## Will the cars and trucks of the future run on biofuels or solar electricity?

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If energy efficiency is a valid predictor of *long term* success, solar has a clear advantage. The efficiencies are approximate, and typical of today's proven or commercially available technology.

Cost matters too, and today's solar electricity cost is more than double that from fossil fuel. Biomass fuels from cellulose are not yet commercial, so costs are very uncertain.

It is possible that efficiency of solar cells could increase by a factor of 2 but the cost tradeoff is unknown. It's also possible that bioengineering could substantially increase biomass conversion efficiency without a corresponding increase in evapotranspiration losses (depleting water supplies).

Aircraft of course are a different story. Biofuel energy densities greater than ethanol will be probably be required for aircraft, but not for efficient cars.



- 1.5% cellulose yield from Heaton et al. <u>Global Change Biology</u>; Vol. 14 Issue 9, p2000-14, 2008
- 15% for PV system in central IL from http://rredc.nrel.gov/solar/calculators/PVWATTS/version1/
- 85% = 90% motor x 94% Lithium ion battery (Krein IEEE VPPC 2007)
- 33% steam-Rankine power efficiency includes transmission losses
- 40% for engine & drivetrain assumes hybrid car where engine efficiency always optimum
- 60% biorefinery conversion is a pure guess, based on comparison with 80% gasoline from crude oil, plus losses due to biomass drying, pretreatment, processing, and distillation and distribution. Consistent with Lynd et al. <u>http://www.springerlink.com/content/y7283224w8412707/fulltext.pdf</u> (however Schmer et al., Proc. Natl. Acad. Sci. 2007 cites 50%)

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