



Shifting molecules to electrons  
IEEJ Roundtable at SIEW 2018, Singapore  
Quentin Vaquette

# HYDROGEN

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a key enabler of the Energy Revolution

**WHY?**

# We will always need to physically move energy around

Total energy demand

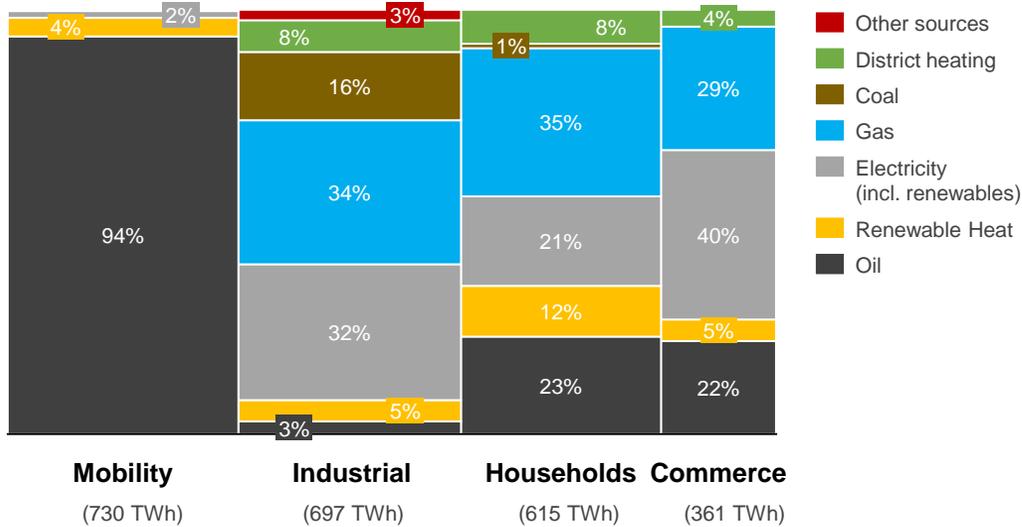
RES potential

Timing

Total energy demand: 2,400 TWh



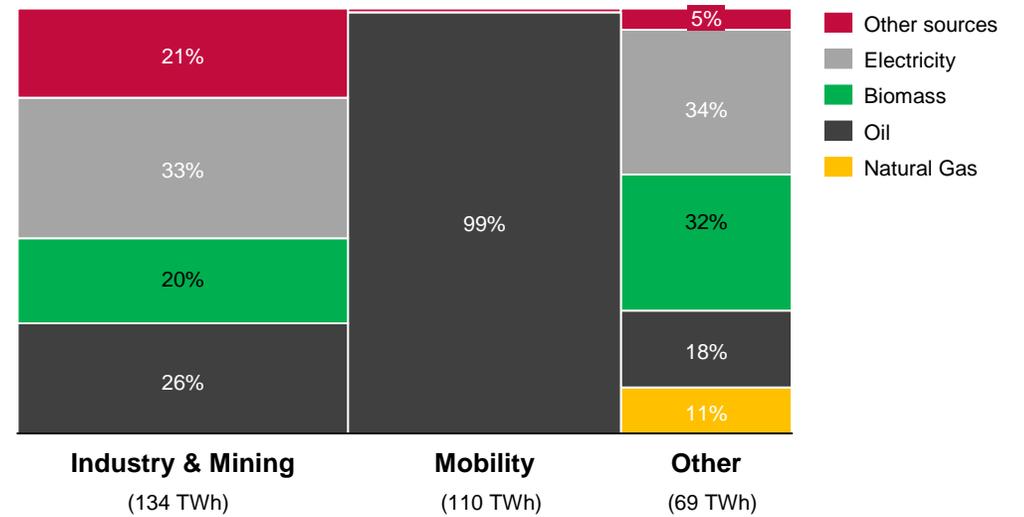
Germany



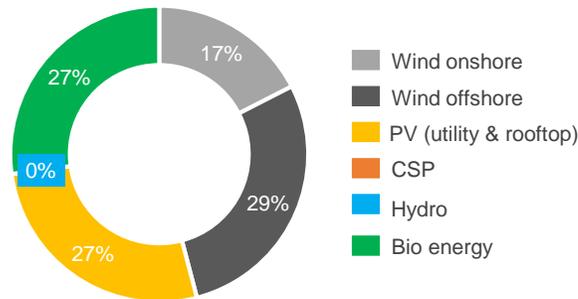
Total energy demand: 313 TWh



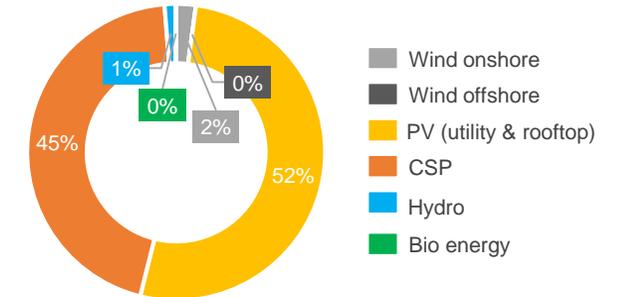
Chile



Total renewable energy potential 1,106 TWh



Total renewable energy potential 5,585 TWh



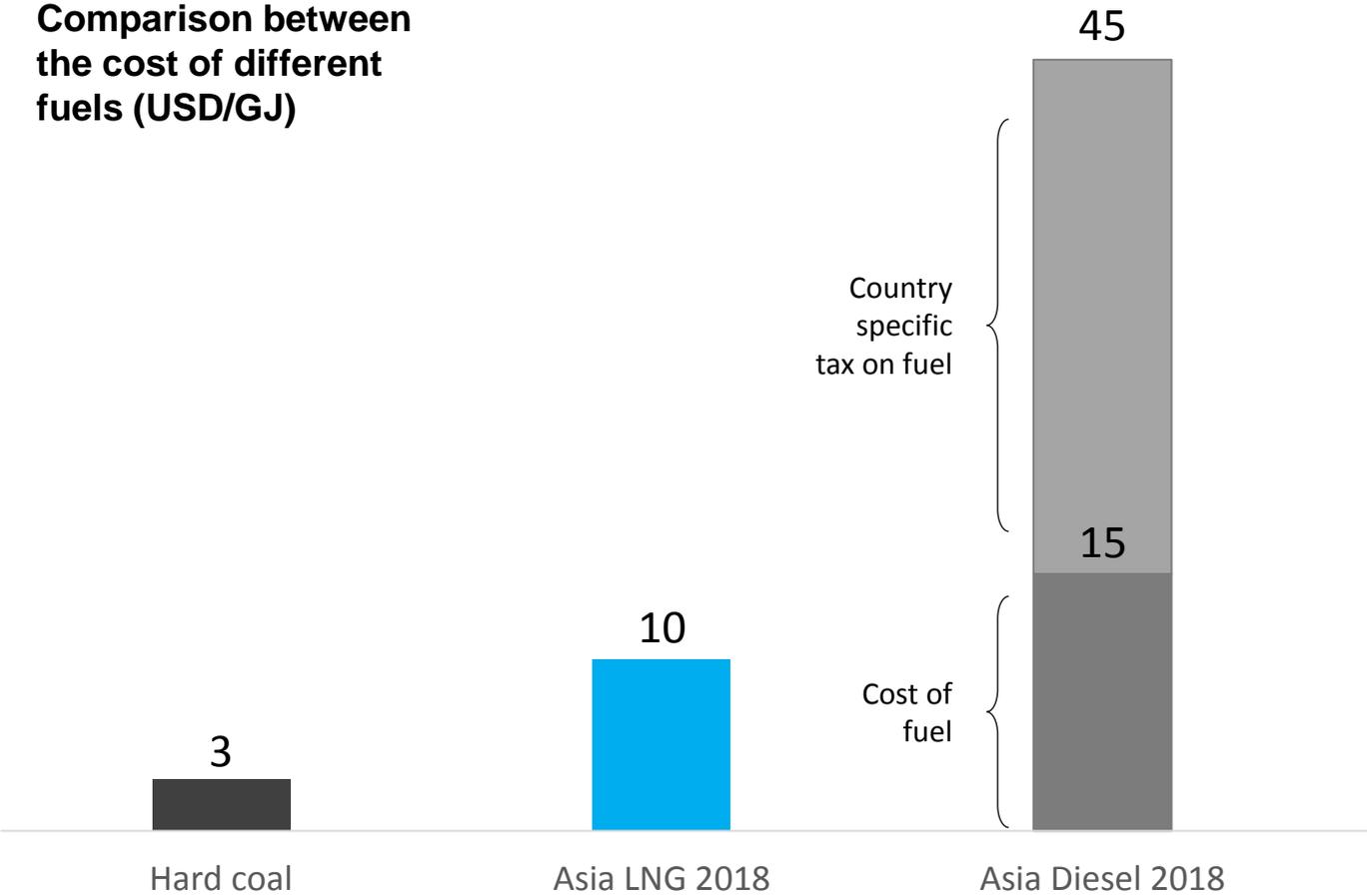
**Bio energy** is a stable source  
**Solar PV** is mostly available during summer  
**Wind** is subject to periods of zero production

**Solar PV** is available during most of the year  
**CSP** is even available throughout day and night

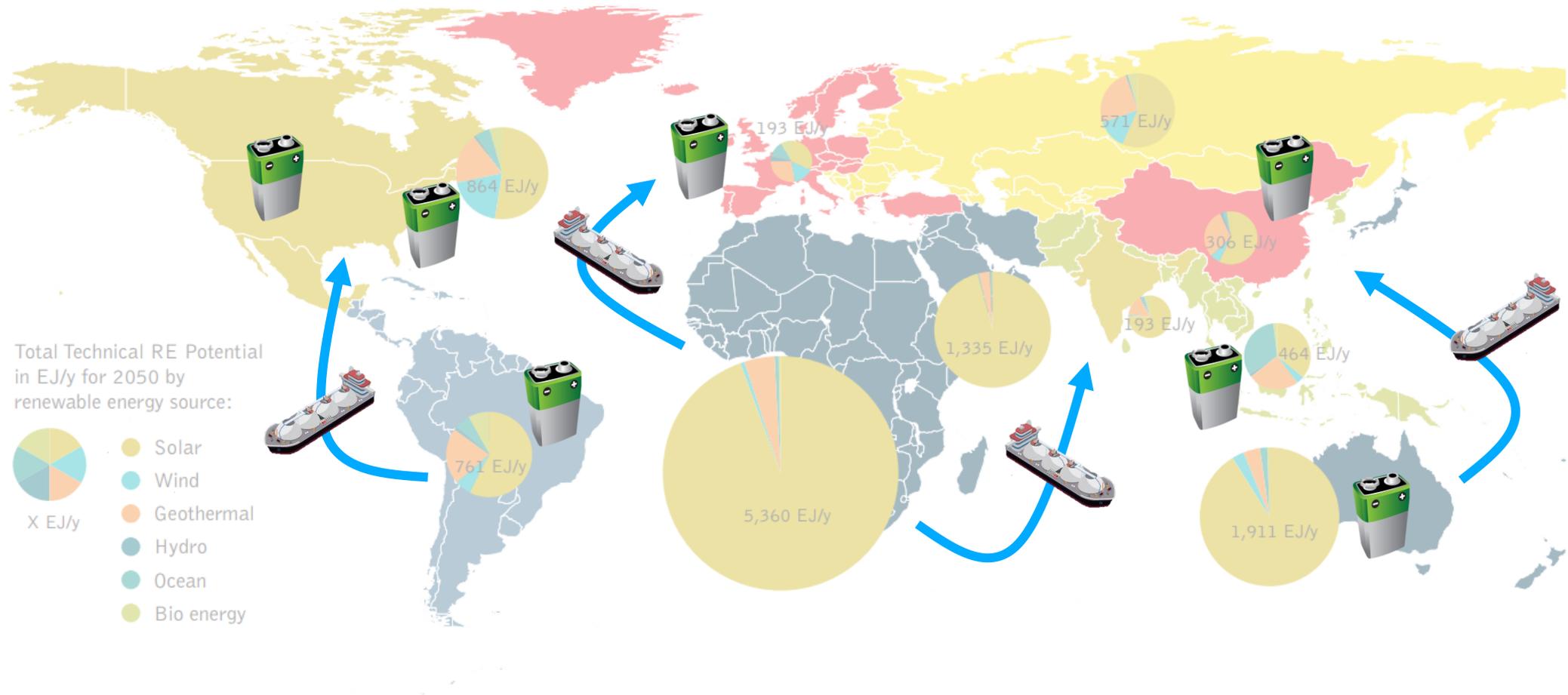
**WHAT?**

# The economics of mass-scale zero-carbon hydrogen are not so different from fossil fuel

Comparison between the cost of different fuels (USD/GJ)



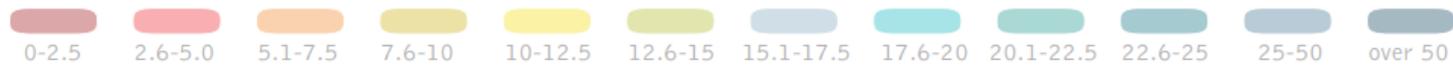
# Hydrogen could become a carbon-free version of today's global LNG market



Total Technical RE Potential in EJ/y for 2050 by renewable energy source:

- Solar
- Wind
- Geothermal
- Hydro
- Ocean
- Bio energy

Map: Technical RE Potential can supply the 2007 primary energy demand by a factor of:



**HOW?**

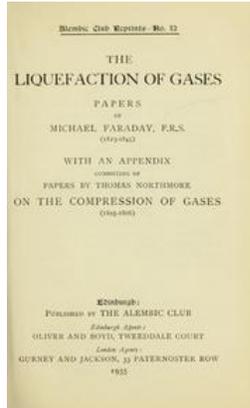
# How do we make zero-carbon hydrogen competitive?



# Are we repeating history from less than 50 years ago?

**1820**

Invention of liquid methane by Faraday



**1959**

First LNG carrier with 5,000 DWT to bring LNG from US to UK (Methane Pioneer)



**1941**

First commercial liquefaction plant in Cleveland, Ohio

**1965**

First LNG shipment brought into France at le Havre by ENGIE on the vessel Jules Verne



**1990's**

Total LNG trade at 50 MTPA

**2012**

Total LNG trade at 240 MTPA



130,000 DWT



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The logo for ENGie features a blue gradient arc above the word "ENGie" in a blue, rounded, lowercase sans-serif font. The background is split diagonally from the bottom-left to the top-right, with white on the left and blue on the right.

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