HYPOWA

Key: ICE = Internal Combustion Engine; BE = Battery Electric; H2 FC = Hydrogen Fuel Cell

Criteria	ICE	BE	H2 FC	Remarks
Emission-Free	1	3	3	BE and H2FC: Renewable energy for the production of green hydrogen and for recharging batteries results in emission-free power generation.
Noiseless	1	3	3	
Environmentally Friendly Production	2	1	3	BE: The production of lithium used in batteries is environmentally unfriendly. There are moral hazards associated with lithium and cobalt mining. Batteries require a lot of energy to produce.
Recycling of Used Vehicles	3	1	3	BE: A large scale recycling concept for batteries does not exist. H2 FC: Up to 98% of a FC can be recycled.
Safety	2	2	3	ICE: When petrol or diesel fuels leak, these fuels pool close to the ground, increasing ignition likelihood. When ignition does occur, it can result in a dangerous and long-lasting fire.* BE: Lithium-ion batteries can fuel hotter fires that release toxic fumes and are harder to extinguish. Small fires can leap into other parts of the battery to ignite them and cause a chain reaction.**
Driving Range/ Operating Time	3	1	3	H2 FC: Due to the energy density of H2 stored in 700 bar tanks, the driving range and operating time of ICE and H2 FC vehicles are comparable.
Refuelling/Recharging Time	3	1	3	BE: Full recharging of batteries takes hours, provided there is reliable electricity supply. H2 FC: Hydrogen tanks can be refuelled in few minutes (a similar time to diesel tanks).
TCO	3	1	2	H2 FC: The TCO of H2 FC will quickly approach the TCO of diesel vehicles, once sufficiently large numbers of vehicles are produced and supportive environmental regulations are in place. BE: The TCO of battery vehicles is low for higher payloads and operating times. More battery vehicles would be needed to achieve similar payloads and operating times, as demonstrated in the Materials Handling Industry (e.g. by Amazon, Wal-mart, BMW.)
V2G (Vehicle-to-Grid)	0	1	3	BE: The low energy density of batteries does not allow the combination of high driving autonomy, high payload and powering external or installed electric appliances for hours. The relatively long recharge of batteries compared to the refilling of hydrogen tanks makes a BE system less suitable for long term power generation in remote areas. H2 FC: Due to the high energy density of hydrogen compressed hydrogen (700 bar) the fuel cell can provide electricity for external and/or installed electric appliances for hours besides driving usage.
Total Score	18	14	26	

*(Source: Pozzi, Silvano; "Hydrogen Fuel Safety: Essential Facts for Transit Operators"; Ballard Power Systems; 12th Oct. 2017)
**(Source: Woodward, Aylin; "Why the Fire that Incinerated a Tesla Was Such a Nightmare to Put Out"; Live Science; 30th March 2018)