Do Hybrid Cars Reduce Air Pollution?

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The fuel economy craze is accelerating the production and sales of hybrid cars. Toyota has increased production by 44% over their earlier projection. (Bloomburg, June 2) There has been a 26% increase in hybrid car registrations nationwide from 2002 to 2003. (The Capitol Times, June 17) Some environmentalists are making wild claims about the emissions reduction benefits in terms of green house gas emissions (CO2) reductions as well as air pollution emissions. The Sierra Club's Hybrid Evolution Campaign claims that hybrids will "clean up our air and curb global warming". (May 27) Since the potential climate change problem (if one exists) has yet to be defined from a cause effect perspective, one cannot remotely speculate on the benefit of the infusion of hybrid powered vehicles. On the other hand we can examine the question of whether the claimed lower tailpipe emissions of nitrogen oxides (NOx), hydrocarbons (NMOG) and Carbon Monoxide (CO) are factual and whether or not such reductions will hypothetically reduce photochemical ozone (smog) and CO exposures. Although CO emissions are lower for hybrid cars such reductions are not needed because the health standards have been amply met everywhere in the Nation with rare exception. Therefor any differential benefits are moot.

Reducing NMOG will certainly incrementally reduce ozone (O3) but only in proportion to the net difference in NMOG emissions between gas and hybrid powered cars. These differences have to be evaluated in the context of their respective contribution to the total inventory of smog related pollutants which will be emitted into the air over cities in the future. Such urban area inventories include all mobile, stationary and area NMOG emissions sources. Stationary sources include power plants, refineries, car and truck painting facilities, fuel storage and handling facilities, etc. Area sources include gas pumps, lawn mowers, etc. Such benefits have to be based on this whole inventory of emissions not just the difference in emissions between two cars. On the other hand NOx emissions differences i.e. lower comparative NOx emissions from hybrid cars will not reduce smog in most cities. The weekday/weekend phenomenon has been well documented (Jones and Lieberman,2000, Lawson,2003, Huess,2003, Pun and Seigneur,2003) which shows that further NOx reductions in the absence of equal NMOG reductions will actually increase O3. Although EPA continues to vigorously promote NOx emissions control across the board, any strategies, which reduce urban ambient levels of NOx, will be counterproductive. Jones and Lieberman concluded that for most urban areas a 1% decrease in the NOx emissions inventory would increase O3 by about 0.5 to 1.8%. The complex chemistry of smog formation includes a step where the NO (the principal componant of NOx) emissions actually react with newly formed O3 (from NMOG emissions) to form oxygen (O2) and nitrogen dioxideNO2). Until all of the available NO has essentially been consumed in this reaction during the morning on a hot sunny stagnant day, O3 will not build up in the afternoon. Hence the lower the morning emissions of NO the higher the build up of afternoon O3 for the same level of NMOG

emissions. The range of the NOx disbenefit estimate cited above was based on the published modeling and observational studies.

What does the official EPA emissions test data tell us? The attached table shows the model year 2004 Certification Data for 3 available hybrid cars and their equivalent make gas powered cousins. All of the 5 models listed show certification emissions well below the current statutory emissions standards for the Low Emissions Vehicle (LEV) class of on road vehicles of 0.3 gpm for NOx and 0.075 gpm for NMOG. The crux of the issue is the fact that the net reduction in NOx between the gas and hybrid models is 4 times greater than the NMOG reductions. In fact the NMOG emissions factor is slightly higher for the Insight than the conventional Civic. If we assume that an equal reduction in NMOG emissions is offset by an equal reduction in NOx emissions, any additional reduction in NOx will produce an increase in O3. This in fact is the case based on the certification data for these models of hybrids.

In the current scheme of things anyone hyping the air pollution benefits of the NOx and NMOG reductions between gas and hybrid cars is blowing smoke.

Conventional Vs Hybrid Powered Car Emissions Factors

Mfg. & Model (gm/mi)	C/H	100k Certification E. F. (gm/mi)		Difference C-H	
		NOx	NMOG	NOx	NMOG
Honda Civic	C	0.10	0.03	------	-----

Honda Civic	H	0.0	0.006	-0.10	-0.024
Honda Insight	H	0.0	0.033	-0.10	+0.003
Toyota Vibe	C	0.10	0.033	------	-----
Toyota Prius	H	0.0*	0.007*	-0.10	-0.026

*150K certification values