El Hidrógeno Verde: retos y oportunidades

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Asociación Chilena de Hidrógeno

Asociación Chilena de Hidrógeno

Constituida el 9 de Enero del 2018, H2 Chile H2 Chile es un **espacio colaborativo**, entre entidades públicas, privadas y académicas que estén interesadas en el uso del hidrógeno como vector energético. Una plataforma para enseñar, educar, colaborar, fomentar y realmente producir un cambio significativo en la manera en que la sociedad ve al hidrógeno, logrando así posicionar a Chile como un líder en la producción y utilización de Hidrógeno Verde.

El objetivo de la Asociación Chilena de Hidrógeno es **acelerar la transición energética** mediante la promoción del desarrollo de las tecnologías del Hidrógeno y su uso como vector energético en aplicaciones industriales, comerciales, residenciales y de movilidad.

Nuestro Logo

<u>Hidrógeno, H_2</u>
Una molécula formada por el átomo más simple y abundante del universo: 1 protón y 1 electrón

<u>Hidrógeno Verde, H_2</u>
Proviene de Energías Renovables:
Solar
Biomasa, Biogás
Eólica, Hidro

<u>Economía Circular</u>
Hidrógeno verde en el centro de una Economía Circular sustentada por el potencial renovable de todo el territorio Chileno

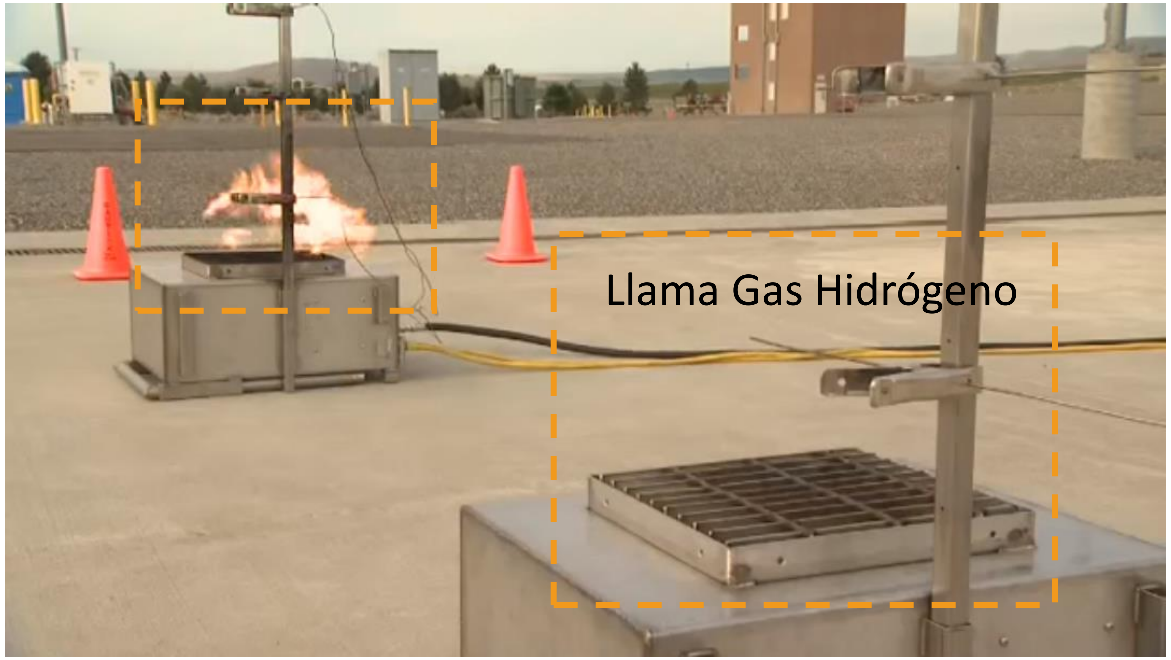
<u>Misión</u>
Acelerar la transición hacia la economía del hidrógeno en Chile.

2

Los Colores del Hidrógeno

Henry Cavendish
(1731-1810)

Llama Gas Propano



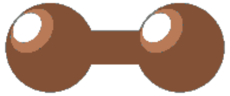
El gas hidrógeno y su llama son incoloros!

HIDRÓGENO
VERDE

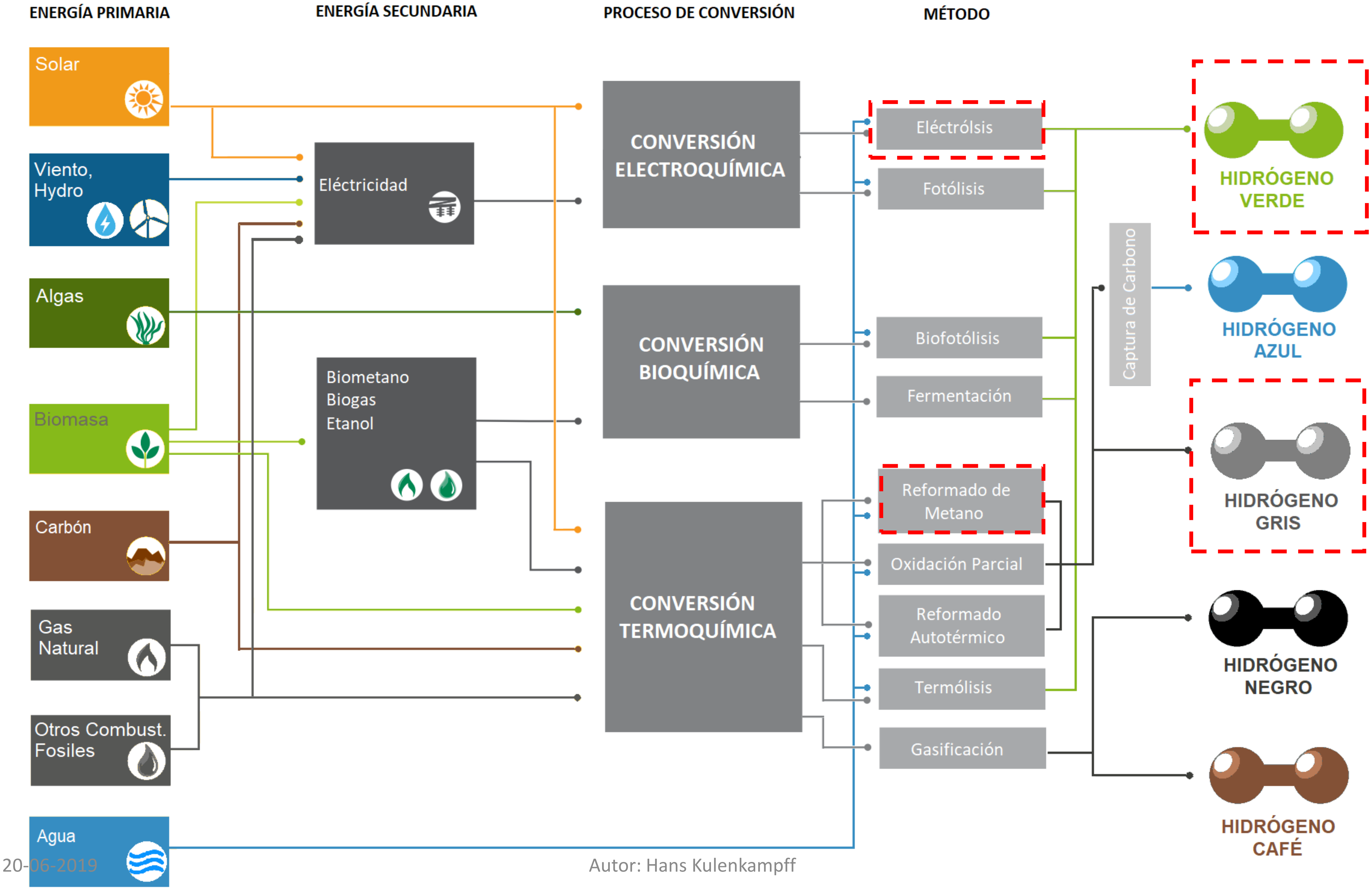
HIDRÓGENO
AZUL

HIDRÓGENO
GRIS

HIDRÓGENO
NEGRO



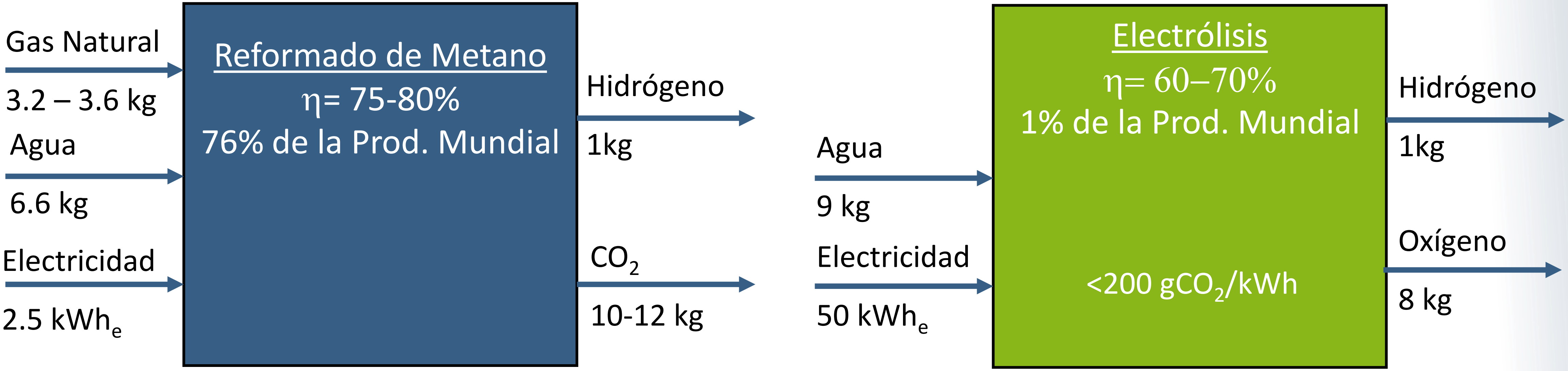
HIDRÓGENO
CAFÉ



20-06-2019 Autor: Hans Kulenkampff

Reformado de Metano v/s Electrólisis

Producción Mundial Anual: 70 Mt = 8.4 EJ



<u>53.2 Mt H_2 mediante Reformado de Metano:</u>

- 205 billones Nm^3/año (6% mercado global)
- 530 Mt CO_2/año (1.5% de las emisiones Globales)

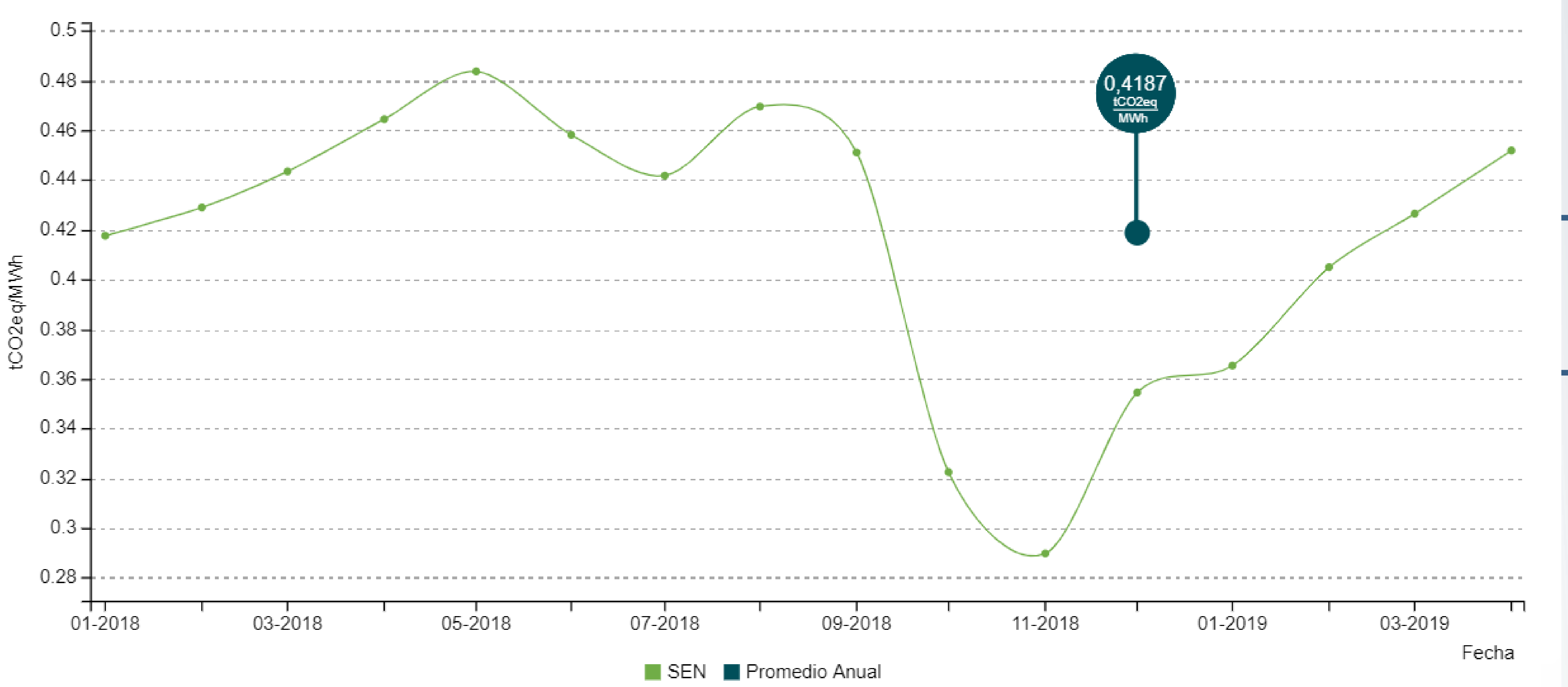
<u>70 Mt H_2 producido mediante electrólisis:</u>

- 617 millones m^3 H_2O/año (1.3% del uso global en sector energía)
- 3600 TWh/año (> electricidad anual U.E.)
    - 70% del potencial solar según Min Energía[1]

[1] PV: 829 GW, fp 27% / CSP: 510 GW, fp 70%

Reformado de Metano v/s Electrólisis

Prod



53.

-
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Reformado de Metano v/s Electrólisis

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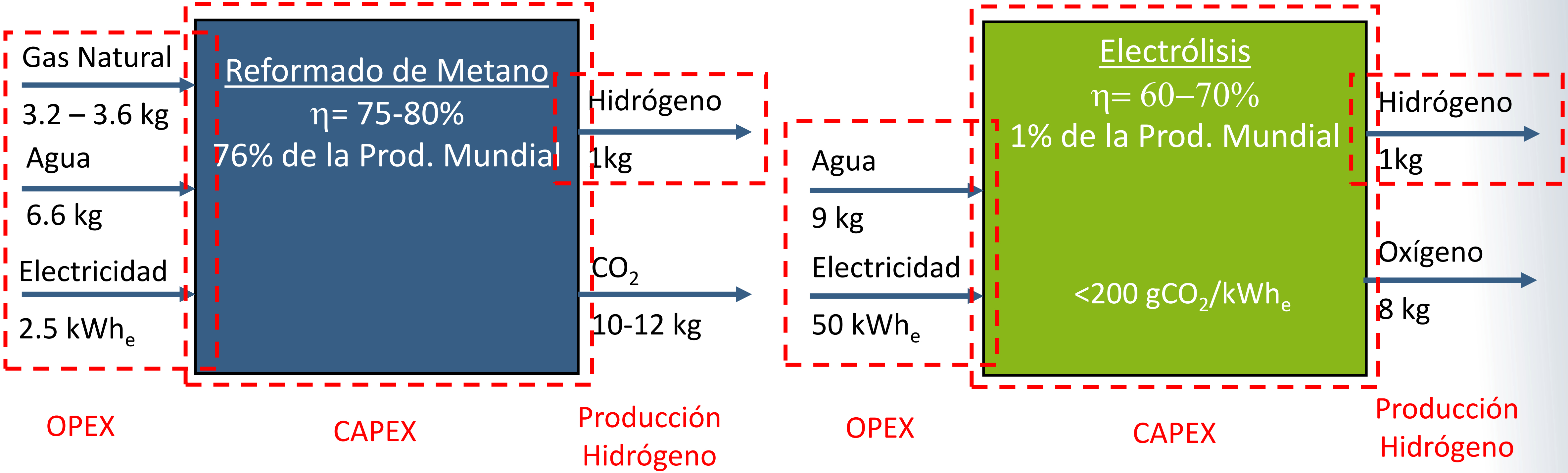
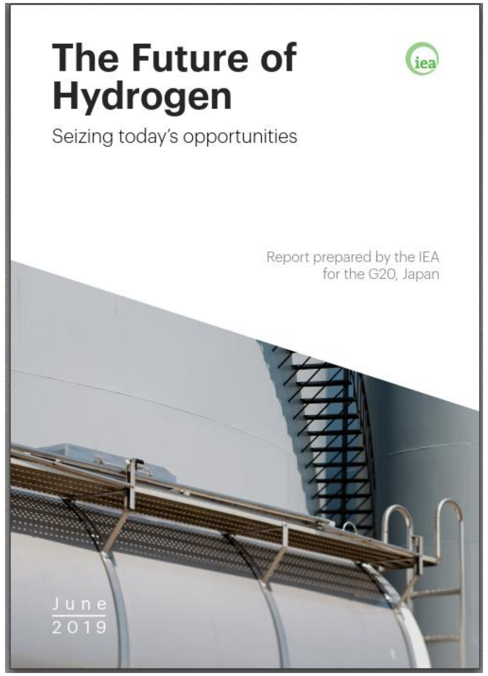


$$LCOH = \frac{VAN(CAPEX + OPEX)}{VAN(\text{Producción } H_2)}, \frac{USD}{kg}$$

3

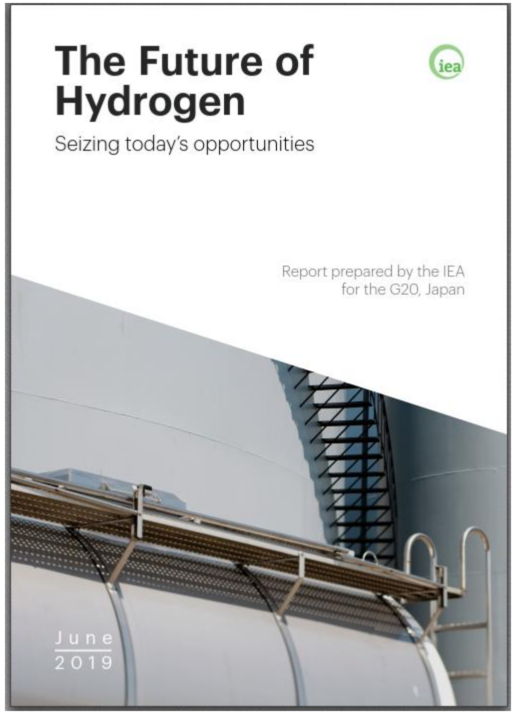
Levelized Cost of Hydrogen



(Click)

G20 – Ministerial Meeting on Energy Transitition

Dr Fatih Birol, the IEA's Executive Director, alongside Mr Hiroshige Seko, Japan's Minister of Economy



"The International Energy Agency has provided in-depth support for this weekend's meeting of G20 energy and environment ministers, including the publication of a major new study on hydrogen's potential role in global energy transitions".

Fuente: https://www.iea.org/newsroom/news/2019/june/iea-takes-part-in-g20-energy-and-environment-ministerial-in-japan.html

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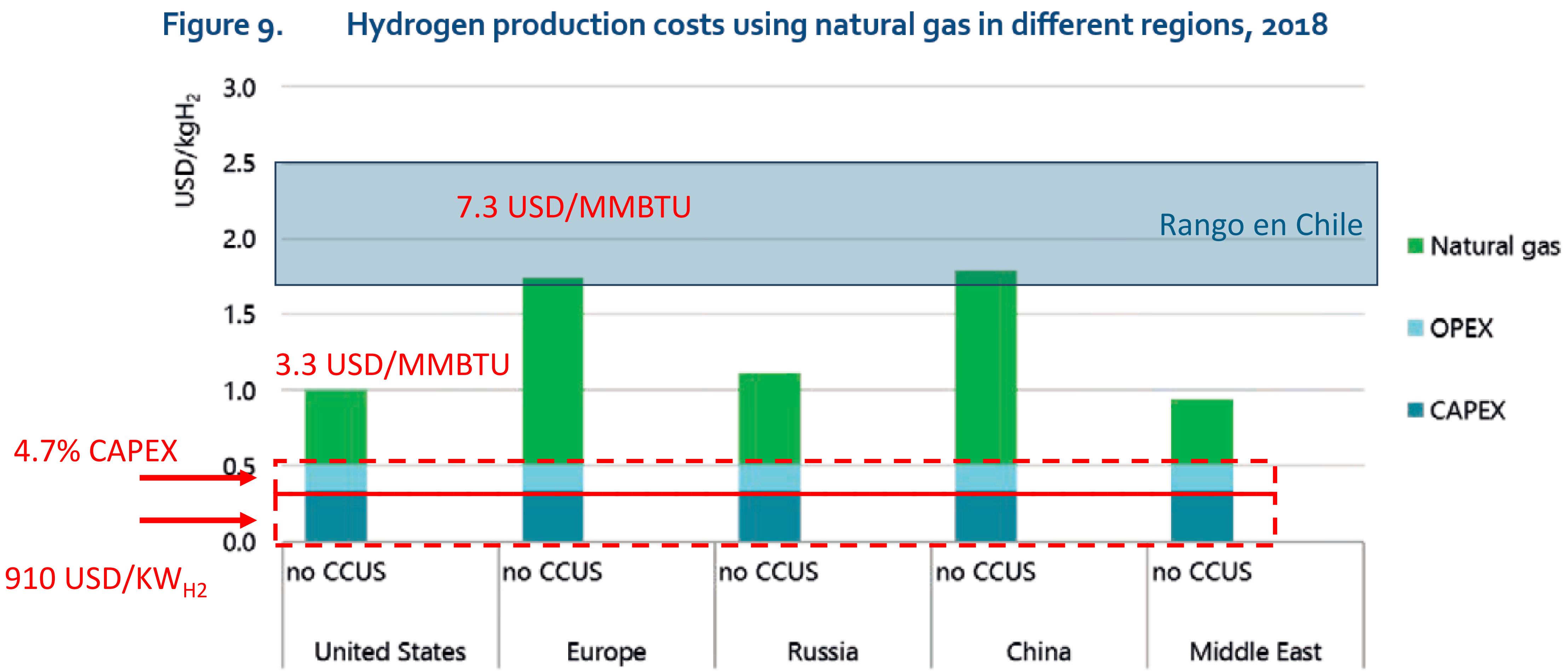
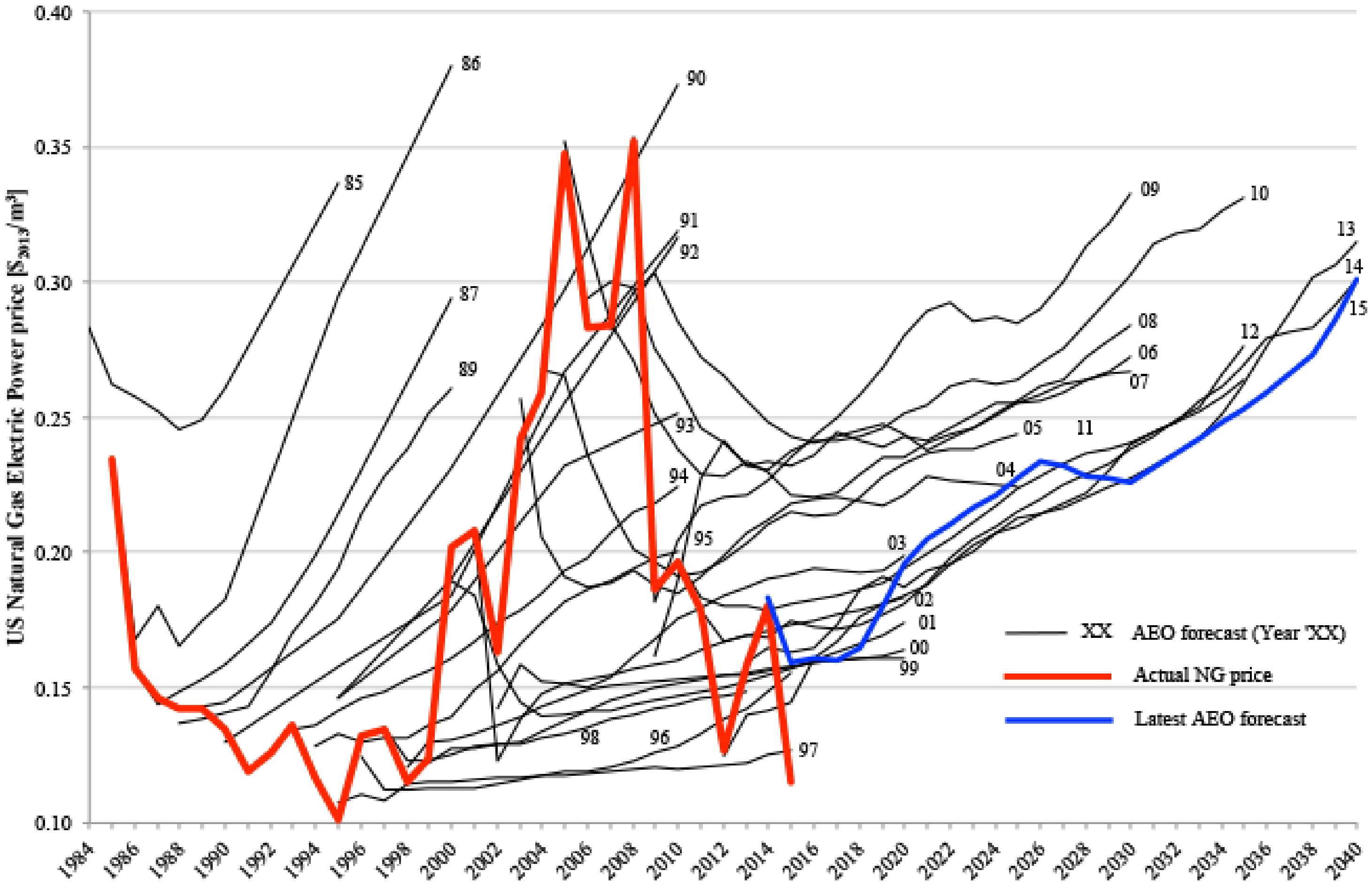
Costo Nivelado de Hidrógeno
Reformado de Metano



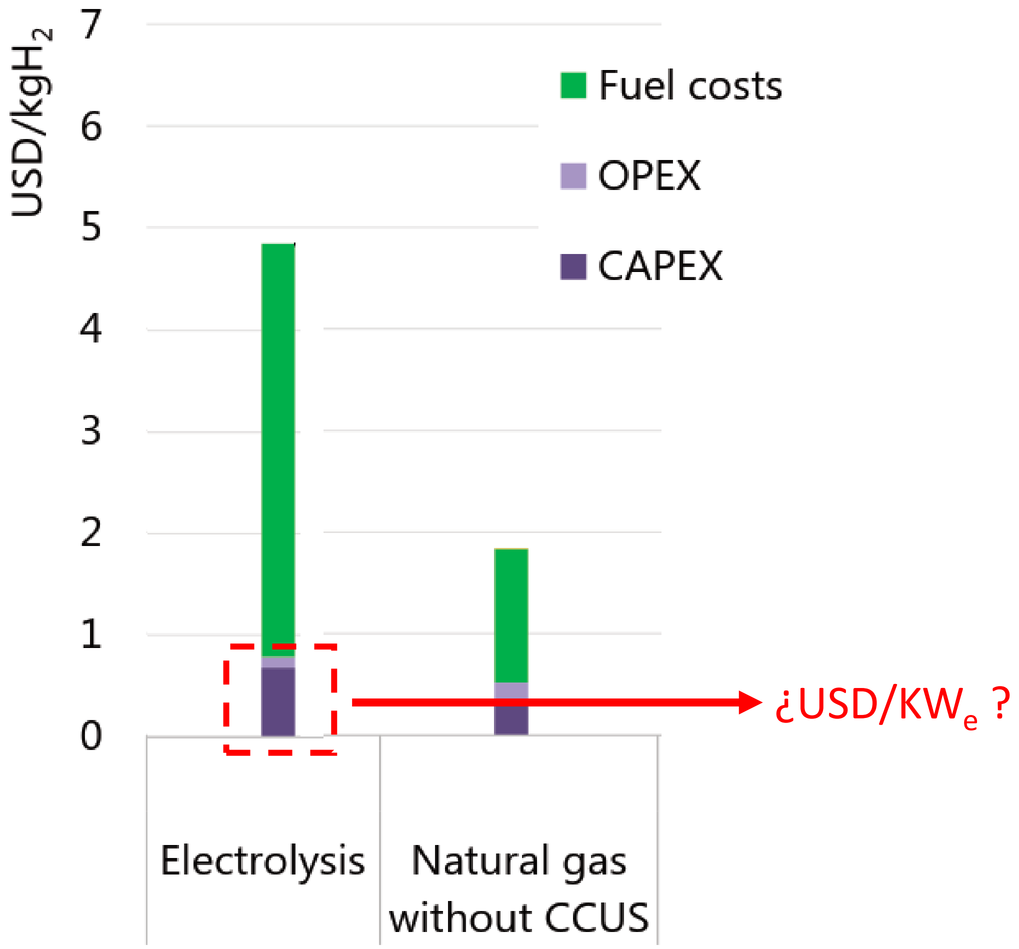
Costo Nivelado de Hidrógeno
Tendencias Gas Natural

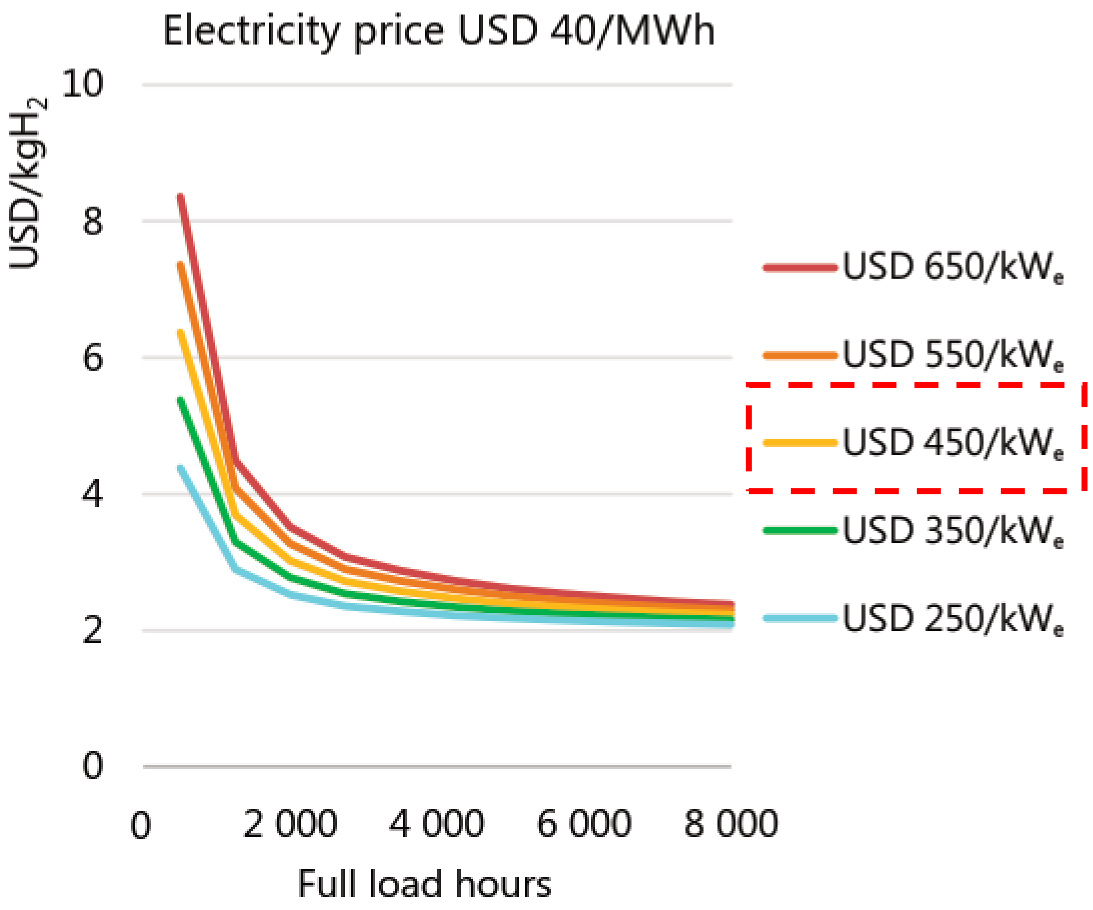


Natural gas for electricity production price in the US: comparison between the yearly EIA Annual Energy Outlook (AEO) price forecasts and the actual values for the years 1985-2015. The black lines are the forecasts made in different years. The red line indicates the actual price. The blue line is the most recent forecast (2015)

Fuente https://www.researchgate.net/figure/Natural-gas-for-electricity-production-price-in-the-US-comparison-between-the-yearly_fig1_317689860

Costo Nivelado de Hidrógeno
Electrólisis



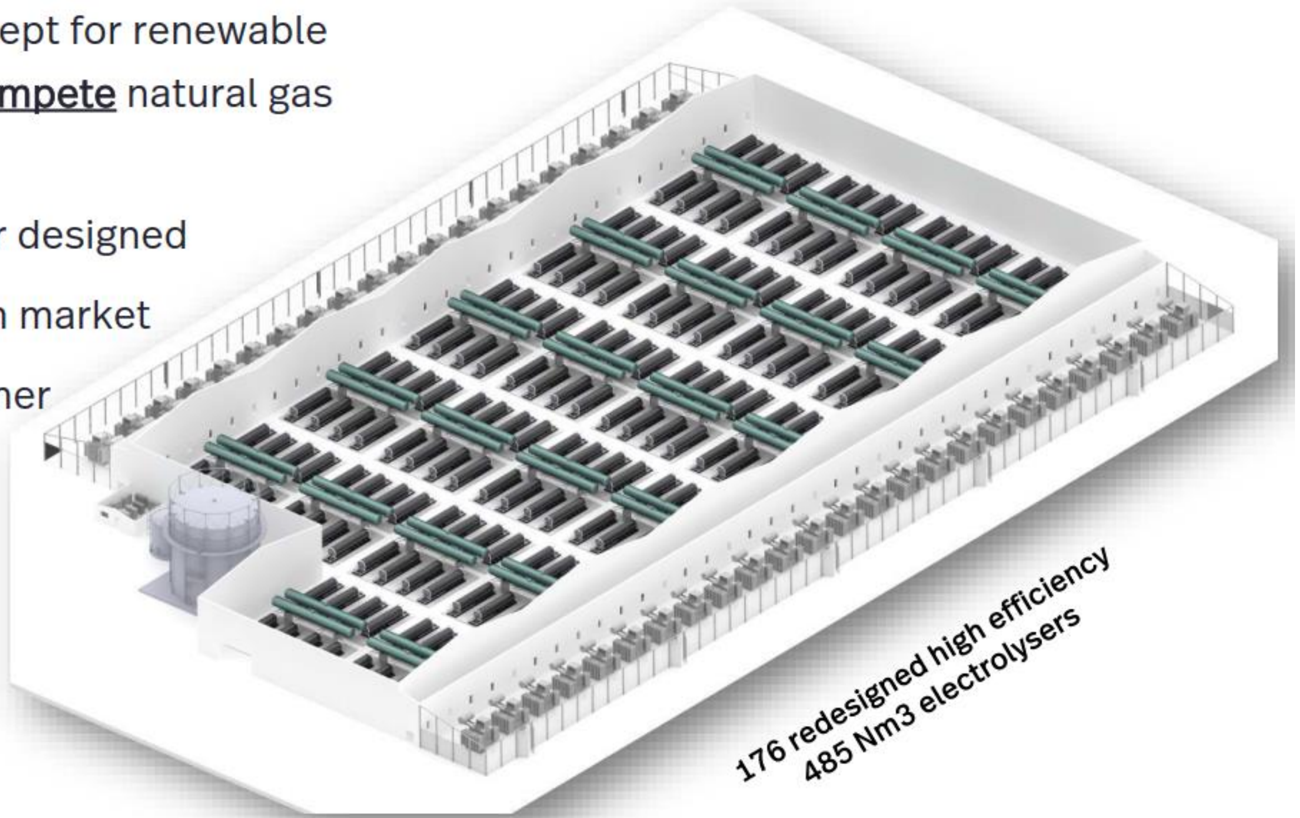


Notes: MWh = megawatt hour.
Based on an electrolyser efficiency of 69% (LHV) and a discount rate of 8%.

Costo Nivelado de Hidrógeno
Tendencias Electrolizadores

Project develop.: 400MW renewable H2 plant to outcompete natural gas reforming
Project examples

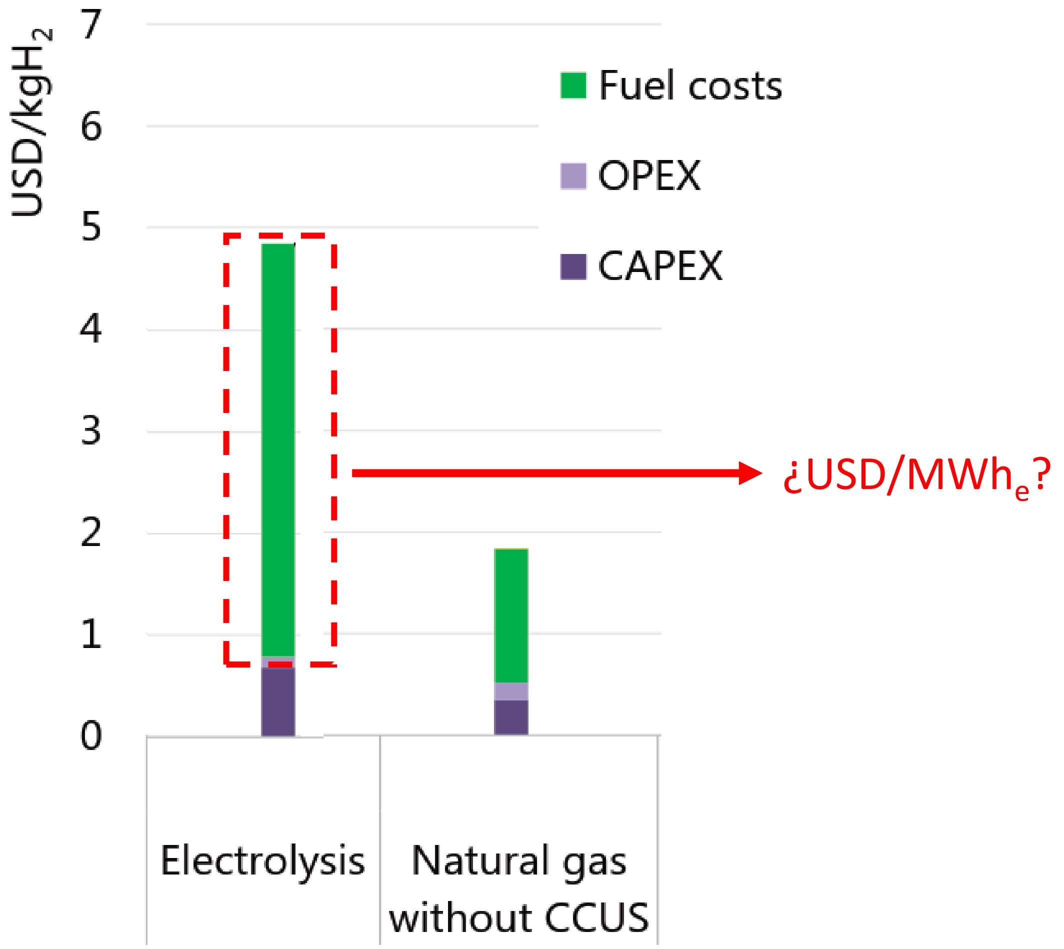
- Working on GIGA factory concept for renewable hydrogen production to <u>**outcompete**</u> natural gas reforming
- Largest electrolyser plant ever designed
- Addressing a USD ~ 150 billion market
- International industrial customer
- Tied to solar power
- CapEx of USD ~175 million
- **Benchmark CapEx ratio:**
  - **0.45 MUSD/MW**

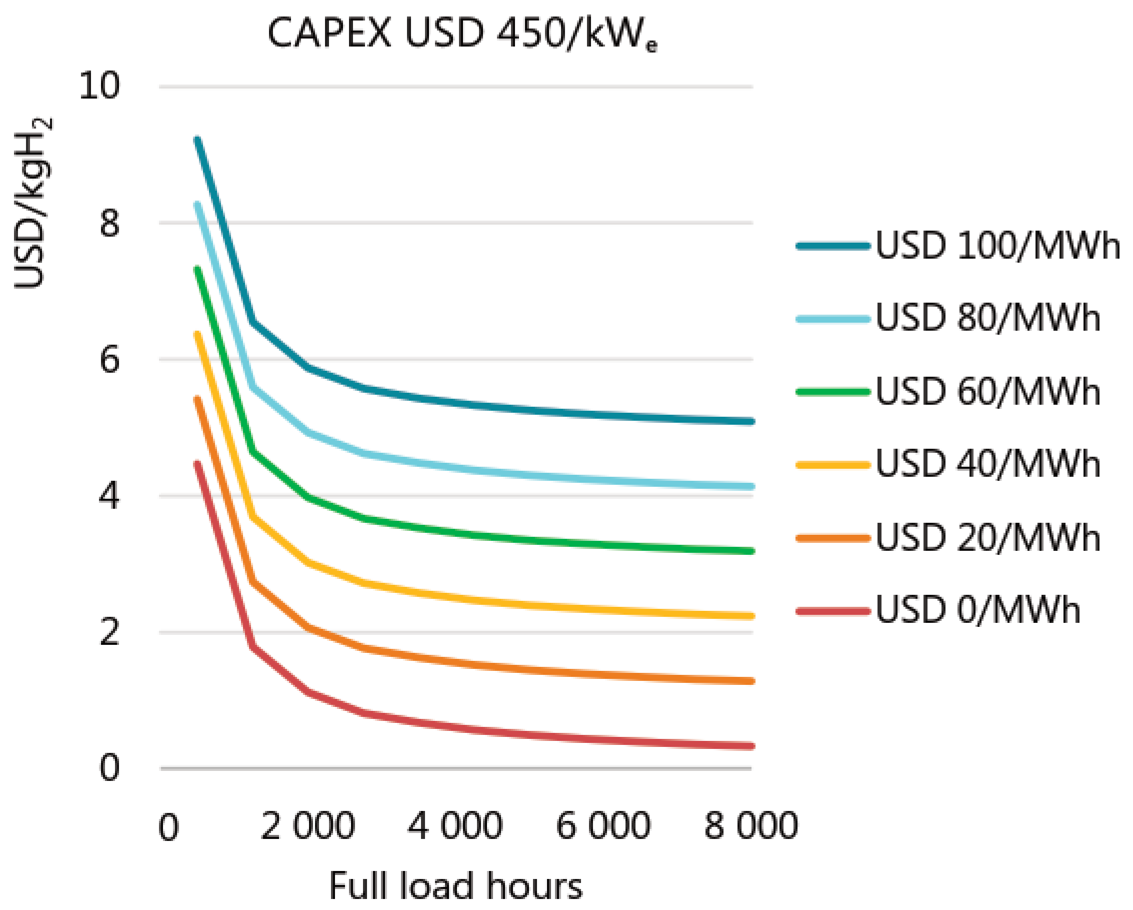


nel·

Fuente: Hannover Messe 2017, Electrolyzer Elevetor Pitch - NEL

Costo Nivelado de Hidrógeno
Electrólisis





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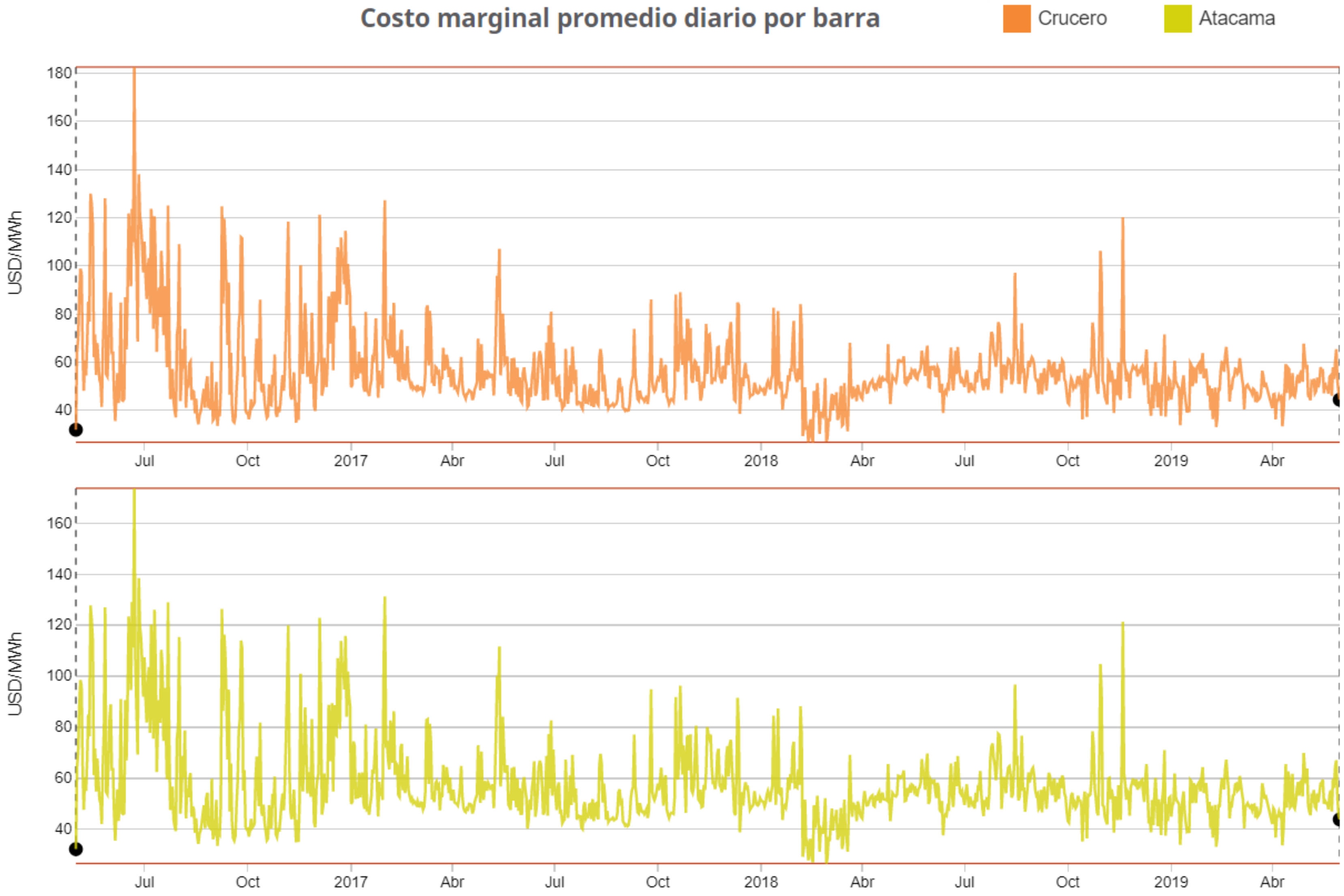
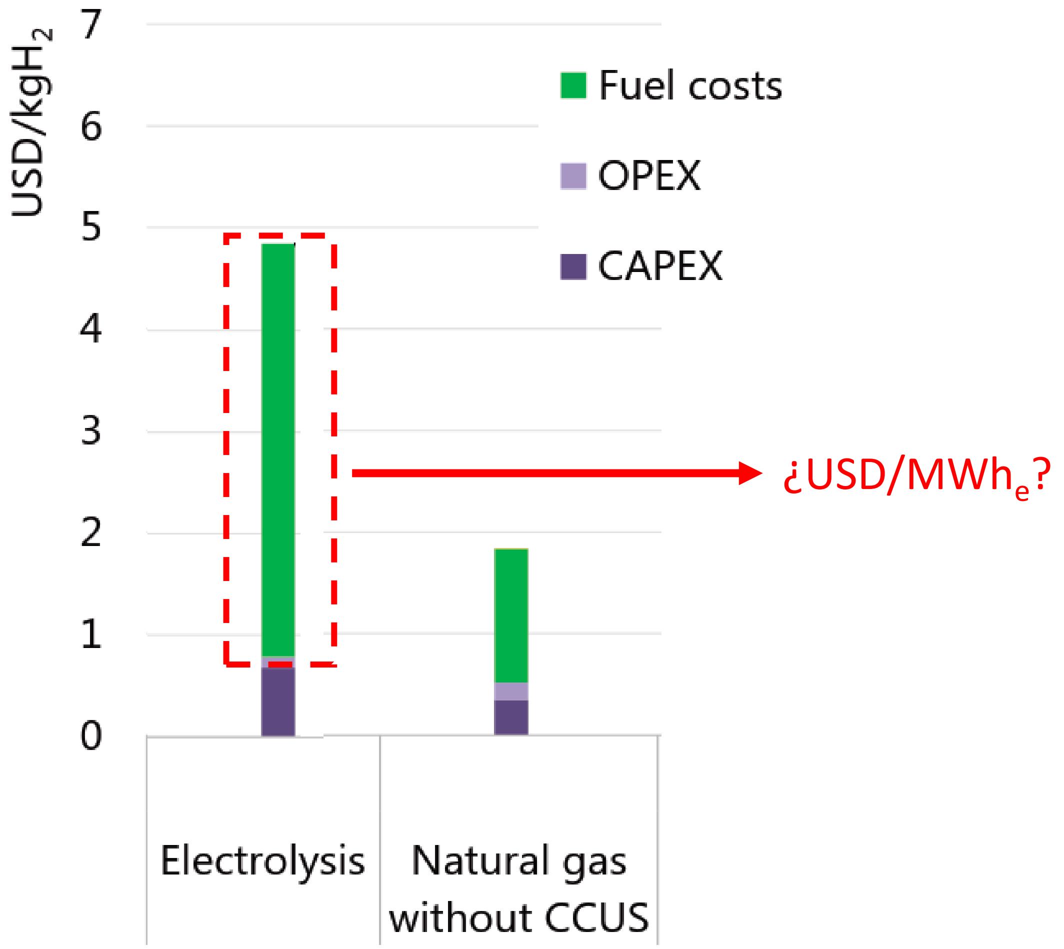
Costo Nivelado de Hidrógeno

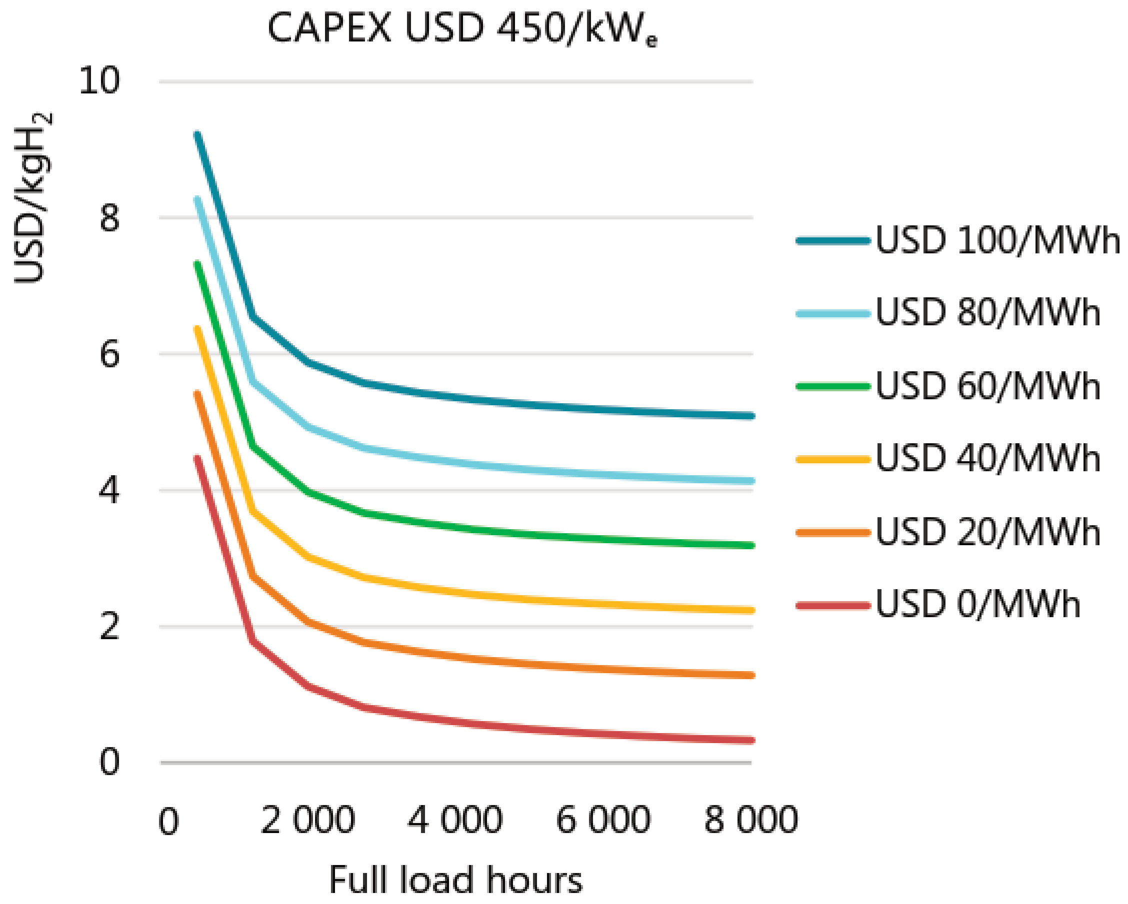
Electrólisis



Fuente: http://energiaabierta.cl/visualizaciones/costo-marginal-promedio-diario/

Costo Nivelado de Hidrógeno
Electrólisis





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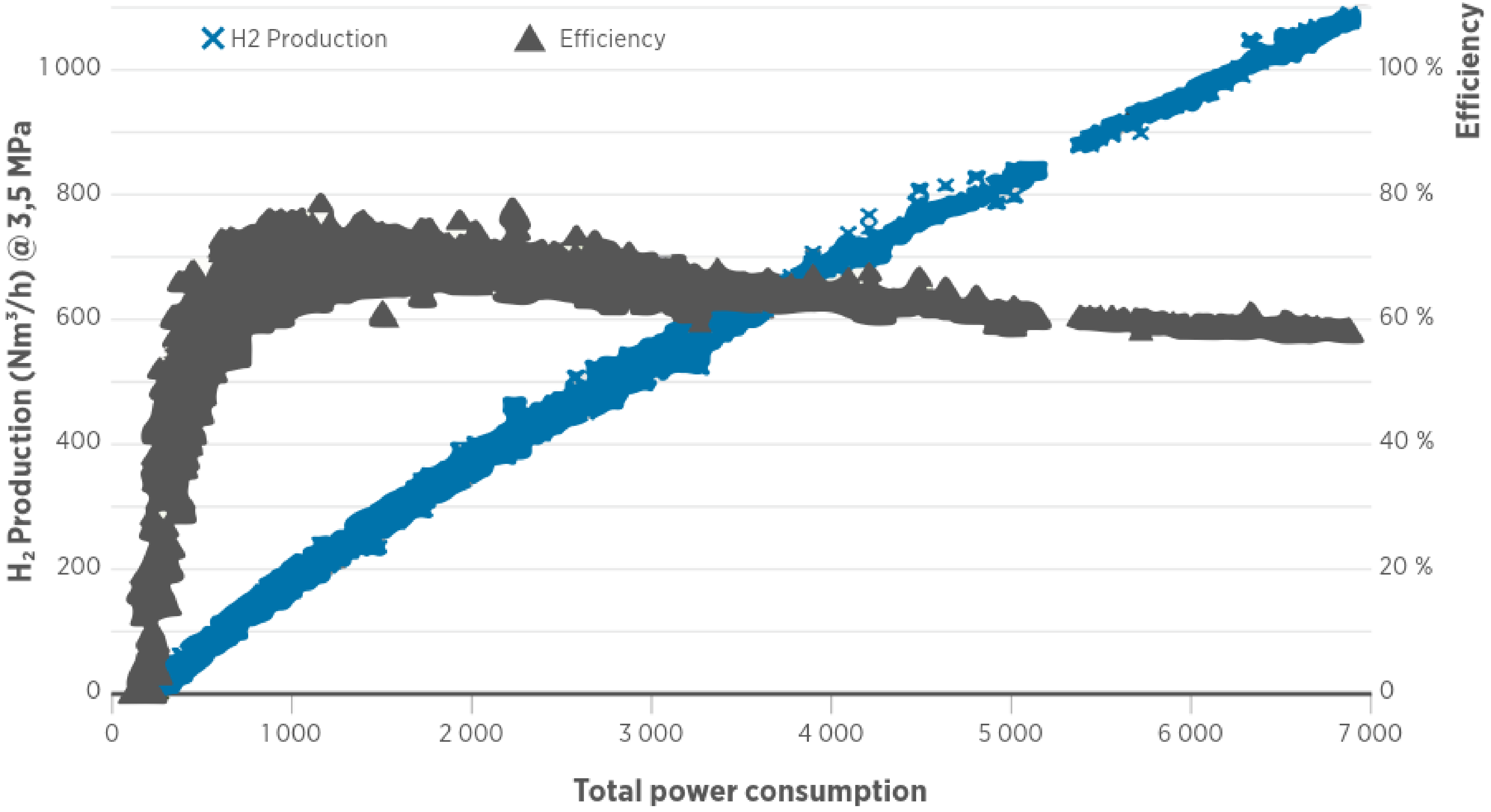
Costo Nivelado de Hidrógeno
Electrólisis



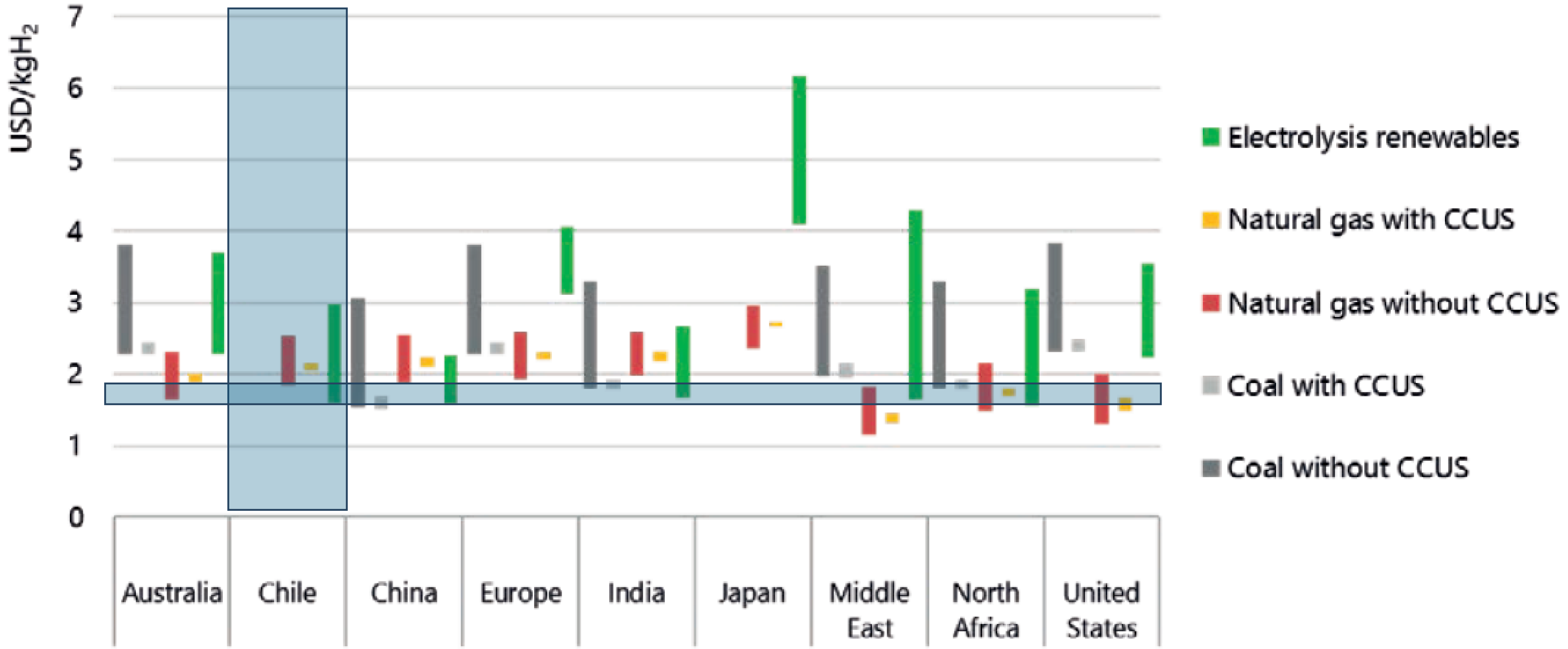
Electrolysers operate more efficiently at lower load, with a counter-intuitive impact on hydrogen cost: contrary to most assets in the power sector, PEM electrolysers have a higher efficiency when operated below nominal load.

Fuente: Irena – Hydrogen from Renewable Power

4

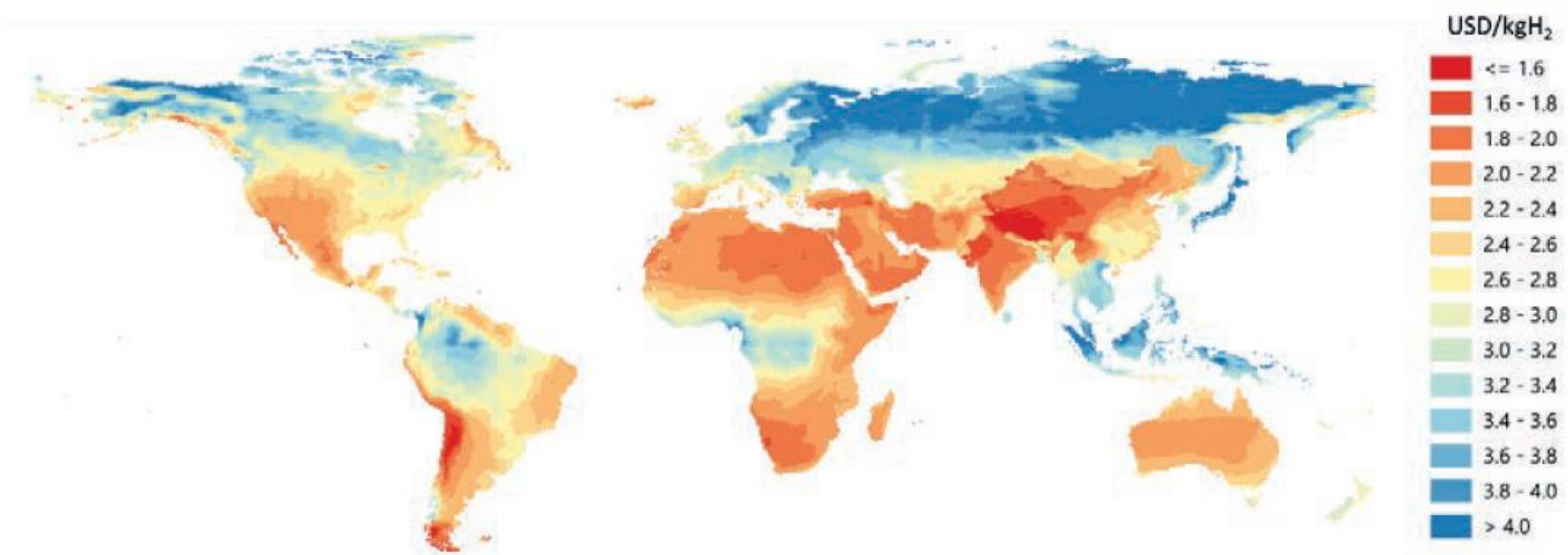
Conclusión: El Caso Chileno

Producción de Hidrógeno en el Mundo

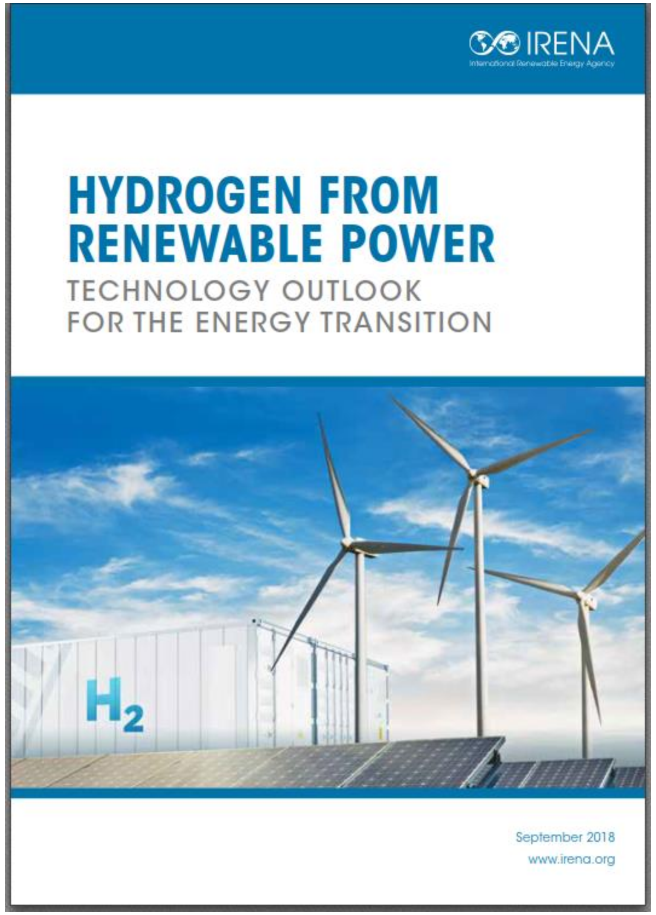


Costo de Producción de Hidrógeno Global

Figure 14. Hydrogen costs from hybrid solar PV and onshore wind systems in the long term



¿Qué están diciendo de Chile?
IRENA



(…)The ideal case for Chilean hydrogen production combines a low LCOE with a high capacity factor, making the best use of cheap renewable electricity and minimising the impact of electrolyser depreciation on the LCOH.

Notably, countries such as Argentina (due to the high load factor of wind generation in Patagonia) and Australia and Chile (due to abundant sun) are developing roadmaps to convert their surplus VRE into compressed gaseous or liquid hydrogen (or another carrier similar to LCOH, see above) for transport to regions with a net demand, such as Japan and the Republic of Korea (…)

¿Qué están diciendo de Chile?
World Energy Council

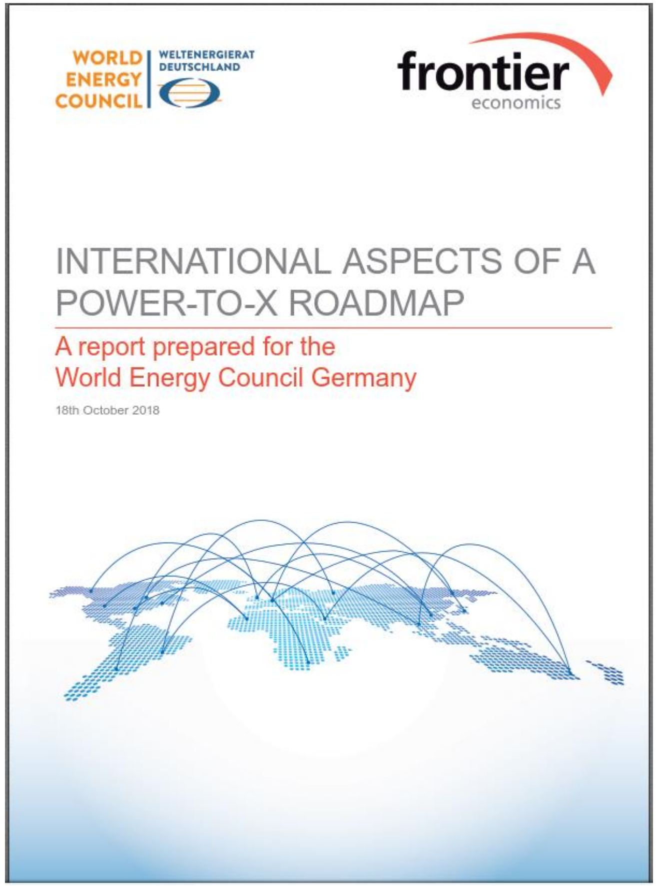


Figure 2 Types of possible PtX producers/exporters and selected example country

Type	PtX motivation and readiness	Selected example
Frontrunners	▪ PtX already on countries (energy) political radar ▪ Export potential and PtX readiness evident ▪ Uncomplicated international trade partner ➢ Especially favourable in early stages of market penetration	Norway
Hidden Champions	▪ Fundamentally unexplored RES potential ▪ Largely mature, but often underestimated, (energy) political framework with sufficiently strong institutions ➢ PtX could readily become a serious topic if facilitated appropriately	Chile
Giants	▪ Abundant resource availability: massive land areas paired with often extensive RES power ▪ PtX readiness not necessarily precondition, may require facilitation	Australia

Chile – the hidden champion: Largely unexplored RES potential paired with strong (energy) political environment

Countries categorised as hidden champions, like Chile, typically demonstrate fundamentally unexplored RES potential with strong climate change targets. Paired with a largely mature (energy) political framework and sufficiently strong institutions – that are often underestimated in the general perception of Latin American countries – PtX could immediately become a serious topic if facilitated appropriately. These countries may well be in the lead in the market penetration phase, fostering the development of PtX technology.

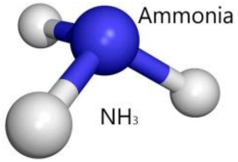
Source: Frontier Economics.

¿Cuánto Importó el 2017 Chile en fósiles u derivados?

Datasur
INFORMACIÓN QUE IMPORTA

~ 3120 million USD/año

~ 2320 million USD/año



~ 86 million USD/año

~ 940 million USD/año

~ 313 million USD/año

~ 118 million USD/año

~ 750 million USD/año

~ 310 million USD/año

~ 84 million USD/año

Total:
8 Billion USD/año

Peróxido de Hidrógeno

~20 million USD/año

H2Chile
ASOCIACIÓN CHILENA DE HIDRÓGENO

Conclusión

Chile tiene el potencial renovable para producir Hidrógeno Verde con uno de los precios más competitivos del mundo.

- Lunes 17 - Powerfuels in the European energy transition
- Martes 18 - The role of low carbonfuels in achieving the Paris agreement
- Martes 18 - Hydrogen enabling the energy transition
- Miércoles 19 - Green hydrogen decoupling the European energy network
- Miércoles 19 - Sectoral integration: shaping EU’s climate-neutral future
- Miércoles 19 - Afternoon Seminar 'Towards a Hydrogen Energy Economy'

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ASOCIACIÓN CHILENA DE HIDRÓGENO

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GRACIAS

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