



KING COUNTY

1200 King County Courthouse
516 Third Avenue
Seattle, WA 98104

Signature Report

December 8, 2015

Motion 14479

Proposed No. 2015-0401.1

Sponsors Dembowski

1 A MOTION approving a report by the fleet administration
2 division on the role of alternative fuel technology fleet
3 vehicles in achieving King County's greenhouse gas
4 reduction goals as required in the 2015/2016 Biennial
5 Budget Ordinance, Ordinance 17941, Section 125, Proviso
6 P1.

7 WHEREAS, in accordance with K.C.C. 2.16.140.D., the fleet administration
8 division is responsible for acquiring, maintaining and managing the motor pool and
9 equipment revolving fund for fleet vehicles and equipment including, but not limited to,
10 vehicles for the department of natural resources and parks, facilities management
11 division, and transportation nonrevenue vehicles, and

12 WHEREAS, the fleet administration division provides fleet support services to
13 most county agencies, and

14 WHEREAS, efficient and effective management of a fleet of diverse vehicles and
15 equipment is the core business of the fleet administration division, and

16 WHEREAS, the fleet administration division uses data-driven decision making
17 and fleet management best practices to provide cost effective and environmentally
18 responsible vehicles for its client agencies, and

19 WHEREAS, the county has shown leadership in the acquisition and use of
20 alternative fueled and advanced technology vehicles, and

21 WHEREAS, the use of alternative fueled and advanced technology vehicles
22 represents an important contribution to reduce greenhouse gas emissions generated by the
23 operation of county vehicles, consistent with the King County Strategic Plan and the
24 county's 2015 proposed update to the Strategic Climate Action Plan, and

25 WHEREAS, the introduction of new alternative fueled and advanced technology
26 vehicles requires special considerations, such as range of vehicle, currently available or
27 needed fueling or charging infrastructure, time required to refuel or charge the vehicle,
28 and expected maintenance and repair requirements and intervals, and

29 WHEREAS, the 2015/2016 Biennial Budget Ordinance, Ordinance 17941,
30 Section 125, Proviso P1, adopted in November 2014, directed the executive to transmit to
31 the council by September 30, 2015, for approval by motion, a report on the role of
32 alternative fuel technology fleet vehicles in achieving King County's greenhouse gas
33 reduction goals;

34 NOW, THEREFORE, BE IT MOVED by the Council of King County:

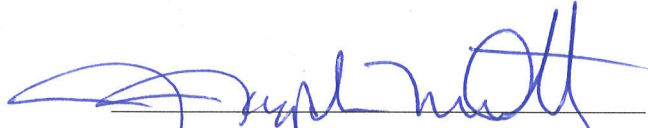
35 The report titled The Role of Alternative Fuel Technology Fleet Vehicles in
36 Achieving King County's Greenhouse Gas Reduction Goals, included as Attachment A to
37 this motion, evaluating the barriers to acquiring alternative fuel technology vehicles,
38 options for connecting vehicle replacement policies and actions to the county's Strategic
39 Climate Action Plan and the greenhouse gas reduction goals and options for uniform

40 policies and funding to support alternative fuel technology vehicle acquisition is hereby
41 approved.
42

Motion 14479 was introduced on 11/2/2015 and passed by the Metropolitan King
County Council on 12/7/2015, by the following vote:

Yes: 8 - Mr. von Reichbauer, Mr. Gossett, Ms. Hague, Ms. Lambert,
Mr. Dunn, Mr. McDermott, Mr. Dembowski and Mr. Upthegrove
No: 0
Excused: 1 - Mr. Phillips

KING COUNTY COUNCIL
KING COUNTY, WASHINGTON



Larry Phillips, Chair

ATTEST:



Anne Noris, Clerk of the Council

Attachments: A. The Role of Alternative Fuel Technology Fleet Vehicles in Achieving King County's
GHG Reduction Goals - September 2015

**The Role of Alternative Fuel Technology Fleet Vehicles
in Achieving
King County's GHG Reduction Goals**

Prepared for:

**King County Executive
King County Council**

Prepared by:

Fleet Administration Division

September 2015



King County

**Fleet Administration Division
Department of Transportation**

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INTRODUCTION

Fleet Administration is responsible for approximately 2,500 vehicles that support County government operations. These vehicles range from small motorized carts that operate within parks and wastewater plants to large dump trucks and other heavy construction machinery that support road operations. Ordinance 17941, Section 125, Proviso P1, in the 2015-2016 budget directed the Executive to transmit a report “regarding the role of alternative fuel technology fleet vehicles in achieving King County’s greenhouse gas reduction goals...”

As specified in the proviso, this report is informed by the proposed 2015 Strategic Climate Action Plan (SCAP) and the King County Auditor’s performance audit of the King County 2012 Strategic Climate Action Plan. It includes an evaluation of the barriers to acquiring alternative fuel technology vehicles; options for connecting vehicle replacement policies and actions to the SCAP greenhouse gas (GHG) reduction goals; potential uniform policies to guide alternative fuel technology vehicle acquisitions; and finance and funding tools to help agencies purchase alternative fuel technology vehicles.

For the purpose of this report and consistent with the updated SCAP, alternative fuel vehicles refer to vehicles that run on alternative fuels including electricity, biofuels, compressed natural gas, liquefied natural gas, hybrid, plug-in hybrid, battery drive, or propane.

Consistent with the proviso, this report focuses on the utilization of alternative fuel technology vehicles managed by Fleet Administration Division. However, it should be noted that a comprehensive approach to reducing GHG emissions from the transportation sector that include reduction in vehicle miles traveled and carbon intensity of fuels is essential to meeting overall GHG reduction goals.

Fleet Administration is structuring its strategic goals, sustainability planning and business practices to align with the goals, targets, and strategies in the 2015 SCAP. Consistent with the proviso, this report describes policy options and approaches that Fleet Administration intends to use to guide the purchase, replacement, and utilization of alternative fuel technology vehicles as part of achieving the County’s GHG reduction goals identified in the SCAP.

King County GHG Reduction Goals

The overall goal for reducing GHG emissions in King County, based on guidance in the 2014 Countywide Planning Policies and recommendations in the proposed 2015 SCAP update is to reduce countywide sources of greenhouse gas emissions, compared to a 2007 baseline, by 25 percent by 2020, 50 percent by 2030, and 80 percent by 2050.

The supporting target for County operations is to reduce total greenhouse gas emissions from government operations, compared to a 2007 baseline, by at least 15 percent by 2015, 25 percent by 2020, and 50 percent by 2030.

King County Performance Audit of the 2012 SCAP

In 2014, the King County Auditor’s Office (KCAO) completed a Performance Audit of the 2012 SCAP. The two findings most applicable to evaluating the role of alternative fuel technology fleet vehicles in achieving King County’s greenhouse gas reduction goals are that:

- The 2015 SCAP should establish explicit, and whenever possible, quantifiable connections between the overarching climate goals and specific strategies and actions.
- The County Executive should ensure that: (a) the 2015 SCAP incorporates verifiable economic analysis of the cost-effectiveness of current and potential actions to reach SCAP targets, and

(b) subsequent SCAP annual reports provide explicit information about progress toward the overarching climate targets and goals.

Additional Drivers for Adopting Alternative Fuels and Vehicle Technologies

The main drivers for adopting alternative fuels and advanced vehicle technology are the environmental benefits they provide and the life cycle cost savings that result from fuel efficiency and lower maintenance costs. With transportation accounting for a large share of the GHG emissions in County operations, curtailing energy use in this sector is important and a 10 percent reduction in energy use in non-Transit fleets over the next five years will result in the reduction of over 2,700 metric tons of CO₂ per year during that period. Finally, addressing the County's value of equity and social justice is an important consideration. Reducing energy consumption and the associated GHG and other harmful tailpipe emissions will improve health outcomes for many members of the population who suffer heightened exposure to vehicle exhaust emissions because they live in low-income housing located next to major arterials and highways.

By continuing to integrate low carbon fuels and clean vehicles into its fleets, King County is positioned to maintain its leadership in transforming the market and creating demand for alternative fueled technology vehicles in the region.

Relationship of Fleet Operations to GHG Reduction Goals

To understand what it would take to achieve adopted countywide GHG targets, King County and city partners collaborated with Climate Solutions' New Energy Cities Program in 2014 to establish specific, quantifiable pathways towards making a 50 percent reduction in GHG emissions by 2030. This analysis began by assessing how existing major federal and state actions will contribute to local GHG emissions reductions over the next 15 years. Figure 1 depicts the level of GHG emissions reductions associated with implementation of existing and anticipated federal and state policies and actions, including federal Corporate Average Fuel Efficiency (CAFE) standards, which require automakers to improve the fuel efficiency of vehicles produced for sale in the US.

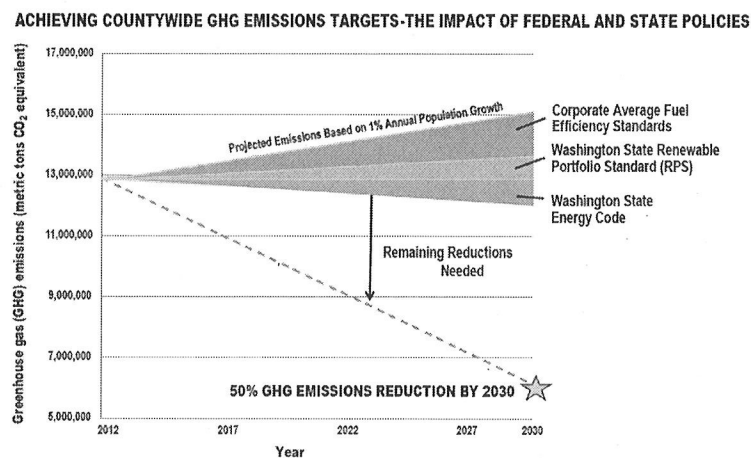


Figure 1: Federal and State Policy Impacts on 2030 GHG Emissions Reduction Goals

After assessing the impact of federal and state policies, the K4C and New Energy Cities analyzed a set of local pathways to close the remaining emissions reductions gap and get the region on track to a 50 percent reduction in GHG emissions by 2030. Figure 2 (below) summarizes K4C pathways that would close the GHG emissions gap identified in Figure 1.

ACHIEVING COUNTYWIDE GHG EMISSIONS TARGETS-THE IMPACT OF K4C PATHWAYS

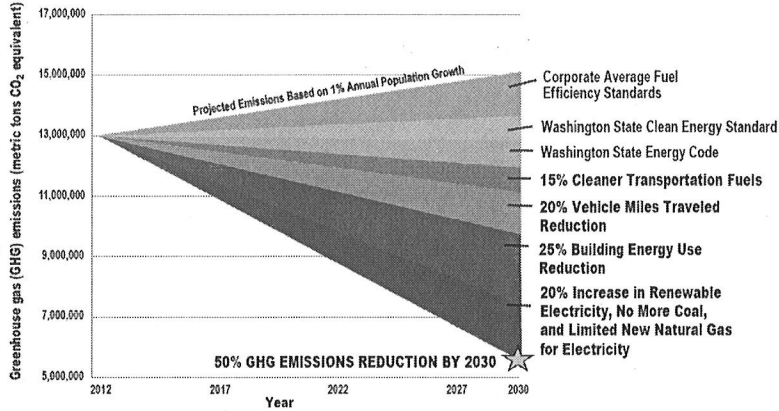


Figure 2: The Impact of K4C Emissions Targets on 2030 Emissions Goals

SCAP GOALS, STRATEGIES, MEASURES AND TARGETS RELATED TO COUNTY FLEETS

The updated SCAP includes the following goal, implementing strategies, and targets related to operation of its vehicle fleets:

Goal: King County will increase the efficiency of its vehicle fleets and minimize their greenhouse gas emissions.

CATEGORY	STRATEGY
<p>Alternative Vehicles, Fuels and Technologies</p>	<p>Strategy A: Use a life-cycle cost assessment, including a cost of carbon pollution, to integrate more fuel efficient vehicles and technologies into County vehicle fleets.</p>
	<p>Strategy B: Use proven alternative fuels that lower GHG emissions, where cost effective, with a priority focus on renewable energy or lower carbon intensity fuels.</p>
	<p>Strategy C: Pilot new alternative fuel programs and projects with a greater potential for reducing carbon intensity, especially when they provide opportunities to stimulate market growth</p>
	<p>Strategy D: Develop a priority list of alternative fuels with the best GHG benefits and lowest carbon intensity for reference by fleet managers during life-cycle cost assessments.</p>

Fleet Efficiencies	Strategy A: Leverage technology to maximize efficient vehicle use and implement operational strategies, such as anti-idling, fuel-saving driving techniques, car sharing, and vehicle rightsizing to reduce emissions.
	Strategy B: Conduct a countywide campaign encouraging employees to use alternative transportation, drive efficiently, and minimize resource consumption and energy use at work.

Measure 1: Energy use by County vehicles.

- **Target 1:** In its vehicle operations (excluding Metro Transit fleet vehicles), King County will reduce normalized net energy use by at least 10 percent by 2020, compared to a 2014 baseline.
- **Target 3:** Across all vehicle operations, King County will increase the usage percentage of alternative fuels in its fleets by ten percent by 2025, compared to a 2014 baseline. Alternative fuels include electricity, biofuels, compressed natural gas, liquefied natural gas, hybrid, plug-in hybrid, battery drive, or propane.

OVERVIEW OF CURRENT ALTERNATIVE FUEL VEHICLE TECHNOLOGIES

Hybrid Vehicles

Hybrid vehicles are internal combustion engine vehicles that use regenerative braking and large batteries to capture energy and increase the efficiency of the vehicle. Although they may not use alternative fuels, the advanced technology can provide significant fuel efficiency over regular vehicles. Hybrid vehicles have the advantage of not requiring special fueling infrastructure to support their inclusion in the fleet because they can be refueled at regular service stations using either gasoline or diesel fuel, depending on the vehicle type.

Because hybrids use unleaded or diesel fuel, they require no special fueling infrastructure and are well suited for the wide variety of King County’s geographical needs and job applications. Hybrid vehicles now make up one of the largest segments of alternative technology vehicles now in the division’s fleet—346 across all vehicles types and 17.4 percent of the on-road vehicle fleet as of June 2015. The technology is well suited for departments such as Public Health, the Assessor’s Office and the non-patrol vehicles in the Sheriff’s Office where members of the units travel many miles each day and service locations across the County. Hybrid applications have been shown to work well in the medium and heavy-duty truck fleet where we have had two bucket trucks, a roll-back truck, and a service truck. Some of these vehicles were acquired with the assistance of the Environmental Protection Agency (EPA) and the Congestion Mitigation and Air Quality Improvement (CMAQ) grant funding.

Mild Hybrids

In addition to full hybrid vehicles, some vehicle manufacturers are now introducing mild hybrid technologies into their internal combustion engine (ICE) units. These models provide some of the technologies and associated advantages found in hybrid vehicles, such as stop-start technology, without the high incremental purchase price of a full hybrid. Fuel economy gains from stop start technology, are typically in the region of five to ten percent. According to the International Council on Clean Transportation:

Another promising dimension is the development of mild-hybrid systems, which will likely provide one-half to two-thirds the fuel efficiency benefits of full-function hybrids at less than half the cost (German, J. International Council on Clean Transportation, July 2, 2015, pg. 2)

The fuel economy gains from the application of mild hybrid technology and other innovations to the ICE is important because, according to Navigant Research in a Q4 2014 publication, “although the use of alternative fuels and electric power is expected to continue growing, gasoline is anticipated to remain the leading fuel, with a strong trend toward stop-start vehicles.”

Electric Vehicles

Electric vehicles (EVs) are generally regarded as the ultimate low carbon technology vehicles especially in the Seattle City Light’s service area where the primary source of energy is renewable hydropower. According to Anair, and Mahmassani, in a 2012 Union of Concerned Scientists publication, “electric vehicles powered by a clean electricity grid offer a key pathway to achieving the greater than 80 percent reduction in global warming pollution we need by mid-century to avoid the worst consequences of climate change” (pg. 1). Fleet Administration Division is open to the use of EVs and already has six Nissan Leafs in the fleet.

Liquid Petroleum Gas (Propane or LPG) Vehicles

Fleet Administration currently has 20 LPG pickups and vans which were partly funded by a Clean Cities/DOE American Recovery and Reinvestment Act (ARRA) grant and with tax credit refunds returned to the County from the dealer. Cost of converting the vehicles ranged from about \$10,000 to just over \$15,000. Compared to gasoline and other fuels, LPG reduces operational costs and lowers emissions.

The propane vehicles were introduced into the fleet without much difficulty because of the following reasons:

- LPG is a fairly widely available alternative fuel and one of the less expensive fueling infrastructures to install because the tanks do not have to be stored underground and the fuel does not have to be stored under high pressures
- Propane vehicles have a lower maintenance cost and, in some cases, it is reported to have an engine life of up to two times that of gasoline engines. Fleet Administration is still monitoring the performance of these vehicles to document this fact
- Fueling a propane vehicle is similar to fueling a conventional vehicle and takes about the same amount of time. In addition, spillage and ground contamination are not concerns with propane because any fuel that might escape dissipates into the air quickly (<http://www.afdc.energy.gov/pdfs/46996.pdf>).

As reported to the Council in a 2014 document, the LPG pickups and vans that were deployed in the fleet starting in 2011 replaced specific working vehicles and assumed duty cycles in various divisions and departments of the County. Fourteen pickups are now in the Road Services Division with duty cycles that included servicing traffic signals and supporting road-maintenance tasks. Of the remaining six, four units are in the Parks and Recreation Division, one in Water and Land Resource Division, and one in Wastewater Division.

Fleet Administration plans to continue purchasing more propane vehicles to meet the demand for alternative fueled vehicles and as a way of meeting the SCAP 2020 and 2030 targets of fuels with reduced carbon intensity and lowering GHG emissions from County vehicles.

Hydrogen Fuel Cell Vehicles

Hydrogen Fuel Cell Vehicles (HFCVs) are the newest vehicle technology to be introduced to the American marketplace. Two car companies, Toyota and Hyundai now offer HFCVs for sale to the public but only in California. HFCV have a range of about 300 miles on a single fill-up and takes about five minutes to refuel but their widespread adoption in California is being hampered by the lack of an extensive fueling infrastructure and by the high price of the vehicles (about \$58,000 for the Toyota Mirai). In the case of the HFCVs, the premium on the up-front cost, so far, is much more than the other clean vehicle options already on the market.

BARRIERS TO ACQUIRING ALTERNATIVE FUELED TECHNOLOGY VEHICLES

The Cost of Emerging Technology

The new and emerging low and zero-emissions technologies are still very expensive to acquire and the high purchase price often creates a financial barrier for government agencies such as King County to overcome. Electric vehicles, hybrid electric vehicles, and vehicles that operate on propane and compressed natural gas (CNG), are some of the technologies that have been introduced into the King County fleet primarily as pilot programs. All of these advanced technology vehicles still remain significantly more expensive to purchase than comparable ICE vehicles with incremental costs ranging from \$5,000 for hybrid sedans to over \$50,000 for some medium and heavy-duty hybrid units. Even after 15 years on the market and reasonable market penetration, financing the premium purchase price of hybrid vehicles still requires careful planning. Below is a table showing the results of a Fuel and Capital Cost analysis that compares a medium sized ICE (Chevrolet Impala) to a comparable hybrid (Ford Fusion) over the life of the vehicles, 100,000 miles.

Fuel and Capital Cost Analysis Comparison of ICE Vehicle to Hybrid Vehicle

Items	Chevy Impala	Ford Fusion hybrid	Difference/Results
Initial Cost	\$20,609	\$ 26,100	\$ (5,491)
Lifetime vehicle fuel use (gal)	4,000	2,381	
Lifetime Cost of Fuel	\$ 12,000	\$ 7,143	\$4,857
Recovery of Initial Capital Cost			(\$ 633)

Table 1: Fuel and Capital Cost Analysis Results
2016 Chevy Impala vs 2016 Ford Fusion

Note: Fuel Rate (cost/gal) \$3.00.

It is important to note that this analysis includes the up-front purchase price and the cost for fuel, but does not consider the cost of carbon or maintenance costs, which can be lower for hybrid vehicles. In the absence of state and federal action to put a price on GHG emissions, it is difficult to integrate the environmental and economic costs associated with different decisions as they relate to GHG emissions. To address this gap in the near term, the updated SCAP recommends that the Office of Performance, Strategy and Budget collaborate with King County agencies to develop and propose an internal “cost of carbon” by the end of 2017. This cost of carbon will be used in life-cycle assessments and decision-making related to County operations, including for purchase of clean vehicles and alternative fuels, for facility construction and resource efficiency projects, and for related technology investments. King County will also pursue using the cost of carbon to inform broader County planning and decision-making.

The updated SCAP also recommends that the County conduct more comprehensive assessments of cost effectiveness: “Building on the pilot cost effectiveness assessment carried out to inform the 2015 SCAP, King County will pilot a cost effectiveness assessment for at least 12 ‘County Operations’ commitments, and provide this information as part of the first annual report on implementation of the 2015 SCAP and will inform future climate action planning” (pg. 36).

The Cost of Low Carbon Fuels

The potential high cost of some low carbon fuels is also a barrier. Biodiesel is a case in point. While Fleet Administration now has a standing order with suppliers to deliver B5 (5 percent biodiesel) whenever the biodiesel price is equal to or less than regular diesel, there were no deliveries in 2014 or any for the first half of 2015, because there weren’t any occasions when the price of biodiesel met the price specification for delivery. The countywide Fleet Managers group maintains close contact with procurement to identify options for getting the best prices for this and other transportation fuels. They will continue to explore all the avenues available to the County as a purchasing unit for getting the best prices possible for biodiesel.

Infrastructure

A barrier closely related to the higher purchase price of alternatively fueled and advanced technology vehicles is the potential cost of the fueling infrastructure. Today, most new technology vehicles do not have the extensive refueling infrastructure seen in gasoline powered vehicles, and without a broad refueling network, the range and utility of the vehicle is often limited. When assessing the barriers to adopting alternative technology and fuels, the prohibitive cost of some fueling infrastructure may overshadow the cost of acquiring the vehicles.

Establishing a network of fueling stations sufficient to support CNG or hydrogen fuel cell vehicles, for example, will not be possible without collaboration with larger partners such as the federal government and industry. Getting a single commercial CNG station up and running costs from \$1 to \$1.8 million (Clean Cities, US Department of Energy, 2014), and hydrogen fueling stations cost \$1.5 to \$7 million to construct (Eckerle, T, & Garderet, R., 2013). Presently, there are only four full service CNG stations in King County: two in Seattle, one at Sea Tac, and one in Bellevue. Additionally, there is a fueling facility at the World CNG corporate office in Kent that is open until 5:00 p.m. (see Appendix A). Establishing a wide network of CNG or hydrogen stations in suitable locations to support the general use of the King County fleet, will require several million dollars. Investment for infrastructure on the scale required for hydrogen and CNG would require a long-term commitment to the particular vehicle technology and alternative fuel across a large number of compatible vehicles.

Fleet Administration’s initial assessment of propane as a potential fuel for inclusion in the County’s fleet, revealed that propane (or LPG) fueling facilities, unlike CNG and hydrogen fuels that require large capital outlay to construct refueling facilities, can be established for relatively modest sums (\$45,000 to \$70,000 new, \$3,000 to \$12,000 to lease, Clean Cities Department of Energy (DOE), 2014). Additionally, many retailers were willing to enter into contractual arrangements where they install the fueling equipment as part of an agreement to provide the fuel for a given period. Fleet Administration currently has contractual arrangements with the LPG fuel provider that includes fueling infrastructure equipment for two locations that required no Fleet capital outlay.

Vehicle Range

Closely related to the lack of an extensive fueling infrastructure is the limited range of some alternative fueled vehicles. EVs are most notable for having a limited range with most of the currently available

vehicles having a range of 70 to 80 miles on a single charge depending on driving conditions. Battery technology is the determining factor in the range of the EV with the cost, the weight, and recharging time of batteries being the main drivers. Fleet Administration has found that the EV range limitation restricts the utility of this vehicle technology within County operations. With the large and varied geographical range that King County covers, many workers are required to travel many miles or to remote sections of the County on a daily basis, such as those in the Department Public Health and the Assessor's Office. Because of the range limitation, the lack of an extensive charging infrastructure and the long charge time required for recharging the battery (about 6 hours), the potential for EV usage remains limited and check out of Motor Pool dispatch EVs have been restricted to one booking per day in order to ensure sufficient recharging time between trips.

Propane vehicles also have range limitations because of the lower energy content per gasoline gallon equivalent (GGE) of propane compared to gasoline or diesel. Although the difference is not enough to induce range anxiety, in a survey of County propane vehicle operators conducted by Fleet Administration after the introduction of the vehicles into the fleet, some drivers noted that they had to refuel more frequently with propane vehicles than with traditional fueled vehicles. In the case of propane, this deficiency can be corrected by installing larger tanks but there is always the tradeoff between bed space or storage space inside the vehicle, and greater fuel tank capacity.

Acceptance Among Users

To gauge acceptance of alternative fuel vehicles by King County fleet users, Fleet Administration conducted a survey in 2014 of County employees who use the Motor Pool dispatch but did not use the EVs, to determine why they were not choosing to use the EVs and how we could change their minds. The responses indicated that users were unsure of the technology and wanted more information about how to use the vehicle. Fleet Administration commissioned an instructional video and will post it on the vehicle reservation web site in the near future.

The utilization of Fleet Administration's six Nissan Leafs have seen some improvement since their introduction and the initial two-year transition period. In 2014, two EVs met the vehicle utilization standard as prescribed in the Light Duty Vehicle Utilization Policy of 70 percent of business days. Three other vehicles have provided business need justifications. One vehicle is still being used as a loaner vehicle designed to familiarize customers with the technology.

Lack of Dealer Support

The lack of dealer support can also pose a problem. Although this is often not an obstacle for large operations such as Fleet Administration, many dealers are not sufficiently trained in the emerging technologies to provide adequate support to clients, including information about the unique characteristics of the technology, availability of fuel, where applicable, and the care and service needs of the vehicles.

Fleet Business Needs

The use of electric vehicles within King County Fleets presents some specific issues:

- The limited range (about 80 miles) of most commercially available EVs limits the utility and flexibility of the vehicle.
- The long recharging time and consequent slow turnaround time of vehicles.
- The uncertainty of the long-term service needs and performance of the batteries.

The first two issues highlighted above, limited range and long recharging time are both impacted by EV battery technology. The large lithium-ion battery that provides motive force for the EV is the most expensive component in the vehicle and, to a large extent, accounts for the high incremental price of EVs on the market today (25 percent, Ars Technica July 16, 2015). The energy density of the battery, or how much energy the battery is able to store, determines how large, how heavy, and, ultimately, how far it will go on a single charge. Similarly, the technology also determines how fast the battery can be recharged. Although some vehicle manufacturers have lowered their prices, the price drop has been due mostly to slow vehicle sales and not the decreasing cost of batteries at this time.

Regarding the long-term performance of the lithium-ion battery, Fleet Administration has embarked on a long-term study in collaboration with MetroPool, the City of Seattle, and Idaho National Laboratory's (INL) Advanced Vehicle Testing Unit. So far, INL collected one set of data in December 2014 from a sampling of the vehicles from these groups and will need to pull at least one additional set of data in December 2015 before they can start making any inferences about the battery performance in the Seattle Area Vehicles. Some preliminary findings are below (Figure 4).

Electric Vehicle Battery Study

Fleet Administration collaborated with MetroPool, the City of Seattle and Idaho National Laboratory (INL) to do a longitudinal study on the lithium-ion battery pack in the Nissan LEAF. After some planning, the first set of data was collected on 11 EVs in December 2014 by Matthew Shirk of INL's Advanced Vehicle Testing Program. Two of the main items assessed were, battery capacity and battery state of charge. These outcomes were compared with four vehicles that the INL Advanced Vehicle Testing program had been testing in Phoenix. Testing showed that all the Seattle area batteries were at about 95 percent state of charge and that the vehicle state of health (which measured the balance among the battery cells) correlated well with capacity at about 90 to 96 percent (Figure 3). With only one set of readings so far, there is little comparison to be drawn between the Seattle and Phoenix battery data and very few conclusions that can be drawn. The plan is for INL to collect another set of data from the same vehicles in December 2015 and to arrange for additional data collection going forward.

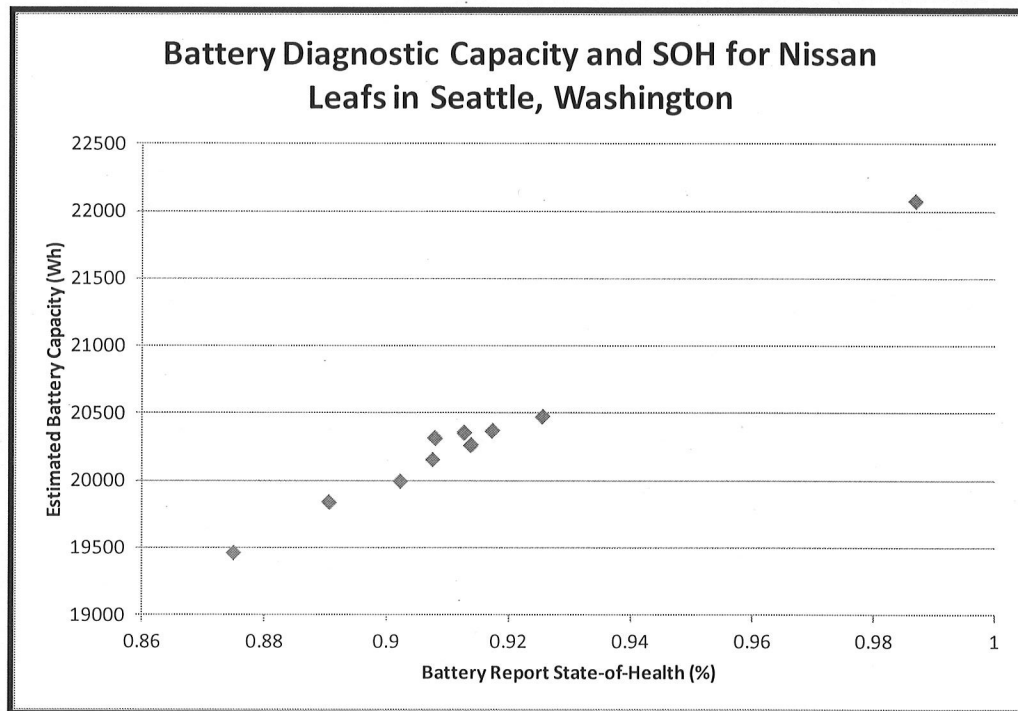


Figure 3: Battery State of Health Report on Seattle Vehicles
The findings are from a preliminary report sent to Fleet Administration by INL in July 2015

ADDITIONAL CONSIDERATIONS

Alternative Vehicle Technology is one of a Suite of Initiatives to Consider

A study by the EPA concluded that by themselves, the individual approaches such as highly efficient internal combustion engine ICE vehicles, hybrids, or EVs, would have a moderate effect on GHG reduction targets. However, the study noted, "by far, the greatest reductions in greenhouse gasses come from a 'systems approach' that accounts for the important relationships among strategies for advanced vehicle technologies, low greenhouse gas fuels, and/or reducing VMT" (Environmental Protection Agency, 2007, pg. 4). The inclusion of alternative vehicle technology is only one of a suite of

initiatives that must be utilized to ensure the achievement of transportation-related GHG reduction goals, strategies, and targets in the updated SCAP.

No One Technology Suitable for All Needs

The commonly held view in the literature is that there will be no single technology or fuel that dominates the industry the way petroleum and the ICE have in the past. Instead, as stated by Kay, Hill, and Newman in Powering Ahead (2013), "...there will be a range of solutions for different transport applications".

Priority and Sequencing of Actions

The carbon management hierarchy model "avoid, reduce, replace, and offset" (Figure 4), developed by Forum for the Future, helps organizations to consider those actions that will have the most transformative and lasting effects on the organization's emissions baseline. The model prioritizes the avoidance of emissions. For example, reduce the size of one's fleet or choose to use Skype for a meeting instead of attending in person. The model's reduction component is achieved through energy efficiency which may mean downsizing vehicles, choosing hybrids or mild hybrid vehicles, using eco-driving techniques or idling less. The replacement component entails replacing high carbon fuels with low or zero-carbon alternatives. At the lowest level of the model is offset, which involves purchasing carbon credits to offset usage. While offsetting is a valuable tool for reducing greenhouse gas emissions, it does not directly reduce the emissions generated by the County.

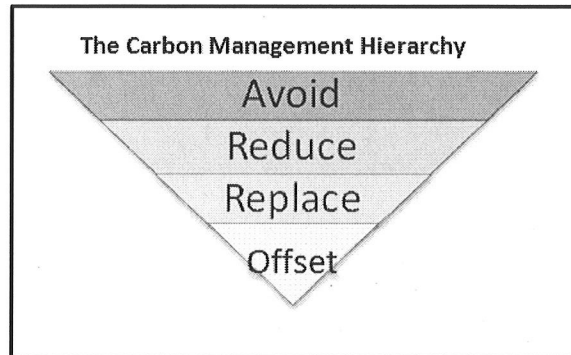


Figure 4: Carbon Management Hierarchy – Forum for the Future

CURRENT APPROACHS FOR INTEGRATING ALTERNATIVE FUEL VEHICLE TECHNOLOGY INTO COUNTY FLEET

Systems Approach

In order to achieve the SCAP energy use and GHG reduction goals, Fleet Administration employs a systems approach to the acquisition and deployment of vehicles.

Current fleet policies and practices include a vehicle utilization policy that encourages the reduction of the number of vehicles if they are not being sufficiently utilized, trip planning, driver education programs, and technologies designed to reduce fuel consumption and idling time of fleet vehicles.

Right Size for the Job

Current vehicle replacement practices require that department and division heads ensure that the vehicles purchased are the most fuel-efficient and “the right size” for the job. Fleet Administration has been seeking to replace pick-ups, vans and trucks with the smallest engine within the category or class, capable of doing the job. Fleet Administration uses this policy as an opportunity to educate its customers about choosing environmentally friendly vehicles when making purchasing decisions and to provide information on alternative fuels and advanced technology vehicles that may help achieve GHG reduction goals. The new effort in connection with the SCAP will be to educate our users about the low carbon fuels and GHG reduction goals and inform how the choice of vehicle will impact these outcomes.

Consider Advanced or Alternative Fuel Vehicle First

Currently, the practice pursued by Fleet Administration for all its customers is to consider an alternative fueled or advanced technology vehicle first when replacing a vehicle. If one is not available, the next consideration is the most fuel efficient vehicle available that is capable of doing the job. When vehicles come up for replacement, it is no longer a matter of simply replacing like for like.

The Division will continue to promote the use of propane and work to replace more eligible vehicles with propane units. At the same time, we will continue to advocate for the installation of more propane vehicle fueling facilities across the County by commercial providers. On the matter of biodiesel, there is currently a standing order with the County’s fuel supplier to automatically supply B5 (five percent biodiesel) whenever the price is the same or less than petro-diesel. Fleet Administration will increase this percentage over the next 10 to 15 years as biodiesel becomes more available and prices decline, the science ensures that the sources are in fact low carbon, and the fuel has evolved to prevent performance and engine problems such as have been experienced in the past, so that by 2030 the diesel fleet will be using at least B20 (20 percent biodiesel).

Purchase Fuel Efficient Internal Combustion Engine (ICE) Vehicles

Fleet Administration will continue to purchase highly fuel efficient ICE vehicles. New Corporate Average Fuel Economy (CAFE) standards are causing vehicle manufacturers to introduce a variety of fuel-saving innovations into their regular models. These include stop-start technology or mild hybrid technology, lighter components and/or body parts, turbocharging their engines and improved aerodynamic designs. Some of these innovations may result in an increase in the cost of the vehicles. However, it is anticipated that any increase will be recovered in fuel savings over the life of the vehicle in the case of cars and light-duty vehicles.

Telematics and Other Fuel-saving Initiatives

In 2015, the King County Auditor identified the reduction of idling as a key to reducing total County fuel use in her *“Light Duty Fleet: Costs and Emissions Could Be Reduced”* report. Fleet Administration is now working with customers that register high idling times to find ways to reduce the rates among their users. One of the ways is through providing regular feedback. This takes the form of quarterly reports that include fuel consumption by division and by types of vehicles and compares the division or department’s performance with others in the County. In some cases, heavy-duty units have been programmed to automatically shut down after five minutes of idling. Additionally, in collaboration with Roads Division and the Assessor’s Office, Fleet Administration is piloting the use of telematics with those two partners to better manage their fleet vehicles.

An indispensable component to decreasing fuel consumption is driver behavior. Fueleconomy.gov and other sources state that the way one operates a vehicle can impact fuel savings by as much as 15 to 30

percent. Because of this, Fleet has developed educational programs that address driver behaviors. One such program is an online Eco Driver training course for which employees receive credit and which they can complete at any time. Another is a fuel efficient driving video developed jointly by the Department of Natural Resources and Parks, and Fleet Administration which is now used in the County's Defensive Driving Course.

FINANCE AND FUNDING TOOLS

Finance and Funding Tools Already in Place

Currently, Fleet Administration budgets vehicle replacement with in-kind vehicles. As the County introduces new vehicles into its fleets, funding models must be adjusted. Historically agencies have incurred additional up-front costs associated with higher sticker prices for these vehicles unless they were offset by grant funding. The current funding plan allows customers to benefit from the lower life-cycle cost of ownership of the vehicle by allowing agencies to access financing for the up-front costs of alternative fuel vehicles with repayment coming from operating and maintenance savings generated over the life of the vehicle.

Additional Finance and Funding Options

Federal and state grants have been a source of funding which Fleet Administration has leveraged in the past to help offset the incremental cost of purchasing alternative fueled and hybrid vehicles. The Environmental Protection Agency and CMAQ grants obtained in 2006 helped offset the incremental cost of early production hybrid trucks. Under this program, Fleet led a consortium of regional governmental agencies to seek out this funding opportunity and four regional agencies purchased hybrid trucks. The fleets provided annual fuel consumption and other performance data to the Environmental Protection Agency (EPA) for four years as part of the condition of the grant. King County acquired five hybrid trucks through that grant program which are still a part of the fleet today and which still consume 20 to 30 percent less fuel than similar non-hybrid vehicles.

The federal ARRA program also provided the opportunity for a collaborative effort with the US Department of Energy Clean Cities Coalition through which Fleet Administration and other entities in the region obtained funding to help finance the incremental cost of a mix of 39 light- and medium-duty advanced and alternative fueled technology vehicles. As with the EPA/CMAQ grant, the terms and conditions of the agreement required Fleet Administration to provide regular reports on the performance of the vehicles.

Federal subsidies and refunds still help to ensure that fueling with propane cost less than using regular diesel or gasoline. Fleet Administration is able to take advantage of a federal tax credit of \$0.50 per gallon for the propane fuel it dispensed under the American Taxpayer Credit Relief Act of 2012 which was extended through December 31, 2014. However, there have been no federal or state grants in recent years and federal transportation grants often give priority to road and highway construction projects. Tax credits and refunds of low carbon fuels expenditure have expiration dates with their renewal not always a certainty.

At the state level, the tax exemption for alternative fuel cars, light-duty trucks, and medium-duty passenger vehicles (with a value of less than \$35,000) has been renewed until July 1, 2019. King County fleets will derive some benefits from these exemptions and we are advocating for the inclusion of heavy-duty vehicles as part of this tax exemption.

OPTIONS FOR UNIFORM POLICIES TO GUIDE ALTERNATIVE FUEL TECHNOLOGY VEHICLE ACQUISITION

As noted in the introduction, the 2015 SCAP Goals, strategies, targets and actions will serve as overall policy guidance for the Fleet Administration Division as it updates approaches, policies, and practices for purchase, replacement, and utilization of alternative fuel vehicles. In addition to using the updated SCAP as overall policy and performance guidance, the Fleet Division will:

- ✓ **Work with King County fleet managers, through the joint forum of the Fleet Managers/Energy Subcommittee for which Fleet Administration is the lead, to develop standard vehicle purchasing specifications for each vehicle class and model so that users will be offered a limited number of choices for vehicle replacements.** Ultimately, standard vehicles within classes will be alternative fueled, advanced technology vehicles, or the most fuel efficient vehicle in the class. Users wishing to order vehicles other than those specified, will need to justify the exception. Additionally, the Forum for the Future’s carbon management hierarchy (Figure 4) will be used as a point of reference and as an opportunity for educating customers.
- ✓ **Encourage user groups to apply new approaches to vehicle use.** Within their work group, they will be encouraged to rethink the way they use vehicles. In the case of meetings, they should consider using Skype – “avoid.” If they do have to travel to a meeting, they should then use the smallest, most fuel-efficient vehicle available and carpooling. In this way they will use less fuel for the trip – “reduce.” By encouraging work units to think of their vehicles as a pool of vehicles instead of individually assigned vehicles, employees are able to, in the course of a work day, choose the vehicle that is most suitable for the job. Such an arrangement will ultimately result in work units using less fuel and quite possibly requiring fewer vehicles for the group.
- ✓ **Participate in development and application of a cost of carbon and more comprehensive approach to life cycle cost analysis.** The updated SCAP includes recommendations:
 - Building on the pilot cost effectiveness assessment carried out to inform the 2015 SCAP, King County will pilot a cost effectiveness assessment for at least 12 “County Operations” commitments. This information will be provided as part of the first annual report on implementation of the 2015 SCAP and will inform future climate action planning.
 - Work with the Office of Performance, Strategy and Budget and other County agencies to develop and propose an internal “cost of carbon” by the end of 2017. This cost of carbon will be used in life-cycle assessments and decision-making related to County operations, including for purchase of clean vehicles and alternative fuels, and for related technology investments.
- ✓ **Review and Update Existing Executive Orders and Policies related to alternative fuel vehicle technology, alternative fuels, and vehicle use for consistency with SCAP.**
 - The updated SCAP contains the following recommendation: “Pursue adoption of a Clean Fuels Executive Order to include a cost of carbon. DOT and DNRP staff will continue to work with the Executive’s Office to formally adopt a clean fuels policy and to collaborate to integrate a cost of carbon into decision making about clean fuels” (pg. 49). In addition, the Executive will review existing Executive Orders related to alternative fuel vehicles and alternative fuels and update as necessary for consistency with targets, strategies, and actions in the proposed 2015 SCAP.

- ✓ **Continue to offer financing** to offset the up-front costs of alternative fuel vehicles with repayment coming from operating and maintenance savings generated over the life of the vehicle, using consistent criteria for evaluating lifecycle costs.
- ✓ **Offer driver education and deploy telematic tools.** Fuel efficient driver training is available via SkillSoft and in the County's Defensive Driving course. Fleet Administration is piloting the use of telematics with two customers to determine the viability of the technology.

SUMMARY

The inclusion of alternative vehicle technology in the County's fleet is one of a suite of options that must be utilized to ensure the reduction of GHG by 10 percent by 2020. Although the technology is not fully adopted into the mainstream at this time, every effort is being made to ensure their testing so that as the research on the technology progresses, the bugs are worked out, and the purchase prices become more affordable, Fleet Administration will have identified the technology best suited for each type of County operation and seamlessly incorporated them into the fleet. This includes preparing customers for wholesale usage of these new technology vehicles. The adoption process will have to accommodate the build-out of a countywide fueling infrastructure that can support the operation of alternative technology /alternative fueled vehicles even during emergencies.

Given the level of funding, market penetration, state of the technology, user acceptance, and the prospect for change in these dynamics in the near and medium term, alternative vehicles will contribute to our 2020 GHG reduction target. It is also necessary to employ a systems approach that includes the improved technology of internal combustion engine vehicles, hybrid vehicles, better route planning, and improved driving habits of our employees.

The propane pilot project undertaken by Fleet Administration demonstrated the suitability of the technology in certain business applications. Currently, the potential barriers to the wholesale adoption of propane into the medium-duty pickup and van fleet are: the lower energy density of the fuel causing drivers to refuel more frequently, and the need for more widespread fuel availability when vehicles are being used continuously for emergency response such as a storm.

We believe the County will meet the GHG reduction targets through multiple initiatives that include the utilization of low carbon fuels and alternative fueled vehicles. However, these will not be the only tools used. As outlined in the carbon management hierarchy, reducing vehicle miles traveled, choosing replacement vehicles that are the smallest, most fuel efficient units for the job, and generally rethinking the way we use fleet vehicles, will all factor into achieving King County's GHG reduction goals in the fleet.

The actions outlined in the previous section will improve the consistency and uniformity of policies used to guide alternative vehicle purchases, replacement, and utilization.

RESOURCES

1. Alternative Fuels Data Center. *Alternative Fueling Station Locator*
<http://www.afdc.energy.gov/locator/stations/>
2. Anair, Don; Mahmassani, Amine. June 2012. State of Charge: Electric Vehicles' Global Warming Emissions and Fuel-Cost Savings across the United States Available online:
http://www.ucsusa.org/sites/default/files/legacy/assets/documents/clean_vehicles/electric-car-global-warming-emissions-report.pdf
3. Brubaker, L., Garvey, E., Poon, L, and Dean, D. April 28, 2015. *Light Duty Fleet: Costs and Emissions Could Be Reduced*. King County Auditor's Office
http://www.kingcounty.gov/~media/operations/auditor/documents/2015Documents/Fleets_Rpt_Final_0428.ashx?la=en
4. Caldwell, Jessica. "Drive by numbers: Tesla in all 50 States." January 29, 2014. *Edmunds.com*.
<http://www.edmunds.com/industry-center/analysis/drive-by-numbers-tesla-in-all-50-states.html?SID=idw0l8ibvh003bkr001ol&kw=flexibletexttool&PID=6154448&AID=10364102&mktid=cj260233&mktcat=affiliates>
5. Clean Air-Cool Planet & Forum for the Future. Getting to Zero: Defining Corporate Carbon Neutrality.
6. Clean Cities, US Department of Energy, Energy Efficiency and Renewable Energy. September, 2014. *Cost Associated with Compressed Natural Gas Vehicle Fueling Infrastructure: Factors to consider in the implementation of fueling stations and equipment*.
http://www.afdc.energy.gov/uploads/publication/cng_infrastructure_costs.pdf
7. Coley, David. 2008. *Energy and Climate Change: Creating a sustainable future*, West Sussex, England: John Wiley and Sons Ltd,
8. Eckerle, T, & Garderet, R. October 2013. *Hydrogen Network Investment Plan*.
http://www.einow.org/images/stories/factsheets/h2nip_full_paper_final.pdf
9. Federal Vehicle Standards. <http://www.c2es.org/federal/executive/vehicle-standards>
10. German, John. *Hybrid Vehicles: Technology development and cost reduction*, International Council on Clean Transportation Technical Brief No. 1.
http://theicct.org/sites/default/files/publications/ICCT_TechBriefNo1_Hybrids_July2015.pdf
11. Greene, D. 2010, February 9-10. Why the Market for New Passenger Cars Generally Undervalues Fuel Economy.
12. Kay, D., Hill, N., and Newman, D. *Powering Ahead: the Future of Low-carbon cars and fuels*.
http://www.racfoundation.org/assets/rac_foundation/content/downloadables/powering-ahead-kay-et-al-apr2013.pdf
13. King County Strategic Climate Action Plan Web Site
(<http://www.kingcounty.gov/environment/climate/king-county/climate-action-plan.aspx>)

14. Loris, Nicolas and Morgan, Derrick. *Cap-and-Trade for Cars Means Higher Prices and Less Choice for Car Buyers* <http://www.heritage.org/research/reports/2012/12/cap-and-trade-for-cars-means-higher-prices-and-less-choice-for-car-buyers>
15. Navigant Research. *Automotive Fuel Efficiency Technologies Powertrain and Body Engineering Technologies for Improved fuel Economy: Global Market Analysis and Forecasts* <http://www.navigantresearch.com/research/automotive-fuel-efficiency-technologies>
16. Office of Sustainability. 2012. The University of South Carolina *AFV Barriers and Policies*. <http://www.sc.edu/TII/BIAF.pdf> accessed 4-10-15
17. Shrinking the Carbon Footprint of Metropolitan America 2008, Brookings – PowerPoint presentation. <http://www3.imperial.ac.uk/pls/portallive/docs/1/50007735.PDF>
18. Study: Seattle area No. 6 on list of smallest carbon footprint. May 28, 2008. *The Seattle Times*: <http://www.seattletimes.com/seattle-news/study-seattle-area-no-6-on-list-of-smallest-carbon-footprint/>
19. MURPHY. Brookings Study Misleads on Carbon Tax. <http://instituteeforenergyresearch.org/analysis/murphy-brookings-study-misleads-on-carbon-tax/>
20. The Washington Plug-In Electric Vehicle Task Force. <http://www.commerce.wa.gov/Documents/PEV-Task-Force-Gov-Rpt-2013.pdf>
21. *Wedge Approach to Climate Change (The)* World Resources Institute. <http://www.wri.org/print/38096>
22. Mui, S., Alson, J. et al. EPA 2007. *A Wedge Analysis of the Transportation Sector* <http://www.epa.gov/otaq/climate/420r07007.pdf> pg. 7
23. Sierra Club (The). *Electric Vehicle Factsheet*. <http://content.sierraclub.org/evguide/factsheet>
24. Sierra Club (The). *Electric Vehicles: Myths vs. Reality*. <http://content.sierraclub.org/evguide/myths-vs-reality>
25. Smith, M., Gonzales, J. August 2014. *Cost Associated with Propane Vehicles Fueling Infrastructure: Factors to consider in the implementation of fueling stations and equipment*. Clean Cities, US Department of Energy, Energy Efficiency and Renewable Energy. http://www.afdc.energy.gov/uploads/publication/propane_costs.pdf
26. “Stabilization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies” published in: *Toward a Hydrogen Economy* (<http://www.princeton.edu/mae/people/faculty/socolow/Science-2004-SW-1100103-PAPER-AND-SOM.pdf>)
27. Seattle’s electric vehicle paradox Tuesday 4, December 2012, <http://crosscut.com/2012/12/seattles-ev-paradox/>

APPENDIX A

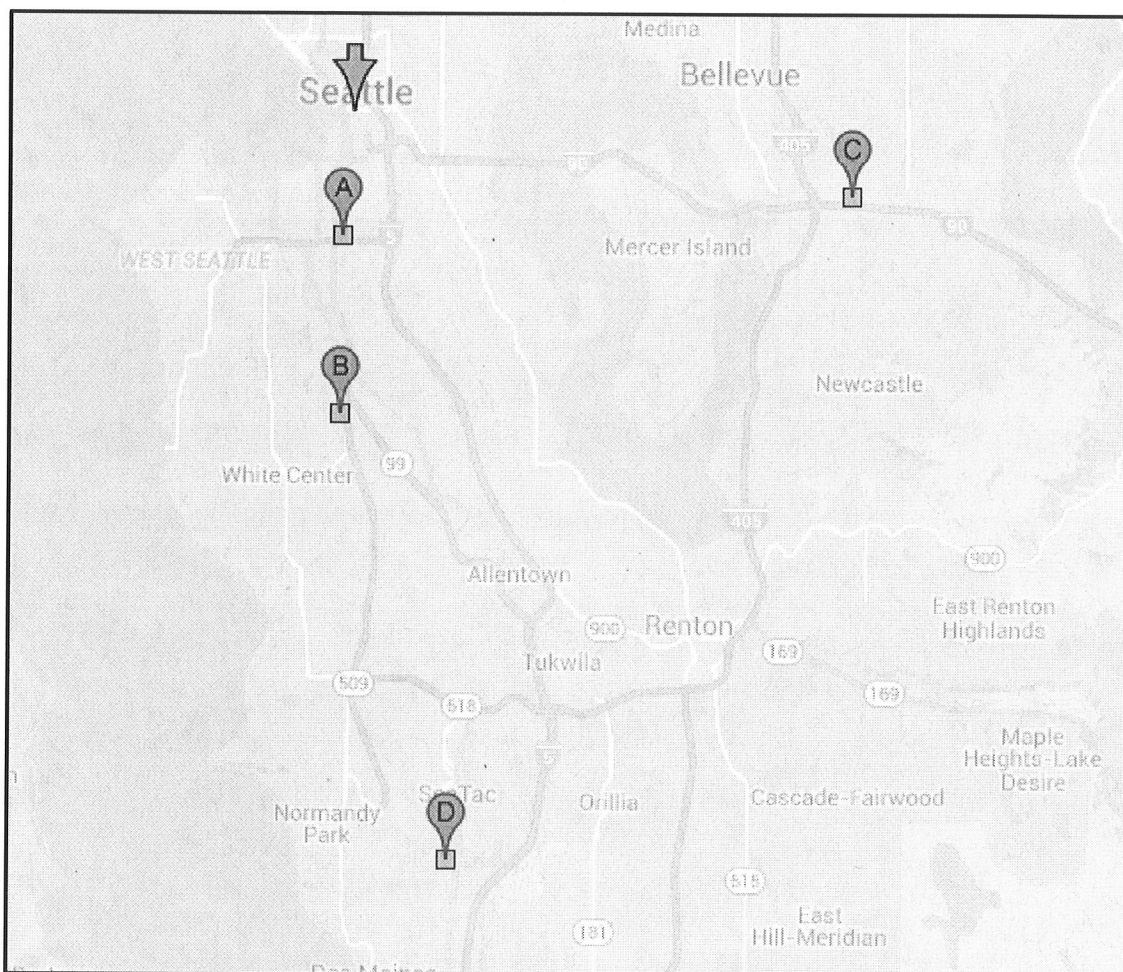
Locations of CNG Stations in King County

A Clean Energy - Seattle Wire and Cable Co
60 S Spokane St
Seattle, WA 98134
Phone: 866-809-4869

C Clean Energy - Bellevue PSE Factoria
13240 SE 32nd St
Bellevue, WA 98005
Phone: 866-809-4869

B Clean N' Green
149 SW Kenyon St
Seattle, WA 98108
Phone: 800-331-3441

D Clean Energy - Seattle-Tacoma International Airport
19425 28th Ave S
Seatac, WA 98188
Phone: 866-809-4869



Source: Alternative Fuels Data Center