

**Hydrogen Economy Conference (HEC) 2020**  
**2020年氫能經濟會議**

# Hydrogen Economy 2.0

**‘Let’s change the world together’**

# Renewable Energy – Devil in the Details

- China's wind power curtailment dipped to record-low in 2019

## 1Q19 China



4% (4,350 GWh)

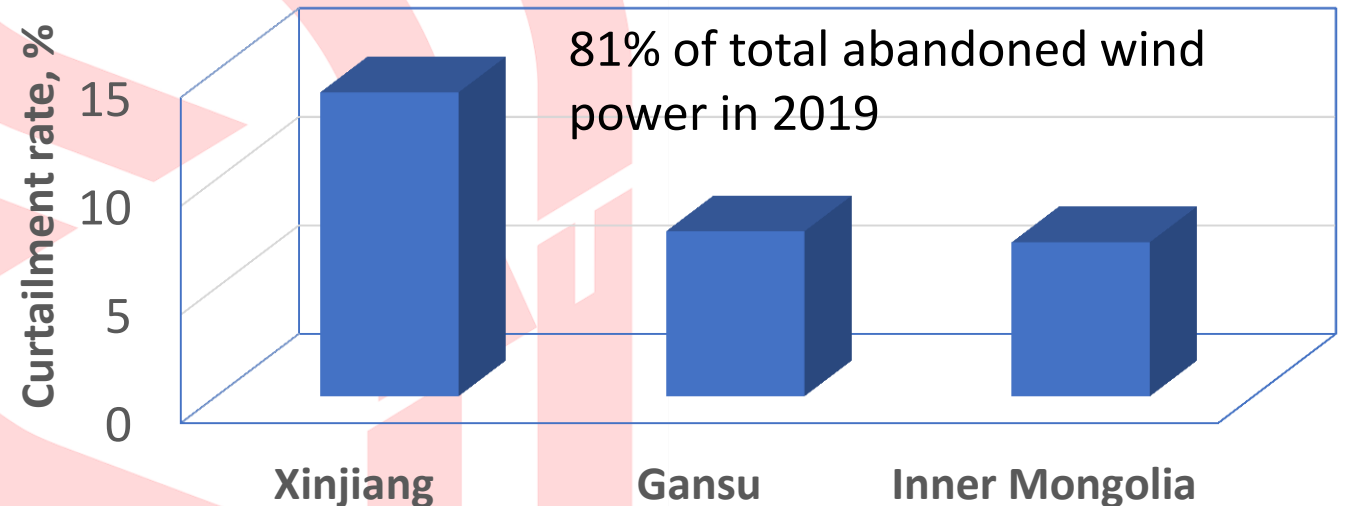


2.7% (1,240 GWh)

Average China Curtailed Electricity  
(GWh/month)

1863.3

## Curtailment rate – Solar & Wind



Average Hong Kong Electricity Consumption  
(GWh/month)

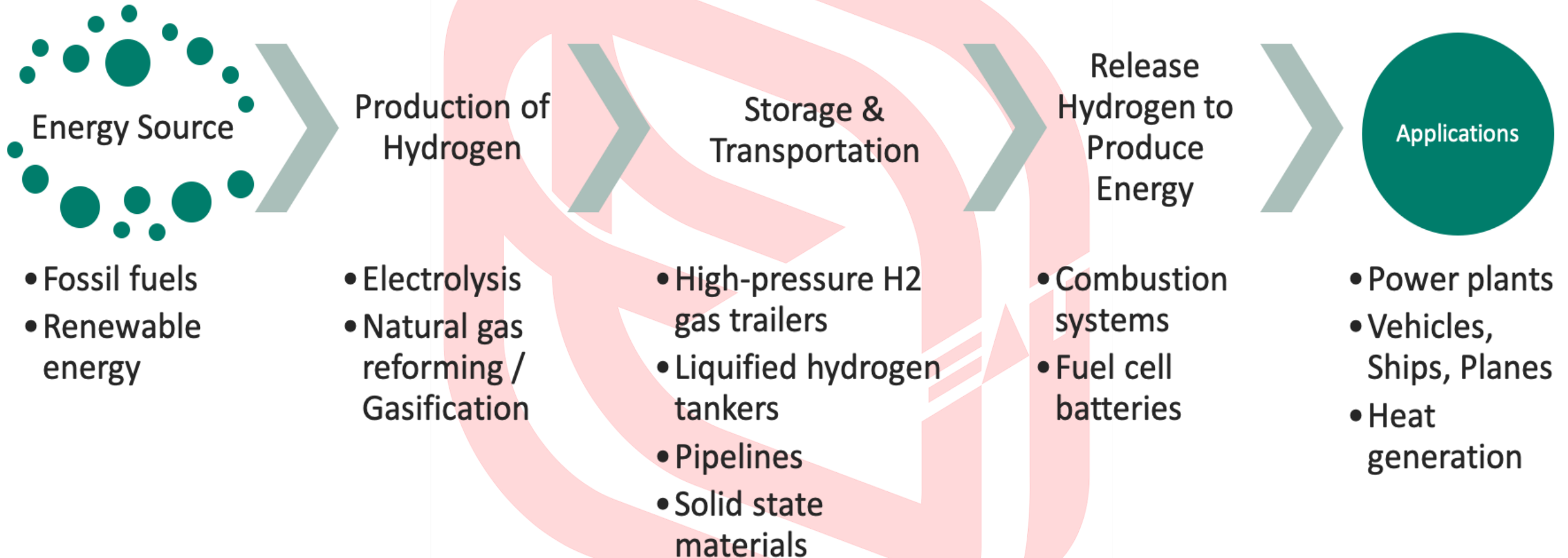
3738.4

# Energy Storage Solutions

- Mobile storage
  - Lithium ion batteries
- Stationary storage
  - Flow batteries
  - Pump hydro stations
- Transformative storage
  - H<sub>2</sub> carriers
    - Solid
    - Liquid
    - Gas



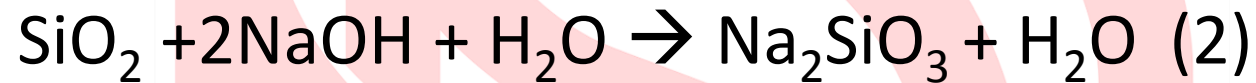
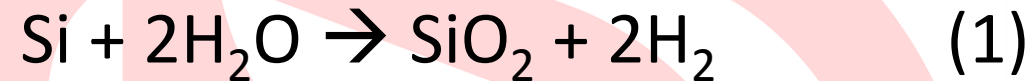
# Problems with Hydrogen Economy 1.0



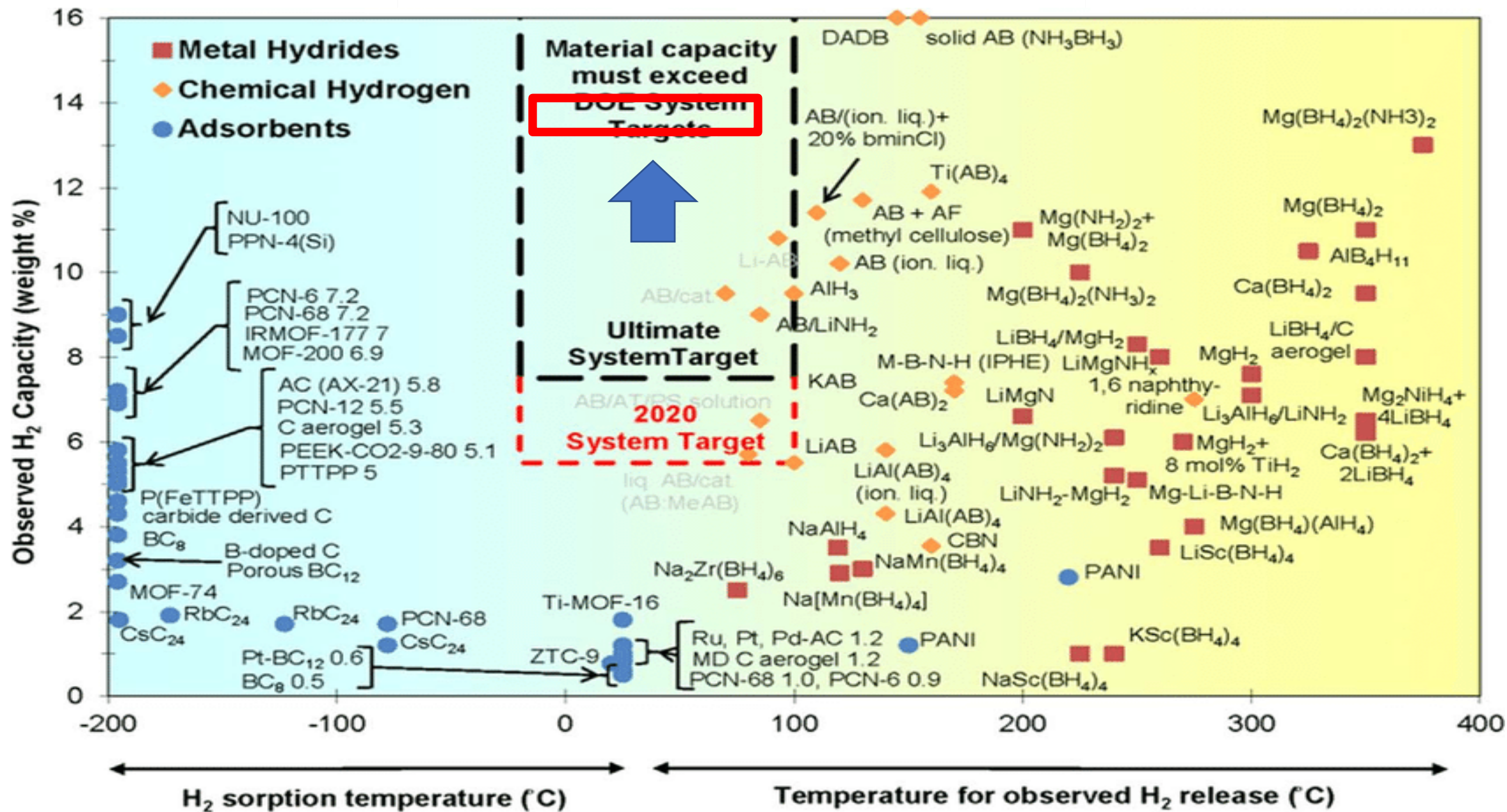
The lack of practical solutions in H<sub>2</sub> storage and transportation inevitably led to the pitfall of Hydrogen Economy 1.0 despite significant advancements in H<sub>2</sub> generation and energy conversion.



# Technological Breakthrough in Silicon



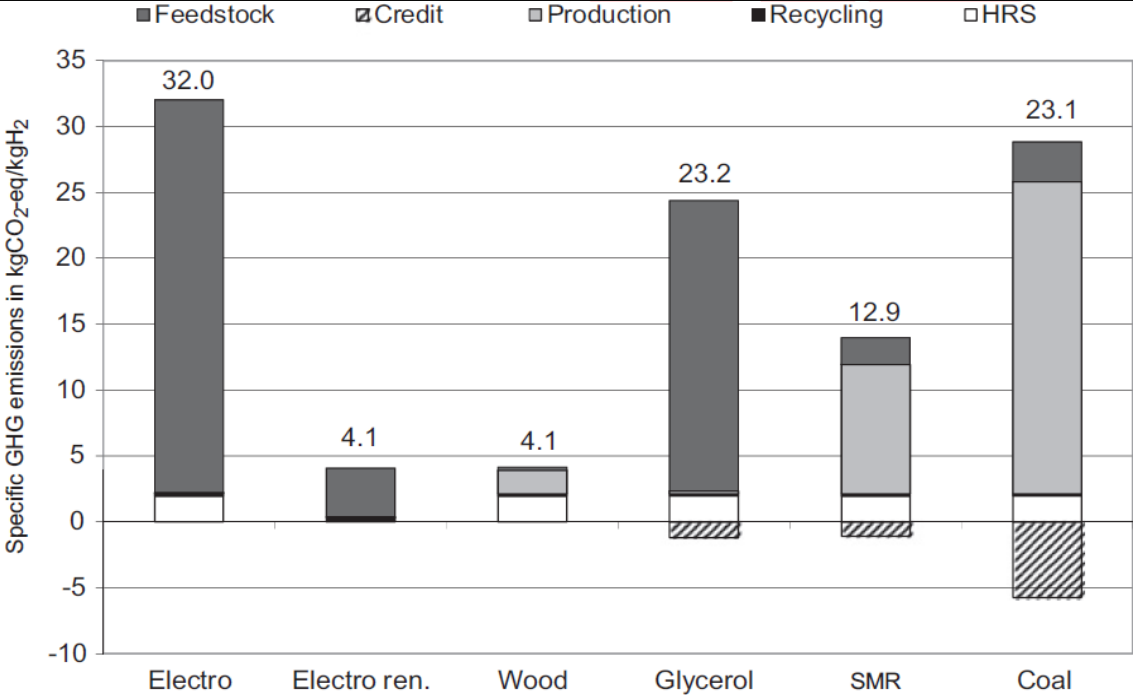
- Controllable  $\text{H}_2$  generation from water or greywater, reaching 14 wt.% with respect to Si
- $\text{Na}_2\text{SiO}_3$  is used commercially in formulation of cements, passive fire protection, adhesives, production of silica gel etc.



# How 'Green' is EAT Si

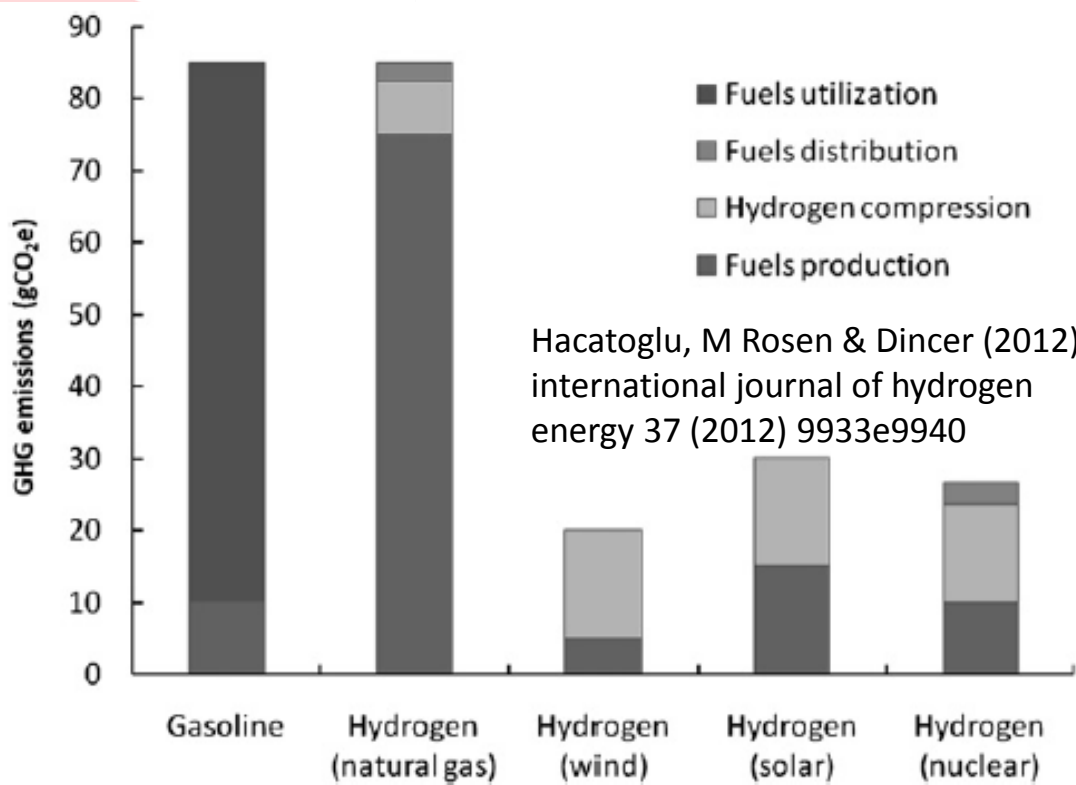
## Global Warming Impact per Kg of Output

Scenario	Product: Na <sub>2</sub> SiO <sub>3</sub> and H <sub>2</sub> (GWP/kg)
High Voltage Grid	15.06
Wind, >3MW turbine	14.05



**Fig. 8 – Results of the LCA for different hydrogen production pathways.**

Wulf, C., & Kaltschmitt, M. (2012). *International Journal of Hydrogen Energy*, 37(21), 16711–16721.



Hacatoglu, M Rosen & Dincer (2012). *international journal of hydrogen energy* 37 (2012) 9933e9940

**Fig. 5 – Life cycle greenhouse gas (GHG) emissions accompanying the production and utilization of 1 MJ of fuel (gasoline or hydrogen) in internal combustion engine or fuel cell vehicles. Data for gasoline, natural gas, wind, and solar pathways obtained from Granovskii et al. [11].**

# EAT Si – Pushing towards Carbon Neutrality

Solved Transportation & Storage issues of Hydrogen Economy 1.0

Average China curtailed wind and solar energy GWh/month	1863.3
Average HK electricity consumption GWh/month	3738.4
GWh consumed to produce 30000T Si /month	~400
GWh generated from 30000T Si *	>100

\* Efficiency @ 80% basing on Alkaline Fuel Cell with Combined Heat and Power recovery

Source: <https://www.gencellenergy.com/news/comparing-fuel-cell-technologies/>



# Conceptual Containerized H<sub>2</sub> Station

mobile 20" H<sub>2</sub> cartridge  
changed twice a week

Estimated system cost @ 6-8M RMB



~3T worth of H<sub>2</sub>  
20" container

40" container 400 – 650kg H<sub>2</sub>/day  
station



H<sub>2</sub> dispensing related systems, pressurization,  
refrigeration, gas dispensing gun etc.

# Ultimate Deep Green Hydrogen Economy 2.0

1. Micro renewable grids, i.e. mobile H<sub>2</sub> stations, to power 21<sup>st</sup> century smart cities
2. Transportation of EAT Si is equivalent to current fossil fuels
3. Minimize investments in traditional H<sub>2</sub> infrastructure enabling a full transformation into H<sub>2</sub> economy
4. Affordable distributed Green H<sub>2</sub> @ ~\$10-12 USD/kg, has possibilities to further reduce by 20 – 40%

# Challenges

- Seeing is believing?
- Breakthrough technology rollout in this complex world
- Competing 'religions and camps' of lithium-ion batteries vs H<sub>2</sub>
- Ensuring the Mission and Vision becomes the ethos of the alliance

# Our Mission

Enabling the reverse trajectory of global warming by means of the plethora of technologies that we have developed, and preserve The Earth for future generations

# Our Vision

The world can be changed by applying our breakthrough energy technologies, and we can achieve this by sharing our technologies to our global alliances to enable the change



Your attention is much appreciated

Let's form an alliance  
to change the world!

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