Leveraging MyGreenCar to Accelerate ZEV Adoption by Eliminating EV Range Anxiety & Charging Uncertainty

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1 Overview of MyGreenCar

MyGreenCar is a smartphone-based tool for car buyers that provides personalized fuel economy and EV range comparisons for any car that a driver is considering, customized to the driver's unique driving patterns. By collecting 1 Hz GPS data during a driver's trips, the app considers a driver's daily travel distance, traffic, terrain, aggressiveness in acceleration and braking, and more, to predict their fuel consumption and battery state-of-charge for any vehicle they are considering to purchase. In the case of plug-in electric vehicles, the app predicts whether a driver would ever be in danger of running out of charge using any assumption of how and where they will charge. Thus, MyGreenCar can eliminate EV range anxiety and charging uncertainties as an obstacles for EV adoption. By allowing drivers to compare any ZEV against conventional or hybrid cars, MyGreenCar advances the VW settlement mission of providing public outreach that increases public awareness of ZEVs. An overview of how MyGreenCar works and it's readiness for public launch is summarized in Figure 1.

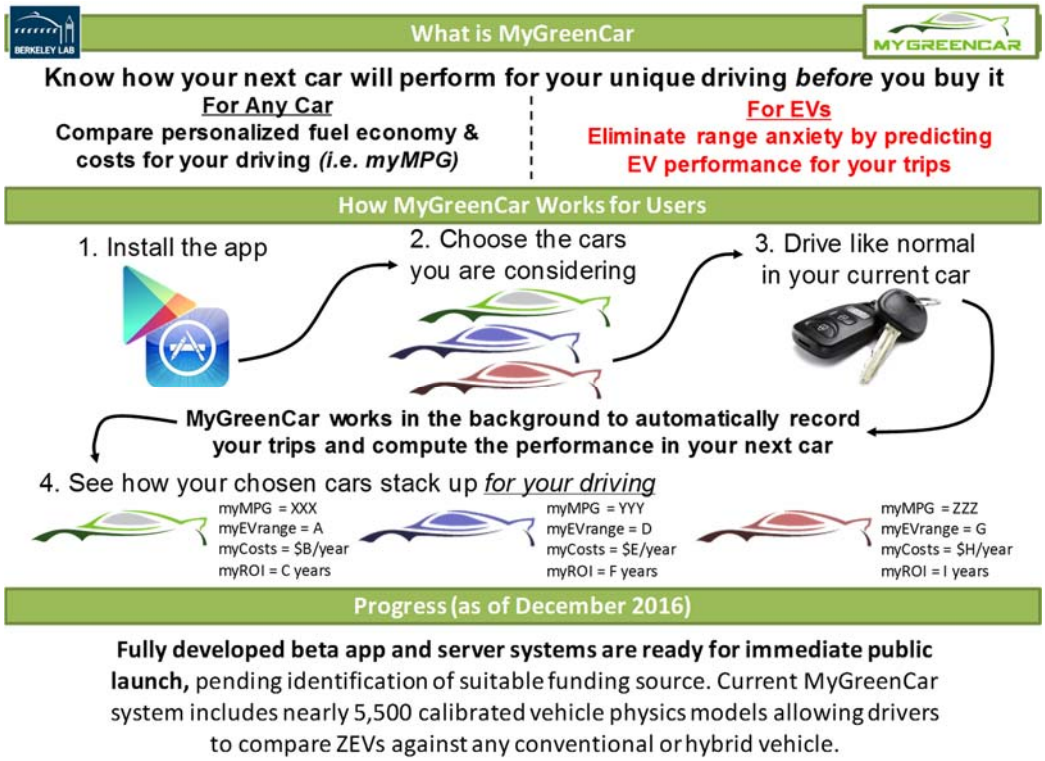

Figure 1 - Overview of MyGreenCar and readiness for public launch

MyGreenCar was developed using internal funding at Lawrence Berkeley National Laboratory, with additional support from federal research grants. Thus, MyGreenCar is already a fully functional app/server system, with nearly 5,500 calibrated vehicle physics models implemented. It is ready for immediate public deployment if a suitable funding source, such as VW investment, is identified.

2 Advancing VW Settlement Priorities

2.1 Early, highly visible progress

California has urged VW to make *early, visible progress* at the beginning of the first 30-month investment cycle [1]. Given that MyGreenCar is fully developed and ready for immediate public launch, pending identification of a funding source, VW's investment in MyGreenCar will immediately produce a highly visible product that can be scaled to millions of car buyers to accelerate ZEV deployment.

2.2 Education and Outreach to increase public awareness and adoption of ZEVs

Under the "Education and Outreach" focus of the VW Settlement, VW aims to establish brand-neutral education and public outreach [1] that builds or increases awareness of ZEVs. MyGreenCar directly addresses this mission for two groups of car buyers: 1) Car buyers already interested in EVs but who are unsure of range adequacy or charging needs, and 2) Car buyers who are not even considering an EV initially.

MyGreenCar for car buyers already interested in EVs:

By measuring a driver's travels with 1 Hz GPS data collection, and feeding this data into accurate vehicle physics models, MyGreenCar shows car buyers whether an EV suits their unique travel needs. MyGreenCar eliminates EV range anxiety as a concern for car buyers by predicts driver's battery state of charge on their own trips *before* they purchase an EV. The system allows the driver to specify any options on how they might charge their vehicle (e.g. home, workplace, L1, L2, fast charging, etc.) to determine whether the charging they will have available will suit their needs. In this manner, MyGreenCar takes uncertainty out of the equation for prospective EV buyers.

MyGreenCar to raise awareness of ZEVs amongst car buyers who are not initially considering ZEVs:

The majority of car buyers today are not even considering an EV in their car shopping. Given that MyGreenCar provides personalized fuel economy comparisons for virtually every car on the market (including conventional and hybrid cars), the majority of users will be attracted to MyGreenCar to compare conventional cars. For these users, MyGreenCar can automatically simulate ZEVs that are comparable to the cars they selected. As illustrated in Figure 2, if comparable ZEV options prove viable and cost competitive for users, the system can automatically notify them of how a ZEV would compare against the cars they selected. In this manner, MyGreenCar can be used to introduce millions of prospective car buyers to the possibility and viability of ZEVs.

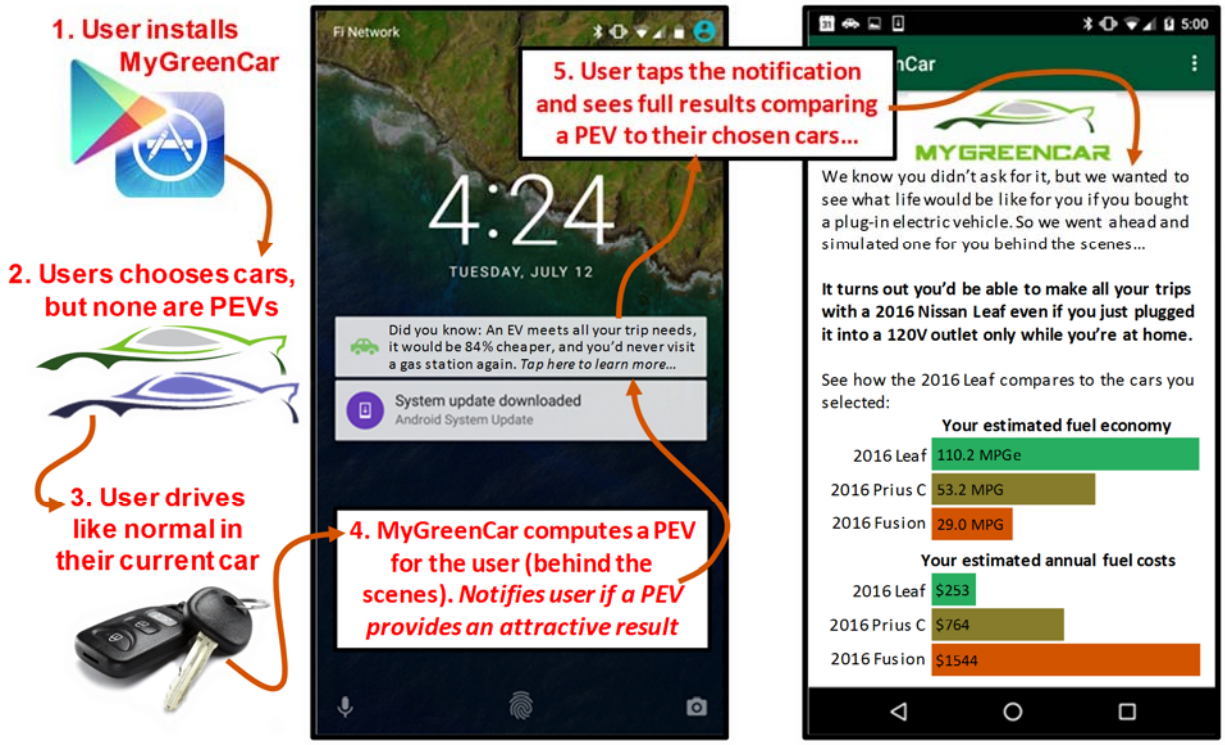

Figure 2 – Example of how MyGreenCar can introduce millions of car buyers to the possibility and viability of ZEVs for their next car purchase

2.3 Measuring success

Through its app-based data collection platform, MyGreenCar provides the ability to measure the impact we have on opening drivers to the possibility of choosing a ZEV. By implementing pre- and post-use stated preference surveys before and after a car buyer uses MyGreenCar, we can measure the impact MyGreenCar has on increasing car buyer's receptiveness to purchasing a ZEV. Further, by implementing a revealed preference survey a few weeks or month after a user finishes using MyGreenCar we can determine what kind of vehicle the driver ultimately purchased. Thus, we can quantify MyGreenCar's impact on accelerating the adoption of ZEVs, and the accompanying fuel, energy, and GHG savings.

2.4 Fit with Experiential Marketing Campaigns

Experiential marketing campaigns, such as ride and drives, have been shown to be effective in getting car buyers to choose a ZEV. A ride and drive, however, only provides a limited duration contact experience for drivers to experience a ZEV. While this short-duration exposure may get drivers aware of the look and feel of a ZEV, it is unlikely to overcome driver's concerns about range anxiety or any uncertainties on their charging needs. At the end of their contact experience, ride and drive staff can encourage participants to install the MyGreenCar app so they can continue a virtual test drive of the ZEV they just drove. This allows ride and drive staff to continue interacting with participants through the app, and ensures that drivers stay engaged with ZEVs after the ride and drive.

3 Advancing VW Strategic Business Directions with MyGreenCar

3.1 VW's TOGETHER Strategy 2025

VW's Together 2025 strategy [2] aims to reinvent several VW business units and create new ones. MyGreenCar directly aligns with many of the strategies being undertaken in Together 2025.

Building a Mobility Solutions Business / MOIA:

VW's MOIA [3-4] venture aims to build new offerings in three areas: 1) Ride hailing, 2) Connected commuting, and 3) Strategic investments through MOIA Next. MyGreenCar directly aligns with all three of these areas.

Ride Hailing: While MyGreenCar currently focuses on helping prospective car buyers overcome uncertainty barriers to choosing greener vehicles (i.e. personalized fuel economy and EV range predictions), the technology can be expanded to give side-by-side comparisons of personal car ownership versus foregoing car ownership for use of mobility as a service. MyGreenCar currently predicts fuel/energy use and associated costs, however by tying into APIs for ride hailing providers, we can compare personal ownership versus ride hailing. A car buyer's personalized ownership costs can be compared against the costs for ride hailing. Further, wait times for ride hailing can be compared against time spent searching for parking or being stuck in traffic in one's own car. In this manner, MyGreenCar can be expanded to directly advance MOIA's focus in ride hailing.

Connected Commuting: MOIA's connected commuting focus aims to allow drivers to stop wondering about limitations of traffic maps to be free to travel where they want. Current EV owners are often faced with uncertainty on whether they can make the trip they want to make given their current state of charge. MyGreenCar's trip planner feature allows drivers to predict whether they can make it to their destination given their current charge. The MyGreenCar trip planner combines MyGreenCar's vehicle physics models with automated algorithms that construct probabilistic drive cycles given current traffic conditions, terrain, etc., thus eliminating range anxiety as a limitation for current EV owners.

MOIA Next: MOIA Next seeks investment opportunities for "the next killer app" that can change the world. Through our market research, we have identified a substantial unmet need and demand for a personalized car comparison app like MyGreenCar. Lawrence Berkeley National Laboratory is seeking partners like MOIA Next to bring MyGreenCar to the market to serve all car buyers across the world.

Enabling Data-Driven Vehicle Design and Engineering:

VW's Together 2025 strategy has a substantial focus on establishing expertise in electrification and releasing several new electrified vehicle models. The 1 Hz on-road driving data collected by MyGreenCar on millions of car buyers can provide a valuable tool to optimize the design of new electrified powertrain systems for VW's next generation of vehicles.

3.2 Promotion of Vehicle-Grid Integration and ISO15118 Standard

Based on VW's presentation at California VGI Standards Workshop [5], VW has an established focus on vehicle-grid integration and the wider implementation of standards such as the ISO15118 vehicle to grid communication interface [6]. At the time of purchasing an EV, MyGreenCar can also provide a tool for car buyers to compare EV chargers they may purchase. The app can be used as a communication tool to

promote ISO15118-compatible chargers, and communicate the personalized benefits that car buyers can capture by having their vehicle's charging be controlled by grid signals that can maximize their use of renewables generation or minimize their charging costs.

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