



# Hydrogen as the Facilitator: Meeting China's Energy Needs

An IHS Markit study

January 2019

# Is there an opportunity for hydrogen use in China?

*Key questions to consider:*

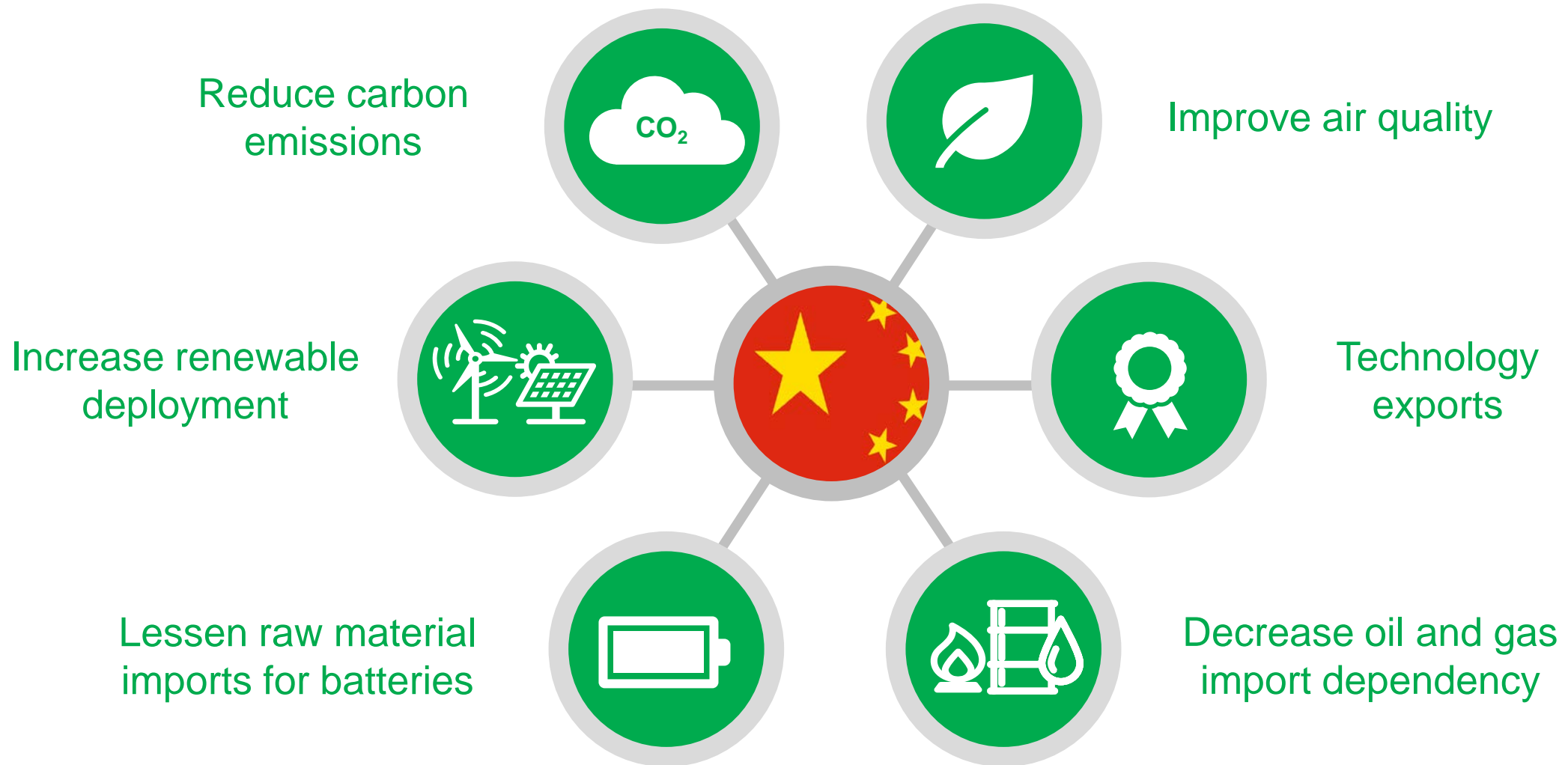
## Supply

- 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



# Why hydrogen? Hydrogen has multiple applications across the economy

## End use applications of hydrogen for energy use

### Transport



Displace batteries or fossil fuels

### Industry



Displace natural gas in pipelines and end uses

### Heating



Replace coal used for direct heat

### Power



Intra-day balancing of renewable generation and power demand

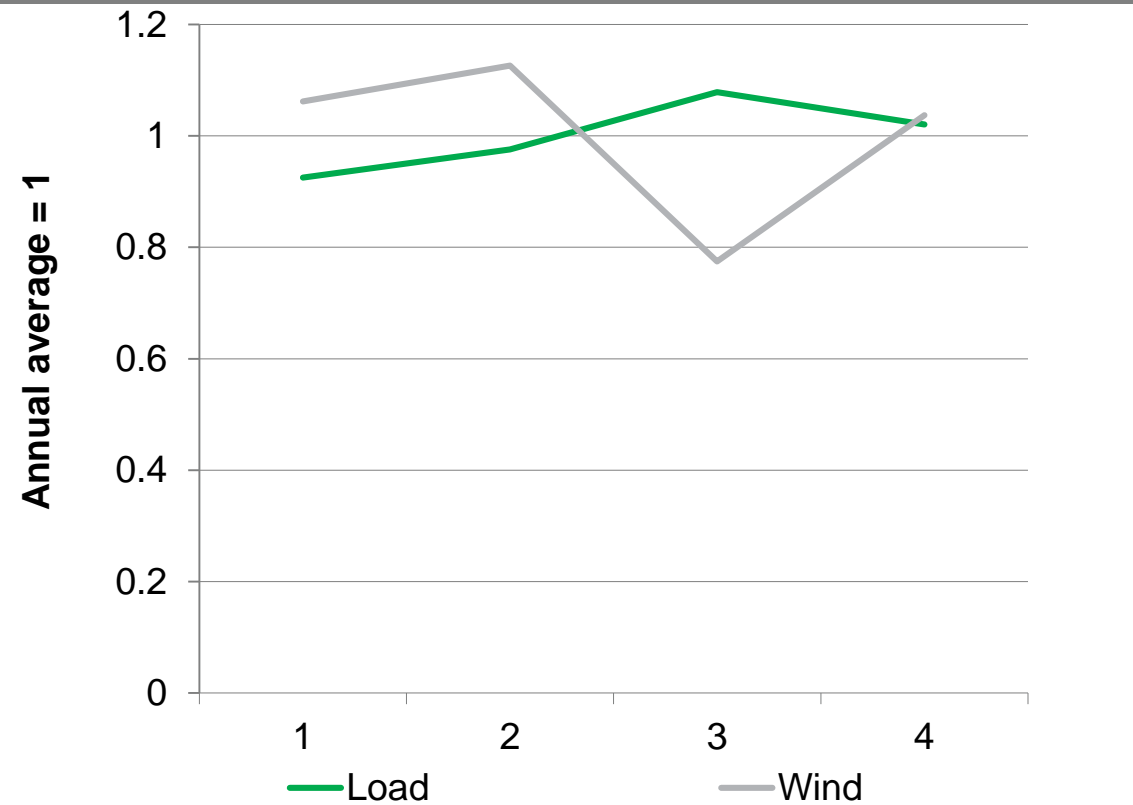
Seasonal balancing of renewable generation and power demand

Reduced fossil generation

# Why hydrogen? Hydrogen can help integrate intermittent renewables

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

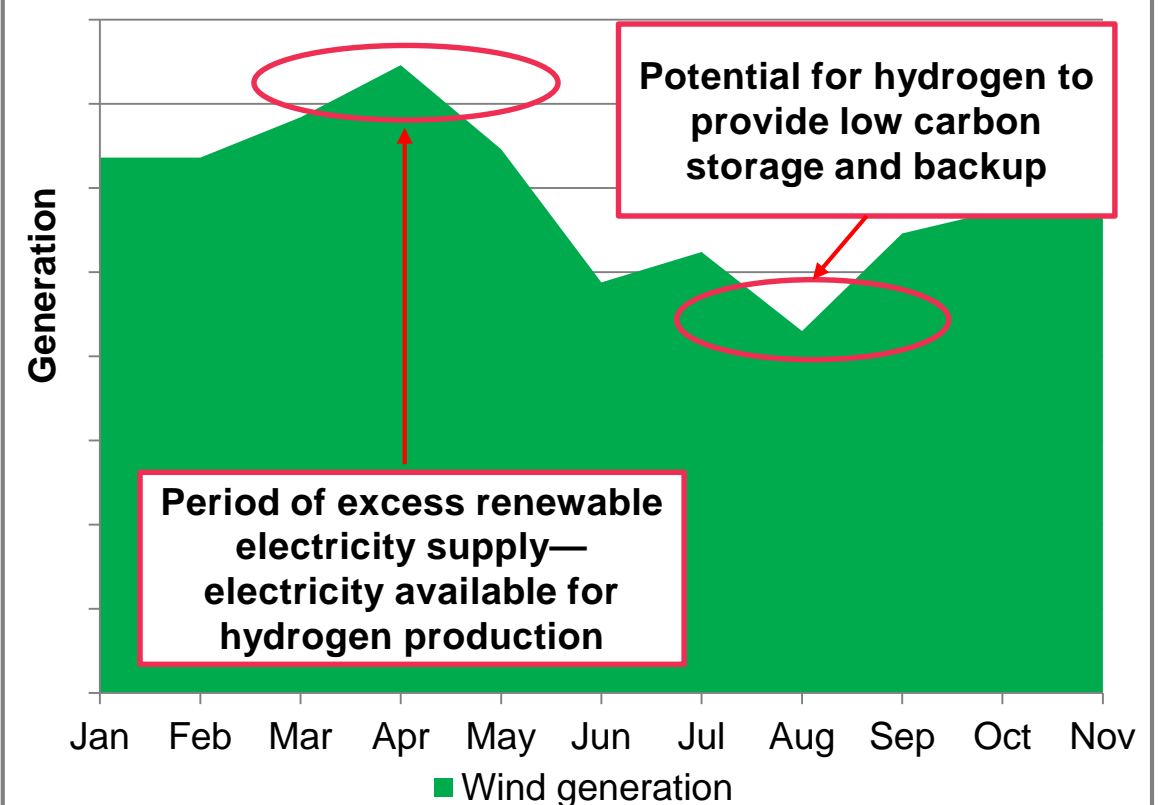
### Misalignment between quarterly load and wind production profile



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### Use of hydrogen to support integration of intermittent renewables

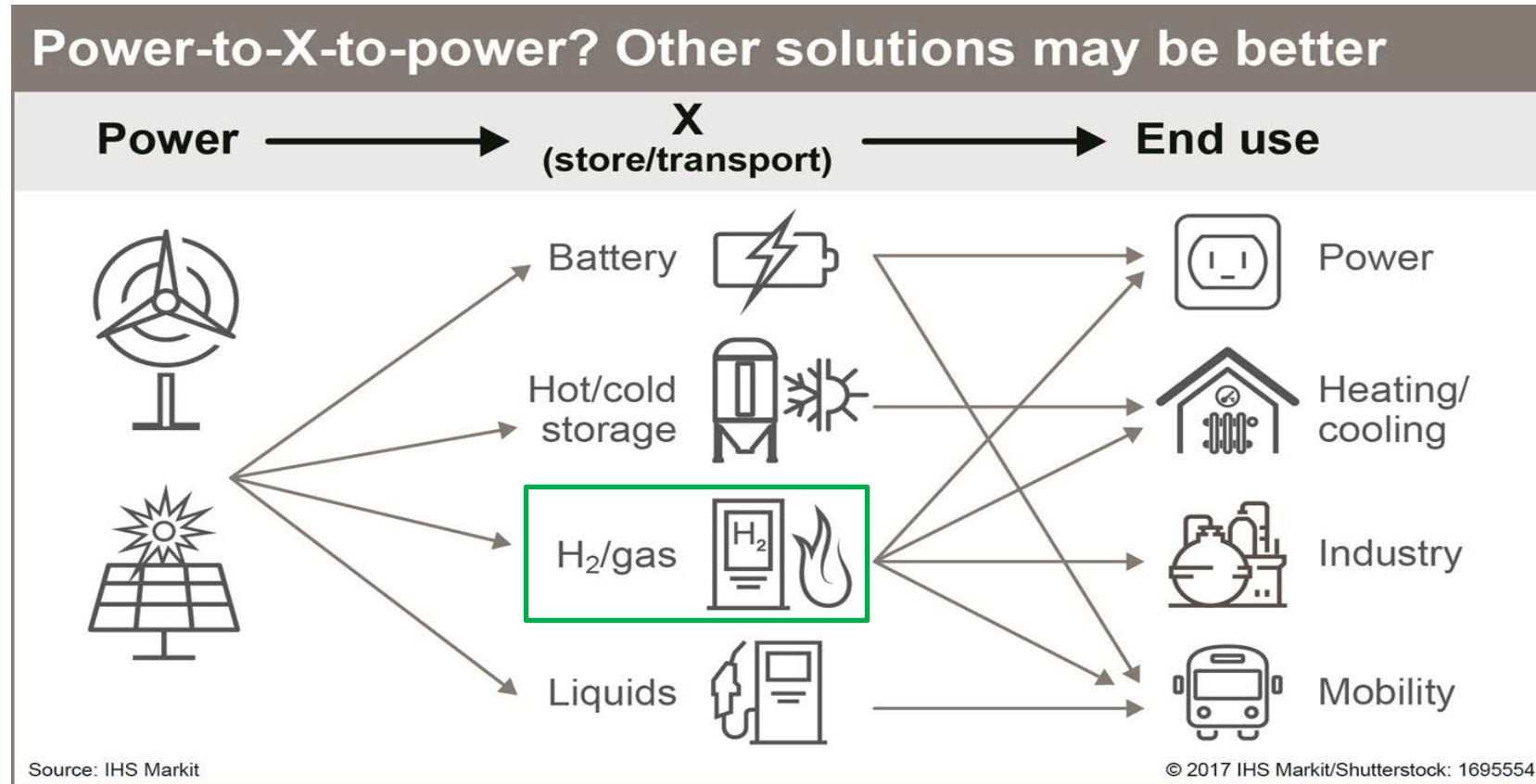


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# Hydrogen is one of many competing options

*Economics and practicality will determine scale and pace of adoption*



Power to hydrogen to power is in direct competition with batteries for intra-day balancing

Power to heat requires a heat sink

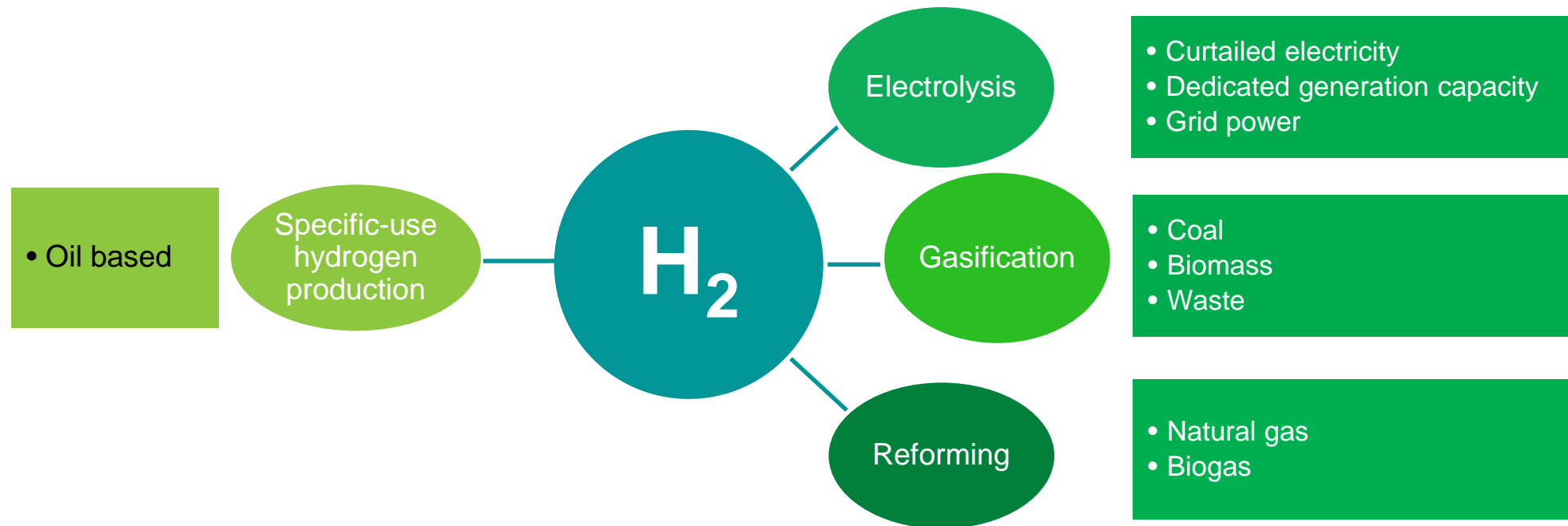
Power to gas could replace natural gas in industry, where the need is often for its hydrogen content

Power to liquids and power to hydrogen competes with gasoline or diesel

# There are many routes to produce hydrogen in China

*The cost, size and production potential varies significantly*

## Existing and potential hydrogen production in China

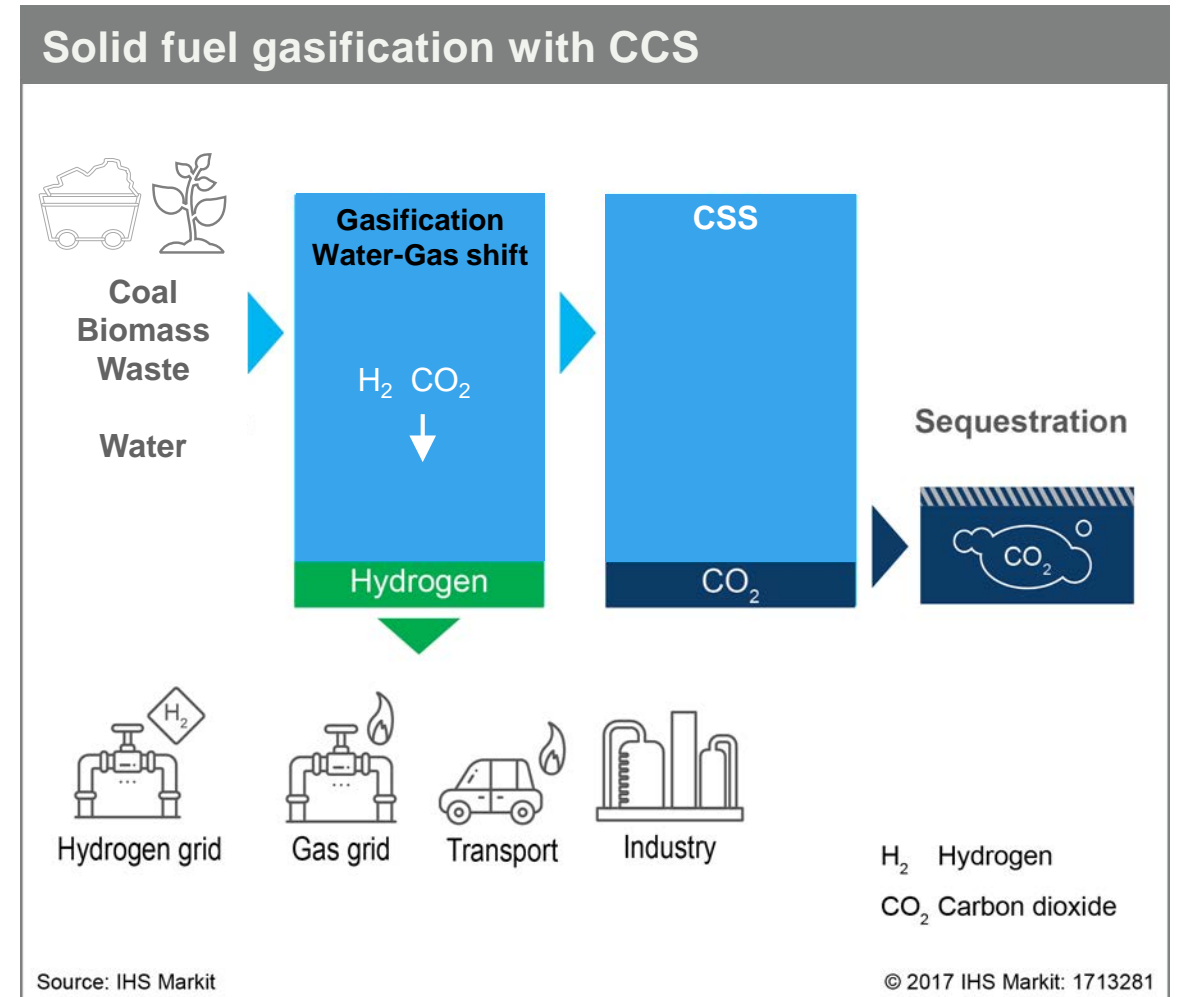
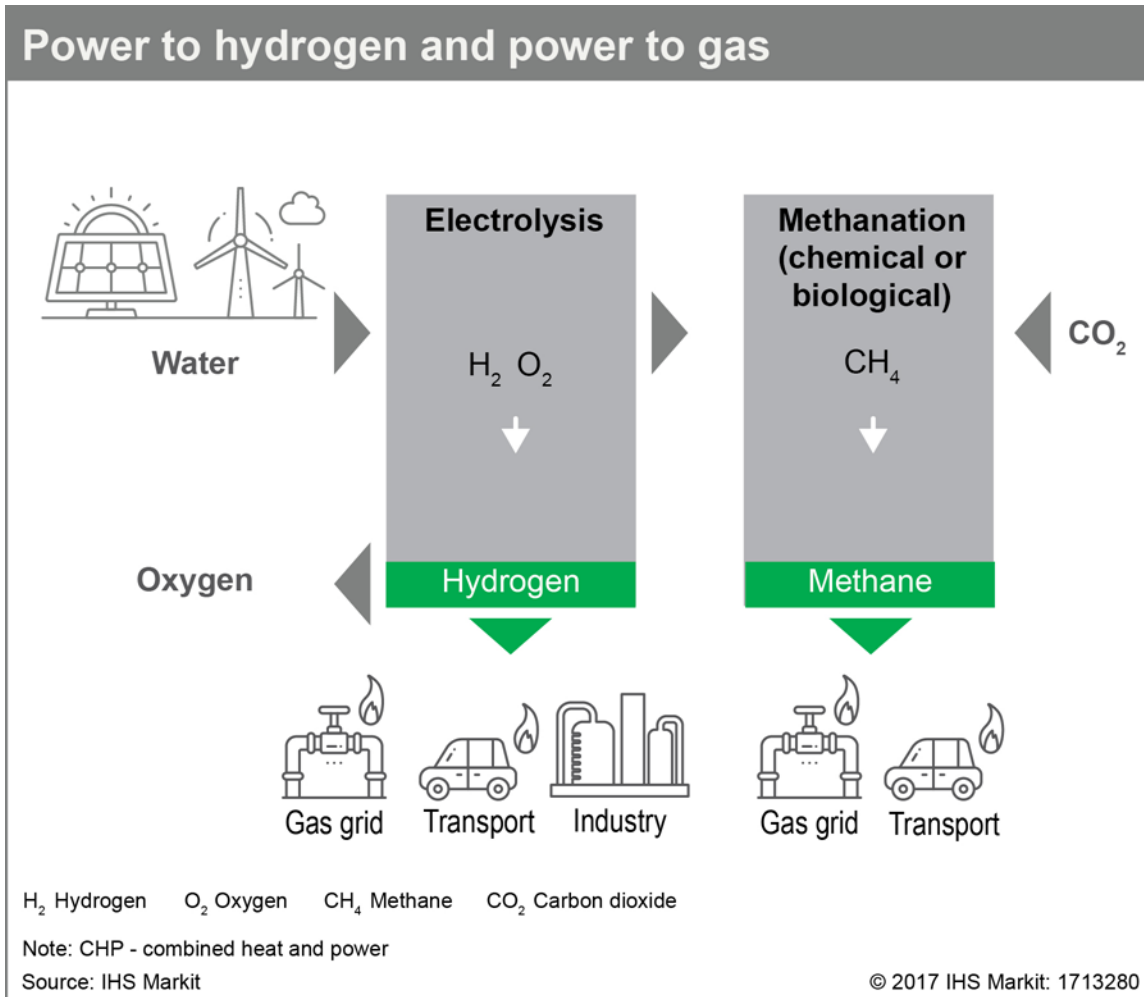


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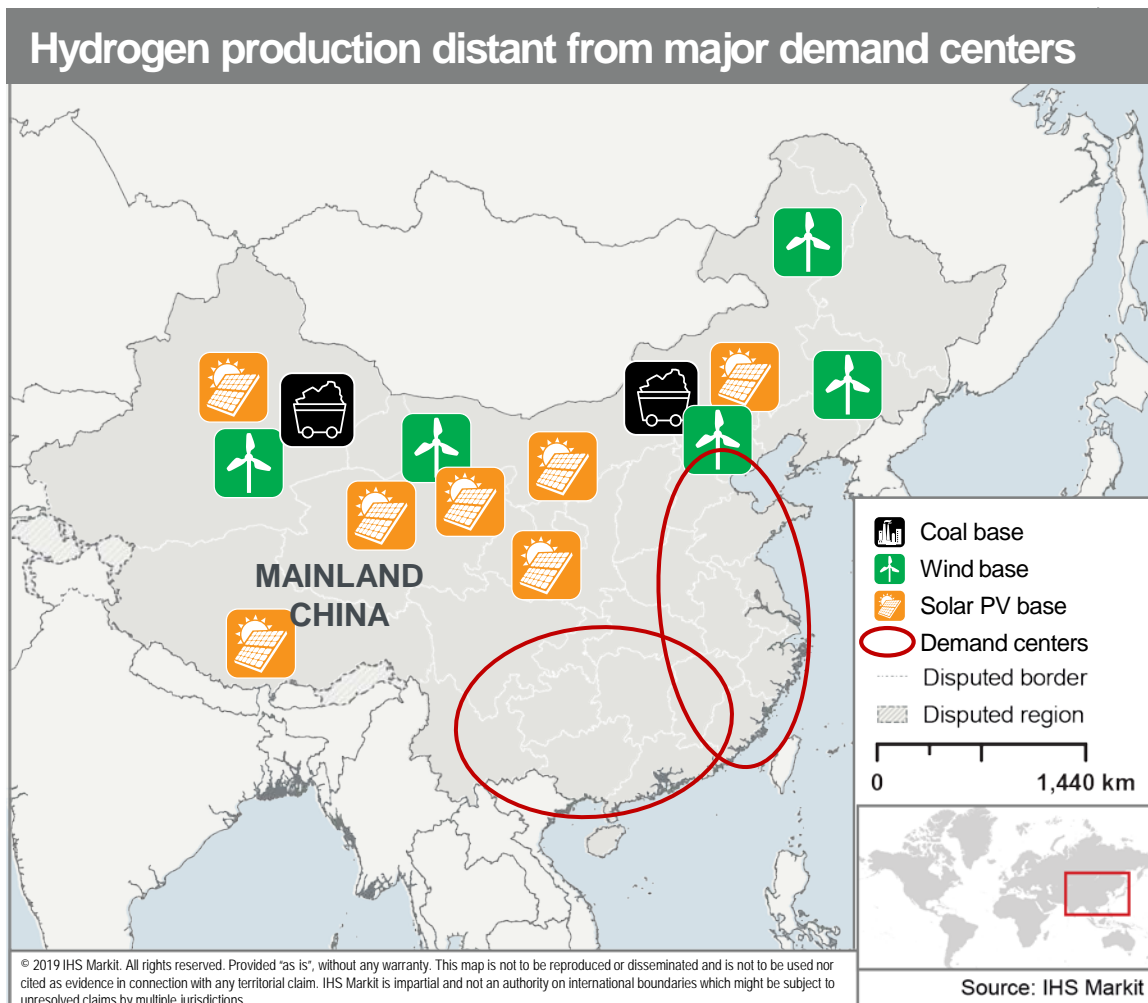
**The study will use a levelized cost of hydrogen model to assess the competitiveness of different sources of hydrogen production and hydrogen's competitiveness with other energy sources.**

# 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 rural 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)

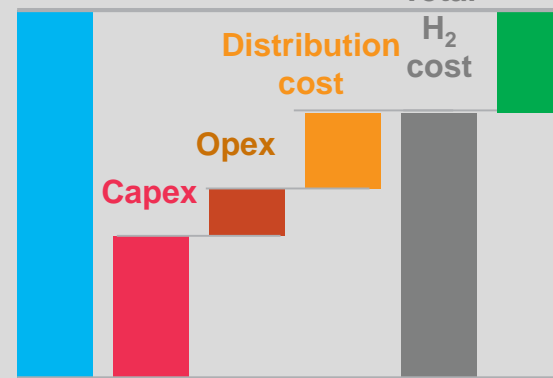
Other H<sub>2</sub> technologies  
(coal, etc.)

*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



**H<sub>2</sub> netback value  
= total product  
value – H<sub>2</sub> costs  
(could be  
negative)**

Power

Space conditioning

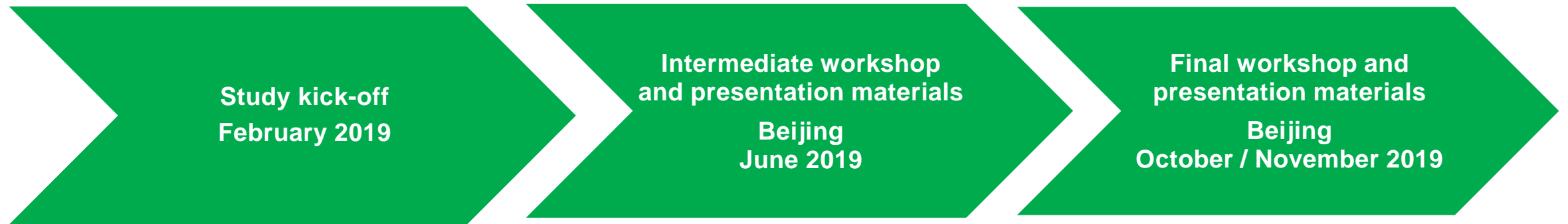
Industry

Transportation

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# 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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