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From the Top of the Organization to the Bottom Line: Understanding the Fleet Market for Plug-in Electric Vehicles

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Abstract

Government and commercial fleets are widely targeted as an ideal market for plug-in electric vehicles (PEVs). However, the reasons are often based on misconceptions regarding past purchases behaviour and misunderstood operational considerations **[1]**. PEVs do have attributes that are valued by organizations, as we learned from drivers, fleet managers and company decision makers who had the opportunity to drive a PHEV for more than a year. In this paper we discuss how the perceived value of a PHEV depends on the employee's responsibilities and role in the organization. We also report on the primary concerns expressed by the project participants regarding the purchase and use of PEVs. These findings provide a better understanding of fleet vehicle purchase priorities and operational considerations that could affect development of the PEV fleet market. Given the varying importance assigned to different PEV attributes by employees throughout the organizational structure, we propose a strategic market approach that targets several people within an organization.

Keywords: list 3-5 keywords from the provided keyword list in 9,5pt italic, separated by commas

1 Introduction

Government and commercial fleets can play an important role in advancing the plug-in electric vehicle (PEV) market. These fleets account for over 750,000 or approximately 6% of all U.S. light-duty cars and trucks sold in 2011 **[2]**. However, PEV sales to these fleet markets are disproportionately low compared to the private household market. In 2013 only 3% of all PHEVs sold in California were to commercial proprietors or public entities [**3**]. If PEVs are to capture a more significant share of the fleet market, it is necessary to understand how vehicles are used in fleets, how fleets purchase those vehicles, and what PEV performance characteristics are valued most by organizations that operate fleets. Only then can appropriate policies, pricing strategies, and marketing approaches be developed to support the incorporation of PEVs into fleet applications.

This paper reports the key values and considerations regarding fleet purchase and use of PEVs as identified by participants of a PEV demonstration project. Participants identified four main areas where PEVs can provide value to their organization. These include:

1. Reinforcing brand and image
2. Improving driver experience and operational efficiency
3. Reducing fuel costs
4. Meeting sustainability goals

However, our results show that these values are typically prioritized differently by organization personnel depending on their position and job function within the organization. CEOs, sustainability officers and marketing directors are typically concerned with areas 1 and 4; drivers with 2; and fleet managers with 3.
While organizations participating in the demonstration project found significant value associated with the adoption and use of the PEVs, fleet managers and vehicle users reported some key operational and procurement issues which could hinder the purchase and full utilization PEVs. We generalize user concerns into three categories:

- Lack of available task-appropriate vehicles
- Installing and using a charging network
- Restructuring fleet purchase criteria

This study provides a strategic start to understand factors which will affect the rate at which PEVs advance into the fleet sector. Results suggests the need to depart from conventional fleet vehicle marketing tactics in favour of adopting broader strategies that engage multiple actors within the organization (not just fleet managers). This important change is necessary to reveal the full value of PEVs to an organization. At the same time, specific policies, product designs and pricing strategies should be pursued to address concerns of prospective PEV fleet users.

2 Project description

As part of an advanced vehicle technology demonstration project sponsored in part by the US Department of Energy, with funds from the American Reinvestment and Recovery Act (ARRA), Chrysler Motor Company designed, built and deployed a fleet of experimental Dodge RAM 1500 crew cab 4x4 PHEV pickup trucks for user testing. The 140 vehicles were deployed strategically across the US with the intention of gathering in-use vehicle data relating to a variety climates, terrains and fleet use patterns. The PH&EV Research Center at the University of California, Davis assessed vehicle performance and driver experiences with twenty-eight of the RAM 1500 PHEVs deployed to fleets in San Francisco and Sacramento.

The vehicles were deployed in a multitude of applications from August 2011 to September 2013 for the primary purpose of transporting people and equipment. The driver's roles within each of the organizations varied but included fleet managers, work crews, and organizational decision-makers. Many of the vehicles were assigned and used by only one person while others were shared, to various degrees, among multiple drivers. All the drivers were volunteers who were comfortable driving large pickups and in fact many owned a pickup truck of their own.

2.1 The RAM 1500 PHEV

The full-size, blended-mode PHEV pickups, built on the Ram 1500 quad cab platform, were equipped with a 12.9 kW-hr Li-ion battery capable of being fully charged in 2-3 hours at 220V. The battery and motors operated in tandem with a 5.7L HEMI V8 400 HP engine, but under light throttle the PHEV was capable of all-electric operation up to about 40 miles per hour. Chrysler specifications stated a fuel economy of 32 mpg in charge depleting mode with an all-electric equivalent range of 20 miles. The vehicles had regenerative braking, a multi-screen human-machine interface (HMI) display, and 6.6 kW of on-board auxiliary power available through several 120V and 220V receptacles (located in the truck bed and cabin). The truck was also capable of meeting the ATZEV emission standards which would make it eligible for a High Occupancy Vehicle (HOV) exemption sticker in California where the 28 PHEVs were operated. Equipment and material transport was limited because a portion of the pickup bed was forfeited to accommodate vehicle instrumentation.

2.2 Data collection and analysis

Between August 2011 and May 2013 researchers conducted multiple semi-structured interviews with each of the 53 vehicle demonstration drivers at their respective workplaces. These interviews provided insight into how the loaned PHEV was used in the context of the fleet and the conditions surrounding the implementation of the vehicle. Interviews with participants lasted about an hour each and were organised to allow participants to freely share their experiences with the demonstration PHEV. In particular this provided participants the opportunity to discuss what features and attributes they valued most about the vehicle and why they valued them. Interviews were followed by an online questionnaire to further explore issues that could impact PHEV sales. In addition, vehicle use and performance data was collected from the 28 PHEV pickups. This data included more than 70 signal values which were recorded on a sub-second interval and pushed to UC Davis servers for processing. The data stream included time and date, gasoline and electricity consumption, speed, mode of operation (CS vs. CD), ambient temperature, auxiliary power usage, air conditioning power use, charging duration and energy demand, continuous battery state-of-charge (SOC), and GPS vehicle tracking.

We draw on all three of these data sources to construct a narrative for each vehicle user. Thematic analysis was used to identify themes from each narrative, which were then grouped by job function within the organization.

3 Results

3.1 Reinforcing brand and image

Vehicle fleets are widely considered a necessary cost of doing business but PHEVs provide an interesting value proposition. They offer an opportunity to enhance public relations and reinforce company culture. Companies like to be seen doing the right thing, making a statement, setting an example, and distinguishing themselves from the competition. However, company branding is not typically a job performance metric for fleet managers who are pre-occupied with the day-to-day travails of keeping vehicles running at minimum cost. Yet, most efforts to market PHEVs to organizations start and end at the fleet level. Aiming higher up the organizational chart and touting the image benefits of PHEVs may prove more effective. Previous research shows that the majority of high-level decision makers considered image benefits more important than economic considerations when considering alternative fuel vehicle purchases **[4]**. They feel more of

an obligation to support efforts to promote their company image and foster public relations. As two decision-makers in the demonstration put it:

"We're part of a city wide plan to reduce our departmental emissions.. and I think my job is to support the department and city"

"Doing what we can is important to show support for the mayor and city policies"

Drivers and fleet managers did support environmental actions and 83% of our survey respondents thought "PHEVs improve the image of their organization". Drivers even took pride when interfacing with the public and sharing information about the PHEV. They were proud ambassadors for their company. In fact, 80% of the survey respondents stated that they wish they had more information to share with the public. However at the fleet level, financial constraints often make it difficult to align attitudes about corporate image with purchase behaviour. This "attitudes-behavior gap" **[5]** was evident among fleet managers.

Top level administrators see the bigger picture. They are also willing to accept much longer PHEV payback periods because company benefits continue to accrue long after the payback is fully realized. Unlike the fleeting recognition resulting from awards and public acknowledgements, PHEV vehicles are on the road everyday attracting attention and enhancing corporate image. The following comments from our project participants summarize the overall sentiment:

"We did a lot of PR stuff with the truck… took some pictures and got it put in the government fleet magazine… under the solar panel... We were the number two green fleet last year, so that was all part of it. We are trying to be number one this year."

"The unofficial catchphrase of our department is clean and green. .. if we clean our fleet I think that's a good PR message to send.

"We have five electric vehicles and now we also have this one. It does help our image to do things when we can."

Fleet PHEVs can also bolster corporate culture and signal a sense of social and environmental responsibility. Individuals recognize and consider corporate cultures when they look for employment opportunities. One survey found that 60% of full-time workers consider an employer's impact on the environment *vital* when evaluating whether to work there **[6]**. Conversely, businesses we spoke with were proud of demonstrating environmental stewardship and welcomed like-minded individuals. When employees feel their company is actively involved in environmental causes they also feel like they are a part of something significant which in turn can boost morale and efficiency **[7]**. High-tech industry companies we interviewed tell us that investing in PHEVs conveys the right corporate culture which is important when recruiting and retaining highly-skilled labour in very competitive markets **[8]**.

4 Improving driver experience and operational efficiency

4.1 Driving characteristics

Drivers were overwhelmingly impressed with the demonstration PHEV performance. However, the luxurious nature of the vehicle, especially compared to their normal work vehicle, was very important when

shaping initial impressions. Comforts and amenities like the high-end media unit, ergonomic adjustments, automatic back window, comfortable seats, cruise control and spacious crew cab were some of the most appreciated features.

However, there were also inherent PEV operational characteristics that were touted by nearly every driver. They liked the quietness when operating in electric mode and the fact that there was no engine idling when stopped. Most were impressed with the power and acceleration noting that the truck had "tons of power" or could really "get up and go". Drivers were surprised that a HEMI engine – an icon of power and high performance – was incorporated into a PHEV which many expected to be "sluggish" or "like a golf cart". The HEMI engine seemed to lend instant credibility to the demonstration vehicle, as users felt like there was no performance trade-off for using a cleaner vehicle. As one participant put it, "it's an electric vehicle but the HEMI is there when you need it". In many cases, the HEMI engine helped sell the PHEV technology to the drivers.

Other driving characteristics commonly expressed include reduced vibration, more stability, less bed bounce, better weight distribution, improved handling, reduced road noise, and a smoother ride. Many mentioned the smooth transition between charge-sustaining (CS) and charge-depleting (CD) modes. The one concern frequently mentioned was a slight but noticeable "lag" when accelerating from a complete stop, although most of the drivers said they "got use to it". Finally, drivers told us of a positive feeling they got while driving the PHEV. One interviewee put it this way:

> *"Talk about the things that make you happy... when I am in electric I am happy. It feels good to be in electric and not using the fuel."*

4.2 On-board auxiliary power

One unique design aspect of the demonstration vehicle of particular interest to designers was the onboard auxiliary power (OAP) unit. The OAP unit consisted of two 110V duplex outlets (20 amp, standard NEMA) and a 220V outlet (30amp) all located on a power panel accessed through the side storage box on the passenger side of the vehicle. The OAP was capable of providing 6.6 kW continuous AC power.

Overwhelmingly, drivers and fleet managers stated that the auxiliary power panel was a valuable feature for work purposes and an intriguing option for personal vehicles. Survey responses support these interview findings (Figure 1).

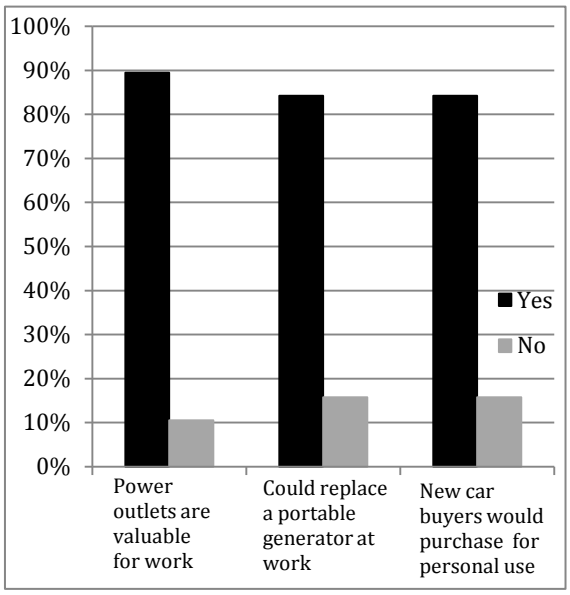

Figure 1: Onboard Auxiliary Power Valuations by Survey Respondents

Like regenerative braking, the OAP is an unfamiliar technology that fleets have difficulty understanding and evaluating. As with many unfamiliar, new and

discontinuous innovations **[9, 10, 11]**, there was considerable uncertainty when trying to predict the OAP's future utility, even after having experienced it. As one fleet manager put it:

> *"Quite honestly, I don't think we have actually thought about all the ways it could help us. If we really sat down to think about how we use a generator, I think we would find all kinds of ways it would be beneficial to us. "*

This was further highlighted during the demonstration when one participant conveyed his excitement about a forthcoming opportunity to use the AOP but on the day of the event "forgot" the demonstration vehicle had auxiliary power available.

Convenience and time savings were cited as the main benefits by those who did use the OAP on a regularly basis. Users appreciated the freed up truck bed space or not having to tow a trailer for generator transport. One participant who used the OAP unit regularly detailed the convenience of it. She did not have to make a trip to the utility yard to pick up a generator and then solicit a fellow employee to help her load it into the truck and unload it at the site. The OAP unit allowed her to perform, single-handedly, what was otherwise a two-person task.

Participants also valued the OAP as potential emergency response equipment, even though usage would be very infrequent. Other stated benefits include the fact that loud, high-polluting generators could be replaced with clean, quite energy while fostering good will with the public and allowing extend work hours in places with strict noise ordinances. However, it was also pointed out that an OAP takes the whole vehicle out of service, whereas a generator can simply be left at the job site. Such trade-offs need to be fully understood by prospective PHEV buyers in order to make an informed decision.

4.3 Less frequent refueling and HOV access

One PHEV fuel economy implication nearly every driver and manager stated was the benefit of fewer trips to the gasoline station. Drivers in San Francisco were especially appreciative because of the limited number of contracted fuel facilities throughout the city. Gasoline refuelling often required an out-of-the-way trip during rush hour followed by a long wait to take a turn at the pump. Drivers and managers noted the convenience and time-savings resulting from fewer trips to the gasoline station.

This attribute could provide a significant economic benefit. In Manhattan gasoline stations are so few, and the lines so long, that FedEx pays drivers overtime to refuel after work hours. These associated refuelling costs are now even included in their return on investment (ROI) calculations, to the benefit of PEVs. **[12]**.

Although the demonstration trucks did not have HOV stickers, some of our interviewees pointed out this potential benefit (based on emission test results, the demonstration PHEVs would be eligible for an HOV sticker). HOV access not only reduces travel time, it can also boost driver morale by mitigating traffic congestion experiences. Perhaps this potential benefit is best characterized by one driver who put it this way:

> *"As soon as I get stickers on the Focus EV, I will probably start driving that for my commute home, I get off just passed where the carpool lane ends. It's awesome!"*

5. Reducing fuel cost

Beyond vehicle comfort, fuel economy was the factor most often cited by participants when evaluating vehicle performance. Participants often drew PHEV fuel economy comparisons to their normal work vehicle. However, fuel economy is a function of many variables including vehicle technology, driving cycles (e.g., stop and go vs. long freeway trips), driving style (e.g., "heavy footed drivers vs. efficient drivers) and the fuel used (total electric miles vs. gasoline).

Driving data from the PHEVs suggest that the potential for fuel savings is substantial but can vary significantly. Although fuel cost is only one component of a vehicle's total lifecycle cost, it is important to fleet operators. Gasoline prices are very volatile which complicates budgeting. Fleet managers explained to us that more predictable fuel costs would be very helpful in the budget process.

In Figures 2 and 3, we show actual average fuel economies for each of the demonstration vehicles over a month period and compare it to the EPA ratings for a gasoline Ram 1500 of the same vintage (model year 2012). As can be seen, the PHEV demonstration vehicle significantly outperformed a gasoline Ram 1500 for both the San Francisco vehicles (more "city" driving demands) and the Sacramento vehicles (more "combined" city and highway driving).

Using the EPA 2012 Ram 1500 "city" standard of 13 mpg as baseline for San Francisco and the EPA "combined" standard of 15 mpg for Sacramento, the calculated monthly gasoline savings for San Francisco and Sacramento are 133.7 gallons (for 5654 miles) and 245.4 gallons (for 13,843 miles), respectively.

Fuel economy results from the demonstration should be viewed cautiously as a representative of what is technologically possible because there is little or no financial or performance incentive for users to drive in an eco-friendly manner or to maximize charging. There was also no concerted effort to place the demonstration vehicles in applications where the full fuel economy benefits could be realized. To illustrate the importance of charging, we compared several weeks of CD fuel economy to several weeks of CS fuel economy when the vehicles were not charged. The average fuel economies in San Francisco were 14.2 mpg in CS mode versus 21 mpg in CD mode. Sacramento averaged 17.2 mpg in CS versus 23.7 mpg in CD mode. On average the vehicles used 38% - 48% less fuel while operating in CD mode during the comparison periods.

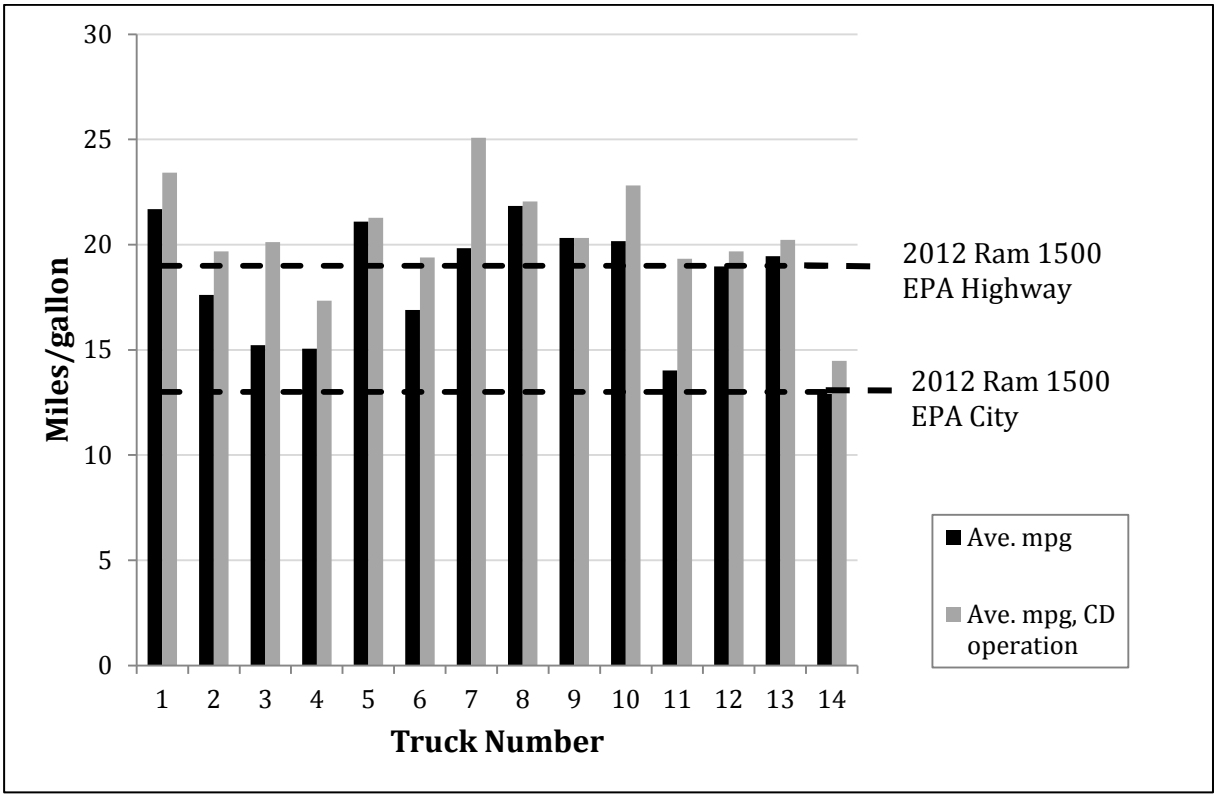

Figure 2: One Month Average Fuel Economy for San Francisco Demonstration PHEVs

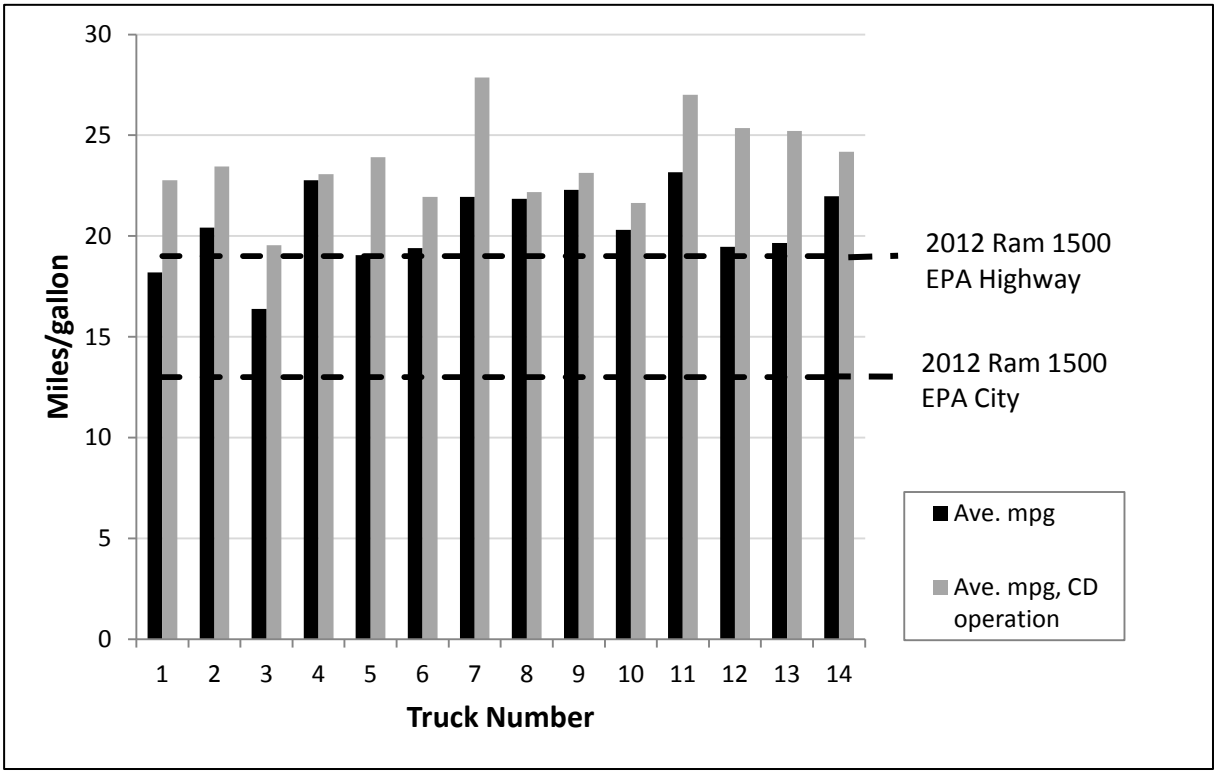

Figure 3: One Month Average Fuel Economy for Sacramento Demonstration PHEVs

6. Meeting sustainability goals

The City of San Francisco fleets which participated in the PHEV demonstration discussed vehicle purchases in the context of the city's clean air vehicle replacement guidelines. Enforced by the department of the environment, the guidelines require all city vehicles (except for law enforcement and emergency response) to be "clean air" certified unless there is a compelling justification why not. One manager explained it this way:

"The city, in regards to going green, has taken a very hard line with what we can purchase. And if they know there is an alternative fuelled vehicle available to purchase and you have asked for a standard fuelled vehicle then you have to have an excellent justification as to why…we are not given a choice."

In addition to requiring the purchase of clean air vehicles each city department has completed a climate action report detailing the sources and quantity of their greenhouse gas emissions and laying out targets and specific strategies to mitigate greenhouse gas emissions.

The enforcement of the clean air replacement vehicle mandate and obligations of meeting climate action plan goals are shaping the purchase behaviour of San Francisco city fleets. They follow developments in clean air vehicles and technology to find the best vehicles to meet their needs. As one manager explained:

"Every year [when doing the budget] we talk about, are there electric vehicles available? Are there alternative fuelled vehicles available that we can load up for our application?"

Department managers, sustainability officers and others tasked with implementing these policies viewed the RAM PHEV as valuable because the PHEV technology, in a work truck format, could be a way to provide appropriate and flexible clean air vehicles for their staff. In fact, evaluating PHEV technology to inform future purchase decisions was high on the list of reasons why these officials volunteered to participate in the project.

As one might expect the extent to which the PEVs would be valued in these terms depends on the existence and enforcement of sustainability, environmental or petroleum reduction goals for an organization. While by no means commonplace in the US, there are a handful of cities, counties and states which are addressing climate change on a state or local level. For instance, 32 states and over 200 cities have climate action plans of varying requirements. In California Senate Bill 375 requires local governments to develop climate action plans to meet greenhouse gas emission targets set by the California Air Resources Board.

These organizational goals are not unique to government fleets. Many companies have also been advancing sustainability efforts and even specifically targeting vehicle fleet electrification.

The extent to which these organizational goals exist, are pursued, and effectively linked to the organization's fleet will undoubtedly contribute to the importance of PEVs. However, as seen in this project, such organizational goals can have a substantial influence on fleet vehicle purchases.

7. Considerations associated with using PEVs in fleet applications

The PHEV demonstration project provided participants with the opportunity to evaluate how a particular plug-in hybrid truck might function within their fleet. Participants also took the opportunity provided by the demonstration to assess conditions under which vehicle electrification might make sense. Interviews with project participants showed that, despite the benefits of PHEVs, certain issues must be addressed before PHEVs could be adopted on a large scale by their organizations. Even then, some fleet vehicle applications may not be conducive to electrification based on drive cycle or vehicle requirements, for example law enforcement pursuit vehicles. We describe these considerations and conditions reported by our users as three themes: Green vehicles must be task appropriate, an appropriate charging network must be installed, and the fleet vehicle purchase process must be restructured.

7.1 "Green vehicles" must be task-appropriate

Fleet managers who participated in the demonstration consistently stressed the importance of purchasing "green vehicles" but also emphasized the fact that the vehicles had to meet the needs of their job functions. As one participant noted,

"At the end of the day the job needs to get done...Whether it's electric or gasoline, it's just got to happen".

The fleet managers we interviewed as part of this demonstration described their placement of the RAM 1500 PHEV as part of a strategic decision-making process which was not representative of how they normally assign fleet vehicles to drivers. Our fleet managers reported trying to select trustworthy and appropriate drivers who had job functions which could be met by the RAM 1500 PHEV. Large vehicle size, limited bed space, expected duty cycle, and participant's inability to modify the vehicle in any substantial way meant that some fleets were un-able to use the vehicle within their normal "work truck" fleet. Fleet managers who had experience with Compressed Natural Gas (CNG) vehicles described similar challenges they've faced incorporating CNG conversion pickup trucks, into their fleet.

"The CNG for us is a big problem. The tank is really huge in the truck bed and that is just killing our staff. The two primary accessories that they [the staff] talk about and need in their beds is having the option to get a dump bed or a lift gate. We have those on practically every one of our trucks…. So when you look at what kinds of accessories are available it's important they have that".

Different aftermarket components options were important to other fleet managers. As one fleet manager put it "any vehicle we purchase will have to be modified to accommodate tool boxes, ladders and enclosures". Fleet managers also noted the reduced physical size of the pickup truck bed as a problem. "Because of that box in the back it's not conducive to being a work truck". Another noted that "a full-sized 8 ft. bed would go over better for those employees who really need a truck".

Some participants also noted that an easier-to-manoeuvre vehicle would be more desirable for city driving. While not all fleet vehicles need to be used in "work" applications, data based on 2011 vehicle registrations **[13]** shows that SUVs, vans and pickup trucks account for approximately 70% of government and commercial (excluding law enforcement) fleet vehicle purchases. Some fleet managers noted that the frequency of fueling and the time associated with traveling to a centralized

refueling station was another issue with CNG vehicles.

"Traveling that extra five miles [to a CNG fueling station] could be half an hour in the city. So the convenience factor is just as big a barrier as anything else."

Based on driving characteristics and CNG vehicle range users estimated having to fill up every one to two days, compared to the once every two weeks with a gasoline vehicle. These general compatibility issues and design deficiencies are often worked around through careful vehicle placement and driver selection. A common adjustment is to place these vehicles with supervisors or other staff who don't require the same cargo capacity or have access to other vehicles with which they may substitute. However since supervisors and office staff typically drive less than most professional work crews, the financial incentives to switch from gasoline to an alternative low-cost fuel decreases proportionally.

One fleet manager thought that PHEV charge-depleting range should be a customizable option since the right sizing of batteries is one of the single most expensive components of a PEV. The duty cycle and operational conditions of fleet vehicles are well understood by managers, although it's not clear that most fleet managers have the analytical resources to account for factors like vehicle load, driving behaviour, charging frequency, and climate control when considering vehicle range.

7.2 Installing and using a charging network

Most of the fleet managers tasked with incorporating the RAM 1500 PHEV into their fleet did not have prior experience with citing, installing or managing charging infrastructure. Yet, proper placement, design and use of the charging infrastructure is critical to maximizing the fuel displacement of PHEVs within fleets. Distributing charging stations within a fleet network to promote easy and convenient charging for all users increases the proportion of CD driving which maximizes environmental benefits, and reduces fuel costs.

Problems with charging infrastructure placement were observed for some of the organizations who participated in the demonstration. Some charging stations were located behind locked gates, far away from where drivers normally parked their vehicle, or in tight spaces that made parking and charging difficult. Overall, 27% of RAM PHEV survey respondents, if given the opportunity, would move their charging station to different location.

As highlighted by those who drove the RAM PHEV home, appropriate charging infrastructure may extend beyond the corporate yard or office depending on how vehicles are used. Providing employees who commute home with a PHEV the option to receive a stipend for days in which they use their home electricity to charge a work PEV, might serve to motivate users to displace more gasoline by aligning their financial incentives with those of the organization. Providing guidelines, charger location information and membership cards for away from home charging networks and communicating the benefits accrued to employees due to their charging may also help set up fleet users for optimal charging routines and behaviours.

With regard to the installation of charging infrastructure most of the fleets had in-house capability to wire and install the single Level 2 J1772 charging station which came with the vehicle. The installation of the charging stations was timely for most of the participants but a few reported it took up to

two months after the placement of the vehicle. Those participants with the longest wait times faced challenges finding a secure location to place a charging station, were waiting for permits or engaged in the process of procuring additional funding for installation. Fleets who chose to install more than one charging station (to prepare for future PEVs) noted that costs quickly became an issue. However, one did point out that the decision was ultimately a matter of prioritizing expenditures: "we have a lot of places to allocate money but this is a priority for us". A nuance to the cost issues associated with installing multiple charging stations at the same time was the upfront "lump sum" payment required for the installation and hardware which would be used for multiple vehicles over the course of many years instead of a recurring payment or lease. One fleet manager found a solution by bundling the installation of the charging stations with that of solar panel covered carports which were being installed at the same time as part of a solar power purchase agreement.

Finally, the fleets taking part in this demonstration project had almost no sense of the cost associated with charging the PHEV or how to separate electric vehicle charging from their total electricity bill. One user estimate that the vehicle used $8 worth of electricity per month based on differences in utility bills (before and after receiving the truck), but forgot to include the cost of electricity which he incurred from charging away from the office.

7.3 Restructuring fleet vehicle purchase criteria

A fleet manager's job performance guidelines dictate that he/she select vehicles with low purchase prices. This emphasis on upfront cost creates obstacles, for fleet managers who want to purchase PEVs. One fleet manager describing how his decisions must make economic sense said:

"I'm trying to migrate people to more fuel efficient vehicles but it's always a challenge because a lot of them aren't running a lot of miles. So, we look at the payback and it's like 15 years sometimes… there is always an economic analysis [associated with] what we're doing."

Part of the problem with purchasing PEVs is a fleet's inability to enter into lease agreements. In general, lease terms for PEVs are more favourable since Federal incentives can be immediately deducted by the dealer on behalf of the vehicle purchaser and absolve the lessee of most maintenance costs.

Since PEVs have been in the market for such a short time, the components which make up an economic total cost of ownership (TCO) for PEVs may not be fully understood by every fleet operator. For instance, there is little information about the residual value or resale value of PEVs. Fleets that are unable to lease and those with mileage-based or time-based vehicle retirement policies face an additional TCO calculation obstacle. As explained by one fleet manager, "the Chevy Volt could be the best fleet car ever because the return on investment is so high, but we just don't know that yet [because the end-of- life value is unknown]"

8. Discussion

We identified four value propositions for plug-in electric vehicles deemed important by organizations which had the opportunity to use a RAM 1500 PHEV for more than a year. These values vary in importance depending not only on the organization but, more importantly, on the responsibilities and job position of the evaluator. What is important for one employee may not even be

a consideration for the individual tasked with purchasing fleet vehicles.

We propose that effective PEV fleet marketing campaigns target strategic coalitions within organizations, so that all the PEV benefits are considered in the vehicle selection process.

The multitude of organizational complexities that affect PEV purchase decisions calls for a broader, more robust, PEV marketing strategy. Whereas vehicle purchase decisions are routine, PEV purchases will likely require a more strategic approach involving several individuals and should not be pursued through normal channels. Tax breaks and subsidies, infrastructure installation, a fleet's ability to accommodate PEVs, sustainability goals, corporate culture and image, and feedback from fleet networks are a few considerations that can complicate the purchase decision. Typically, no single person in the organization has full knowledge of all these factors.

The decision itself can take many paths. It may be a team collaboration that requires bargaining or compromise, a linear process that relies on an "idea champion" to move it up the chain of command, or a decision sent down from the top of the organization. Decision interrupts and vetoes anywhere in the decision process can undermine a chain of "yes" votes. Even top-down PHEV purchase directives can fail if the decision is not properly implemented. In some cases, the fleet manager my simply need a nod from upper management for her to feel comfortable enough to break with the convention of purchasing the least expensive option.

Our results also highlight a number of issues that must be addressed to ensure successful adoption of PEVs into fleets. Again, some of these - like charger installation - require input and action from employees who are not normally involved in the vehicle purchase process. Engaging these employees is imperative and requires planning before the purchase. In short, the rate at which PEVs enter the fleet market depends on getting the right message to the right people within each organization.

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