

The Transit Bus Niche Market For Alternative Fuels:

Module 1: Introduction and Characterization of the Transit Bus Business

Clean Cities Coordinator Toolkit

Prepared by
TIAX LLC, Irvine Office

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TIAX LLC
One Park Plaza, 6th Floor
Irvine, California 92614
949-833-7131 /
leonard.jon@tiaxllc.com

Name and Objectives of the Project

Official project name: "Market Analysis of Transit as an Alternative Fuel Niche Fleet"

Objectives:

- **Assess the current status** of alternative fuel use in transit bus applications
- **Provide** Clean Cities Coordinators with **the data and tools** necessary to:
  - **Better understand** transit fleet operations involving alternative fuels
  - **Identify opportunities and successful strategies** to increase AF use in the sector
  - **Work with the most-promising local transit agencies** to begin using alternative fuels, or expand existing operations

Deliverables:

- Coordinator "guidebook" (Powerpoint modules on CD ROM)
- Cost evaluation tool for transit fleets
- Workshops at regional Clean Cities meetings

The Electronic Toolkit Includes the Following "Modules" of Information:

MODULES BY DESCRIPTION

Module 1: ***Intro / Characterization of the Transit Bus Niche***

Module 2: ***Basics of Alternative Fuels for Transit Buses***

Module 3: ***CNG as a Transit Bus Fuel***

Module 4: ***LNG as a Transit Bus Fuel***

Module 5: ***Propane (LPG) as a Transit Bus Fuel***

Module 6: ***Biodiesel as a Transit Bus Fuel***

Module 7: ***Emerging Diesel Technology and Hybrids in Transit***

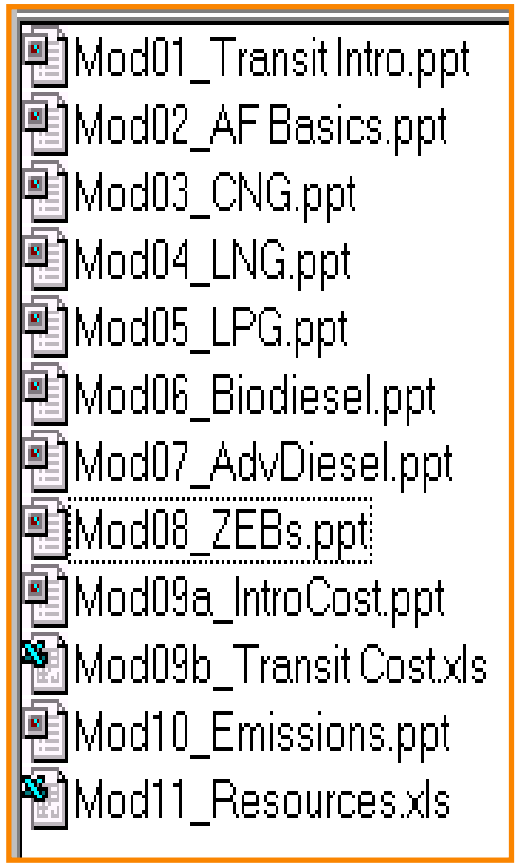
Module 8: ***Advanced Hybrid and Fuel Cell Bus Technologies***

Module 9a: ***Introduction to Transit Bus 1.0 Cost Model***

Module 9b: ***Transit Bus 1.0 Cost Model (MS Excel Program)***

Module 10: ***Emissions Benefits of Alternative Fuel and Advanced Technology Transit Buses***

Module 11: ***List of Contacts and Resources***



Modules by file name

Note: only the highlights can be discussed in a 90-minute presentation!

A key premise for this toolkit is:

"Knowledge is power."

-Francis Bacon, 1597

The best approach to help a transit agency commit to alternative fuels / clean technologies is to gain as much knowledge as possible about

- ***The transit "niche" in general,***
- ***The specifics of various available technologies, and***
- ***Unique circumstances and operational characteristics of that particular agency.***

Also realize that:

"It helps to feel their pain."

- *William Jefferson Clinton, 1997*

The transit business is very demanding and constantly in the public eye, sometimes for the wrong reasons. Pressures can be intense to keep buses running on time ***-- at low cost and with minimal environmental impacts. These goals may be conflicting***.

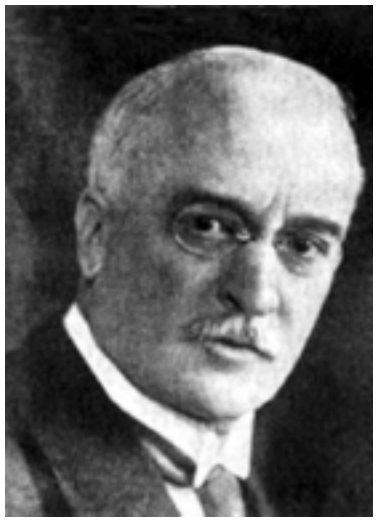
Therefore, it helps to keep in mind the following:

1. Using alternative fuels and clean technologies is the right thing to do, but it may not be the *EASY or CHEAP* thing to do.

2. Alternative fuels may not be suitable for all transit agencies. Region- and agency-specific issues come into strong play. *Customized programs and solutions are frequently necessary to achieve success.*

A Key Basic Point: Diesel is the Standard Fuel of the Transit Niche

What is Diesel?



Rudolf Diesel (1858-1913)
Inventor of Diesel Engine

It's a liquid hydrocarbon fuel *packed* with energy . . .

. . . used in large heavy-duty engines

. . . that power our heavy-duty transportation sector . . .

. . .while emitting harmful NOx and PM emissions.

The diesel engine is the backbone of our economy and a threat to our health.

Understanding the "competition" for alternative fuels is essential

Today's diesel engines offer many advantages . . .

- **Safety** - Diesel is a safer fuel than gasoline and some of the alternatives (less flammable and explosive).
- **Energy Density** - Diesel fuel contains the highest energy per gallon of currently available transportation fuels. This delivers good vehicle range.
- **Efficiency** - diesel engines operate in a "lean" (excess air) combustion mode, which provides inherently high fuel efficiency and minimizes CO_2 emissions.
- **Performance** - Diesel technology has a greater power density than other fuels - it packs more power per unit volume than other fuels.
- **Durability** - Diesel engines are renowned for their durability, lasting hundreds of thousands of miles. This helps conserve resources.
- **Continuous Improvements** - Significant progress has been made in reducing emissions from diesel engines of all kinds. Today's trucks and buses are eight times cleaner than those built just a dozen years ago.

Key Questions: Can H-D diesel engines meet the stringent 2010 NOx and PM standards? At what cost?

The Size of the Transit Bus Market Inherently Limits Advanced RD&D

- Developing new transit bus technologies can be very costly for vehicle manufacturers, especially advanced prototype RD&D
- Given the limited market, the transit industry cannot perform the same level of manufacturer-led product development as the consumer auto industry
  - A total of about 7,500 buses (~5,000 transit) are built each year in the U.S.
  - GM alone built more than 5.5 million LDVs in 2002, with > 700,000 of the most popular model
- Low volume prevents bus manufacturers from allocating the level of resources that auto manufacturers allocate for research and development
- Buses are often built to each agency's specification as opposed to building standard models that are available to all customers
- Extensive on-road testing is unaffordable -- OEMs must instead rely on transit fleets that are willing to operate vehicles as they progress from prototypes to full commercial models
- Order size also causes difficulties in the development process: smaller orders work well for transit agencies (helps workout the bugs), but less well for manufacturers

The Transit Business is Nearly an "Open Book" of Information

The public nature of the transit business makes it one of the best-documented fleet "niche" market for alternative fuels - ***a major advantage for Coordinators****:*

- The American Public Transportation Association (APTA) produces extensive, agency-specific data and information from annual transit district surveys
  - Existing fleets by agency name, number of buses, size and type of buses, type of fuel / technology, price of buses, etc.
  - Buses on order and "potential" future procurements
- Transit agencies conduct public meetings and operate informative web sites
  - Details about short- and long-term budgets
  - RFPs for upcoming bus procurements
  - Reports about bus performance
- Federal, state, and local gov't agencies carefully document transit activities e.g.
  - DOE / NREL Alternative Fuel Information Series and Tiger Team activities
  - Clean Cities success stories and niche fleet summaries
- Media and trade associations (e.g., NGV Coalition) provide additional info

Overview of the Transit Bus Application

- "Transit" entails virtually all types and sizes of on-road vehicles, but transit buses are the most common vehicle type used for local service:
  - Provide about **60% of miles traveled**
  - Service approximately **160,000 directional route-miles** (U.S.)
- Roughly **57,000** transit buses are currently available for service
  - Nearly 75% of the fleet consists of 40 foot buses
  - About 8% are 35 feet in length
  - About 5% are 30 feet in length
  - About 4% are 60 foot articulated buses
- About **2.4 billion total vehicle miles** are traveled annually
  - Average trip taken: ~ 4 miles
  - Average speed in revenue service: ~ 12.8 mph
- Total annual operating expenses: ~ $13.3 billion
  - ~ 19% goes toward vehicle maintenance
  - ~ 4% to 5% goes toward purchase of fuels and lubricants
- On average, fare revenue covers ~22% of expenses (capital and operating)

Definitions (from the American Public Transportation Association)

Transit Bus:

- the most common bus (by far) used for local service
- mostly 40 feet long, but 35-foot and 30-foot versions are also common in smaller cities and on lightly-patronized routes
- 2 doors: front and center
- rear-mounted engine (normally)
- low-back seating, without luggage compartments or restroom facilities

Trolleybus (Trolley Coach, Trackless Trolley):

- rubber-tired electrically powered passenger vehicle operating on city streets drawing power from overhead lines with trolleys
- used in Seattle, Boston, Philadelphia, and a few other cities

Articulated Bus (or Trolleybus):

- extra-long (54 to 60 feet) bus with two passenger compartments, connected by a joint mechanism that allows the vehicle to bend during turns and curves
- normally operated in local service in very large metro areas on very heavy routes

Intercity Bus:

- 40 to 45 feet buses with a front door, separate luggage compartments, restroom facilities (usually), and high-backed seats for use in high-speed long-distance service
- used by the largest transit agencies and companies on limited-stop routes

Definitions from APTA (continued)

Demand Response:

- aka **"paratransit"** or **"dial-a-ride"**
- The most widely available transit service
- Provided in the U.S. by more than **5,000 transit agencies**
- Vehicle dispatched to pick up the passengers and transport them to their destinations
- Service usually limited to disabled persons (w/ attendants or companions) and senior citizens

Operations Characterized by:

- Response by demand to calls from passengers or their agents
- Usually no fixed routes or schedules (exception: temporary basis for special needs)
- Often dispatched for multiple parties with different destinations
- Much more **prominent use of gasoline-fueled vehicles** (LDVs and MDVs) including passenger cars, vans or small buses
- >97% of vehicles are less than 30 feet in length
- Despite small size, most vehicles have two doors (including rear door used for wheelchairs)
- Large transit districts frequently outsource paratransit portion of their operations to private companies
- Some types of service are required by law (e.g., some fixed routes for disabled and elderly), while others are voluntary (e.g., general demand response service)

American Public Transportation Association (APTA) 2003 Transit Survey

Survey and database involves ***transit-related*** passenger services only

Transit Buses

- 2,250 transit bus agencies exist in North America
- 258 agencies (11.5%) responded, representing ~ 67% of all buses
- Survey captured 90% of buses 35 to 45 feet, and 99% of articulated buses
- Finding: **57,461 operational transit buses in U.S., 95.8% of which are "active"**
- APTA estimates that most vehicles NOT REPORTED are 30 feet or less in length and operated by small-city and rural agencies

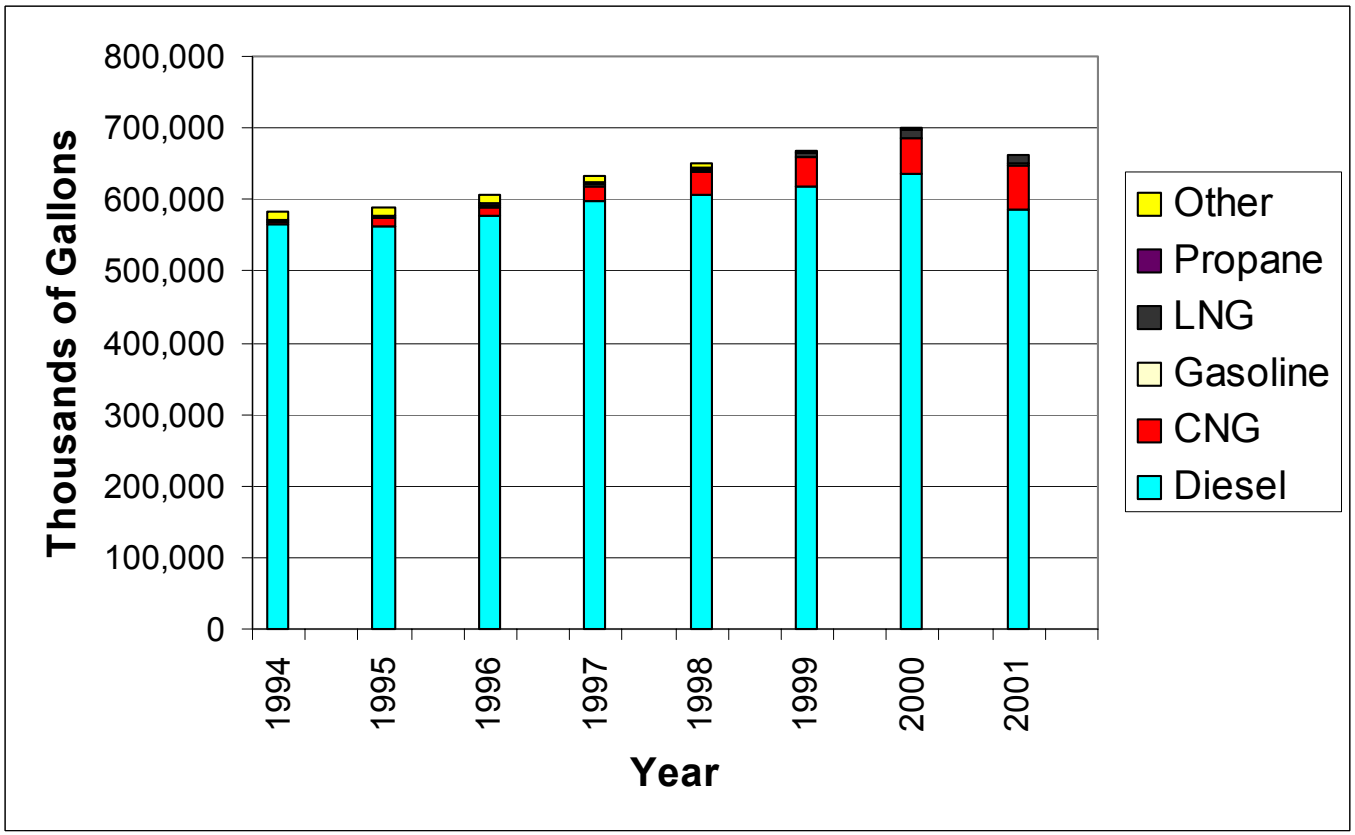
Demand Response (Paratransit) Buses

- 5,000 paratransit agencies exist in North America
- Fewer than 200 agencies responded (4%), representing ~ 22% of all paratransit vehicles
- 10,810 paratransit vehicles are operational, 97.1% of which are "active"
- Nearly all non-reported vehicles are taxis, vans, minibuses, etc.

Nearly 89% of the fuel consumed in the U.S. transit bus sector is diesel

- Approximately **625 million gallons of diesel fuel** are used annually
- Approximately 78 million gallons of **non-diesel fuels** are used annually
- On average, each vehicle consumes about 10,000 gallons (DGE) per year

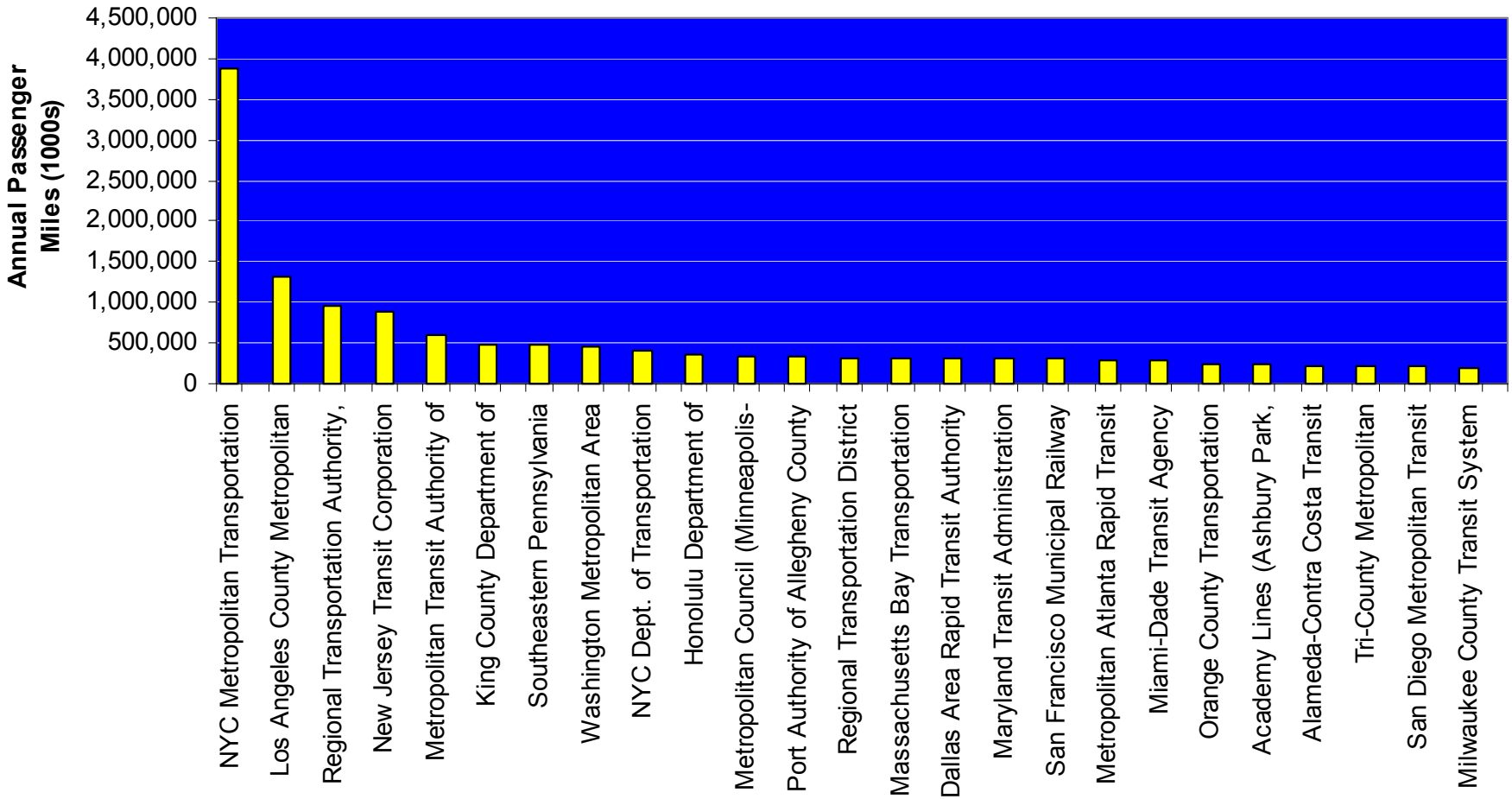
U.S. Transit Bus Fuel Consumption, 1994-2001*



*Data includes passenger vehicles; excludes non-passenger-vehicle and non-vehicle consumption

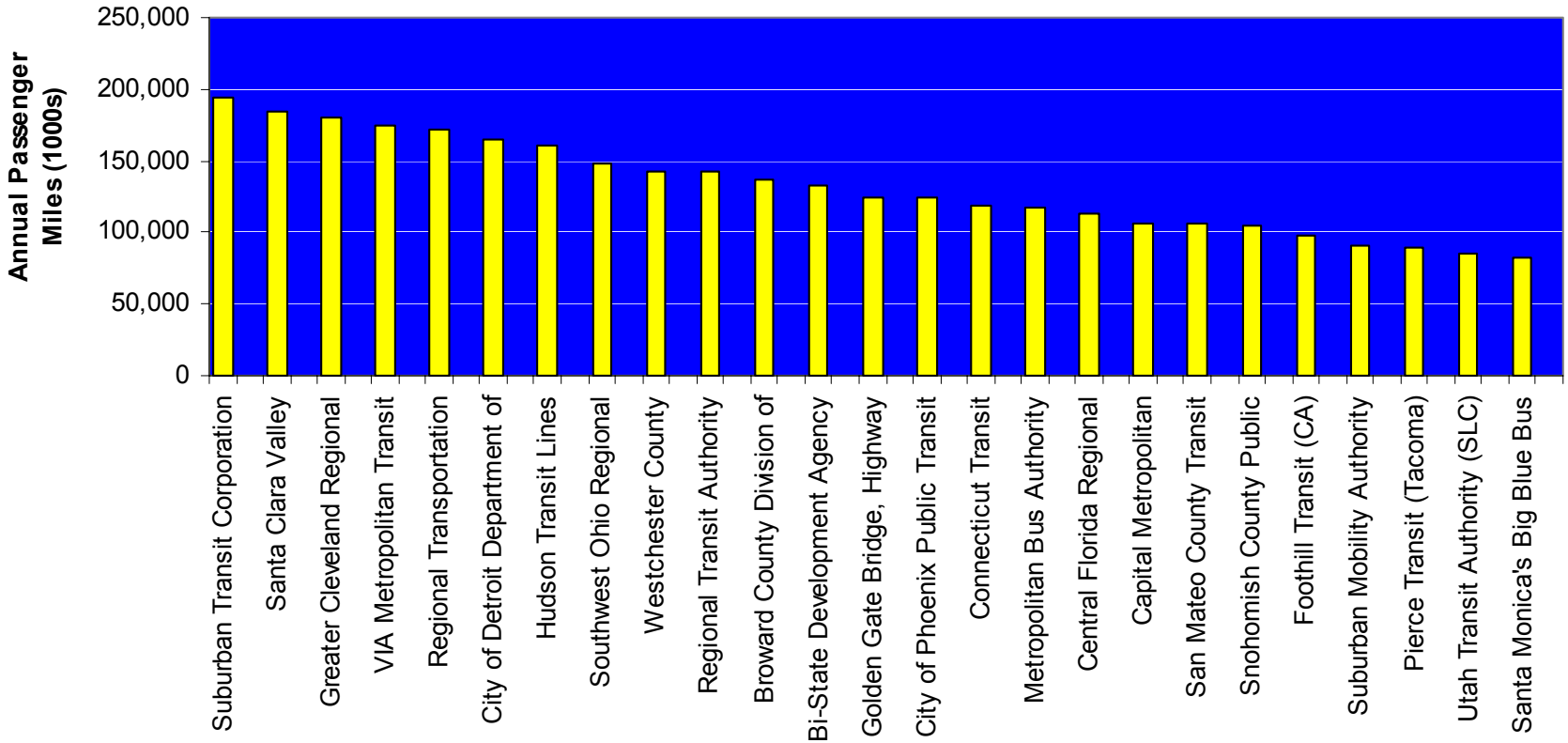
2001 data are preliminary. **Source: APTA (http://www.apta.com/research/stats/bus/busfuel.cfm)**

U.S. Transit Providers Ranked 1st through 25th by Annual Passenger Miles (FY 2001)



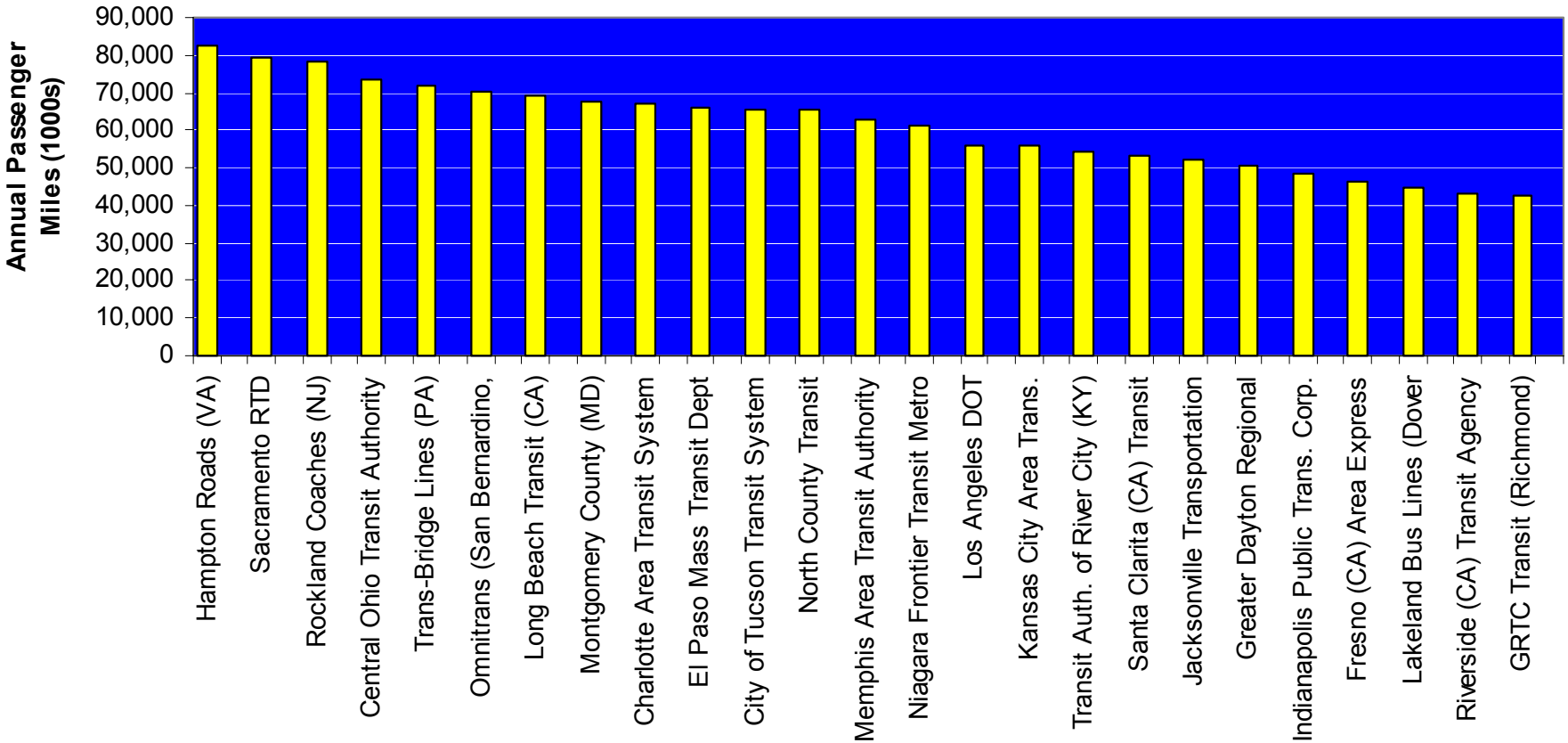
Source: FTA, cited by APTA in Table 75 (http://www.apta.com/research/stats/bus/75largest.cfm)

U.S. Transit Providers Ranked 26th through 50th by Annual Passenger Miles (FY 2001)



Source: FTA, cited by APTA Table 75 (http://www.apta.com/research/stats/bus/75largest.cfm)

U.S. Transit Providers Ranked 51st through 75th by Annual Passenger Miles (FY 2001)



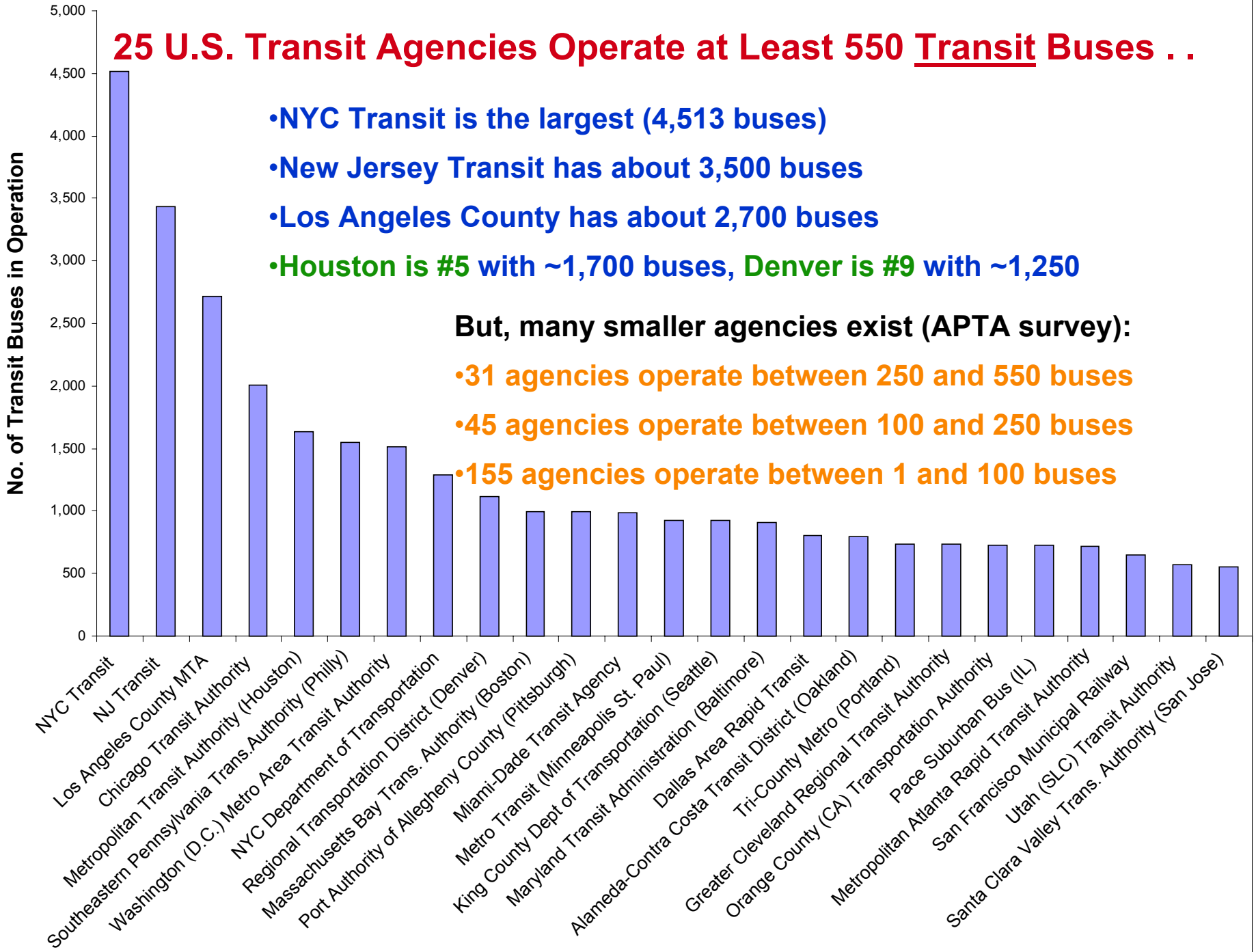
Source: FTA, cited by APTA Table 75 (http://www.apta.com/research/stats/bus/75largest.cfm)

25 U.S. Transit Agencies Operate at Least 550 Transit Buses . .

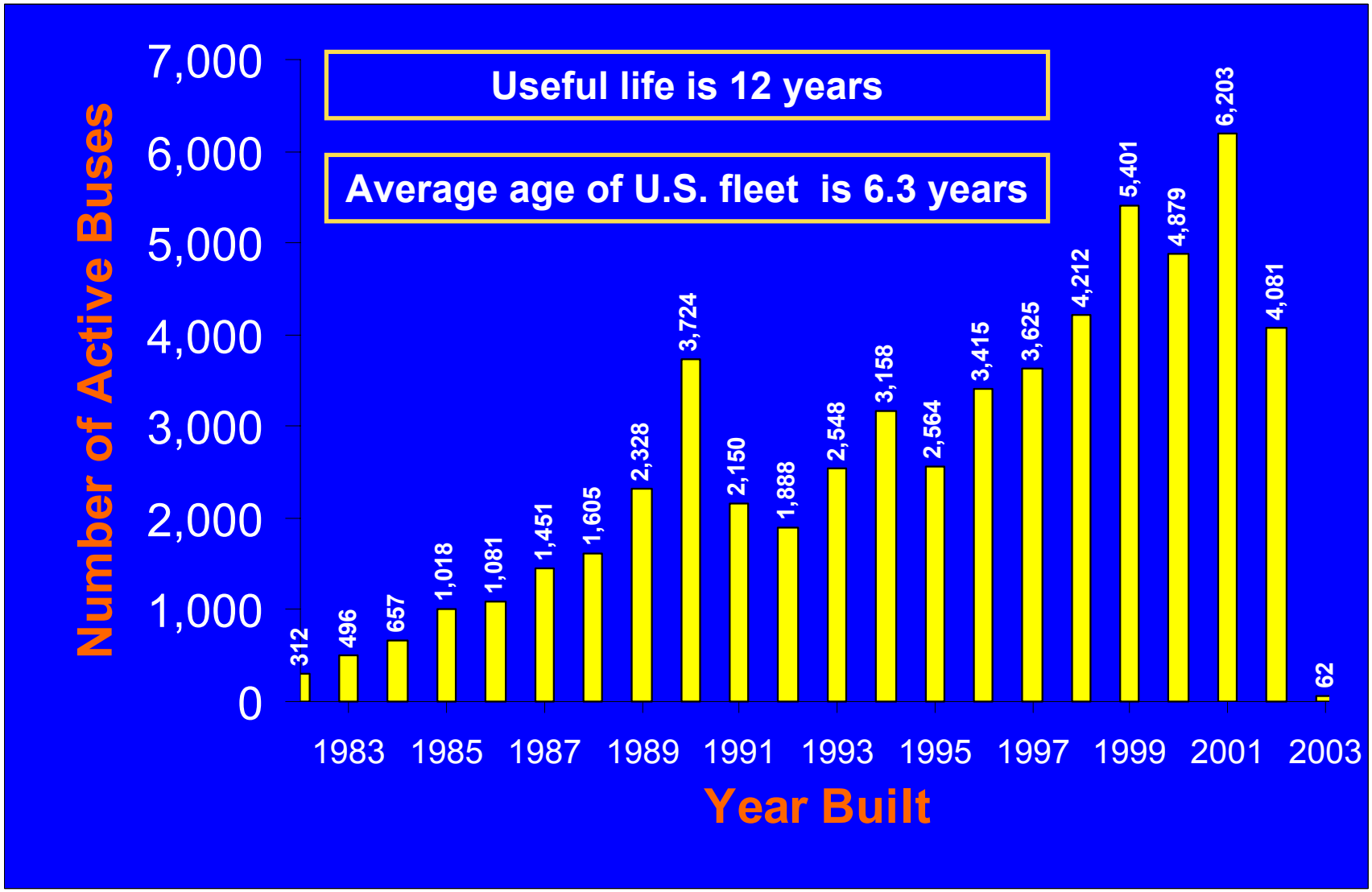
- NYC Transit is the largest (4,513 buses)
- New Jersey Transit has about 3,500 buses
- Los Angeles County has about 2,700 buses
- Houston is #5 with ~1,700 buses, Denver is #9 with ~1,250

But, many smaller agencies exist (APTA survey):

- 31 agencies operate between 250 and 550 buses
- 45 agencies operate between 100 and 250 buses
- 155 agencies operate between 1 and 100 buses

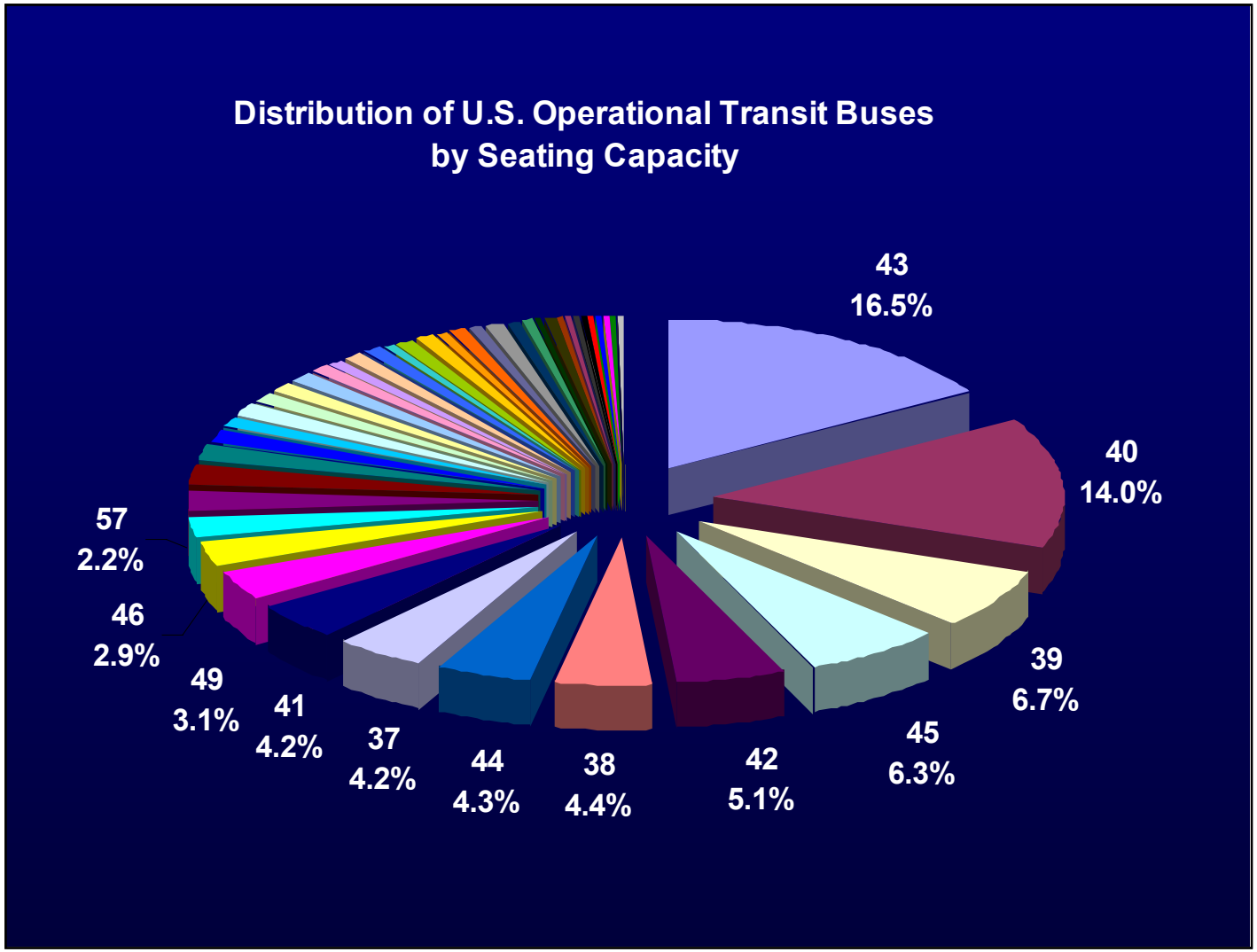


Breakout of Active U.S. Transit Buses by Year Built



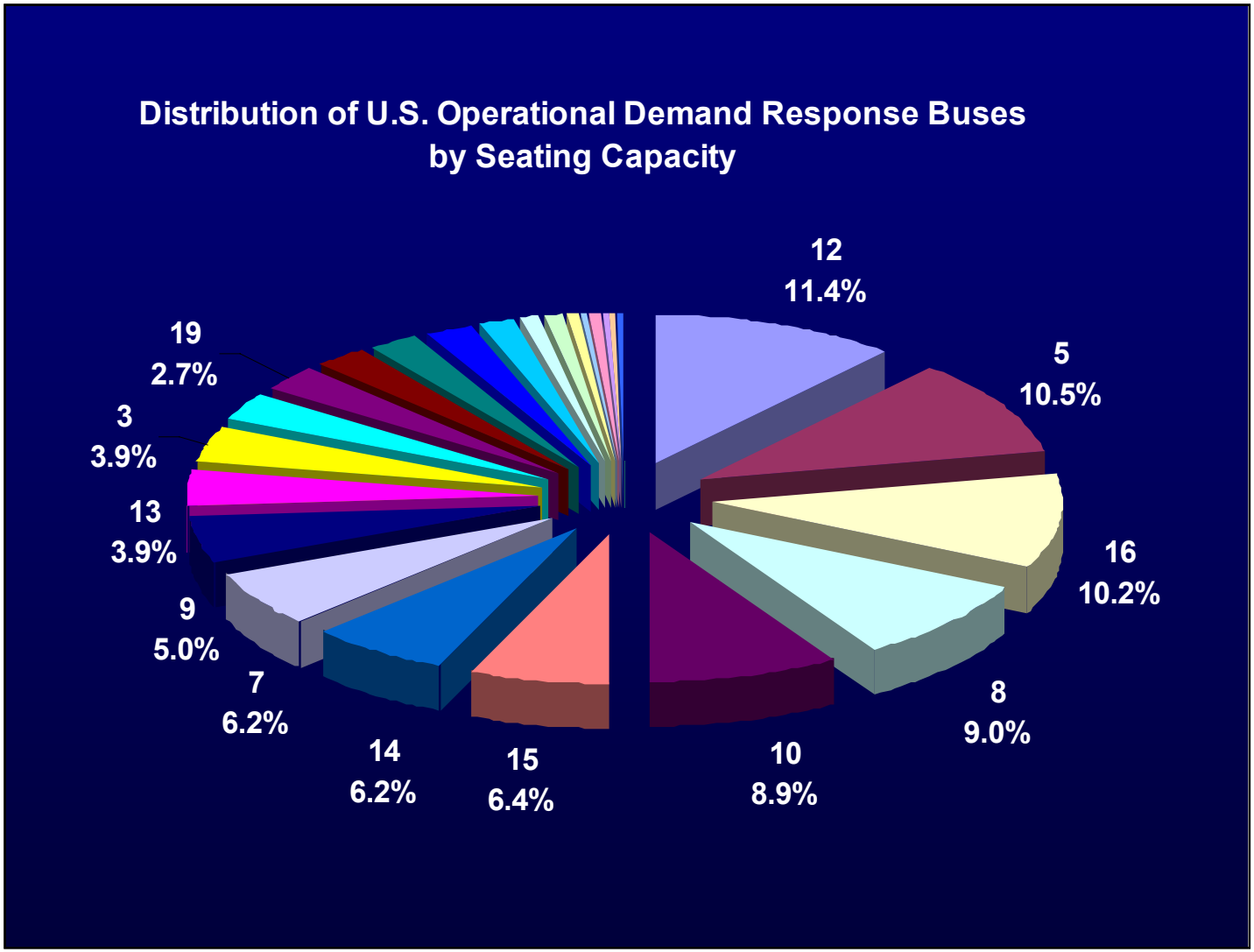
Source: Table 16 from APTA 2003 Database. Note: 2003 is a partial year.

The predominant seating capacities for transit buses are 43 and 40 passengers



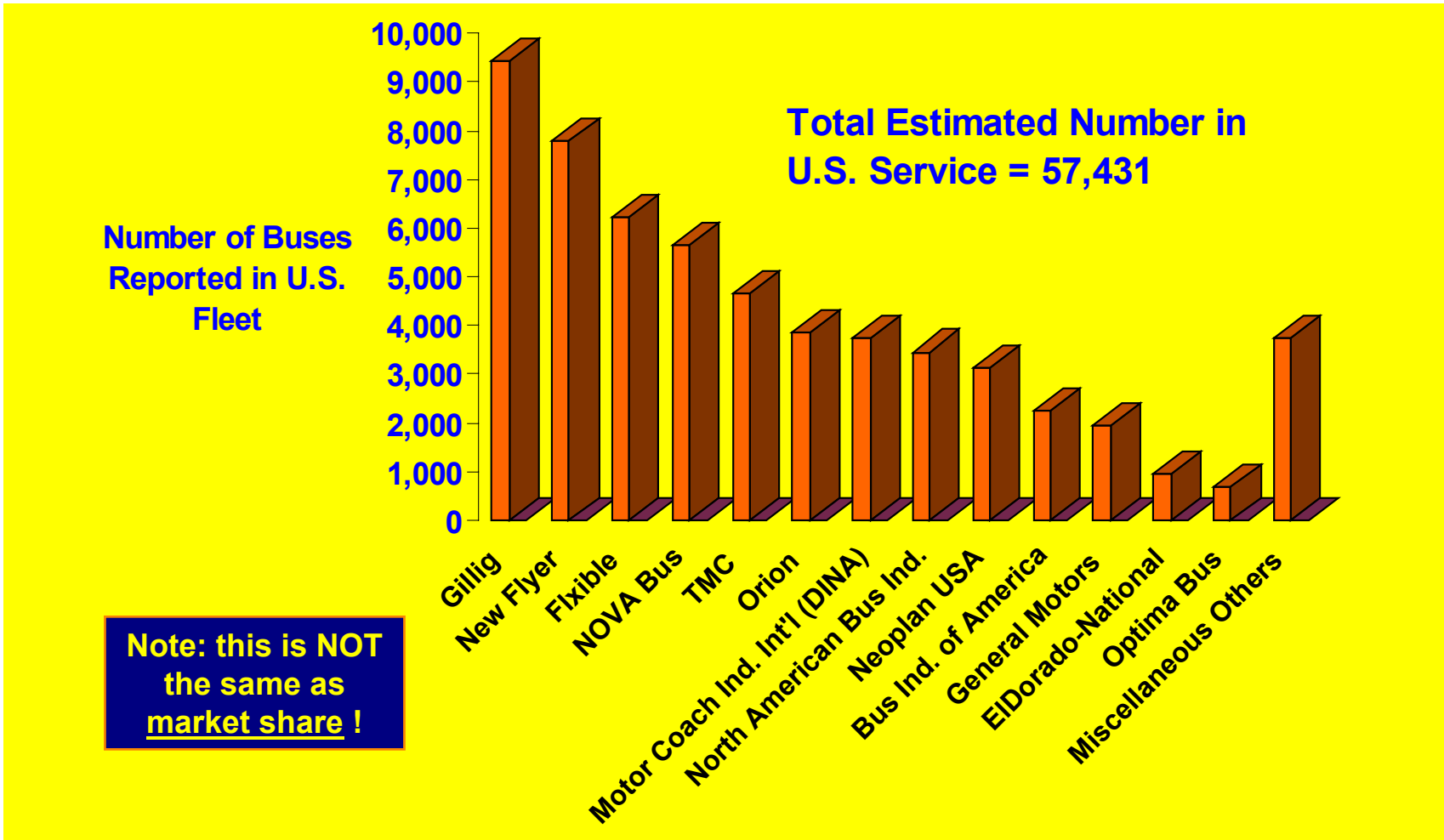
Source: APTA 2003 Database

Demand response (paratransit) vehicles typically seat 5 to 16 passengers



Source: APTA 2003 Database

Distribution of U.S. Operational Transit Buses by Bus Manufacturer (late 2002)



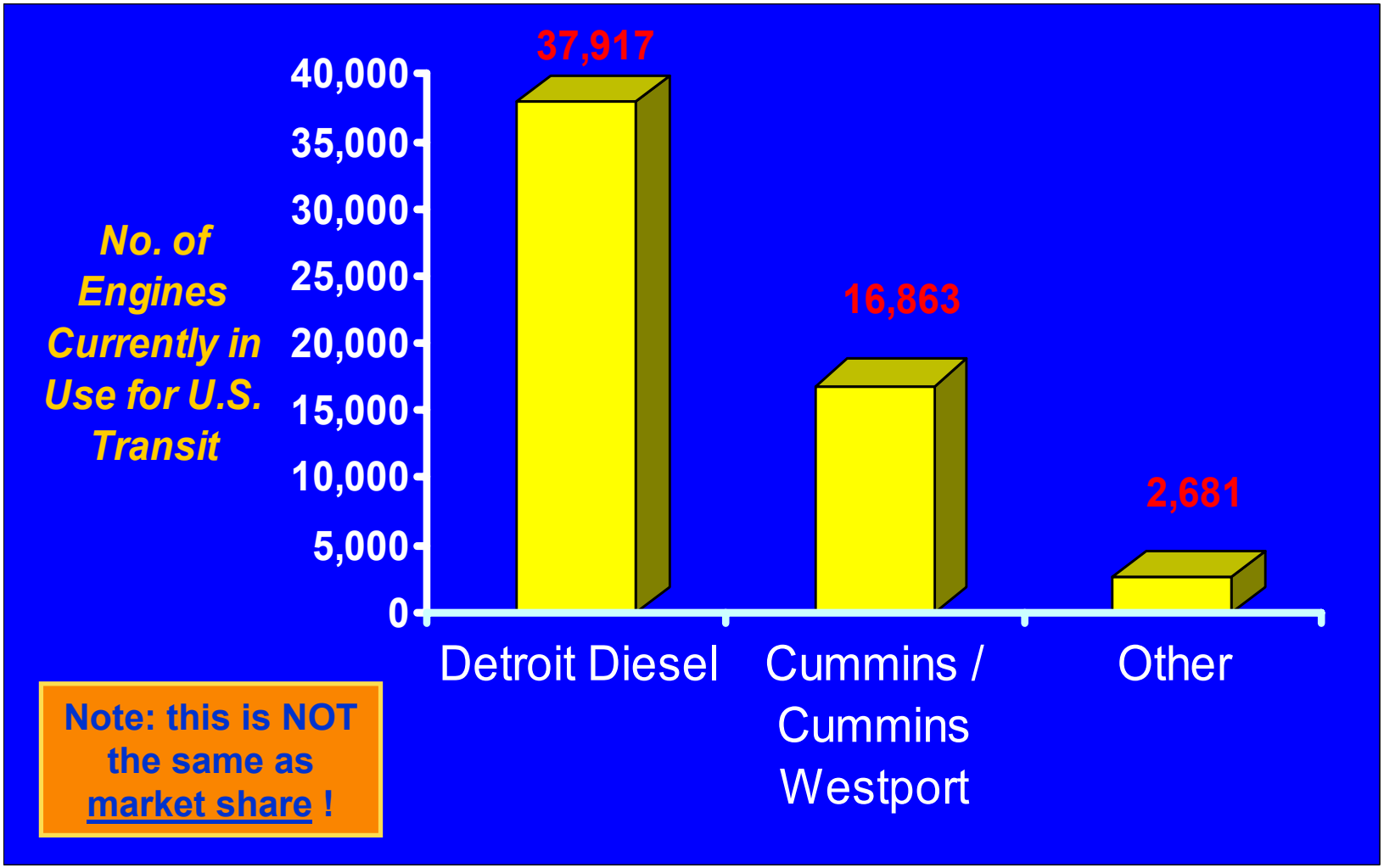
Source: APTA 2003 Database Table 9

Distribution of U.S. Operational Paratransit Vehicles by Manufacturer (2002)

Paratransit Bus Manufacturer	2003 APTA Survey Total	% of Total In-Use Fleet
ElDorado-National (formerly ElDorado Bus & Natl Coach)	3,194	29.5%
Goshen Coach	1,952	18.1%
Coach and Equipment Manufacturing Company	881	8.1%
Ford Motor Corporation	836	7.7%
Supreme Corporation (Startrans)	704	6.5%
Champion Motor Coach	571	5.3%
Braun Corporation	523	4.8%
Dodge Division, Chrysler Corporation	405	3.7%
Ricon Corporation	279	2.6%
Blue Bird Corporation	168	1.6%
All Others (31 Separate OEMs)	1,297	12.0%
	10,810	100.0%

Note: this is NOT the same as market share !

Distribution of U.S. Operational Transit Buses by Engine Manufacturer (late 2002)



Source: APTA 2003 Database Table 10

Market for New Bus and Trolleybus Orders by Manufacturer, 2002-2007

Recent Trend: Market Share Shifts from Year to Year

	BUILT IN 2002		ON ORDER JANUARY 2003		POTENTIAL ORDERS (a)	
	NUMBER	PER CENT	NUMBER	PER CENT	NUMBER	PER CENT
Gillig	1,101	26.0%	1,026	17.5%	NA	NA
Motor Coach Industries	731	17.3%	339	5.8%	NA	NA
New Flyer	629	14.9%	799	13.7%	NA	NA
North American Bus	393	9.3%	1,698	29.0%	NA	NA
Nova BUS	378	9.0%	3	0.1%	NA	NA
Orion	334	7.9%	966	16.5%	NA	NA
Neoplan	253	6.0%	496	8.5%	NA	NA
All others	170	4.0%	86	1.5%	NA	NA
Optima Bus	73	1.7%	47	0.8%	NA	NA
El Dorado-National	65	1.5%	17	0.3%	NA	NA
Thomas Dennis/Thomas	52	1.2%	63	1.1%	NA	NA
BlueBird	50	1.2%	4	0.1%	NA	NA
Van Hool	2	0.0%	189	3.2%	NA	NA
Electric Transit	0	0.0%	113	1.9%	NA	NA
Total	4,231	100.0%	5,846	100.0%	8,996	100.0%

Source: APTA survey, Table 59. Bus data are about 67% and trolleybus data 100% of national totals.
(a) DATA ARE TENTATIVE; SOME POTENTIAL ORDERS MAY NOT OCCUR.

New Bus and Trolleybus Market by Power Source, 2002-2007

	Built in 2002		On Order January 2003		Potential Orders(a)	
	Number	Percent	Number	Percent	Number	Percent
Diesel ICE	3,389	80.1%	4,026	68.8%	5,275	58.7%
Dedicated CNG	641	15.2%	1,216	20.8%	2,432	27.0%
Dual-Power*	44	1.0%	403	6.9%	307	3.4%
Electric Catenary	88	2.1%	141	2.4%	0	0.0%
Gasoline ICE	11	0.3%	1	0.0%	48	0.5%
Dedicated LNG	52	1.2%	56	1.0%	154	1.7%
Dedicated Propane	4	0.1%	3	0.1%	41	0.5%
All others	2	0.0%	0	0.0%	73	0.8%
Undecided	NA	NA	NA	NA	666	7.4%
Total	**4,231**	**100.0%**	**5,846**	**100.0%**	**8,996**	**100.0%**

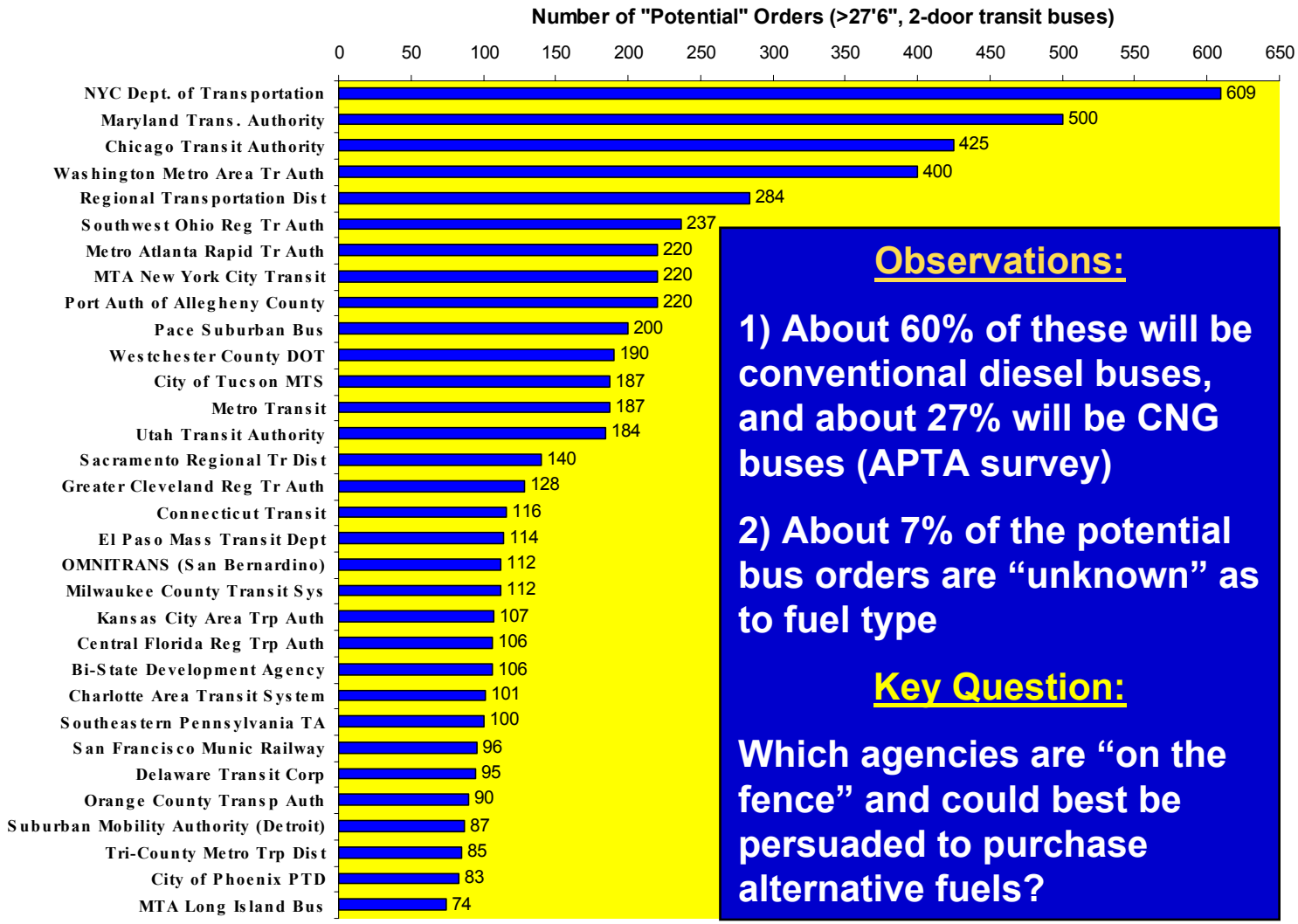
Source: APTA survey, Table 60. Bus and trolleybus data are about 67% and 100%, respectively, of national totals.
(a) Data are tentative. Some potential orders may not occur.

*"Dual-power " means hybrid buses in this case.

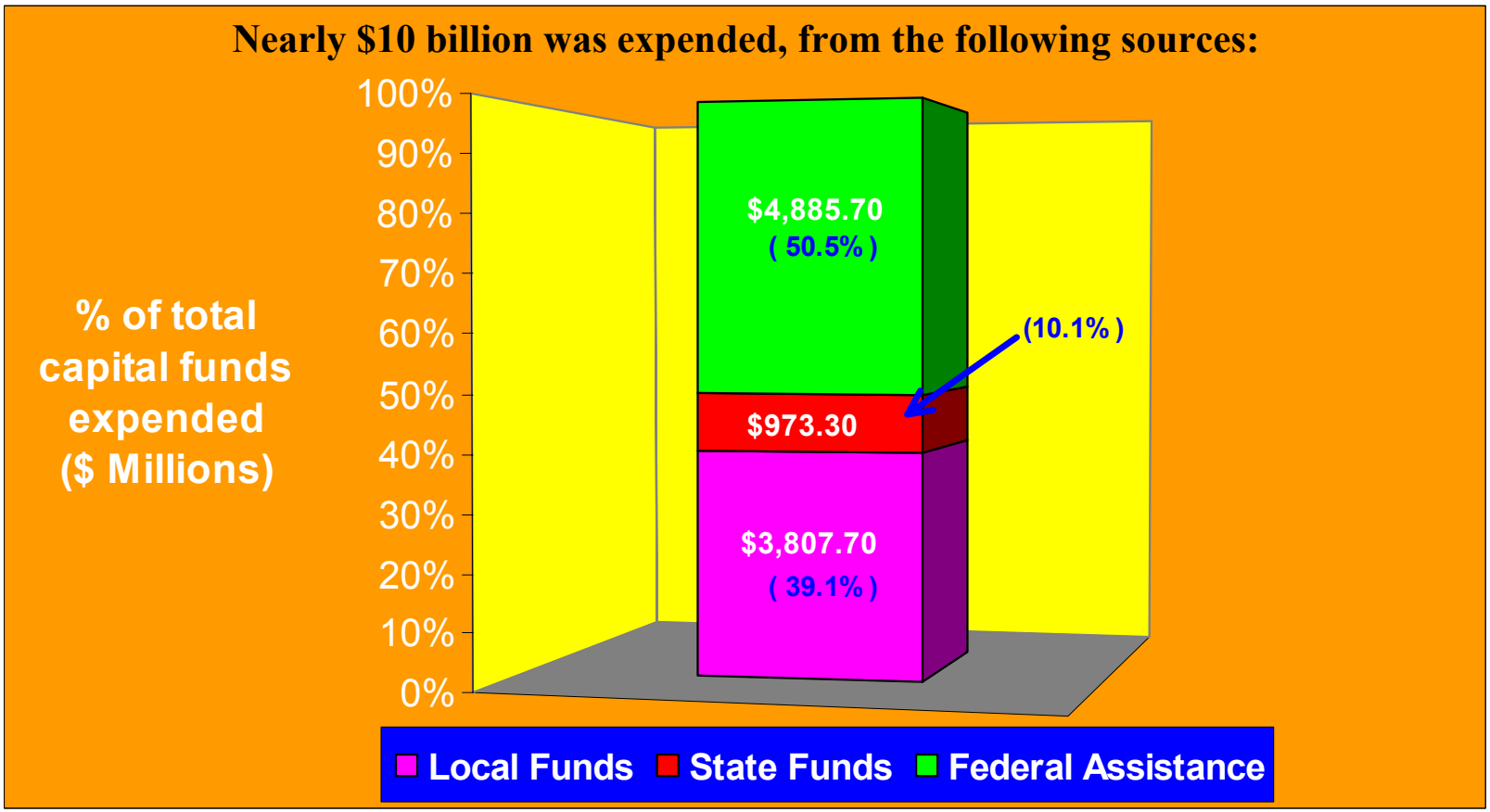
APPARENT TRENDS:

- Market share for conventional diesel ICE buses is declining
- Market shares for CNG buses and hybrid diesel-electric buses (referred by APTA as "Dual-Power") are increasing
- Trend for LNG buses is less clear, but market share appears to be increasing

APTA: more than 7,600 transit buses are “potential”orders (next few years)



Sources of capital funds expended for total U.S. transit (Year 2000)



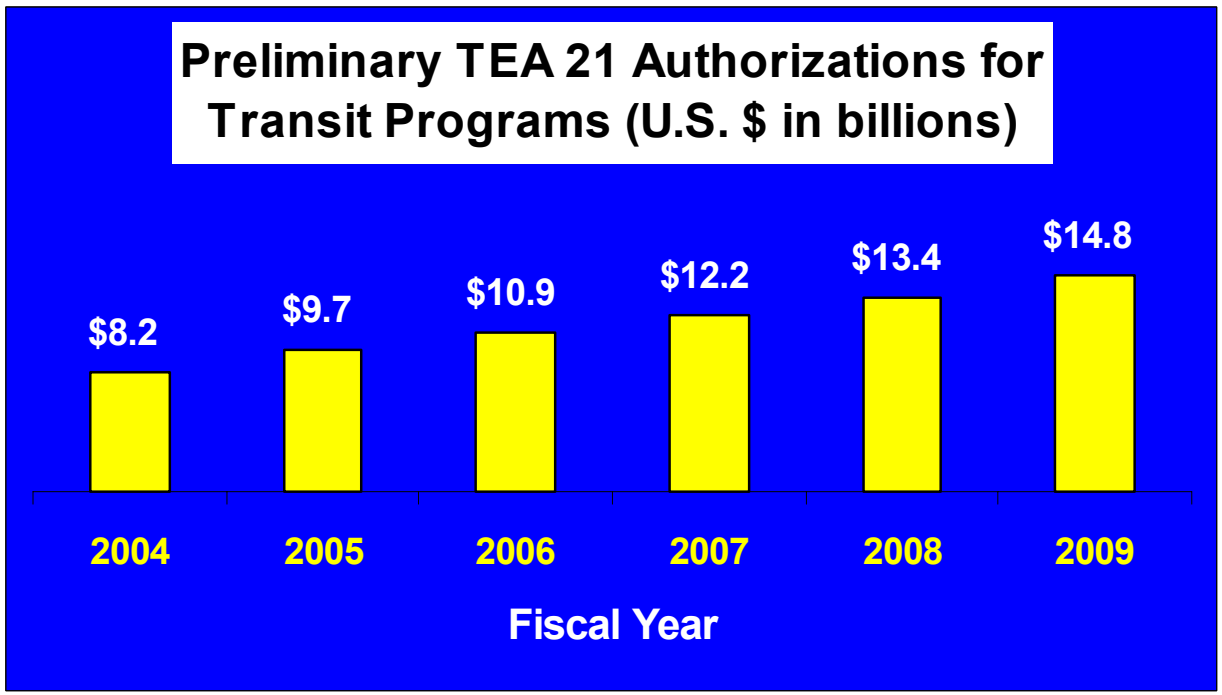
Note: Federal assistance includes federal capital funds

Source: National Transit Profile 2000, www.ntdprogram.com

Funding programs for alternative fuel transit buses are region-specific, and they can be quite complex -- but also very effective to help agencies "buy down" the cost of their buses.

Transit Funding for FY 2004 - FY 2009 (tentative, as of December 2003)

- Mid November 2003: House Transportation and Infrastructure Committee (T&I) unveils TEA 21 reauthorization bill as part of overall U.S. Energy Bill
  - $69.2 billion over six years for the federal transit program
- The bill follows TEA 21's general program structure and ratios
- Some new programs are included (e.g., hydrogen fuel cell bus programs)
- Annual authorized funding levels for transit portion of the program:



Update December 2003:
Senate filibuster kills Energy Bill

Chattanooga (CARTA) Program: Example of How Clean Buses are Funded

- **Federal Program Funding Received:**
  - **FTA Bus Modernization Program:** 80% funding for electric & hybrid electric buses, 80% funding for intercept garages
  - **FTA Alternative Fuels Program:** ~$4M to develop and deploy purpose-built hybrid electric buses with microturbines
  - **FTA Formula Grants:** approximately 21% of ongoing maintenance costs for battery electric & hybrid-electric buses
  - **DARPA:** $350,000 to fund Capstone microturbines and all-electric air conditioning system
  - **TVA:** capital funding for Electric Vehicle Information Center
- **State Program Funding Received:**
  - **Tennessee DOT:** 10% match to total FTA grant programs named above
- **Local Program Funding Received:**
  - **City:** 10% match to FTA grant programs named above, 60% of funding for third intercept garage, operating assistance to CARTA

Source: Electric Vehicle Association of America, http://www.evaa.org/evaa/pages/who_carta.htm