



Hydrogen: The Swiss Army Knife

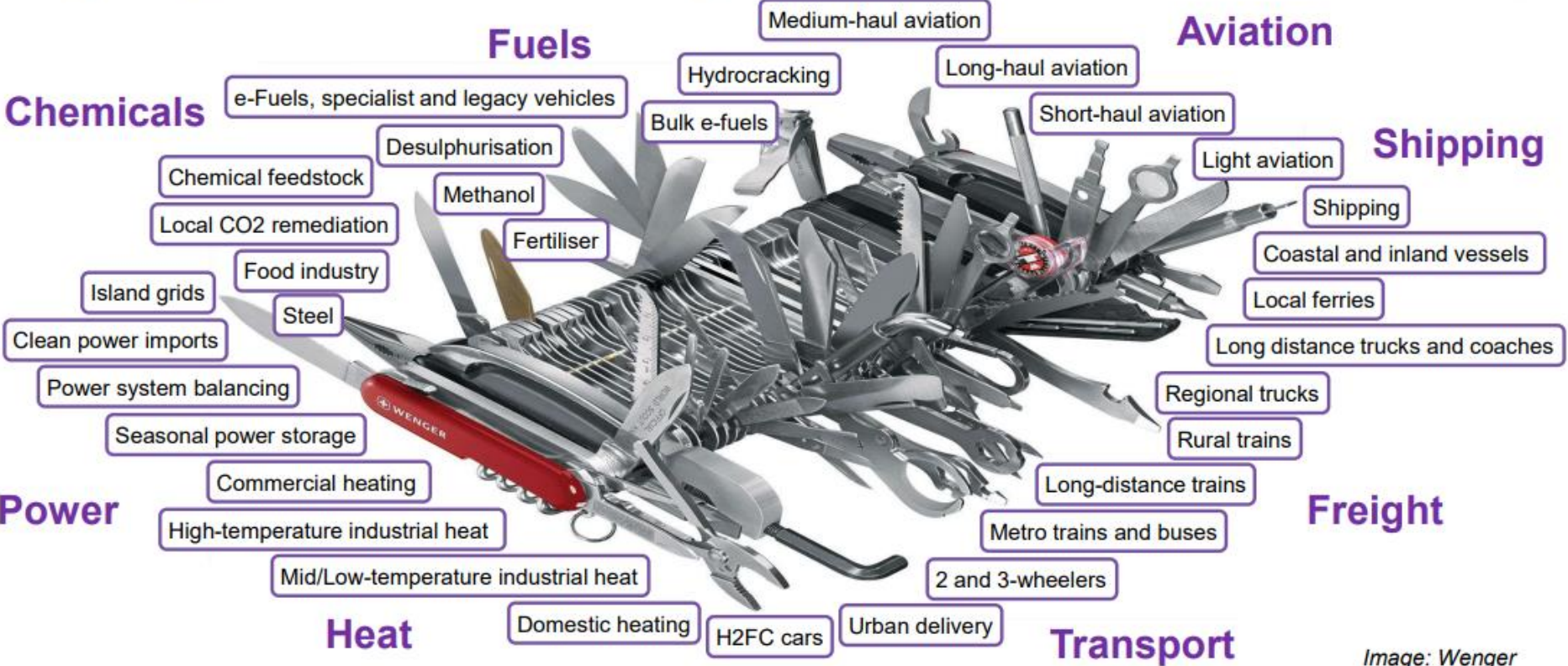










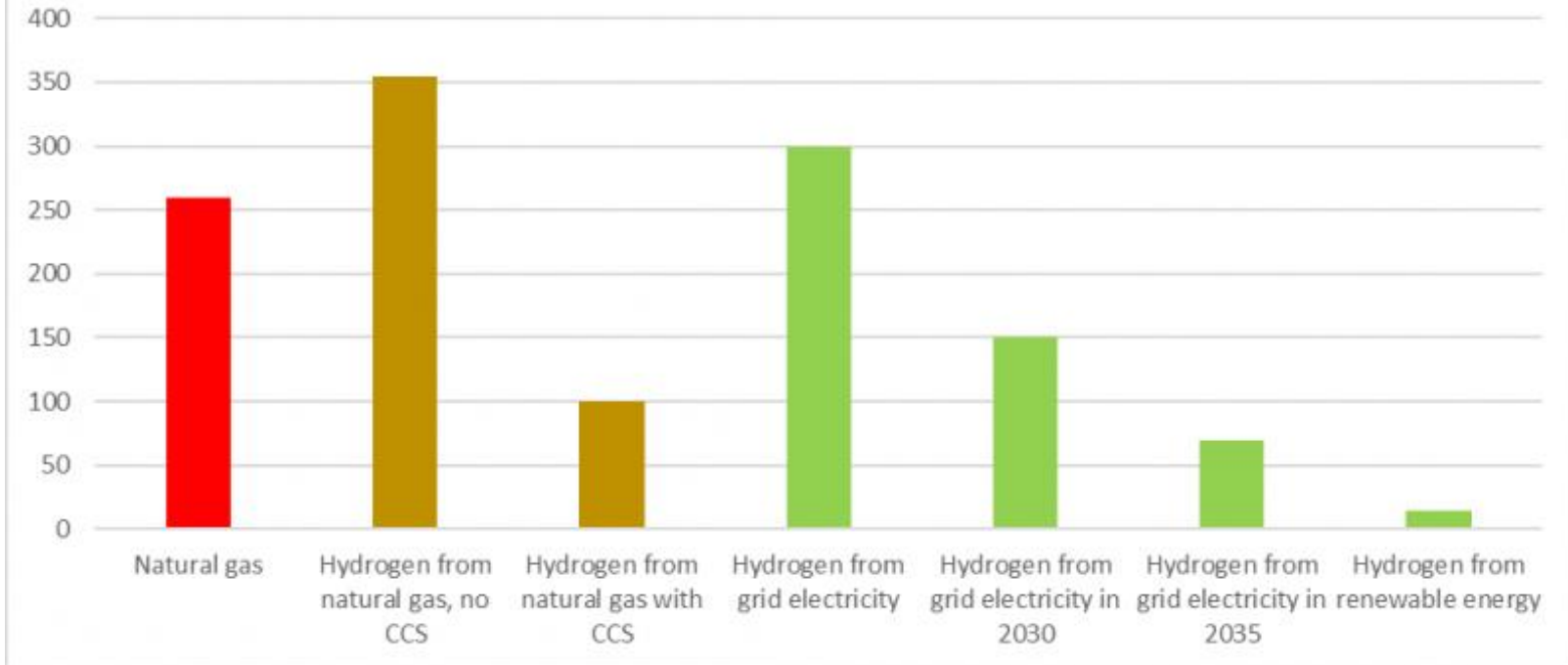
Image: Wenger

COLOUR

DESCRIPTION: FEEDSTOCK

	Grey: natural gas reforming without CCUS
	Brown: brown coal (lignite) as feedstock
	Blue: natural gas reforming with CCUS
	Green: electrolysis powered through renewable electricity
	Pink: electrolysis powered through nuclear energy
	Turquoise: methane pyrolysis
	Yellow: electrolysis powered through electricity from solar
	Orange: electrolysis powered through electricity from wind

Carbon intensity of hydrogen compared to natural gas (gCO₂/kWh)

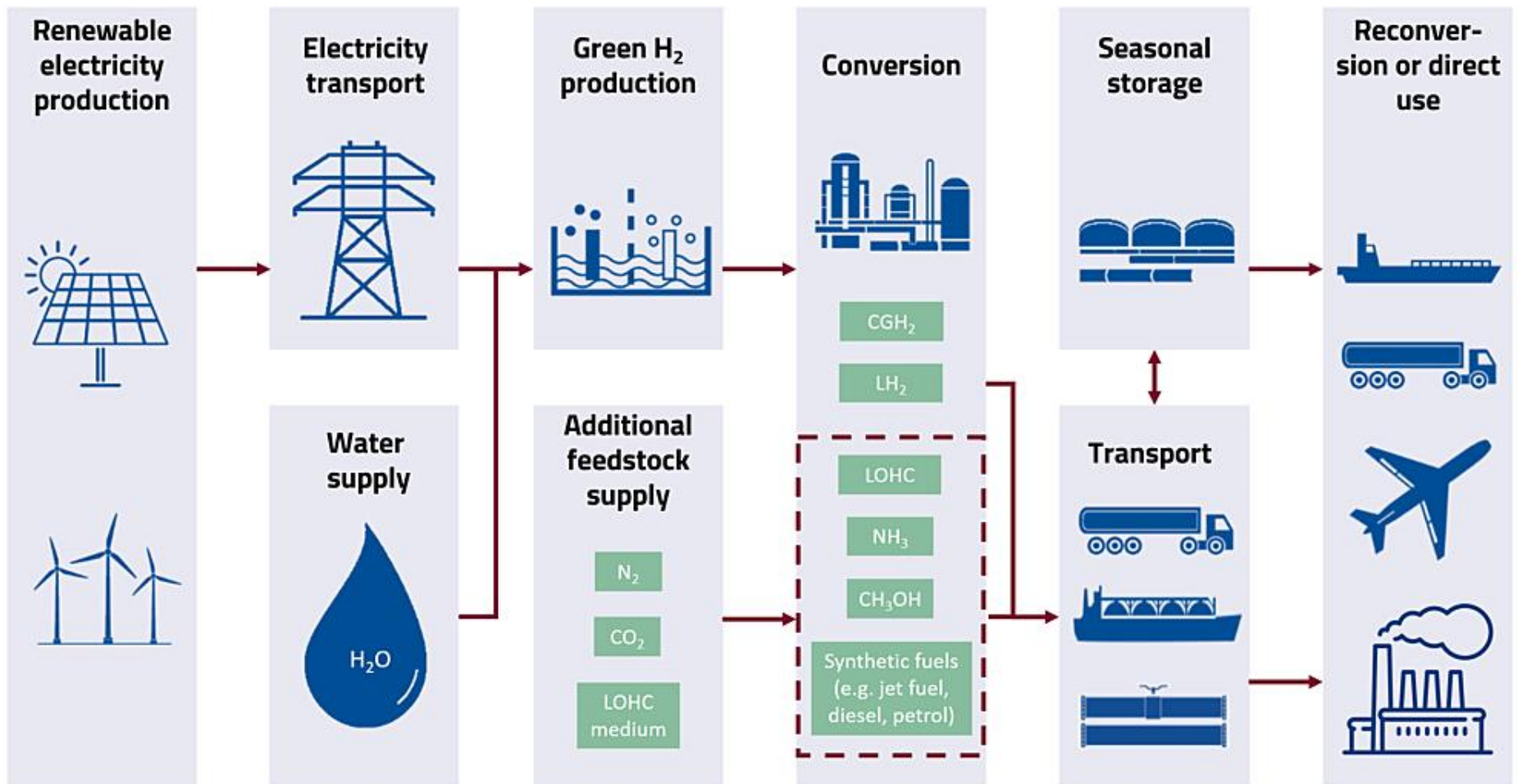


For Water Splitting

$$285.8 \times 10^3 \frac{J}{mol} \times \frac{1 \text{ mol } H_2}{2.016 \text{ g}} \times \frac{1000 \text{ g}}{1 \text{ kg}} = 141.8 \text{ MJ/kg}$$

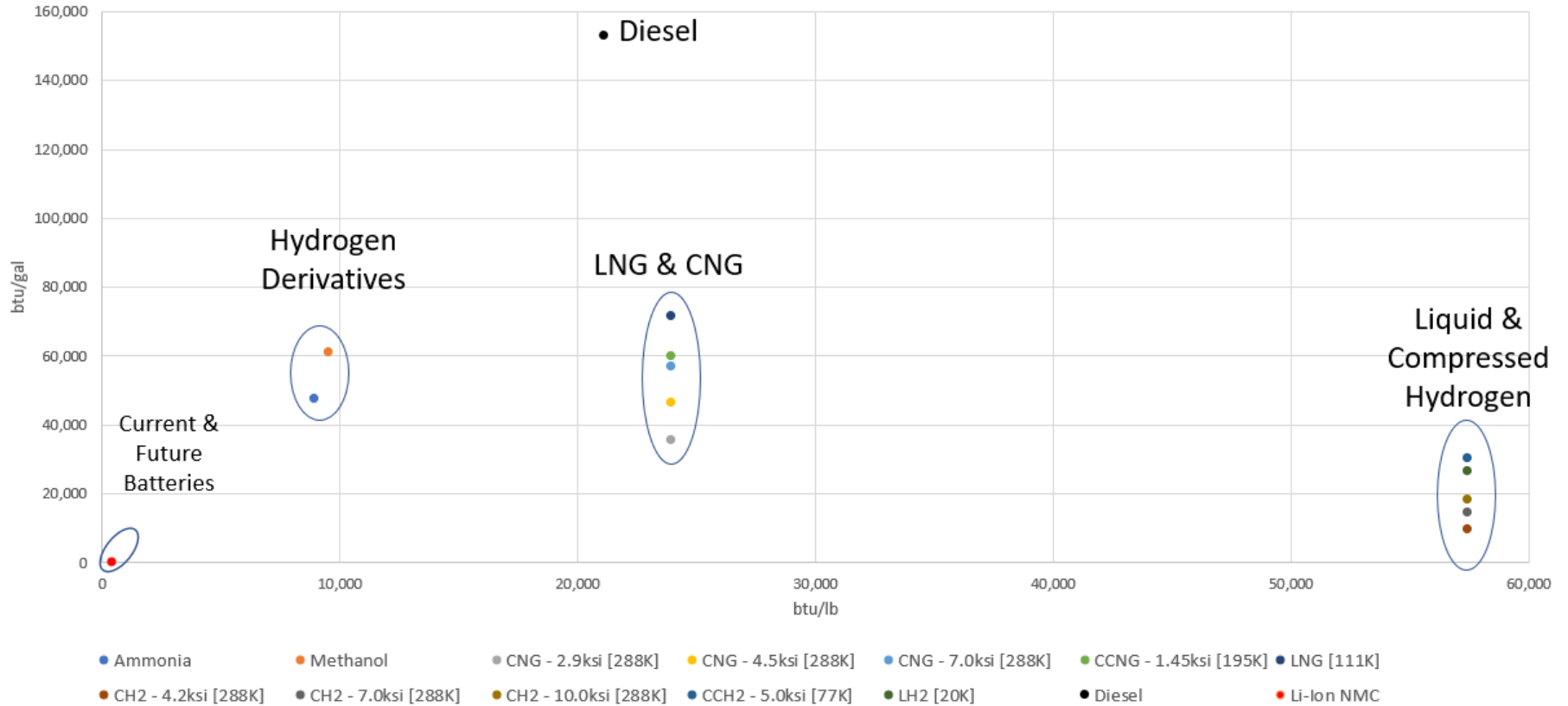
$$141.8 \frac{MJ}{kg} \times \frac{1 \text{ Watt. sec}}{J} \times \frac{1 \text{ kW}}{1000 \text{ W}} \times \frac{1 \text{ hr}}{3600 \text{ sec}} = 39.4 \text{ kWh/kg}$$

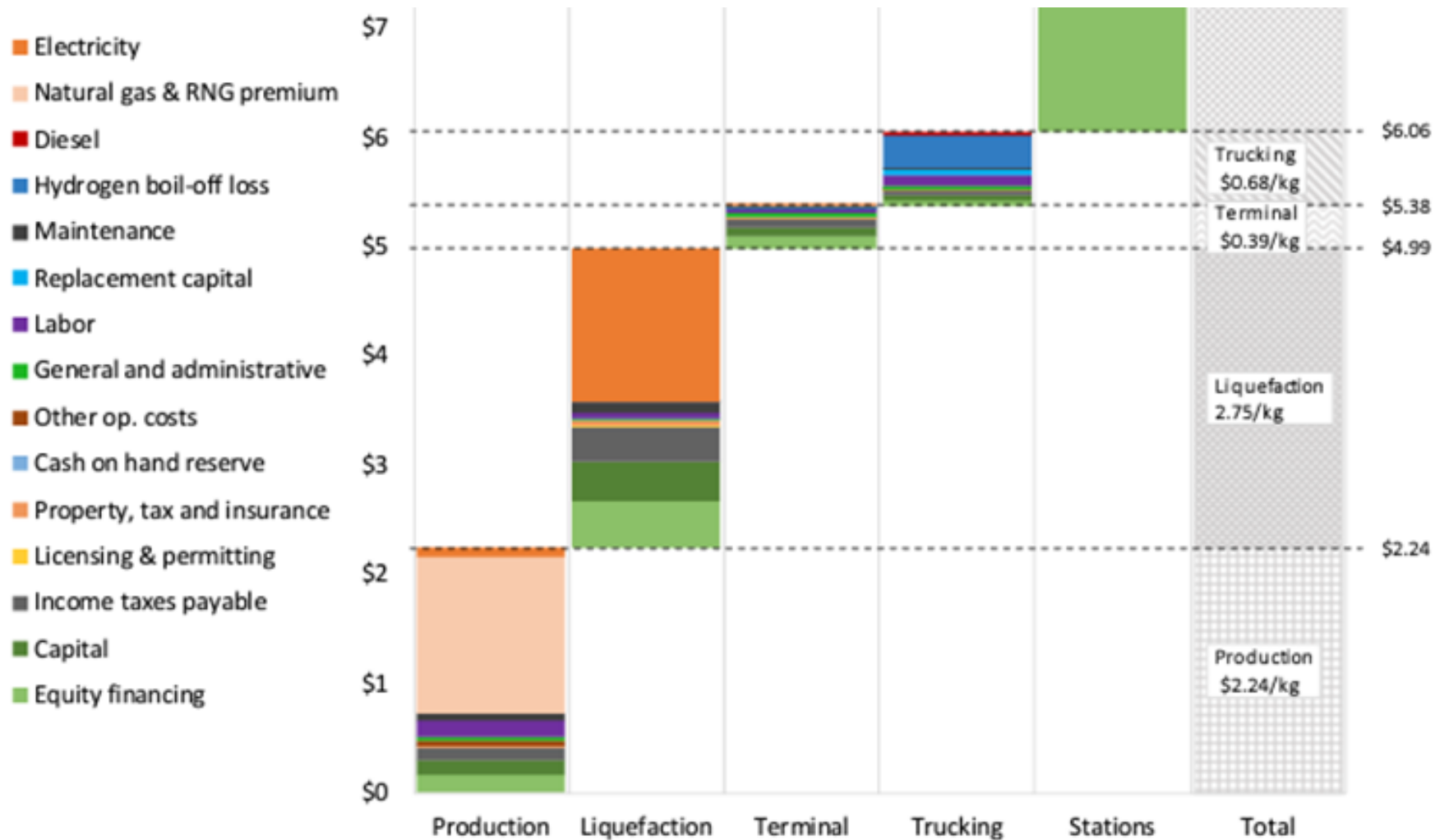
Source: U.S. Department of Energy



Source: <https://www.hoou.de/projects/green-hydrogen/pages/3-4-hydrogen-supply-chains>

Energy Density of Fuels for Heavy Duty Applications

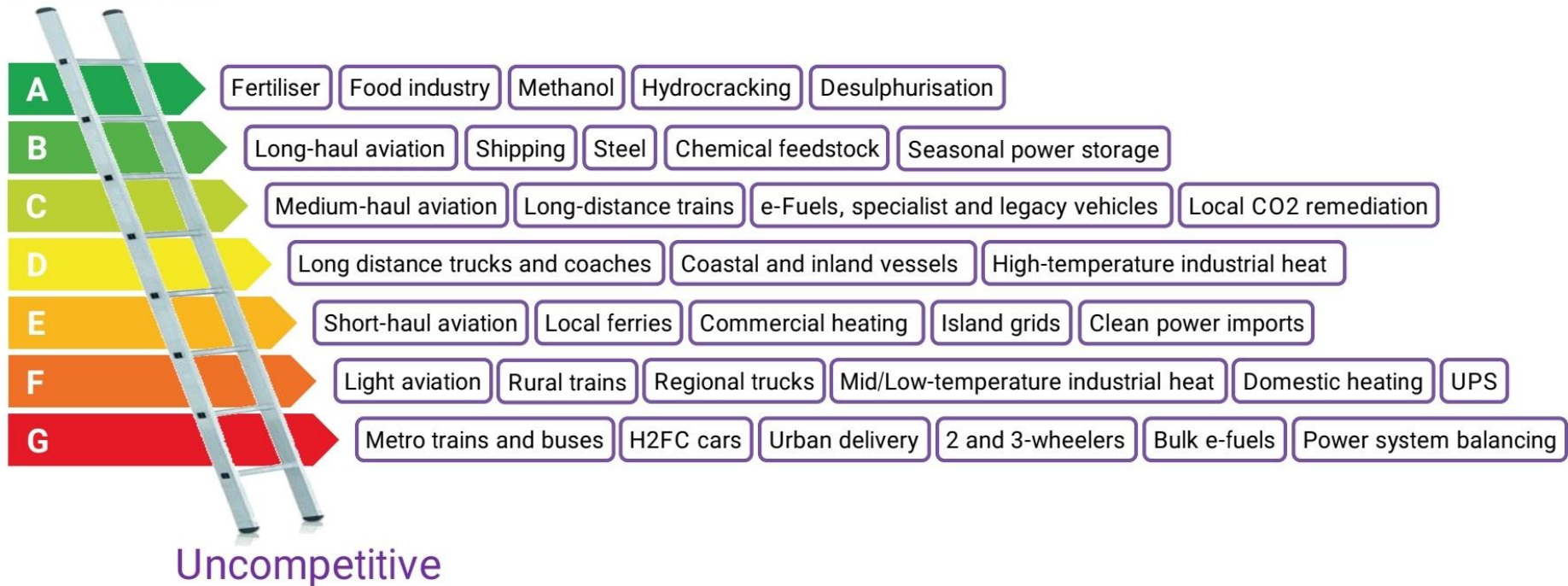




Source: U.S. Department of Energy

Hydrogen: The Ladder

Unavoidable



Source: Liebreich Associates Concept: Adrian Hiel/Energy Cities

