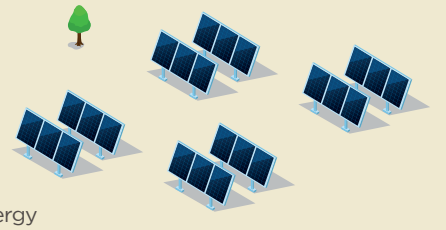
METHANOL AS A HYDROGEN CARRIER

1
- Carbon intensity of the grid determines the carbon intensity of electrified applications
- Most grids have low integration of renewable energy capacity

Country					
Carbon intensity of Grid $kgCO_2eq/kWh$	0.40	0.20	0.42	>0.70	0.70





2
- Renewable energy generation has to be **X3 or X4** larger than electricity demand to address intermittency
- Cost to integrate fully renewable grids:
  - **>USD 4.5 trillion**
  - **>USD 3.6 trillion**
  - **>USD 11 trillion**



3
- Rising cost of electricity brings cost of H2 to **>USD 3.5/kg** (based on price of US industrial electricity)



4
- Electrolysis of water requires **50 – 55 kWh/kg** of H_2
- H_2 produced is not green with a carbon intensity of **21 $kgCO_2eq/kg$ of H_2** (based on carbon intensity of US grid electricity)

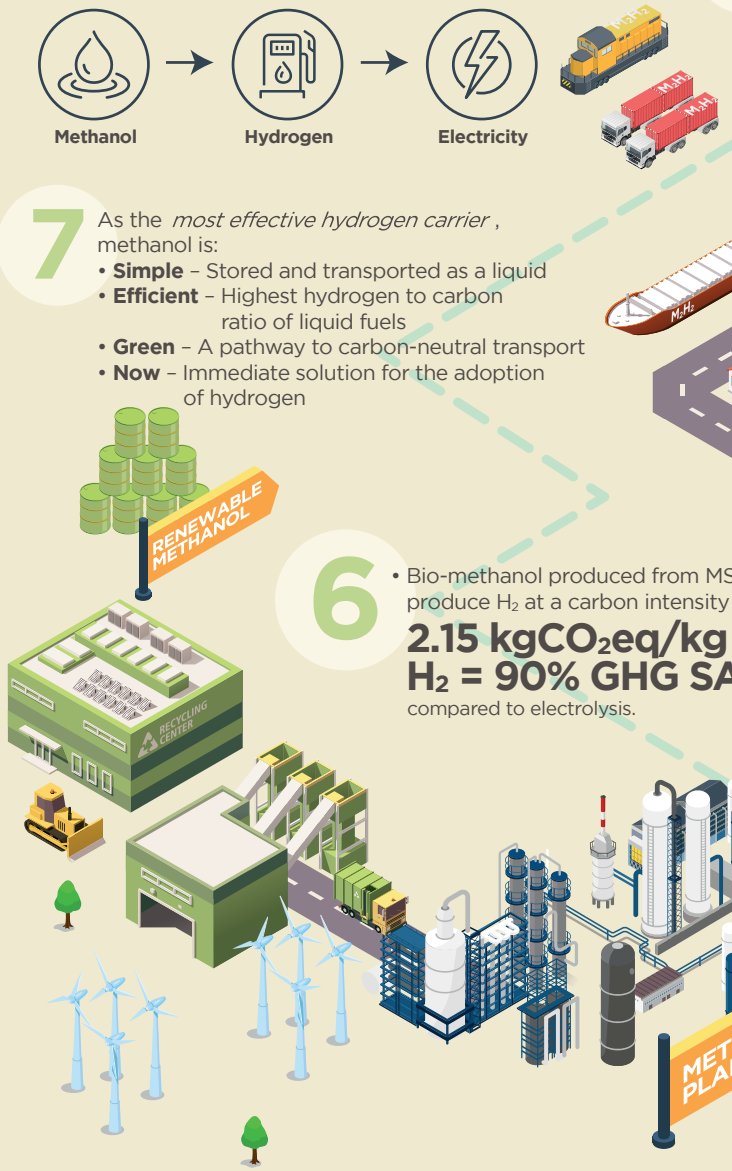


5
- Methanol has a **low carbon intensity**, and can be **carbon-neutral**, when produced from sustainable feedstocks such as municipal solid waste (MSW), agricultural waste, and captured CO_2

6
- Bio-methanol produced from MSW can produce H_2 at a carbon intensity of **2.15 $kgCO_2eq/kg$ of H_2 = 90% GHG SAVINGS** compared to electrolysis.

7
As the *most effective hydrogen carrier* , methanol is:
- **Simple** – Stored and transported as a liquid
- **Efficient** – Highest hydrogen to carbon ratio of liquid fuels
- **Green** – A pathway to carbon-neutral transport
- **Now** – Immediate solution for the adoption of hydrogen

8
Vehicles with onboard methanol reformation incur **LOWER CAPEX** and **OPEX** for **LONGER RANGE, SHORTER REFILL TIME**, and **LOWER EMISSIONS**



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