# 绿色金融+数字化技术助力氢能可持续发展
# Promote Hydrogen Sustainable Development with Green Finance and Digital Technology

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# 发言提纲 Outline

- 引子：氢能是“瑞士军刀”还是“阶梯”？
  Introduction: Is Hydrogen “a Swiss Army Knife" or “a Ladder"?

- 绿氢项目融资
  Green Hydrogen Project Financing

- AIoT助力氢能
  Promote Hydrogen with AIoT

- 建议：氢能数字平台
  Suggestion: Hydrogen Energy Digital Platform

# 氢有多能？How capable is hydrogen?

氢是能源解决方案的瑞士军刀：多重用途、可储存、转换和运输能源、零碳排放

Hydrogen is a Swiss Army Knife for energy solutions: multiple uses, an energy that can be stored, converted and transported, and free of carbon emission

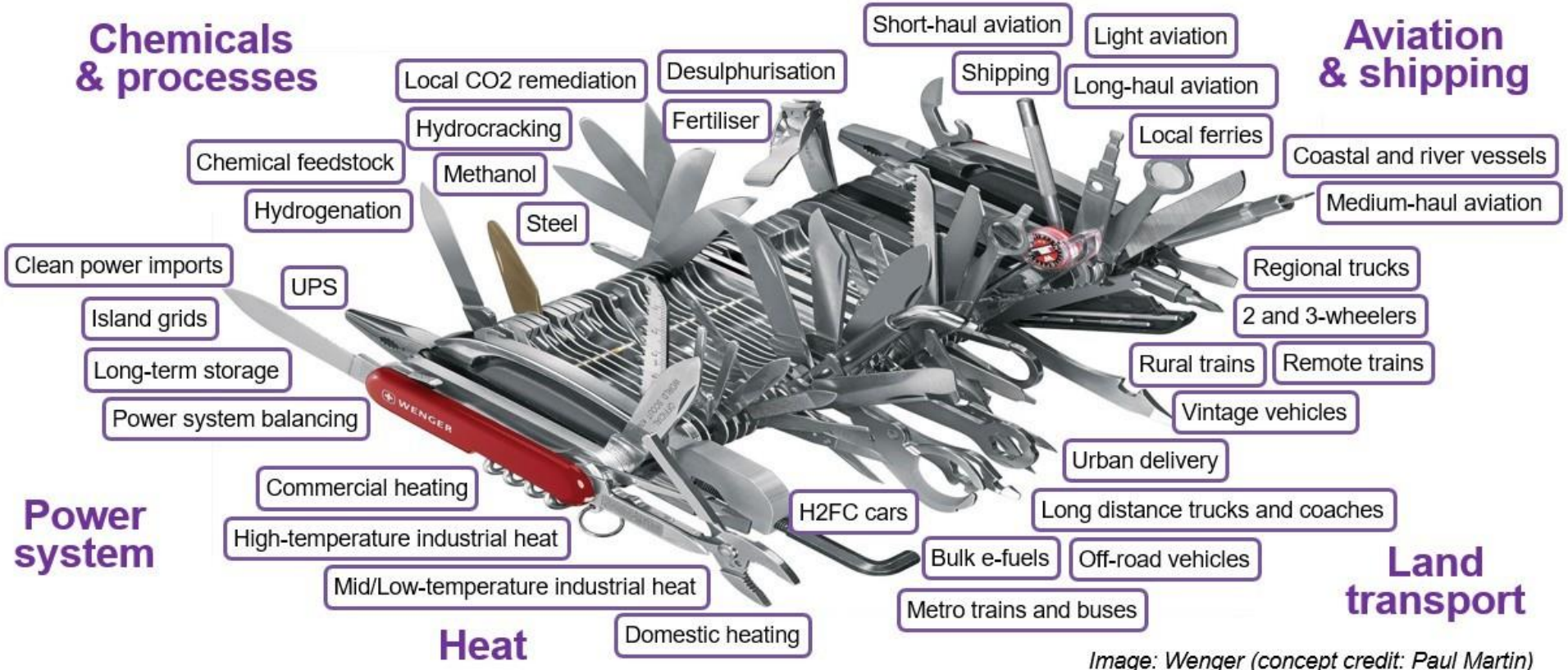
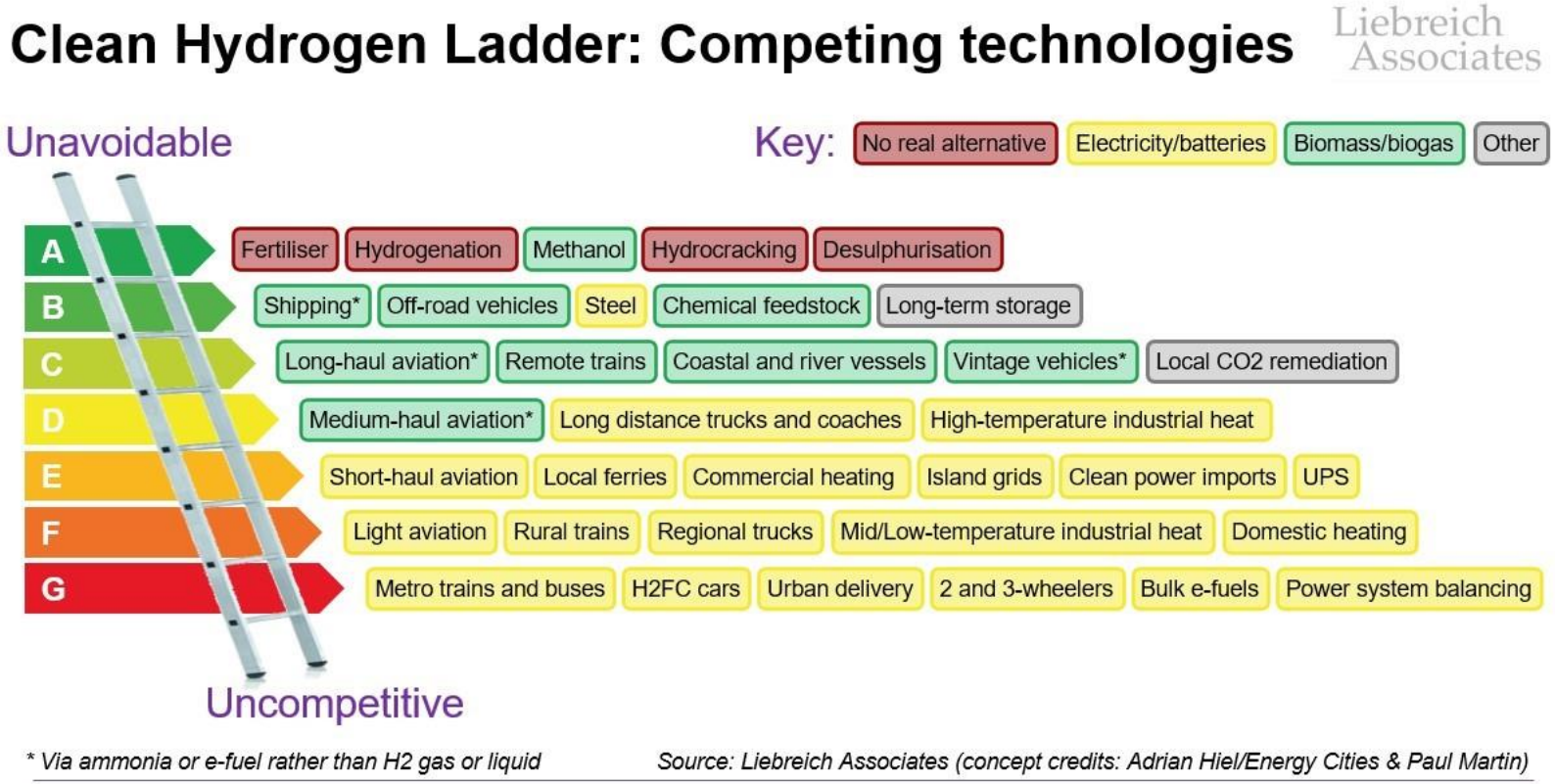



*Image: Wenger (concept credit: Paul Martin)*

# 氢有多能？How capable is hydrogen?

氢无所不能，但是只是在没有其他更便宜、更简单、更安全、更方便的解决方案时，才会用到氢

Hydrogen is omnipotent, but will only be used when there is no cheaper, simpler, safer and more convenient solutions available.



# 氢能市场 Hydrogen Energy Market
## 政府的关键作用 Key Role of the Government

- 绿氢尚无竞争力 Green hydrogen is not yet competitive

绿氢的生产以及应用仍处于早期阶段。与以化石燃料的现有工艺相比，绿氢成本高出3-4倍。
The production and application of green hydrogen are still in the early stage. Compared with the existing processes of fossil fuels, the cost of green hydrogen is three to four times higher.

SUSTAINABLE FUTURE

**‘No commercial case for green hydrogen’ yet: Siemens Energy CEO**

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- 政府的作用 Role of the Government

政府的支持对于启动绿氢市场至关重要，通过向工业、交通和其他领域使用绿氢的项目提供补贴来推动市场需求。政府还需要在氢气运输基础设施的发展中发挥作用，包括经济激励措施，并设立适用于管道、卡车和船舶氢运输的标准和法规。

Government support is crucial to launching green hydrogen market. Providing subsidies to green hydrogen consuming projects in industry, transportation and other sectors could boost market demand. The government should also play a role in developing hydrogen transportation infrastructure, using economic incentives and establishing standards and regulations suitable for hydrogen transportation by pipelines, trucks and ships.

# 氢能项目融资 Green Hydrogen Project Financing
## 碳价的作用 The Role of Carbon Pricing

- 项目融资 Project Financing

项目融资是为主要能源和基础设施项目筹集长期债务的一种行之有效的方法。贷款由项目产生的现金流独立偿还，对投资者资产的追索权有限。

Project financing is an effective way to raise long-term debt for major energy and infrastructure projects. The loan is repaid independently by the cash flow generated by the project, and the recourse to investors' assets is limited.

- 绿氢项目融资 Green Hydrogen Project Financing

随着绿氢行业的成熟、成本的持续下降以及与绿氢项目相关的技术和市场风险的下降，项目融资有望成为绿氢项目的重要资金来源。对于银行来说，项目融资的黄金标准是与公用事业公司签订的长期固定价格承购合同。

With green hydrogen industry maturing, cost dropping constantly and relative technical and market risks reducing, it’s possible that project financing will become a major source of green hydrogen project funding. For banks, the gold standard of project financing is the long-term fixed-price off-take contracts signed with public utility companies.

- 碳价的作用 The Role of Carbon Pricing

绿氢与15年前的光伏相当，当时政府以固定上网电价支撑市场，以规模和技术进步降低成本。长期来看，氢能融资的最重要因素是碳价，成为弥合绿氢成本与和传统工艺之间成本差距的关键。

Green hydrogen is similar to the photovoltaic industry 15 years ago, when the government supported the market with a fixed on-grid price mechanism and its cost was reduced by scaling up and technological progress.
In the long run, the most important factor of hydrogen financing is carbon pricing, which is the key to bridge the cost gap between green hydrogen and traditional processes.

# 案例：Case Study

## 世界首次：智利政府提供5000万美元补贴招标建设绿氢设施

## The first in the world: Chilean government invites bids to build green hydrogen facilities with a subsidy of 50 million USD

- 智利具有世界上最高的太阳辐射和优良的风能资源，政府目标在2030年建设5吉瓦绿氢产能，成为全球最具竞争力的绿氢生产和出口基地。

  Chile has the world's best solar radiation and excellent wind resources. The Chilean government targets 5 GW of green hydrogen production capacity by 2030, making it the most competitive green hydrogen production and export base in the world.

- 2021年4月智利经济发展局（CORFO）绿氢项目招标，提供5000万美元补贴（单个项目补贴不超过3000万美元），在智利投资建设10兆瓦以上的绿氢设施，完工不迟于2025年12月。

  In April 2021, Chilean Economic Development Agency (CORFO) called for bids for green hydrogen projects in Chile at above 10 MW with completion date no later than December 2025 and provided a subsidy of 50 m USD (no more than 30 m USD for each project).

- 参与竞标公司包括意大利Enel、法国Engie、法液空、爱尔兰Linde等10家公司，项目规模平均20兆瓦。

  There are ten bidders including Enel (Italy), Engie (France), Air Liquide (France) and Linde (Ireland). The average project scale is 20

| SELECTION CRITERIA | PONDERATION |
|---|---|
| Electrolyzer's nominal capacity | 30 percent |
| Efficiency of the contribution requested for the project[3] | 20 percent |
| State of maturity of the project | 20 percent |
| Experience of the Bidder and/or its subcontractor | 20 percent |
| Financial model of the project | 10 percent |

# 案例：Case Study

## 欧洲HyDeal Ambition绿氢项目（67吉瓦）

## HyDeal Ambition (67 GW) in Europe

- 据不完全统计汇总，各国目前有26个吉瓦规模的绿氢开发项目，总计达到260吉瓦；新的项目每周都在增加。最大的项目是欧洲HyDeal Ambition项目（67吉瓦）

  According to incomplete statistics, currently there are 26 gigawatt-scale green hydrogen projects in the world, with a total capacity of 260 GW. New projects emerge every week. The largest project is HyDeal Ambition (67 GW) in Europe.

——地点：西欧多个地点，从西班牙和法国西南部开始，延伸到法国东部和德国

Location: multiple locations in Western Europe, from Spain and Southwest France to East France and Germany

——电源：多地的95吉瓦光伏为67吉瓦电解槽供电

Power Supply: 95 GW solar PV powers up 67 GW of electrolyzers in several places

——市场：以1.50欧元/千克的价格在欧洲提供绿氢

Market: Green hydrogen is sold at 1.50 Euro/kg in Europe

——开发商：30家欧洲能源公司　Developers: 30 European energy companies

——产量：360万吨/年　Output: 3.6 million tons/year

——计划竣工日期：2030年前　Planned Completion Date: Before 2030

——预计投资成本：未说明　Estimated Investment Cost: Unspecified

——开发阶段：项目于2021年2月宣布，仍处于早期开发阶段

Development Stage: The project was announced in February 2021 and is still in the early development stage

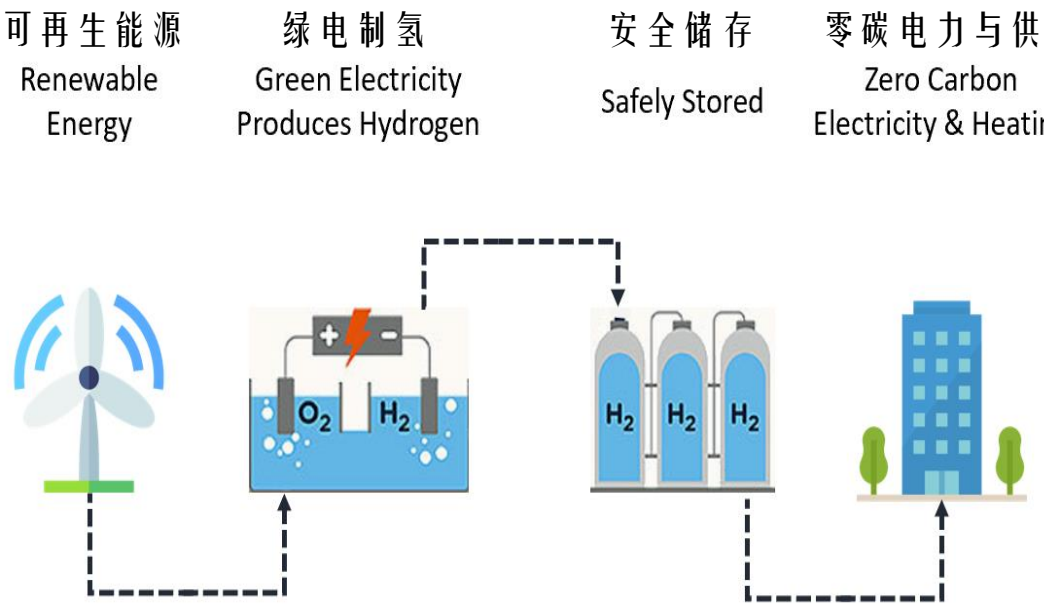
# AIoT：
# 人工智能（AI）和物联网技术（IoT）的结合助力氢能发展
# The integration of artificial intelligence (AI) and Internet of Things (IoT) promotes the development of hydrogen

- 数字孪生（digital twins）：对多种设计和场景进行建模，包括天气、需求波动和本地基础设施（当前和未来）；监测和控制能源消耗、工厂性能、生产率、纯度和储存等制氢的关键性能指标，以确保高效生产。

  Digital Twins: Model for multiple designs and scenarios, including weather, demand fluctuations and local infrastructure (present and future); monitor and manage key performance indexes of hydrogen production such as energy consumption, factory performance, productivity, purity and storage, to ensure efficient production.

- 绿氢溯源：基于区块链的平台从可再生能源工厂收集发电数据验证注入电解槽的份额和过程中产生的氢气量；监控绿色氢气的输送。由于区块链上的审计跟踪，平台中共享的所有信息都是可信、透明和不可篡改的。

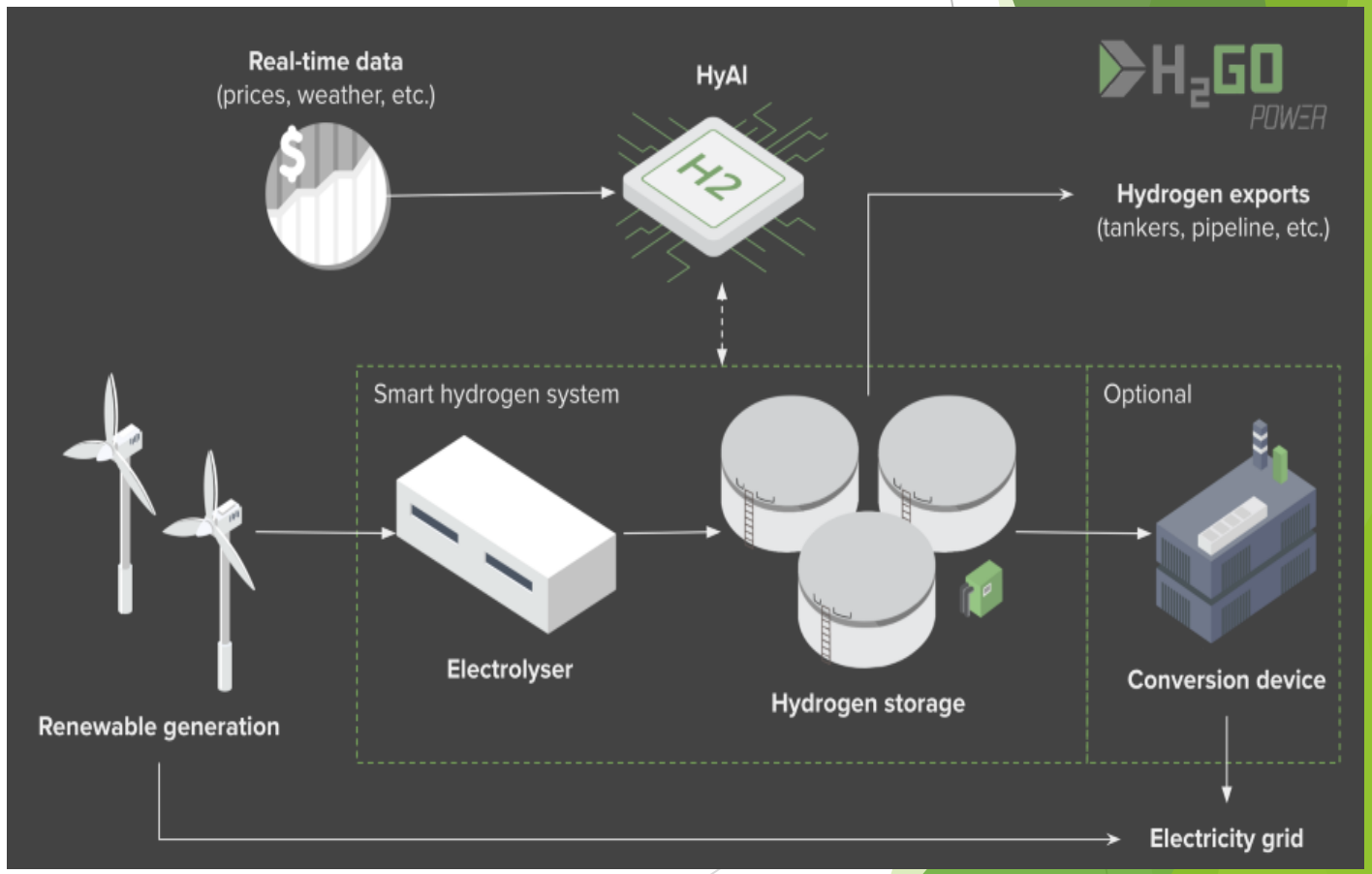
  Green hydrogen origin: A blockchain-based platform collects the power generation data from renewable energy plants, verifies the share of hydrogen injected into electrolyzers and the amount of hydrogen generated in the process, and monitors the transportation of green hydrogen. Due to the audit trail on the blockchain, all information shared on the platform is authentic, transparent and immutable.



# 案例：Case Study
## 英国氢能人工智能（HyAI）项目
## The Hydrogen Artificial Intelligence (HyAI) Project in Britain

- 英国H2GO Power，低压氢能存储和人工智能驱动的资产管理软件开发商，与欧洲海洋能源中心（EMEC）和伦敦帝国理工学院合作HyAI（氢人工智能）项目。
  H2GO Power, an asset management software developer driven by low-pressure hydrogen storage and artificial intelligence, cooperates with European Marine Energy Center (EMEC) and Imperial College London on HyAI Project.

- 把人工智能软件与储氢硬件集成，利用EMEC制氢厂提供的数据，与人工智能预测算法中的天气、电价和电网管理数据相结合，预测未来电力成本和用户需求，优化存储系统的运行，从而实时做出智能、数据驱动的决策，优化可再生能源与英国电网的集成。
  Integrating AI software with hydrogen storage hardware, using data provided by EMEC hydrogen production plant, and combining weather, power price and power grid management data in AI prediction algorithm to forecast future power cost as well as user demand and improve the operation of the storage system, so as to make real-time smart and data-driven decisions and optimize the integration of renewable energy with the British power grid.



# 案例：Case Study
## 西班牙区块链绿氢溯源平台
## The Blockchain Green Hydrogen Traceability Platform in Spain

- 西班牙ACCIONA公司开发GreenH2chain®，世界上第一个基于区块链技术的平台，确保绿色氢的可再生来源，允许客户在世界任何地方实时验证和可视化整个绿色氢气价值链

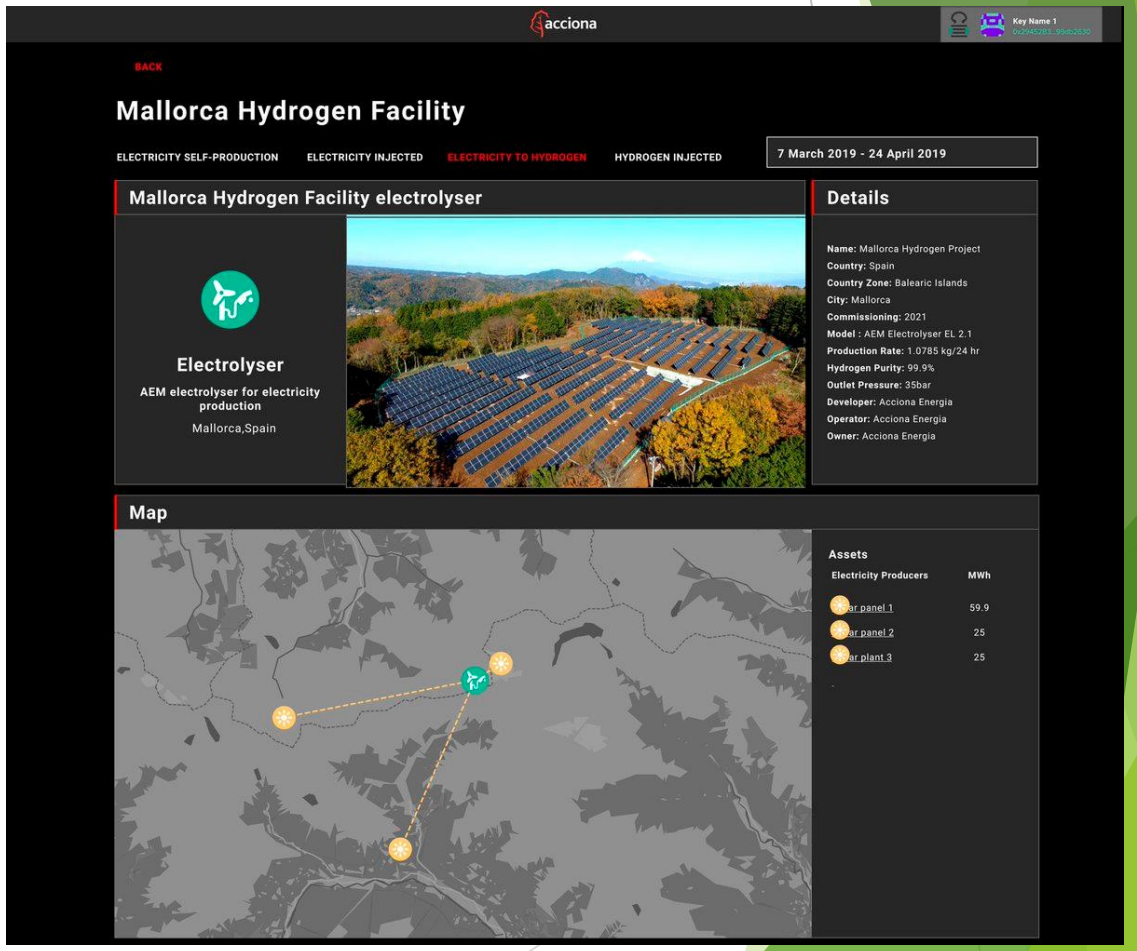
  GreenH2chain®, developed by a Spanish company called ACCIONA, is the world's first platform based on blockchain technology that ensures renewable sources of green hydrogen, allows customers to verify it in real time anywhere in the world and visualize the whole green hydrogen value chain.

- 计算消费者通过使用绿氢避免的二氧化碳排放量

  Calculate $CO_2$ emissions that consumers avoided by using green hydrogen

- 在马洛卡岛（西班牙）绿氢项目试点实施

  A pilot green hydrogen project has been implemented in Mallorca Island, Spain.



# 建议：Suggestions

## 建设全产业链绿氢平台，与碳市场对接

## Build a whole-industrial-chain green hydrogen platform to align with the carbon market

- 以数字化技术构建全产业链绿氢平台，涵盖绿氢产业的供给和需求的数量和价格信息。
  Build a whole-industrial-chain green hydrogen platform with digital technology, covering the amount and price information of supply and demand of the green hydrogen industry.
- 发布绿氢指数，包括价格指数、交易量指数、行业指数等。
  Release green hydrogen indexes, including price indexes, trading volume indexes, industrial indexes, etc.
- 建立从制氢到用氢的氢能全产业链$CO_2$减排方法学，明确整个氢能产业链中每部分的碳排放和相比不同参考模式下的减排量，与碳市场的对接。
  Establish a methodology of CO2 emission reduction covering the whole hydrogen energy industrial chain from hydrogen production to application and clarify carbon emissions of each part in the chain and the comparison of emission reductions under different reference modes to connect with the carbon market.
- 基于区块链技术确保绿氢的可再生来源。
  Ensure renewable sources of green hydrogen based on blockchain technology.
- 对接绿色金融平台，投资绿氢产业链各个环节。
  Align with green financial platforms and invest in all parts of the green hydrogen industrial chain.

➡ 全产业链绿氢平台建设需要各方支持和参与！

It is essential that all parties supports and participates in the building of a whole-industrial-chain green hydrogen platform.