Technical Documentation – Volume Three

Fleet Transformation Strategy

SUSTAINABLE Raleigh

City of Raleigh
Climate/Energy Action Plan
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City of Raleigh Climate/Energy Action Plan
Comprehensive Fleet Transformation Strategy – Initial Step

One of the top CEAP strategies is Strategy FLT-1-10: Increase City Fleet Alternative Fuel Vehicles. Under this strategy, the City's fleet would continue to be replaced with alternative fuels and/or hybrid vehicles when it is deemed that the optimal life cycle of the existing vehicle has been reached. Enhancements to this strategy will require some additional information. The purpose of this Volume is to provide background information and a list of data that will be needed to develop a decision support system that would facilitate the execution of this strategy.

Working to lower emissions and operating costs, a comprehensive fleet management program will examine the full lifecycle of vehicles to determine when it is best to retire, repair, or replace vehicles in favor of cleaner, more efficient options. This strategy will provide a decision support system to measure the existing performance and operating cost of individual vehicles to determine at which point in time, either now or in the future, it would be best to replace the vehicle, maintaining the optimal lifecycle of the existing asset while minimizing overall emissions. The strategy involves understanding many things including the average life, emission factors, cost of a vehicle over its lifecycle, and time replacement relative to the maintenance and repair cost versus that of new technology. Using both statistical modeling and decision analysis, individual vehicles in a fleet can be evaluated as part of the entire fleet, in order to minimize the actuarial present value of all future costs associated with the fleet, and thus the long-term consumption of scarce resources.

Implementation of this decision support system will provide a scientific analysis to aid in the establishment of fleet management policies including defined guidelines for what equipment is best for what use, as well as the lifecycle costs and emissions threshold that trigger retire, repair, or replace decisions for the existing fleet. It will be necessary to generate defined data and apply the tool to analyze how to minimize the future costs and emissions associated with the fleet, and thus the long-term impacts of operating suboptimal equipment.

The result will ultimately be a vehicle decision support system that manages the obsolescence, retirement, and replacement of vehicles as they age, while maximizing the useful life of each vehicle.

Methodology

This decision support system (DSS) will monitor key economic costs associated with not owning a new, more efficient, replacement vehicle. Data will be used to support decisions which minimize the actuarial present value of all such future costs for each individual vehicle, and its successors, using the method described in "Obsolescence Risk and the Systematic Destruction of Wealth" (T.E.Wendling, Society of Actuaries, 2012). This method minimizes the future costs of vehicle assets when aggregated across an entire fleet. The primary purpose of this data collection is to enable quantification of the following economic costs:

- Opportunity costs of newer vehicles
  - Lower energy consumption, lower fuel costs, lower routine maintenance requirements, lost tax shelter from expired depreciation, and any opportunity costs associated with not having a newer replacement vehicle
- Unscheduled repair costs
  - These become greater in frequency and severity as the vehicle ages
- Expected loss costs
  - Any estimated costs associated with potential down time due to the vehicle becoming less reliable as it ages

This approach requires continuous, ongoing data collection to achieve a comprehensive fleet transformation process, rather than just a one-time initial investment in new vehicles. As the vehicles age, and as new technology becomes available, this Decision Support System continuously generates decisions about which vehicles to replace, when, and with what type of vehicle. This requires at least an annual review of new technology available on the market, and quarterly to semi-annual review of the data being recorded by this system, in order to schedule vehicles for replacement. All of this activity minimizes the sum of the replacement costs and the operating costs being measured. It also selects the right number of vehicles to be in the initial investment. Understanding the challenges associated with collecting data across multiple departments, comprising a fleet of more than 2,000 vehicles, this methodology outlines a scaled approach and examines "good", "better", and "best" data sets for analysis. The data sets will have a level of granularity corresponding to each vehicle on an individual basis. This allows for flexibility in preparing to implement the program.

"Good" Data Set

The minimum data needed to conduct the program will provide for broad calculations that will drive better decisions about repair and replacement of the fleet. Total emission reductions and total long-term cost reductions would be expected to be forecasted to be within about the 15 percent range of actual. Data needed for "good" analysis includes a one-time collection of the following:

- Annual maintenance costs per vehicle
- Total mileage and fuel usage for one calendar year for each vehicle
- Year the vehicle entered the fleet

It is critical that all data points are recorded at the level of granularity corresponding to each vehicle. These data points can be recorded by Fleet staff in a spreadsheet format.

"Better" Data Set

Additional data will allow for further comparison of existing fleet performance against replacement options, resulting in fewer variances in the forecasting of future costs for the existing vehicle repair and maintenance. Total emission reductions and total long-term cost reductions would be expected to be forecasted to be within about the 10 percent range of actual. Data needed for "better" analysis includes two to three years of collection of the following:

- Annual routine maintenance costs (parts and labor) per vehicle (oil changes, replacing timing belt, replacing tires, and other manufacturer-recommended maintenance tasks)
- Annual non-routine maintenance costs (parts and labor)
- Annual time spent in service shop (total days)
- Odometer mileage at end of each year
- Daily log detailing destination, task, and miles driven
- The depreciation schedule used for the vehicles
- Total rental costs for use during vehicle repair or out of town travel

As above, it is critical that all data points are recorded at the level of granularity corresponding to each vehicle and can be recorded by Fleet staff in a spreadsheet format.

"Best" Data Set

The "best" data set for analysis would be generated through a systematic, ongoing, real-time collection of the data through a Computerized Maintenance Management System (CMMS), programmed to capture the data outlined above. Total emission reductions and total long-term cost reductions would be expected to be forecasted to be within about the 5 percent range of actual. The CMMS is described further below.

Data Development

Operational and policy information will also be needed to implement the program, as follows:

Individual Vehicle Operational Information	Relevance
General vehicle data	A basic inventory of the existing fleet is required to conduct analysis
Define each vehicle's primary and secondary (if any) use: ▪ **Passenger** ▪ **Light duty**: Transportation of equipment, field vehicle, occasional light load hauling up to 14,000 lbs ▪ **Medium duty**: Some hauling of light equipment and materials from 16,000 to 26,000 lbs. ▪ **Heavy duty**: Large load hauling from 26,000 to 33,000 lbs ▪ **Specialty purpose equipment**, i.e., trailer ▪ **Public Safety**: Police, Fire, EMC	Understanding the percentage of time that a vehicle is used for a specific type of task helps establish the optimal ratio of the varied vehicle types
Questions to be answered for each vehicles: ▪ What exact tasks and assignments is the vehicle is used for? ▪ Could an alternative, more efficient vehicle function just as well as the existing vehicle (consider a compact car instead of a pick-up truck?) ▪ Are there uses for which only a 4-wheel drive vehicle is suitable? Which vehicles in the fleet require such needs? ▪ Which vehicles could be shared or pooled?	Based on each individual vehicle's usage, significant cost savings and emissions reductions may be gained Defines possibilities for optimizing and "leaning" the fleet's larger vehicles May identify the need for route optimization software or radio meters that could reduce vehicle usage
Type(s) of fuel used for each vehicle	Needed to project and compare total cost and emissions for retire, repair, or replace decisions

<table>
<tr><th>Policy and Purchasing Information</th><th>Relevance</th></tr>
<tr><td>Fleet polices and agreements</td><td rowspan="4">Understanding the practices, policies, and purchasing arrangements that support the existing fleet will provide operational data critical to determining and forecasting life cycle costs for retire, repair, or replace decision</td></tr>
<tr><td>Fuel purchasing methods, costs, and agreements</td></tr>
<tr><td>Vehicle purchasing methods, costs, and agreements</td></tr>
<tr><td>Existing fleet maintenance and operational practices including maintenance facility operations and support assets such as fueling stations</td></tr>
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Implementation Utilizing a Computerized Maintenance Management System

The advantages of using a Computerized Maintenance Management System (CMMS) in a comprehensive fleet transformation analysis include:

- Fewer data discrepancies
- Ongoing measurements of the costs described above
- Analyses can be conducted at any point, providing more insight when making critical decisions throughout the year about a specific vehicle
- Allows development of accurate savings created during the years following implementation of the decision support system
- Better synchronization with the natural mortality of vehicles
- Corroboration of actual savings in fleet costs to demonstrate the return on investment in new vehicles
- Scheduling, tracking, and optimizing routine maintenance costs to extend the natural life of vehicles

If modification of an existing CMMS is needed or a new CMMS is required, it must be configured for the following capabilities:

- Continuous monitoring of the economic costs associated with not having a newer, more efficient replacement vehicle
- Management, scheduling, and control of preventive, predictive and corrective maintenance tasks, costs, and frequencies
- Detailed equipment maintenance and replacement histories of vehicles
- Maintaining a spare parts and materials inventory system
- Automatic generation and issuing of work orders
- Tracking equipment performance, service history, repair warrantees, repair costs, installation dates, and replacement values
- Potential interfacing with finance department data

Replacement with Most Efficient New Technology

The method used in this decision support system will consider the advantages of new and emerging technology on a continuous basis. For example, as soon as the efficiencies of a new hybrid vehicle become apparent, these potential savings are entered into the CMMS and then used to support decisions as to whether or not to replace a vehicle, in real time, while also considering:

- Other operating costs
- Vehicle emissions
- The cost of the newer replacement vehicle
- The uncertainty of how long the newer replacement vehicle will be owned

Summary

Implementation of this decision support system will provide a scientific analysis to aid in the establishment of fleet management policies including defined guidelines for what equipment is best for what use, as well as the lifecycle costs and emissions threshold that trigger retire, repair, or replace decisions for the existing fleet. The result will ultimately be a vehicle decision support system that manages the obsolescence, retirement, and replacement of vehicles as they age, while maximizing the useful life of each vehicle.

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