Wisconsin Office of Energy Innovation

Sun Prairie

Wisconsin's SAFER2 Program

September 2021

The Wisconsin Office of Energy Innovation's SAFER2 Program is a U.S. Department of Energy- funded effort to improve the efficacy of the state's response to long-term energy outages via ongoing collaboration with regional, tribal, county and local emergency management professionals. Wisconsin Clean Cities (WCC) is proud to partner with the Wisconsin Office of Energy Innovation and Wisconsin Emergency Management to serve local, county and tribal emergency managers and achieve the following goals:

- *Gaining a better understanding of the resiliency of critical energy infrastructure around the state*
- *Providing templates for fuel shortage contingency plans and cybersecurity awareness in energy outages sharing lessons learned from the 2018 Dark Sky exercise and state fuel planning process*
- *Enhancing the understanding of the roles and responsibilities of state and tribal/local partners during an energy emergency*

This Alternative Fuel Vehicle and Feasibility Study is based on information and data collected during Wisconsin Clean Cities conversations with the associated fleet. Therefore, this report is intended to be used as a reference and not as a substitute to strategic decision-making that may incorporate other administrative and operational factors.

Wisconsin Clean Cities is a 501(c)(3) nonprofit organization managed by Legacy Environmental Services, Inc., an Indiana Certified Women's Business Enterprise. Established in 1994, Wisconsin Clean Cities is one of the U.S. Department of Energy's more than 75 Clean Cities coalitions. The organizations support the nation's energy and economic security by building partnerships to advance affordable domestic transportation fuels, energy efficient mobility systems and other fuel-saving technologies and practices.

Sun Prairie
Fleet Analysis Table of Contents

Fleet Analysis Introduction **2**

Alternative Fuel Comparison **3**

Alternative Fuel Vehicle Analysis **5**

1.) Small Cars **8**
2.) Midsized Cars **16**
3.) Sport Utility Vehicles **23**
4.) Minivan **27**
5.) Pickup Trucks **31**

Opportunities for Electric Vehicle Charging Infrastructure Deployment **34**

Other Renewable Fuel Opportunities **39**

Fleet Assessment Introduction

Wisconsin Clean Cities (WCC) has partnered with the Wisconsin Office of Energy Innovation to assist local governments in advancing energy emergency resiliency, mitigation, and response. This project is part of the Wisconsin Statewide Assistance for Energy Resiliency and Reliability or SAFER2 Program.

This Alternative Fuel Vehicle and Feasibility Study is designed to examine the feasibility and cost-savings potential of deploying a range of commercially available alternative fuel, advanced vehicle, and efficiency solutions within Sun Prairie's fleet of vehicles.

Sun Prairie provided for analysis a listing of 84 gasoline and hybrid vehicles for analysis. These consisted of vehicles from 12 departments. Vehicle types ranged from small sedans provided for administrative checkout to a Chevrolet Silverado 5500 used by the Fire Department. Diesel fleet vehicles are an opportunity for future project discussions. At the request of Sun Prairie fleet analysis was focused on 15 vehicles that were under consideration for near term replacement. Consisting of small cars, midsized cars, sport utility vehicles, a minivan, and pickups, most vehicles traveling only within the city of Sun Prairie. Small cars and the minivan are assigned to Admin Checkout and are occasionally used for longer distance travel.

Providing an excellent opportunity for electric vehicle deployment, a Chevrolet Bolt is already being used by the Public Works department with positive results. Sun Prairie has a strong sustainability mission with reports constructed in 2020 and being a long-term participant in the Energy Independent Communities program. Expanding the use of electric and hybrid vehicles as a method to decrease fleet operation costs, emissions, and create opportunities for renewable energy integration will be the focus of this report. Details related to other fuels will be provided for reference and consideration.

WCC and the Wisconsin Office of Energy Innovation are pleased to present the following Alternative Fuel Vehicle and Feasibility Report to Sun Prairie. This report is designed to provide the following core deliverables:

1) Develop priority criteria and goals for the fleet in evaluating technologies.
2) Provide a baseline analysis for current fleet operations.
3) Outline relevant alternative fuels and efficiency improvements for the fleet's operations.
4) Assess the operating costs and other investments needed to implement the various technology options.
5) Provide total cost of ownership scenarios and recommendations based on the analysis.

Priority Criteria for Analysis

1) Use total cost of ownership projections as the primary tool for evaluating each potential fuel and vehicle technology option.

2) Provide data on environmental performance, which will factor into the decision matrix as a secondary evaluation tool.

WCC will utilize this priority criteria to evaluate alternative fuel and efficiency technologies that will be most relevant and effective for the fleet's operations. Findings throughout this report were calculated using the U.S. Department of Energy's AFLEET tool, GREET tool and the U.S. Environmental Protection Agency's Diesel Emissions Quantifier tool.

Process and Method of Analysis

In addition to the priority criteria, the analysis utilized real world fleet data provided by Sun Prairie to create key current vehicle performance profiles. The analysis utilized these profiles to create alternative fuel vehicle replacement scenarios and chart similar models of alternative fuel vehicles (including vehicle acquisition costs, miles per gallon differences, maintenance cost differences, etc.). The core analysis and report focus is on comparing the operational costs and returns on investment between the fleet's current vehicle performance profiles and various alternative fuel replacement vehicle scenarios.

Alternative Fuel or High Efficiency Vehicles

The market for and use of high efficiency and alternative fuel vehicles has continually expanded in recent years. The transportation market now includes vehicles that can fuel, or be powered by, propane, electricity, compressed or liquefied natural gas and other fuels such as ethanol or biodiesel. The enhanced fuel economy and use of alternative fuels provides fleets with an opportunity to achieve a blend of reduced operating costs, vehicle emissions and petroleum consumption. However, operational savings achieved through use of these fuels or technologies comes at a higher upfront incremental vehicle purchase price, with savings accruing over the lifecycle of the vehicle.

ALTERNATIVE FUEL COMPARISON

Fuel Type Overview

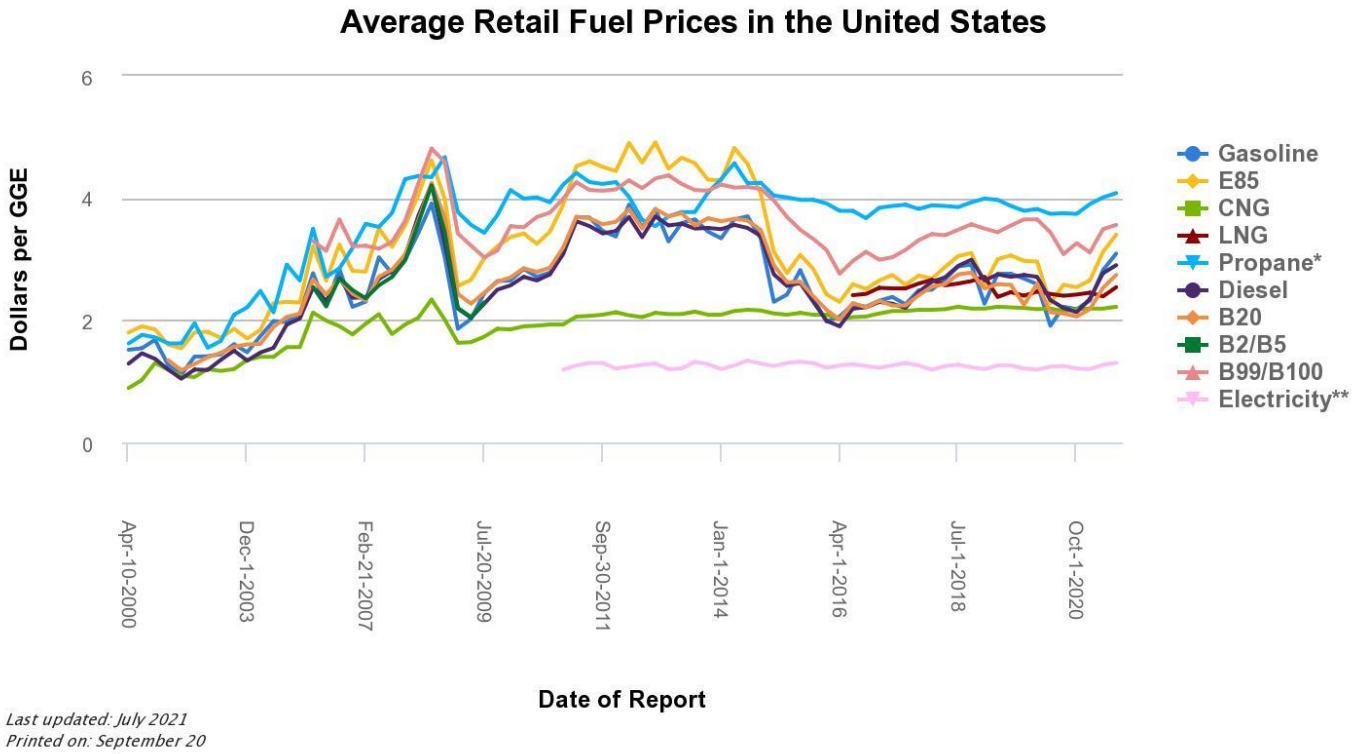
This report provides a range of alternative fuel and vehicle options for the fleet's operations. This section is designed to provide foundational information for the high-level comparison of five commercially available alternative fuel types: biodiesel (B20), ethanol (E85), compressed natural gas (CNG), propane (LPG) and electric vehicles (EV). The following sections of this report will provide a more detailed explanation and analysis of each fuel type, as well as chart out prospective vehicle and capital cost return on investment scenarios based on each fleet partner's real-world vehicle and usage data. Table 1 provides a high-level summary of each fuel option.

Table 1. High Level Alternative Fuel Comparisons					
	Biodiesel (B20)	**Ethanol (E85)**	**CNG**	**Propane**	**EV**
Basics	Biodiesel is a renewable fuel that can be manufactured from organic oils, fats or recycled grease for use in diesel vehicles	Ethanol is a widely used renewable fuel made from corn and other plant materials. It is blended with gasoline	Natural gas is a domestically abundant gaseous fuel that can have significant fuel cost savings over gasoline and diesel fuel	Propane is a readily available gaseous fuel that has been widely used in vehicles throughout the world for decades	Electricity can be used to power plug-in electric vehicles, which are increasingly available. Hybrids use electricity to boost efficiency
Retail Availability	Widely available	Widely available	Purchased through utility pipeline or retail filling station, if station infrastructure is available	Regional/local distributors	Charging infrastructure varies based on desired charging speed
Retail Cost	Moderate	Moderate	Low	Low to Moderate	Low
Tailpipe Emissions	B100 emissions offer 74% lower GHG emissions compared to petroleum diesel[1]	E85 emissions produce 40% less GHG emissions with corn-based ethanol vs. gasoline	CNG vehicles emit 13-21% fewer GHG emissions vs. gasoline and diesel vehicles[2]	Propane vehicles reduce GHG emissions by nearly 10%. When derived as a by-product of natural gas product, propane reduced petroleum use by 98% to 99%[3]	An all-electric vehicle doesn't produce any tailpipe emissions. A plug-in hybrid electric vehicle doesn't produce any emissions when it is in battery mode[4]
Major Pros	Universal availability and moderate cost. Environmental benefit	Universal availability and moderate cost savings	Low fuel cost. Low emissions & noise. Extensive distribution	Simpler station than CNG. Fuel savings vs. gasoline likely in fleets.	Lower maintenance costs, lower fuel costs, and no tailpipe emissions
Major Cons	No major cost savings. Cold flow issues if not properly treated	Lower energy per gallon. Limited environmental benefit	High cost/complexity of stations	Seasonal price spikes if not under contract. No heavy vehicle options	Limited range and not well suited to heavy vehicles because of range and battery weight. A charge takes hours and applications are limited based on vehicle drive cycle

[1] Alternative Fuels Data Center, *Biodiesel Vehicle Emissions.* https://www.afdc.energy.gov/vehicles/diesels_emissions.html
[2] Alternative Fuels Data Center, *Natural Gas Vehicles: Status, Barriers, and Opportunities*. https://www.afdc.energy.gov/pdfs/anl_esd_10-4.pdf
[3] Alternative Fuels Data Center, Propane Vehicle Emissions. https://www.afdc.energy.gov/vehicles/propane_emissions.html
[4] Alternative Fuels Data Center, Electric Vehicle Emissions. https://www.afdc.energy.gov/fuels/electricity_benefits.html

Fuel Price Report

Fuel is consistently one of the largest components of a fleet's total operating costs. And, as with most commodities, fuel prices fluctuate driven by seasonal driving demand, weather conditions, events in crude oil markets, and many other potential factors. The chart below shows average monthly retail fuel prices in United States from April 2000 to July 2021[5].



The chart above also depicts the volatility of the retail fuel price market since 2000. Even in the most aggressive scenarios of alternative fuel adoption, the fleet will continue to use significant amounts of gasoline and diesel in various operations for years to come. Therefore, in addition to exploring hedging options, we recommend the fleet use lifecycle cost analyses to select the most energy-efficient conventional vehicle models if acquiring new gasoline or diesel-powered units.

Sun Prairie FLEET ANALYSIS

Alternative Fuel Vehicle Analysis

The city of Sun Prairie is interested in identifying opportunities to reduce the cost and emissions associated with its vehicle fleet. To identify potential opportunities, WCC performed a total cost of ownership calculation for replacing certain segments of the organization's fleet with alternative fuel or advanced vehicle technologies.

[5] Alternative Fuels Data Center, *Fuel Prices*, https://afdc.energy.gov/fuels/prices.html

In order to provide an accurate comparison among fuel and infrastructure types that would best suit the needs of the fleet, WCC used the following fuel costs:

Table 2. Fuel Cost Comparison		
Fuel Type	**Unit Price**	**Fuel Per One Gallon of Gasoline**
Unleaded Gasoline	$2.998 gallon	1 gallon of gasoline
Diesel	$3.166 gallon	0.88 gallons of diesel
Electricity	$0.1065 kWh	33.7 kilowatt-hours*
Propane (LPG)	$2.94 gallon	1.353 gallons of LPG
Compressed Natural Gas (CNG)	$2.01 GGE	126.67 cubic ft. of CNG
Ethanol (E85)	$2.34 gallon	1.39 gallons of E85

* According to the EPA, burning one gallon of gas produces 115,000 BTUs (British thermal units). To generate the same amount of heat by way of electricity, it takes 33.7 kilowatt-hours (kWh). Kilowatt-hours is the standard energy unit for electricity. If an electric vehicle can travel 100 miles on 33.7 kWh of electricity, the EPA rates it at 100 MPGe. As you can see, this would be a very efficient vehicle, because a gas car would have to travel 100 miles per gallon to be equivalent.

Fuel prices were based on a variety of sources, including:

- The U.S. Department of Energy's Alternative Fuel Price Report for the Midwest
- AAA Gas Prices daily average value for Wisconsin
- Electricity Local
- Fuel pricing estimates from vendors

In review of the National Renewable Energy Laboratory Alternative Fuel Data Center TransAtlas Dane County has public refueling stations for CNG, Ethanol (E85), Electric, and Propane. Biodiesel blends can be purchased for use in county owned fueling facilities. Electricity is priced based on commercial rates and may differ from what is available from public and dedicated county installed infrastructure. The City of Sun Prairie currently has 3 electric vehicle charging stations and 2 stations offering ethanol blends.

In the case of ethanol E85, it was unknown whether any of the fleet's existing vehicles were flex fuel vehicles capable of running on E85 or mid-level ethanol blends. If this was the case, the fleet could investigate the cost of a blender pump and fuel cost for higher ethanol blends, as there may be long- term savings with this option.

Sun Prairie Fleet

WCC performed a total cost of ownership calculation using the current fleet's usage data to provide cost comparisons for replacing certain fleet segments with new alternative fuel and high efficiency vehicles, instead of conventionally fueled vehicles. To do so, WCC grouped vehicles into segments based on vehicle size and vocation to provide a more accurate comparison between current and potential vehicle replacements. The total cost of ownership calculation provides an objective comparison of the operating and fixed costs associated with the ownership of these vehicles over their associated lifespans.

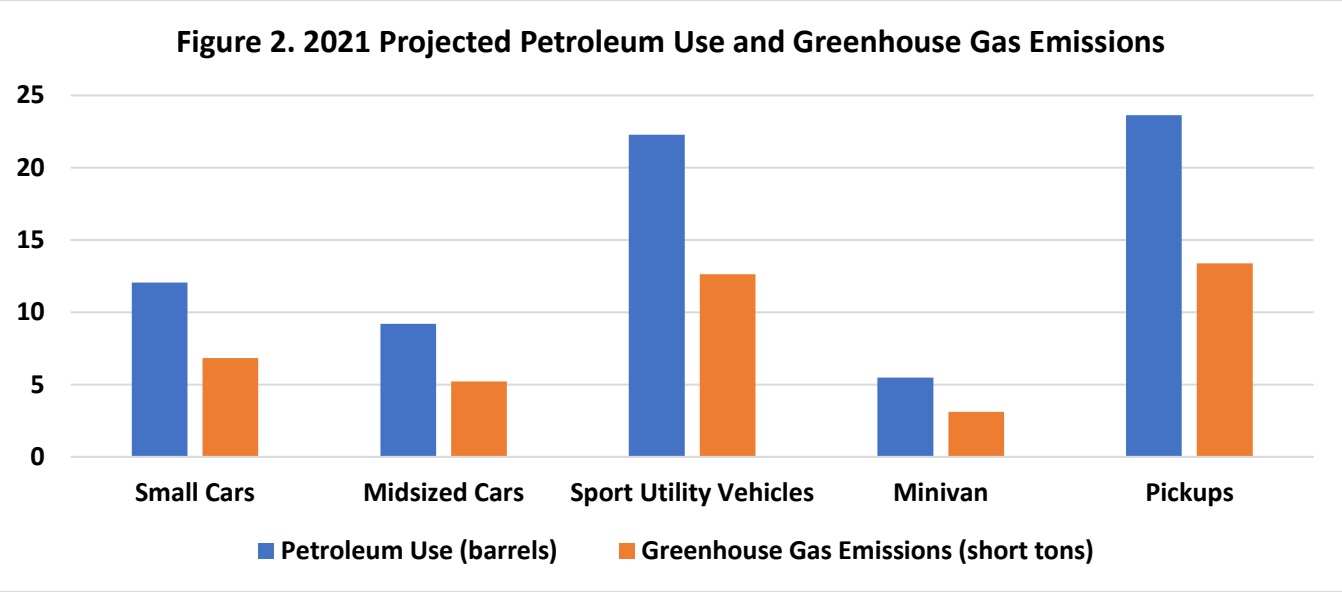
Sun Prairie provided WCC with a vehicle asset list which included unit number, department, make, model year, model, type of fuel, and current odometer readings. Also provided was fleet forecast detailing initial purchase price, expected operational life, year purchased, replacement budget and expected replacement year. Fuel consumption and pricing information was provided on an aggregated by department level. WCC separated vehicles into classes based on size and fuel type, as seen in Table 3 below. Annual vehicle miles traveled in Table 3 is based on estimates for use in 2021. Gallons of fuel consumed was calculated based on estimated vehicle city fuel economy from The U.S. Department of Energy www.fueleconomy.gov.

Table 3. Sun Prairie Analyzed Fleet Breakdown

Type	Number of Vehicles	Fuel	Average Model Year	Average Annual VMT	Average Annual Fuel Consumption
Small Car	3	Gasoline	2010	4,822	193.63
Midsized Car	2	Gasoline	2018	4,652	221.52
Sport Utility Vehicle	3	Gasoline	2017	4,473	357.79
Minivan	1	Gasoline	2010	4,489	264.06
Pickup	6	Gasoline	2015	3,156	189.69
Total	**15**		2014	4,318	245

Since the type, total mileage, and annual mileage of the Engineering department SUV indicated that it was likely a retired Police unit, the replacement was modeled with the same values as those used by Building Inspection. Other vehicles by the Engineering department averaged 3,041 miles annually.

Figure 2 provides a baseline measurement for each fleet segment's well-to-wheels petroleum use (barrels) and greenhouse gas emissions (short tons) for the operating year of 2021 based on predicted vehicle use provided by Sun Prairie. These measurements are designed to establish operational emission baseline measurements for the fleet's current operations. These measurements can be used to gauge reductions in petroleum use and greenhouse gas emissions for the fleet moving forward.



Vehicle emissions throughout this report were calculated on a well-to-wheels basis. WCC used data from Argonne National Laboratories' Greenhouse gases, Regulated Emissions, and Energy use in Transportation (GREET) fuel-cycle model to generate necessary well-to-wheels petroleum use and greenhouse gas (GHG) emission co-efficient for key fuel production pathways and vehicle types. This tool also uses the U.S. Environmental Protection Agency's Motor Vehicle Emission Simulator (MOVES) and certification data to estimate tailpipe air pollutant emissions.

Vehicle Analysis #1: Small Cars

Sun Prairie deploys 3 small cars consisting of 2 model year 2009 and one model year 2013 Ford Focus. The 2009 model year cars are used for Admin Checkout and the 2013 model year car is used for Building Maintenance. The 2009 model year cars are pending replacement this year, while the 2013 is scheduled for 2023. Fuel economy is rated at 24-27 city and 33-36 highway. A budget of between $26,000 and $30,00 has been designated for 2021 and 2023. Individual vehicle details and calculated annual miles and fuel consumption is provided in table 4 below.

Table 4. Current Small Car Fleet

UNIT	Department	Vehicle Model Year	Make	Model	Estimated City MPG	Estimated Hwy MPG	Replacement Year	Budget	Annual miles	Fuel Consumption
317	ADMIN CHECKOUT	2009	FORD	FOCUS	24	33	2021	$ 30,000	4,563.75	190.16
318	ADMIN CHECKOUT	2009	FORD	FOCUS	24	33	2021	$ 26,000	5,175.92	215.66
321	BUILDING MAINTENANCE	2013	FORD	FOCUS	27	36	2023	$ 28,600	4,726.50	175.06

Admin Checkout vehicles may need to travel outside of Sun Prairie, however the use for all vehicles in this category is primarily within the city. The greatest cost savings can be achieved through the replacement of these vehicles with electric, plug-in hybrid, or hybrid vehicles which can be over twice as efficient in city operation as existing vehicles. Many of the alternative fuel vehicle options can be obtained within the desired budget range without need for incentives, however alternatives also become possible if eligible for fleet pricing or tax incentives. Since mileage travelled annually is low a regulated checkout practice would allow for full electric vehicles to be deployed on any city travel and plug-in or standard hybrids for longer travel. As an

example, the entry level 40KW-hr battery Nissan LEAF offers 149 miles of range which would be sufficient for a full day of in city use with only overnight charging. Plug in Hybrids in this category and price range offer electric only operational ranges in the 25-to-37-mile range. This would provide an opportunity to do most travel as electric, charging on local infrastructure, but eliminating any range and infrastructure concerns when travelling as they can revert to hybrid operation when plugin infrastructure is not available.

Electric Vehicle Options

Several electric vehicles are available within the projected budget range:

- Within budget:
  - 2021 Nissan LEAF (40 KW-hr Battery) 149 mile range, base price $27,400

- Within budget with incentives:
  - 2022 Chevrolet Bolt $31,000
  - 2022 Chevrolet Bolt EUV $33,000
  - 2022 Hyundai Kona Electric $34,000
  - 2022 Nissan LEAF (62 KW-hr Battery) $32,400

- Slightly above budget with incentives:
  - 2021 Kia Niro EV $39,090
  - 2021 Tesla Model 3 (Standard Range) $39,990
  - 2021 Tesla Model Y (Standard Range) $39,990
  - 2021 Volkswagen ID.4 $39,995

All of these options offer over 100mpge in city operation, vehicles that are above budget without incentives generate total cost of ownership that is higher for the life of the vehicle compared to conventional vehicles. Savings can be achieved by year 5-6 for any of the vehicles within budget with incentives (no incentives applied in calculation) and immediately with the 40 KW-hr battery Nissan LEAF. For comparison purposes 4 electric vehicles were modeled with outputs generated for both city only and mixed (equal city and highway) use.

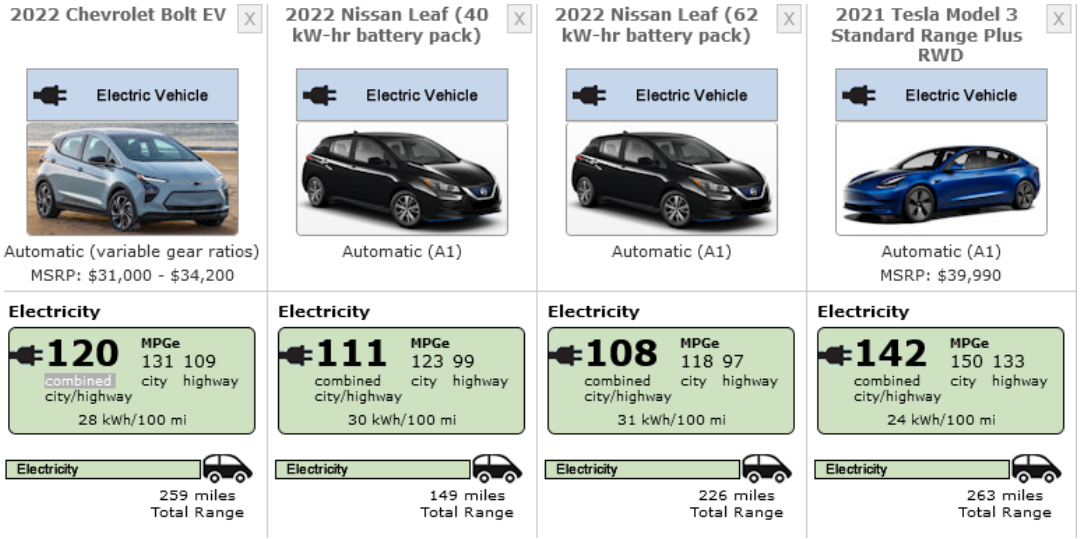
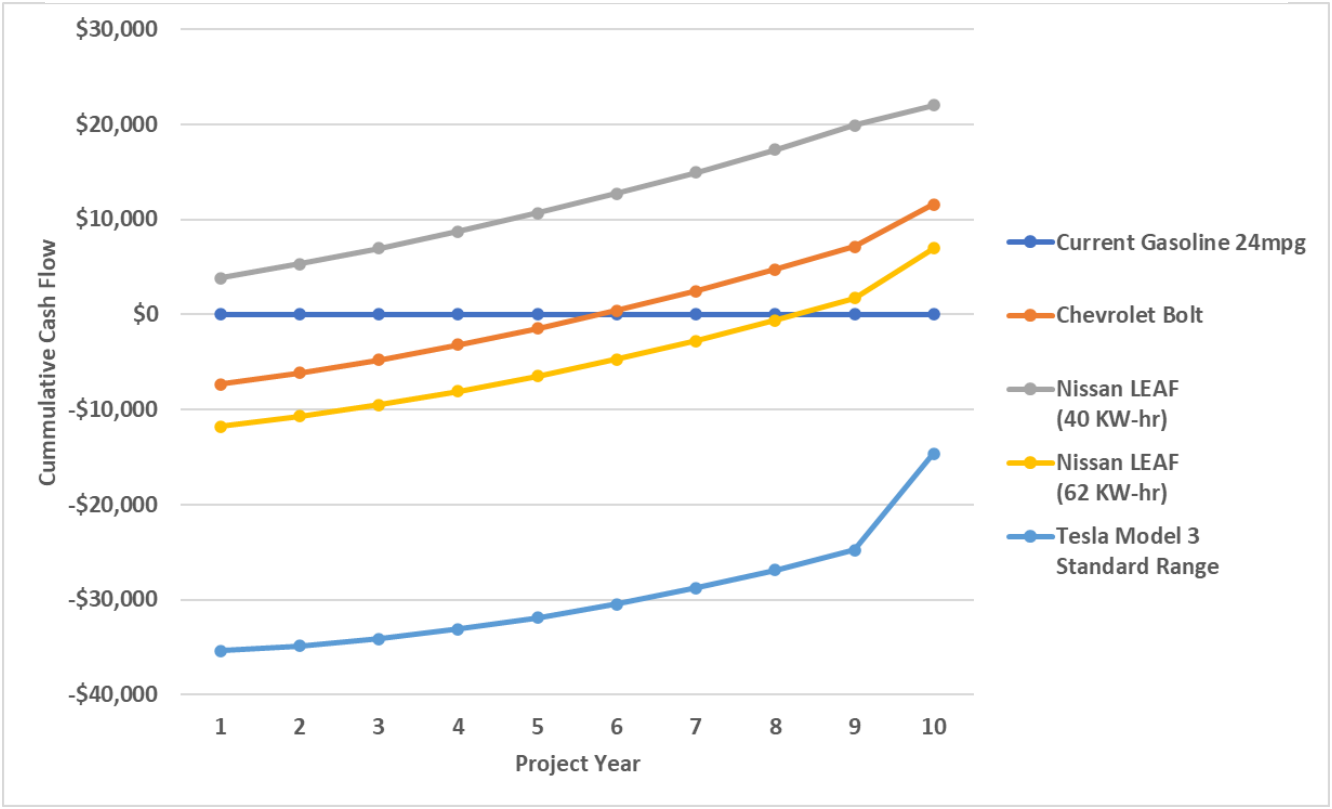


Table 5. Total Cost of Ownership Comparison Small Car Options - Electric - City Only Operation					
	Current Gasoline 25mpg	Chevrolet Bolt	Nissan LEAF (40 KW-hr)	Nissan LEAF (62 KW-hr)	Tesla Model 3 Standard Range
Price Per Vehicle	$28,200	$31,000	$27,400	$32,400	$39,990
Depreciation	$65,765	$72,295	$63,899	$75,560	$93,260
Fuel	$19,198	$4,132	$4,400	$4,587	$3,608
Diesel Exhaust Fluid	$0	$0	$0	$0	$0
Maintenance and Repair	$20,695	$13,048	$13,048	$13,048	$13,048
Insurance	$31,445	$33,237	$30,933	$34,133	$38,989
License and Registration	$2,414	$5,254	$5,254	$5,254	$5,254
Total Cost of Ownership	**$139,518**	**$127,965**	**$117,535**	**$132,581**	**$154,159**

As can be seen above replacing the current vehicles in city only operation would save the City of Sun Prairie between $6,937 and $21,983 if the Chevrolet Bolt or Nissan LEAF is selected, only the Tesla results in a higher cost of ownership over the projected 10-year lifespan.

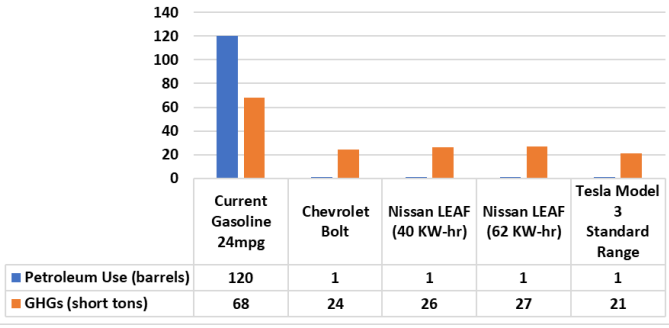
Figure 3: Cumulative Cash Flow – Small Cars City Only Use – EV vs Gasoline



In regards to emissions, selection of any electric vehicle option will provide massive decreases in all pollutant categories and petroleum use. This is displayed in table 6 and figure 4 on the following page.

Table 6. Lifetime Vehicle Operations Air Pollutants Comparison Small Car Options - Electric - City Only Operation					
	Current Gasoline 24mpg	Chevrolet Bolt	Nissan LEAF (40 KW-hr)	Nissan LEAF (62 KW-hr)	Tesla Model 3 Standard Range
Petroleum Use (barrels)	120	1	1	1	1
GHGs (short tons)	68	24	26	27	21
CO (lb)	279	0	0	0	0
NOx (lb)	5	0	0	0	0
PM10 (lb)	9	9	9	9	9
PM2.5 (lb)	2	1	1	1	1
VOC (lb)	47	0	0	0	0
Sox (lb)	1	0	0	0	0

Figure 4. Lifetime Petroleum Use and Greenhouse Gas Emissions

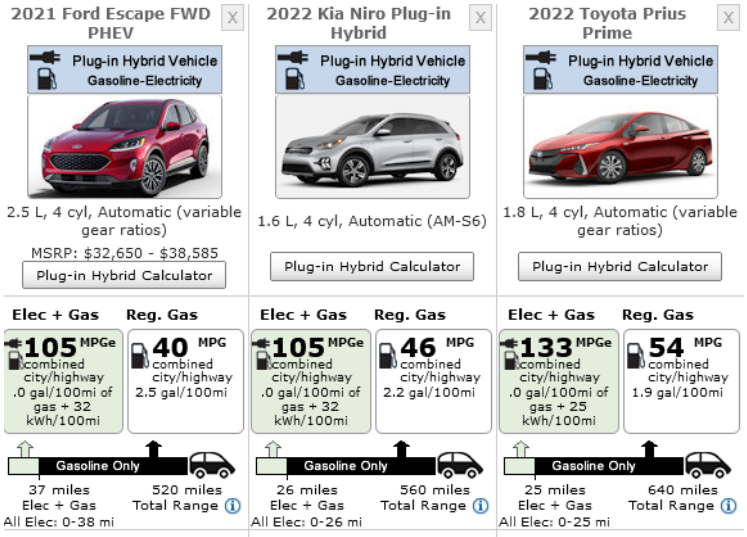


Plug in Hybrid Options

As the admin checkout operated vehicles may be required to travel a distance greater than the electric range and may encounter areas that do not possess charging infrastructure. This type of operation is an ideal opportunity to consider the increased deployment of hybrid and plug in hybrid vehicles in the fleet. Offering greater fuel economy, especially in city where the majority of miles are travelled, while also allowing for greater range flexibility. Plug in hybrids are available in the budgeted range and would allow for many trips within the city to be completed while only using electricity and charging at city owned stations.

- PHEV available within budget:
  - 2022 Kia Niro PHEV, 26-mile electric range, $29,590
  - 2022 Toyota Prius Prime, 25 miles electric range, $28,220

- PHEV slightly above budget:
  - 2021 Ford Escape PHEV FWD, 37 miles electric range, $33,075



As these vehicles are more likely to be travelling extended distances outside of Sun Prairie, modeling uses the combined city/highway fuel economy for hybrid values. Combined fuel economy is also used for the comparison gasoline vehicle.

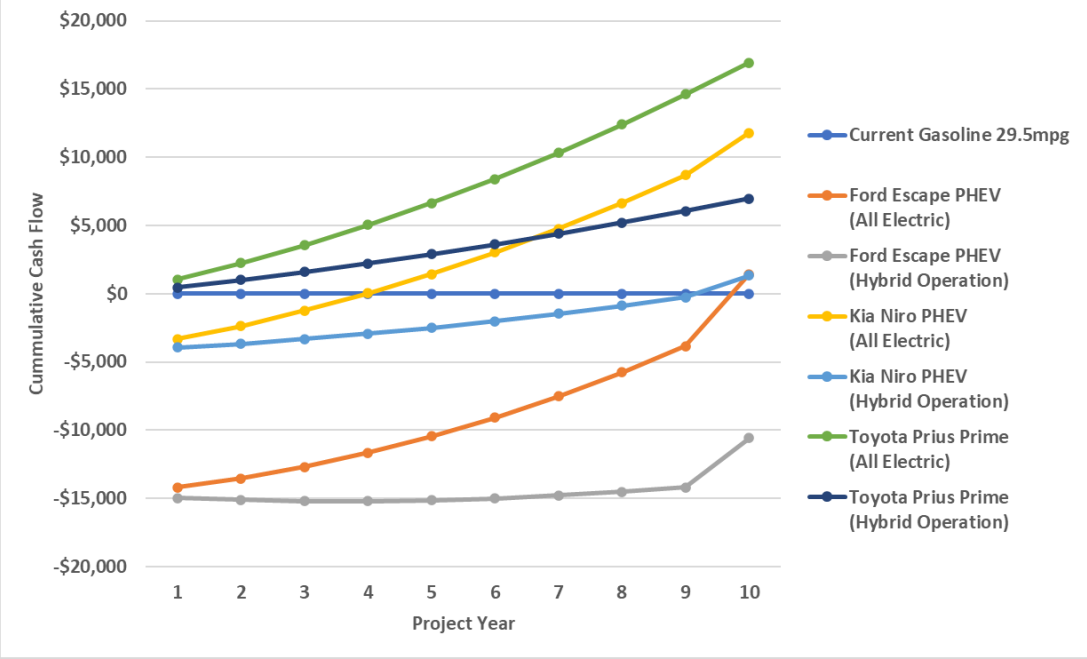
Table 7. Total Cost of Ownership Comparison Small Car Options - Plug-in Hybrid - Mixed Use Operation							
	Current Gasoline 29.5 mpg	Ford Escape PHEV (All Electric)	Ford Escape PHEV (Hybrid Operation)	Kia Niro PHEV (All Electric)	Kia Niro PHEV (Hybrid Operation)	Toyota Prius Prime (All Electric)	Toyota Prius Prime (Hybrid Operation)
Price Per Vehicle	$28,200	$33,075	$33,075	$29,590	$29,590	$28,220	$28,220
Depreciation	$65,765	$77,134	$77,134	$69,006	$69,006	$65,811	$65,811
Fuel	$16,270	$5,155	$11,999	$5,155	$10,434	$4,070	$8,888
Diesel Exhaust Fluid	$0	$0	$0	$0	$0	$0	$0
Maintenance and Repair	$20,695	$13,048	$18,919	$13,048	$18,919	$13,048	$18,919
Insurance	$31,445	$34,564	$34,564	$32,335	$32,335	$31,458	$31,458
License and Registration	$2,414	$5,254	$4,544	$5,254	$4,544	$5,254	$4,544
Total Cost of Ownership	**$136,589**	**$135,155**	**$147,160**	**$124,797**	**$135,238**	**$119,641**	**$129,621**

Plug in hybrid vehicles offer a cost savings during all electric operation ranging from $1,434 for the Ford Escape PHEV to $16,948 for the Toyota Prius Prime. In hybrid operation both the Kia Niro and Toyota Prius Prime offer savings at $1,351 and $6,968 respectively. In hybrid operation the Ford Escape PHEV has an added cost of $10,571 compared to a conventional gasoline car in this category.

If the majority of in city trips are less than the 25-26 mile range that is offered by the Kia Niro or Toyota Prius Prime they offer total costs of operation that is comparable to that of full electric vehicles, and offer the backup option of standard hybrid operation if longer trips are necessary. During standard operation savings are still generated with the Toyota Prius Prime remaining similar in total cost of ownership to full electric vehicles.

Figure 5 illustrates the cost flow generated by plug in hybrids. It can be noted that the Prius Prime offers savings from year one, while the Kia offers savings as an EV by year 4 and a hybrid by year 9. The Ford provides savings if operated primarily as an EV by near year 10.

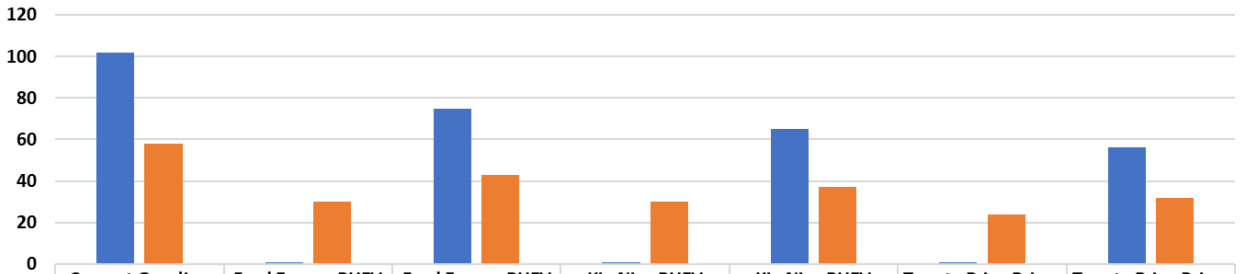
Figure 5: Cumulative Cash Flow – Small Cars Mixed Use – PHEV vs Gasoline



Although plug in hybrids create large decreases in petroleum use while in electric mode, they have much more moderate decreases in petroleum use while operating as hybrids. Emissions levels are roughly equivalent to conventional vehicles.

Table 8. Lifetime Vehicle Operations Air Pollutants Comparison Small Car Options - PHEV - Mixed Use Operation							
	Current Gasoline 29.5mpg	Ford Escape PHEV (All Electric)	Ford Escape PHEV (Hybrid Operation)	Kia Niro PHEV (All Electric)	Kia Niro PHEV (Hybrid Operation)	Toyota Prius Prime (All Electric)	Toyota Prius Prime (Hybrid Operation)
Petroleum Use (barrels)	102	1	75	1	65	1	56
GHGs (short tons)	58	30	43	30	37	24	32
CO (lb)	279	0	279	0	279	0	279
NOx (lb)	5	0	4	0	4	0	4
PM10 (lb)	9	9	9	9	9	9	9
PM2.5 (lb)	2	1	2	1	2	1	2
VOC (lb)	47	0	30	0	30	0	30
Sox (lb)	1	0	0	0	0	0	0

Figure 6. Lifetime Petroleum Use and Greenhouse Gas Emissions



	Current Gasoline 29.5mpg	Ford Escape PHEV (All Electric)	Ford Escape PHEV (Hybrid Operation)	Kia Niro PHEV (All Electric)	Kia Niro PHEV (Hybrid Operation)	Toyota Prius Prime (All Electric)	Toyota Prius Prime (Hybrid Operation)
Petroleum Use (barrels)	102	1	75	1	65	1	56
GHGs (short tons)	58	30	43	30	37	24	32

Hybrid Electric Options

A large number of hybrid electric vehicles are available which offer greater than 40 miles per gallon rating in the city, and all except for the Ford Escape also offer greater than 40 miles per gallon on the highway. All hybrid options listed fit within the budgeted range for small cars. The following list summarizes these options.

- Hybrid Options:
  - Ford Escape Hybrid
  - Honda Insight
  - Honda Accord Hybrid
  - Hyundai Elantra Hybrid
  - Hyundai Sonata Hybrid
  - Hyundai Ioniq Hybrid
  - Kia Niro
  - Toyota Prius
  - Toyota Corolla Hybrid

As fuel economy falls into groups of either 40mpg or 50 mpg range the following vehicles were modeled: Ford Escape hybrid, Honda Insight, Hyundai Ioniq, and Toyota Prius. Sun Prairie is already acquiring a Ford Escape

hybrid and as the vehicles are available in the budgeted rage a comparison will allow for selection based on both budget and added utility that may become available from selection of a larger vehicle.

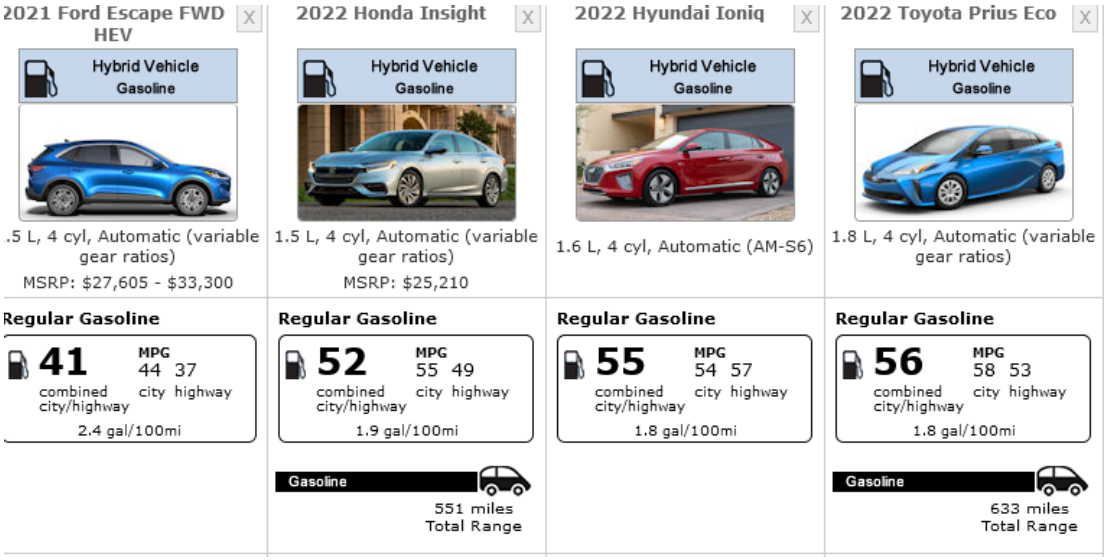
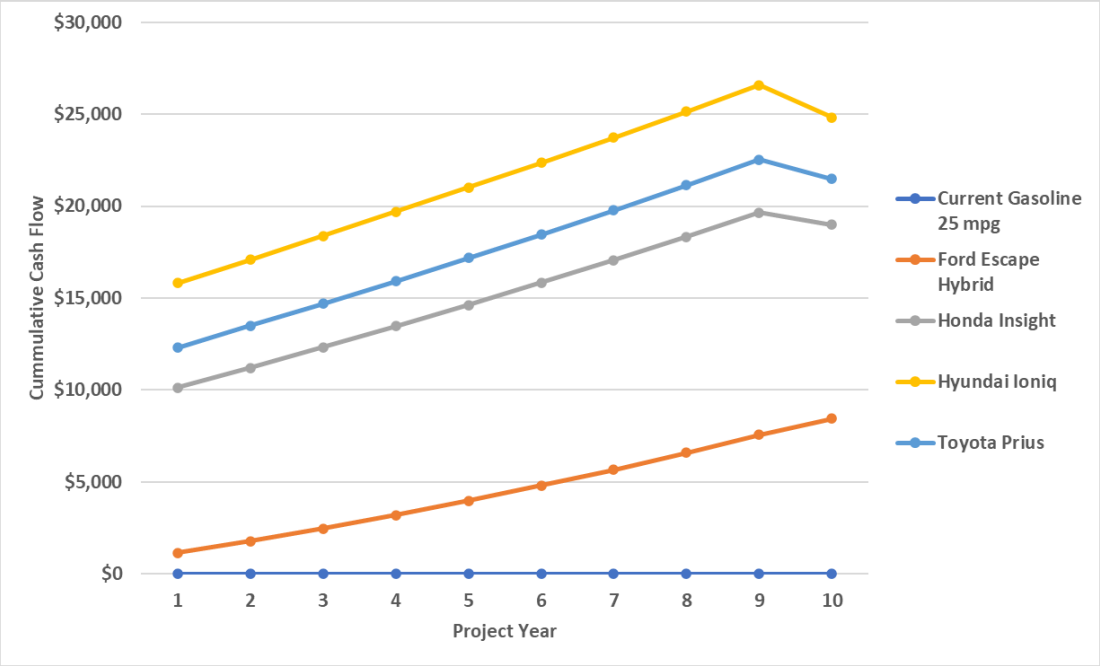


Table 9. Total Cost of Ownership Comparison Small Car Options - Hybrid Electric Vehicles - Mixed Use Operations					
	Current Gasoline 29.5 mpg	**Ford Escape Hybrid**	**Honda Insight**	**Hyundai Ioniq**	**Toyota Prius**
Price Per Vehicle	$28,200	$28,030	$25,210	$23,400	$24,525
Depreciation	$65,765	$65,368	$58,792	$54,571	$57,194
Fuel	$16,270	$11,851	$9,230	$8,135	$8,648
Diesel Exhaust Fluid	$0	$0	$0	$0	$0
Maintenance and Repair	$20,695	$18,919	$18,919	$18,919	$18,919
Insurance	$31,445	$31,336	$29,532	$28,374	$29,094
License and Registration	$2,414	$4,544	$4,544	$4,544	$4,544
Total Cost of Ownership	**$136,589**	**$132,019**	**$121,017**	**$114,543**	**$118,399**

In the mixed use scenario, all hybrid vehicle options provide a lower cost of ownership than the current fleet vehicles offering a savings range of $4,570 for the Ford Escape to $22,046 for the Hyundai Ioniq. This can be compared to table 10 which provides the range of total cost of ownership for only city operation.

Table 10. Total Cost of Ownership Comparison Small Car Options - Hybrid Electric Vehicles - City Only Operations					
	Current Gasoline 25 mpg	**Ford Escape Hybrid**	**Honda Insight**	**Hyundai Ioniq**	**Toyota Prius**
Price Per Vehicle	$28,200	$28,030	$25,210	$23,400	$24,525
Depreciation	$65,765	$65,368	$58,792	$54,571	$57,194
Fuel	$19,198	$10,908	$8,726	$8,275	$8,275
Diesel Exhaust Fluid	$0	$0	$0	$0	$0
Maintenance and Repair	$20,695	$18,919	$18,919	$18,919	$18,919
Insurance	$31,445	$31,336	$29,532	$28,374	$29,094
License and Registration	$2,414	$4,544	$4,544	$4,544	$4,544
Total Cost of Ownership	**$139,518**	**$131,076**	**$120,514**	**$114,683**	**$118,026**

Figure 7: Cumulative Cash Flow – Small Cars City Only Use – HEV vs Gasoline



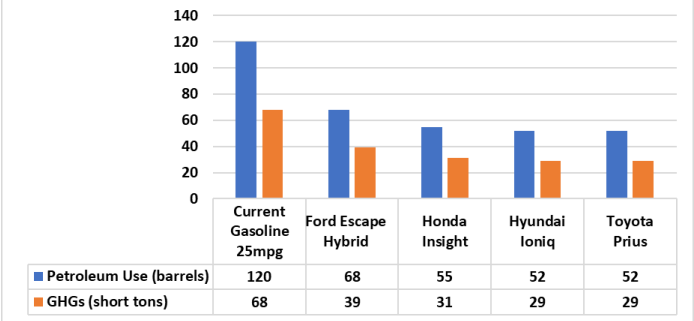
In contrast to other vehicle options, hybrid electric vehicles offer immediate payback for all options considered, with the Hyundai Ioniq offering the best results for savings compared to a conventional vehicle. It should also be noted that the Hyundai Ioniq, Toyota Prius, and Honda Insight all have decreasing benefit after year 9 and if purchased should be replaced as benefits decrease.

In review of total cost of ownership, hybrid electric vehicles offer savings in both city and mixed operation comparable to electric and plug in hybrid vehicles at lower initial costs. If incentives are not available and challenges are encountered related to the deployment of electric vehicle charging infrastructure hybrids offer a clear pathway to decreased costs and emissions. Table 11 and Figure 8 provide details related to lifetime emissions from the evaluated standard hybrid vehicles based on city only operation.

Table 11. Lifetime Vehicle Operations Air Pollutants Comparison Small Car Options - Hybrid Electric - City Only Operations

	Current Gasoline 25mpg	Ford Escape Hybrid	Honda Insight	Hyundai Ioniq	Toyota Prius
Petroleum Use (barrels)	120	68	55	52	52
GHGs (short tons)	68	39	31	29	29
CO (lb)	279	279	279	279	279
NOx (lb)	5	4	4	4	4
PM10 (lb)	9	9	9	9	9
PM2.5 (lb)	2	2	2	2	2
VOC (lb)	47	30	30	30	30
Sox (lb)	1	0	0	0	0

Figure 8. Lifetime Petroleum Use and Greenhouse Gas Emissions



Conventional Options

Conventional vehicles fuel economy has advanced to the extent that many small sport utilities are able to achieve equal fuel economy to the Ford Focus that is currently operated by Sun Prairie. Further, most sedans that would be in the same class as the Ford Focus currently achieve around 40 miles per gallon highway and 30 or better in the city. Market shifts have also lead to a much smaller number of traditional small sedans being available due to discontinuation of models from Chevrolet, Ford, and Stellantis (Chrysler, Dodge, Fiat). Therefore if a conventional vehicle must be the choice as a small car replacement a review of the following would be recommended as options from an efficiency perspective.

- 40 mpg highway options
    - Honda Civic
    - Hyundai Elantra
    - Kia Forte
    - Nissan Versa
    - Toyota Corolla
    - Volkswagen Jetta

These conventional options all have starting prices of $5,000 less than the amount budgeted for replacement in this category. Table 12 provides details on all vehicles considered for this category with color coding index below.

Color	Representation
	Full Electric
	Hybrid
	Plug in Hybrid
	Alternative suggestion
	Price above budgeted range without incentives
	Price above budgeted range with incentives

Table 12: Options available in the Small Car Category

Notes	Vehicle Model Year	Make	Model	Estimated City MPG	Estimated Hwy MPG	Base Price Range
259 Mile Electric Range	2022	Chevy	Bolt	131	109	$31,000
247 Mile Electric Range	2022	Chevy	Bolt EUV	125	104	$33,000
	2021	Chevy	Trailblazer	26 to 29	30 to 33	$21,600 to $25,700
	2021	Chevy	Trax	23 to 24	30 to 32	$21,400 to $23,200
	2021	Chevy	Equinox	25 to 26	30 to 31	$23,800 to $27,600
	2021	Ford	Ecosport	23 to 27	29	$20,395 to $23,960
	2021	Ford	Escape (FWD)	28	34	$25,555 to $27,035
	2021	Ford	Escape (Hybrid FWD)	44	37	$28,030
105MPGe 37 Mile Electric range	2021	Ford	Escape (PHEV FWD)	43	38	$33,075
	2021	GMC	Terrain	25	30	$28,500
	2022	Honda	HR-V	28	34	$21,420
	2022	Honda	CR-V	28	34	$25,750
	2022	Honda	Civic	31	40	$21,700
	2022	Honda	Accord	30	38	$24,970
	2022	Honda	Insight	55	49	$25,210
	2022	Honda	Accord Hybrid	48	48	$26,570
	2022	Hyundai	Kona	30	35	$20,950
258 Miles Electric Range	2022	Hyundai	Kona Electric	132	108	$34,000
	2022	Hyundai	Tucson	26	33	$24,950
	2022	Hyundai	Elantra	31	41	$19,850
	2022	Hyundai	Elantra Hybrid	53	56	$23,550
	2021	Hyundai	Sonata	27	37	$23,950
	2021	Hyundai	Sonata Hybrid	50	54	$27,750
Plug in, all electric versions available, not WI	2021	Hyundai	Ioniq Hybrid	58	60	$23,400
	2021	Jeep	Compass	22	31	$24,495
	2021	Jeep	Cherokee	22	31	$27,210
	2022	Kia	Soul	28	33	$19,190
	2022	Kia	Seltos	29	35	$22,690
	2022	Kia	Sportage	23	30	$24,090
	2022	Kia	Niro	51	46	$24,690
105MPGe 26 Mile Electric range	2022	Kia	Niro Plug-in Hybrid	48	44	$29,590
239 Mile Electric Range	2021	Kia	Niro EV	123	102	$39,090
	2021	Kia	Forte	29	40	$19,390
	2022	Kia	K5	27	37	$23,690
	2021	Mazda	CX-3	29	34	$20,790
	2021	Mazda	CX-30	25	33	$22,050
	2021	Mazda	CX-5	25	31	$25,370
	2021	Mazda	3 Sedan	28	36	$20,650
	2021	Mazda	6 Sedan	26	35	$24,475
	2021	Mitsubishi	Outlander Sport	24	30	$20,995
	2021	Mitsubishi	Eclipse Sport	26	29	$23,395
	2021	Nissan	Kicks	31	36	$19,600
	2021	Nissan	Rogue Sport	25	32	$24,160
	2021	Nissan	Rogue	27	35	$26,050
	2021	Nissan	Versa	32	40	$14,980
	2021	Nissan	Sentra	29	39	$19,510
	2021	Nissan	Altima	28	39	$24,550
149 Miles Electric Range	2022	Nissan	LEAF (40 KW-hr Battery)	123	90	$27,400
226 Miles Electric Range	2022	Nissan	LEAF (62 KW-hr Battery)	118	97	$32,400
	2022	Subaru	Impreza	28	36	$18,795
	2021	Subaru	Crosstrek	28	33	$22,245
263 Miles Electric Range	2021	Tesla	Model 3 Standard Range	150	133	$39,990
244 Miles Electric Range	2021	Tesla	Model Y Standard Range	140	119	$39,990
	2022	Toyota	Prius	54	50	$25,735
	2022	Toyota	Prius L Eco	58	53	$24,525
133 MPGe 25 Miles Electric Range	2021	Toyota	Prius Prime	55	53	$28,220
	2022	Toyota	Corolla	31	40	$20,075
	2022	Toyota	Corolla Hybrid	53	52	$23,650
	2022	Volkswagen	Taos	28	36	$22,995
	2022	Volkswagen	Jetta	30	41	$18,995
250 Miles Electric Range	2021	Volkswagen	ID.4	104	89	$39,995

Vehicle Analysis #2: Midsized Cars

In the midsized car category Sun Prairie deploys two Ford Fusion sedans purchased in 2018 and 2019 with replacement scheduled for 2028 for both vehicles. As these are used by the Building Inspection department all miles are accumulated driving within the city and only achieving an EPA rated city economy of 21 miles per gallon. Average annual miles and calculated fuel consumption can be seen in table 13 below.

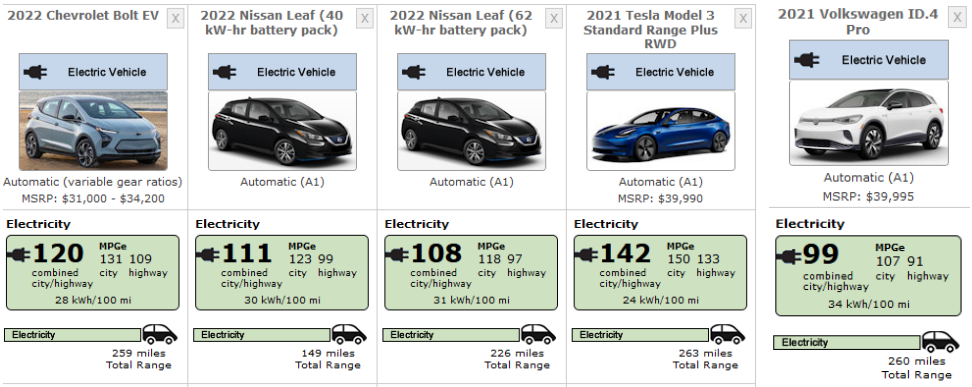
Table 13. Current Midsized Car Fleet

UNIT	Department	Vehicle Model Year	Make	Model	Estimated City MPG	Estimated Hwy MPG	Replacement Year	Budget	Annual miles	Fuel Consumption
324	BUILDING INSPECTION	2018	FORD	FUISION	21	32	2028	35000	3,625	172.62
325	BUILDING INSPECTION	2019	FORD	FUISION	21	31	2028	36000	5,679	270.43

The poor fuel economy, combined with a projected budget amount of $35,000 to $36,000 creates an opportunity for savings when they are replaced with alternative options. Many vehicle options modeled in the small car category such as the Chevy Bolt, Kia Niro, Nissan Leaf, and Toyota Prius may be viable options for replacement as they offer similar interior space. Additionally, vehicles such as the Tesla Model 3 and Model Y, and Volkswagen ID.4 become more viable options even if slightly above budget due to total cost of ownership savings. As the existing fleet in this category is less than 4 years old, has minimal mileage, and 7 years before replacement the options presented below are condensed for educational reference purposes. There are several full electric vehicles projected for availability starting in 2023 that will be worth watching for this category.[6]

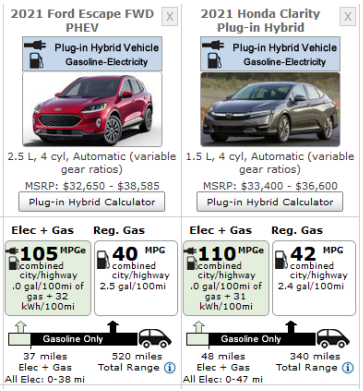
Vehicle Options

- Electric Vehicles

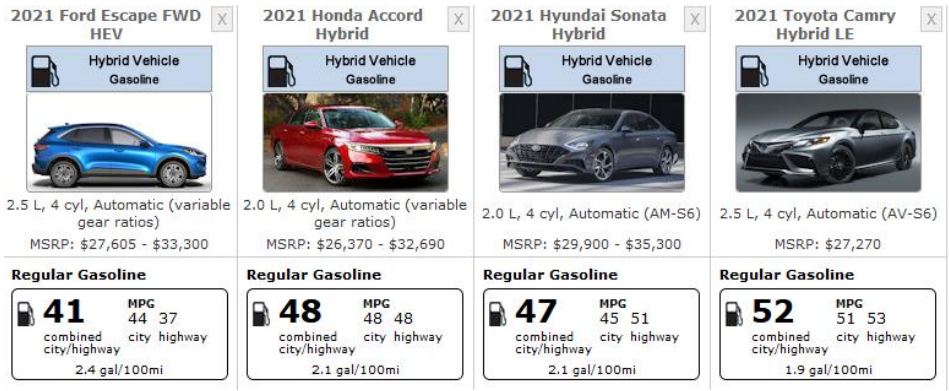


[6] Car and Driver. *Every Electric Vehicle That's Expected in the Next Five Years.* https://www.caranddriver.com/news/g29994375/future-electric-cars-trucks/

- Plug in Hybrid Electric Vehicles



- Hybrid Electric Vehicles



In evaluation of total cost of ownership, the 42 KW-hr Nissan LEAF again provides the lowest value and greatest savings opportunity. Interestingly the next lowest is achieved by the Honda Accord Hybrid, followed by the Toyota Camry Hybrid and then the Chevrolet Bolt. All options listed provide a level of savings compared to the conventional sedans. Details can be reviewed in Table 14. Cumulative cash flow is displayed in Figure 9, with details in Table 15 on the following page.

Table 14. Total Cost of Ownership Comparison Midsized Car -City Only Operation

	Type	Price Per Vehicle	Depreciation	Fuel	Diesel Exhaust Fluid	Maintenance and Repair	Insurance	License and Registration	Total Cost of Ownership
Current Gasoline 21mpg	Gasoline	$35,500	$55,193	$14,699	$0	$13,310	$24,077	$1,609	$108,889
Chevrolet Bolt	Electric	$31,000	$48,196	$2,657	$0	$8,392	$22,158	$3,503	$84,906
Nissan LEAF (40 KW-hr)	Electric	$27,400	$42,599	$2,830	$0	$8,392	$20,622	$3,503	$77,946
Nissan LEAF (62 KW-hr)	Electric	$32,400	$50,373	$2,950	$0	$8,392	$22,755	$3,503	$87,973
Tesla Model 3 Standard Range	Electric	$39,990	$62,173	$2,321	$0	$8,392	$25,993	$3,503	$102,381
Volkswagen ID.4	Electric	$39,995	$62,181	$3,347	$0	$8,392	$25,995	$3,503	$103,418
Ford Escape PHEV (Electric Operation)	Plug in Hybrid	$33,075	$51,423	$3,315	$0	$8,392	$23,043	$3,503	$89,675
Honda Clarity (Electric Operation)	Plug in Hybrid	$33,400	$51,928	$3,165	$0	$8,392	$23,182	$3,503	$90,168
Ford Escape Hybrid	Hybrid	$28,030	$43,579	$7,016	$0	$12,168	$20,891	$3,029	$86,683
Ford Escape PHEV (Hybrid Operation)	Plug in Hybrid	$33,075	$51,423	$7,179	$0	$12,168	$23,043	$3,029	$96,842
Honda Accord Hybrid	Hybrid	$26,570	$41,309	$6,431	$0	$12,168	$20,268	$3,029	$83,206
Honda Clarity (Hybrid Operation)	Plug in Hybrid	$33,400	$51,928	$7,016	$0	$12,168	$23,182	$3,029	$97,322
Hyundai Sonata Hybrid	Hybrid	$27,750	$43,144	$6,174	$0	$12,168	$20,772	$3,029	$85,286
Toyota Camry Hybrid	Hybrid	$27,380	$42,568	$6,053	$0	$12,168	$20,614	$3,029	$84,432

Figure 9: Cumulative Cash Flow – Midsized Car Options

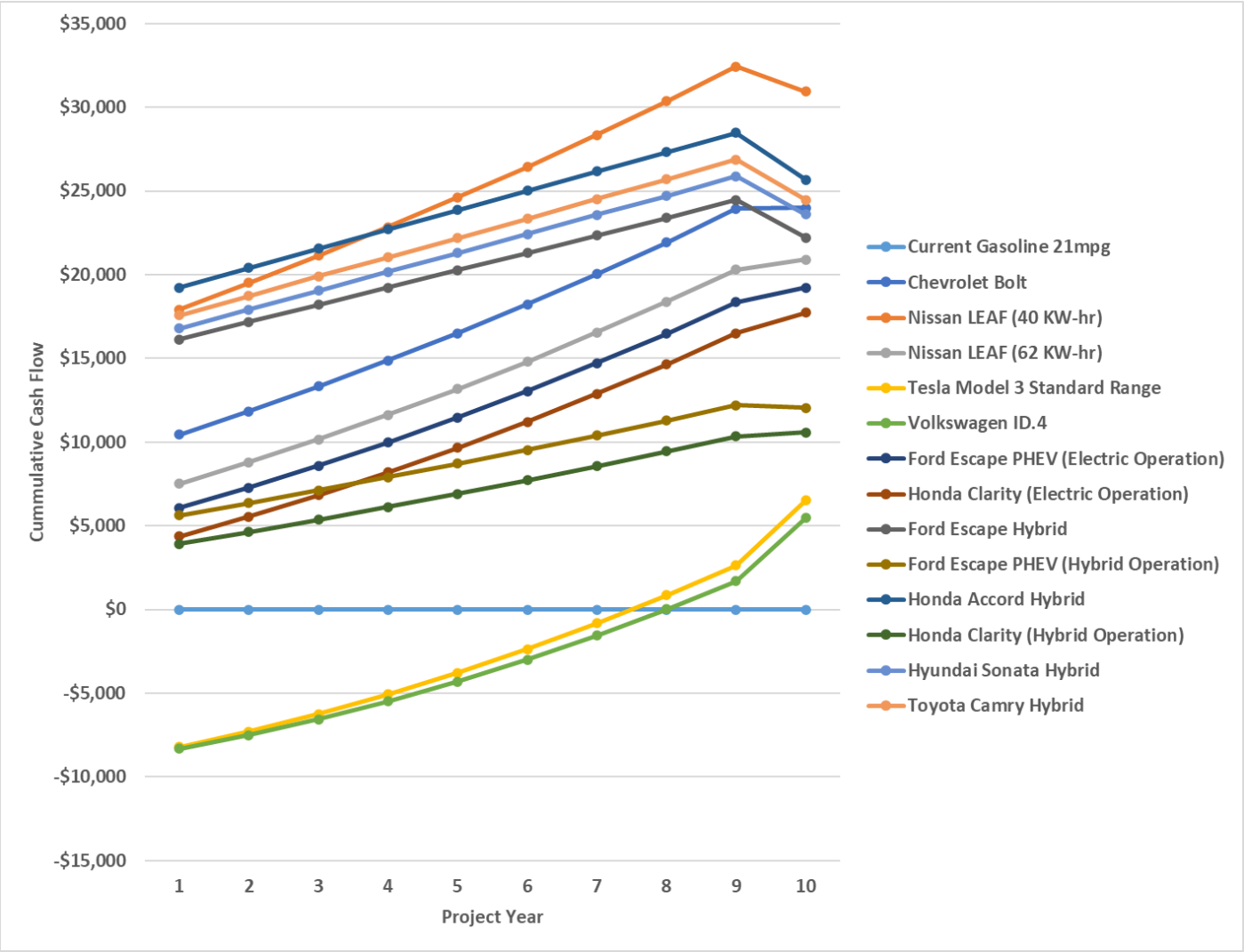


Table 15. Cummulative Cash Flow - Midsized Cars

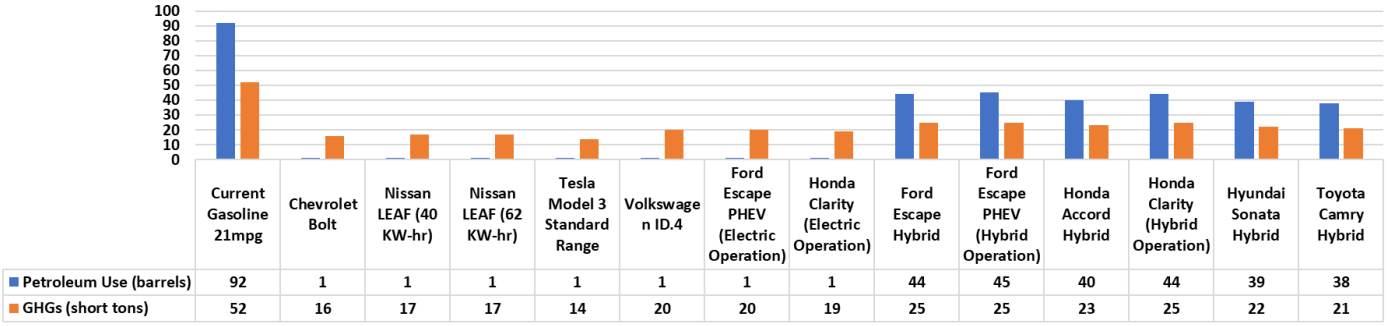
Year	Chevrolet Bolt	Nissan LEAF (40 KW-hr)	Nissan LEAF (62 KW-hr)	Tesla Model 3 Standard Range	Volkswagen ID.4	Ford Escape PHEV (Electric Operation)	Honda Clarity (Electric Operation)	Ford Escape Hybrid	Ford Escape PHEV (Hybrid Operation)	Honda Accord Hybrid	Honda Clarity (Hybrid Operation)	Hyundai Sonata Hybrid	Toyota Camry Hybrid
1	$10,449	$17,919	$7,510	-$8,213	-$8,323	$6,071	$4,370	$16,129	$5,623	$19,218	$3,923	$16,788	$17,568
2	$11,844	$19,502	$8,796	-$7,297	-$7,507	$7,283	$5,550	$17,172	$6,363	$20,398	$4,631	$17,924	$18,736
3	$13,321	$21,146	$10,172	-$6,248	-$6,559	$8,589	$6,828	$18,206	$7,124	$21,562	$5,365	$19,052	$19,895
4	$14,874	$22,847	$11,632	-$5,075	-$5,488	$9,982	$8,198	$19,236	$7,906	$22,716	$6,124	$20,176	$21,048
5	$16,507	$24,612	$13,178	-$3,780	-$4,295	$11,464	$9,661	$20,265	$8,711	$23,863	$6,911	$21,300	$22,199
6	$18,221	$26,442	$14,811	-$2,366	-$2,985	$13,034	$11,216	$21,297	$9,539	$25,008	$7,725	$22,427	$23,352
7	$20,030	$28,354	$16,544	-$823	-$1,545	$14,708	$12,877	$22,338	$10,395	$26,158	$8,570	$23,565	$24,514
8	$21,936	$30,350	$18,378	$848	$21	$16,485	$14,645	$23,392	$11,280	$27,317	$9,448	$24,715	$25,689
9	$23,930	$32,424	$20,305	$2,635	$1,703	$18,356	$16,509	$24,458	$12,193	$28,485	$10,356	$25,879	$26,876
10	$23,983	$30,943	$20,917	$6,508	$5,472	$19,214	$17,730	$22,206	$12,048	$25,684	$10,576	$23,603	$24,457

Regarding emissions, the selection of any non-conventional option provides a decrease in emissions by at least 50%, with electric vehicles having the greatest reductions. Plug in hybrid vehicles that operate as electric vehicles match the greenhouse gas emissions of the Volkswagen ID.4 but do not offer significant reductions compared to standard hybrids such as the Toyota Camry Hybrid or Hyundai Sonata Hybrid which have 1 and 2 short tons of additional emissions respectively. This can be seen in table 16 and figure 10 below.

Table 16. Lifetime Vehicle Operations Air Pollutants Comparison
Midsized Car - City Only Operations

	Petroleum Use (barrels)	GHGs (short tons)	CO (lb)	NOx (lb)	PM10 (lb)	PM2.5 (lb)	VOC (lb)	Sox (lb)
Current Gasoline 21mpg	92	52	179	3	6	1	30	0
Chevrolet Bolt	1	16	0	0	6	1	0	0
Nissan LEAF (40 KW-hr)	1	17	0	0	6	1	0	0
Nissan LEAF (62 KW-hr)	1	17	0	0	6	1	0	0
Tesla Model 3 Standard Range	1	14	0	0	6	1	0	0
Volkswagen ID.4	1	20	0	0	6	1	0	0
Ford Escape PHEV (Electric Operation)	1	20	0	0	6	1	0	0
Honda Clarity (Electric Operation)	1	19	0	0	6	1	0	0
Ford Escape Hybrid	44	25	179	3	6	1	19	0
Ford Escape PHEV (Hybrid Operation)	45	25	179	3	6	1	19	0
Honda Accord Hybrid	40	23	179	3	6	1	19	0
Honda Clarity (Hybrid Operation)	44	25	179	3	6	1	19	0
Hyundai Sonata Hybrid	39	22	179	3	6	1	19	0
Toyota Camry Hybrid	38	21	179	3	6	1	19	0

Figure 10. Lifetime Petroleum Use and Greenhouse Gas Emissions



A full list of vehicles considered for this fleet segment can be seen in table 17 with associated color code index below.

Color	Representation
	Full Electric
	Hybrid
	Plug in Hybrid
	Alternative suggestion
	Price above budgeted range without incentives
	Price above budgeted range with incentives

Table 17: Options available in the Midsized Car Category

Notes	Vehicle Model Year	Make	Model	Estimated City MPG	Estimated Hwy MPG	Base Price Range
259 Mile Electric Range	2022	Chevy	Bolt	131	109	$31,000
247 Mile Electric Range	2022	Chevy	Bolt EUV	125	104	$33,000
	2022	Chevy	Equinox	25 to 26	30 to 31	$23,800 to $27,600
	2021	Chrysler	300 (v-6)	19	30	$31,540
	2021	Dodge	Charger (v-6)	19	30	$30,755 to $32,775
	2021	Ford	Escape (FWD)	28	34	$25,555 to $27,035
	2021	Ford	Escape (Hybrid FWD)	44	37	$28,030
105MPGe 37 Mile Electric range	2021	Ford	Escape (PHEV FWD)	43	38	$33,075
	2021	GMC	Terrain	25	30	$28,500
	2022	Honda	HR-V	28	34	$21,420
	2022	Honda	CR-V	28	34	$25,750
	2022	Honda	CR-V Hybrid	40	35	$30,960
	2022	Honda	Accord	30	38	$24,970
	2022	Honda	Accord Hybrid	48	48	$26,570
110MPGe 48 Mile Electric range	2021	Honda	Clarity	44	40	$33,400
	2022	Hyundai	Tucson	26	33	$24,950
	2022	Hyundai	Tucson Hybrid	37	36	$31,650
	2022	Hyundai	Tucson Hybrid Blue	38	38	$29,050
	2022	Hyundai	Sante Fe Hybrid	33	30	$33,650
	2022	Hyundai	Sante Fe Hybrid Blue	36	31	$33,650
	2021	Hyundai	Sonata	27	37	$23,950
	2021	Hyundai	Sonata Hybrid	50	54	$27,750
Plug in, all electric versions available, not WI	2021	Hyundai	Ioniq Hybrid	58	60	$23,400
	2021	Jeep	Cherokee	22	31	$27,210
	2022	Kia	Sportage	23	30	$24,090
	2022	Kia	Niro	51	46	$24,690
105MPGe 26 Mile Electric range	2022	Kia	Niro Plug-in Hybrid	48	44	$29,590
239 Mile Electric Range	2021	Kia	Niro EV	123	102	$39,090
	2022	Kia	Sorento	24	29	$29,490
	2022	Kia	Sorento Hybrid	39	35	$33,990
	2022	Kia	K5	27	37	$23,690
	2021	Mazda	CX-5	25	31	$25,370
	2021	Mazda	CX-9	22	28	$34,160
	2021	Mazda	6 Sedan	26	35	$24,475
	2021	Mitsubishi	Outlander Sport	24	30	$20,995
	2021	Mitsubishi	Eclipse Sport	26	29	$23,395
	2021	Nissan	Rogue Sport	25	32	$24,160
	2021	Nissan	Rogue	27	35	$26,050
149 Miles Electric Range	2021	Nissan	Altima	28	39	$24,550
226 Miles Electric Range	2022	Nissan	LEAF (40 KW-hr Battery)	123	90	$27,400
	2022	Nissan	LEAF (62 KW-hr Battery)	118	97	$32,400
	2022	Subaru	Legacy	27	35	$22,995
263 Miles Electric Range	2021	Tesla	Model 3 Standard Range	150	133	$39,990
244 Miles Electric Range	2021	Tesla	Model Y Standard Range	140	119	$39,990
	2022	Toyota	Prius	54	50	$25,735
	2022	Toyota	Prius L Eco	58	53	$24,525
133 MPGe 25 Miles Electric Range	2021	Toyota	Prius Prime	55	53	$28,220
	2022	Toyota	Camry	28	39	$25,295
	2022	Toyota	Camry Hybrid	51	53	$27,380
	2021	Toyota	Rav4	28	35	$26,350
	2021	Toyota	Rav4 Hybrid	41	38	$28,900
	2022	Volkswagen	Taos	28	36	$22,995
	2022	Volkswagen	Tiguan	23	29	$25,245
250 Miles Electric Range	2021	Volkswagen	ID.4	104	89	$39,995

Vehicle Analysis #3: Sport Utility Vehicles

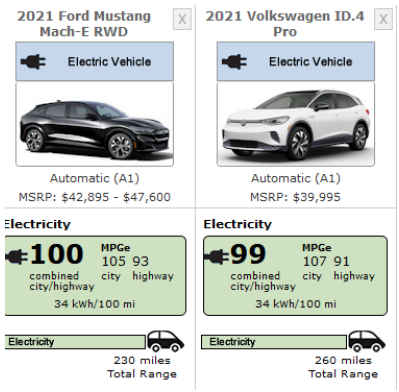
The Sun Prairie sport utility vehicle fleet consists of 3 vehicles operated by two departments. Building Inspection operates a 2018 Ford Explorer and a 2019 Dodge Journey with replacement dates of 2028 and2029 respectively. The third sport utility vehicle operated by the Engineering department is a 2013 Ford Police Utility, no details on replacement plans were provided. The sport utilities operated by Building Inspection average 4,473 miles annually based on calculations from their provided odometer readings. It is likely that the vehicle operated by the Engineering Department was acquired as a retired police unit as it has odometer readings of 88,277 and an annual calculated mileage of 11,034 miles. In review of pickups operated by the Engineering department an average annual mileage of 3,041 is calculated. Due to this the potential replacement of this vehicle was grouped with the two other sport utility vehicles. As was the case with midsized sedans, this class currently has low fuel economy and 7 or more years before likely replacement for at least two of the units, thus recommendations here are for reference purposes. If the unit employed by the Engineering department is to be replaced in the near term this analysis can be adjusted to evaluate a single unit related to vehicles available or projected to be available at that time. A summary of the current fleet is provided in table 17 below.

Table 18. Current Sport Utility Fleet

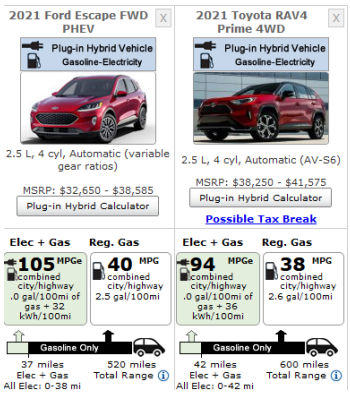
UNIT	Department	Vehicle Model Year	Make	Model	Estimated City MPG	Estimated Hwy MPG	Replacement Year	Budget	Annual miles	Fuel Consumption
323	BUILDING INSPECTION	2018	FORD	EXPLORER	17	24	2028	40000	4,484	264
328	BUILDING INSPECTION	2019	DODGE	JOURNEY	19	25	2029	41000	4,463	235
409	ENGINEERING	2013	FORD	POLICE UTILITY	19.2	0	?	?	11,035	575

At the current time there are two electric, two plug in hybrid, and nine hybrid sport utility vehicles on the market. Many of these options are not oriented towards work operations, however, so for additional consideration analysis has included the conventional Ford Transit Connect Wagon and hybrid Toyota Sienna. The Ford Transit Connect Wagon would offer similar or greater person and cargo space than the currently operated sport utilities while increasing fuel economy to 24 mpg in city operation. The Toyota Sienna offers fuel economy that is similar to many of the hybrid sport utility vehicles while offering additional space while still being under the proposed budget amounts. The following are a representative sampling of vehicles by category modeled. Note, as the Ford Transit Connect Wagon is a conventional gasoline vehicle a cumulative cash flow details are not available through the AFLEET analysis.

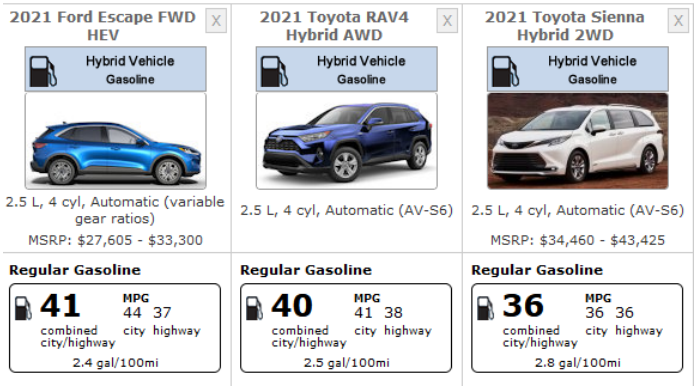
- Electric



- Plug in Hybrid Electric



- Hybrid Electric



- Conventional

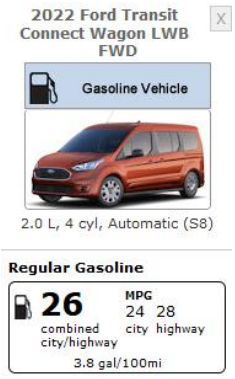


Table 19. Total Cost of Ownership Comparison Sport Utility Vehicle -City Only Operation

	Type	Price Per Vehicle	Depreciation	Fuel	Diesel Exhaust Fluid	Maintenance and Repair	Insurance	License and Registration	Total Cost of Ownership
Current Gasoline 18mpg	Gasoline	$40,500	$94,449	$24,734	$0	$19,797	$39,315	$2,840	$181,136
Ford Mustang Mach E	Electric	$42,895	$100,245	$4,782	$0	$12,482	$40,905	$5,680	$164,093
Volkswagen ID.4	Electric	$39,995	$93,272	$4,828	$0	$12,482	$38,992	$5,680	$155,253
Ford Escape PHEV (Electric Operation)	Plug in Hybrid	$33,075	$77,134	$4,782	$0	$12,103	$34,564	$5,254	$133,837
Toyota Rav4 Prime (Electric Operation)	Plug in Hybrid	$38,350	$89,436	$5,341	$0	$12,103	$37,940	$5,254	$150,074
Ford Escape Hybrid	Hybrid	$28,030	$65,368	$10,119	$0	$18,098	$31,336	$4,970	$129,892
Ford Escape PHEV (Hybrid Operation)	Plug in Hybrid	$33,075	$77,134	$10,354	$0	$17,550	$34,564	$4,544	$144,146
Toyota Rav4 Prime (Hybrid Operation)	Plug in Hybrid	$38,350	$89,436	$11,130	$0	$17,550	$37,940	$4,544	$160,599
Toyota Rav4 Hybrid	Hybrid	$28,900	$67,397	$10,859	$0	$18,098	$31,893	$4,970	$133,218
Toyota Sienna	Hybrid	$34,460	$80,364	$12,367	$0	$18,098	$35,451	$4,970	$151,250
Ford Transit Connect Wagon	Gasoline	$27,920	$65,112	$18,551	$0	$19,797	$31,266	$2,840	$137,566

In review of the total cost of ownership for the modeled options available, the most effective choice is the Ford Escape Hybrid at $129,892, followed by the Toyota Rav4 Hybrid and Ford Escape PHEV. If selected as an alternative to sport utility options, the Ford Transit Connect Wagon offers the next lowest cost of ownership at $137,566. As will be seen later, the Fort Transit Connect is available in several alternative fuel options such as E85, Propane/Bi-Fuel, and CNG/Bi-Fuel. The selection of one of these alternative fuel choices would increase the initial cost due to the upfit equipment but would decrease the fuel costs. If a larger vehicle is needed based on the larger size of the Ford Explorer / Police Utility currently used either the Ford Transit Connect or Toyota Sienna would offer cost savings if selected. It should be noted that additional full electric sport utility vehicles will be available in the near future and definitely before the projected 2028/2029 replacement schedule.

Evaluation of the cumulative cash flow presented in figure 11 and table 20 demonstrates the vast difference between the Ford Escape Hybrid and most other options in this category. This is also confirmation of the selection made by Sun Prairie to have a Ford Escape Hybrid already planned for its fleet.

Figure 11: Cumulative Cash Flow – Sport Utility Vehicle Options

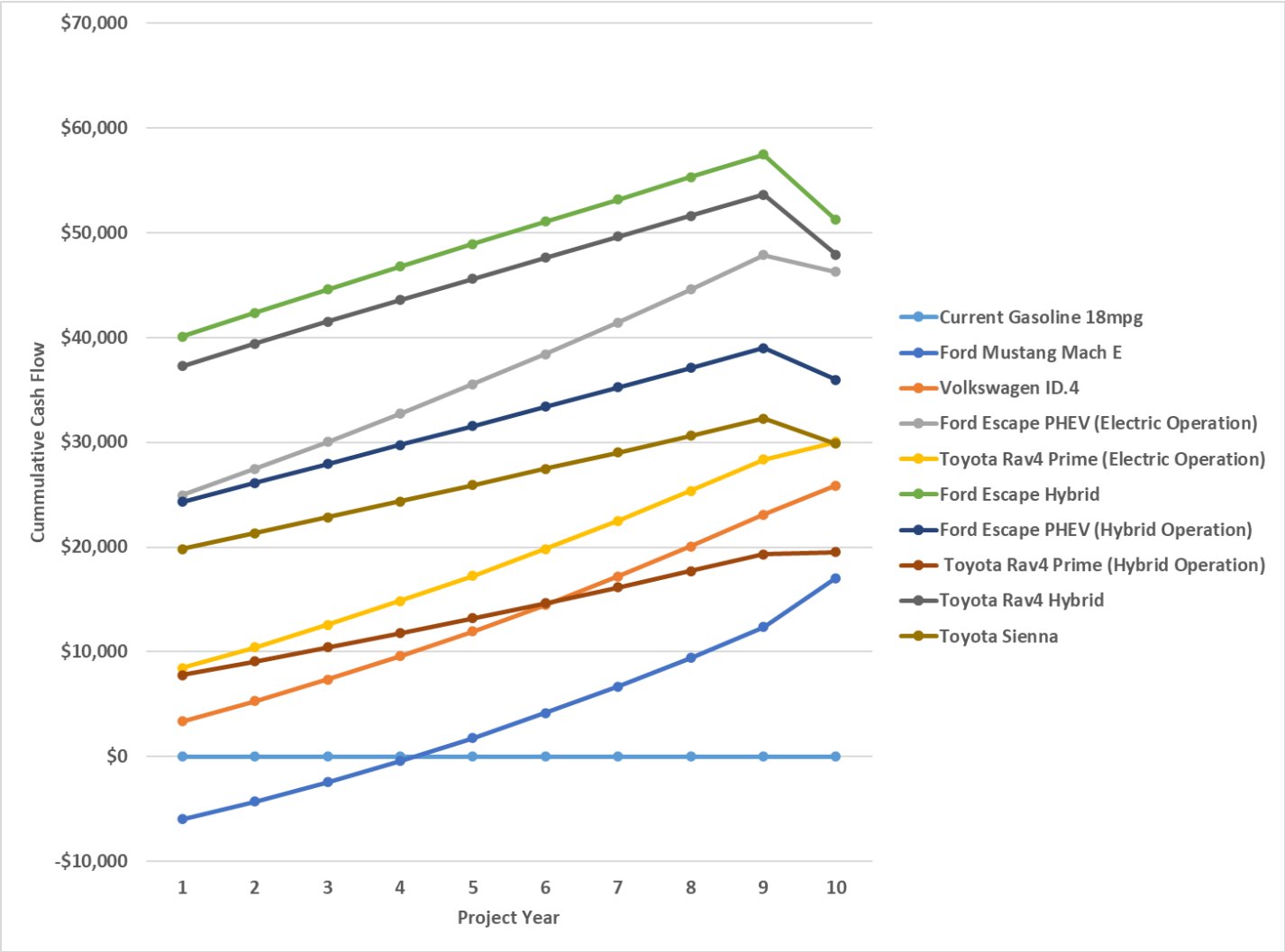


Table 20. Cummulative Cash Flow - Sport Utility Vehicles

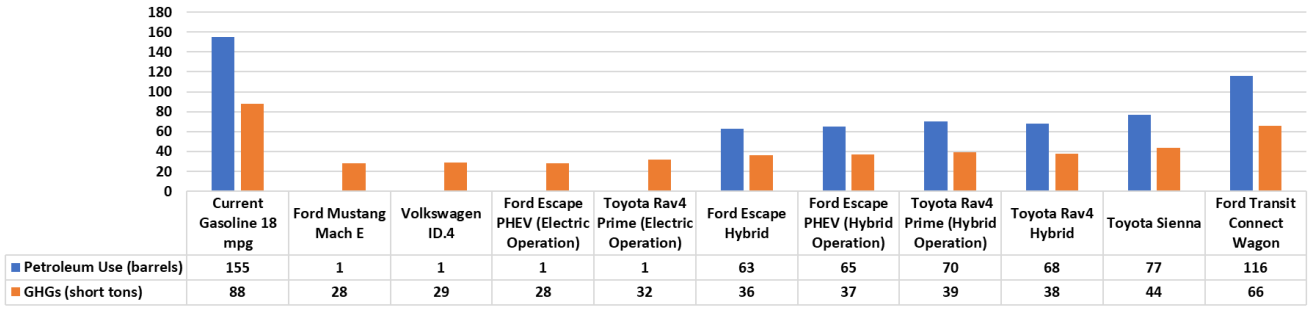
Year	Ford Mustang Mach E	Volkswagen ID.4	Ford Escape PHEV (Electric Operation)	Toyota Rav4 Prime (Electric Operation)	Ford Escape Hybrid	Ford Escape PHEV (Hybrid Operation)	Toyota Rav4 Prime (Hybrid Operation)	Toyota Rav4 Hybrid	Toyota Sienna
1	-$5,951	$3,371	$24,951	$8,442	$40,069	$24,309	$7,784	$37,288	$19,809
2	-$4,288	$5,285	$27,450	$10,437	$42,344	$26,129	$9,082	$39,421	$21,327
3	-$2,438	$7,360	$30,047	$12,573	$44,571	$27,943	$10,417	$41,511	$22,848
4	-$415	$9,585	$32,737	$14,844	$46,758	$29,755	$11,790	$43,566	$24,374
5	$1,782	$11,963	$35,528	$17,252	$48,915	$31,571	$13,203	$45,597	$25,911
6	$4,148	$14,491	$38,422	$19,797	$51,052	$33,398	$14,658	$47,610	$27,462
7	$6,702	$17,189	$41,445	$22,499	$53,181	$35,244	$16,160	$49,619	$29,038
8	$9,440	$20,058	$44,598	$25,358	$55,310	$37,114	$17,711	$51,631	$30,640
9	$12,348	$23,082	$47,873	$28,362	$57,442	$39,009	$19,309	$53,648	$32,270
10	$17,043	$25,883	$46,273	$30,037	$51,245	$35,964	$19,511	$47,919	$29,887

The lifetime emissions generated by vehicles in this category can be reviewed in table 21 and figure 12 below. The Ford Transit Connect Wagon in standard configuration reduces petroleum use by 39 barrels and short tons of green house gas emissions by 22. Most hybrid options decrease petroleum use by between 53 and 39 from this value. Electric vehicle options or use of plug in hybrid electrics in electric only mode provide the greatest decrease in emissions.

Table 21. Lifetime Vehicle Operations Air Pollutants Comparison
Sport Utility Vehicle - City Only Operations

	Petroleum Use (barrels)	GHGs (short tons)	CO (lb)	NOx (lb)	PM10 (lb)	PM2.5 (lb)	VOC (lb)	Sox (lb)
Current Gasoline 18 mpg	155	88	290	5	9	2	42	1
Ford Mustang Mach E	1	28	0	0	8	1	0	0
Volkswagen ID.4	1	29	0	0	8	1	0	0
Ford Escape PHEV (Electric Operation)	1	28	0	0	8	1	0	0
Toyota Rav4 Prime (Electric Operation)	1	32	0	0	8	1	0	0
Ford Escape Hybrid	63	36	290	5	9	2	27	0
Ford Escape PHEV (Hybrid Operation)	65	37	258	4	9	2	28	0
Toyota Rav4 Prime (Hybrid Operation)	70	39	258	4	9	2	28	0
Toyota Rav4 Hybrid	68	38	290	5	9	2	27	0
Toyota Sienna	77	44	290	5	9	2	27	0
Ford Transit Connect Wagon	116	66	290	5	9	2	42	1

Figure 12. Lifetime Petroleum Use and Greenhouse Gas Emissions



A listing of all vehicles considered for this fleet segment are displayed in table 22 on the following page. Please use the following color index to help identify electric, plug-in hybrid electric, and hybrid electric vehicles.

Color	Representation
	Full Electric
	Hybrid
	Plug in Hybrid
	Alternative suggestion
	Price above budgeted range without incentives
	Price above budgeted range with incentives

Table 22: Options available in the Sport Utility Vehicle Category						
Notes	Vehicle Model Year	Make	Model	Estimated City MPG	Estimated Hwy MPG	Base Price Range
	2022	Chevy	Equinox	25 to 26	30 to 31	$23,800 to $27,600
	2021	Dodge	Durango (V-6)	18 to 19	25 to 26	$32,962 to $37,352
	2021	Ford	Escape (FWD)	28	34	$25,555 to $27,035
	2021	Ford	Escape (Hybrid FWD)	44	37	$28,030
105MPGe 37 Mile Electric range	2021	Ford	Escape (PHEV FWD)	43	38	$33,075
	2021	Ford	Explorer (I-4 AWD)	20	27	$32,925 to $35,075
	2021	Ford	Edge	19 to 21	25 to 29	$32,750
230 Mile Electric Range base	2021	Ford	Mustang Mach E	105	93	$42,895
	2022	Ford	Transit Connect Wagon	24	28	$27,920
	2021	GMC	Terrain	25	30	$28,500
	2022	Honda	CR-V	28	34	$25,750
	2022	Honda	CR-V Hybrid	40	35	$30,960
	2021	Honda	Passport	20	25	$32,790
	2022	Hyundai	Tucson	26	33	$24,950
	2022	Hyundai	Tucson Hybrid	37	36	$31,650
	2022	Hyundai	Tucson Hybrid Blue	38	38	$29,050
	2022	Hyundai	Sante Fe	25	28	$27,200
	2022	Hyundai	Sante Fe Hybrid	33	30	$33,650
Plug in version available, not WI	2022	Hyundai	Sante Fe Hybrid Blue	36	31	$33,650
	2021	Jeep	Grand Cherokee	19	26	$34,970
	2022	Kia	Sorento	24	29	$29,490
	2022	Kia	Sorento Hybrid	39	35	$33,990
	2021	Mazda	CX-5	25	31	$25,370
	2021	Mazda	CX-9	22	28	$34,160
	2022	Mitsubishi	Outlander	24	31	$25,795
74 MPGe 24 Mile Electric Range	2021	Mitsubishi	Outlander PHEV	26	26	$36,295
	2021	Nissan	Murano	20	28	$32,810
	2022	Nissan	Pathfinder	21	27	$33,410
	2021	Subaru	Forester	26	33	$24,795
	2021	Subaru	Ascent	21	27	$32,295
	2021	Toyota	Venza	40	37	$32,670
	2021	Toyota	Rav4	28	35	$26,350
	2021	Toyota	Rav4 Hybrid	41	38	$28,900
94 MPGe 42 Mile Electric Range	2021	Toyota	RAV4 Prime	40	36	$38,350
	2021	Toyota	Sienna	36	36	$34,460
	2022	Volkswagen	Tiguan	23	29	$25,245
	2021	Volkswagen	Atlas Cross Sport	21	24	$30,855
	2021	Volkswagen	Atlas	21	24	$31,555
250 Miles Electric Range	2021	Volkswagen	ID.4	104	89	$39,995

Vehicle Analysis #4: Minivan

Sun Prairie currently operated one minivan, a 2010 Dodge Grand Caravan with 49,379 miles on the odometer operated as Admin Checkout. Due to this designation both city only and mixed use were modeled for comparison purposes. The calculated annual vehicle miles traveled is 4,489 at a EPA rating of 17 city / 24 highway / 20.5 combined. Based on the age of this vehicle it is scheduled for replacement this year and has a budget of $39,200 available. Table 23 provides a summary of these details.

Table 23. Current Minivan Fleet										
UNIT	Department	Vehicle Model Year	Make	Model	Estimated City MPG	Estimated Hwy MPG	Replacement Year	Budget	Annual miles	Fuel Consumption
320	ADMIN CHECKOUT	2010	DODGE	GRAND CARAVAN	17	24	2021	39200	4,489	264

Minivans offer unique cargo and passenger flexibility, unfortunately the majority of manufacturers no longer offer minivans in their lineup. Those that remain generally have marginal fuel economy improvements over the currently owned 2010 Dodge Caravan. SUVs are offered with third row seating and marginally improved city fuel economy. If third row seating is needed a minivan is still a better option than a three row SUV. Vans all have larger cargo volumes, especially with the seats folded or removed as well, so if cargo capacity is needed the remaining minivans are a better choice.

There is a single plug-in hybrid option in the Chrysler Pacifica, however it's price exceeds the budgeted amount by over $5,000.

The best options in this category are the Toyota Sienna which offers excellent fuel economy as a hybrid vehicle that falls within the budgeted amount, and the Ford Transit Connect Wagon which offers improved city fuel economy at a considerable cost discount compared to the budget.

The closest direct replacements, with nearly identical fuel economy to the current fleet are the Chrysler Voyager and Honda Odyssey, both under the budgeted amount, with the Chrysler offering a savings of over $11,000 compared to the budgeted amount.

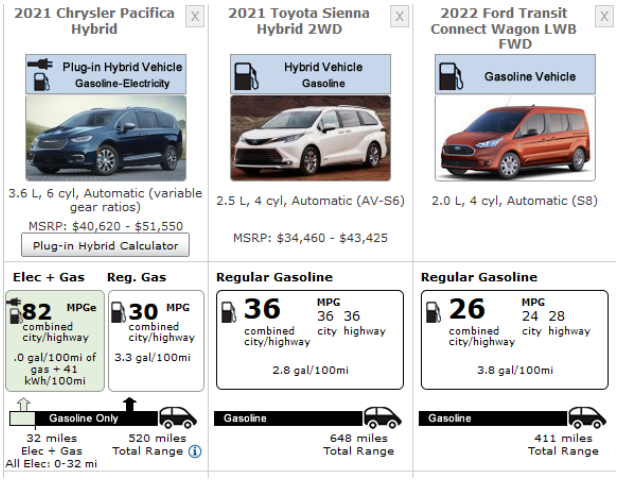
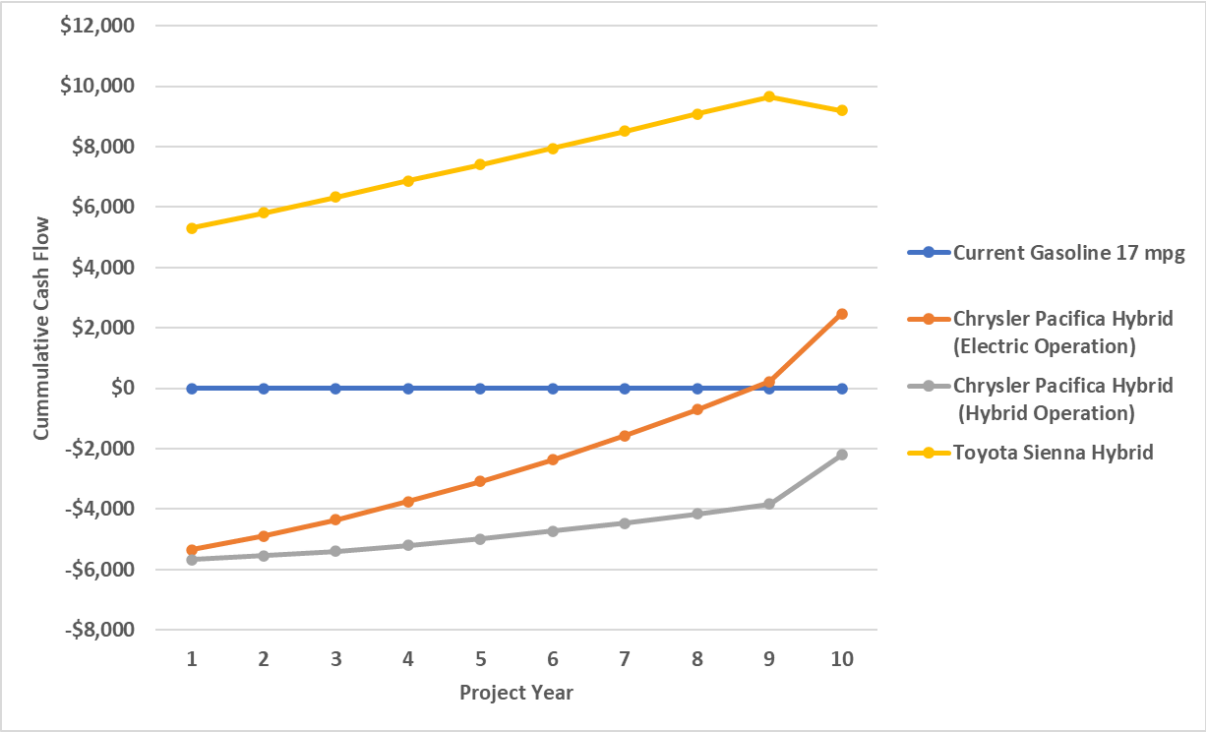


Table 24. Total Cost of Ownership Comparison Minivan Options - City Only Operation					
	Current Gasoline 17 mpg	**Chrysler Pacifica Hybrid (Electric Operation)**	**Chrysler Pacifica Hybrid (Hybrid Operation)**	**Toyota Sienna Hybrid**	**Ford Transit Connect Wagon**
Price Per Vehicle	$39,200	$44,920	$44,920	$34,460	$27,920
Depreciation	$30,473	$34,919	$34,919	$26,788	$21,704
Fuel	$8,761	$2,048	$5,136	$4,122	$6,206
Diesel Exhaust Fluid	$0	$0	$0	$0	$0
Maintenance and Repair	$6,422	$4,049	$5,871	$5,850	$6,422
Insurance	$12,828	$14,048	$14,048	$11,817	$10,422
License and Registration	$805	$1,751	$1,515	$1,515	$805
Total Cost of Ownership	**$59,288**	**$56,815**	**$61,488**	**$50,092**	**$45,558**

In Table 24 the total cost of ownership is provided for comparison between the reviewed options. In this case likely due to the high initial purchase cost the Chrysler Pacifica plug in electric operations provides a minimal level of savings, while actually having a higher total cost of ownership if operated as a hybrid. The Toyota Sienna generates a savings of $9,196 and is likely the best option related to conventional minivans offered. If a slightly smaller, 4 cylinder minivan which still offers 7 passenger seating, can accommodate normal use it offers the greatest savings at $13,730.

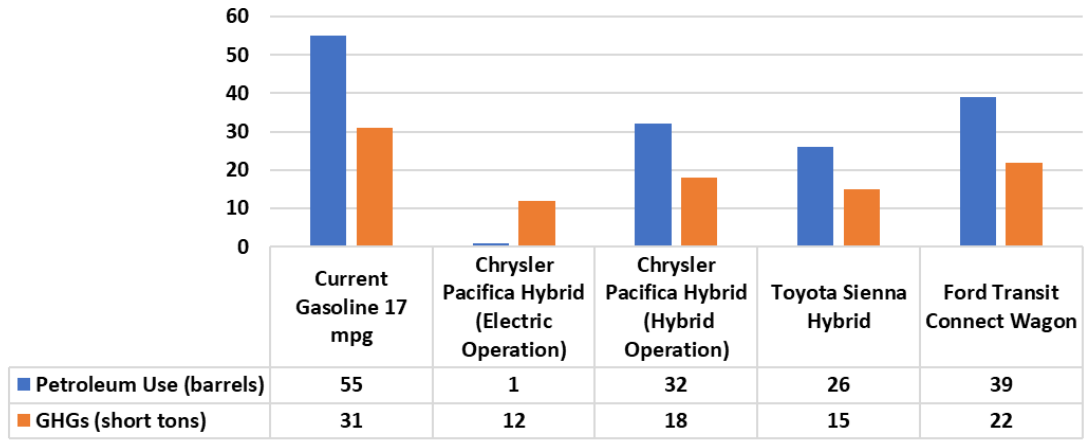
Figure 13: Cumulative Cash Flow – Minivan Options



As can be expected when reviewing the emissions generated by vehicle options in this category, the greatest opportunity for reduction is achieved through electric operation of the Chrysler Pacifica Hybrid. The differences between the Chrysler Pacifica Hybrid and Toyota Sienna Hybrid are relatively small when the Pacifica is in hybrid operation. A shift to the Ford Transit Connect instead of the current van or those with similar fuel economy provides decreases in petroleum use by 16 barrels and green house gas emissions by 9 short tons. Overview of emissions details is provided in table 25 and figure 14 on the following page.

Table 25. Lifetime Vehicle Operations Air Pollutants Comparison Minivan Options - City Only Operation					
	Current Gasoline 17 mpg	Chrysler Pacifica Hybrid (Electric Operation)	Chrysler Pacifica Hybrid (Hybrid Operation)	Toyota Sienna Hybrid	Ford Transit Connect Wagon
Petroleum Use (barrels)	55	1	32	26	39
GHGs (short tons)	31	12	18	15	22
CO (lb)	86	0	86	86	86
NOx (lb)	2	0	1	1	2
PM10 (lb)	3	3	3	3	3
PM2.5 (lb)	1	0	1	1	1
VOC (lb)	15	0	9	9	15
Sox (lb)	0	0	0	0	0

Figure 14. Lifetime Petroleum Use and Greenhouse Gas Emissions



In review of changes when modeling operations as mixed use, the increased fuel economy for the existing vehicle decreases total cost of ownership to $57,792. As the fuel economy in city and highway is equal for the Toyota Sienna, and nearly equal for the Pacifica Hybrid in hybrid operation (29 city/30 highway) there are minimal changes to the cost of ownership and emissions. In mixed use the total cost of ownership for the Ford Transit Connect Wagon decreases from $45,558 to $45,081.

A listing of all vehicles considered for this category are displayed in 26 on the following page. This listing includes both minivans and the three row sport utility vehicles that replaced them for many manufacturers.

Color	Representation
	Full Electric
	Hybrid
	Plug in Hybrid
	Alternative suggestion
	Price above budgeted range without incentives
	Price above budgeted range with incentives

Table 26: Options available in the Minivan Category						
Notes	Vehicle Model Year	Make	Model	Estimated City MPG	Estimated Hwy MPG	Base Price Range
	2021	Chevrolet	Traverse	18	27	$29,800
	2021	Chysler	Pacifica	19	28	$35,820
82 MPGe if plugged in 32 miles electric only range	2021	Chysler	Pacifica Hybrid	29	30	$44,920
	2021	Chrysler	Voyager	19	28	$27,860 to $30,570
	2021	Dodge	Durango (V-6)	18 to 19	25 to 26	$32,962 to $37,352
	2021	Ford	Explorer	27	29	$32,925
	2022	Ford	Transit Connect Wagon	24	28	$27,920
	2022	Honda	Odyssey	19	28	$32,290
	2022	Hyundai	Palisade	19	26	$32,675
	2022	Jeep	Wagoneer (Grand Cherokee L)	16	22	$38,635
	2022	Kia	Telluride	20	26	$32,790
	2022	Kia	Carnival	19	26	$32,100
	2021	Mazda	CX-9	22	28	$34,160
	2021	Mercedes Benz	Metris (Passenger)	18	22	$36,840
	2022	Mitsubishi	Outlander	24	31	$25,795
	2021	Subaru	Ascent	21	27	$32,295
	2021	Toyota	Sienna	36	36	$34,460
	2021	Volkswagen	Atlas	21	24	$31,555

Vehicle Analysis #5: Pickup Trucks

The pickup fleet of Sun Prairie consists of 6 vehicles ranging in age from a 2009 Chevrolet Silverado 1500 to a 2019 Ford F-150. Replacement years provided range from 2024 to 2029. The oldest vehicle does not provide a replacement year, however based on the fleet forecast document a projected life of 10 years would be likely with replacement due in the current or future year. Pickups are operated by three departments – Building Inspection, Building Maintenance, and Engineering. Average calculated annual mileage is 3,155, with a range of 1,806 for Unit 326, the newest F-150, to 5,067 for unit 319, the oldest Silverado 1500. As pickups have wide range of potential specifications fuel economy was estimated for the most efficient EPA values usually consisting of V-6 and 2 wheel Drive.

Table 26. Current Pickup Truck Fleet										
UNIT	Department	Vehicle Model Year	Make	Model	Estimated City MPG	Estimated Hwy MPG	Replacement Year	Budget	Annual miles	Fuel Consumption
322	BUILDING MAINTENANCE	2017	FORD	F-150	19	22	2027	42000	2,937	155
326	BUILDING INSPECTION	2019	FORD	F-150	17	21	2029	40000	1,807	106
407	ENGINEERING	2015	FORD	F-150	19	26	2025	39000	3,140	165
408	ENGINEERING	2016	FORD	F-150	18	24	2026	40000	3,442	191
319	BUILDING INSPECTION	2009	CHEVY	SILVERADO 1500	14	20	?	?	5,068	362
406	ENGINEERING	2014	FORD	F-150 CREW CAB	16	22	2024	38000	2,541	159

Pickups offer a wide range of specification and upfitting options which makes direct comparisons, budgets, and expected savings more difficult to estimate. Pickups are one of the areas where alternative fuels are more of an option as diesel, biodiesel, CNG, Propane, and hybrid electric options all exist currently with full electric becoming available in the near future.

Currently available gasoline models, when specified as rear wheel drive and highest efficiency do not offer considerable fuel economy benefits compared to the current fleet. Two hybrid full sized pickups are currently for sale – the Ford F-150 and Ram 1500. These models improve city fuel economy by 5 to 10 miles per gallon, with the Ford offering additional benefits related to being able to act as a on site generator. If a smaller truck would be capable of meeting requirements, the Ford Maverick will be offered as a hybrid with a starting price of $19,995.

An option to consider would be replacing pickup trucks with compact cargo vans. These offer improved city fuel economy (20 to 24 vs. 14 to 19), drastically lower purchase prices (starting at a bit over $23,000) and can be upfit with internal storage racks and external ladder racks that would be able to more securely hold equipment and parts that would be likely used by the departments operating them. Additional considerations are that they would have easier parking within sometimes confined city spaces and parking lots and would offer greater ability to add graphics promoting city programs.

If the capacity of a full sized truck is needed from a weight perspective, consideration of full sized vans would also be worth consideration. Fuel economy and purchase price would be similar to current pickups, however it would offer the benefits of an enclosed cargo space, easier upfitting options, lower cargo floor, and easier access due to being able to enter via side doors and walk inside.

If passenger seating for more than 2 is required both Ford and Mercedes Benz offer what are termed "crew van" options that offer a second row of seating with the remainder of the van configurable for cargo or work space.

All van options also include the possibilities of deploying alternative fuels and even full electric through manufacturer certified vendor upgrades.

Modeling of this fleet segment is not possible at the current time without additional details. Fuel economy values have not been released at the date of this report for the Ford Maverick, and pricing details are unavailable for the Ford F-150 Hybrid. Depending on specifications the Dodge Ram Hybrid only offers 1 additional mile per gallon of efficiency compared to the estimated fleet values. EPA fuel economy estimates are not required for commercial vans. Pricing details are not available for upfit alternative fuel van and pickup options – if this is of interest additional work can be performed to obtain estimates and associated calculations. This market segment is also likely to see large changes prior to the purchasing of scheduled replacement vehicles. Electric pickups will be available starting next year with the Ford F-150 Lightning starting production, and announcements from Chevrolet, Ram, and several new manufacturers starting in 2022-2023.[7]

Tables 27, 28, and 29 provide details on all vehicles evaluated for this category and a sampling of alternative fuel options for vehicles that could be considered. The following color index identifies areas of missing information and hybrid vehicles.

Color	Representation
	Full Electric
	Hybrid
	Plug in Hybrid
	Alternative suggestion
	Price above budgeted range without incentives
	Information unavailable: * pending manufacturer announcement or dependent on vehicle specification

[7] Motortrend. *Electric Rodeo: Every Electric Pickup Truck on the Way Soon.* https://www.motortrend.com/news/future-electric-pickup-trucks/

Table 27: Options available in the Pickup Truck Category					
Vehicle Model Year	**Make**	**Model**	**Estimated City MPG**	**Estimated Hwy MPG**	**Base Price Range**
2021	Chevy	Colorado	18	25	$25,200
2021	Chevy	Silverado (3L DSL)	23	33	
2021	Chevy	Silverado (4.3L V-6)	16	21	$30,995
2021	Chevy	Silverado (2.7L I-4)	20	23	$31,150
2021	Chevy	Silverado (5.3L V-8)	15	21	$32,340
2022	Ford	Maverick			$19,995
2021	Ford	Ranger	21	26	$25,070
2021	Ford	F-150 Hybrid	25	26	
2021	Ram	1500 (3.6 Hybrid)	20	25	$32,795
2021	Toyota	Tacoma	18	22	$26,400
2021	Toyota	Tundra	13	17	$34,025
2021	Nissan	Frontier	18	24	$27,190
2021	Nissan	Titan	16	21	$36,950

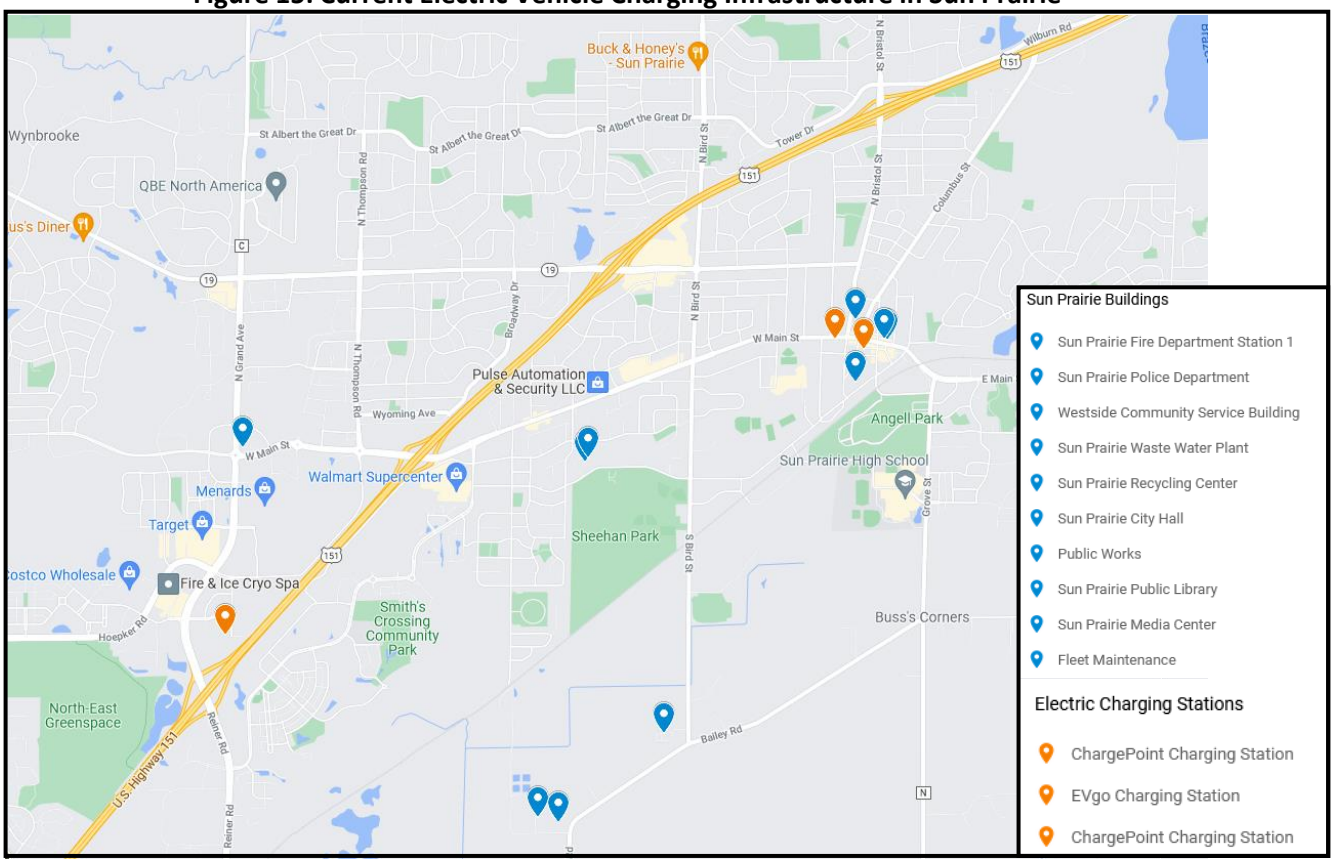
Table 28: Options available Cargo Van Alternatives					
Vehicle Model Year	**Make**	**Model**	**Estimated City MPG**	**Estimated Hwy MPG**	**Base Price Range**
2021	Ford	Transit Connect (2L I-4)	24	27	$24,665
2021	Ford	Transit Connect (2.5L I-4)	20	27	$24,665
2021	Ram	Promaster City	21	28	$25,065
2021	Nissan	NV200	24	26	$23,630
2021	Mercedes Benz	Metris	19	23	$32,630
2021	Ford	Transit	15	19	$35,270
2021	Ram	Promaster			$30,590
2021	Mercedes Benz	Sprinter			$36,355
2021	Nissan	NV Cargo			$30,640

Table 29: Options available Cargo Van Alternatives					
Vehicle Model Year	**Make**	**Model**	**Fuel**	**Estimated City MPG**	**Estimated Hwy MPG**
2022	Chevy	Colorado	Biodiesel	20	30
2022	GMC	Canyon	Biodiesel	20	30
2021	Ford	F-150	Ethanol	17	23
2021	Ford	F-150	Biodiesel	20	27
2021	Ford	F-150	Propane / Bi-Fuel		
2021	Ford	Transit Connect	E85	24	27
2021	Ford	Transit Connect	Propane / Bi-Fuel		
2021	Ford	Transit Connect	CNG / Bi-Fuel		
2021	Ford	Transit	E85	11	14
2020	Ford	Transit	Electric		
2020	Ford	Transit	Hybrid Electric		

Opportunities for Electric Vehicle Charging Infrastructure Deployment

Sun Prairie is currently home to 3 electric vehicle charging stations, 1 DC Fast Charge and 2 Level 2. The two level 2 chargers are part of the ChargePoint network with one operated by Sun Prairie Utilities and the other located at a Woodman's Grocery store. The DC Fast Charge station is operated by the City of Sun Prairie and is part of the EVgo network. Figure 15 below plots existing charging stations and City of Sun Prairie Buildings.

Figure 15: Current Electric Vehicle Charging Infrastructure in Sun Prairie



The majority of existing stations are present near the city center of Sun Prairie which provides easy access to the public during events and for city fleet vehicles to charge. Although distances are small this concentration leaves a large number of opportunities for charging station development which can be primarily for city function and secondarily for public access charging either for free or as a revenue source for the city.

As a starting point the Fleet Maintenance building should be a priority for installation of electric charging, particularly DC Fast charge capability. As more electric vehicles become available, especially in the pickup truck and sport utility vehicle market, these will be frequent visitors to this location. For additional consideration is the benefit of proximity to the city wastewater treatment plant and available land which could be configured to provide renewable electricity for vehicle charging.

Following city government buildings, the next locations that should be prioritized are areas where city vehicles will frequent. A mix of new stations at existing parking lots and community parks which have parking space available. Charging infrastructure in locations where vehicles will be parked for periods of time allow for top off or full battery charging. Community parks have the added benefit of being located around the periphery of Sun Prairie which would improve charging access when vehicles have to travel to the edges of the city boundary. Figure 16 provides a map of existing parking lots in Sun Prairie, figure 17 maps community park locations that have parking available.

Figure 16: Sun Prairie Parking Lots

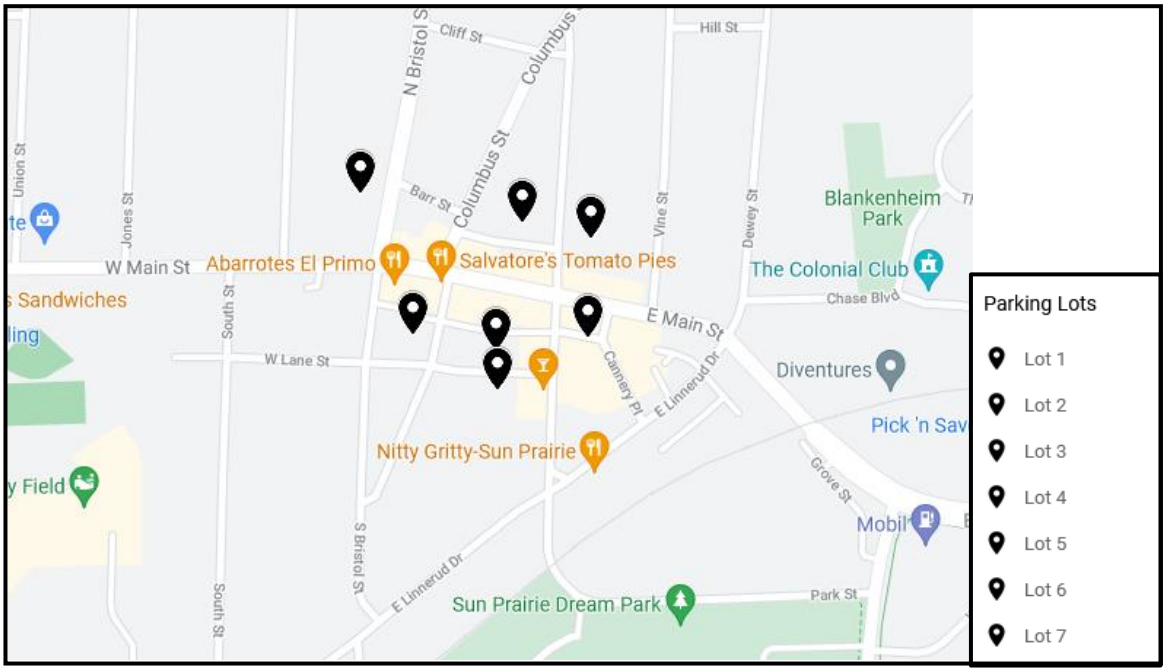
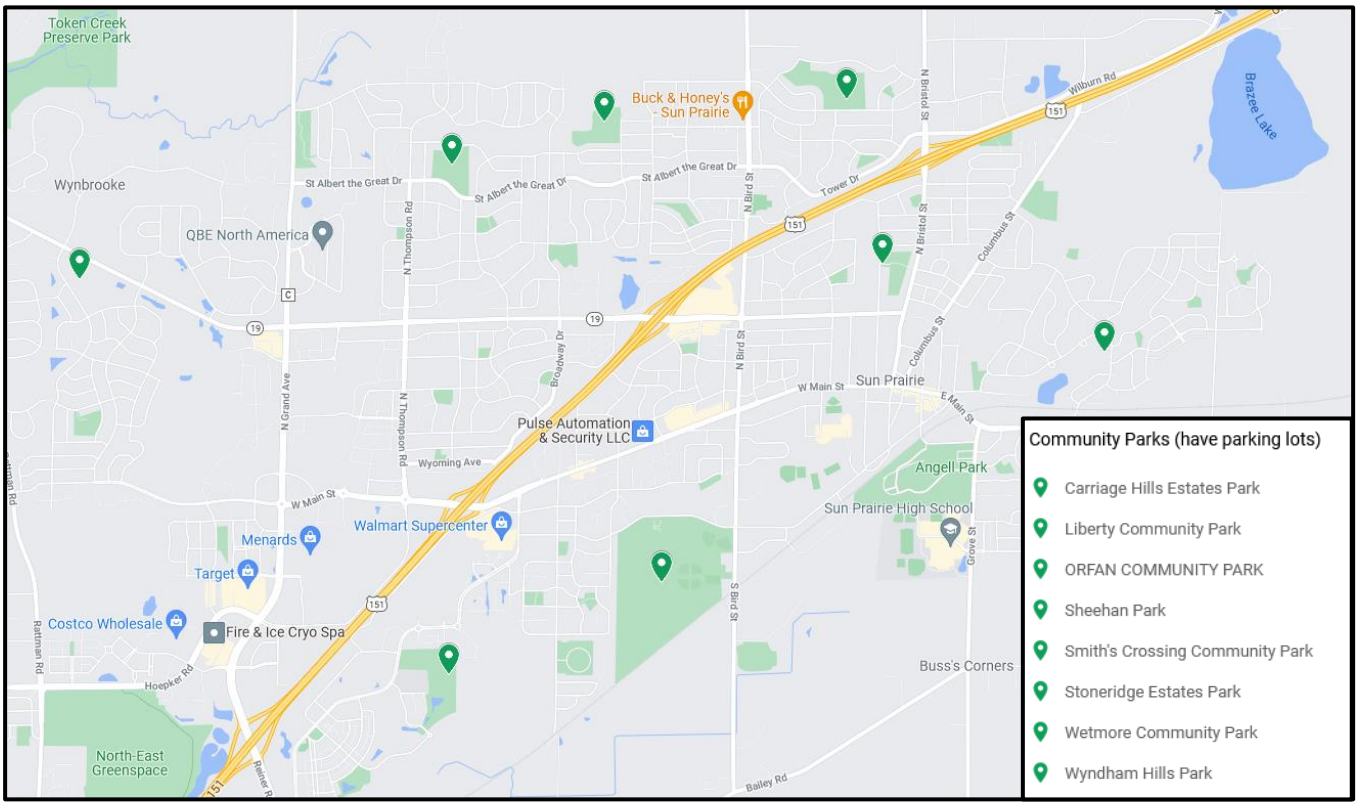


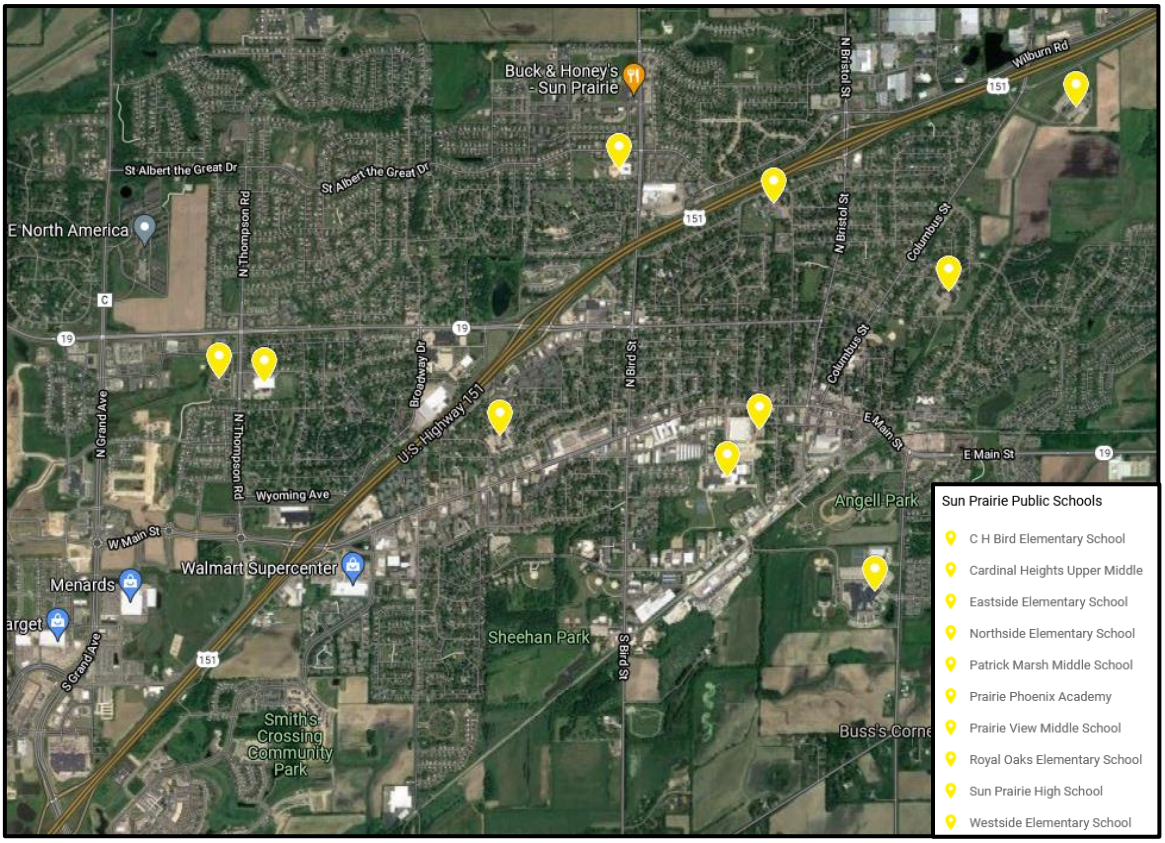
Figure 17: Sun Prairie Community Parks



The next area to consider for the installation of electric vehicle charging infrastructure is the public school system. The schools are a place where the city connects with the community on a daily basis and people stay parked for longer periods of time allowing charging to be viable. In future analysis it may be possible to incorporate some charging infrastructure capable of supporting school bus or shuttle charging which as well would decrease emissions during pickup and drop off periods if idling can be reduced or eliminated. Figure 18 shows locations of schools in Sun Prairie.

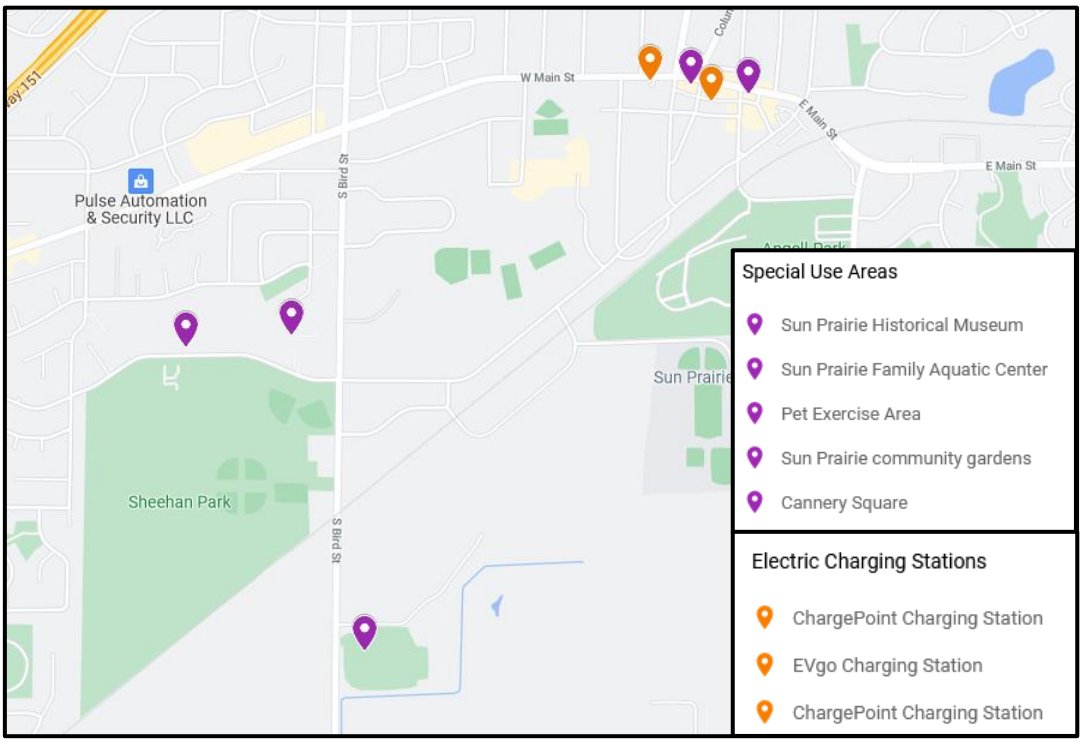
The ability to install electric vehicle charging systems at schools is also the opportunity to develop STEM educational curriculum and hands on programs that will help students become aware of the technologies and gain the skills to participate in what will likely be an standard aspect of society moving forward. If the system can incorporate renewable energy generation systems and statistical/operational data should be a high priority for consideration for both school and park locations.

Figure 18: Sun Prairie Public Schools



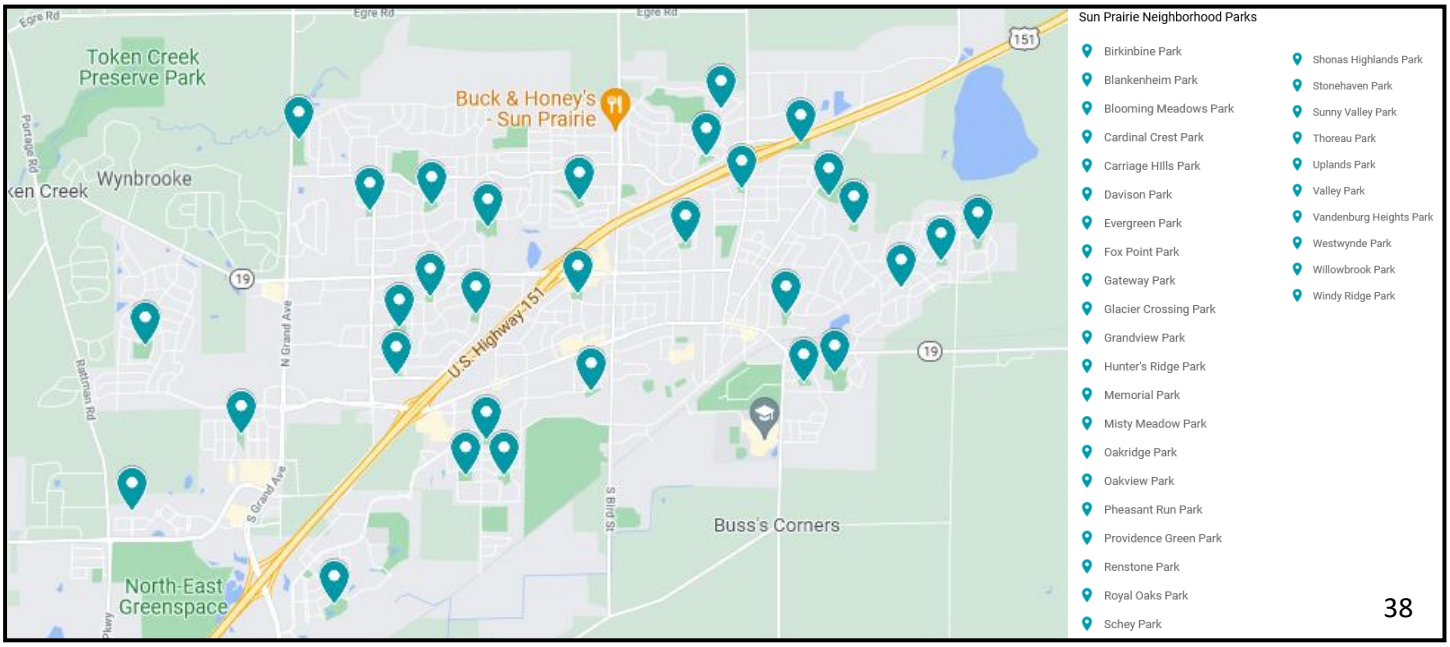
The next area for consideration for electric vehicle charging is Sun Prairie Special Use areas. While the Historical Museum and Cannery square are already in close proximity to electric vehicle charging infrastructure, the community gardens, aquatic center, and dog park have no charging options currently. By expanding current availability or installing new infrastructure these locations where communities gather can be a good method to have citizens more engaged and comfortable with electric vehicle acquisition. Figure 19 displays Sun Prairie Special Use locations.

Figure 19: Sun Prairie Special Use Areas



The last category of locations to consider in Sun Prairie is neighborhood parks. These do not offer any parking lots and any chargers installed would have to be roadside access pedestal types. The benefit to start installing stations at these parks as it makes them more accessible to the general public which would increase local support for electric vehicles. If the stations installed can be adapted to also support charging of park maintenance equipment would provide additional benefit. If installation at these sites is pursued it is recommended that they be installed in areas with disadvantaged populations first and accompanied with programs that enhance access to electric vehicles, car pooling, and public transit efforts. If the parks are located on or could be associated with public transit routes would also be worth consideration. Figure 20 provides an overview of neighborhood park locations.

Figure 20: Sun Prairie Neighborhood Parks



If interested in viewing and creating additional maps based on points of interest displayed in figures 15-20 please visit the following link:

https://www.google.com/maps/d/edit?mid=1OZ8oMO7E8DUTvV52gW1c6AUZp6pea5bX&usp=sharing

There are currently programs offered by many of the utilities in the state to encourage the deployment of electric vehicle charging infrastructure. The local utility, Sun Prairie Utilities offers $250 or up to a maximum of 50% of installed cost is less than $500 for residential level 2 chargers and $1,500 (maximum 50% of installed not to exceed $1,500) for dual head commercial chargers. If the City of Sun Prairie can engage with local companies through the Economic Development department the utility funding could be leveraged to greatly spread system deployment throughout the city.

Review of other utility programs of municipal utilities in the state shows only Manitowoc Public Utilities offers more funding for residential chargers at $500 and only Mount Horeb Electric Utilities offers up to $2,000 for commercial chargers. In regards to the Investor Owned Utilities Alliant Energy offers up to $750 for residential systems and up to $1,500 for commercial systems. An investigation of methods to increase funding availability to match or exceed the best programs in the state should be considered.

Other Renewable Fuel Opportunities

- Utilization of the Sun Prairie Wastewater Treatment Plant and beneficial proximity to the Fleet Maintenance Building

The Sun Prairie Wastewater Treatment plant operates one stage of its process as anaerobic digestion. This process creates biogas that currently is used in combustion systems to heat the treatment plant systems.

Modification of systems to include gas clean up would allow for either the use of gas if upgraded to compressed natural gas quality directly in vehicles or combusted to generate electricity. If electricity is generated it would still be possible to capture waste heat for plant operations. This fuel generated could be employed in Sun Prairie vehicles such as bi-fuel Ford Transit / Transit Connect / or F-150 models. CNG would also have the opportunity be used as a replacement fuel for any diesel vehicles that are currently operated. Alternatively, if electricity is generated any current and future electric vehicles or use to replace utility purchased electricity.

Due to the proximity of the two buildings a microgrid or district heating development should also be considered. Electrical and heat generation could easily be supplemented with the installation of solar panel systems. This would be a project that could be supported through Wisconsin grant programs, especially if efficiency improvements are incorporated at the same time.

Also visible in the image above is Kobussen Buses. Ltd. The proximity of this business would also create the opportunities for a renewable natural gas or electric fueled school bus fleet. By combining efforts in a public-private partnership and increasing emissions reductions would make obtaining project funding more likely.

- OEI EIGP Grant

This grant was recently open for comment and would support the development of a number of different energy related projects. The development of microgrids and electric vehicle charging would likely to be included. To learn more use the link below and sign up for program updates.

https://psc.wi.gov/Pages/Programs/OEI/EnergyInnovationGrantProgram.aspx

Wisconsin Clean Cities can assist in grant applications and assist in finding project partners when it does become available.

- Learn more about Developing Electric Vehicle Charging Infrastructure

The Alternative Fuel Data Center has a large number of publications and case studies that can be useful to consider when starting to develop or partnering with commercial entities for the deployment of electric vehicle charging infrastructure.

  - Developing Infrastructure to Charge Plug-In Electric Vehicles
    - https://afdc.energy.gov/fuels/electricity_infrastructure.html
  - Charging Infrastructure Procurement and Installation
    - https://afdc.energy.gov/fuels/electricity_infrastructure_development.html
  - Charging Infrastructure Operation and Maintenance
    - https://afdc.energy.gov/fuels/electricity_infrastructure_maintenance_and_operation.html
  - Workplace Charging for Plug-In Electric Vehicles
    - https://afdc.energy.gov/fuels/electricity_charging_workplace.html