



# 可再生氢在中国的前景 及其在工业脱碳中的作用

## Prospects of Renewable Hydrogen in China and Its Role in Industrial De-carbonization

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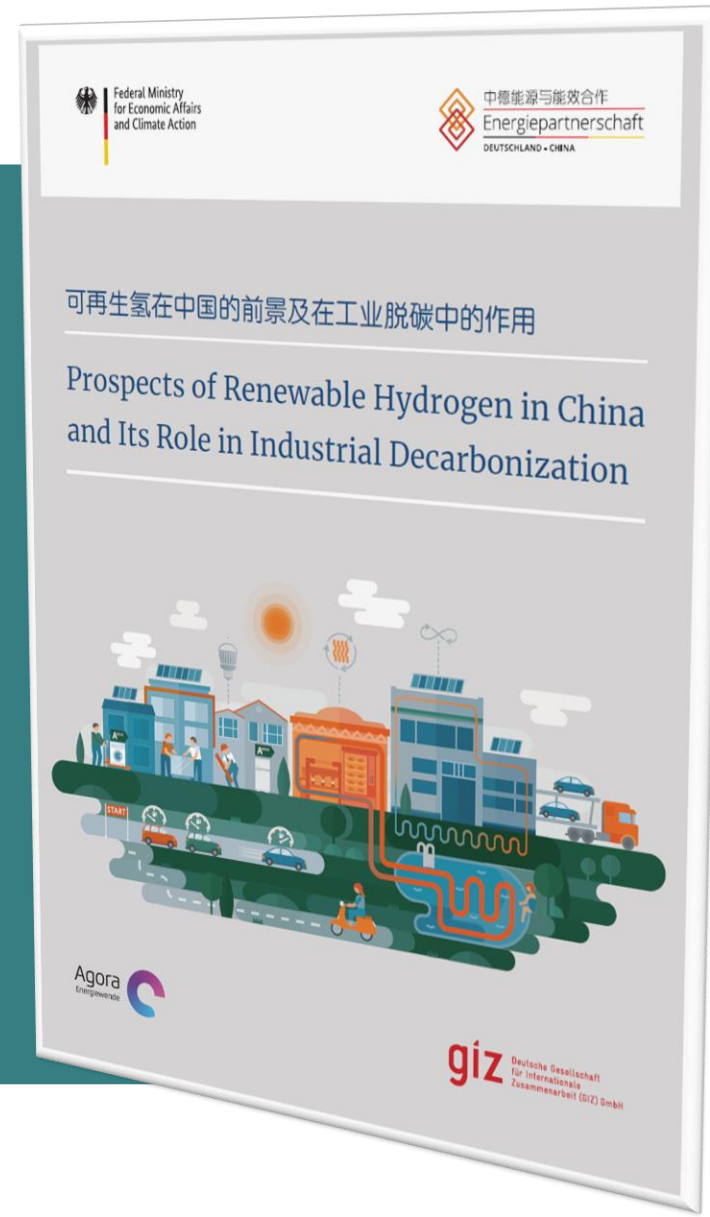
博众智合能源转型论坛 Agora Energy Transition China

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# 讲座要点 Key points

- ✓ 中国氢能现状 China hydrogen status-quo
- ✓ 氢能多场景应用 Multi-scenario applications of H2
- ✓ 德国国家氢能战略  
The German National Hydrogen Strategy
- ✓ 电动汽车发展助力减排的启示  
Implications from electric vehicles' role in transport decarbonization
- ✓ 政策建议 Policy recommendations



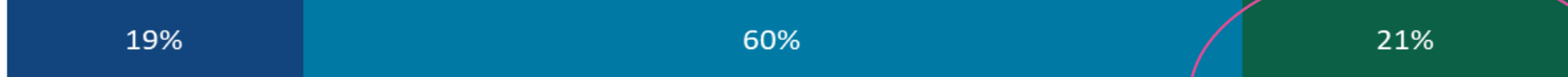
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# 中国氢能现状：以煤为主要制氢来源

## China hydrogen status-quo: production dominated by coal

世界氢气供应（副产氢单列） World (by-product separated)



中国氢气供应（副产氢单列） World (by-product separated)



世界氢气供应（按原料） World (by source)



中国氢气供应（按原料） China (by source)



- Coal 煤炭
- Natural gas 天然气
- Oil 石油
- Electrolysis 电解水制氢
- Dedicated electrolysis 电解槽制氢
- By-product 副产氢

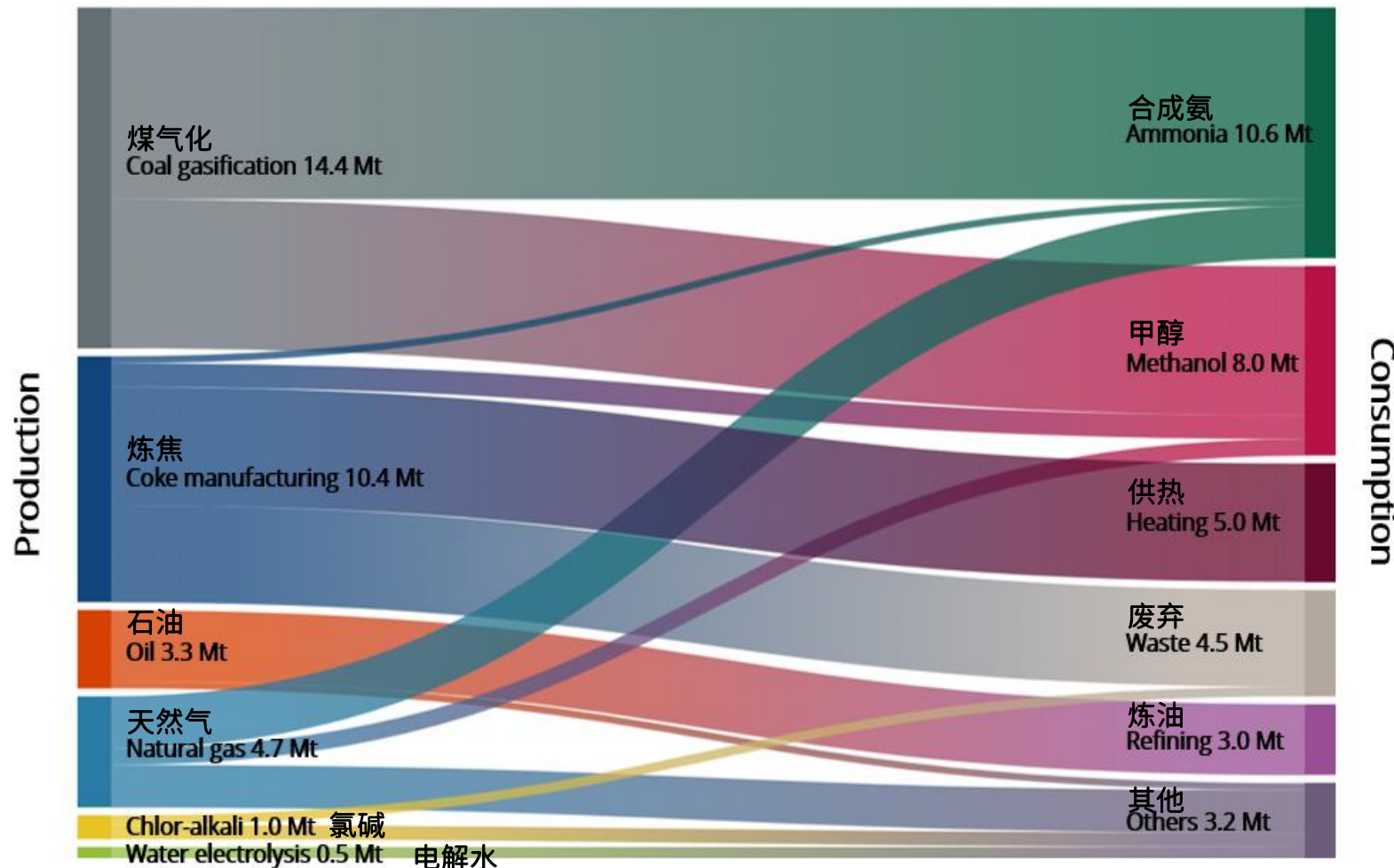
- 全球96%氢气供应来自化石燃料 96% of H2 are from fossil fuels globally
- 甲烷和煤炭是主要来源 Methane and coal are major sources



# 提升氢能利用潜力巨大 Significant potential to scale up hydrogen utilization in China



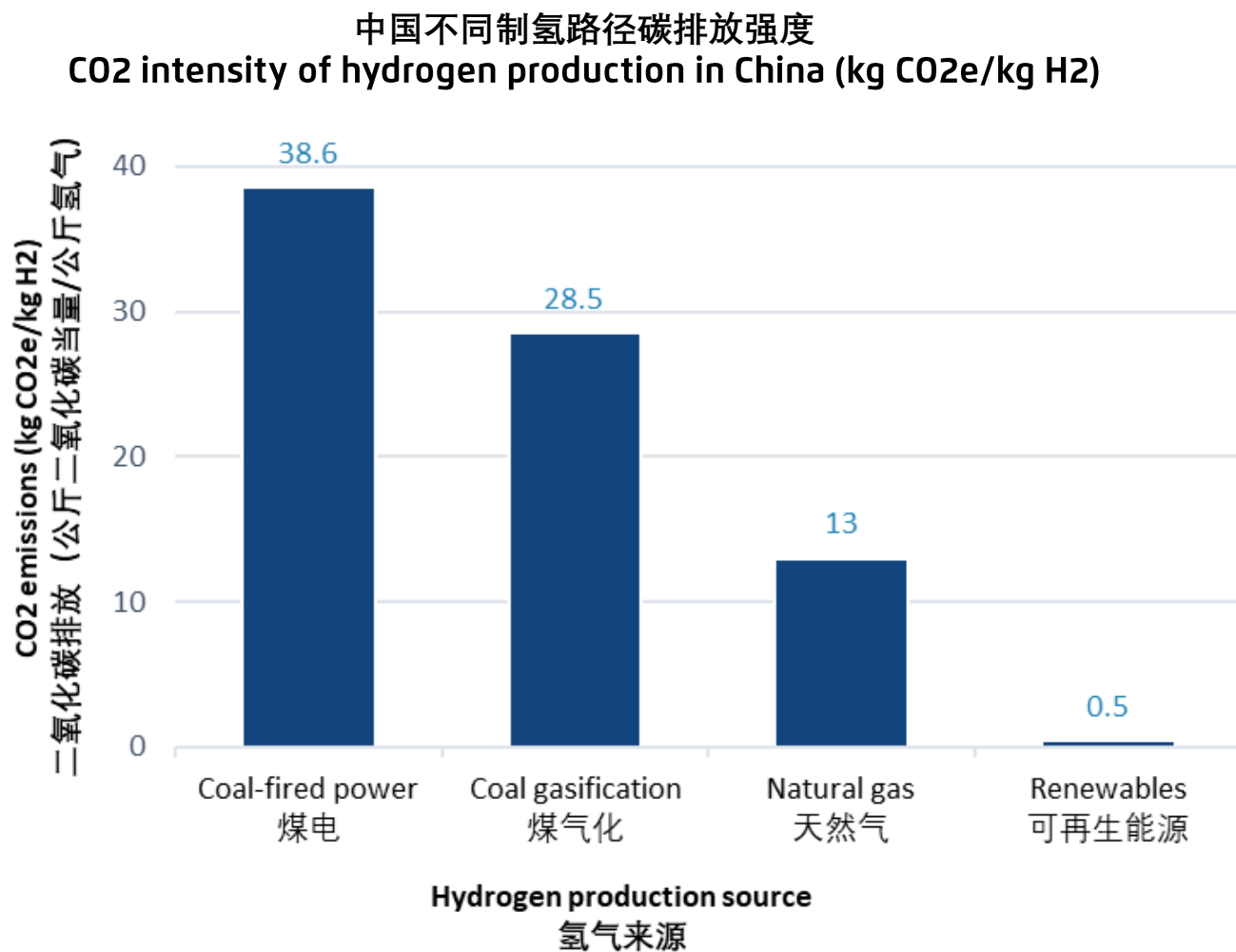
中国氢能生产与消费流向图 China hydrogen flow



- 中国主要氢气消费行业有：合成氨、甲醇、石油精炼  
Ammonia, methanol and oil refining are the main hydrogen consuming industry in China
- 每年450万吨未被有效利用，500万吨用于供热的可转做其他用途  
4.5Mt of waste H<sub>2</sub> and 5 Mt used for heating could be better utilized each year
  - 燃料电池汽车示范城市群  
Fuel cell vehicle demonstration
  - 氢冶金-焦炉煤气直接还原铁  
H<sub>2</sub> metallurgy – direct reduced iron with coke oven gases

# 可再生氢减排潜力巨大

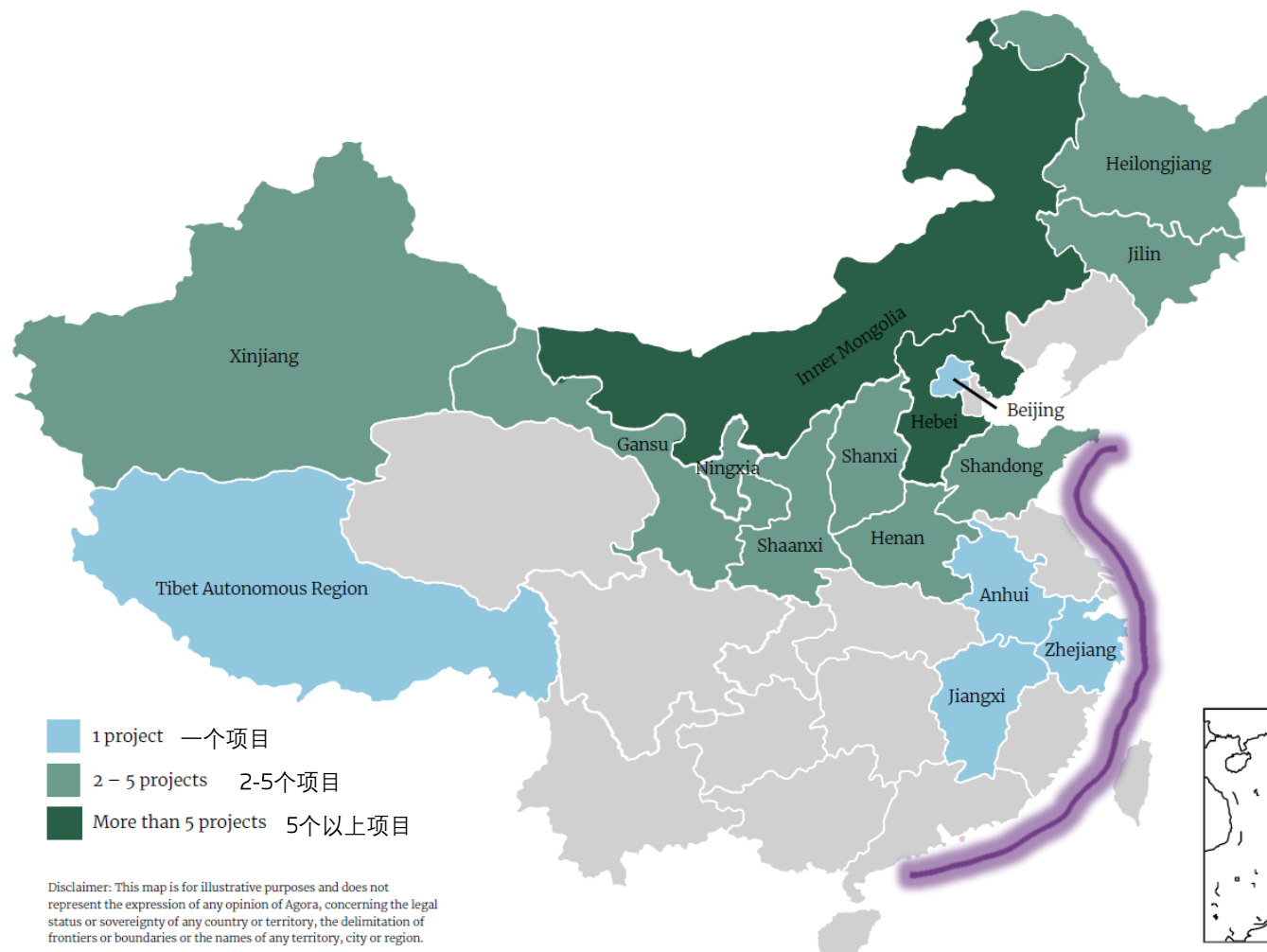
## Great carbon abatement potential by renewable hydrogen



- 氢能的碳减排效益与氢的生命周期碳足迹息息相关  
Carbon abatement benefits of hydrogen depends on the its life-cycle carbon footprint
- 发改委确定原料用能不纳入能源消费总量控制，强调不是放松对石化和煤化工行业发展的严格审批  
China continues strict permitting of new capacity in petrochemical and coal chemical sectors despite that energy commodities used as feedstock are not subject to total energy consumption control

# 中国氢能现状：可再生氢示范项目集中在华北和西北

## China hydrogen status-quo: Renewable hydrogen production concentrates in the North and Northwest



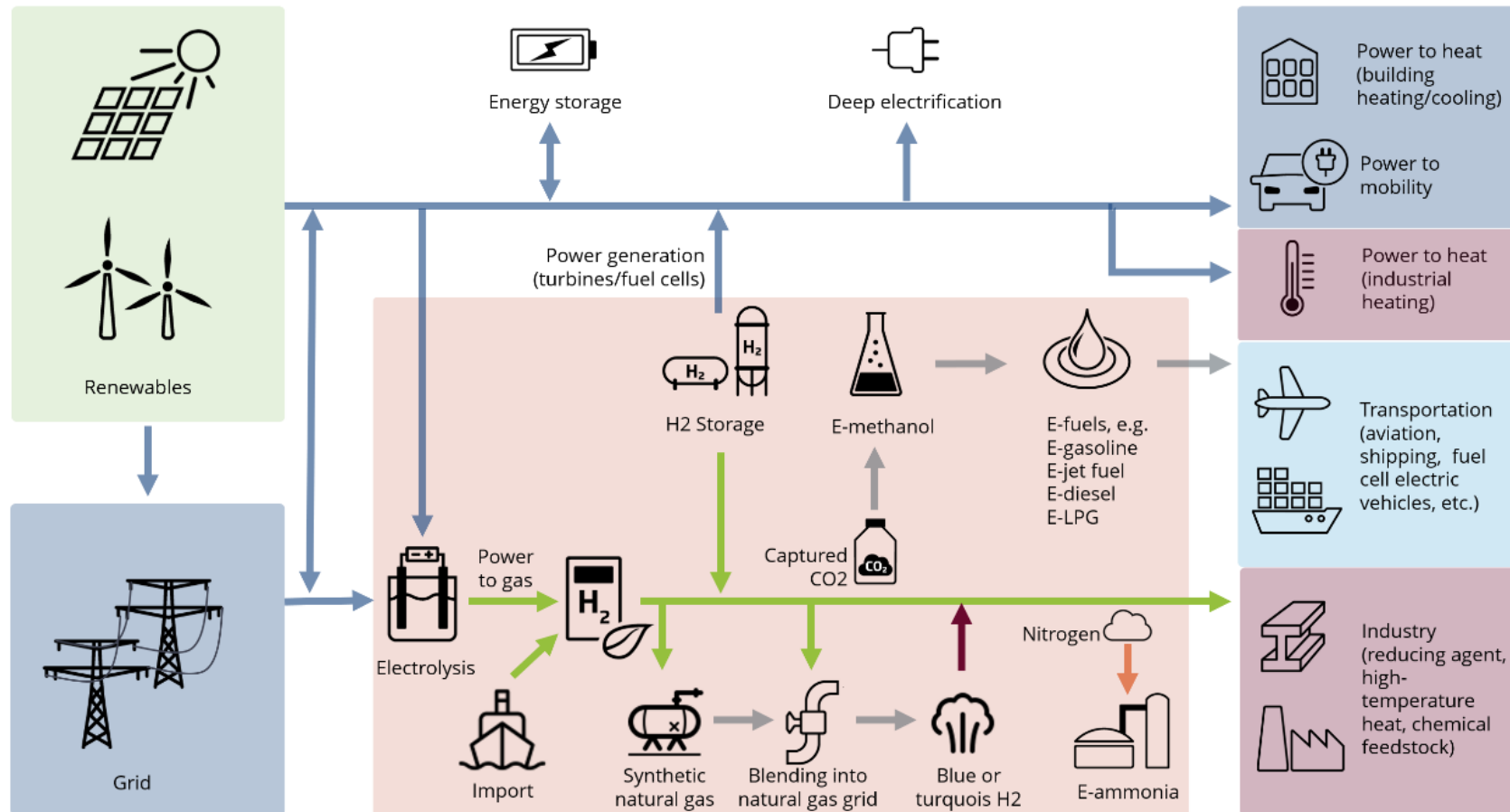
- 截至2022年7月，我们统计到50个已规划的可再生氢生产项目  
By July 2022, 50 renewable hydrogen production projects have been invested in China

- 内蒙古发展氢能的优势：全国最大的风电装机量（39.9吉瓦）、最大的太阳能潜力和现有的工业副产氢基础  
Inner Mongolia takes advantage of its largest installed wind capacity (39.9 GW) in China, biggest solar energy potential, and existing by-product hydrogen production.

- 河北9个可再生氢项目集中在风电丰富的张家口  
All the 9 projects in Hebei are located in Zhangjiakou, a city in the northwest of the province where wind energy resources are abundant.

# 氢能多场景应用：以可再生氢为基础的电力多元转换





## Multi-scenario applications of H<sub>2</sub>: Power to X based on renewable hydrogen



- 行业耦合把发电和能源消费相结合，更适应未来以可再生能源为主体的电力系统  
Sector coupling links power generation and energy consumption and works better with power systems that rely on renewables
- 氢能可以有效补足可再生能源的间歇性、并通过制成品与传统化石能源运销用体系结合  
H<sub>2</sub> compliments the variability of renewables and integrates with the current fossil fuel system well

# 可再生氢“无悔”应用场景与碳减排潜力

## No-regret renewable hydrogen application and its potential in carbon emissions abatement

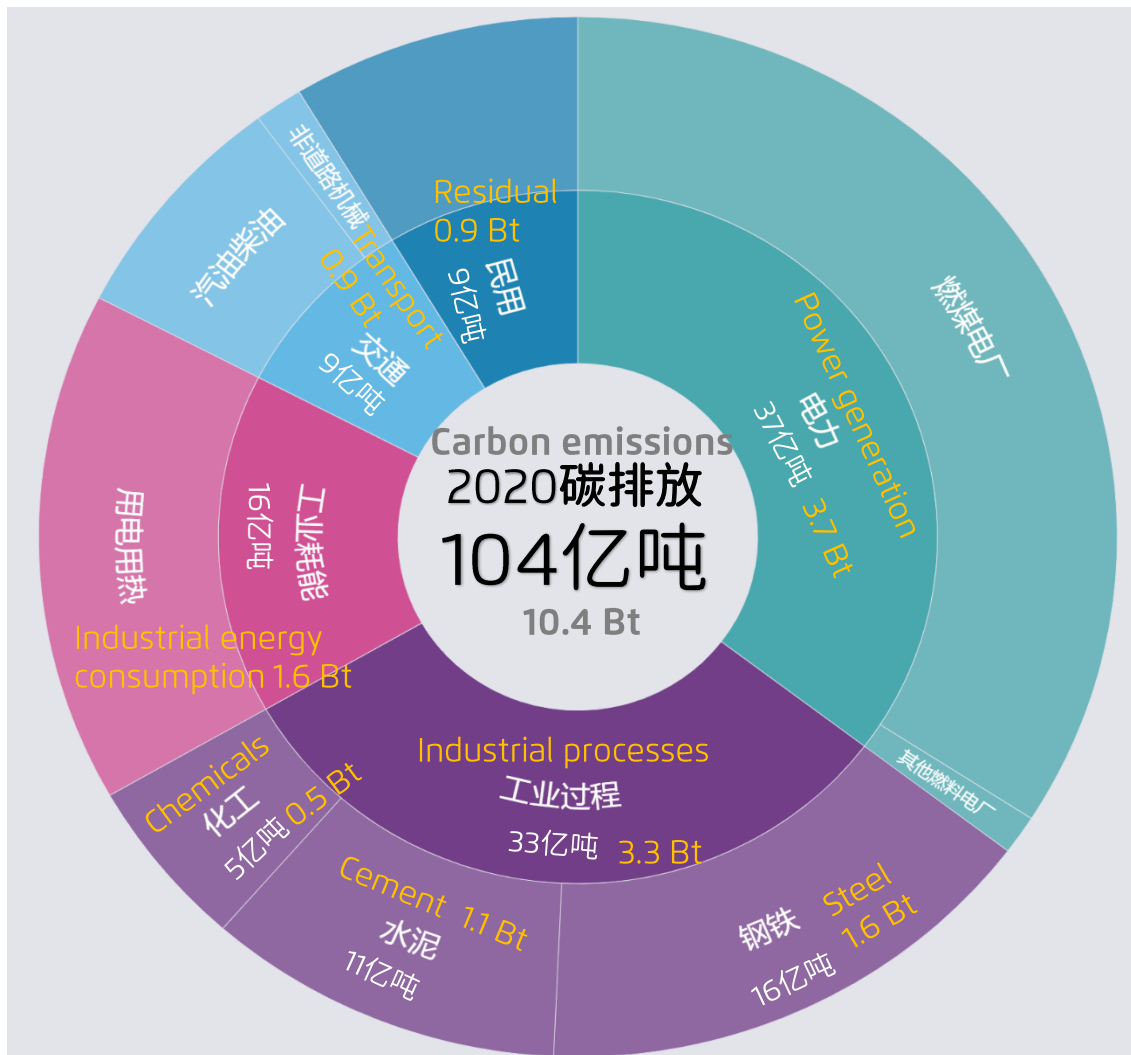
可再生氢应用 Renewable H2 application	无悔 No-regret	存在争议 Debatable	不宜应用 Bad idea
工业 Industry 	<ul style="list-style-type: none"> <li>Reaction agents (DRI steel)</li> <li>Feedstock (ammonia, chemicals)</li> </ul>	<ul style="list-style-type: none"> <li>High-temperature heat</li> </ul>	<ul style="list-style-type: none"> <li>Low-temperature heat</li> </ul>
交通运输 Transport 	<ul style="list-style-type: none"> <li>Long-haul aviation</li> <li>Maritime shipping</li> </ul>	<ul style="list-style-type: none"> <li>Commercial vehicles with ports and industry clusters</li> <li>Short-haul aviation and shipping</li> <li>Long-haul heavy-duty trucking</li> <li>Trains (depending on distance, frequency and energy supply options)</li> </ul>	<ul style="list-style-type: none"> <li>Passenger cars</li> <li>Light-duty vehicles</li> </ul>
电力 Power 	<ul style="list-style-type: none"> <li>Renewable energy back-up (seasonal demand)</li> </ul>	<ul style="list-style-type: none"> <li>Absolute size of need given other flexibility and storage options</li> </ul>	
建筑 Buildings 		<ul style="list-style-type: none"> <li>Heating grids</li> </ul>	<ul style="list-style-type: none"> <li>Building level heating</li> </ul>

Source: adapted from Agora Energiewende (2021)



# 为什么要关注工业领域碳排放?

## The importance of industrial decarbonization

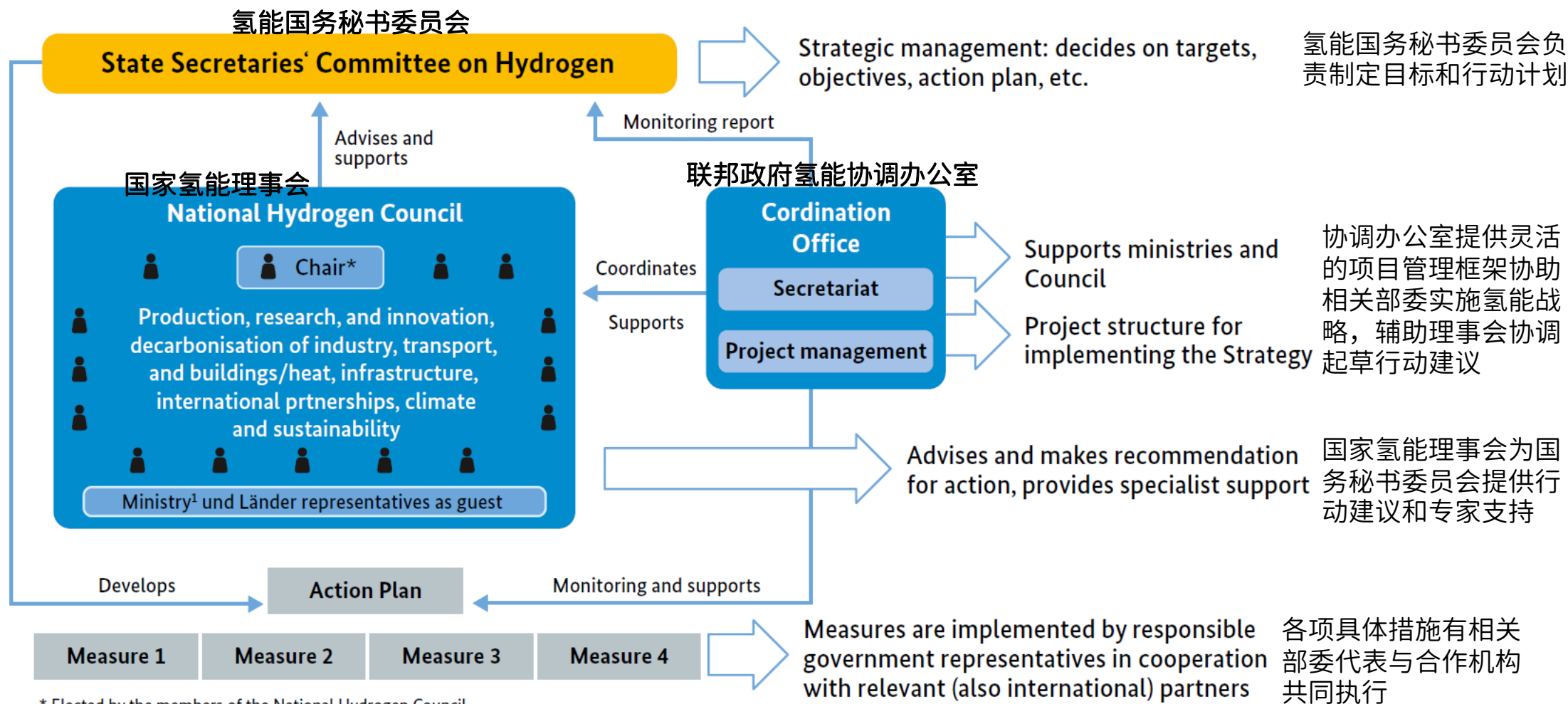


- 工业碳排放占比大，技术选择少  
Substantial carbon emissions from industries have few abatement options
- 工业行业对氢的需求持续且稳定  
Industrial demand for renewable hydrogen are long-term and steady
  - 2050年氢气直接还原铁带来约670万吨/年的可再生氢需求  
6.7 Mt of renewable H2 demand from H2 DRI by 2050
  - 挑战在于需要额外增加储能或网电来补充可再生能源的间歇性  
Extra cost to compensate for the variability of renewables

根据贺克斌院士为网易碳中和报告提供的2020年中国细分行业碳排放数据整理制图

# 德国国家氢能治理框架

## Governance structure of German National Hydrogen Strategy



\* Elected by the members of the National Hydrogen Council

<sup>1</sup> e.g at Director-General level

Source: The National Hydrogen Strategy (Germany)

# 德国国家氢能战略

## The German National Hydrogen Strategy

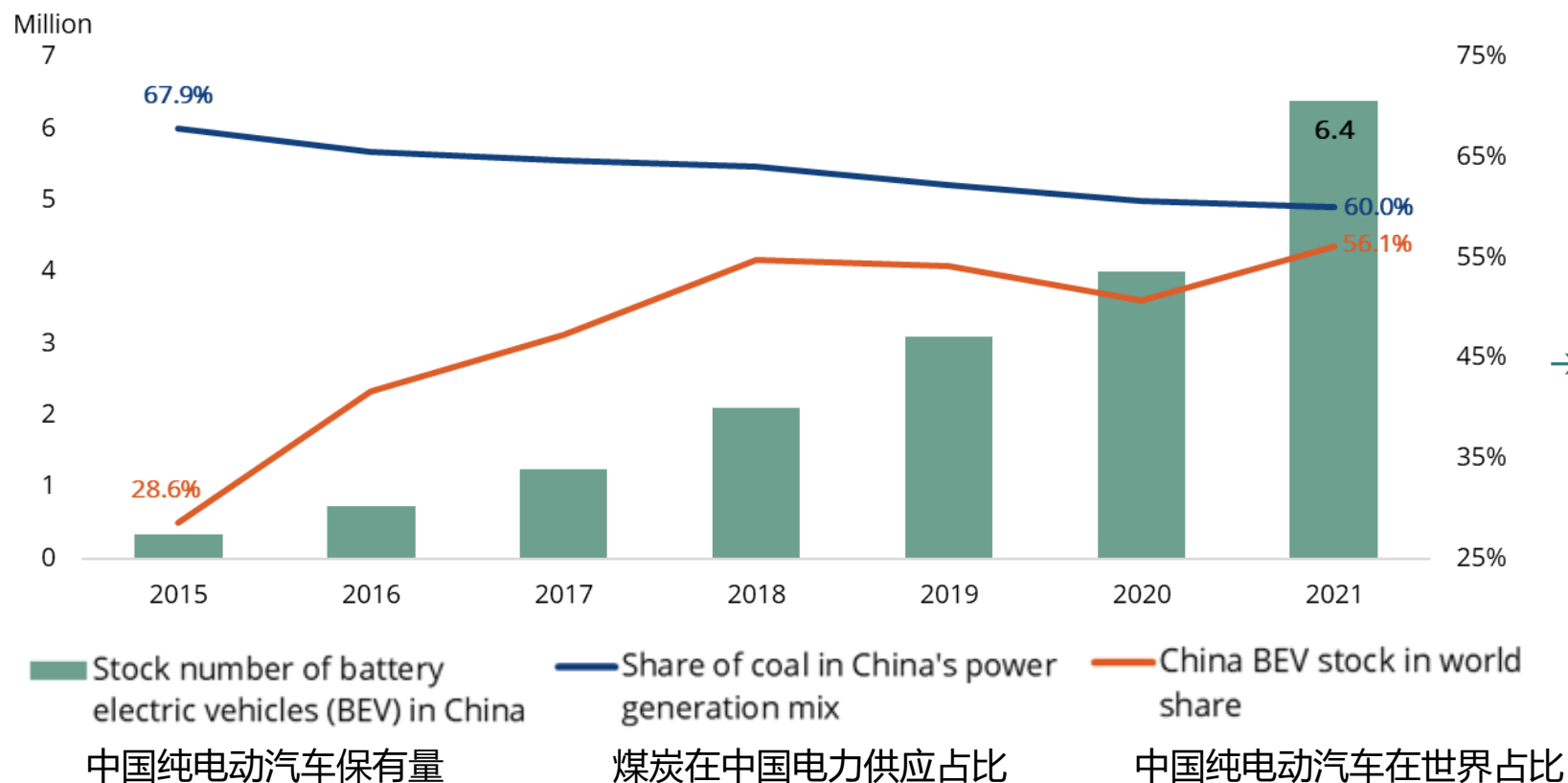


# 电动汽车发展助力减排的启示

## Implications from electric vehicles' role in transport decarbonization



中国煤电占比以及纯电动汽车保有量的增长，2015-21  
Share of coal power & rising deployment of battery EVs in China



→ 2015-2021期间，煤炭在中国电力供应中的比例下降了8个百分点，赋能电动汽车助力交通领域碳减排

During 2015-2021, coal's share in China's power generation mix dropped by 8 percentage points, empowering EVs to decarbonize transportation.

→ 2016年，财政部对93家主要的新能源汽车生产企业进行专项检查，发现骗补和违规谋补涉及补贴金额近93亿元

In 2016, an investigation into 93 carmakers revealed ¥9.3 billion of aggregate subsidy fraud.



# 政策建议（一）

## Policy recommendations

- 1. 氢能管制应更多侧重其能源属性  
Regulate H2 more in accordance with its intrinsic nature of an energy carrier**
- 2. 设立氢能部际协调机制并考察无悔基础设施布局  
Establish an inter-department coordination mechanism, with the mandate to examine no-regret infrastructure**
- 3. 防范“骗补”乱象，促进公平竞争  
Avoid subsidy fraud and promoting fair competition**
- 4. 营造更公平的竞争环境，大幅加强知识产权保护，积极消除市场准入壁垒  
Foster a level playing field, strengthen IP protection and eliminate market barriers**



## 政策建议 (二) Policy recommendations

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### 5. 充分利用现有化石燃料制氢产能，同时激励可再生氢产能的持续增长

**Make full use of fossil fuel-based hydrogen production and incentivize renewable hydrogen capacity additions to grow**

- 在氢价值链创建初期，扩大氢能的下游需求与上游的低碳生产应该区分对待

The utilization of hydrogen should be separated from cleaning up carbon-intensive upstream production before the value chain is established

### 6. 可再生氢在工业深度脱碳中的作用应被优先考虑，并重点聚焦钢铁、石油化工和煤化工产业

**Prioritize renewable hydrogen in industrial decarbonization, especially iron and steel, petrochemical, and coal chemicals**

- 排放密集工业行业纳入全国碳排放交易体系  
Carbon-intensive industrial sectors to be included in ETS
- 绿钢政府采购 Government procurement of green steel
- 碳差价合约 Carbon contract for differences
- 气候友好型原材料需求配额 Demand quota for climate-friendly raw materials



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