Oil to PV Solar – Attachment Two

Photovoltaics Versus Oil in New Zealand

Electric power produces motive power using modern electric motors at close to 90% efficiency, while petrol does the same in an internal combustion engine (ICE) at about 31% efficiency, where two-thirds of the theoretically available petrol energy is lost as hot air (from the radiator), hot exhaust gasses (from the tail pipe together with unburnt carbon particles, nitrous oxides etc.) and even some energy as unpleasant audible noise! But that is not the end of the story. Further losses before the energy gets used to turn the vehicle's wheels comes from parasitic engine losses (eg. water cooling pump, alternator and engine idle) of 5% and gear drive-train losses of 6% leaving only about 20% of the originally available energy to turn the vehicle's wheels. (See https://www.fueleconomy.gov/feg/atv.shtml 'where the energy goes').

Compare the ICE car's efficiency (20%) with that of an Electric Vehicle (EV), where only 18% of the electrical energy supplied is lost in battery charging, parasitic losses and electric drive system, leaving 82% to turn the wheels. Assume that the two vehicles need the same amount of energy at the wheels, so that the electrical energy (E1) needed to replace the petrol energy (E0) for the EV is only:

$$E1 = 0.2\ (1 + 0.18)EO$$

$$E1 = 23.6\%\ \text{of}\ E0.$$

Under these circumstances it will only be necessary to replace petrol use with electrical energy at a rate of 23.6% of the theoretical energy content of petrol, wherever petrol is used to produce motive power.

Similarly, for a diesel-powered vehicle, the modern diesel engine is about 35% efficient, but subtract another 11% for parasitic and gear train losses, but assume the same efficiency as before for the electric vehicle replacement of 82% efficient, 18% lost we get:

$$E1 = 0.24(1+0.18)E0$$

$$E1 = 28.3\%\ \text{of}\ E0$$

where E0 and E1 are now for diesel.