It's Electrifying: Insights About Steering Medium- and Heavy-Duty Fleets Toward Electric Vehicles

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ABSTRACT

Electrification of transportation offers substantial untapped potential to reduce greenhouse gas emissions, especially in locations where the electricity generation already relies on (or soon will use) non-fossil fuel sources of energy. Policymakers, regulators, electric utilities, the automobile industry, and others have taken note. There is excitement around electric cars and light-duty trucks and substantial effort to advance the vehicle battery technology and charging infrastructure to accelerate a transition to private electric vehicles. Utilities are incorporating future electricity demand from vehicle charging into their planning for future supply needs, developing some of the vehicle charging infrastructure, creating rates appropriate for vehicle charging, and even promoting electric vehicle transportation.

Similar efforts to transition medium- and heavy-duty vehicles away from fossil fuels are less visible, but are also essential to meet global, national, and some states' climate targets. This paper presents results from market research conducted for Southern California Edison for its effort to facilitate electrification of these larger vehicles. We present a brief characterization of fleets in 11 segments of medium- and heavy-duty vehicle use in Southern California and qualitative research into perceptions, decision-making practices, and anticipated adoption of electric vehicle options by fleet managers. The research is based on secondary data of fleet registrations, surveys completed by 58 fleet managers, and interviews with 11 fleet managers.

Introduction

Electrification has the potential to significantly reduce global greenhouse gas emissions. With transportation fuels accounting for more than a quarter of America's emissions, the transportation sector offers the largest untapped potential to reduce emissions via electrification (EPA 2019). Policymakers and utilities have taken note. For example, the state of California has recently pledged to ban the sales of all new gasoline vehicles by 2035 (Newsom 2020). Utilities in the state and nationwide are investigating how they can best support the transition to electric transportation and serve a unique new load.

This paper provides insights from market research about medium- and heavy-duty fleet characteristics, purchasing practices, and perceptions of fleet managers to help inform efforts to steer larger vehicles toward electric choices. Much focus has been on the transition of light-duty vehicles (under 10,000 pounds) toward electric options, which are becoming increasingly common as vehicle manufacturers shift their offerings toward electric. Utilities are following suit by offering specialized electric vehicle rates and planning to ensure future charging needs can be met. Some are promoting electric vehicle purchases and developing vehicle charging infrastructure.

The focus on medium- and heavy-duty trucks and specialized vehicles has been more limited so far, but forward-looking utilities and policymakers are also seeking ways to transition these fleets toward electric options by overcoming their additional perceived limitations, including reduced transport weight due to large batteries and the feasibility of extended travel routes. Technology for medium- and heavy-duty electric vehicles has been improving rapidly, with some larger companies beginning to utilize heavier electric vehicles. As many companies and public agencies (e.g., municipal governments) operate fleets of

heavier vehicles, it is important for policymakers to understand how these fleets operate in order to more effectively push companies to electrify their fleets.

This paper presents insights on barriers and potential drivers toward electrification of commercial fleets of larger vehicles. We present a characterization of applicable company fleets and vehicle purchasing processes, current levels of use of alternative fuels (whether electric, biodiesel, compressed natural gas, or something else), satisfaction with the performance of these vehicles, perceptions of electric vehicles, and what may or may not lead fleet managers to shift toward electrification of their fleets. We provide additional, deeper insights from in-depth interviews with fleet decision-makers in four key industry segments (drayage transport, regional goods distribution, private shuttle transportation, and warehouse transport).

Research Objectives and Methodology

The research presented herein was conducted by Evergreen Economics for Southern California Edison's (SCE's) transportation electrification team in 2020.[1] The underlying study focused on medium- and heavy-duty vehicles operated by corporate or organizational fleets in Southern California in any of these 11 segments:

1. Drayage
2. Private shuttle transportation
3. Regional goods transportation
4. Warehouse transportation
5. Campus fleets[2]
6. Long haul transportation
7. Municipal fleets
8. Port equipment
9. Truck and rest stops[3]
10. Utility work
11. Waste hauling

The study goals were to segment the commercial vehicle fleet market, identify drivers and barriers for the use of electric vehicles, understand fleet decision-making, and identify messaging and channels for any program interventions. As such, this study was a formative evaluation, intended to inform on-going and future program approaches.

The study drew on secondary data of segment-specific fleet data, a mixed mode telephone and web survey of 58 fleet decision-makers, and 11 in-depth interviews of fleet managers—seven of those with survey respondents and four with additional fleet managers. Table 1 summarizes the topics addressed in the survey and interviews. Surveyed and interviewed fleet managers were sampled from a list of fleet-owning customers provided by SCE and invited to participate in a survey via email. Members of segments of high priority to the utility (drayage, regional goods transportation, shuttle transportation, and warehouse transportation) were contacted via telephone and offered a telephone survey if they did not respond to the web survey invitation. Respondents comprised 8 of the 11 segments. Segment-level

[1] Two of the authors—Bensch and Shimazu—led and worked on the study while employed at Evergreen Economics, and the third—Schultz—oversaw and directed the study for SCE.

[2] Fleet data suggest that many of these campuses are associated with institutions of higher learning.

[3] The truck and rest stop segment is broader than the name would imply. It includes car dealerships, gas stations, and at least one refinery with trucking facilities.

response rates ranged from 3 to 25%. For interviews, we recruited primarily from among the high priority segment respondents to the survey.

Table 1. Survey and interview topics

	Addressed in survey	Addressed in interviews
Fleet overview	X	X
Fuel types used	X	X (including consideration of, reason for, and use of any alternative fuel vehicles)
Distances traveled by class of vehicle	X	X (including types of routes)
Use of vehicles by class	X	X
Vehicle purchase decision-makers	X	X (including roles)
Vehicle purchase key considerations	X	X (including triggers for purchases)
Vehicle purchase process		X (including standards / requirements)
Experiences with any alternative fuel vehicles in fleet		X
Disposition toward future purchases of electric medium- or heavy-duty vehicles	X	X (focus on perceptions of electric options)
Drivers and barriers for any potential electric vehicle purchases	X	X
Current or potential role of infrastructure development and mandates in future purchase choices		X (including awareness and reaction to current SCE efforts)
Timing of future medium- or heavy-duty vehicle purchases	X	
Impact of pandemic on vehicle purchases	X	
Firmographics	X	

Characterizing Commercial Fleets

Fleet registration data obtained by SCE from IHS Markit (2019) provided the information needed to characterize commercial fleets of medium- and heavy-duty vehicles in the counties served by SCE into 11 segments of interest to the utility's transportation electrification program. As noted, these segments include:

- The transportation of goods at various points of their transfer between modes, transportation, distribution, storage, and delivery (drayage, regional goods transportation, warehouse transportation, long haul transportation, and port equipment);
- The local transportation of people in larger vehicles within defined areas or for point-to-point transportation (private shuttle transportation and possibly campus fleets); and
- Specialized vehicles in the service of infrastructure and jurisdictional needs (campus fleets, municipal fleets, truck and rest stops, and waste hauling).

SCE defines fleets of interest as containing 10 or more vehicles, so we excluded companies and organizations with smaller numbers of vehicles from our analysis and results shown.

Most of the segments are well represented in the region that SCE serves and would be common in any larger urban area (except for port equipment). For nearly every segment, the number of fleet-controlled vehicles in Southern California numbers in the single-digit thousands, and they are generally distributed across dozens of businesses or organizations. Most fleets contain fewer than 25 vehicles; larger fleets are more common among municipal fleets and truck and rest stops.

Existing hybrid and electric vehicles exist in low numbers in some of these segments. Registration data suggest a penetration rate of 2 percent for hybrids among medium- and large-duty vehicles in municipal fleets, but electric vehicles were noted in only small numbers among private shuttles and campus vehicles. While too small to provide noticeable reductions in greenhouse gas emissions, these vehicles' existence is potentially meaningful for their demonstrational and testimonial benefit within those sectors.

The geographic distribution of fleets, as well as the routes they cover, are also highly relevant for efforts to promote their conversion to electric vehicles. As noted in Table 2, fleets for drayage, private shuttle transportation, port equipment, and utility work are heavily concentrated—mostly in the core urban areas of metropolitan Los Angeles—and would be similarly distributed in other metropolitan areas. Their distribution in close proximity to other commercial fleets of larger vehicles makes them easier to serve with the needed charging infrastructure when shared charging stations are of benefit, such as for regional routes that require distances that exceed vehicle ranges and for long-haul transportation.

Meanwhile, routes of some more widely distributed fleet types, such as those associated with campuses, municipal governments, and waste hauling, tend to stay close to their home base or travel well-established, predictable routes. These characteristics also make it easier to serve them with the needed charging infrastructure in Southern California with similar tendencies in other urban areas.

Table 2. Fleet characterization for vehicle classes 2 through 8 by segment in Southern California

Segment	Total fleet vehicles registered	Businesses with fleets >= 10	Notes
Drayage	4,919	178	Most fleets 11 to 25 vehicles; 40 registered vehicles are identified as hybrid; highly concentrated geographically
Private shuttle transportation	2,439	98	Most fleets 11 to 25 vehicles; 22 vehicles registered as electric, 1 as hybrid; highly concentrated geographically
Regional goods transportation	25,226	418	Most fleets 11 to 25 vehicles; 37 vehicles registered as hybrid; moderately concentrated geographically
Warehouse transportation	2,668	129	Most fleets 11 to 25 vehicles; 6 vehicles registered as hybrid; moderately concentrated geographically
Campus fleets	143	25	Most fleets 11 to 25 vehicles; 17 vehicles registered as electric; somewhat diversely distributed
Long haul transportation	6,933	217	Most fleets 11 to 25 vehicles; 3 vehicles registered as hybrid; moderately concentrated geographically
Municipal fleets	4,571	178	Fleets run larger than for other segments with 26 to 50 vehicles most common and fleets up to 200 vehicles not uncommon; 88 vehicles registered as hybrid; somewhat diversely distributed
Port equipment	2,236	121	Almost all fleets are 11 to 25 vehicles; 14 vehicles registered as hybrid; highly concentrated geographically
Truck and rest stops	1,283	53	Fleets run larger than for other segments with 11 to 25 vehicles most common and fleets up to 200 vehicles not uncommon; no vehicles registered as hybrid or electric; moderately concentrated geographically
Utility work	3,276	80	Most fleets 11 to 25 vehicles; no vehicles registered as hybrid or electric; highly concentrated geographically
Waste hauling	375	15	Half of fleets 11 to 25 vehicles; no vehicles registered as hybrid or electric; moderately concentrated geographically

Geographic density presented here is based on author's review of county-based maps of densities of applicable fleets by county within Southern California Edison's service area. We used the term "highly concentrated" to describe segments for which most fleets were located in one county or a limited number of geographically small counties that are adjacent to each other. "Moderately concentrated" refers to evidence of some clustering, but with distribution across larger parts of the service area.

Our survey of fleet managers corroborated the tendency of businesses to have smaller fleets of 11 to 20 or 21 to 50 vehicles, as shown in Figure 1.

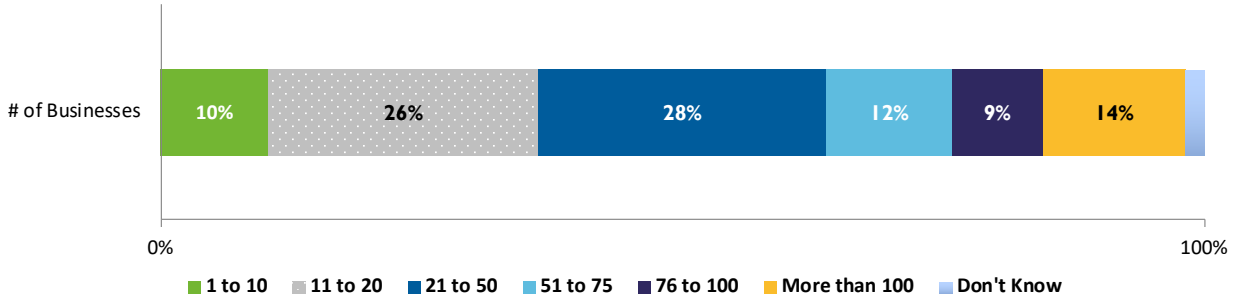

Figure 1. Distribution of fleet sizes among responding fleet managers (n=58)

While electric vehicles are uncommon in commercial fleets of medium- and heavy-duty vehicles, our survey of fleet managers revealed occasional use of alternative fuels. A fifth of the fleets managed by survey respondents already included an alternative fuel vehicle. As shown in Table 3, the fuel type varied, but most use a form of natural gas—either liquified, compressed, or propane. The use and greater adoption of these alternative fuel vehicles could indicate that non-electric alternatives to diesel are currently more established than electric models.

Table 3. Alternative fuels used by surveyed fleet managers

Fuel type	Count (n = 12)
Biodiesel	3
Ethanol (E85)	1
Hydrogen fuel cells	1
Liquified natural gas	1
Compressed natural gas	7
Propane	2
Electricity (plug-in hybrid)	5
Electricity	2

Respondents could select more than one response.

Fleet Decision-Making: Interest, Opportunities, and Barriers to Electric Vehicles

Revealed interest in medium- and heavy-duty electric vehicles is low, as noted by the small number on the roads in Southern California. For this reason, we explored latent interest, opportunities for their adoption, and barriers to their selection by fleet managers in our survey and subsequent interviews.

Barriers and Potential Concerns Exceed Drivers

One metric of earnest consideration and progression toward technology change is the time frame in which decision-makers could envision acquiring the new technology. In the case of fleet managers, the largest group (one third of respondents) could see electric vehicles in their fleet in two to three years, as shown in Figure 2, which represents a small share of the 58% of respondents who anticipated their next vehicle purchase of any type to occur within a year (which is not shown in the figure).

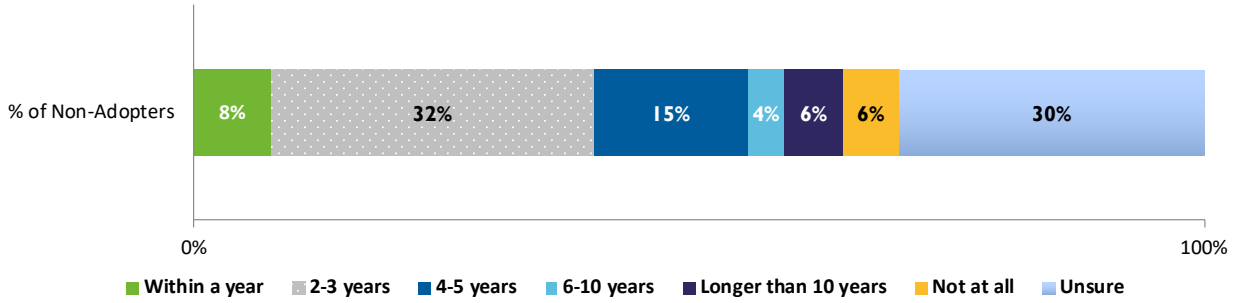

Figure 2. Time frame for potential adoption of electric vehicles (n=53)

One major reason for the uncertainty about potential future electric vehicle purchases by 30% of respondents appears to be questions concerning the practicality of larger electric vehicles. A full quarter of respondents thought that electric vehicles would be completely infeasible in their fleets, while another 17% suspected they would be somewhat impractical.

Range anxiety (the concern about how far a charge will take an electric vehicle) exists for larger vehicles as well as for passenger cars, where the term appears to have originated. In the case of medium- and heavy-duty fleets, the concern takes on some nuance, as the key metrics are not always distance between charges, but the ability to charge along set routes, whether the vehicle can complete one or more loops on a charge so it can be recharged at its base location, and whether the driver's time can be used productively during charging.

In interviews, fleet managers expressed concerns about vehicle maintenance. They indicated that they have developed the needed infrastructure and capacity to maintain diesel vehicles, but were concerned about needing to shift their maintenance capabilities to deal with electric vehicles. (We note here that we were surprised by these comments and have not determined whether they reflect a real or perceived barrier. Generally, electric vehicles are simpler and should be easier to maintain than those with internal combustion engines. We do not know whether concerns revolve around the batteries, high tech features included in newer vehicles that are independent of their fuel and drive system, or just a fear of the unknown.)

Fleet managers also talked of their uncertainty about the effective load carrying capacity of electric versions of their heavier vehicles. Without having researched capacities, they anticipated that the weight of the batteries needed to run heavier vehicles would reduce the legal cargo capacity of the vehicles.

These concerns and uncertainties combine with the high cost of medium- and heavy-duty vehicles. Fleet managers emphasized that purchases of these types of vehicles are major investments for many firms. As a result, shifting to unknown models and technologies involves risk until the newer types of vehicles are proven and become a known quantity. Few fleet managers seemed anxious to be the first to try them.

Drivers

One fleet manager we interviewed had already adopted electric vehicles at a national level and stressed the consistency of electric vehicles with the company's sustainability goals and their desire to be seen as a leader in this respect. Incidentally, this company had managed to figure out the needed infrastructure and routing to make it work on a larger scale, but that appeared to require effort and commitment.

For some fleet owners, segment-specific external requirements and inducements serve as additional drivers toward either electric or other alternative fuel vehicles. In Southern California, this is led by statewide policy drivers, but supply chain expectations of client businesses may also be a factor at a national level.

An executive order by Governor Gavin Newsom in September 2020 will prompt California Air Resources Board (CARB) regulations to require sales of all new passenger vehicles in California to be zero-emission by 2035, while mandating the operations of drayage medium- and heavy-duty vehicles to be zero-emission by 2035 and by 2045 for all other vehicles in these size classes (Newsom 2020).

Previously, the Port of Los Angeles had already been imposing clean truck requirements for port-owned vehicles (Port of Los Angeles 2019), while ensuring that externally-owned vehicles operating at the port, including older models, adhere to current CARB emissions requirements (Port of Los Angeles undated). The requirements for port-owned equipment include the expectation that the "lowest emission" vehicles available be employed and that alternatives to diesel be adopted if they are among the lowest emission options available. It should be noted, however, that this requirement is technology neutral among the non-diesel options and places compressed natural gas and liquid natural gas in the same favored category as hybrid and electric vehicles.

Conclusions and Recommendations

Any transition to electric medium- and heavy-duty vehicles is still in its infancy. Policymakers, vehicle manufacturers, utilities, and others are putting the pieces in place, but adoption and readiness to adopt the technology is still low among commercial fleet managers in Southern California (and probably nationally).

It is interesting and important to note that some current policy drivers are focused on a shift away from diesel rather than a shift specifically to electric vehicles. Greater familiarity with compressed natural gas and liquified natural gas could prompt fleet managers to replace vehicles with these other technologies instead of electric ones even if viable electric options exist. While a technology-neutral stance is appropriate policy, it leaves the door open for alternative paths for industry and fleets.

Nevertheless, we would assume that fleets of larger vehicles would follow the electric technology path given the transition of transportation infrastructure toward electric transportation overall and the emphasis of newer policy directives, such as statewide directives in California, on zero emissions of greenhouse gases. Within this transition, electric vehicle adoption will not follow a single technology adoption curve, but several of them. All indications are that passenger cars and light trucks will continue to lead a transition to electric vehicles with other vehicles to follow in a similar, but delayed pattern. Within medium- and heavy-duty vehicles, for some vehicle types, the local infrastructure needed and readiness to adopt may vary by vehicle type and segment, leading to a sequence of technology adoption curves, as illustrated in Figure 3.

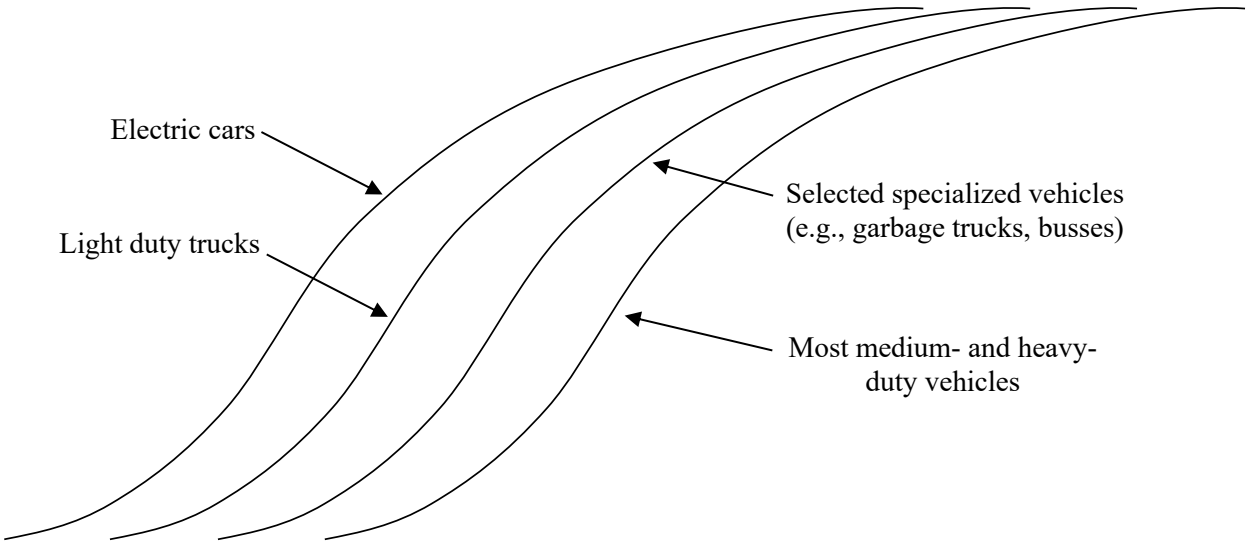

Figure 3. Staggered adoption curves (theorized)

Some commercial fleets of larger vehicles are more likely to adopt electric vehicles than others. Given decision-making considerations communicated by fleet managers, we see earlier adopters as including those who:

- Already use electric versions of their light duty vehicles and have gained familiarity and comfort with those vehicles, and established an internal infrastructure for their operation, planning routes and charging, and maintenance.
- Follow routine and local routes so that charging needs can be predicted and planned, preferably at one of the company's facilities.
- Have a sustainability goal or plan, which is an indication that the company values the benefits of electric transportation for internal or marketing purposes and, thereby, sees greater benefits than those for whom vehicle choices are a narrower lifecycle or first cost assessment.
- Have the needed maintenance capabilities and are comfortable that their maintenance staff can handle the transition.
- Are the targets of external requirements imposed on the business by regulators, customers' supply chain expectations, or third parties.

While utilities are often focused on rates and charging infrastructure, accelerating a transition to electric medium- and heavy-duty vehicles will require more than a "if you build it, they will come" strategy. Acceleration could also be facilitated by:

- Assurance that electric (rather than gas-based) technology is the future for individual fleets' vehicle types and will be here to stay.
- Success stories that demonstrate the practicality of electric vehicle adoption now for companies with similar needs (and possibly even a playbook for how to address route planning and charging).
- Alternate payment and ownership structures to reduce the perceived risk of the large capital outlays of new vehicle purchases, as well as the construction of the needed charging infrastructure.
- Tracking and credible communications of the vehicle options by type that use electric vehicles along with their specifications and performance (i.e., a "Consumer Reports" for emerging electric vehicle options for medium- and heavy-duty vehicles by function.

This list highlights the need to think beyond rates and charging infrastructure, but utilities need to bear in mind that they are not the only potential influencers in the market. In some cases, utilities may find themselves to be the primary drivers; in other cases, they could simply be catalysts or purveyors of information. Coordination and partnerships with other players should be part of the playbook for utilities seeking an active role in driving the market.

For utilities seeking an active role in facilitating the transition, a segment-oriented approach such as that adopted by Southern California Edison's transportation electrification team, allows for programs to make meaningful distinctions among the medium- and heavy-duty fleets and tailor approaches and communications based on the fleets' needs and options. Figure 4 illustrates one way of thinking about a utility-focused intervention strategy. Under this potential model, a segment-oriented approach begins with an assessment of whether electric vehicles already exist to meet the particular business needs of the segment. If they do not exist yet, segment-specific market intervention may need to wait until viable models are available. If they do exist, further strategies will depend on the awareness and perception of the fleet decision-makers. Interventions could then be designed to help overcome the barriers specific to the segment.

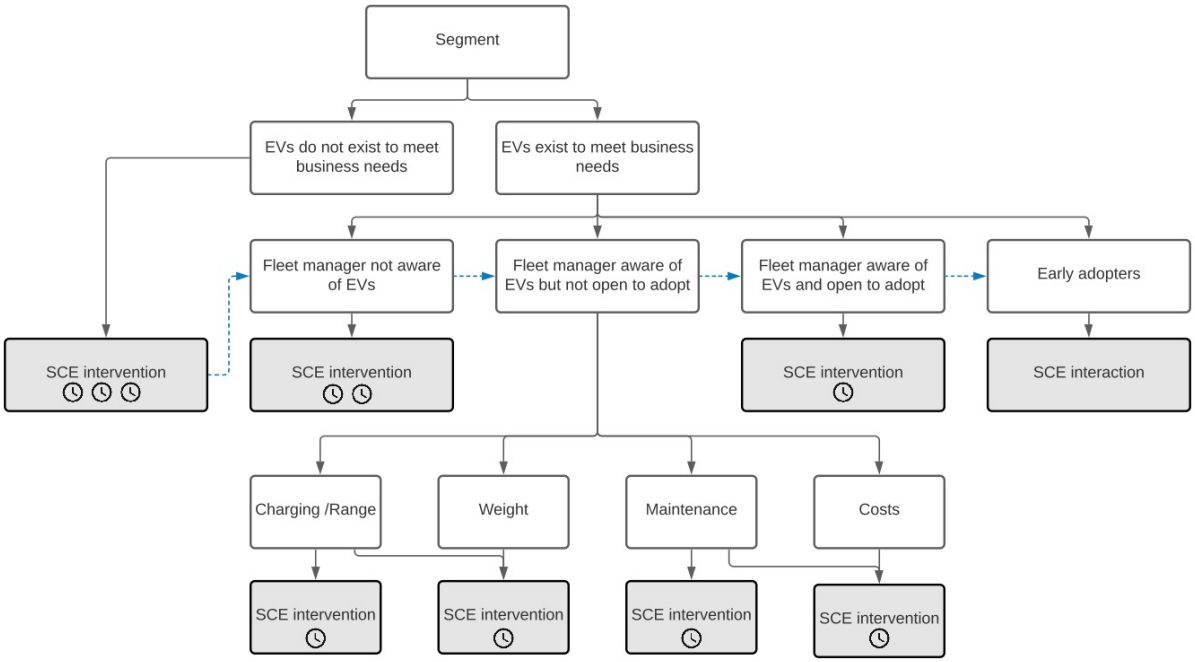

Figure 4. Illustrative segment-specific utility intervention strategy

Utilities could play a direct role in overcoming informational barriers and hesitancy from those who do not want to be at the "bleeding edge" of technology adoption. These are purely informational barriers for which outreach and credible information could be transformative. Most utilities with energy efficiency programs already have the needed skills and infrastructure to leverage customer testimonials, case studies, and demonstrations to facilitate customer learning about new technology. Where unresolved technical or logistical barriers deter adoption, utilities could serve the role of an information clearinghouse about the state and readiness of the technology and delay active encouragement of a transition to electric models while their viability and performance for fleets in the segment improves and is proven.

Utilities have a range of options to support customer needs and facilitate transportation electrification during the early days of the transition of medium- and heavy-duty vehicle fleets toward electric models. These options begin with the development of appropriate rates and support of charging infrastructure, but they could extend to more active encouragement of electrification where this is viable and a good solution for customers.

Opportunities for further research to inform utility (or any) programs to encourage adoption of electric alternatives to medium- and heavy-duty vehicles include active tracking of the models available by function for dissemination to fleet decision-makers, tracking of adoption rates, and secondary research on the extent to which concerns expressed by non-adopters (such as maintenance costs and challenges) are real or misperceptions.

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