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## **Buffalo CarShare Electric Vehicle Demonstration**

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### **Summary**

Buffalo CarShare was awarded a project to test electric vehicles (EV) with car-sharing, evaluate and enhance public education of EVs throughout Buffalo, and understand the operational characteristics of EVs in this setting. This project illuminated some existing issues and opportunities for EVs in car-sharing operations. Public education is vital to program success. Some minor issues arose with charging, activation, and cold weather operation. The EVs were only used 53% as much as the conventional gasoline cars. While heavier use would be needed for economic justification, the environmental savings are notable even at lower utilization rates.

*Keywords: EV (electric vehicle), car-sharing, demonstration, vehicle performance, business model*

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## **1 Introduction**

### **1.1 Project Overview**

Buffalo CarShare (BCS) began operations in June 2009 with four vehicles and 30 pioneering members. New York State Energy Research and Development Authority (NYSERDA) and New York State Department of Transportation (NYSDOT) provided some initial funding and the organization quickly grew. By September of 2012, BCS had grown to over 500 members and 12 vehicles. Car-sharing allows members to reduce their transportation costs while enjoying increased mobility and many rely on the service to access healthy food, medical care, and employment opportunities. BCS members reserve vehicles by the hour, which are located throughout the City of Buffalo in Western New York State. The program offers the peace-of-mind of the automobile without the up-front costs, hassles, or larger environmental impacts of private vehicle ownership.

Electric vehicles (EVs) are ideal for short trips in city locations – which match well with the characteristics of many car-sharing service providers. EVs have lower operating costs, so this technology presents an opportunity to increase the cost effectiveness of the car-sharing program. With additional funding from NYSERDA, BCS conducted a demonstration of four EVs at various sites in the City of Buffalo to determine if the technology is able to serve the needs of the members and be cost effective for their car-sharing program. Subcontractor, Energetics Incorporated, assisted BCS with the evaluation of the demonstration activities. Three other key members of the project team are the Buffalo Niagara Medical Campus (BNMC), Buffalo State University, and Baptist Manor, which agreed to host the EVs for the duration of the project.



Figure 1. Ford Focus EV and Level 2 Charging Station in the Buffalo CarShare Fleet

BCS selected Ford Focus EVs (Figure 1) due to their available features that were comparable to existing vehicles in the BCS fleet. BCS leased two Ford Focus EVs for a 24-month term starting in June 2013. The EVs were initially placed on the BNMC where they had already installed charging stations for their staff and visitors—in the parking lot across from the Innovation Center and the visitor garage across from the Gates Vascular Institute. BCS eventually moved both of these EVs to the parking lot by the BNMC SmartHome Buffalo House on Washington Street where all BCS members could better access them. This was BCS’s main hub where several conventional gasoline vehicles were based. When BCS was ready to lease additional EVs, they chose to continue using Ford Focus EVs because they were performing well and it simplified the car-sharing management and operations to use the same models since staff and members had familiarity with the vehicles. BCS added the third Ford Focus EV in January of 2014 and based it at the BNMC SmartHome Buffalo House for four months until Buffalo State University installed a charging station through this project. The fourth Ford Focus EV was leased for 24 months, starting in May 2014, and placed at Baptist Manor, a senior citizen apartment building on Linwood Avenue. The locations of the EVs for the project and timeline during which each was stationed there are shown in Figure 2.

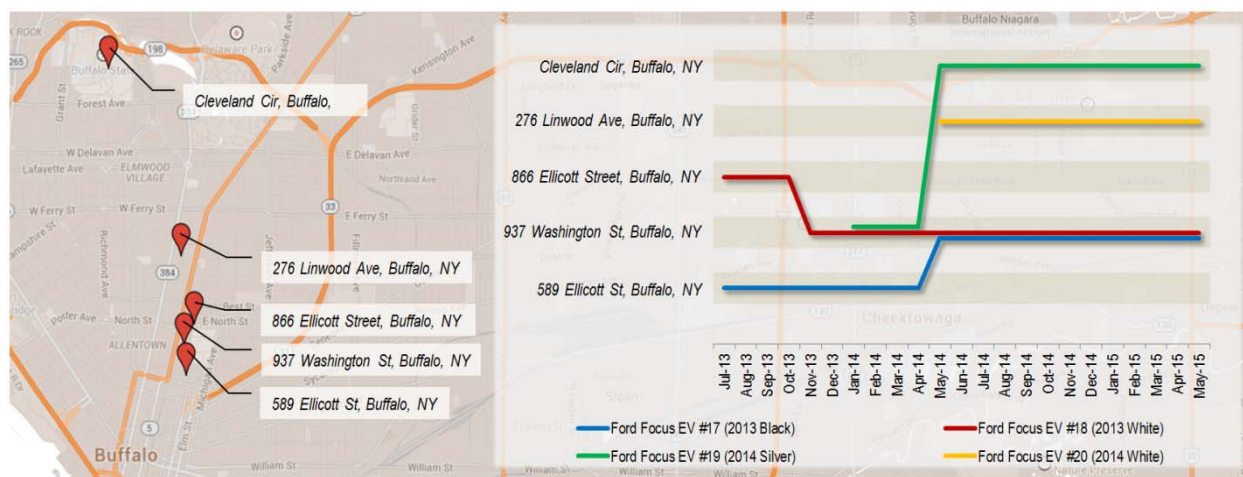


Figure 2: Map and Schedule for Electric Vehicle Base Locations

Charging stations were installed using project funding because BCS EVs needed a dedicated charging outlet because it would serve as their primary (and likely only) charging location. Simple non-networked Level 2 charging stations (Figure 1) were selected to minimize costs. These stations do not have the capability to monitor charging activity, but the EVs themselves can document the amount of energy obtained during each charging event.

## 1.2 Electric Vehicle Data Collection Protocol and Evaluation Procedure

The Project Team used two systems to collect data from the EVs for each trip or event. BCS has Metavera Car Sharing Solution for managing vehicle reservations, member accounts, vehicle status, and billings. This data set has all vehicle activity from both conventional models with internal combustion engines (ICEs) and EVs. MyFordMobile is the EV manufacturer's system for tracking vehicle activity. In addition to monitoring each driving event (time, distance, and duration), MyFordMobile also monitors charge events, battery state of charge, and driving efficiency. Unfortunately, there is no option on the MyFordMobile website to download all this data, so it must be manually transferred into a spreadsheet on a weekly basis (the website limits the number of events displayed, so historical data was only available for a limited time). Additional information from other sources was used to enable a comprehensive evaluation of the performance and economic viability of the EVs. This included EV costs, conventional vehicle costs, maintenance costs, fuel costs, electricity costs, and the average hourly rental fee. The Project Team integrated all this data to evaluate the overall utilization of the EVs as compared to conventional vehicles in the car-sharing program and determine the economic viability of this advanced technology in this application.

## 2 Performance Evaluation

BCS offers a variety of vehicle types to provide members with a range of options to best fit their needs. This included compacts, hybrid-electrics, minivans, and pickup trucks, shown by portion of the total fleet in Figure 3. The adoption of EVs provides users with a more environmentally friendly option that can fulfill many of the member's transportation needs while reducing fuel consumption, emissions, and potentially operational costs for BCS. While there is no financial incentive for BCS members to select the EVs, these vehicles are the newest in the fleet and deliver near silent operation. Where feasible, BCS attempted to provide both an EV and conventional vehicle option to members at the same location, but this was not possible at all the project sites. Also, if one vehicle was already reserved, the second member might not have the choice of vehicle. The overall utilization and operational benefits, including fuel, emissions, and costs savings, are presented below to quantify the potential benefits of using EVs in a car-sharing program.

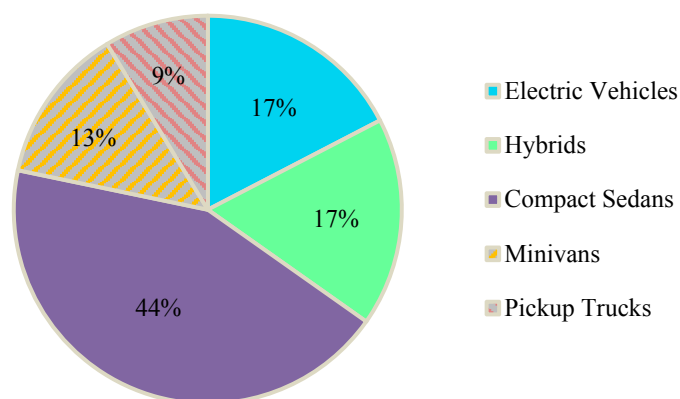


Figure 3. BCS Fleet Vehicle Make-up During the EV Demonstration

### 2.1 The Fleet

During the EV demonstration project, BCS operated a fleet of conventional vehicles. A complete list of BCS vehicles operated during the EV demonstration period are shown in Table 1 with the manufacturer suggested retail prices (MSRP) for that 2015 vehicle model and U.S. Environmental Protection Agency (EPA) listed city mpg rating. The vehicles shown in Table 1 represent all of the vehicles that were operated by the BCS during the evaluation period. However, some vehicles were replaced, cycled out, or added to the fleet during this period. The period during which the vehicle was used in the BCS program is listed under its "Data Period". The annual depreciation costs for all vehicles were estimated using data from Edmunds.com "True Cost to Own" calculator [1]. This evaluation only considered the depreciation, maintenance, and repair data (values specific to the BCS

were available for the other categories including insurance, car-sharing hardware and software, and mileage). The Edmunds.com “cost to own” values are dependent on the vehicle age, so an annual average during its first 5 years was used. The evaluation to follow excluded the pickup truck and minivans because they are not directly comparable with the EVs and likely experience specialized use.

Table 1: Buffalo CarShare Vehicle Inventory During the EV Demonstration

| Vehicle Model         | Vehicle Year | MSRP (new) | mpg | Data Period             | 5 Year Cost to Own [1] |                      |
|-----------------------|--------------|------------|-----|-------------------------|------------------------|----------------------|
|                       |              |            |     |                         | Depreciation           | Maintenance & Repair |
| Toyota Yaris          | 2009         | \$14,430   | 30  | 8/1/2013 - 7/25/2014    | \$3,457                | \$5,437              |
| Toyota Prius C Hybrid | 2012         | \$19,080   | 53  | 8/1/2013 - 12/31/2014   | \$12,210               | \$4,303              |
| Toyota Yaris          | 2009         | \$14,430   | 30  | 8/1/2013 - 12/31/2014   | \$3,457                | \$5,437              |
| Toyota Corolla        | 2009         | \$16,800   | 28  | 8/1/2013 - 7/7/2014     | \$3,694                | \$5,454              |
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| Ford F-150 Pickup     | 2006         | \$24,445   | 17  | 8/1/2013 - 10/29/2014   | \$6,159                | \$8,902              |
| Nissan Frontier       | 2010         | \$18,741   | 21  | 10/29/2014 - 12/31/2014 | \$8,029                | \$4,810              |
| Toyota Prius C Hybrid | 2013         | \$19,080   | 53  | 8/1/2013 - 12/31/2014   | \$12,210               | \$4,303              |
| Toyota Sienna         | 2010         | \$26,920   | 18  | 8/1/2013 - 12/31/2014   | \$7,241                | \$5,246              |
| Dodge Grand Caravan   | 2007         | \$30,783   | 20  | 12/29/2013 - 12/31/2014 | \$19,704               | \$3,745              |
| Dodge Grand Caravan   | 2013         | \$30,783   | 20  | 4/7/2013 - 12/31/2014   | \$19,704               | \$3,745              |
| Toyota Yaris          | 2010         | \$14,430   | 30  | 8/1/2013 - 12/31/2014   | \$3,457                | \$5,437              |
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| Toyota Yaris          | 2012         | \$14,430   | 30  | 8/1/2013 - 12/29/2014   | \$3,457                | \$5,437              |
| Kia Soul              | 2013         | \$14,900   | 24  | 8/1/2013 - 12/31/2014   | \$11,735               | \$5,050              |
| Toyota Prius C Hybrid | 2012         | \$19,080   | 53  | 8/1/2013 - 12/31/2014   | \$12,210               | \$4,303              |
| Kia Soul              | 2011         | \$14,900   | 24  | 8/1/2013 - 12/31/2014   | \$11,735               | \$5,050              |
| Toyota Prius C Hybrid | 2013         | \$19,080   | 53  | 8/1/2013 - 12/31/2014   | \$12,210               | \$4,303              |
| Ford Focus Electric   | 2013         | \$35,170   | N/A | 8/1/2013 - 12/31/2014   | \$8,051                | \$5,605              |
| Ford Focus Electric   | 2013         | \$35,170   | N/A | 8/1/2013 - 12/31/2014   | \$8,051                | \$5,605              |
| Ford Focus Electric   | 2014         | \$35,170   | N/A | 1/1/2014 - 12/31/2014   | \$8,051                | \$5,605              |
| Ford Focus Electric   | 2014         | \$35,170   | N/A | 5/1/2013 - 12/31/2014   | \$8,051                | \$5,605              |

The average monthly use for each EV varies slightly, dependent on seasonal variations in member demand and vehicle performance. However, compared to the ICE cars, the EVs had consistently lower utilization rates, as shown for August 2013 through May 2015 in Figure 4. This difference may be partially attributed to the vehicle’s limited range, but may also be due to a lack of knowledge and possible range anxiety on the part of the BCS members.

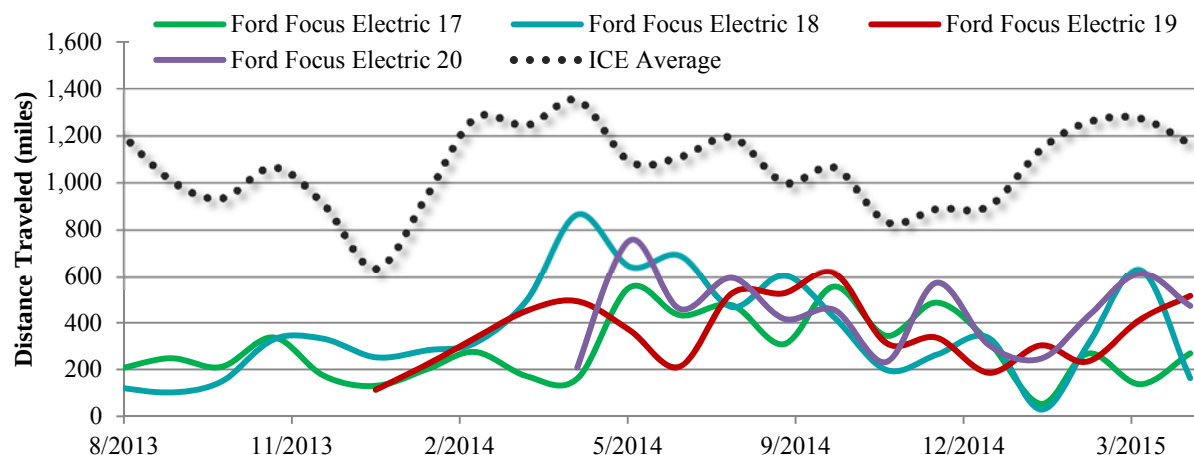


Figure 4: Buffalo CarShare Vehicle Utilization Rates

## 2.2 Vehicle Use Analysis

The individual utilization of each vehicle heavily affects the overall operating cost because many of the operating costs are fixed per month and additional reservation time results in increased revenue. This is especially true for the EVs because energy costs, which are related to overall mileage, are insignificant compared to the upfront vehicle costs. Figure 5 plots the actual operating data (reserved time and average miles per reserved hour) per month for the EVs, along with ICE vehicle data for trips under 50 miles (EVs are restricted to trips less than 50 miles because their batteries can be depleted). EV utilization rate per hour is typically similar to conventional vehicles but the reservation rate is noticeably lower for trips under 50 miles.

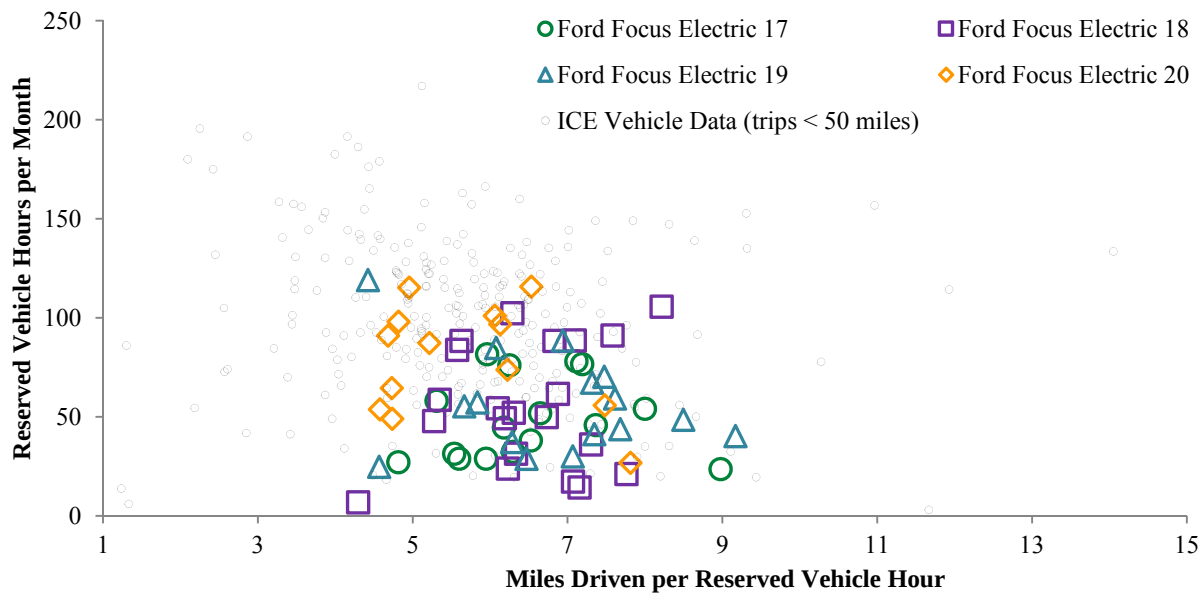


Figure 5: EV vs ICE Reservation and Utilization Levels

Figure 6 shows the same EV data points as Figure 5, but adds curves that represent the monthly cost savings potential compared to an ICE vehicle if it was used for the same number of reserved hours and miles. This shows that many of the EVs could have economic benefits over an ICE vehicle if they had similar utilization.

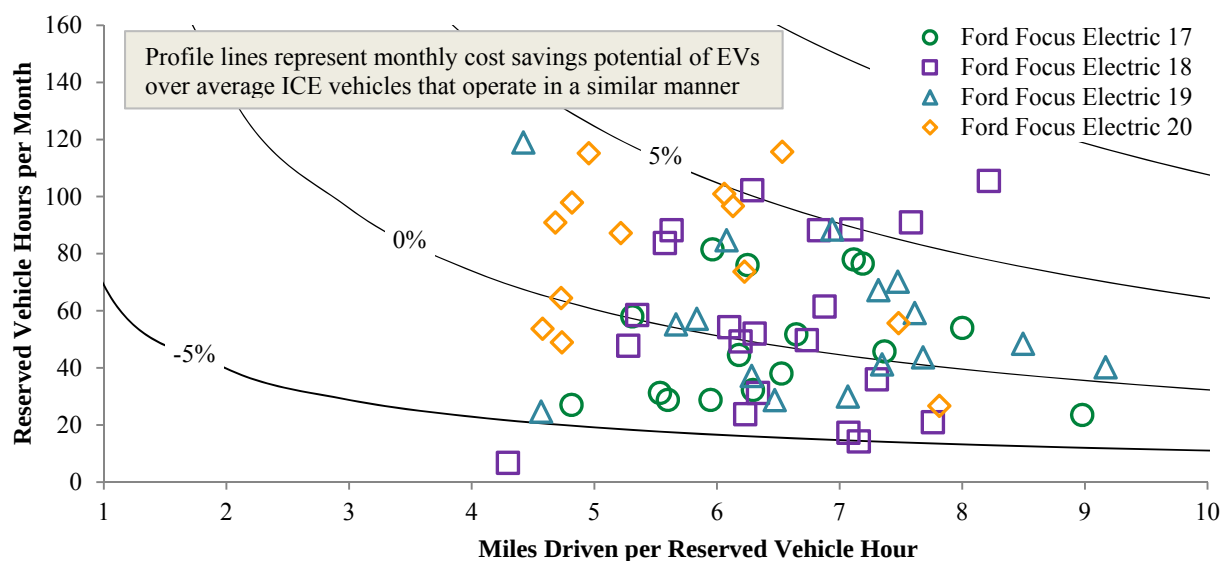


Figure 6: EV Economics for Similar Utilization Levels

However, as previously shown in Figure 5, the majority of the ICE vehicles are used significantly more than the EVs. Therefore, the lower utilization rates of EVs result in a much higher operational cost on a per-mile basis, as well as on a per-reserved hour basis. With less use, the fixed cost items, such as depreciation, insurance, and hardware, end up costing significantly more per hour reserved and the potential energy cost savings by using electricity cannot offset this. Overall, the fixed monthly ownership costs of the EVs are only \$284 more than the estimated fleet average for the ICE cars. If the EVs were used the same amount as the ICEs, the EV's higher monthly fixed costs can quickly be offset through energy (fuel) cost savings over the ICE cars.

Figure 7 shows the estimated annual cost per reserved hour for all of the BCS cars (excluding the truck and vans). Notice that the annual insurance (in blue) and hardware/software costs (in yellow) are identical in actual dollars for all BCS vehicles and the variation in the cost per mile of those items is due to difference in vehicle usage. A gas price of \$3.61 per gallon and an electricity cost of \$0.13 per kilowatt-hour (kWh) was used in the calculation [2,3].

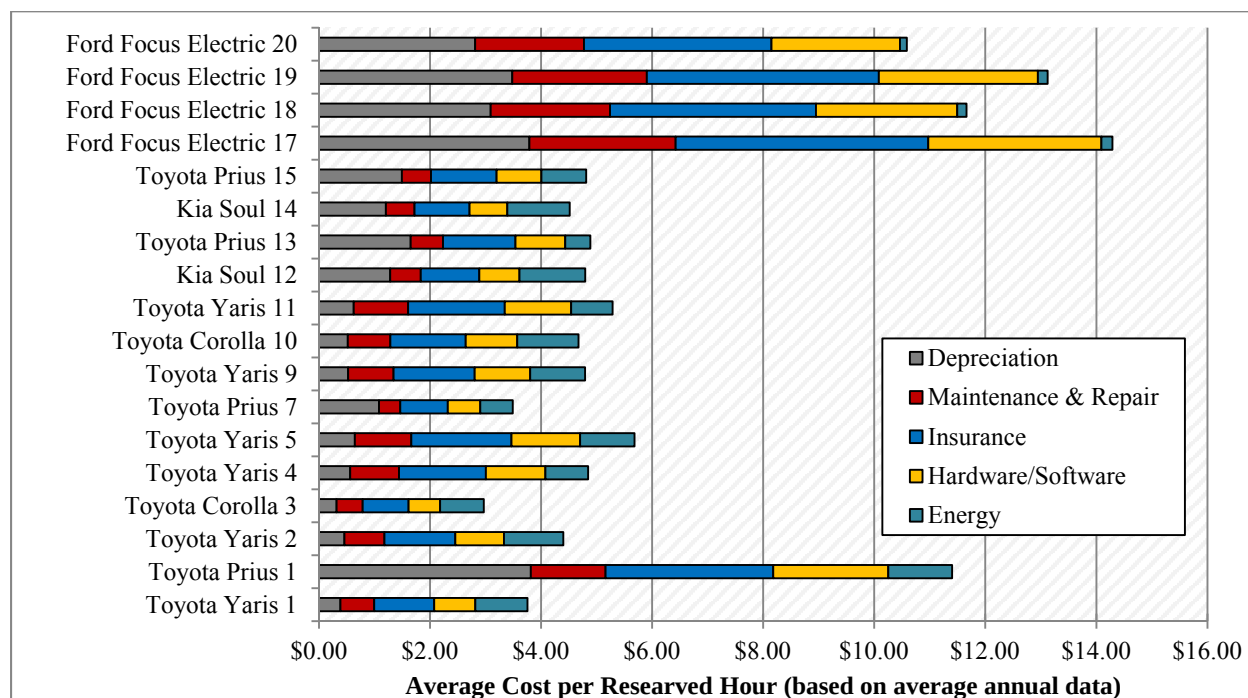


Figure 7: Buffalo CarShare Vehicle Operating Cost

The operational cost difference between ICEs and EVs is almost entirely due to the lower utilization. EVs must be used more to be cost beneficial in the BCS program. Based on the average ICE car use over the past year, an EV must travel, on average 82% of the total miles an ICE car is used per month to provide equal economic results. However, the highest utilization per month by an EV as compared to the ICE car average was only 53% and often much lower than that.

In addition to the fuel and cost savings, the use of EVs in the BCS fleet also provides emission savings when compared to the ICE cars. Based on emission factors for gasoline and electricity, the EVs are capable of offsetting approximately 40.5 pounds of carbon dioxide every 100 miles they are driven instead of an ICE car [4,5] From August 2013 to May 2015, the four EVs have been driven 26,200 cumulative miles, offsetting over 10,600 pounds of carbon dioxide.

The majority of BCS member trips are relatively short, as they travel primarily in and around the city of Buffalo. However, some longer trips taken by ICE cars account for a relatively large portion of the total mileage. EVs cannot support long trips due to their limited range. To date, there have only been seven trips over 60 miles (these included trips of 61, 63, 64, 65, 68, and 70 miles), and the majority of EV trips are below 20 miles. Figure 8 shows the distribution of average number of trips per month based on trip distance for ICE cars and EVs.

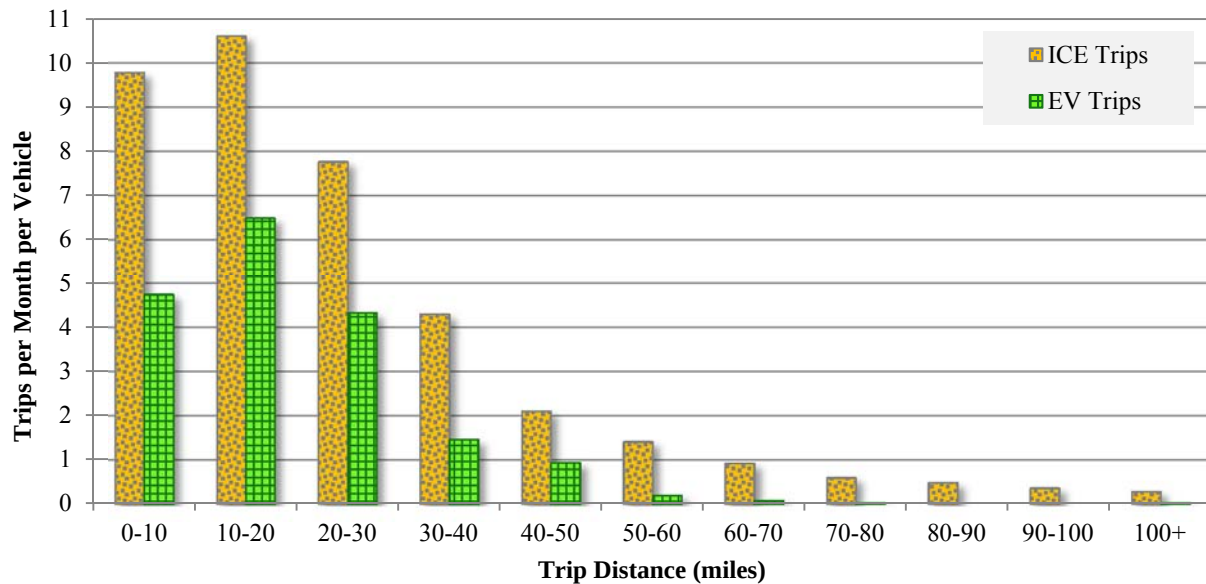


Figure 8: Buffalo CarShare Vehicle Trip Distance Distribution

One limiting factor for EV use by BCS members during winter months is the shorter range available with colder weather. Due to preheating, defrosting, and lower battery performance, less energy is available to drive the EVs. A slight decrease in efficiency occurs with high temperatures as well due to increased air conditioning load and efficiency losses within the electrical system.

While longer trips require ICE cars, BCS members predominantly use ICE cars instead of EVs for shorter distance trips. Figure 9 shows that EVs are capable of being used for many more trips. This data is based on the approximate EV range that was estimated per month based on average monthly EV efficiency (kWh/mile) and a maximum battery discharge of 80%. The ICE usage data shown here is averaged per vehicle for ICE cars located near the EVs to ensure comparable data.

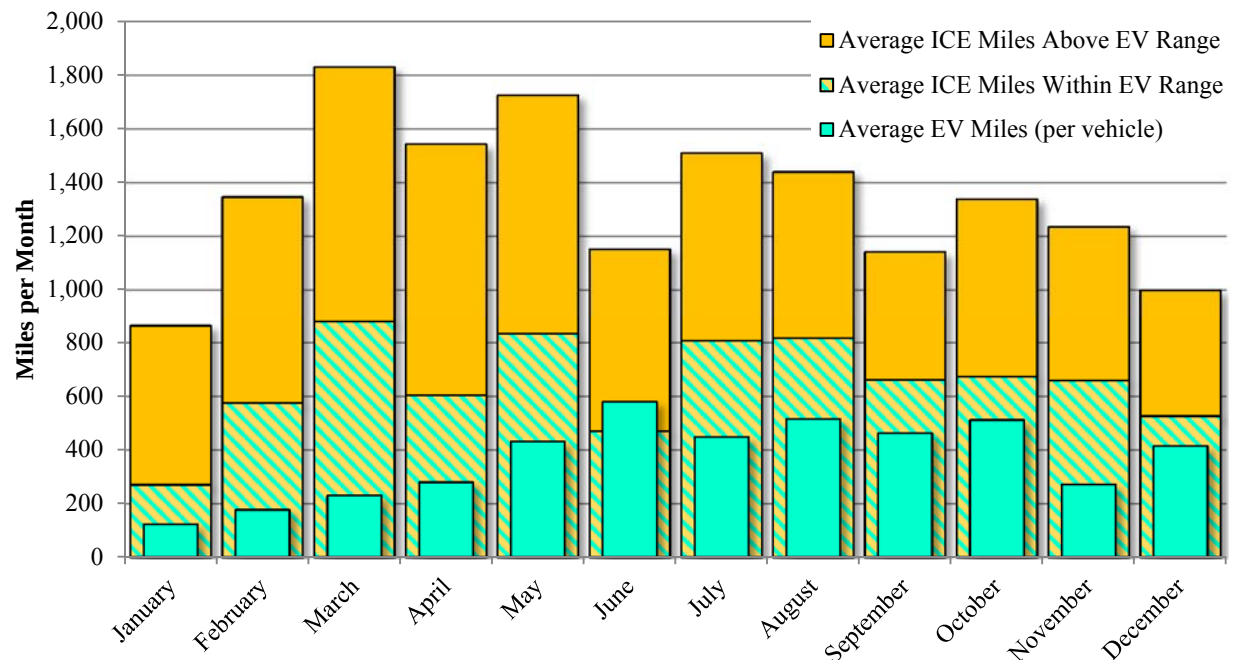


Figure 9: Potential and Actual EV Use per Vehicle

## 2.3 EV User Evaluation

During the 17 months of the EV Demonstration Project at BCS, approximately 30% of their members have tried an EV at least once (175 unique drivers have tried an EV in total). Thirty-eight percent of these users have not used the EV after that initial trip. Some of these members may have used the EV for the first time in the last two months of the period for which this analysis was performed and did not have a need to use any BCS vehicle since, while others may not regularly use a BCS vehicle where the EVs are located. To reveal the BCS member's choice of vehicle technology, EV use was compared to the closest ICE car for BCS member trips after they had tried the EV for the first time. The Figure 10 data analysis results show that BCS members more often choose the EV for shorter distance trips after driving the EV for the first time.

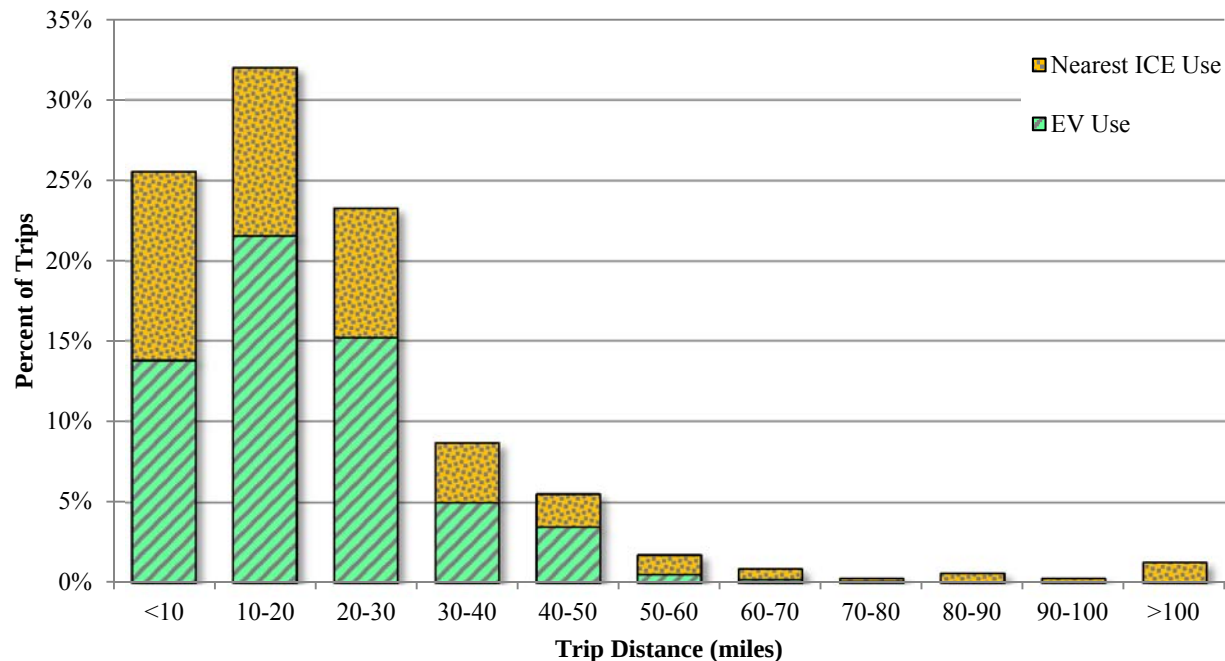


Figure 10: Experienced EV User Localized Preferences

## 2.4 Environmental Savings

Environmental savings can be experienced from the use of EVs compared to conventional vehicles throughout the US. However, due to significant clean sources of electrical generation in New York State, offsetting gasoline combustion with electricity with EVs is even more beneficial. Most of New York's electrical energy comes from nuclear, hydroelectric, or other clean, renewable sources [6]. Because of the extremely clean electrical energy available in New York State, EVs are able to reduce greenhouse gas emissions by over 37% on a per mile basis on the BCS operation. This data was based on average data gathered from BCS operations and emission factor data from the US EPA [7].

# 3 Lessons Learned from BCS EV Deployment

## 3.1 Issues and Resolutions

BCS staff closely monitored the EVs throughout this project to ensure that the members used the vehicles properly and to address any issues or concerns that arise. The following is a summary of issues and resolutions that occurred during the demonstration project.

- **Member Anxiety or Confusion** - Most BCS members were a little anxious about using the EV for the first time. From the beginning, notices popped up on the reservation system whenever a member reserved an EV, and instructions were placed in each car. For almost every first-time EV driver, BCS staff had to talk with that member over the phone or meet them at the EV in person to provide instructions.
- **EV car problems** - In general, the EVs did not have many maintenance issues, but there were a few recalls that had to be addressed by BCS staff during the demonstration. The Ford Focus EVs selected for this project were some of the first models released by Ford, which led to a higher than expected level of problems that needed fixing.
- **EV Charging** - BCS elected to place a maintenance reservation on the EVs each night from 2 am to 6 am so they must be parked in their space and charging during this time. BCS staff try to regularly monitor the EV's state of charge to proactively address when a charger is not working properly.
- **Quick depletion of battery** - Extreme warm or cold weather impacts the available driving range of the EVs. First-hand experience from this demonstration confirmed this. In spring and fall, the available EV range could be as high as 80 miles. On hot days this could drop down to 50-60 miles. During an extreme cold month in February 2015, the available EV range dropped as low as only 20 miles.
- **Stranded EVs with dead batteries** - Despite all the warnings provided by the EV to the driver regarding available range, there were a handful of times that a BCS member drove the EV until its battery was completely dead. This resulted in a stranded EV that had to be towed.
- **Poor Traction in Snowy Conditions** – The EVs used by BCS were equipped with low rolling resistant tires that proved to be inadequate for snowy roads during the winter in Buffalo. Initially, the EVs were removed from service during inclement weather. Later, snow tires were added to two of the EVs which effectively remedied the traction issue.
- **Lower than expected usage** - Throughout the project, the EVs did not experience as much usage as the other conventional vehicles. Where possible, BCS placed a conventional vehicle at the exact location of the EV so vehicle preference would not be influenced by the location. However, the EVs continued to have lower use.
- **EV Charger Issues** - Overall, the charging stations used were quite reliable and straightforward to use. However, some issues did arise with cord management and snow management which limited station ventilation.

## 4 Conclusions

Overall, the EVs proved their functionality within the car-sharing setting and provided reliable service with limited issues. The Project Team successfully completed the project objective to evaluate EVs in the car-sharing environment. While the economic viability for BCS to operate EVs was not good, user satisfaction and performance, along with additional factors (e.g., public awareness, information gathering, and outreach) were highly positive outcomes of the demonstration. A final report detailing the project was published [8].

The economic analysis showed strong economic potential for EVs, but these vehicles lacked sufficient use to see this potential realized. Throughout this demonstration, the average utilization level of the EVs was only 53% of the gasoline-powered cars. For the EVs to be economically viable for Buffalo CarShare, they needed to achieve a utilization rate of 82% (unlikely due to the current EV's range which limits its use on longer trips). Because of the higher acquisition costs associated with the EVs, the limited use (compared to gasoline cars) did not provide enough operational savings over the existing vehicle fleet.

A survey administered near the end of the demonstration revealed that 90% of the EV users were very or extremely satisfied with the EV performance and their overall driving experience. There were a few issues reported with the operation of the EV (e.g., starting, driving, and plugging in), but most were quickly overcome after the member's first experience with the EV. One general issue addressed by BCS during the demonstration was outfitting two of the EVs with snow tires to improve winter performance since the factory-issued low-rolling

resistant tires provided poor grip in snow and ice. From this group of EV drivers, there was strong interest in keeping the EVs in the fleet and over 95% of responders would choose an EV in the future if it could meet their required driving range.

During warm weather operations, the vehicle's range and performance met or exceeded BCS member's needs for many of the trips made by the car-sharing users (even if the users chose a gasoline vehicle the EVs could have completed the trip if chosen). However, a lot of the revenue generation for the organization (reserved hours) and operational costs saving potential for the EVs (driven miles) comes from longer trips that are not feasible with EVs. Also during some months, cold weather, and to some extent, extremely hot weather lowered the EV range below what was needed for even some of the shorter in-town trips.

Additional benefits of this project was public outreach and an increased knowledge of EV operations in various conditions. To maximize their impact, the vehicles were brightly identified with large environmental logos and charged in visible location throughout the City. Hands on public awareness significantly increased through this project, since most of the 175 EV users never previously drove an EV. The California Air Resources Board became very interested in the concept of a low-income EV car-sharing program and called the project team to learn about this demonstration. In July of 2015, a \$1.6 million state grant was awarded for a car-sharing program in low-income Los Angeles neighborhoods that will operate about 100 electric and hybrid vehicles.

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## References

- [1] Edmonds.com, "True Cost to Own" Calculator, [www.edmunds.com/tco.html](http://www.edmunds.com/tco.html)
- [2] Gas price retrieved on February 7, 2014 from [www.buffalogasprices.com/MetroGasTemperatureMap.aspx](http://www.buffalogasprices.com/MetroGasTemperatureMap.aspx)
- [3] Electricity price retrieved on February 7, 2014 from [www.eia.gov/electricity/monthly/epm\\_table\\_grapher.cfm?t=epmt\\_5\\_6\\_a](http://www.eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_5_6_a)
- [4] Emission factor for gasoline retrieved February 7, 2014 from [www.bnl.gov/earthday/docs/ORNL-Idle-Reduction-Guide.pdf](http://www.bnl.gov/earthday/docs/ORNL-Idle-Reduction-Guide.pdf)
- [5] Emission factor for electricity retrieved February 7, 2014 from [www.eia.gov/electricity/data/state/](http://www.eia.gov/electricity/data/state/)
- [6] US Energy Information Administration. New York. Retrieved April 27, 2015 from [www.eia.gov/state/?sid=NY#tabs-4](http://www.eia.gov/state/?sid=NY#tabs-4)
- [7] US Environmental Protection Agency. Calculations and References, retrieved April 27, 2015 from [www.epa.gov/cleanenergy/energy-resources/refs.html](http://www.epa.gov/cleanenergy/energy-resources/refs.html)
- [8] NYSEDA. Demonstrating Electric Vehicles in Buffalo CarShare. September 2015. [www.nyserda.ny.gov/-/media/Files/Publications/Research/Transportation/demonstrating-electric-vehicles-in-Buffalo-CarShare.pdf](http://www.nyserda.ny.gov/-/media/Files/Publications/Research/Transportation/demonstrating-electric-vehicles-in-Buffalo-CarShare.pdf)

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