# A Case for Environment Friendliness Ratings

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Such diversified renewable energy sources as hydro, solar, geothermal, wind, and ocean offer opportunities for green energy. However, the level of green credentials varies. Some sources are greener than others. Many of the renewable energy sources are not considered fully green as determined by grams of $CO_2$ equivalent produced per kWh electricity generated.

Hydropower is the largest renewable energy source. However, this completely relies on stable weather patterns. The throughput varies as per the rainfall in the catchment area. The underlying environmental issue is about the ecosystem getting adversely affected. Smaller (micro-hydel) power plants can alleviate this problem to an extent. However, it may not be workable all the time. The carbon footprint varies widely from 6 to 147grams of $CO_2$ equivalent (eq) with the higher emissions in the tropical areas. Hydropower is the biggest renewable source of energy sitting at more than half of all.

Solar energy is completely renewable and the generation of electric energy through solar cells (Photovoltaics or PV) does not emit any gas or any other pollutant. The generation is fully clean and green. However, when an environmental analysis is mapped, the cradle-to-cradle process does throw some environmental issues into the mix. This is illustrated by the fact that energy intensive glass and metals, including heavy metals and hazardous chemicals, are required in the production of the photovoltaics. Down the supply chain, large scale solar generation involves extensive use of land which cannot be used for any other purpose. Water and power are also required to maintain clean solar panels. Some noise is another by-product. The disposal of the photovoltaics, after average 30 years life, is another challenge. With 12 to 42g $CO_2$ eq per kWh, depending upon the mounting and technology, solar presents a good case especially with floor mounted CIGS PVs (at ~12g). Solar and wind provide cheapest power and the uptake is sizeable. 13% of global renewable energy comes from Solar.

Geothermal utilises energy from earth's interior. The process does involve some minor Greenhouse Gas (GHG) emissions. However, it is placed sixth lowest across all fuels at 38g $CO_2$ eq. At 14GW globally, this form of energy is rather found in some regions only.

Wind energy involves the conversion of wind energy to mechanical energy by rotating the windmill blades and in turn the rotor to generate electricity. The GHG emissions are mainly in the form of the chlorofluorocarbons (CFCs), laughing gas and methane. The emission is one of the lowest from 8 to 23g eq depending upon the onshore or offshore location of the towers respectively. Almost a quarter of renewable energy

generation is wind powered.

Ocean energy can be harnessed for generating heat and energy through wave and the tidal currents. It is still at a nascent stage although this does hold out a great promise.

It is safe to say that the major sources of renewable energy sources are hydel, wind and solar while around 80% of global energy is still derived from the fossil fuels. Using energy from these sources to run the electric vehicles including the fuel cell ones (FCEV) adds further layers of complexities in determining the overall green status.

The use of Electric Vehicles involves a composite supply chain including lithium batteries and the use of electricity to charge the batteries. Chen et al (2022) discuss the application of the cradle-to-cradle approach to the lithium batteries putting a spanner into the sustainability credentials of Electric Vehicles. The GHG emission is heavily dependent on the quality of energy, meaning its green credentials. The production of lithium batteries in the Norway will be lot greener than producing those in China. Norway's energy is 98% renewable while China's mix has majority of fossil fuels (>70%). This presents parallels for producing green hydrogen with electrical energy being at the core. Also lithium mining involves potential harm to the environment presenting huge challenges to the 'lithium triangle' countries.

Moving further on the supply chain from power generation to using it for Electric Vehicles (including FCEVs) it will be extremely difficult to discover as to how green are the credentials of the composite process (the life cycle assessment – LCA – along the power generation, lithium batteries and the car manufacturing). The intent behind buying of EVs has lot to do with the green orientation however, it will be practically impossible for the EV owner to comprehend how green it is.

The discussion of star ratings deserves a mention here. Star ratings provide a useful reference point regarding the energy efficiency and water consumption by the gadgets while many organisations and comparison sites use their own Star ratings providing a basic comparison between the competing products and services e.g., Canstar for financial services, Canstar Blue for various goods and services, Choice magazine for a diverse range of products and services, and Health star ratings. While the energy, water and health star ratings are run by the Government there exist many led by the private sector.

The rating method can probably be adapted for energy being distributed by a particular retailer/wholesaler to the end consumers (including car manufacturers and the battery companies if they don't use captive power) and similarly for car production and lithium batteries lifecycle assessment. Washing machines display the water and energy efficiency stars likewise there could be for Cars converted from the respective 'Grams of $CO_2$ equivalent' to Stars – each for Energy, car production and lithium battery. The stated star ratings will be drawn from the respective sources. While this is not the practice currently, an example, rather hypothetical, is in order –

- the power distributor to the homes, car manufacturing companies and lithium battery manufacturers say supplies energy and mentions itself as 4 Star (out of 6 Based on the grams of $CO_2$ equivalent (eq).
- Car production facility based on the above and their own sustainable efficiencies provide a score, say 5 Stars (out of 6 again because their energy efficiency is quite high with almost the least $CO_2$ equivalent (eq) emission.
- The lithium battery manufacturer in turn captures the complete supply chain emissions (eq) including the disposal or recycling of the used and exhausted batteries, resulting in 3 out of the total 6 stars.

This can even be converted to a composite score, based on the respective weights of each of these. Assuming equal weights could be assigned the resultant composite score will be 4 Stars (out of 6 from (4+5+3)/3=4) to show how green that car is eventually. The only other variable at the customer's end will be the green credentials of the energy used to charge the EV. A step in this direction is for the companies to get standalone Climate ratings as proposed by the Harvard Business Review article on sustainable practices.

As a consumer one has the right to know how green is the green that is being offered by the marketers. This can be an important differentiator, while also avoiding the typical zero-sum loop where newest technologies are touted as path breaking and sustainable only to discover at the end that a holistic view was missing and it was not true.


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