

City of Alexandria, Virginia

MEMORANDUM

DATE: APRIL 24, 2012

TO: THE HONORABLE MAYOR AND MEMBERS OF CITY COUNCIL

FROM: RASHAD M. YOUNG, CITY MANAGER 

SUBJECT: BUDGET MEMO #56: FUTURE BUS PROCUREMENT BY THE CITY OF ALEXANDRIA - HYBRID BUSES VERSUS NEW AND REFURBISHED CLEAN DIESEL BUSES

The purpose of this memorandum is to provide City Council members with background information requested at the February 28, 2012 Alexandria Transit Company (ATC) stockholders meeting and DASH work session on what type of buses have recently been ordered and the costs and benefits of purchasing refurbished diesel, clean diesel, and hybrid buses.¹

DASH most recently purchased 10 hybrid buses at the end of calendar year 2011 as replacements for existing units and is preparing to order an additional 10 hybrid buses, pending approval of a capital allocation request at the April 24, 2012 City Council legislative meeting.

STAFF RECOMMENDATION

Staff recommends that all future bus purchases continue to be hybrid buses due to the environmental benefits of reduced emission and improved fuel economy, the operating advantages of reduced noise and exhaust fumes, and reduced maintenance requirements. Hybrid buses may also have a cost advantage over clean diesel buses, however the amount of hybrid cost savings depends on the price of fuel, which is highly unpredictable.

T&ES staff presented their recommendation and information to the Environmental Policy Commission (EPC) and Alexandria Transit Company Board (ATC) last month, and both bodies unanimously endorsed the recommendation to purchase hybrid buses. The staff and board recommendations were made citing the following areas of criteria: vehicle cost and life cycle, maintenance, environmental considerations, noise pollution, and other considerations.

¹ The hybrid technology referenced in this memorandum is clean diesel/hybrid, which operates on an electric motor with additional power provided by a clean diesel engine.

ENVIRONMENTAL CONSIDERATIONS

With recent stringent Environmental Protection Agency (EPA) standards on lower sulfur content in diesel fuel and particulate emissions, new diesel buses emit significantly less SO₂ and particulates, two criteria pollutants, compared to older diesel buses.

Hybrid buses are subject to the same new EPA standards but consume 30 to 45 percent less fuel than clean diesel buses (See Table 4). As a result of the reduced fuel consumption and engine operation, hybrid buses are expected to produce even lower SO₂ and particulates, in addition to 30 to 70 percent less carbon monoxide (CO) and oxides of nitrogen (NO_x) emissions reported in the literature, other two criteria pollutants. Furthermore, hybrid buses are expected to significantly reduce greenhouse gas (GHG) emissions by 30-45%, the prime objective of the City's Energy and Climate Change Action Plan which City Council adopted in 2011. Hybrid buses are also a much better fit with the Environmental Action Plan (EAP) 2030 which City Council adopted in 2009. A number of action steps and objectives stipulated in the EAP 2030 favoring the purchase of hybrid buses are as follows:

1. Develop a DASH policy that requires all new buses to be low emission, hybrid or CNG vehicles.
2. Lengthen the allowable payback period for the City's energy efficiency investments from 7 years to 15 years to be more consistent with the City's cost of capital.
3. Create a City Fleet Management Plan (FMP) to minimize the emission of greenhouse gases and other pollutants from City-owned and operated vehicles.
4. Reduce Alexandria community GHG emissions by 20% below 2005 levels by 2020.

NOISE POLLUTION

Hybrid buses are quieter than clean diesel buses, which is also important in the assessment of future bus purchases. The City is planning to expand transit services into residential areas through the use of neighborhood circulators and Bus Rapid Transit (BRT) feeder services. DASH has already received feedback from several Alexandria residents expressing their satisfaction with the new, quieter hybrid bus technology. Additionally, surveys regarding hybrid buses indicated that the quieter operations can result in increased public satisfaction and transit buy-in from the community at large.

MAINTENANCE

Hybrid buses are less expensive and easier to maintain than diesel buses. A hybrid bus electric drive has fewer parts. As a result of the hybrids greater fuel efficiency, they require fewer oil changes and experience less engine wear and tear. Additionally, the braking systems for hybrid buses last longer than those of diesel buses. Hybrids do require maintenance for batteries; however the service life is not well documented due to the lack of users' longevity of

experience. It is expected that these batteries must be replaced every 5-7 years. DASH currently has the ability to service both clean diesel and hybrid buses. Refurbished diesel buses would require considerably more ongoing maintenance, and would need to be replaced every 5-7 years.

OTHER CONSIDERATIONS

Hybrid buses also foster the goals of the Eco-City Alexandria and with the buses displaying the Eco-City logo, help market the City as an Eco-City. In addition, if hybrids are selected, it is recommended that DASH incorporate hybrid and environmental stewardship into its marketing strategy.

VEHICLE COST AND LIFECYCLE

The fiscal impact of purchasing all hybrid buses depends largely on the future price of fuel. Hybrid buses cost more to purchase initially, but the operating cost savings from improved fuel efficiency reduce the overall capital and operating cost difference over the life of the vehicle. As fuel prices increase, the hybrid operating savings increases and the overall cost difference is reduced. The opposite occurs when fuel prices decrease. At the current price of \$3.25 per gallon, a hybrid bus would cost approximately \$100,000 more in capital and operating than a new clean diesel bus and \$178,000 more than a refurbished clean diesel bus over its 12 year useful life.² Hybrid buses become equivalent to the cost of new clean diesel buses at approximately \$5.50 per gallon and to refurbished clean diesel buses at approximately \$7.00 per gallon.

Table 1
Hybrid Bus 12-Year Cost/Savings Relative to Clean Diesel

Price/ Gallon	Hybrid Purchase Cost Difference	Annual Hybrid Fuel Savings	12-Year Hybrid Fuel Cost Savings	Net 12-Year Hybrid Cost/(Savings)
\$3.25	\$250,000	(\$12,536)	(\$150,429)	\$99,571
\$4.00	\$250,000	(\$15,549)	(\$185,143)	\$64,857
\$5.50	\$250,000	(\$21,214)	(\$254,571)	(\$4,571)
\$7.00	\$250,000	(\$27,000)	(\$324,000)	(\$74,000)
\$8.50	\$250,000	(\$32,786)	(\$393,429)	(\$143,429)

Assumes 45,000 miles per year at 3.5 miles per gallon for clean diesel and 5 miles per gallon for hybrids. Does not include hybrid bus maintenance savings, for which a quantified estimate was not available, but does assume a battery replacement during the 12-year period.

As Table 2 below indicates, refurbishing buses is the least expensive option based on capital expenditures. Considering that the refurbished buses last approximately five years, the capital cost for a 12-year cycle for refurbished buses (i.e. replace 2.4 times in 12 years) is estimated to be \$372,000, which is less than the cost of the clean diesel vehicles and the hybrid vehicles. While the option of refurbishing DASH buses appears to be a good option from the perspective of capital cost savings, there are a number of negative aspects that make this option less

² Assumes 5 miles-per-gallon fuel efficiency for hybrids as compared to 3.5 miles-per-gallon for clean diesel and 45,000 miles of service annually.

desirable. Refurbished buses do not include critical elements such as low floor or kneeling features. These buses also require more ongoing maintenance and do not have the many of the features and comfort found in newly manufactured buses and generate significantly more pollution than brand new buses. Therefore, staff does not recommend refurbishing DASH buses for planned future bus acquisitions.

**Table 2
Bus Capital Costs and Average Life of Vehicle**

	Refurbished Vehicle	Clean Diesel Vehicle	Hybrid Vehicle
Capital Cost	\$155,000	\$450,000	\$700,000
Life of Vehicle	5 Years	12 Years	12 Years
12 Year Cost	\$372,000*	\$450,000	\$700,000**

*Assumes vehicle is replaced 2.4 times in 12 years.

**Base cost of \$650,000 plus \$50,000 battery replacement after approximately 6 years.

While the capital cost of hybrid buses is the highest, the fuel cost of hybrids is the lowest. As Table 1 illustrates, the cost effectiveness of hybrid buses improves as fuel prices increase. In the scenario in Table 1, the cost difference between hybrid buses and clean diesel buses diminishes as fuel prices increase until the two become cost equivalent at approximately \$5.50 per gallon, at which point the hybrid option becomes more advantageous as prices continue to rise. Table 2 is based on several variables, including miles of operation, fuel efficiency, and capital purchase costs that could change the costs in either direction. It does not include maintenance costs or any repair or equipment replacement costs for either type of vehicle except the \$50,000 hybrid battery replacement for hybrid buses.

There is also the potential for grant and other federal funds to be available in the future to purchase hybrid buses. If this occurs, the economics with hybrid buses would become more favorable, as capital costs could be subsidized with federal dollars but the operating savings would come to DASH. Also, as with any new technology implementation, the cost of hybrid buses is expected to come down with more usage and development costs having been recovered by the manufacturer. For instance, the first batch of hybrid buses cost New York City about \$1 million each, while its latest hybrid buses only cost about \$500,000 each (37-foot buses).

Table 3 on the following page summarizes some of the advantages and disadvantages of hybrid and clean diesel buses.

Table 3
Comparison of Hybrid Buses to Diesel-Powered Buses

	HYBRID BUSES	CLEAN DIESEL BUSES
ADVANTAGES	Fuel Savings: 25-40% more fuel efficient	Capital Cost – Lower capital cost than hybrid buses, allowing for more buses to be acquired with same capital
	Noise reduction: Hybrid buses are significantly quieter	Maintenance Expertise: Currently, DASH mechanics are more familiar with diesel engines than hybrid engines
	Emission Reduction: Much lower (30-70% reduction) CO, NO _x and GHG emissions	
	Reduced Maintenance: Fewer oil changes, less engine wear and tear, electric drive has fewer parts, extended brake life	
	Acceleration: Better acceleration from a stop due to increased low-end torque provided by electric motors	
	Customer Satisfaction: Increased overall customer and driver satisfaction	
	Eco-City: A much better fit with the Eco-City Alexandria goals, hybrid buses help market Eco-City	
DISADVANTAGES	Capital Cost: Higher costs than diesel buses	Technology: Likely to be phased out in the next decades
	Long-Term Battery Durability: The longevity of battery packs has not been fully proven	Public Health Impact: Diesel exhaust classified as a probable human carcinogen with no known safe level of exposure
		Fuel Cost Uncertainty: The cost of diesel fuel is expected to rise in the long term, reducing the payback time for the hybrid option