

Fuel consumption comparison between the Toyota Avensis, Toyota Prius and a Series HEV powered by Pempek's Linear Generator (the FP3HEV)

Constants and Variables used in the FP3HEV model:

Constants:

Vehicle Mass	= 1500 kg
Wind Resistance Area	= 2.6 m ²
Air Density	= 1.202 kg/m ³
Fuel Density	= 740 g/l
Fuel Energy	= 43 kJ/g

Wind Resistance Factor	= 0.26 ^[1]
Tank to Battery Efficiency η_t	= 0.40 ^[2]
DC Controller Efficiency η_c	= 0.98
Battery Efficiency η_b	= 0.92 ^[3]

Variables:

Vehicle Speed	= NEDC ECE+EUDC Figures 1 and 2
Vehicle Acceleration	= NEDC ECE+EUDC Figures 1 and 2
Tyre Roll Resistance	= 0.013 to 0.015 (function of speed ²)
Wheel Motor Efficiency η_m	= 0.96 to 0.98 (function of torque ²)
Inverter Efficiency η_i	= 0.96 to 0.98 (function of power)
Tank to Wheel Efficiency, direct	= 0.37 to 0.38 ($\eta_t * \eta_i * \eta_m$)
Tank to Wheel Efficiency, via battery	= 0.34 to 0.35 ($\eta_t * \eta_b * \eta_i * \eta_m$)
Battery to Wheel Efficiency	= 0.85 to 0.88 ($\eta_b * \eta_i * \eta_m$)
Regenerating Efficiency	= 0.85 to 0.88 ($\eta_m * \eta_i * \eta_b$)

The TOYOTA Avensis

http://www.toyota.de/cars/new_cars/avensis_2003/co2_disclaimer.asp

The TOYOTA Prius

http://www.toyota.de/cars/new_cars/prius2003/co2_disclaimer.asp

- [1] Published drag coefficient of the TOYOTA Prius 2004
<http://www.answers.com/topic/drag-coefficient-1>
- [2] Free Piston Engines achieve higher efficiencies compared to conventional internal combustion engines due to their mechanical simplicity. Innas BV has demonstrated a 50% efficiency on a test engine. The estimated 40% efficiency used in this model can therefore be considered an achievable target.
http://www.innas.com/Chiron_efficiency.html
- [3] Published battery charge efficiencies range from 92% to 96%. The 92% efficiency used in this model can therefore be considered an achievable target.
http://www.powerdesign365.com/Battery_charger/Article6764.aspx?

NEDC - ECE Cycle - City

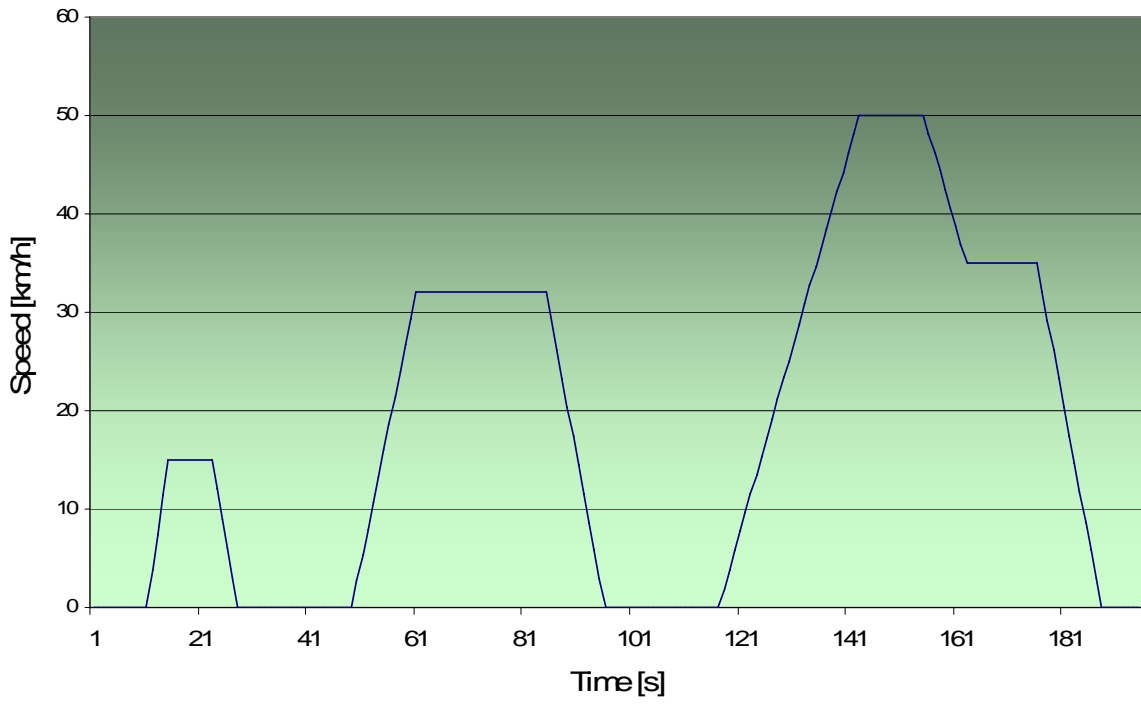


Figure 1

NEDC - EUDC Cycle - Highway

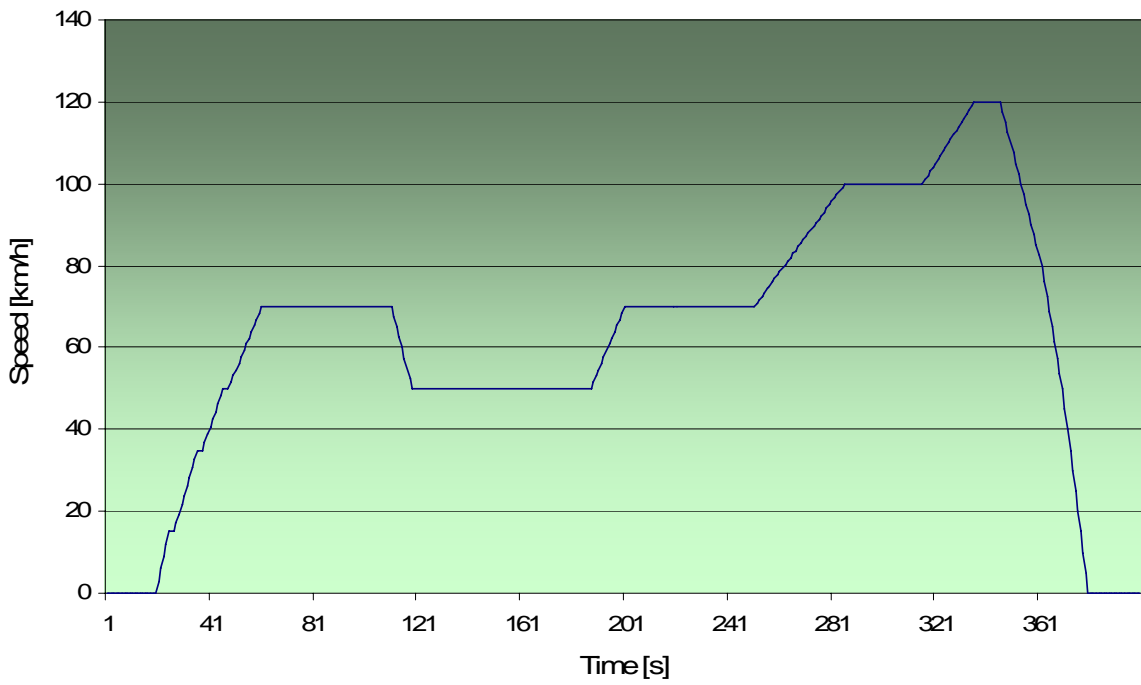


Figure 2

NEDC - ECE Fuel Consumption - City

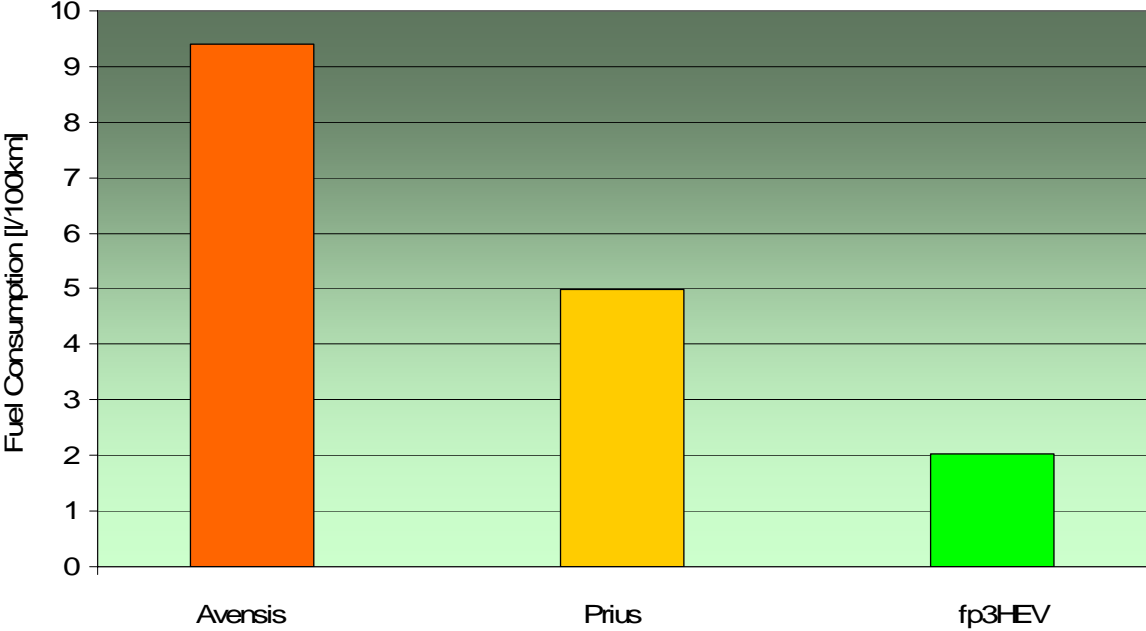


Figure 3

NEDC - EUDC Fuel Consumption - Highway

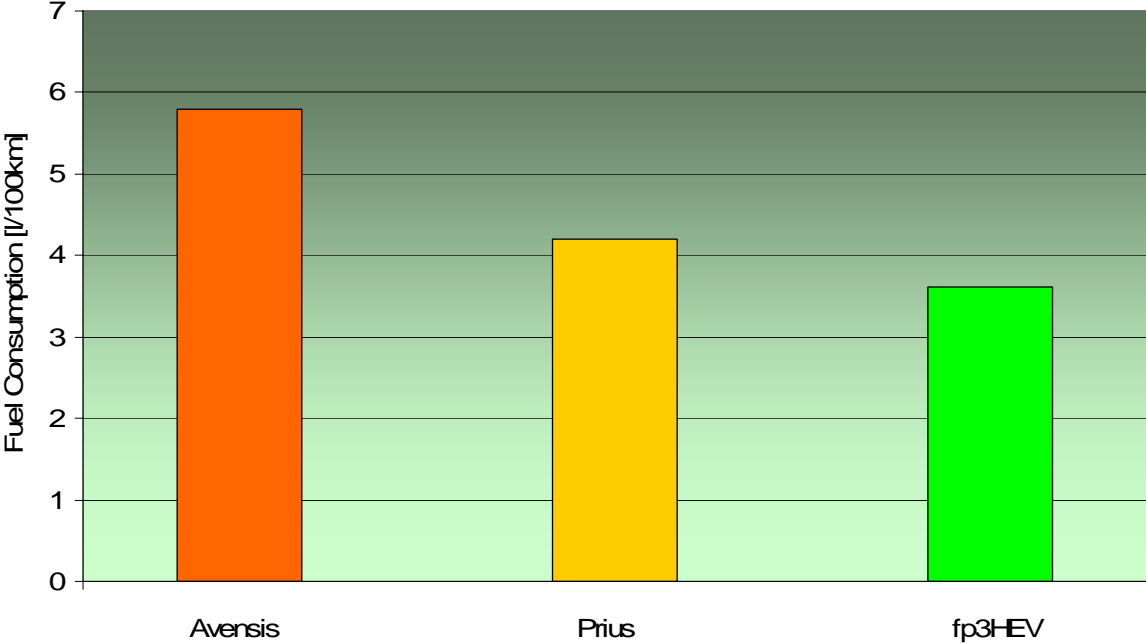


Figure 4