"> 安凯客车 美锦能源 中国中车 江铃汽车 海马汽车 	<ul style="list-style-type: none"> 杭叉集团 安徽合力 柳工 徐工机械 山推股份 	<ul style="list-style-type: none"> 潍柴动力 东方电气 中广核技 华能国际 新奥能源 	<ul style="list-style-type: none"> 河钢股份 宝武股份 八一钢铁 酒钢宏业 中钢国际 	<ul style="list-style-type: none"> 中国石化 中国石油 中化国际 东华能源 宜丰能源

Policy & Planning

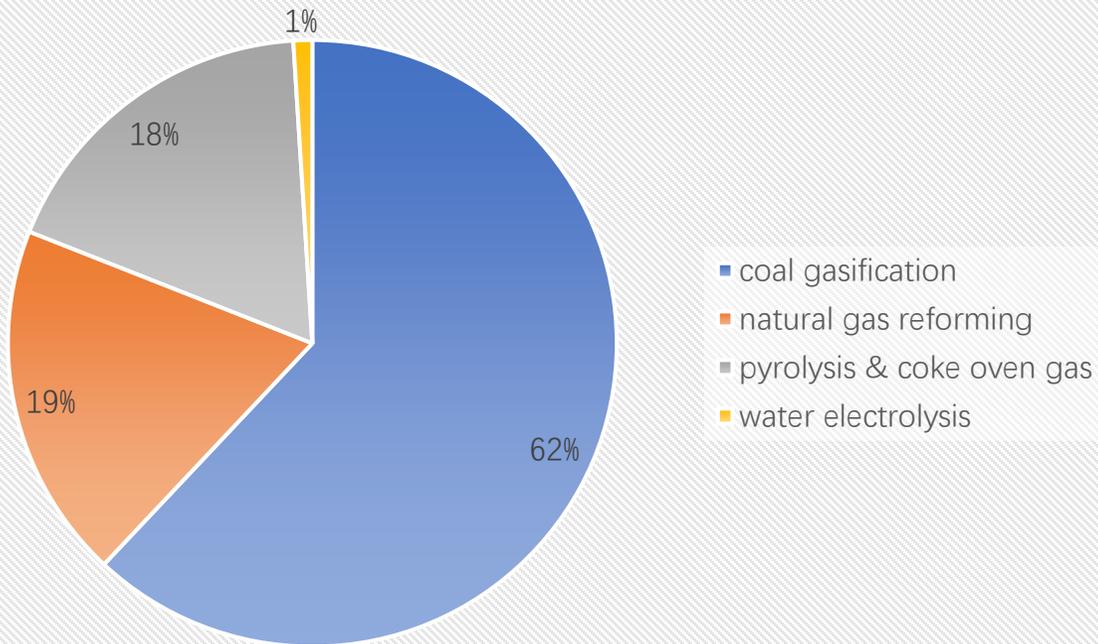
Province	Target year	Scale of industry (billion yuan)	Leading players	FCV	HRS
Beijing	2023	8.5	3-5	3000	37
	2025	24	5-10	10000	74
Guangdong	2022	/		demonstration	300
	2023	100		10000	100
Shanghai	2021	10			Included
Hebei	2022	15			included
Henan	2025	10		5000	80
	2021	50		2000	20
Jiangsu	2025	Complete value chain		10000	50
Zhejiang	2022	10		1000	30
	2022	/		5000	30
Shandong	2025	Complete value chain	10	20000	100



Hydrogen demonstration city clusters

Production of hydrogen

hydrogen production mix 2020



Hydrogen production		Carbon footprint (kgCO ₂ e/kgH ₂)	Cost (Yuan/kgH ₂)
Coal gasification	Without CCUS	~19	6.77~12.14
	+CCUS	<2	25.8~32.1
Natural gas SMR	Without CCUS	~9.5	7.5~24.3
	+CCUS	<1	
Water electrolysis	Grid power	38~45	>40
	Hydro power	<1	<20
	Solar PV	<3	<20

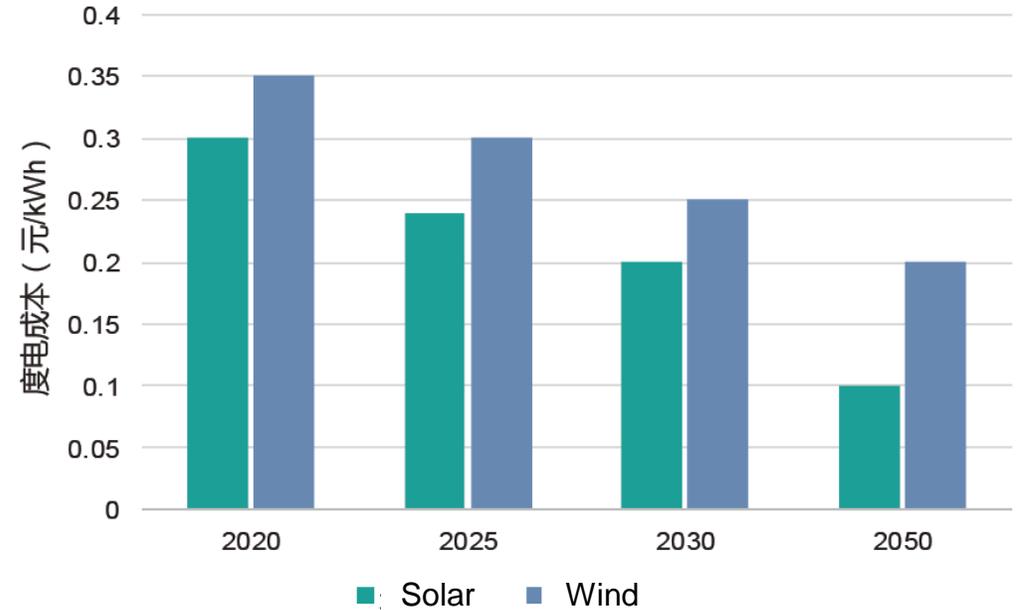
Source: China EV 100

Renewable hydrogen will be mainstreamed



Source: CPIA

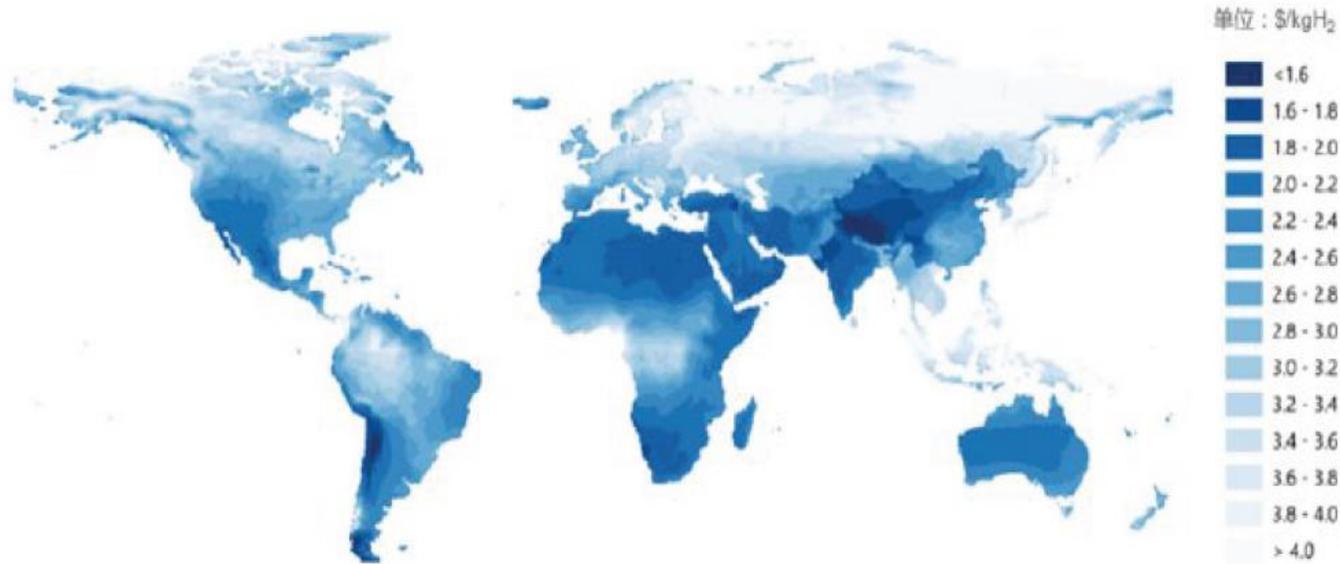
Lowest bidding price in solar PV projects (2013-2021)



Source: State Grid

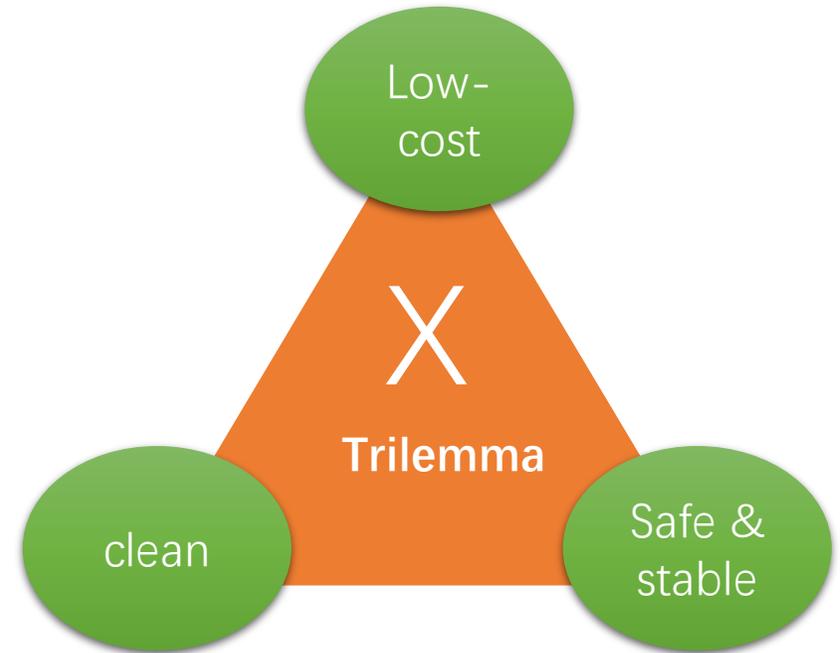
Forecast on China's solar & wind power cost (2020-2050)

Hydrogen of energy, hydrogen as energy



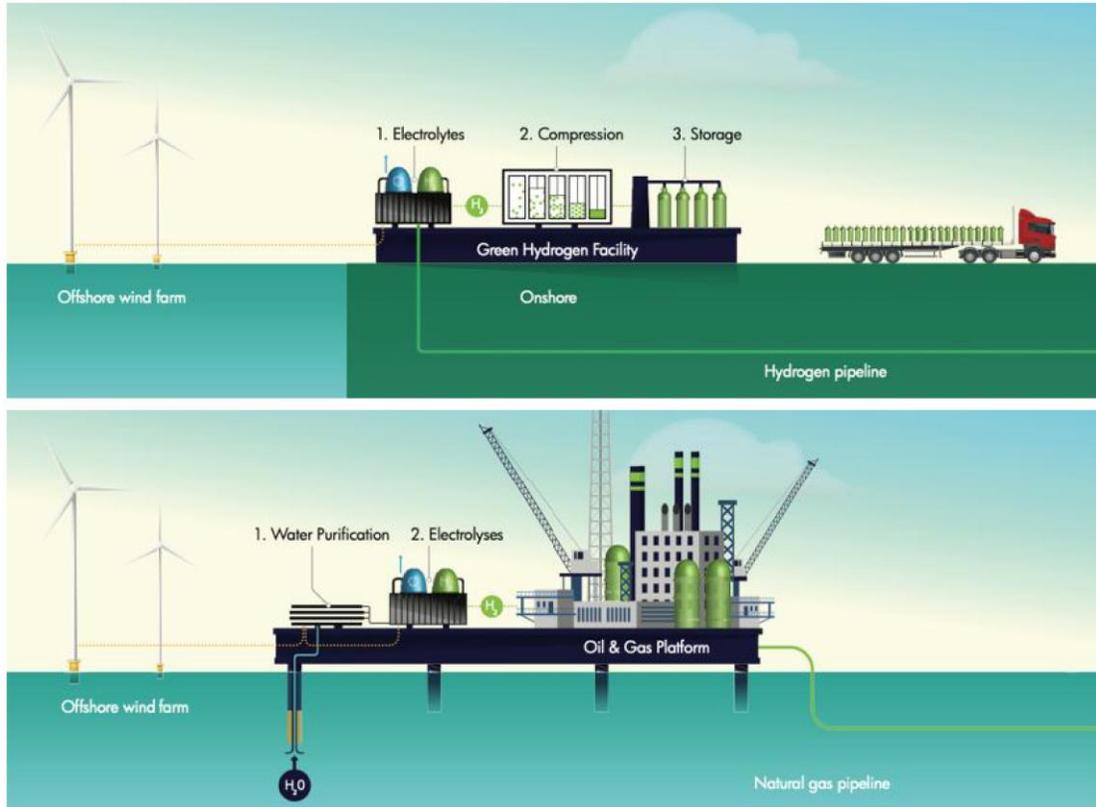
Source: IEA

Global Cost Comparison of Green Hydrogen

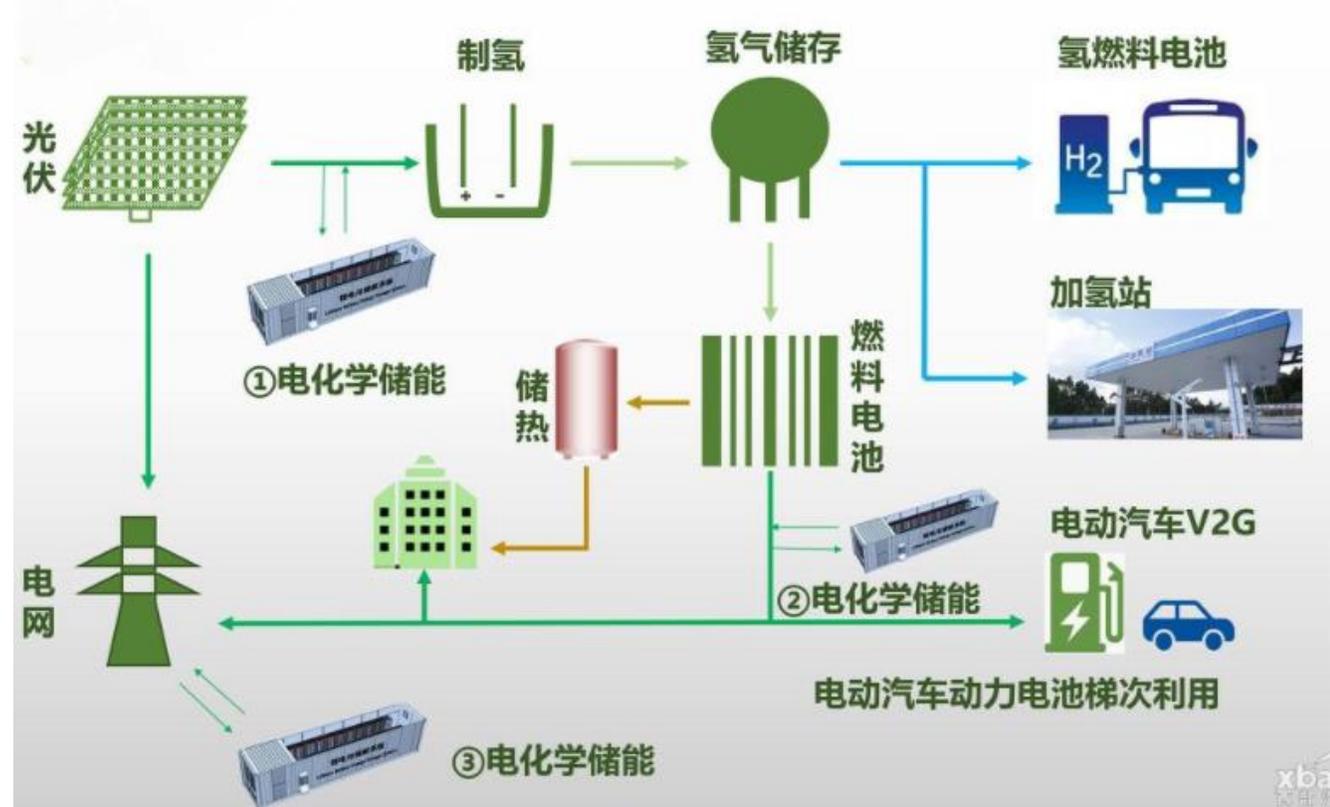


The Impossible Trinity in Renewable Energy

Hydrogen as storage for renewable energy

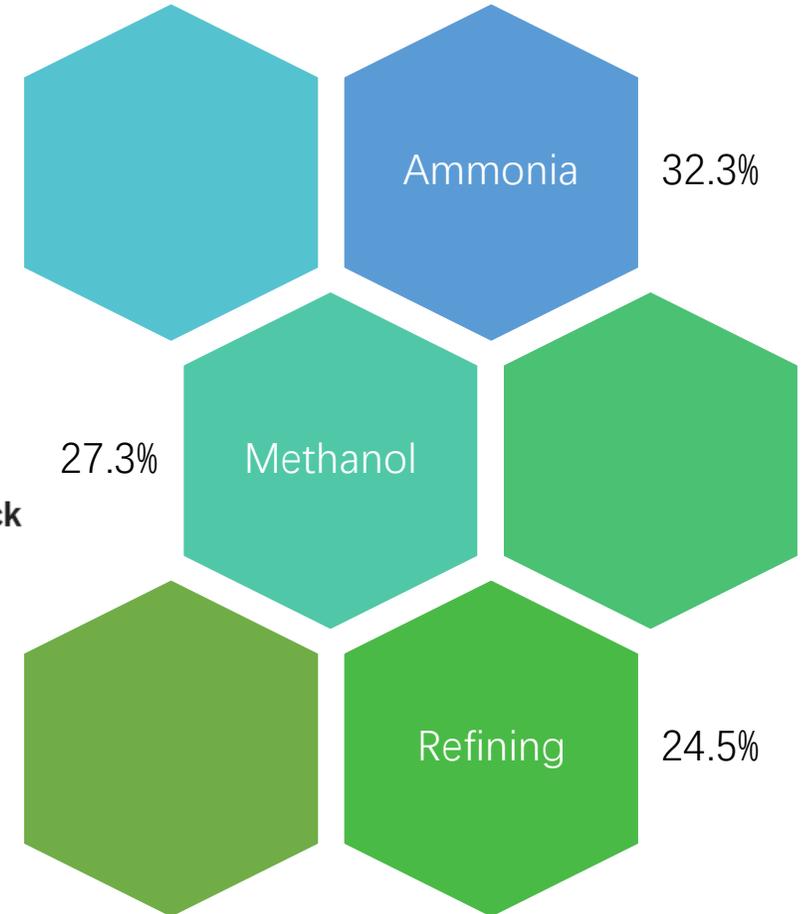
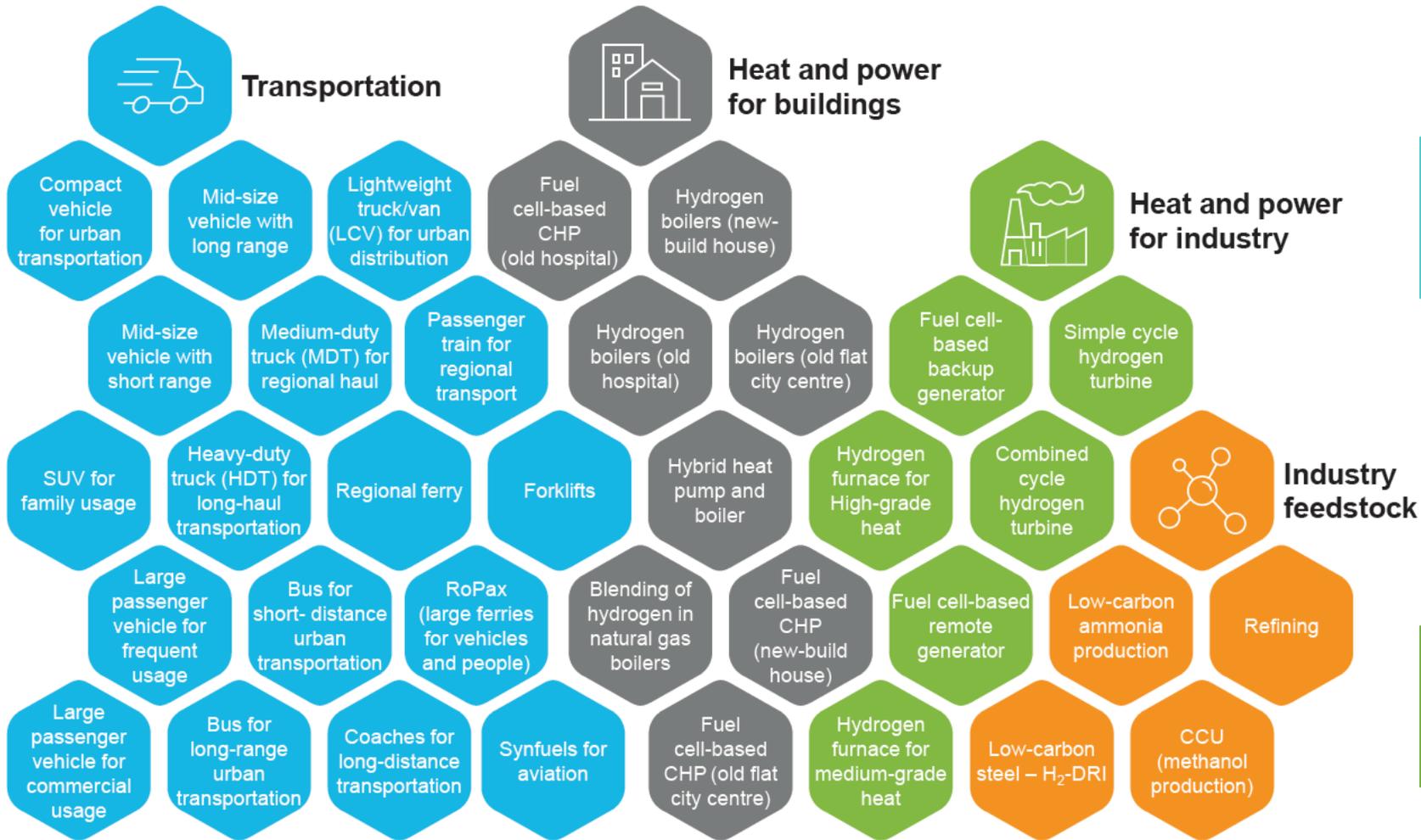


Off-Shore Wind: Power-to-X

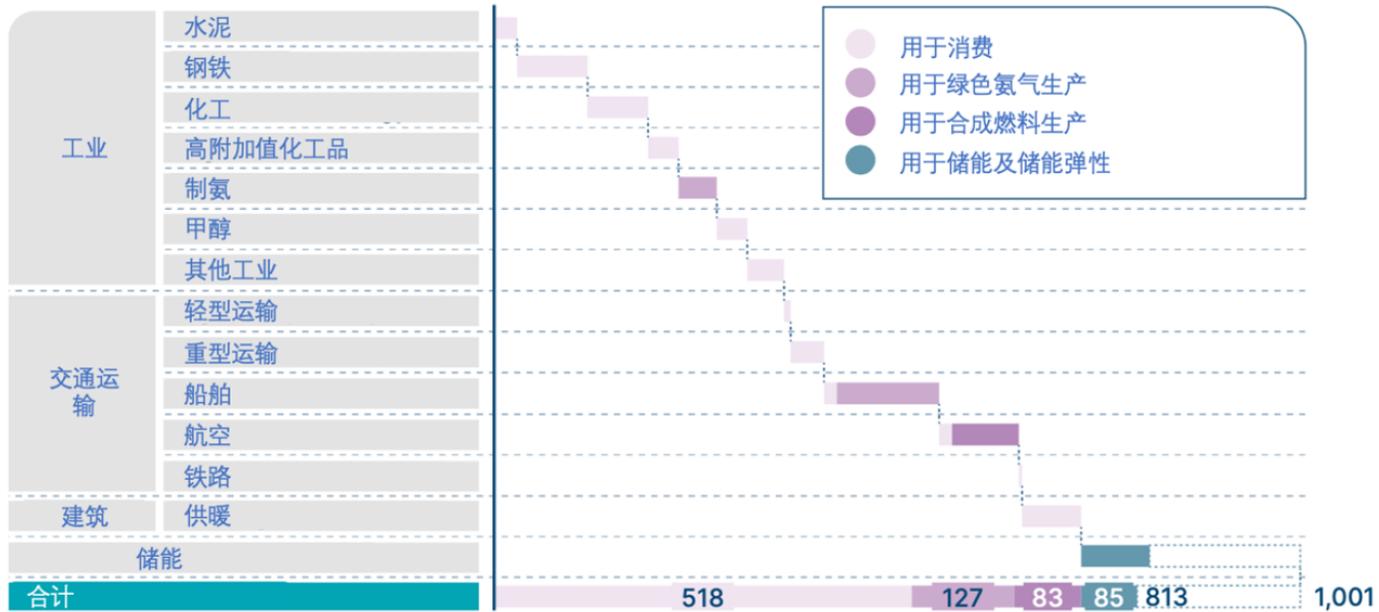


Source-Network-Load-Storage Integration

Consumption of hydrogen

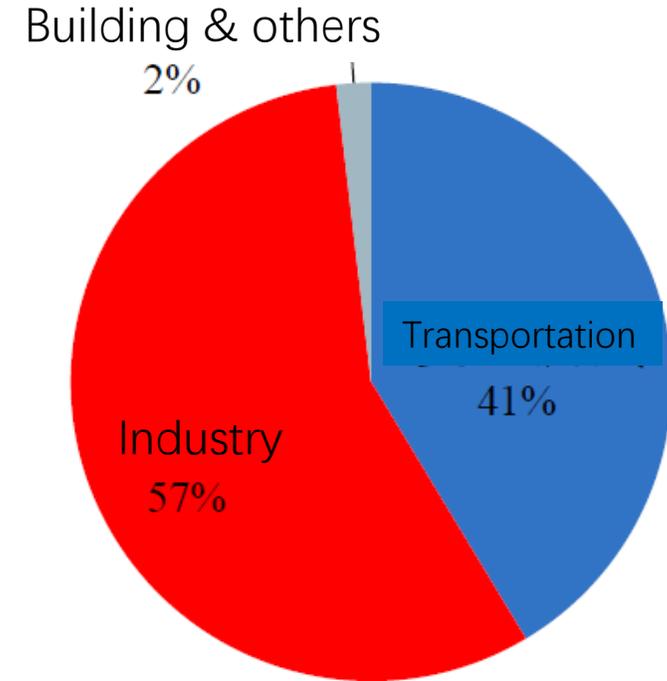


Prospect: hydrogen consumption mix



Source: ETC

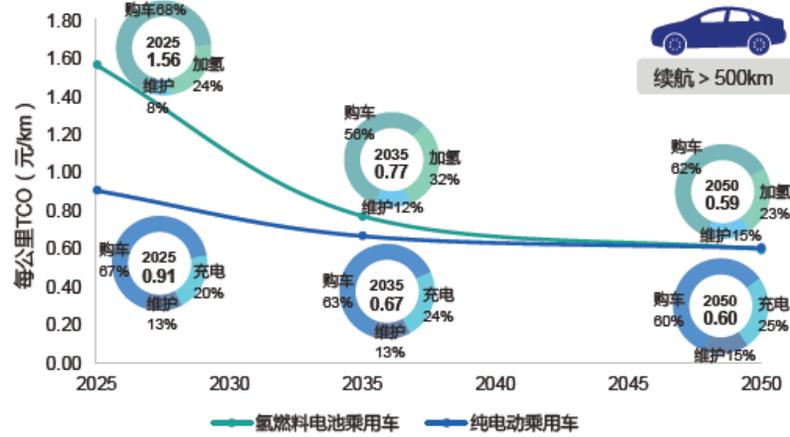
Global forecast of hydrogen consumption in 2050



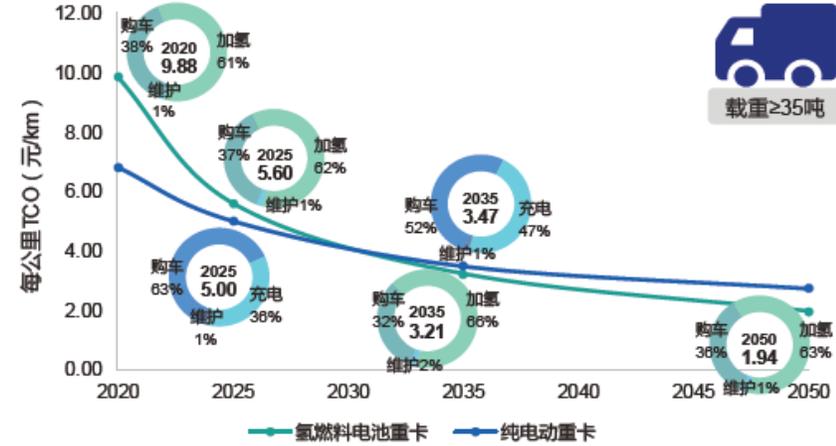
China's forecast of hydrogen consumption in 2050

Hydrogen in transportation: FCV Vs. EV

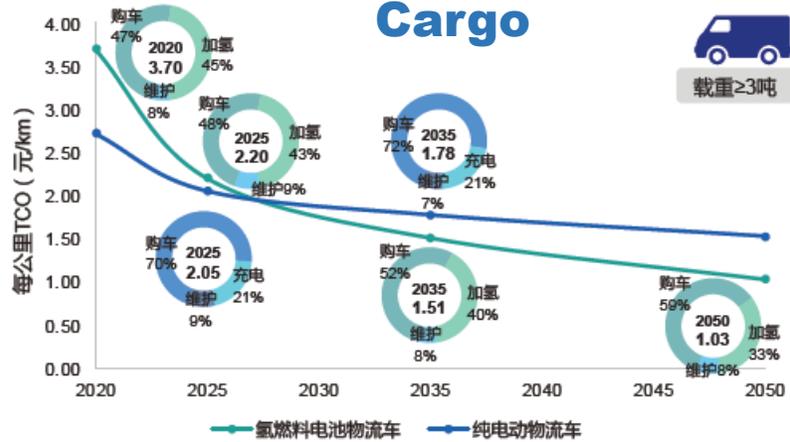
Passenger vehicle



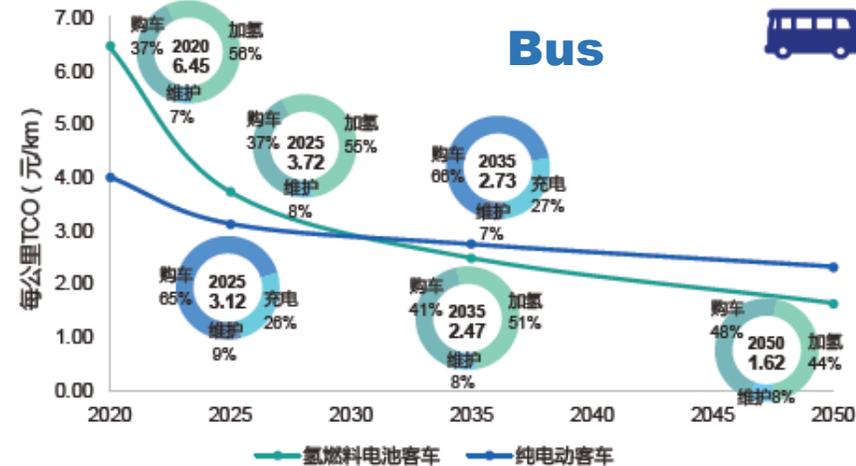
Heavy-duty truck



Cargo

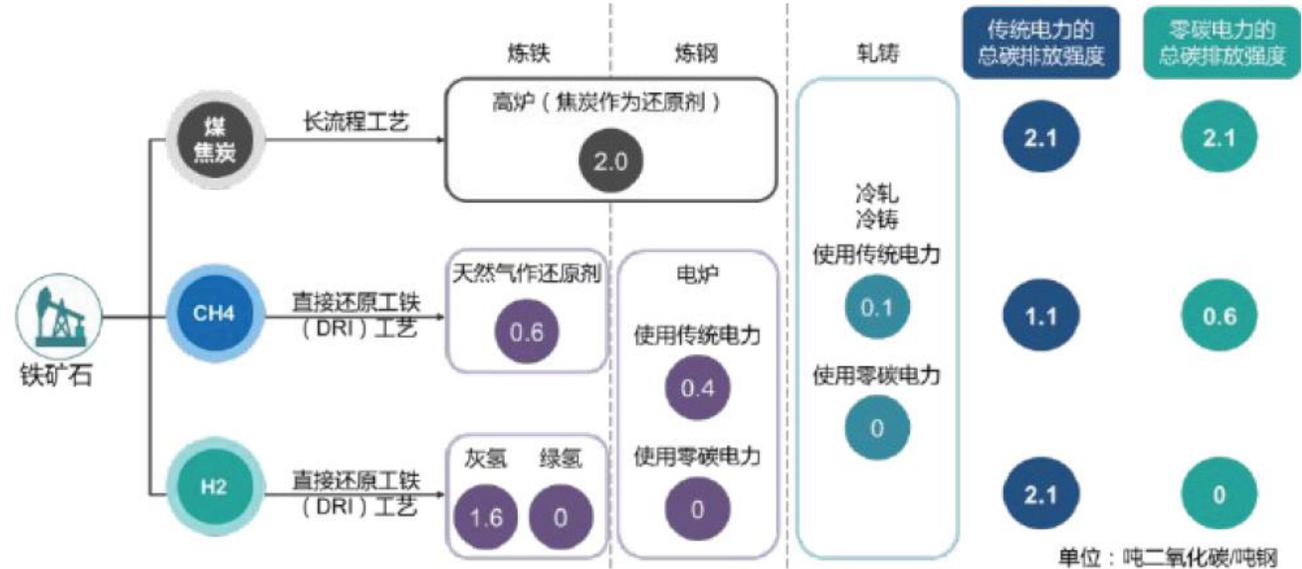


Bus

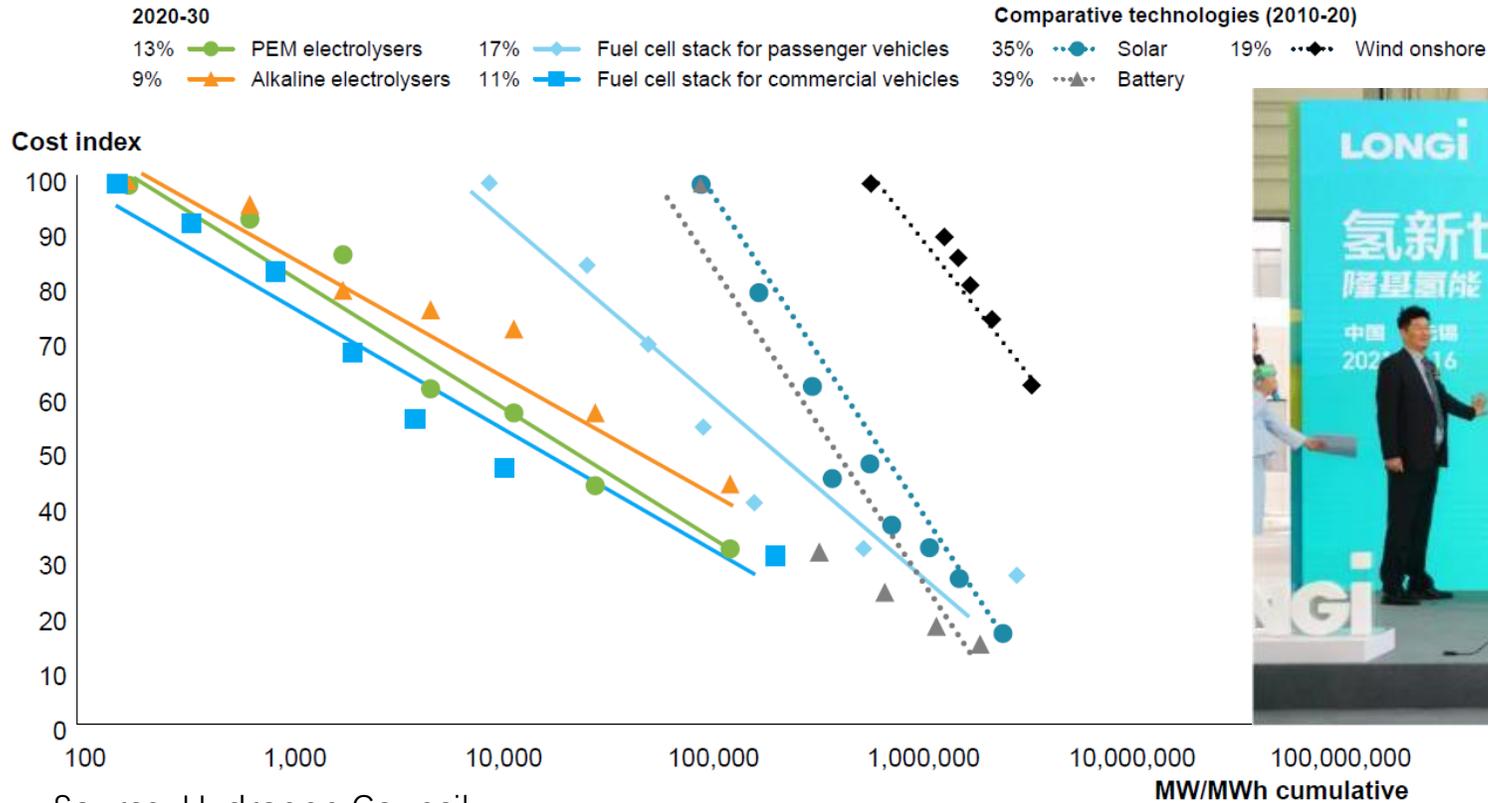


Hydrogen in industry

- Steel: H₂-DRI
- Green Chemical
- HCNG
- Fuel cell based CHP
- Hydrogen boilers/furnace



Economies of scale



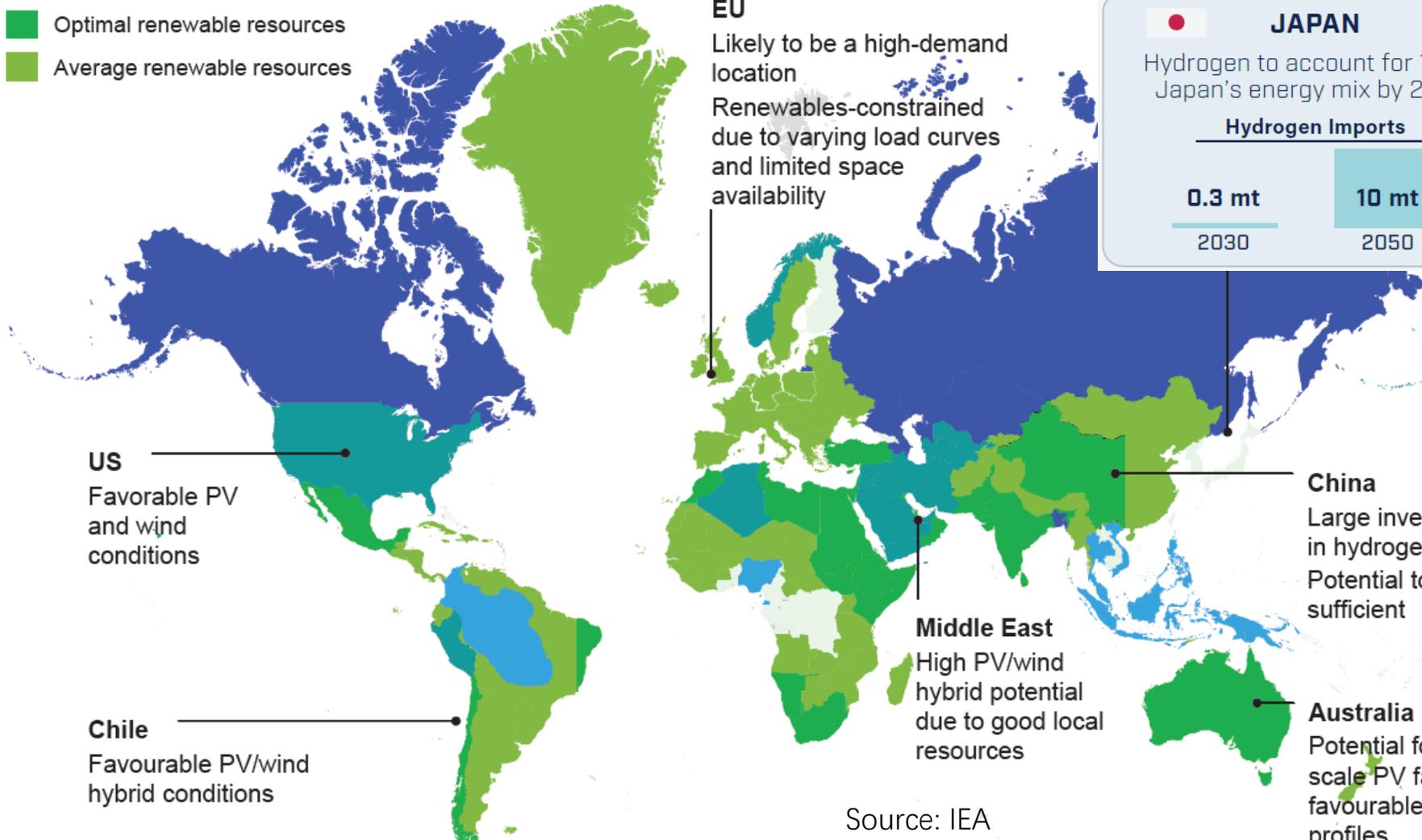
Source: Hydrogen Council



- Electrolyser costs are expected to fall rapidly in the coming decade as production scales up. In EU electrolyser costs have already been reduced by 60% in the last decade and will halve again by 2030 compared to today with further economies of scale.
- Hydrogen Council predicted that eletrolyser cost will be reduced by 60-80% by 2030 with technology advancement and increasing economies of scale.

Green hydrogen trade

- Optimal renewable and low-carbon resources
- Optimal low-carbon resources
- Average low-carbon resources
- Optimal renewable resources
- Average renewable resources



Japan/Korea

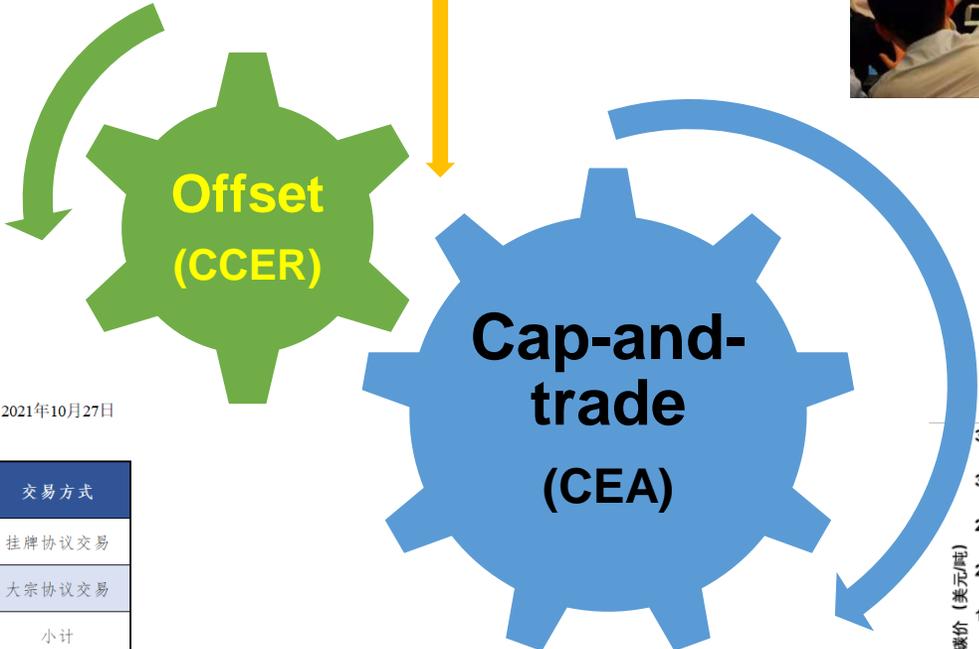
JAPAN Hydrogen to account for 13% of Japan's energy mix by 2050.	KOREA All commercial vehicles to run on hydrogen by 2025.								
<u>Hydrogen Imports</u>	<u>Hydrogen Imports</u>								
<table style="margin: auto;"> <tr> <td style="border: 1px solid black; padding: 5px;">0.3 mt</td> <td style="border: 1px solid black; padding: 5px; background-color: #008080; color: white;">10 mt</td> </tr> <tr> <td style="text-align: center; font-size: small;">2030</td> <td style="text-align: center; font-size: small;">2050</td> </tr> </table>	0.3 mt	10 mt	2030	2050	<table style="margin: auto;"> <tr> <td style="border: 1px solid black; padding: 5px;">0.4 mt</td> <td style="border: 1px solid black; padding: 5px; background-color: #008080; color: white;">5.2 mt</td> </tr> <tr> <td style="text-align: center; font-size: small;">2030</td> <td style="text-align: center; font-size: small;">2050</td> </tr> </table>	0.4 mt	5.2 mt	2030	2050
0.3 mt	10 mt								
2030	2050								
0.4 mt	5.2 mt								
2030	2050								

Source: IEA

A rising carbon market

Current study (Sandbag, 2021) showed that the financial costs of a switch from unabated fossil hydrogen to renewable hydrogen are very close to the current CO2 market price of EU-ETS, and such switch in methanol and fertiliser sectors will be profitable based on price forecast of phase IV of the EU ETS.

CO2 abatement from green hydrogen substitution

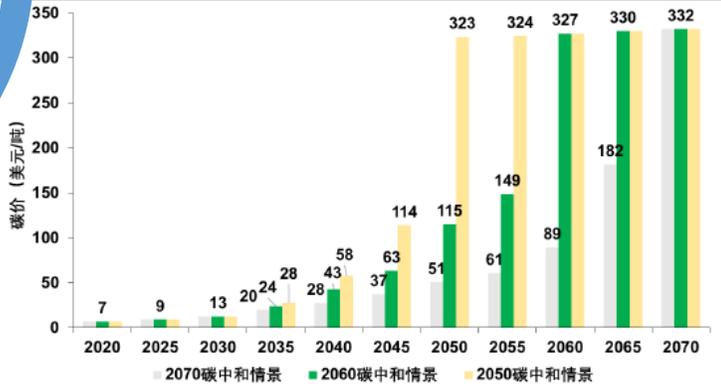


全国碳排放权交易

全国碳市场每日成交数据

2021年10月27日

交易品种	开盘价 (元/吨)	最高价 (元/吨)	最低价 (元/吨)	收盘价 (元/吨)	涨跌幅	成交量 (吨)	成交额 (元)	交易方式
CEA	38.50	42.75	38.50	42.61	-0.09%	10,635	453,171.25	挂牌协议交易
						300,000	12,550,000.00	大宗协议交易
						310,635	13,003,171.25	小计
截至当日累计						5,977,888	305,039,482.41	挂牌协议交易
						13,543,754	574,960,740.99	大宗协议交易
						19,521,642	880,000,223.40	合计



THANK YOU!