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# Hydrogen as the Enabler: Meeting China's Energy Challenge?

An IHS Markit study

2019

# Is there an opportunity for hydrogen use in China?

Key questions to consider:

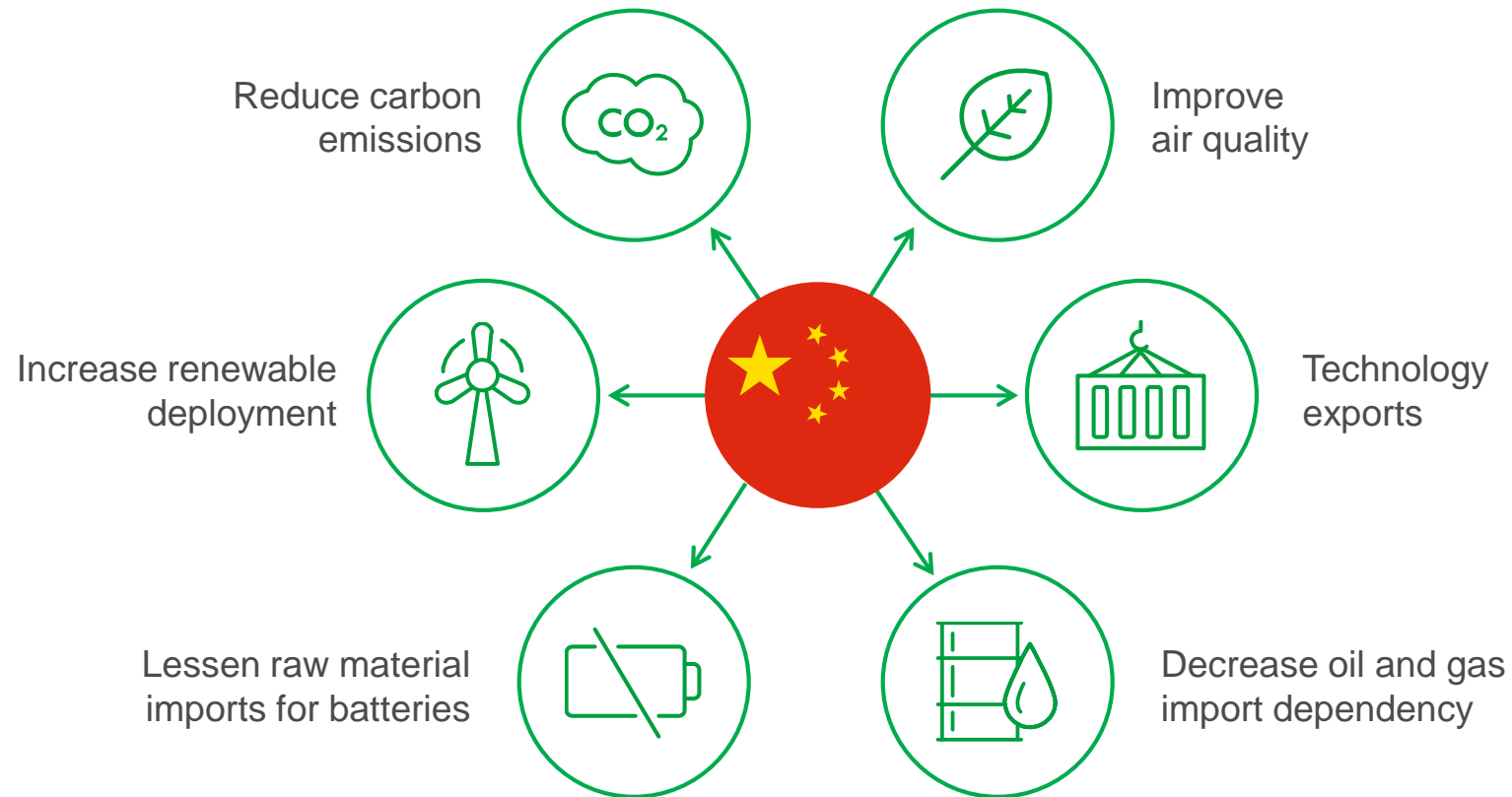
## Supply

- How competitive is hydrogen with alternative fuels?
- How much curtailed electricity is there and will it grow in the future with renewable capacity additions?
- Could hydrogen allow for a reduction in imported fuels?

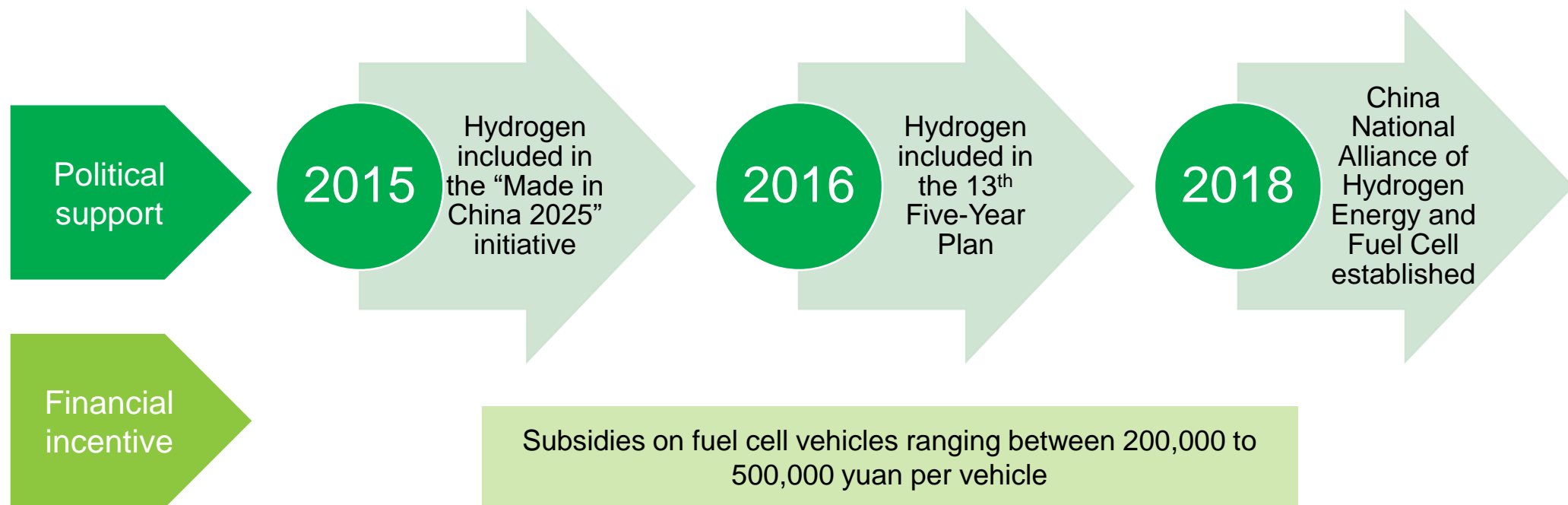
## Demand

- Which are the most prospective end-use sectors for hydrogen use?
- With the addition of substantial new renewable capacity, how can hydrogen help to balance the power system?

# Hydrogen deployment is consistent with many of China's long-term goals



# Hydrogen energy development is receiving increasing attention and support from the Chinese Government



# Why hydrogen? Hydrogen has multiple applications across the economy

## End use applications of hydrogen for energy use



### Transport

- Displace batteries or fossil fuels



### Industry and Heating

- Displace natural gas in pipelines and end uses
- Replace coal used for direct heat



### Power

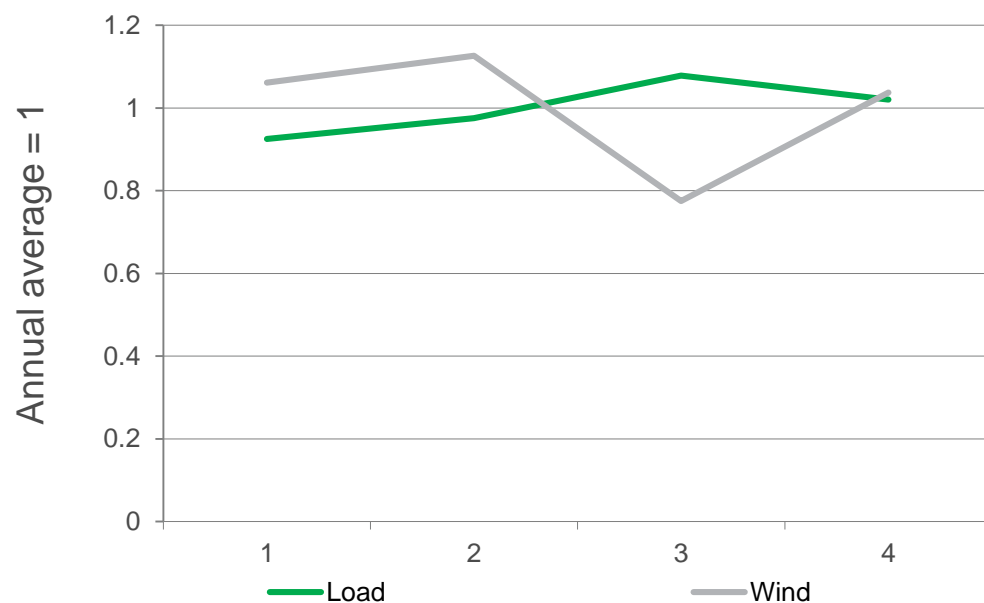
- Intra-day balancing of renewable generation and power demand
- Seasonal balancing of renewable generation and power demand
- Reduced fossil generation

Source: IHS Markit

# Why hydrogen? Hydrogen can help integrate intermittent renewables

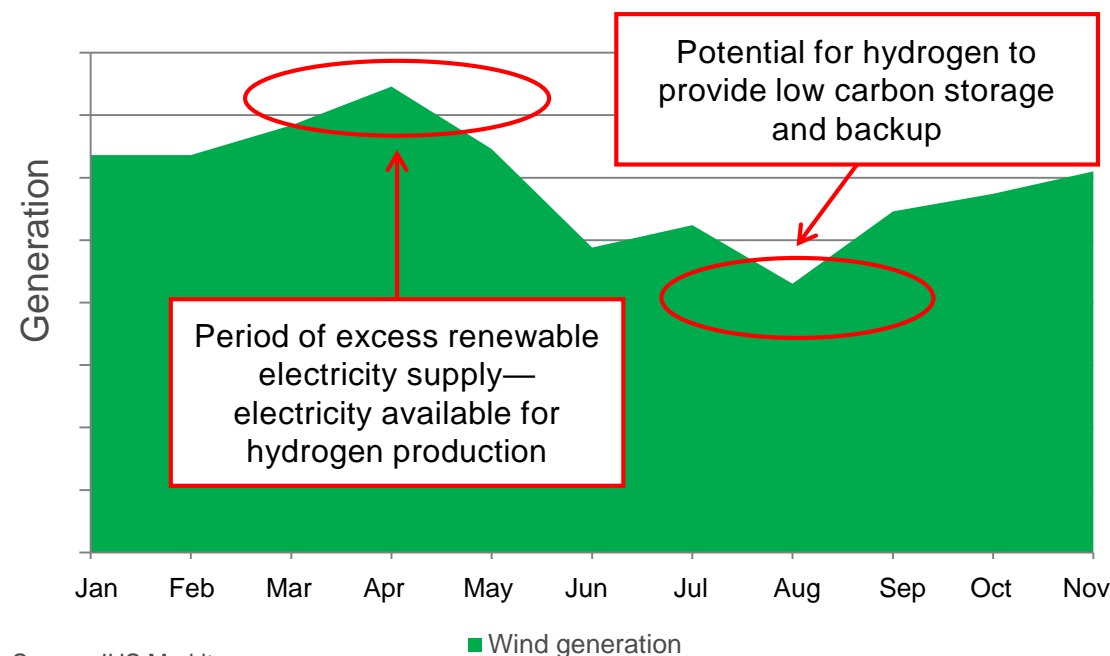
Using electricity that would otherwise be curtailed, while also providing low-carbon backup power

Misalignment between quarterly load and wind production profile



Source: IHS Markit

Use of hydrogen to support integration of intermittent renewables



Source: IHS Markit



# Hydrogen is one of many competing options

Economics and practicality will determine scale and pace of adoption

Power-to-X-to-power? Other solutions may be better

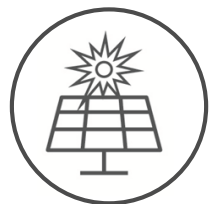
Power



X  
(store / transport)



End use



Battery



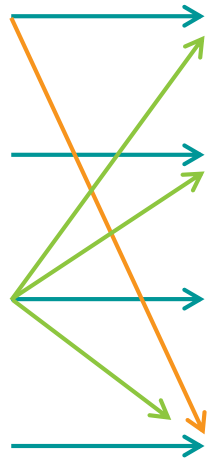
Hot/cold  
storage



H<sub>2</sub>/gas



Liquids



Power



Heating/  
cooling



Industry



Mobility

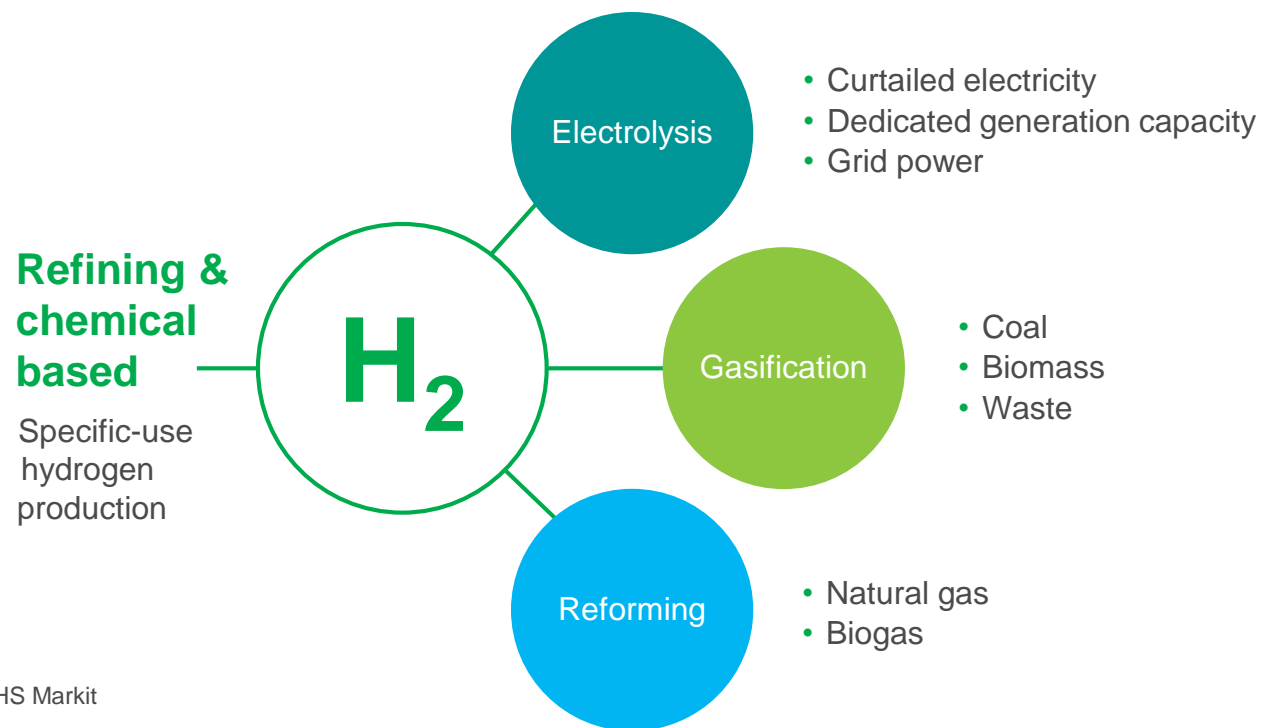
- Power to hydrogen to power is in direct competition with batteries for intra-day balancing
- Power to heat requires a heat sink
- Power to gas could replace natural gas in industry, where the need is often for its hydrogen content
- Power to liquids and power to hydrogen competes with gasoline or diesel

Source: IHS Markit

# There are many routes to produce hydrogen in China

The cost, size, and production potential varies significantly

## Existing and potential hydrogen production in China

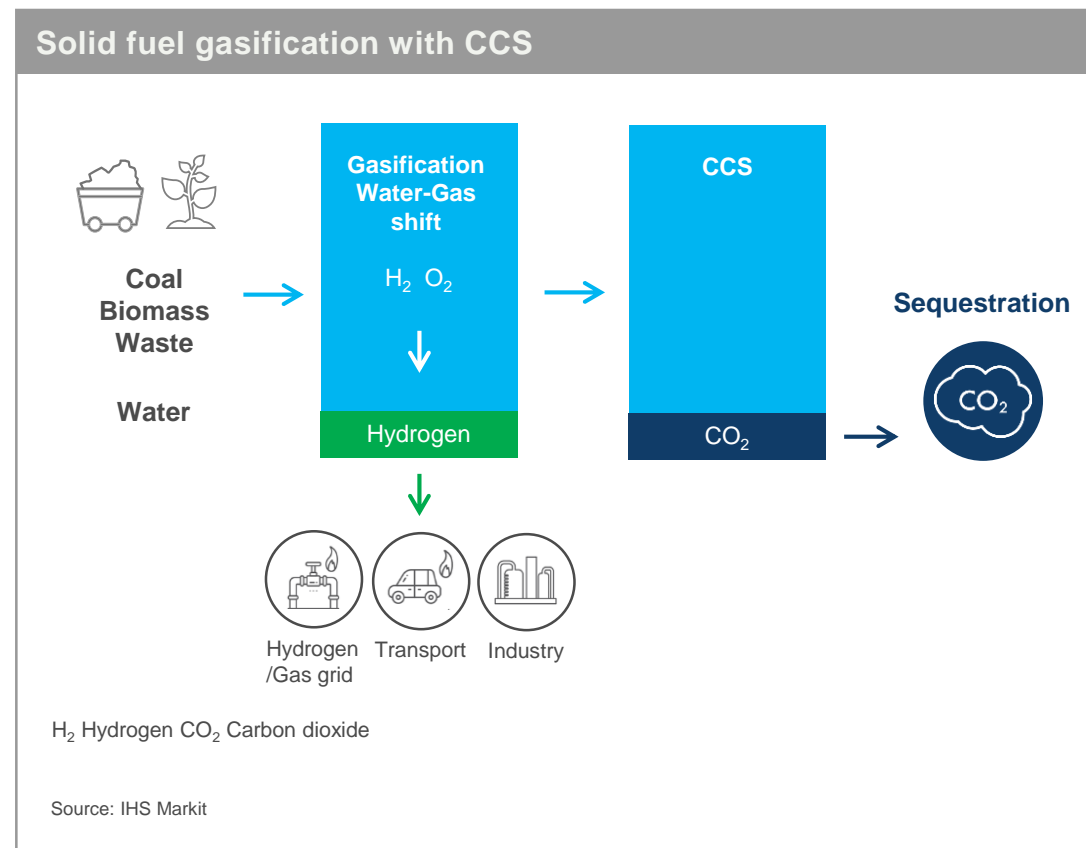
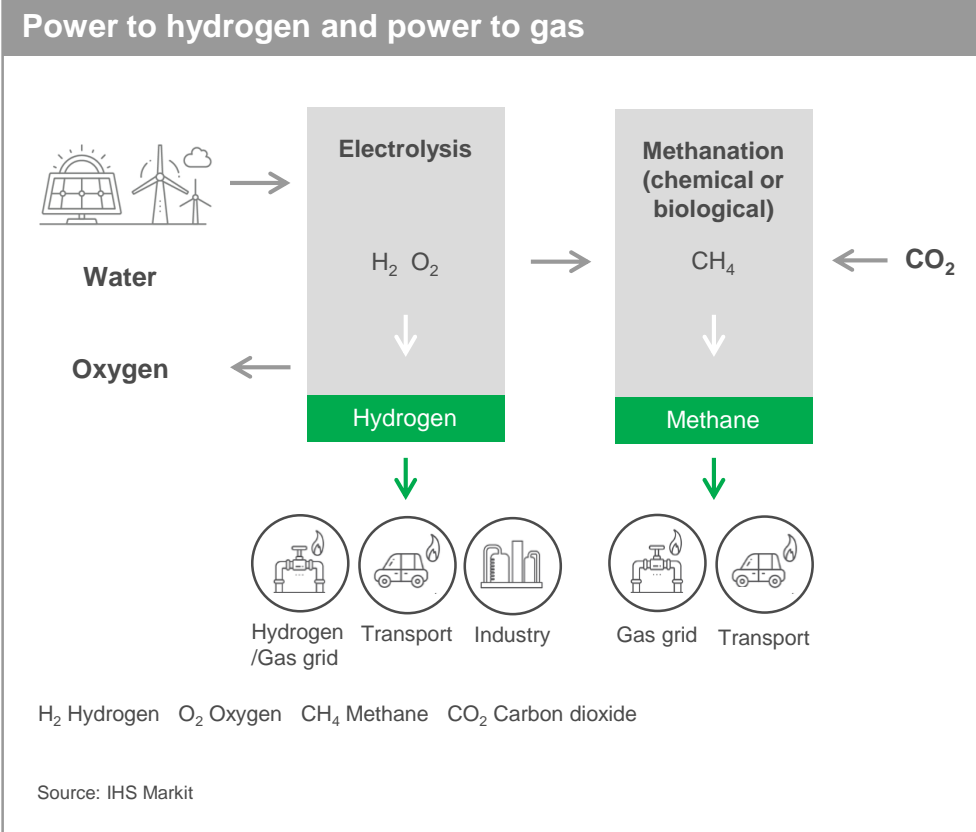


The study will use a levelized cost of hydrogen model to assess the competitiveness of different sources of hydrogen production and hydrogen's competitiveness with other energy sources.

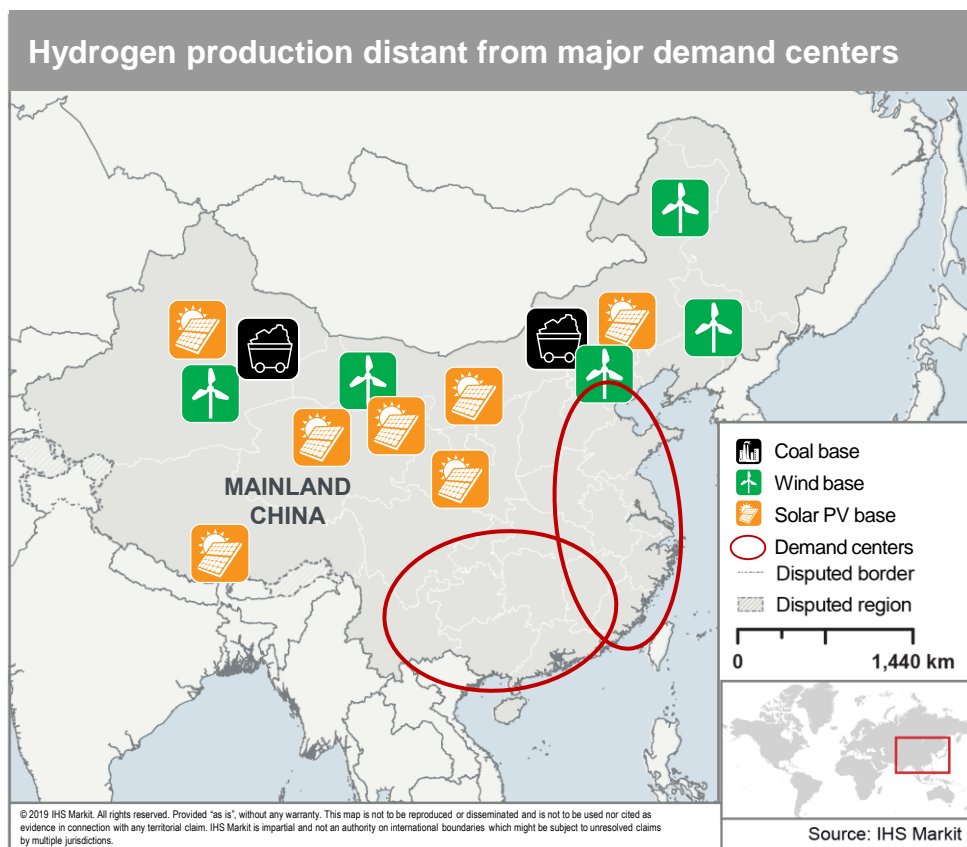
Source: IHS Markit



# Power to gas (electrolysis) or gasification technologies could be options for China to expand hydrogen production for energy use



# Large-scale hydrogen production potential is likely to be situated far from the major demand centers



- Hydrogen produced from curtailed electricity or coal gasification could be used in local demand centers near the point of production
- The greatest potential for large-scale hydrogen production is located far from the major demand centers
- Large-scale adoption of hydrogen across the economy would require the development of hydrogen transmission infrastructure

## Research topic areas – production and transport

- Hydrogen production supply costs—creation of a levelized cost of hydrogen model for the following sources:
  - > Electrolyser – three sources of electricity: (i) Curtailed electricity, (ii) dedicated generation capacity, (iii) grid power
  - > Gasification – three sources (i) Biomass, (ii) coal, (iii) waste
  - > Reforming of natural gas
- Technology developments—focus on electrolyser costs
- Example cost calculations of producing hydrogen at distant locations and transporting to a demand center
- Comparison of hydrogen costs to natural gas and other energy sources

## Research topic areas – end-use sector analysis

- Heating sector—is there an opportunity for hydrogen to be the energy source in CHP?
- Transport—sector analysis for use in road transport.
  - > Can hydrogen vehicles compete in any part of the transport sector with other technologies?
- Power sector analysis
  - > Use of curtailment—power that is produced for which there is no demand
  - > Balancing power system—how can hydrogen play a role?
- Global developments—what is happening in other regions that could be applicable to China?

# Overall quantitative approach

## Putting together costs and opportunities

**Supply cost analysis:  
Green and other  
hydrogen production  
technologies analysis**

*Levelized cost of  
hydrogen under  
various technology  
starting points*

Green H<sub>2</sub> (electrolysis)

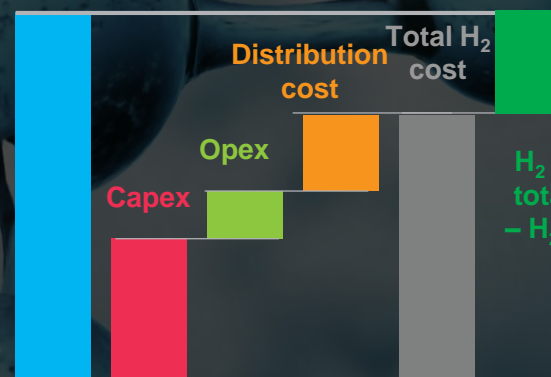
Other H<sub>2</sub> technologies  
(coal, etc.)

*Case study on costs  
of hydrogen  
transportation*

**Tipping point  
analysis by end  
use sector**

*Identify the netback value  
or cost of hydrogen in  
each major end use under  
various sensitivity cases  
of future costs and policy.*

Total product value



Power

Space conditioning

Industry

Transportation

Source: IHS Markit



# Project timeline and deliverables: an approximately eight-month schedule



- **Study kick-off**
  - **Introduce the study participants.**
  - **Overview of the project timeline and scope.**
  - **Discuss the first workshop agenda and logistics.**
- **Why hydrogen now:**  
an overview of policy initiatives supporting hydrogen development.
  - **Hydrogen supply analysis:**  
presenting the results and insights from the IHSM Levelized Cost of Hydrogen (LCOH<sub>2</sub>) modeling from electrolysis, gasification and reforming.
  - **Cost competitiveness:**  
determining how hydrogen compares with other forms of energy.
- **Practicalities:**  
understanding the technical and policy issues impacting the potential role of hydrogen in power, industry, transport, and heat in China.
  - **Identifying the tipping points:**  
determining the triggers and conditions required for hydrogen to be used more widely.
  - **Costing:**  
quantifying indicative costs needed to move hydrogen from demonstration to commercial success in each principal end use.



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