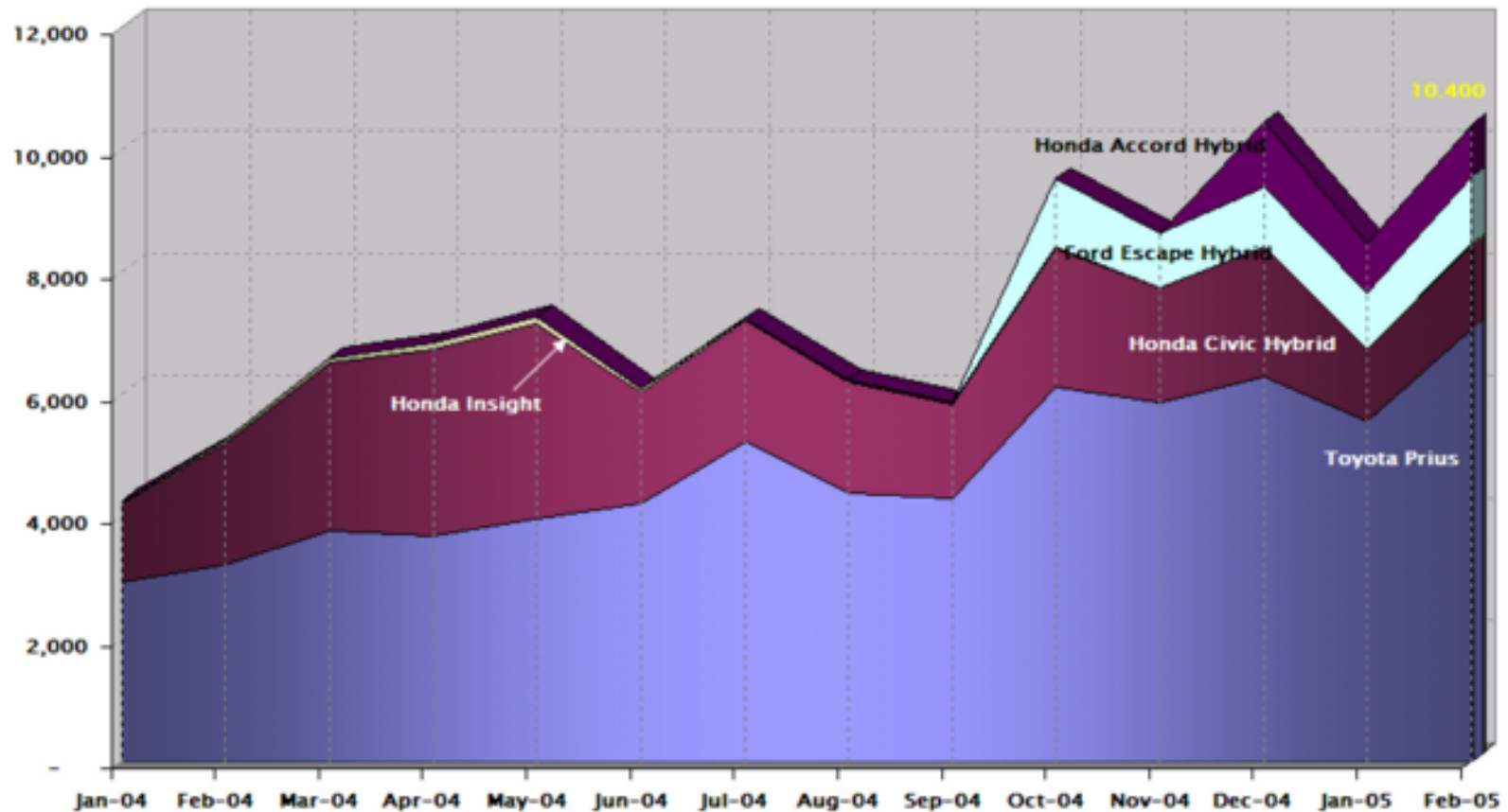


A Variety of Hybrid Powertrains are Now Available to U.S. Customers. More are Coming

Model	Type		Electric Motor/Generator (GEN)	Battery	Battery (Volts)	~ mpg gain %	Engine Downsizing?
Civic	Parallel	FWD	10kw	10 kW	144 (V)	23-47	Yes
Accord	Parallel	FWD	12kw	12 kW	144 (V)	20-35 +	Intermittent
Prius THS I (2000)	Parallel/Series	FWD	33kw/10kw (Gen)	20 kW	274 (V)	?	Yes
Prius THS II (2004)	Parallel/Series	FWD	49kw/10kw (Gen)	21 kW	202 (V)	70 est.	Yes
Escape	Parallel/Series	FWD	70kw/28kw (Gen)		330 (V)	46-56	Yes
Escape	Parallel/Series	4WD	70kw/28kw (Gen)		330 (V)	57-62	Yes
Lexus 400h	Parallel/Series	4WD	Front:123kW/109kW (Gen): Rear 50 kW	45 kW	288 (V)	39 +	No
Toyota Highlander	Parallel/Series	4WD	Front:123kW/109kW (Gen): Rear 50 kW	45 kW	288 (V)	30-46 +	No
GM 5.3 L Pickups	ISG	RWD			42V	9	No
GM 5.3 L Pickups	ISG	RWD			42V	10	No
GM/Daimler Future	Parallel/?	RWD	???	???	???	25 +?	Probably not

Total hybrid sales are expanding, but were level from April to Sept.

US Hybrid Sales 2004-2005



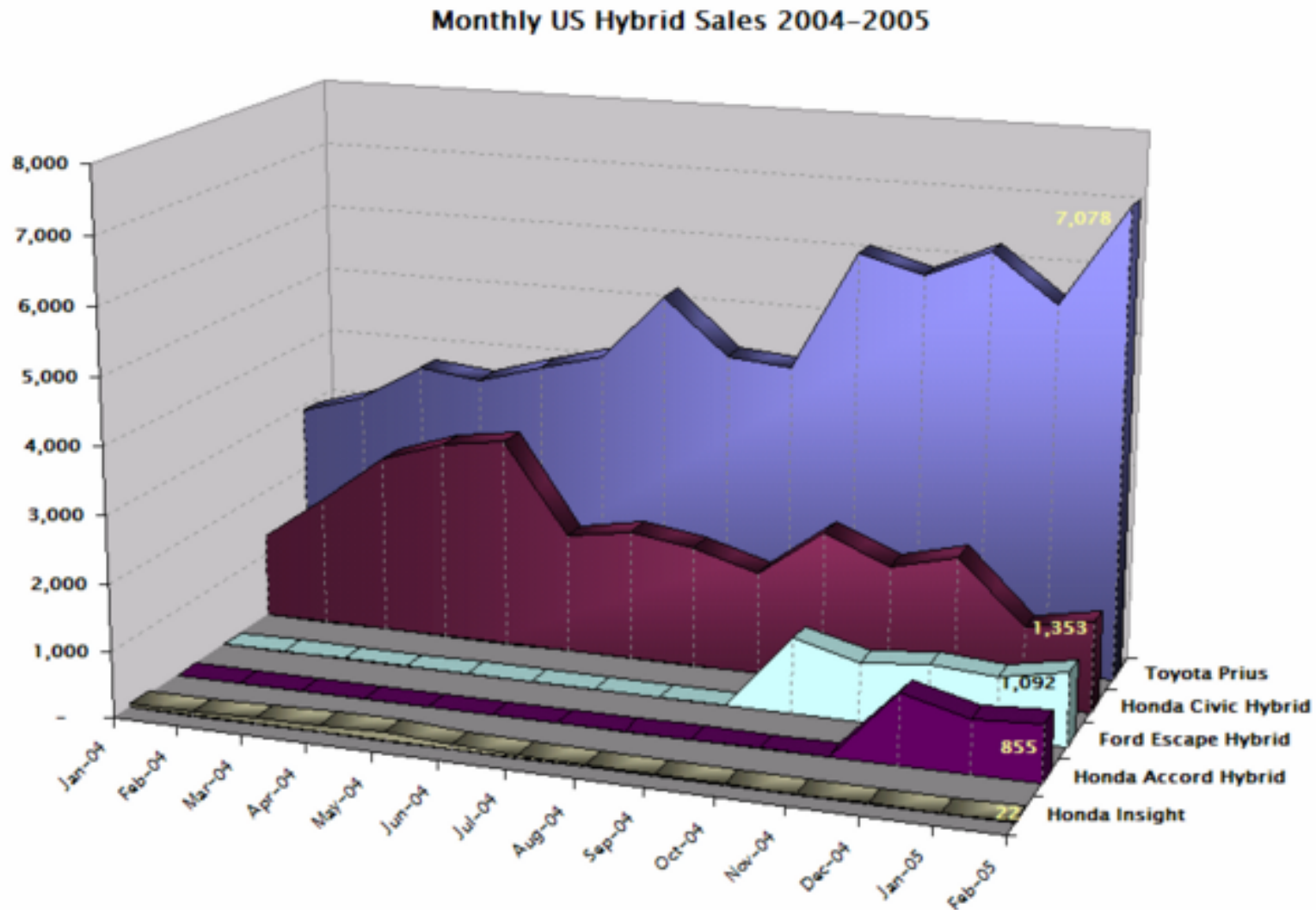
USA HEV Vehicle sales

- combined US sales of hybrids in January 2005 almost doubled from levels in January 2004, rising to 8,455 units from 4,252 units

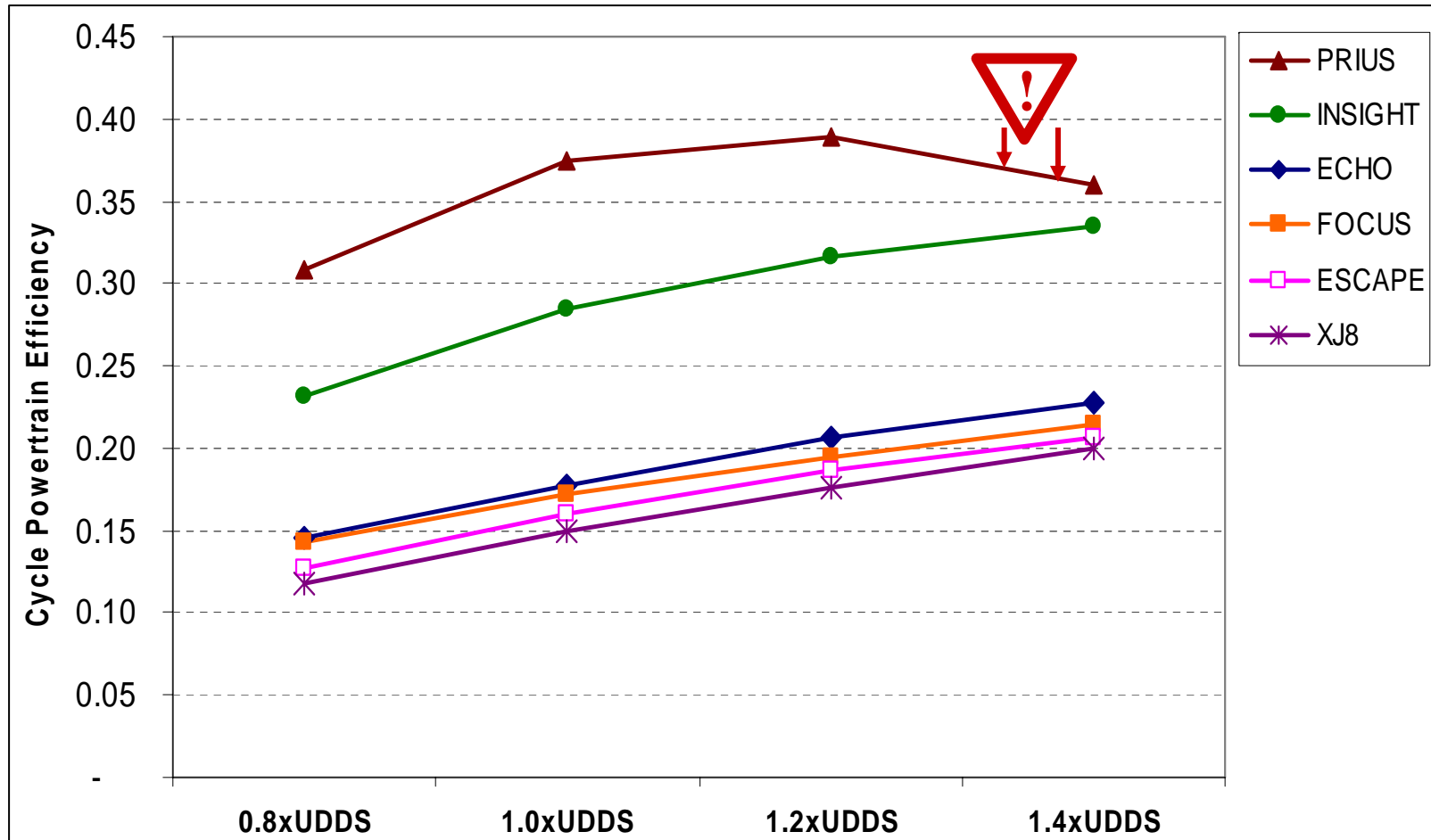
January 2005:

- Toyota Prius #5566
- Honda Civic #1169
- Ford Escape #908
- Honda Accord Hybrid #805
- Honda Insight #7

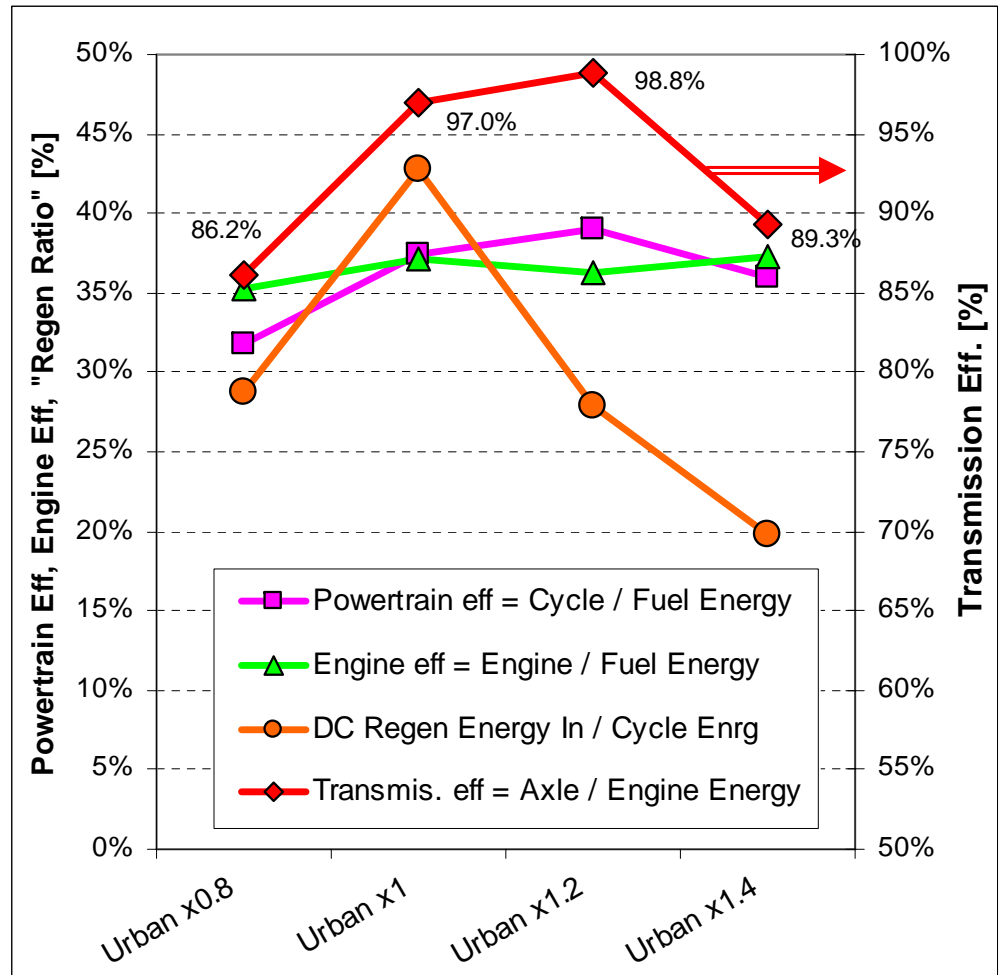
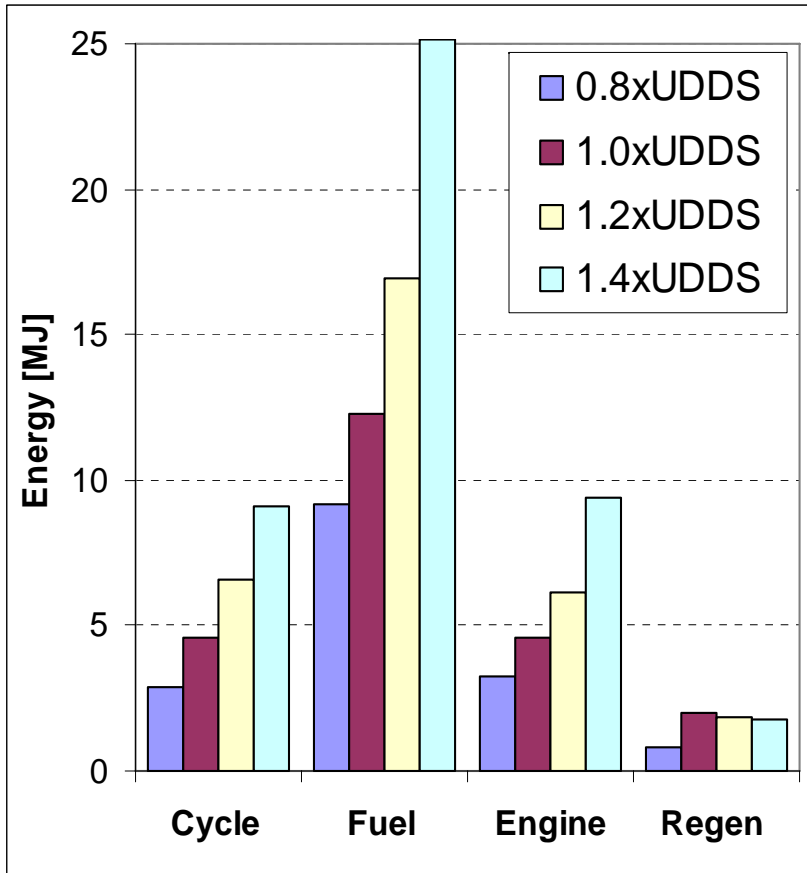
The PRIUS Hybrid is highly successful, and may be taking market share from Civic Hybrids. Not all hybrid sales are expanding



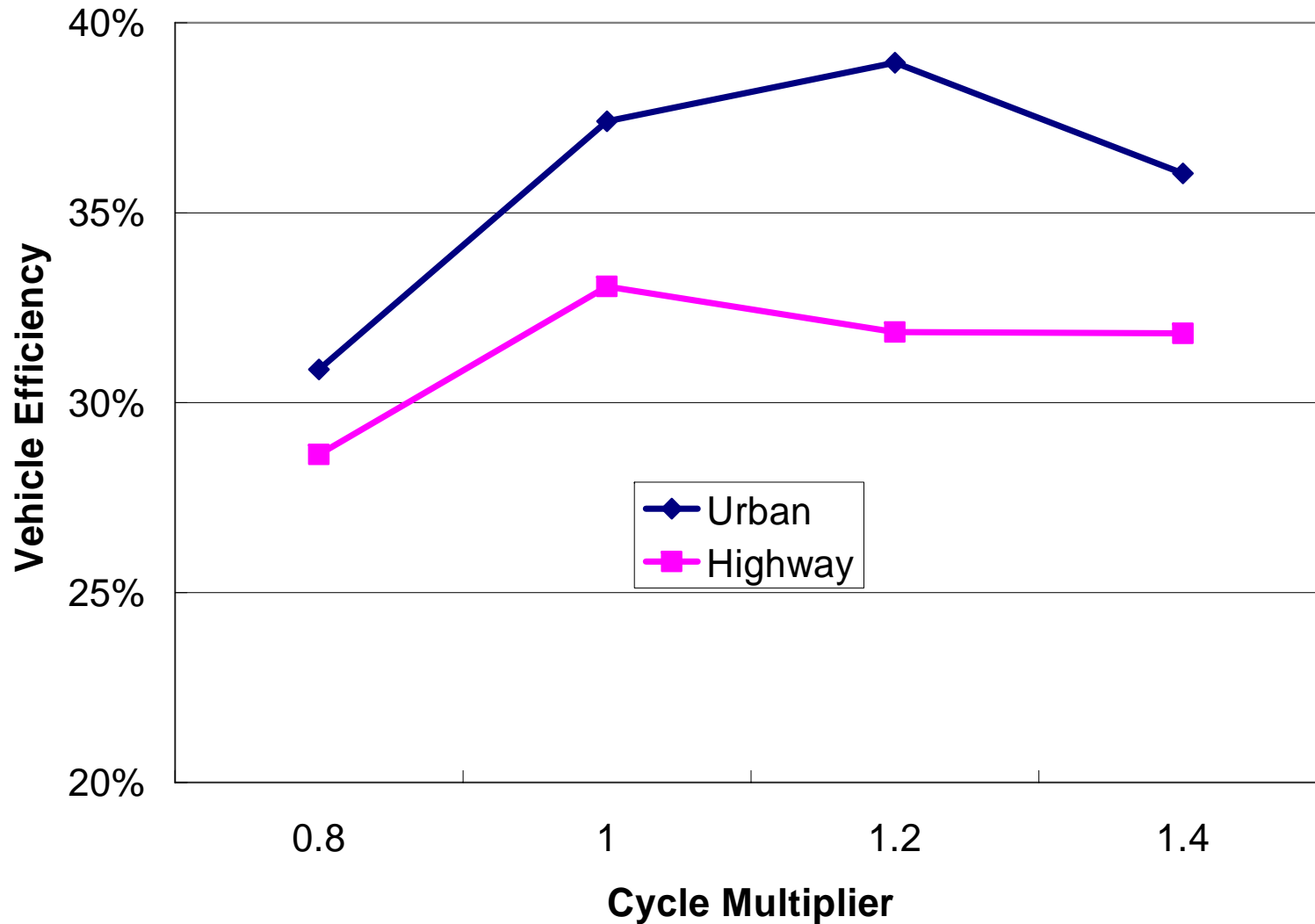
Powertrain Efficiencies Increase With Higher Multiplier Factor, Except Prius



Culprit: 1) Relative Regen Amounts 2) EVT (Trans) Efficiency

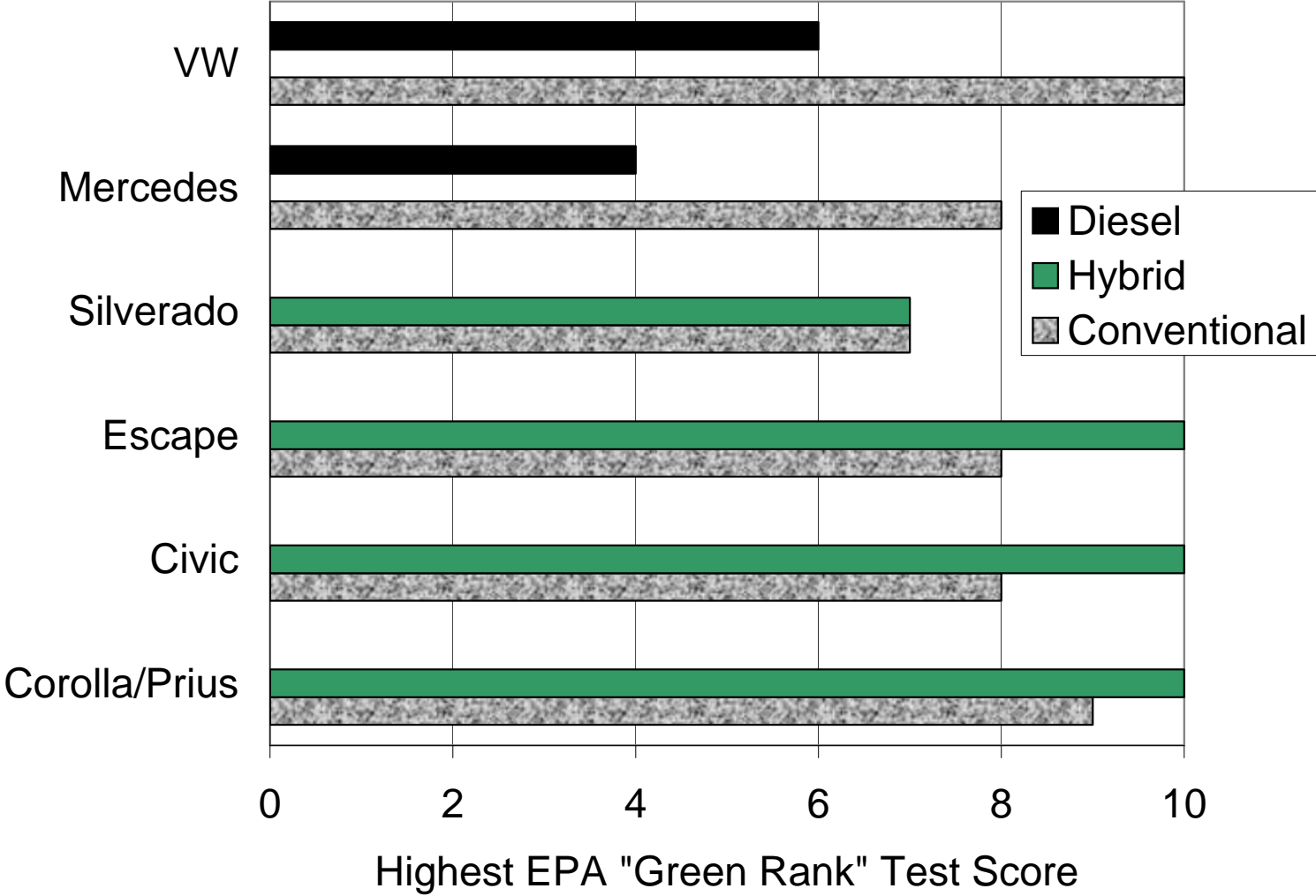


The Eco-driving program/concept initiated in Finland may be far more important for hybrid vehicles



Prius Efficiency – ANL Tests by Driving Cycle “Aggressiveness”

By EPA's Current Emissions Rating, Hybrid Powertrains are Often the Cleanest Available in a Model Line



The Current EPA 1-10 Ranking is NOT Identical to Tier II Bins

Tier 2 Standards (Fully in Effect in 2009, g/mi. for 100K miles)

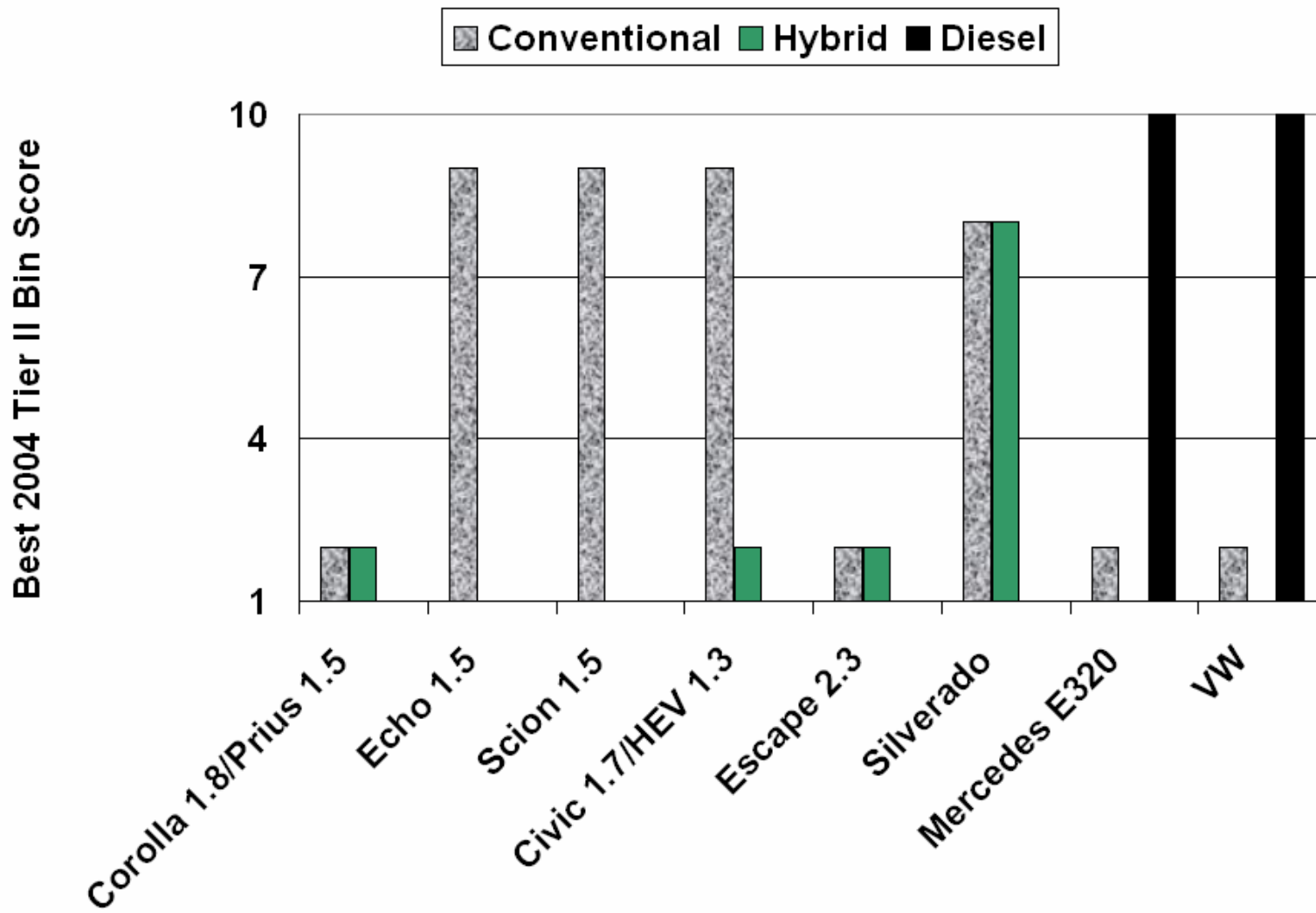
	<i>NMOG</i>	<i>CO</i>	<i>NO_x^c</i>	<i>PM</i>	<i>HCHO</i>
Bin 10^{a,b}	0.156/0.230	4.2/6.4	0.6	0.08	0.018/0.027
Bin 9^{a,b}	0.090/0.180	4.2	0.3	0.06	0.018
Bin 8^a	0.125/0.156	4.2	0.20	0.02	0.018
Bin 7	0.090	4.2	0.15	0.02	0.018
Bin 6	0.090	4.2	0.10	0.01	0.018
Bin 5	0.090	4.2	0.07	0.01	0.018
Bin 4	0.070	2.1	0.04	0.01	0.011
Bin 3	0.055	2.1	0.03	0.01	0.011
Bin 2	0.010	2.1	0.02	0.01	0.004
Bin 1	0.000	0.0	0.00	0.00	0.000

^a The high values apply to HLDTs. The low values applied to cars and LLDTs.

^b Bins 10 and 9 will be eliminated at the end of 2006 model year for cars and LLDTs and at the end of 2008 model years for HLDTs.

^c Corporate average NO_x standard will be 0.07 g/mi. and will be fully in place by 2009.

In Terms of Tier II “Bin” Score, Diesels Require Much Improvement. Some HEVs are at the Minimum.



Best Tier II Bin Score for Automatic Transmission Models

The statement “gasoline hybrid vehicles are little cleaner than conventional gasoline vehicles of the same size” may be gently questioned. Prior slides did not account for upstream emissions, which are a function of amount of fuel consumed. Perhaps we should say they are “a bit cleaner” with respect to criteria pollutants and some can be a lot cleaner with respect to GHGs.

Toyota Prius sales for Feb 05 were 7,078 and for the Jan-Feb 05 2-month period were 12,644 (up from 6,140 for the corresponding Jan-Feb period in 2004). All figures quoted here are from Automotive News. Remember, too, that Prius sales in the US are production constrained, unlike practically every other vehicle on sale now.

The bottom line is this: if the Prius was a brand in and of itself, it would be larger than Suzuki, Audi, Mini, Jaguar, Land Rover, Saab, Porsche, Hummer or Isuzu. Its sales exceed the sales of the car divisions of those 9 brands plus Infiniti, Scion and Lincoln and exceeds the sales of the truck divisions of those 9 brands plus Infiniti, Scion, Volvo, Lincoln, Mitsubishi, Volkswagen, Mercedes-Benz, Saturn, Subaru, Acura, Cadillac, BMW, Mercury, Mazda, Buick and Pontiac.

In addition to those 9 brands, the Prius outsells every individual model from BMW, Mercedes-Benz, Cadillac, Pontiac, Saturn, Acura, Kia, Mazda, Infiniti, every Nissan model except the Altima or Sentra, every Subaru, every Lexus except the RX330, and every VW.

It also outsells the Chrysler Pacifica, Jeep Wrangler, Buick LaCrosse, Chevrolet Aveo, Corvette, Monte Carlo, Avalanche, Suburban, GMC Canyon, Envoy, Suburban/Yukon XL, Yukon, and the Honda Element (to name a few more well-known vehicles).

In February 2005 it garnered 1.20% of the new passenger car market in the US (7,078 sales in a total of 587,978) and 0.56% of the total light vehicle market, with the production artificially constrained.

I guess Bob Lutz and Carlos Ghosn are right – hybrids will never catch on.

Chris Atkinson Former WVU Professor, works on neural net modeling for ANL