

NJ Transit Meadows Maintenance Complex and Rail Operations Center: Potential Electric Drive Vehicle Replacements

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Vehicle Replacement Analysis
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Analysis Task Background

- **New Jersey Transit has requested DOE input into potential Plug-in electric vehicle (PEV) replacements for vehicles at NJT's Meadows Maintenance Complex and Rail Operations Center (MMC&ROC)**
- **Information provided to DOE:**
 - **Odometer reading**
 - **Model year**
 - **Manufacturer**
 - **Model**
 - **Equipment use (On/Off road, sedan, hybrid, passenger van)**
 - **2 or 4 wheel drive**
- **DOE Goal: Identify vehicle types that would**
 - **Maximize all electric miles**
 - **Maximize petroleum reduction use**
- **Qualifier: DOE cannot recommend one vehicle or piece of equipment model or brand over a competing brand**

Assumptions Employed

- **Based on the information provided to DOE, the following assumptions are used:**
 - **Odometer data and model year were be used to calculate average miles driven per day**
 - **Specific per vehicle mission requirements are unknown**
 - **Therefore near identical vehicle models are presumed to be required**
 - **Replacements must have similar attributes: Sedan versus Sport Utility Vehicle (SUV) versus Van. And, 2 wheel versus 4-wheel drive)**
 - **There is a column marked “Replacement” that may be NJT’s capital funding expectation. However, this ignores savings from lower replacement fuel costs and lower maintenance costs, which can have significant life-cycle economic benefits**
 - **When Plug-in Hybrid Electric Vehicles (PHEVs) are recommended, it is assumed the first miles driven each day will be in electric mode**

Assumptions Employed – Cont'd

- The vehicle model year and odometer are used for annual mileage
- 225 annual working days used for daily miles driven
- Chevy Volt 's 38 all-electric miles and 37 mpg per DOE/EPA 2013 Fuel Economy Guide used to determine percent electric miles driven and gasoline miles driven
- The Fuel Economy Guide per each vehicle model year was used to determine mpg estimates for current fleet. Excess idling times may result in lower actual mpg
- Per INL testing experience, 3 miles per kWh efficiency is assumed for the Chevy Volt, which is the PEV sedan replacement example
- 9.38 cents per kWh used per the EIA Transportation electricity cost for New Jersey. Assumed NJT would be able to use same rate to recharge vehicles
http://www.eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_5_6_a
- \$3.20 per gallon used. Various sources and best guess as to NJT buying power

NJT Sedans Information

- The below information was provided to INL for the sedans in the NJT MMC&ROC fleet
- It is the basis of the sedans replacement analysis

Vehicle	Miles	Model year	Manuf	Model	Equip	User
C4143	168459	2004	DODGE	STRA	SEDAN	2WD
C8136	125189	2007	TOY	PRIU	SEDAN HYB	2WD
C5107	163244	2005	DODGE	STRA	SEDAN	2WD
C1110	75999	2001	CHEVY	MALIBU	SEDAN	2WD
C4101	154505	2004	DODGE	STRA	SEDAN	2WD

NJT Current Sedans Analysis

- The current fleet fuel use was determined by averaging the total miles over the age of each vehicle
- Average miles per day was based on a 225 day work year
- MPG was based on the Fuel Economy Guide for that year model
- Annual gasoline costs was based on an assumed \$3.20 per gallon cost

Manufacturer	Average Annual Miles	Miles per Day	MPG	Annual Gasoline Gallons	Annual Gasoline Costs
DODGE Strada	18,718	83	25	749	\$2,396
Toyota Prius	20,865	93	55	379	\$1,214
DODGE Strada	20,406	91	24.5	833	\$2,665
CHEVY Malibu	6,333	28	24.5	259	\$827
DODGE Strada	17,167	76	25	687	\$2,197

NJT Sedans Replacement Findings

- The total Chevy Volt fuel costs were determined and subtracted from current vehicle costs to determine fuel cost savings and gallons of gasoline saved
- The Toyota Prius should not be replaced as the Volt would have \$118 higher fuel costs. The other vehicles had cost savings from \$629 to \$1,373 (second column from the right)
- All other vehicles should be replaced with a Volt or similar PEV that has as high all electric miles and miles per gallon

Manufacturer	Percent Electric	Annual Electric miles	Percent Gasoline	Annual gasoline miles	kWh used	Gasoline used	Cost kWh Transportation	Cost / gallon Gas	Total Volt Fuel costs	Fuel Cost saving	Gallons Gas Saved
DODGE Strada	0.457	8,550	0.543	10,168	2,850	275	\$267	\$879	\$1,147	\$1,249	474
Toyota Prius	0.410	8,550	0.590	12,315	2,850	333	\$267	\$1,065	\$1,332	\$(118)	47
DODGE Strada	0.419	8,550	0.581	11,856	2,850	320	\$267	\$1,025	\$1,293	\$1,373	512
CHEVY Malibu	1.000	6,333	0.000	0	2,111	0	\$198	-	\$198	\$629	259
DODGE Strada	0.498	8,550	0.502	8,617	2,850	233	\$267	\$745	\$1,013	\$1,185	454

NJT SUV Information

- The below information was provided to INL for the SUVs in the NJT MMC&ROC fleet
- It is the basis of the SUV replacement analysis

Vehicle	Miles	Model year	Manuf	Model	Equip	User
B5237	115809	2005	DODGE	DURA	ON/OFF ROAD	4WD
B12111	21693	2012	FORD	ESCP	ON/OFF ROAD	4WD
B8155	62880	2008	FORD	ESCP	ON/OFF HYB	4WD
B2189	257676	2002	CHEVY	BLZR	ON/OFF ROAD	4WD
B8157	85416	2008	FORD	ESCP	ON/OFF HYB	4WD
B9112	105885	2009	FORD	ESCP	ON/OFF NON HYBRID	4WD
B5147	219007	2005	CHEVY	BLZR	ON/OFF ROAD	4WD

NJT Current SUVs Analysis

- The current fleet fuel use was determined by averaging the total miles over the age of each vehicle
- Annual gasoline costs was based on an assumed \$3.20 per gallon cost

Manufacturer	Average Annual Miles	Miles per Day	MPG	Annual Gasoline Gallons	Annual Gasoline Costs
DODGE Durango	14,476	64	16	905	\$2,895
Ford Escape	21,693	96	23.5	923	\$2,954
Ford Escape Hybrid	12,576	56	28	449	\$1,437
Chevy Blazer	23,425	104	17.5	1339	\$4,283
Ford Escape Hybrid	17,083	76	28	610	\$1,952
Ford Escape Hybrid	26,471	118	21	1261	\$4,034
Chevy Blazer	27,376	122	17	1610	\$5,153

NJT SUVs Replacement Analysis

- The 2013 Toyota Highlander hybrid was used for the analysis as it has the highest mpg (28) of any hybrid sport utility vehicle (SUV)
- Highlander HEV fuel savings and costs were determined
- The two Ford Escape Hybrids should not be replaced – no fuel savings. The other vehicles had fuel savings of \$475 to \$2,024
- The other five SUVs should be replaced with a Highlander or similar high mileage HEV SUV as there currently not any PEV SUVs available. Via Motors has announced upcoming PEV SUV during early 2014

Manufac-turer	Annual gasoline miles	Highlander 4x4 Gallons	Highlander Gasoline costs	Fuel Cost Savings	Gallons Gasoline Saved
DODGE Durango	14,476	517	\$1,654	\$1,241	388
Ford Escape	21,693	775	\$2,479	\$475	148
Ford Escape Hybrid	12,576	449	\$1,437	\$0	0
CHEVY Blazer	23,425	837	\$2,677	\$1,606	502
Ford Escape Hybrid	17,083	610	\$1,952	\$0	0
Ford Escape	26,471	945	\$3,025	\$1,008	315
Chevy Blazer	27,376	978	\$3,129	\$2,024	633

NJT Pickups Information

- The below information was provided to INL for the Pickups in the NJT MMC&ROC fleet
- It is the basis of the pickups replacement analysis

Vehicle	Miles	Model year	Manuf	Model	Equip	User
A11105	46115	2011	GMC	SIE	PICK UP 3M	4WD
A12419	3505	2013	GMC	SIE	PICK UP 3M	4WD
A5358	151609	2005	FORD	F350	PICK UP 6M	4WD
A6220	65899	2006	FORD	F250	PICK UP 6M	4WD
A9101	68374	2009	FORD	RANG	PICKUP TRUCK	2WD
A9225S	41695	2009	FORD	F250	PICK UP 3M	4WD

NJT Current Pickups Analysis

- The current fleet fuel use was determined by averaging the total miles over the age of each vehicle
- Annual gasoline costs was based on an assumed \$3.20 per gallon cost

Manufacturer	Average Annual Miles	Miles per Day	MPG	Annual Gasoline Gallons	Annual Gasoline Costs
GMC Sierra	23,058	102	18	1281	\$4,099
GMC Sierra	3,505	16	18	195	\$623
Ford F350	18,951	84	15	1263	\$4,043
Ford F250	9,414	42	14	672	\$2,152
Ford Ranger	17,094	76	20	855	\$2,735
Ford F250	10,424	46	15	695	\$2,224

NJT Pickups Replacement Analysis

- The 2013 GMC Sierra hybrid was used for the analysis as it has the highest mpg (21) of any hybrid 4 x 4 or 4 x 2 pickup
- Sierra HEV fuel use and costs were determined
- The current Sierras and Ranger should be replaced with a Sierra HEV or similar high mpg pickup
- It is assumed the three F250s and F350s are required to have a similar payload. Currently, no PEV or HEV exists with this payload.
- Via Motors has announced PEV conversion pickups may be available during early 2014, but no independent data is available

Manufac-turer	Annual gasoline miles	Sierra HEV 4x4 Gallons	Sierra HEV Gasoline costs	Fuel Cost Savings	Gallons Gasoline Saved
GMC Sierra	23,058	1,098	\$3,514	\$586	183
GMC Sierra	3,505	167	\$534	\$89	28
Ford F350					
Ford F250					
Ford Ranger	17,094	814	\$2,605	\$130	41
Ford F250					

NJT Van Information

- The below information was provided to INL for the Vans in the NJT MMC&ROC fleet
- It is the basis of the van replacement analysis

Vehicle	Miles	Model year	Manuf	Model	Equip	User
PC270	179538	2001	FORD	WIND	VAN PASS 5/7	PC270
B5152	118622	2005	DODGE	CRV	VAN PASS 5/7	B5152

NJT Current Van Analysis

- The current fleet fuel use was determined by averaging the total miles over the age of each vehicle
- Annual gasoline costs was based on an assumed \$3.20 per gallon cost

Manufacturer	Average Annual Miles	Miles per Day	MPG	Annual Gasoline Gallons	Annual Gasoline Costs
Ford Windstar	14,962	66	20.5	730	\$2,335
Dodge Caravan	14,828	66	21.5	690	\$2,207

NJT Pickups Replacement Analysis

- The 2013 Toyota Highlander HEV was used for the analysis as it has the highest mpg (28) of any hybrid that is capable of carrying up to 8 people as the current vans can
- Highlander HEV fuel use and costs were determined
- The current Windstar and Caravan should be replaced with a Toyota Highlander HEV or similar high mileage vehicle capable of carrying 8 people
- Currently, no HEV Van exists with the 8-passenger payload. However, Via Motors has announced PEV conversion Vans may be available during early 2014, but no independent data is available

Manufac-turer	Annual gasoline miles	Highlander HEV Gallons	Highlander HEV Gasoline costs	Fuel Cost Savings	Gallons Gasoline Saved
Ford Windstar	14,828	530	\$1,695	\$512	160
Dodge Caravan	14,828	530	\$ 1,695	\$512	160

NJT Miscellaneous Vehicle

- The below vehicle cargo payloads are unknown based on the information provided. Cargo bed access is unknown
- There are not any known high rail PEVs available
- The F350 also does not have a known PEV replacement
- The cargo trucks may have replacements from Smith Electric vehicles or Boulder Electric. These manufacturers should be contacted directly with specifications needs

Vehicle	Miles	Model year	Manuf	Model	Equip	User
N12427	2545	2014	FREIG	M2106	R78 CARGO TRUCK	WORK
N12428	3548	2014	FREIG	M2106	R78 CARGO TRUCK	WORK
N7802	102491	2007	STRL	ACTER	TRUCK CARGO	2WD
N8801	54699	2008	STRL	ACTER	TRUCK CARGO	2WD
V1069	8916	2011	FREIG	----	PRES VACCUM	2WD
E8233	57099	2008	FORD	F350	UTILITY 3M	4WD
N6902HK	24412	2006	FREIG	M112	STAKE KNUCKLE BM	WORK
S12128H	1289	2013	FORD	F550	TRUCK SERVICE	4WD

Other Vehicles

- **Cushman type utility – 27 units**
 - **It is unknown what the missions and payload requirements are for these vehicles, nor the distances traveled daily. Therefore, it is not possible to estimate replacement vehicles. Examples of similar vehicles the INL/DOE has tested can be found at: <http://avt.inel.gov/nev.shtml> The information includes charging times, range and other performance specifications**
 - **Neighborhood electric vehicles (NEVs) that the INL has tested, which is the same class as the Cushmans, have seen actual field use as Air Force base fire trucks, ambulances, and other first responder vehicles, as well as patrol vehicles, and general utility vehicles**

Other Vehicles

- **Fork Lift – 26 units**
 - **The current United States market is 60% electric. So, options exist but the payload and operating environments are unknown for the lifts in the NJT fleet**
- **Scissor Lifts – 36 units**
 - **Information on payloads and heights were not provided. However, a Google search indicates many electric options are available, with prices ranging from \$285 per unit to \$22,750 per unit for various different functionalities**
- **Walk behind Lifts – 6 units. Functionality and requirements are again not known**

Analysis General Discussion

- **Average daily mission needs and miles driven can only be estimated given the current level of knowledge**
- **DOE and INL has various processes for more in depth fleet replacement studies. However, resources and additional time are required to complete this process**
- **For instance, the Micro Climate assessment process includes:**
 - **Data loggers can be placed on individual vehicles to calculate idling times, actual daily miles driven, minimum and maximum miles driven, and actual current mpg. All of this can vary significantly within the same vehicle class**
 - **Existing electric infrastructure drawings can determine suitable placement and charging infrastructure levels**
 - **Travel patterns and rest locations can identify charging locations**
- **Given the time and funding level constraints, available data was used to identify potential PEV and partial electric drive vehicle replacements.**

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