

如何在中国实现绿色氢能产业链的经济性

How to Realize Economic Benefits of Green Hydrogen Industrial Chain in China



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Summary

1) 中国氢能产业发展瓶颈

Bottleneck of Hydrogen Industry Development in China



当前,中国氢能产业发展初具条件,但仍存在成本高企、基础设施建设不足的障碍。报告人认为,中国基建力量强大,一旦发力,建设氢能基础设施不成问题。因此,氢能产业链的高成本是最大障碍。

At present, China has preliminary conditions for the development of hydrogen industry, but there are still obstacles such as high cost and insufficient infrastructure. I believe that since China takes pride in its strong infrastructure construction capacity, the construction of hydrogen infrastructures will not be a bottleneck. Therefore, the biggest obstacle of hydrogen industrial chain is high cost.

报告人认为在中国实现绿色氢能产业链的经济性需从下面四个方面入手。即：氢能的政策、法规和标准，技术进步，规模化与国产化以及氢能的哲学支撑。

In my opinion, in order to realize the economic benefits of green hydrogen industrial chain in China, the following four aspects should be the starting points: **hydrogen related policies, regulations and standards**, technological progress, **scaling up and localization**, and philosophical support for hydrogen.

2) 氢能需要政策、法规、标准支持

The hydrogen industry needs support from policies, regulations and standards



现有的政策体系不适应可再生能源（氢能）体系, 提高了氢产业链成本。
The existing policy system is not compatible with the renewable energy (hydrogen) system, which increases the cost of hydrogen industrial chain.

例如 **For example**

- 氢的危化品属性与能源商品的属性的政策处理

The management of hydrogen's attributes of hazardous chemical and energy commodity according to related policies

- 制氢工厂必须建在化工园区 Hydrogen plants must be located in industrial parks
- 气氢运输车压力标准: **20兆帕?**

Pressure standard of transport vehicles of hydrogen gas: 20MPa?

- 要求制氢加氢站分建; 加氢站必须使用商业用地

It is required to build hydrogen production stations and hydrogen refueling stations separately. Hydrogen refueling stations must use commercial land.

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2) 氢能需要政策、法规、标准支持

The hydrogen industry needs support from policies, regulations and standards



国家主席习近平10月12日下午以视频方式出席在昆明举行的《生物多样性公约》第十五次缔约方大会领导人峰会并发表主旨讲话。

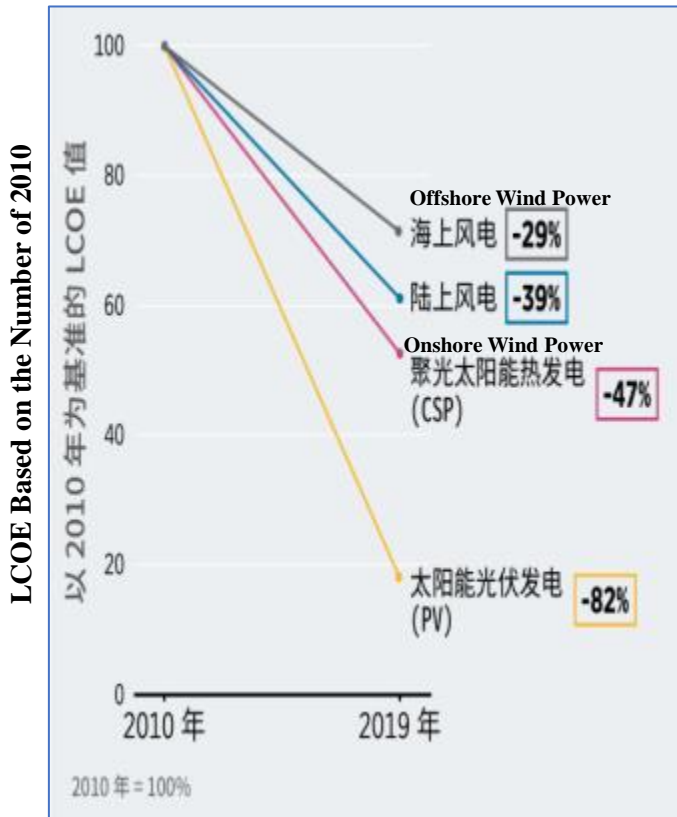
On the afternoon of 12 October, Chinese President Xi Jinping delivered a keynote speech via video at the Leaders' Summit of COP15 on Biological Diversity.

国家主席习近平：“为推动实现碳达峰、碳中和目标，**中国将陆续发布重点领域和行业碳达峰实施方案和一系列支撑保障措施，构建起碳达峰、碳中和‘1+N’政策体系。**

Chinese President Xi Jinping: To achieve carbon peaking and carbon neutrality targets, **China will release implementation plans for peak carbon dioxide emissions in key areas and sectors as well as a series of supporting measures, and will put in place a "1+N" policy framework for carbon peaking and carbon neutrality.**

3) 氢能技术进步 Hydrogen Technological Progress

3.1) 可再生能源技术进步，使可再生能源度电成本不断下降，为绿氢实现经济性打下基础。 Technological progress in renewable energy reduce cost per kWh, laying the foundation for the economic benefits of green hydrogen.



左图是各种新能源从2010年到2019年十年间成本下降情况。从中可见，太阳能成本下降了82%，下降幅度显著高于其他所有发电技术。

The graph shows the cost reduction of various new energy sources during 2010-2019. The decrease rate of solar energy costs reached 82%, significantly higher than that of any other power generation technologies.

2020年8月20日 隆基董事长钟宝申接受专访时说，如果单纯从发电成本来看，目前在中国的一类区或者说光照小时数超过1500小时的地区，发电成本都可以做到一毛钱一度电以内。

On August 20, 2020, Zhong Baoshen, Chairman of LONGi Group, said in an interview that, in terms of power generation cost only, it can be as low as under 10 cents per kWh in the first-class areas in China, i.e. areas with more than 1,500 hours of sunlight.

来源：每日经济新闻 任钢 许恋恋 Source: By Ren Gang and Xu Lianlian, *National Business Daily*

2021年4月19日 日前,OFweek太阳能光伏网获悉,全球最低光伏上网电价记录被刷新,一度电仅1.04美分(约合人民币0.068元)。据悉,该出售电力的光伏电站为沙特Al Shuaiba光伏项目。

April 19, 2021 Recently, the solar PV website OFweek became aware that the record of the lowest on-grid price of PV power in the world saw a record low at 1.04 cents (about RMB 0.068) per kWh. It is reported that the PV power station involved is the Al Shuaiba PV project in Saudi Arabia.

3.2) 技术进步使电解水设备生产能力增加，减低制氢成本

Technological progress increases the production capacity of water electrolysis equipment and thus reduces the cost of hydrogen production.



国产1000Nm³/h中压水电解制氢装置
A domestic 1000Nm³/h medium pressure
water electrolysis hydrogen production
facility

- 技术进步使单台电解水设备生产能力增加，由几百标方/时，提高到1千标方/时，售价由1万人民币/标方产能降低为7千人民币/标方产能。
Technological progress has increased the production capacity of individual water electrolysis facilities from several hundred Nm³/h to 1,000 Nm³/h, and the price has been reduced from 10,000 yuan/Nm³ capacity to 7,000 yuan/Nm³ capacity.
- 技术进步使单机产能提高，减低设备单价，也降低制氢成本。
Technological progress has improved the production capacity of individual facilities and reduced facility unit prices, making hydrogen production cost lower.

3.3) 技术进步使FC体积功率密度提升，促使FC成本下降

Technological progress improves FC volume power density and thus drives down FC cost



NEDO(日本新能源产业技术综合开发机构)发布了2040年日本国内的燃料电池目标计划，其电堆功率密度9kW/L。目前丰田mirai车电堆功率密度已由3.1kW/L提升到5.4kW/L。

NEDO (New Energy and Industrial Technology Development Organization of Japan) released Japan's domestic fuel cell target plan toward 2040, setting its goal for stack power density at 9 kW/L. At present, the stack power density of Toyota mirai vehicles has been increased from 3.1kW/L to 5.4kW/L.

3.4) 数字技术、智能制造技术发展，提升氢能产业链的经济性

The development of digital technology and smart manufacturing technologies will improve the economic benefits of hydrogen industrial chain.



- 数字化将在氢能产业链系统层面大大提升能源供给和消费侧的整体效率，带来显著的经济性。
Digitalization will significantly improve the overall efficiency of energy supply and consumption of hydrogen industrial chain at the system level , leading to remarkable economic benefits.
- 利用数字技术连续地在线监测某些行业 and 产品的碳排放，更完善的碳排放核算体系，也有利于氢能链企业更好地参与国内外竞争。如，对接近期欧盟推出的“碳边境调节机制”（CBAM）。
Using digital technology to continuously monitor carbon emissions of some sectors and products from on-line helps create a better carbon emission accounting system and enables hydrogen enterprises to be more competitive in domestic and international market. For example, addressing to the Carbon Border Adjustment Mechanism recently introduced by EU.

3.4) 数字技术、智能制造技术发展，提升氢能产业链的经济性

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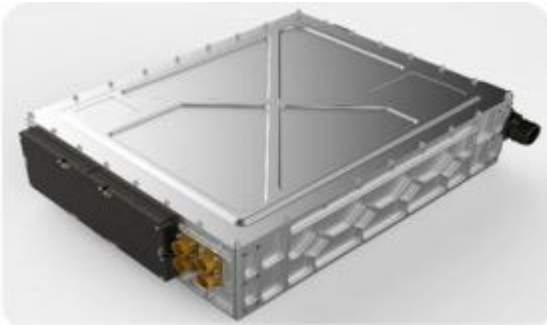


发展绿色智能制造是发展中国氢能的重要举措。数字化技术给予氢能产业链能通过提高质量、降低原材料损耗、缩短生产周期等降低生产成本，减少碳排放、实现绿色制造；智能制造则通过自动化、动态监控控制等方式提高生产效率，最终**提升氢能产业链的经济性**。

Developing green smart manufacturing is an important tool for hydrogen development in China. Digital technology enables hydrogen industrial chain to improve quality, lower raw material loss and shorten production cycle, so as to reduce cost and carbon emissions and realize green manufacturing. Intelligent manufacturing can improve production efficiency through automation and dynamic monitoring and management, and finally **improve the economic benefits of hydrogen industrial chain**.

4) 规模化、国产化带来效益 Scale and localization bring benefits

4.1) 绿氢产业链规模化带来效益 Scale of green hydrogen industrial chain brings benefits



据报道，2020年中国氢燃料电池汽车产销量分别为1199辆和1177辆。主要参与企业包括宇通、中通等10家。平均每家年产100多台车，燃料电池电堆及车的成本均居高不下。

It is reported that the numbers of hydrogen fuel cell vehicles produced and sold in China were 1,199 and 1,177 respectively in 2020. There are ten major producers such as Yutong Group and Zhongtong Bus. The average annual output for each company is about 100 vehicles and the cost of fuel cell stacks and vehicles remains high.

通常，单位产品成本与其产量呈负相关，产量增加，单位产品成本降低。目前国内已有公司报价38-75KW电堆：200台起 1999元/kw，2000台起 1599元/kw；10000台起 1199元/kw；链接：<https://xueqiu.com/8972527392/164860415>

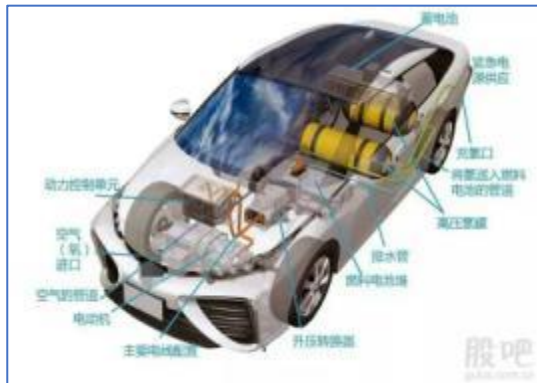
In general, unit product cost has a negative correlation with its output. The output increases while the unit product cost decreases. At present, some domestic companies quoted for 38-75KW stacks at: 1,999 yuan /kw for orders of not less than 200 units, and 1,599 yuan/kw for orders of not less than 2,000 units, and 1,199 yuan/kw for orders of not less than 10,000 units. Link: <https://xueqiu.com/8972527392/164860415>

为减低燃料电池组等专用部件的价格，丰田采取与旗下混合动力汽车共享电动部件，本田则是与旗下插电式汽车(PHEV)共用底盘。这些都是提高零部件规模化生产。

In order to reduce the prices of special-use components such as fuel cell stacks, Toyota uses the same electric components in its hybrid vehicles, while Honda uses the same chassis in its plug-in hybrid electric vehicles (PHEV). All these measures are taken to enhance the scale production of parts.

4) 规模化、国产化带来效益 Scale and localization bring benefits

4.1) 绿氢产业链规模化带来效益 Scale of green hydrogen industrial chain brings benefits



- 我国国产碱性电解槽技术领跑国际先进水平，单电解槽容量已达1000立方米氢气/小时，成本已下降至7000元/kW左右，仅为发达国家的一半甚至更低。
Domestic Chinese alkaline electrolyzer technology is world leading, with single electrolyzer capacity at 1,000 m³ H₂/hour and cost at about 7,000 yuan/kW, merely half of that in developed countries.
- 国内燃料电池电堆上游产业链企业国产化初有成效 Domestic enterprises in the upstream industrial chain of fuel cell stacks have achieved preliminary success in localization.
 - 膜电极、质子交换膜和双极板厂商已具备国产化能力 There has been domestic manufacturers of membrane electrodes, proton exchange membranes and bipolar plates.
 - 气体扩散层企业开始小规模生产 Gas diffusion layer enterprises have started small-scale production.
 - 催化剂企业正处于研发阶段 Catalyst enterprises are working on R&D.
 - 金属双极板企业开始国产化阶段 Metal bipolar plate enterprises have started localization.

生产规模最大+国产化率最高+智能化=经济效益最好

Largest production scale + Highest localization rate + Intelligitization = Best Economic Benefits

5) 氢能国际合作必不可少 International cooperation on hydrogen is essential



全球能源转型快速推进，氢能有望成为国际合作新热点。

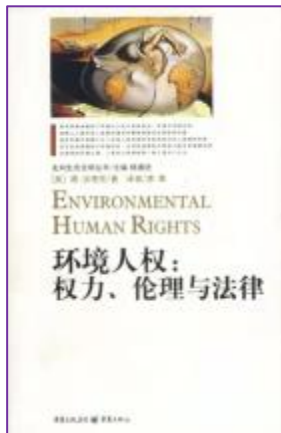
With global energy transformation advancing rapidly, hydrogen is likely to become a new hotspot for international cooperation.

- 紧随一带一路
Follow the Belt and Road Initiative
- 出租设备
Equipment renting
- 输出技术
Technologies export
- 生产绿氢、绿氨等
Produce green hydrogen, green ammonia, etc.
- 出售绿氢、绿氨等
Sell green hydrogen, green ammonia, etc.
- 分享利润、共同富裕
Share profits and enjoy prosperity

绿氢给中国的机会:一带一路的战略支撑!

Green hydrogen brings an opportunity to China: the strategic support from the Belt and Road Initiative

6) 氢能的哲学支撑：氢能伦理 Philosophical Support for Hydrogen: Hydrogen Ethics



氢能伦理 (Hydrogen Ethics) 是氢能发展应该遵循的各种道德准则。氢能伦理的核心就是以自然为本,可持续发展。氢能伦理是能源伦理的一部分, 指导氢能健康地发展。

Hydrogen Ethics is a variety of moral principles that should be followed in the development of hydrogen. Its core is **nature and sustainable development**. Hydrogen Ethics is a part of energy ethics, which could guide the healthy development of hydrogen.

- 焦炉煤气是很好的蓝氢来源。但是我们不应为获得这种蓝氢而发展炼焦行业, 排放更多CO₂。
Coke oven gases are a good source of blue hydrogen. However, the coking industry should not be developed in order to obtain it; otherwise, more CO₂ will be emitted.
- 为了能源安全, 应该提倡能源多样化, 如氢电并举、宜氢则氢、宜电则电。
Energy diversification should be promoted for energy security purposes. Both hydrogen and electrification shall be developed and adopted where suitable.
- 记牢发展氢能初衷, 不要拘泥氢能目前的经济性, 而应关注可持续性。
The original intention of developing hydrogen shall never be forgotten. We should pay attention to the sustainability instead of sticking to the current economic benefits of hydrogen.
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7) 小结 Summary 1/2

- A) 中国已经开启伟大的能源长征，中国2060年“碳中和”目标就是中国能源长征目的地。中国实现“碳中和”之时就是中国能源独立之日，也是中国对人类社会发展的贡献。

China has begun the great energy journey with the goal of carbon neutrality by 2060 as its destination. The day when China realizes carbon neutrality marks the day it achieves energy independence, which would also reflect China's important contribution to the development of human society.

- B) 中国要2060年达到“碳中和”，现在就必须有计划开展绿氢、绿电替碳，提高绿色氢能产业链的经济性成为重要任务。

In order to achieve carbon neutrality in 2060, it is high time that China replaces coal with green hydrogen and green electricity in a well-planned manner and make it an important task to improve the economic benefits of green hydrogen industrial chain.

7) 小结 Summary 2/2

C) 适合绿色氢能产业链的政策、法规和标准有助于提高绿色氢能产业链的经济性。

Policies, regulations and standards compatible with the green hydrogen industrial chain are helpful to improve its economic benefits.

D) 氢能产业的经济性依赖技术进步，包括数字化、智能化。

The economic benefits of the hydrogen industry depends on technological progress, including digitalization and intelligentization.

E) 规模化、国产化显著地改善绿色氢能产业链的经济性。

Scaling up and localization could remarkably improve the economic benefits of green hydrogen industrial chain.

F) 开展氢能国际化合作，为一带一路服务，共同富裕、氢满天下。

International cooperation should be carried out to serve the Belt and Road Initiative, promote green hydrogen globally and realize common prosperity.

G) 重视氢能的哲学支撑：使氢能健康发展，也体现氢能经济性。

Attention should be given to the philosophical support for hydrogen to promote the healthy development of hydrogen and to realize its economic benefits.

谢谢出席，敬请指正！
Thank you for your attention.
Comments are welcome.

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