Green H-rich feedstock and fuels - Global trade opportunities

Cédric Philibert *former International Energy Agency senior analyst*

ATA Webinar: Clean energy trade across the Mediterranean

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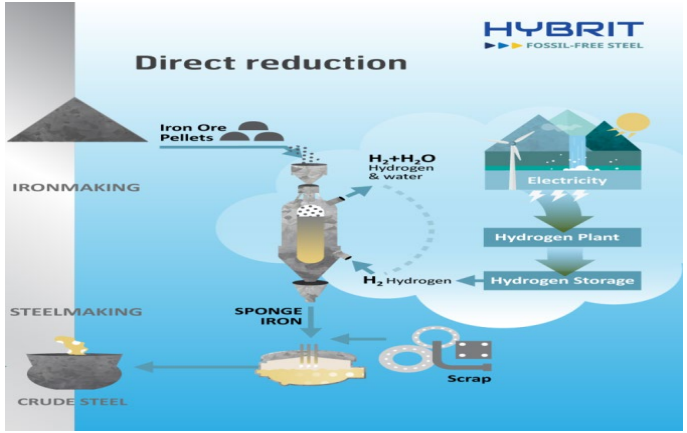
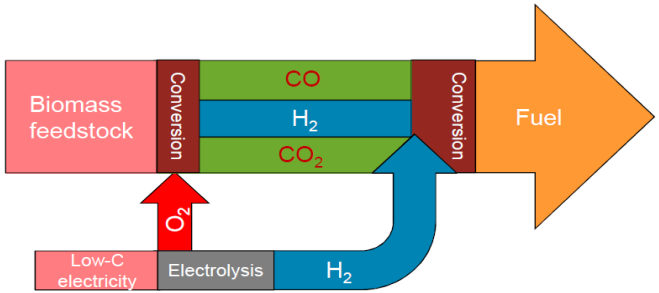
Most relevant areas for green hydrogen use

- Green ammonia & methanol for industrial uses
- Refineries (to upgrade and clean fuels)
- Direct iron reduction in steelmaking
- H_2/NH_3 storable/shippable fuels in power systems
- NH_3 as fuels (deep sea shipping, furnaces…)
- H_2 in trucks, coaches, buses, cars, trains?
- Sustainable aviation fuels
  - With biogenic or atmospheric carbon

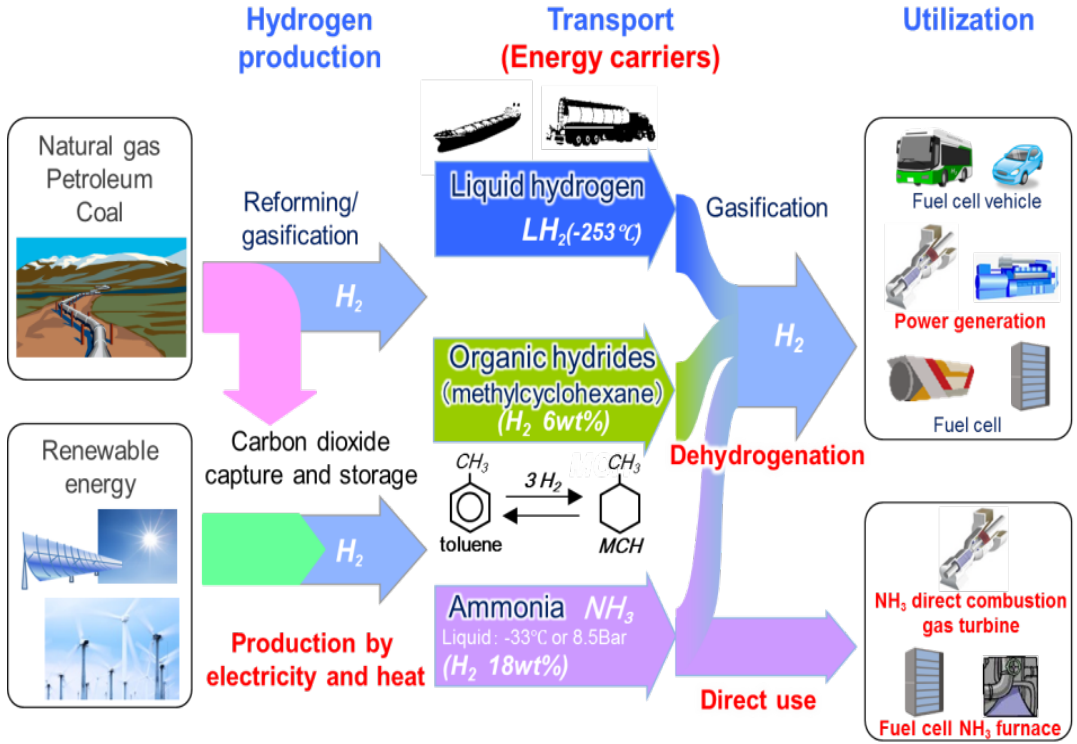




Source: Hannula, 2017

blogcedricphilibert@gmail.com

Exploiting cheap RE will require massive trade…



Source: Japan's Energy Carriers Program, 2017

Japan is considering liquefied hydrogen, organic hydrides and ammonia as possible energy carriers from Australia and Middle East to Japan – with a growing preference for ammonia

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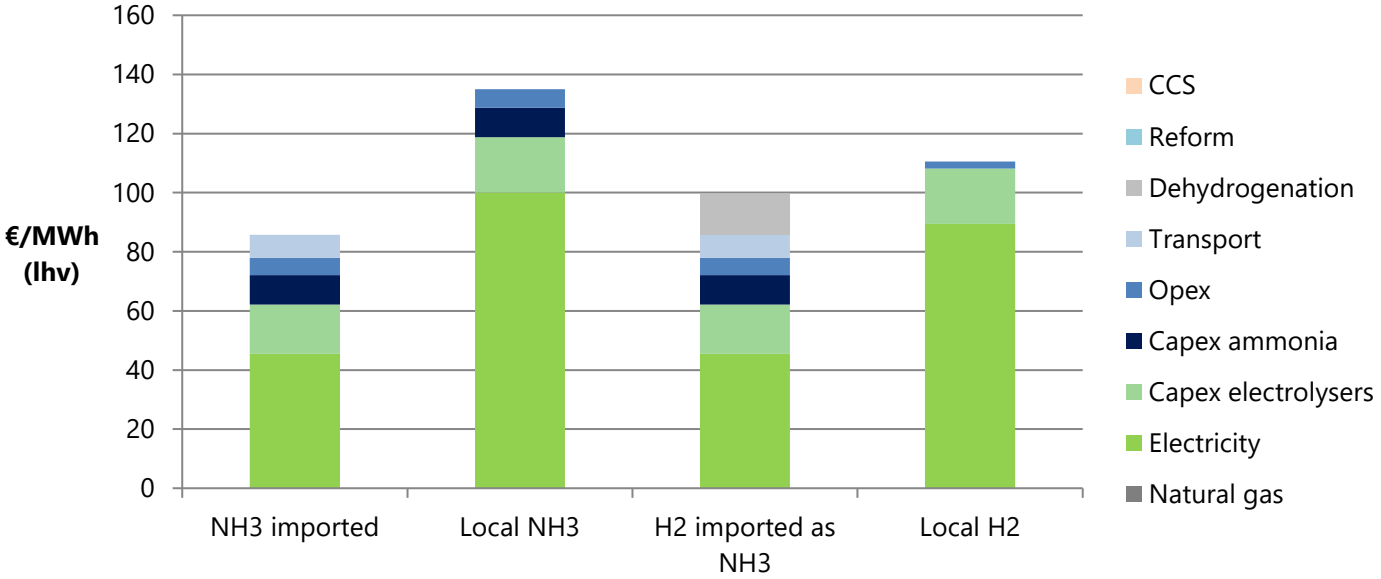
… however, pure H_2 « carriers » may not fly…

Costs of energy in Europe of » imported » vs « local » H_2 and NH_3, natural gas and « blue » hydrogen



Imported NH_3 made from power @ $30/MWh outcompetes NH_3 produced with $60/MWh
H_2 extracted from NH_3 is barely cheaper than H_2 produced locally even at higher power cost

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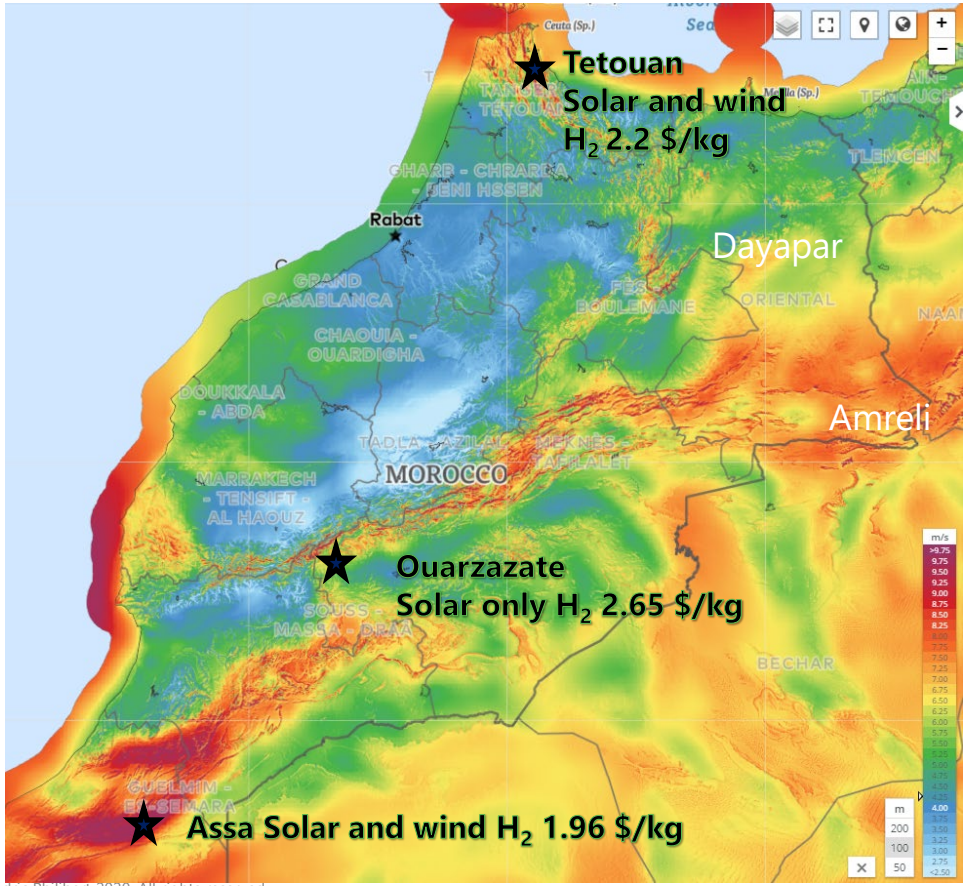
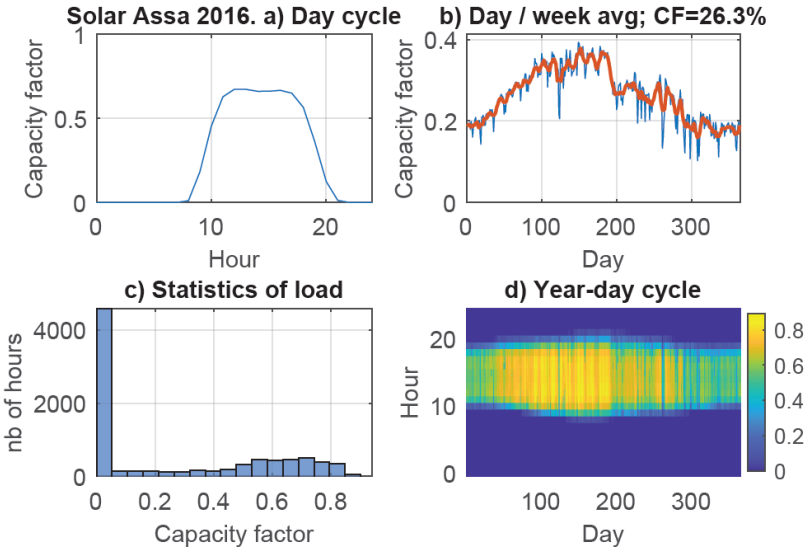
Three locations in Morocco with diverse meteo conditions



To assess the costs of producing H_2, NH_3, MeOH, synfuels, metal iron… from solar and wind, you must look at their variability on all time scales



Source: Global Wind Atlas

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To sum up

- Easy to store & ship H-rich fuels/feedstock will be traded
  - Ammonia in its current industrial and future fuel roles
  - Methanol for the chemical industry
  - Synthetic hydrocarbons (FT-fuels) for aviation
  - Hot briquetted iron (HBI) for steel making
- North Africa may export H_2 in pipelines to Europe
- Global decarbonisation of industry and long-range transports will require large additional amounts of renewable electricity
  - 50% to 75% of total electricity generation in 2018
  - ~ten times the current electricity from solar and wind

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