


City of Alexandria, Virginia

MEMORANDUM

DATE: NOVEMBER 22, 2017

TO: THE HONORABLE MAYOR AND MEMBERS OF CITY COUNCIL

FROM: MARK B. JINKS, CITY MANAGER 

SUBJECT: DASH CONVERSION TO CLEAN DIESEL AND FUTURE ELECTRIC BUS IMPLEMENTATION

The purpose of this memorandum is to provide City Council with information about a recent resolution by the Alexandria Transit Company (DASH) Board of Directors. On Tuesday night at Council's Legislative Meeting there will be an oral presentation on this subject. The resolution (which is attached) endorses the DASH General Manager's proposal to switch the purchasing policy of replacement buses from hybrid¹ technology to clean diesel technology. Further, the resolution instructs the General Manager to pursue the gradual transition to an all-electric bus fleet as soon as it is technically and financially possible.

Recently you received a letter from the Environmental Policy Commission (EPC) outlining a position that includes more aggressively pursuing the implementation of all-electric buses. The DASH Board also received this letter and factored it into their decision on this matter.

Based on the DASH Board resolution and support from City Staff, this memo serves to inform City Council that DASH will use approximately \$13 million in prior year bus replacement funds to purchase approximately 27 clean diesel buses. DASH has a pending order with secured production slots and pricing that require notification to the manufacturer no later than December 31.

BACKGROUND: DASH has 34 "old" diesel buses remaining in the fleet – none of which meet modern (EPA 2010) emissions standards. Further, the FY 2018-2027 CIP does not provide sufficient funding to meet the bus replacement schedule while adhering to a hybrid bus purchasing plan. The decision to switch technologies by the DASH Board is based in part on economic, environmental, service reliability, and ongoing maintenance cost factors. The DASH Board also notes that in September, WMATA approved a fleet replacement plan that now replaces buses with clean diesel in lieu of hybrid because of similar factors.

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.

The switch to clean diesel is in keeping with the City's Eco-City Charter and is in compliance with the Environmental Action Plan. This change enables the DASH fleet to catch up with state of good repair (SGR), improve service reliability and reduce maintenance costs all while improving the riders' experience and lowering the environmental impact of the fleet. Of note:

- Hybrid bus purchases cost approximately 40% more than modern clean diesel buses (approximately \$200,000 per bus, see Table 1).
- DASH initially transitioned to hybrid buses expecting, in part, to realize reduced maintenance costs from fewer oil changes, less engine wear and tear, extended brake life, and fewer replacement parts needed for electric engines. However, a two-year look back at actual maintenance costs shows that hybrids have cost DASH more in maintenance costs due, in part, to the agency's need to outsource (Table 2)
- DASH buses accumulate approximately 300,000 miles over a lifetime, resulting in a lifetime fuel savings of an estimated \$50,000 per bus, at current fuel price of \$2.20 per gallon. (25% return on investment, see Table 3). Hybrid buses also require an additional \$3.8 million line item in the City's 10-year Capital Improvement Program to provide battery packs for hybrid buses. The batteries, which are rated for a seven-year life span, require mid-life battery overhaul for each bus, which are on a 12-year life cycle. This means DASH and the City must budget for approximately \$43,000 in additional capital costs per bus.
- Although hybrids achieve approximately 25% increase in fuel economy, modern clean diesel buses have been proven to achieve similar fuel savings due to advancements in automatic transmission technology, and electrification of major mechanical components (engine cooling, A/C, etc.)
- A comparison of hybrid, clean diesel and neutral factors is included in Table 4 on page 5 of this memorandum.

EMISSIONS

All 34 of DASH's old diesel buses are of the pre-2010 EPA standards. Diesel buses manufactured since 2010 produce significantly less particulate matter. Modern hybrid buses achieve approximately a 96% total emissions reduction over old diesels and clean diesel buses achieve approximately a 95% total emissions reduction over old diesels.

OTHER IMPACTS

Hybrid-Electric buses account for approximately 65% of the DASH fleet since a move to this technology was adopted in 2011. This fleet has made a substantial impact in reducing our environmental impact and improving the rider experience.

Since that time, however, hybrid technology has been found to be substantially less reliable and more costly to maintain. Clean Diesel in the same time period has accomplished significant emissions reductions and substantially improved reliability over hybrids. The total cost of ownership has also become significantly less due to a consistent pattern of lower fuel costs.

Table 1
Bus Capital Costs and Average Life of Vehicle

	Clean Diesel	Hybrid
Capital Cost	\$480,000	\$700,000
Life of Vehicle	12 Years	12 Years
Mid-Life Battery Pack Replacements	<i>Not Required</i>	\$50,000
12 Year Capital Cost	\$480,000	\$750,000

Table 2
Two Year Look Back DASH Actual Maintenance Costs

Diesel Bus	\$1,665,794
Hybrid Bus	\$1,750,998

Data Reliability Note: *There are 9 more hybrids than diesels in this comparison, however 6 of those Hybrids are brand new 2017 Model Year and were not included in the sample. True margin of error in data is +/- 3 buses.*

The original decision to switch to hybrids included other social and environmental factors such as noise reduction and improved fuel economy. The switch to Clean Diesel will carry similar benefits over the buses they replace thanks to major improvements in technology, noise reduction and emission controls. In fact, Clean Diesel is rated as 15% quieter than the old diesel buses they replace, while Hybrids are rated as 18% quieter.

The transition to Clean Diesel technology allows DASH to purchase more buses, more quickly, and more reliably. This significantly speeds the replacement of equipment that has exceeded its useful life and does not comply with modern environmental emissions standards. An estimate of the change in vehicle quantity from currently allocated (existing) funding is an increase from approximately seventeen (17) buses to approximately twenty-seven (27).

Table 3
Fuel Consumption and Fleet MPG

CLEAN DIESEL PROGRAM											
Fleet Composition	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Old Diesels	34	14	8	0	0	0	0	0	0	0	0
Hybrids	52	52	52	52	52	52	52	37	27	27	20
Clean Diesels	0	20	26	28	28	28	28	43	53	53	60
Electric	0	0	0	6	6	6	6	6	6	6	6
Overall Fleet MPG	4.23	4.62	4.75	5.19	5.19	5.19	5.19	5.21	5.23	5.23	5.24
Fuel Consumption (gal)	472,710	432,843	420,883	385,002	385,002	385,002	385,002	383,579	382,629	382,629	381,965

HYBRID PROGRAM											
Fleet Composition	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Old Diesels	34	20	16	10	4	0	0	0	0	0	0
Hybrids	52	66	70	76	82	86	86	86	86	86	86
Clean Diesels	0	0	0	0	0	0	0	0	0	0	0
Electric	0	0	0	0	0	0	0	0	0	0	0
Overall Fleet MPG	4.23	4.48	4.56	4.68	4.81	4.90	4.90	4.90	4.90	4.90	4.90
Fuel Consumption (gal)	472,710	446,132	438,538	427,148	415,757	408,163	408,163	408,163	408,163	408,163	408,163

TRANSITION TO ELECTRIFICATION

As a part of the resolution passed by the DASH Board, a commitment has been made to adopt electric bus technology as soon as possible. The DASH General Manager has indicated his intention to work closely with the EPC to evaluate when and how this transition may be possible. Further, funding applications in the future will prioritize electric technology and ensure facilities and staff is equipped to support the equipment.

Staff is preparing the FY 2019 to FY 2028 CIP which will be proposed to Council in February 2018 and which will reflect an eventual conversion technically and as financially feasible to electric buses. DASH staff will continue to work with the Environmental Policy Commission (EPC) to evaluate opportunities and constraints.

ATTACHMENTS:

Attachment 1: Alexandria Transit Company Resolution, November 8, 2017

Attachment 2: EPC Letter

cc: Paul R. Abramson, Chairman, Alexandria Transit Company Board

Table 4
Comparison of Hybrid Buses to Low-Emission, Clean Diesel

Hybrid Buses	Clean Diesel	Neutral
Fuel Savings: Hybrids are slightly more fuel efficient, weight affects true performance	Fuel Savings: Modern clean diesels are lighter and more fuel efficient	Fuel Savings: Fleet net improvement over current regardless of bus technology
Emissions: 96% reduction	Emissions: 95% reduction	Emissions & Public Health Benefit: 1% variance, Net benefit regardless of technology due to fleet wide improvements
Fuel Cost Uncertainty: A major increase in fuel prices could cause MPG variance to have a larger impact for Diesels.	Capital Cost: Clean Diesel is less costly to purchase and maintain	Acceleration: Sufficient for application using either technology
Noise Reduction: low noise due to electric drive train	Noise Reduction: significant reduction in noise as compared to old diesels they replace	Customer Satisfaction: Clean, new fleet, smoother ride and best public image
	Reduced Maintenance: Fewer complex systems reduce downtime and reliability issues	Eco-City: Both technologies meet Eco-City Charter
	Maintenance Expertise: DASH staff are able to repair & rebuild in house	
	No Battery Replacement: Lower ongoing capital costs (~\$50k savings per bus)	

Resolution Supporting the Recommendations of the Alexandria Transit Company General Manager for Purchase of Clean Diesel Buses

BE IT RESOLVED by the Alexandria Transit Company Board of Directors (Board) that the Board hereby supports the General Manager's **recommendation to adopt a policy of purchasing Clean Diesel Buses for all bus replacement procurements on the basis that Hybrid-Electric Technology** is no longer economically responsible and Clean Diesel technology meets the goals of Eco-City Alexandria. Further, BE IT RESOLVED that the Board endorses a gradual transition to all electric (Battery Powered) buses as soon as it is technically and financially possible. As the Alexandria Transit Company recognizes its role as a part of Alexandria's Eco City Charter, it endorses all efforts previously made and conducted in the future towards a goal of Environmental Sustainability.

BE IT RESOLVED that the Alexandria Transit Company certifies that it will make every effort to adopt electric bus technology as soon as possible, while maintaining a focus on service quality and being a good steward of public funds. It is the request of the Alexandria Transit Company Board of Directors that The Alexandria City Council prioritize funding wherever possible towards the Alexandria Transit Company bus fleet replacement program and expansion programs with electric bus technology as a priority.

The undersigned duly qualified and acting Chairman of the **Alexandria Transit Company** certifies that the foregoing is a true and correct copy of a Resolution of the Board of Directors has adopted at a legally convened meeting of the Alexandria Transit Company held on the Eighth day of November, 2017.


(Signature of Recording Officer)

CHAIRMAN, ATL
(Title of Recording Officer)

November 8, 2017
(Date)



November 4, 2017

Honorable Mayor Allison Silberberg and Members of City Council
City Hall
301 King Street
Alexandria, VA 22314

Re: DASH Clean Diesel Conversion Plan

Dear Mayor Silberberg and Members of Council:

The Alexandria Transit Company (DASH) has asked the Environmental Policy Commission (EPC) to support DASH's: 1) Short term plan to purchase 27 clean diesel buses (i.e. replacing approximately one-third of DASH's current fleet) using presently available capital funds (i.e. ~ \$13 million); and 2) Longer term Proposed Clean Diesel Conversion Plan ("Conversion Plan") that is intended to address future fleet needs. We have greatly appreciated the significant amount of time that DASH has spent answering EPC's questions and the spirit of collaboration that they have brought to this important investment decision.

DASH leadership and its Board have stated that a future goal is the "gradual transition to all electric (Battery Powered) buses as soon as it is technically and financially possible."¹ We commend and support this goal, but have not seen evidence that DASH has yet meaningfully evaluated how it would make such a transition. Until DASH evaluates the electrification of the bus fleet with the same detail and thoroughness as hybrid and clean diesel technologies, the Commission is unable to support DASH's full request.

Instead, the EPC supports the purchase of only seven (7) clean diesel buses to replace the oldest and dirtiest diesel buses in DASH's fleet (one 2000 Model Year (MY) and six 2002MY).² Doing so would reduce harmful emissions and move towards achieving State of Good Repair (SGR) in the short term, while preserving the majority of available capital funds until DASH and the City can make a well-informed decision on the feasibility of purchasing electric buses. As such, the EPC advises Council against any additional financial commitment to clean diesel or hybrid technology at this time.

It is worth noting that DASH has presented a well-reasoned and supportable argument that pursuing clean diesel in lieu of hybrid buses will yield better outcomes with respect to certain environmental, fiscal, and operational impacts over the operational life of the new buses. The

¹ DASH Board Resolution for Hybrid vs. Clean Diesel Proposal by General Manager, p. 17 (Handout from October 2017 DASH Board Meeting).

² DASH noted in an email dated October 30, 2017 that the 27 new clean diesel buses would replace those from the oldest buses in the fleet, presumably 1 2000MY, 6 2002MY, 14 2005MY, and 6 2007MY.

data appears to indicate that purchasing new hybrid buses no longer makes sense for the City.³ However, EPC's preliminary research on the feasibility of electric buses shows that transitioning to electric now may be feasible, even under current fiscal and operational constraints, and doing so would include significant ancillary benefits for the City and its residents.⁴

The Commission provides the following additional recommendations to DASH and Council.

1. **Request for Information.** Issue a Request for Information ("RFI") to solicit input on various topics associated with electrifying the bus fleet, including financing options for purchasing electric buses, costs and requirements associated with installing and maintaining associated infrastructure, and any implications for the local grid to support the new infrastructure. Ideally, DASH would establish connections and receive interest and input from electric bus manufacturers, electric utilities (i.e. Dominion), and other organizations with experience in electric bus systems.
2. **Financing Options.** Identify possible funding mechanisms for large-scale acquisition of electric buses and associated infrastructure upgrades.⁵ The upfront sticker price of an electric bus is significantly higher than either a clean diesel or hybrid, and the current strategy to purchase buses outright with capital funds is a hindrance in making electric buses a viable option to meet DASH's State of Good Repair requirements under current CIP funding levels. However, as noted in the Columbia University study (note 4), there are other ways to approach bus purchases, including factoring in savings from reduced lifetime operation and maintenance costs. Electric bus manufacturers are offering financing options through which electric buses are available for roughly the same up-front price as diesel buses, allowing transit agencies to fit electrification with their current capital and operating budgets by applying the operating cost savings vs diesel toward a battery lease payment. EPC encourages DASH to leverage expertise on City staff to explore these various calculation methods, discuss financing options with electric bus manufacturers or other organizations similarly situated via the RFI or by other means, to tailor existing analysis of these topics to DASH's specific constraints.
3. **Complete Cost/Benefit Profile.** Incorporate the positive externalities associated with electrifying the bus fleet (significant reduction in greenhouse gas emissions, elimination of particulate matter and NOx emissions leading to reduced impacts to human health and the local environment, etc.) when making this long term decision, with a particular focus on those factors that can be quantified as cost reductions or net benefits to the City. For example, the social cost of carbon – a measure, in dollars, of the long-term damage done by a ton of carbon dioxide emissions in a given year – is a way to quantify and compare this societal cost between clean diesel, hybrid, and electric buses. EPC would like an evaluation of greenhouse gas emissions impacts to factor into bus fleet and other decisions the City considers.

³ DASH's analysis is reinforced by external studies and decisions by other jurisdictions to move away from hybrid technology in favor of clean diesel as a bridge to electric buses.

⁴ See Aber, Judah, Columbia University, "Electric Bus Analysis for New York City Transit" (May 2016), concluding that conversion to an all-electric bus fleet, made possible by capitalizing the operations and maintenance cost savings associated with electric buses, "would provide an improvement in overall lifetime bus cost to the city, while reducing greenhouse gases appreciably, and significantly improving the health of NY City residents, and lowering their cost of healthcare."

⁵ Under the current Conversion Plan, DASH intends to pilot an electric bus program in 2020 by purchasing 6 electric buses with VW Mitigation funds awarded through Virginia DEQ. While certainly a worthy use of these funds, EPC cautions against characterizing the reliance on external, temporary funding sources like this when creating a long-term strategy for electrifying the bus fleet.

4. **Alexandria's Commitment to be an Eco-City.** Consider how the Conversion Plan fits within the City's broader Eco-City commitments, including the Environmental Action Plan (EAP), the Energy and Climate Change Action Plan (CCAP), and the City's recent pledge to uphold goals embodied in the Paris Agreement under the United Nations Framework Convention on Climate Change.
- a. As you know, this fiscal year the Commission and City staff are concentrating efforts to update the Environmental Action Plan (EAP). Adopted in 2009, the EAP is the City's blueprint to implement and achieve the goals established in the Eco-City Charter. Given advances in clean bus technology, the current Conversion Plan could be viewed as a step back from these commitments.
 - b. In its 2011 CCAP Alexandria cited DASH's hybrid bus purchases as case in which the City was leading by example to "accelerate the goal of reducing fossil fuel use, greenhouse gas and particulate matter emissions, and environmental noise pollution."⁶ Electrification poses an opportunity to recommit to those goals.
 - c. By signing onto the Mayor's National Climate Action Agreement (MNCAA) in 2017, Alexandria committed to "intensify efforts to meet [its] current climate goals" and "push for new action to meet the 1.5 degrees Celsius target".⁷ Accelerating electrification of the DASH fleet is a means by which the City can intensify its efforts and push for new actions.

EPC applauds the work that DASH has completed so far in this process and believes that with some additional work to examine the feasibility of electrifying the bus fleet, DASH, the City, and its residents will be in the best position to make a long-term commitment on the direction of the bus system. EPC would welcome the opportunity to collaborate closely with DASH and City staff during the Capital Improvement Plan process that will reopen next fiscal year to develop a common vision for the transition to an electric fleet.

Thank you for your continued leadership and steadfast commitment to the City's Eco-City Charter.

Sincerely,



Jim Kapsis
Chair
Alexandria Environmental Policy Commission

⁶ City of Alexandria Energy and Climate Change Action Plan, p.41 (2011)

⁷ 382 US Climate Mayors commit to adopt, honor and uphold Paris Climate Agreement goals.
<http://climatemayors.org/actions/paris-climate-agreement/>