

# South Coast AQMD Hydraulic Hybrid Forum

## Hydraulic Hybrid Vehicles

Economics and Needed Investment

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**John J. Kargul**

*Director of Technology Transfer*

*Office of Transportation and Air Quality*

*U.S. Environmental Protection Agency*

*(734) 214-4386*

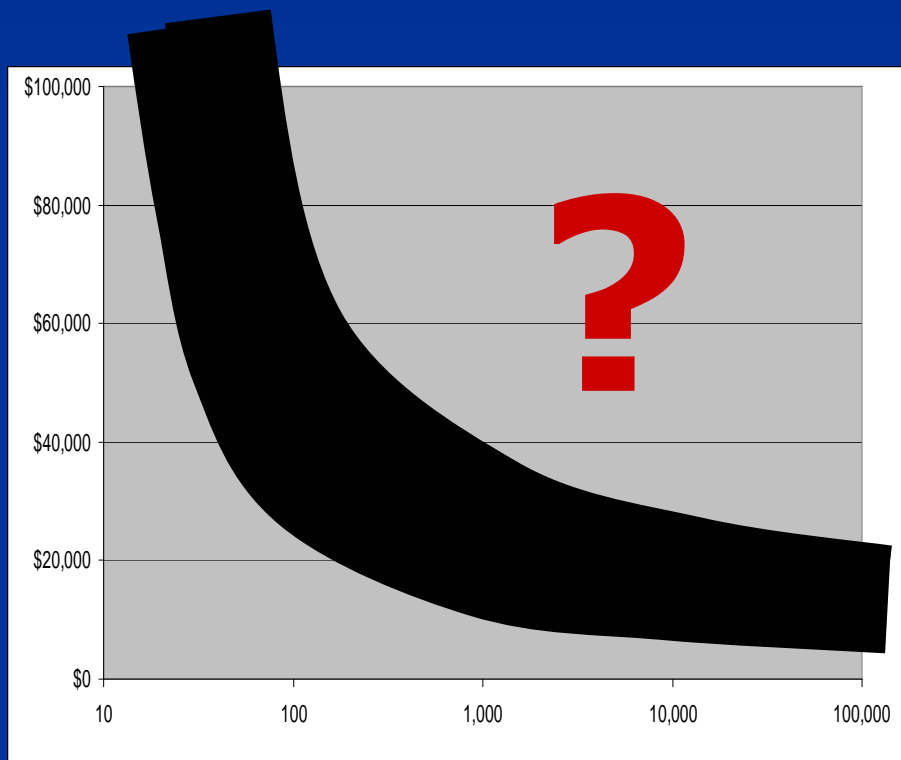


***Clean Automotive Technology***

[www.epa.gov/otaq/technology](http://www.epa.gov/otaq/technology)

# The \$64 Questions - Pricing?

How long will prices stay high?  
How low will prices go?



## Complicated Equation

1. Cost of engineering?
2. Cost of materials?
3. Cost of manufacturing?
4. Cost to adapt across different types of vehicles?
5. Support for pilot projects?
6. Support for early adopters?
7. Price of fuel?
8. Fleet demand?
9. Supplier ROI/profit?

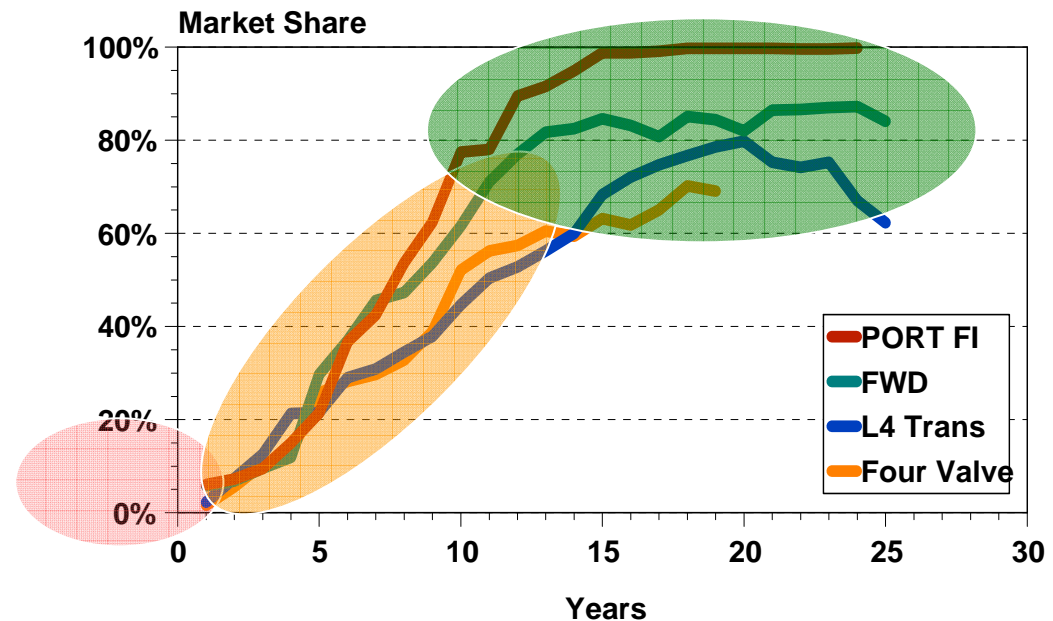
# Where Are We Today?

## *Understanding Market Penetration Perspectives from Light-Duty Vehicles*

### Growth Phases

- ✓ **Evaluation:** 4-8 years to achieve “first significant use” (at least 2%)
- ✓ **Growth:** 8-10 years to reach more than 60%
- ✓ **Mature:** 100% penetration is rare

**Car Technology Penetration  
Years After First Significant Use**



*Full Market Penetration Can Take 10 Years after 2%*

# 2% in Today's Heavy Truck Market

## Year 2003 Truck Sales Data

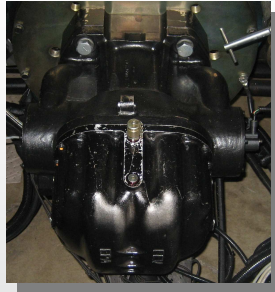
Class      2003 Sales      Gross Vehicle Weight (lbs)

		2%	35%	
Class 3	85,000	1,700	29,750	10,001–14,000
Class 4	45,000	900	15,750	14,001–16,000
Class 5	29,000	580	10,150	16,001–19,500
Class 6	51,000	1,020	17,850	19,501–26,000
sum	210,000	4,200	73,500	

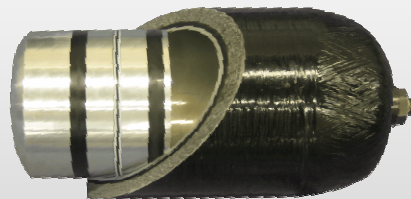
- ✓ **We are not anywhere near 2%**
- ✓ **This market is big enough to get to high volumes**
- ✓ **It is too early for the "market" to down-select**

# HHV - Potential for Low Cost *Simple Components*

## Engine Pump-Motor



## Accumulators



## Rear Drive Pump-Motor



## Miscellaneous Components

- ✓ Hoses
- ✓ Controller
- ✓ Filter
- ✓ Wiring
- ✓ Cooler

## Eng-Off Accessories (for series HHVs)

- ✓ Power Brakes
- ✓ Power Steering
- ✓ Air Conditioning

# Example of Best Possible Business Case for HHV Delivery Vehicles\*

1. Fuel Economy Increase	60-80%
2. Incremental Cost for Hybrid Systems (high volume)	10-15% of base vehicle cost
3. Payback Period	2-3 years

*EPA has been focusing its efforts to demonstrate the potential of Series Hydraulic Hybrids to cost-effectively achieve these goals.*

\* Each vehicle type/vocation has a unique Best Business Case

## Areas for Investment...

# HHV Projects and Pre-Production Trials

### Active Projects

- ☑ **Parallel Refuse Truck (HRB)** – 2 trucks, *NYSERDA+NASEO, Bosch Rexroth*
- ☑ **Parallel Refuse Truck (HLA)** – 12 pre-production trucks, *NTRD/Eaton*
- ☑ **Parallel Shuttle (HLA)** – 1 truck, *HTUF/DOT, Eaton*
- ☑ **Series Urban Delivery Vehicle** – 2 prototypes, *Eaton/International/EPA/UPS*
- ☑ **Series Yard Hostler** – 2 trucks, *Parker/Kalmar /EPA/APM/PONY-NJ*

### Pending Projects

- ☐ **Package Delivery Truck** – HTUF Package Delivery Working Group RFP
- ☐ **Series UPS Trucks** – possible pre-production, *UPS/Eaton/International/EPA*
- ☐ **Series Shuttle Bus** – possible prototype demonstration with EPA
- ☐ **Yard Hostler** – possible HHV pre-production, *Port of Long Beach/Kalmar/Weststart*

**Initial production versions from some of these projects will start showing up for sale in the 2008 - 2010 timeframe.**

### Possible New Projects

- ☐ **Heavy Trucks** – Refuse Trucks, Yard Hostlers, Drayage Trucks, Transit Buses
- ☐ **Medium Trucks** – Delivery Vehicles, Shuttle Buses, School Buses
- ☐ **Lighter Trucks** – Delivery Vehicles, Shuttle Buses, Work Trucks
- ☐ **Passenger size** – Taxis, Pickups, Work Trucks

## HHV Components

Examples of enabling technologies necessary to lower costs & assure safe/efficient vehicles

### Engine-Off Operation

- ✓ Power Brakes
- ✓ Power Steering
- ✓ Air Conditioning

### Energy Storage

- ✓ Improved N<sub>2</sub> barrier materials\*
- ✓ Safety - fluid shut-off valve(s)
- ✓ High volume sources for accumulators

\* Would benefit from research funding