

Designing Electric Vehicle Infrastructures and Opportunities to Benefit All Residents [Traditional Research Paper]

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Designing Electric Vehicle Opportunities to Benefit All Residents

Abstract

Countries around the globe have set electric vehicle adoption goals to address environmental and health concerns, but engineering planners and community policy experts cannot separate the socioeconomic factors from transportation needs. This mixed-methods case study indicates that because transportation decisions are inextricably linked to health, work, and housing, EV adoption must also address multifaceted human needs. To avoid the transportation mistakes of the past, it is essential that people in communities are consulted in the adoption process and have opportunities so all may actively benefit from the infrastructures and economic growth caused by electrification. “If you don't know the space in the communities and the harms that they've felt, if you don't hear those stories, you can inadvertently just reimpose harm,” said one study participant. The purpose of this study was to provide an empirically-based, transferable roadmap that can be used to guide community engagement efforts for electrification in other communities. The study was guided by the questions: 1. What factors support or limit procedural integrity (i.e., community decision-making power) and distributive integrity (i.e., community benefits from electrification)? 2. What are community concerns regarding EVs and how do communities hope to benefit? and, 3. What are the factors and processes that lead to strong partnerships relative to EV implementation?

Over the time period of one year, researchers collected in-depth data using multiple methods and sources (public meetings, local news forums, surveys, and interviews) for a rich context that sought to understand community needs and priorities, build from local knowledge, refine research questions to improve relevance, and disseminate results. Data analysis indicated a need for attention to workforce development (e.g., “It would be disingenuous of us to imagine a transition in our electric system that doesn't include workforce, that doesn't think about how it impacts people”). A primary outcome of the research is a workforce development plan with best-practices recommendations. Policy experts can use this case study as a guide for further community engagement in any geographic areas planning electrification efforts.

Key words: community engagement, electric vehicles, environment, participatory research, transportation, workforce development

Introduction

Countries around the globe have set electric vehicle adoption goals to address environmental and health concerns [1], but engineering planners and community policy experts cannot separate the socioeconomic factors from transportation needs [2], [3]. Global electrification is complex and requires research on many technical and engineering aspects [4], [5], [6], [7], environmental implications [8], [9], [10], [11], health impacts [12], [13], financial costs [14], [15], [16], manufacturing and workforce requirements [17], [18], [19], [20], parity concerns [21], [22], [23], [24], [25], [26], [27], [28], [29], and the resulting policy recommendations [30], [31], [32], [33]. This article reports on a review of existing literature in these subject areas, and the gaps found that led to a mixed-methods case study of a near-port community in the Western United States. The study investigated factors related to community decision-making power and benefits from electrification, community concerns and hopes related to EVs, and how to build strong partnerships relative to EV implementation.

Following the literature review, this paper reports on the study methodology, context and setting, data collection, data analysis, limitations, findings, and conclusions. A primary outcome of the inductive research has been a workforce development plan with best-practices recommendations. The researchers hope this case study can be useful in engineering design and community engagement courses, as a guide for policy experts planning electrification efforts, and as an impetus for more community-engaged research in the area of global electrification.

Literature Review

Tens of thousands of research articles have been published on electric vehicles in the past couple of years. This literature review found that electric vehicle adoption is not solely a transportation topic, but is intertwined with basic human concerns about health, employment, education, and finances [3], [22]. This finding led to an inductive community-engaged research study to explore factors contributing to or hindering procedural and distributive impartiality relative to electrification. In this section, the literature discussion will be organized around six

themes that emerged: environmental concerns, factors influencing EV adoption, charging infrastructure, impartiality concerns, community decision making, and workforce development.

Environmental Concerns

Literature in the review commented on electric vehicles as a means to improve environmental factors that impact human health. Electric vehicles are cited as the leading replacement for fossil-fueled vehicles, and EV use is expected to expand very significantly in the next twenty years [34]. Canepa et al. identified a need for more electric vehicles in communities to improve air quality and improve environmental parity [35]. The U.S. Environmental Protection Agency acknowledges that high toxic burdens exist in some areas; some communities say these harms have yet to be remediated and more participatory decision-making is needed [12]. Many countries have focused on transportation as the key to reaching greenhouse gas mitigation goals [36]. Electric vehicle adoption has also been criticized for extractive practices required for batteries and infrastructure, and violation of Indigenous rights [9], [10]. Concerns about the global environment have drawn attention to electric vehicles as a leading solution to fossil fuels and the associated air quality issues.

Factors Influencing EV Adoption

With this focus on electric vehicles have come strategies to promote more widespread adoption. Studies report on EV battery range, charging stations, utility supply, financial costs, and convenience as factors for decision makers. Some articles discuss technology related to energy storage and battery charging speed [37], while others look at the convenience of charging stations, including self-scheduling at “smart parking lots” and how it may influence consumers [34], [38]. Hathaway et al. suggest electric utility companies sponsor charging access in some communities to support wider adoption [31]. In China, a study spanning 20 provinces found that high-powered, public-access EV charging was a factor in vehicle purchases [39]. Public charging availability is significant in more densely populated urban areas where vehicle owners are not charging their cars at single-family homes. In the state of California, which leads the

U.S. in EV sales, charging access disparity was found between racial and income groups [32]. Other studies evaluated consumer awareness [40] and the impact of consumer information, including environmental benefits, on buyer intentions [36]. After considering vehicle range issues, charging stations, consumer information, “the affordability of EVs remain[s] the greatest barrier [31].” In summary, factors related to EV were found to be battery and charging technology, access and convenience, environmental value, and primarily affordability.

Charging Infrastructure

Other scholarship has focused more specifically on best practices in building charging station infrastructure. These included land use clustering [41], community charging hub models for multi-dwelling EV drivers [42], and supply/demand optimization algorithms [5]. Carlton and Sultana’s research included analysis of travel behaviors that identified a need for more widely-available public fast charging, and found that existing charging options favor wealthy EV drivers [41]. Researching Canada, China, Denmark, India, Japan, Norway, UK, and USA, Deb et al. found the global scenario has social, economic, and technological barriers which call for collaboration among researchers, industrialists, and governments [5]. The literature commented on financing of charging stations, variations in user needs and incomes, public v. private options, travel behaviors, demand optimization, land use, and community impacts.

Impartiality Concerns

Because of the intertwined nature of transportation with multiple facets of life, research about EV use and the impacts on communities merits its own section for further discussion. Some researchers call for targeted policy interventions in order to prioritize electric vehicle charging infrastructure across all areas as EV adoption expands [43]. Mapping tools and other means have been used in this effort, but identifying local needs and incorporating community input is also important when choosing charging locations as well as assessing the benefits. Infrastructure alone “does not inherently mean that those EV chargers provide benefits to residents of that community” noted Zhou et al. [44]. In a manuscript submitted for publication

[3] we report on community-engaged research that found some residents want amenities for residents without electric cars. These suggestions included micro-mobility options such e-bikes, scooters, and car shares; as well as pedestrian amenities such as benches, shade, trash cans, phone charging, and WIFI. Chatterjee et al. report that “many countries are incentivizing the manufacture, sale, and purchase of low carbon-emitting vehicles such as electric vehicles” [45]. For example, EV buyers in the U.S. benefit from \$4,000-7,500 tax credits [46]. What benefits can non-EV owners expect? New research by Gao et al. found that emerging high-tech travel solutions and transportation innovations “do not impact all travelers equally-and some exacerbate existing inequities, with significant drawbacks for certain populations [47].” Rouhana et al. note that EV adoption contributes to clean energy and job creation, and “it also raises concerns regarding its potential impact on the human rights of people impacted by the production, use, and end-of-life of EVs [48].” Other researchers similarly reported on skewed disparities and exacerbated disadvantages [11], [22], [26] and the need for community-engaged engineering in the planning of infrastructures [32]. Reynante wrote that engineers must be trained to “demonstrate humility, empathy, and consideration for social, environmental, and ethical dimensions of their designs [49].” Despite these concerns, the emphasis in studies on public views of EV infrastructure and EVs is in terms of consumerism, not parity impacts [50]. This literature review found a lack of specific solutions for how EV adoption can benefit people who do not own cars. Our research addresses this gap by proposing plans for workforce development in job areas expected to grow from EV adoption.

Community Decision Making

Development of infrastructure and a workforce that supports electric vehicle adoption should include the voices of all community members, since all are effected by the changes [12], [22], [32], [44]. Participatory research is described by Finley-Brook and Holloman [12] as informing policy and action by honoring three tenets of energy integrity: procedural, distributive, and recognition. They specify that this type of research builds from local

knowledge, understands the priorities of the community, improves relevance with new research questions, disseminates results, and follows through on objectives. Energy integrity requires “not only ending disproportionate harm, it also entails involvement in the design of solutions and fair distribution of benefits, such as green jobs and clean air [12].” Hsu and Fingerma n also call for acknowledging all people in EV adoption process, noting that collaborative, community-based planning “could increase their decision-making power, bring economic opportunities to the community, and raise EV awareness [32].”

Workforce Development

A key area for possible economic opportunity is workforce development in jobs related to EV production, maintenance, charging stations, electrified roadways, recycling of batteries, etc. Research has shown there are some challenges as technology advances, so new skills must be developed and some enterprises experience occupational shifts [17]. Cotterman et al. describe EV adoption as the largest transition in over a century in the area of personal transportation, and their analysis of large-scale components manufacturing finds that labor demand will increase [1]. Workforce implications from roadway electrification is an aspect of EV adoption that is underexplored in the existing literature [51], but production, maintenance, and recycling are discussed. Since recent data continue to show that economic factors are the greatest limiter to EV ownership [52], this paper suggests that support for accessing EV-related job training and improved job opportunities is one of the best ways all communities can benefit from the global EV transition.

Currently, some students are less well prepared, starting in K-12, to enter the workforce than their classmates [53], so improved unilateral support is certainly called for. The literature shows another significant gap in knowledge relating to the impact of EV adoption for rural-based businesses [54]. A study of multiple countries found a lack of skilled EV technicians available for garages looking to hire [55]. Saleet et al. suggest that EV skills be taught at levels suitable for vocational, technical, and higher diplomas [19], Liu et al. report on a university

electric vehicles certificate that can be completed in nine months [56], and Yeh discusses community college partnerships [57]. Vijayalayan details a model-based approach to learning EV skills in motor control, battery management, fuel cells, electrical systems, and system simulation [58]. Reolfi et al. offer a database delineating the skills needed for EV light-duty automotive service work [59]. Car manufacturers will need to strategize extensive workforce planning to anticipate shifting labor needs in production and supply chains [60], [61]. One proposed solution is to provide support for workers to develop new skills and possibly relocate in the supply chain, for example moving from production of components to recycling of them [62], [63]. It must be noted that as governments change leadership, political and economic support for electrification also changes, impacting buyer incentives, and potentially EV sales, then possibly manufacturing demand, and infrastructure funding [64]; all of which impacts the workforce [18]. In light of concerns raised by numerous EV analysts, and workforce opportunities highlighted here, an inductive research case study was conducted to seek community participation on a path forward.

Report on Community Participatory Research Case Study

The literature reviewed above noted a significant gap in existing research for concrete plans addressing how people who do not own electric vehicles can benefit from EV adoption. The research reported below was motivated to help fill this gap by listening to people in a near-port community, then amplifying their concerns and solutions. What follows are the study methods, findings, discussion and recommendations, and conclusions.

Methodology

This inductive, mixed-methods case study was designed to provide information on how members of a near-port community perceive electric vehicles, and what concerns and advice they have related to advancing transportation, environmental, employment, and health gains related to electric vehicles. An additional question was which factors and processes lead to strong partnerships regarding EV implementation. “Case studies are widely used among qualitative researchers

because of their explicit focus on context and dynamic interactions [66].” This is well-suited to a community study focused on the local context and relationships. The community-engaged approach of this study also responds to the gap found in the literature review, calling for more research that gives community members openings to share their knowledge and put forward solutions addressing their concerns about EV adoption. Preliminary findings [2] and findings that resulted in a novel proposal for community benefits as part of charging station infrastructure were reported previously [3], whereas this paper focuses on findings related to workforce development.

Context and Setting

Over the time period of one year, the research team collected in-depth data using multiple methods and sources: public meetings, local news forums, surveys, and interviews. These data provided a rich context to aid understanding community needs and priorities, build from local knowledge, refine research questions to improve relevance, and then disseminate the results. In terms of background, family and job experiences, and language skills, it is a varied team with some members who have lived or worked in the study area, a near-port community in the Western United States.

Data Collection

Team members attended public meetings and events, including at least 2-3 of each of the six community councils in the Southside (anonym) area, meetings of a collaborative Southside Coalition that includes the six council chairs and other community leaders, and dozens of community service days, international market, and related conferences, panels, film screenings, and school and library events. Notes were kept of people’s comments and concerns expressed at these events, and recurring agenda topics. The field notes included describing behaviors, activities, reflections on mood, interactions, processes, and context, so that “themes, patterns, understandings, and insights” could be extracted during analysis [67].

The news forums monitored included local newspapers (also coverage of local news on

national and international news websites), community newsletters from each of the community councils, bulletins from the city council members who cover the area, and daily listserv news summaries from the American Society for Engineering Education (ASEE) on engineering and technology news selected from thousands of sources. Topics included news of Southside partners, jobs, the sponsoring engineering research center, environment, education, inland port, air quality, energy and energy policy, electric vehicles and/or EV charging, EV legislation, electrification, and EV battery materials.

Five survey sessions were held in library, community recreation center, and market spaces. Participants were recruited with posters in English and Spanish that invited participation in a 5-minute survey with 15 questions, in exchange for \$5 cash to honor their time. Approved researchers distributed the surveys with pens on clipboards, so participants could find a place to answer privately. Completed surveys were kept securely and results stored in a password-protected online database. A copy of the survey is provided as Appendix A.

Twenty-one 90-minute interviews were conducted on Zoom with 11 community leaders and 10 liaisons recruited through publicly available email addresses or contact with the research center's community outreach staff. Snowball method extended the recruiting to other community members recommended in interviews or by email recipients. Participants were given a choice of interview format (phone, in-person, or online), and preferred honorarium (\$50 gift card or check). A wide range of people were in this group in terms of background, family and job experiences, ability, education, wealth, and religion, in order to represent the broad community. Community leaders were defined as people in elected or appointed positions or working in libraries or schools in the Southside area. Community liaisons were defined as people affiliated with organizations working to advance community engagement or energy solutions in the Southside geographic area. Participant selection was based foremost on direct work with geographic sub-communities, and focal interest areas identified (transportation, environment, or health).

Data Analysis

Quantitative data from the Likert survey questions were analyzed. The transcripts of interviews, field notes from public meetings and events, survey short answer responses, and files from local news forums were the basis of the qualitative analysis. The transcripts were coded individually using a constructivist approach of coding/open coding [68] to determine categories. This process particularly kept in mind the research questions. Interview participants were asked to describe their community, its strengths, values, priorities, and goals. Other questions were about community partnerships, specifically related to transportation, health, employment, education, and desired community outcomes related to electric vehicles.

Limitations

As a bounded case study, the data collected is from a very particular place and time, and materials were available only in Spanish and English. Some people may also not have participated due to lack of transportation to the research sites, or being too busy with other life demands. As this is a large and varied community, a lack of familiarity with some cultural norms, distrust of strangers, or discomfort with data collection could have been barriers to recruiting participants. Frequent discussions among team members worked to establish respectful interactions and to overcome many limitations, but no study can represent every view in the community.

Findings

The survey was very useful in providing data on community concerns relative to EVs and as well as hoped-for benefits. The majority of survey respondents said that electric vehicles can have positive health impacts by reducing toxic air pollution (94% said a moderate to great deal of positive effect). Respondents said EV can benefit the community by helping the environment (89% moderate to great deal of benefit). On workforce impact, only 8% said no benefit while 71% said moderate to great deal of benefit. Some questions asked about potential community harms (electricity demand, ugly wires or power stations, taxes to support

infrastructure, unwanted traffic) and replies indicated little to moderate concern. Asked if local access to charging would benefit the community, 3% said not at all, 13% a little, 28% a moderate amount, 32% a lot, and 24% a great deal. Predicting community use of public charging stations with fast charging for e-bikes and scooters as well as cars, replies ranged from 2% not at all, 8% a little, 25% a moderate amount, 41% a lot, to 25% a great deal. The most common subject in the write-in question on the survey was economic concern (16 respondents), followed by 13 comments positive about environment/health impacts, 12 comments negative about environmental impact to produce/dispose of EV, 10 about charging infrastructure, 9 generally positive, and 5 addressing education about EV.

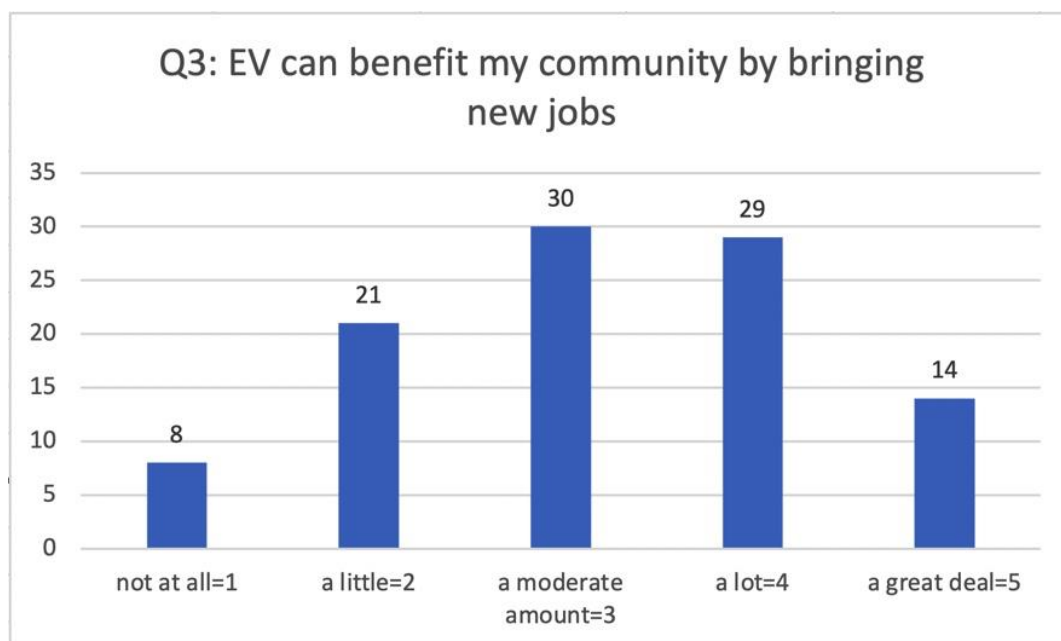


Figure 1 Graph of survey responses to question 3

The interview data provided a richness to the discussion of factors related to community decision-making power and benefits from electrification, community concerns and hopes related to EVs, and how to build strong partnerships relative to EV implementation. During the semi-structured interviews, participants described their community strengths, values, goals, and priorities. They also gave examples of what makes good or bad community partnerships.

Participants further discussed what parity would look like for their community with transportation, health, education, and employment. Since this paper focuses on the intersection of jobs and transportation, particularly EV workforce development, those responses will be shared, whereas readers may find a more complete report in another paper [3].

Theme	Sample quote
Public Transportation	“Public transit [is] just not reliable enough to be able to stick to a work schedule.”
Work Commutes	“The majority of Southside residents [have] to commute somewhere for work. We have to make it more convenient, more affordable, and easier.”
Health	“Then people also will not be skipping work or not being able to go to work because they're not getting sick as frequent as how they're getting sick right now.”
Workforce	“They don't know what else is out there for them. And so, they end up just working menial jobs and not knowing where to go next.”

Table 1 Sample quotes from participant interviews

Themes that emerged from the interviews include public transportation access, work commutes, related health issues, and workforce development support. Examples of comments about public transportation included: “We've got people who have to walk two miles to work, because they can't rely on public transportation,” “Public transit [is] just not reliable enough to be able to stick to a work schedule,” and “What we have is a commuter system, one designed to filter people into and out of the [city] for commerce purposes, but it relies upon you [having]...some kind of car.” Comments about work commutes included: “Just the nature of the blue-collar employment is not really something that can be done remotely,” “The majority of Southside residents [have] to commute somewhere for work. We have to make it more convenient, more affordable, and easier,” and “All this forces you to buy a car because people, they have to give up some things in order to buy a car so they can go to work.” Comments related to health included: “I have friends and neighbors who don't particularly come out when their air quality is bad. But then, not being able to come out means that she can't work. So that's just like this cycle of chaos that needs to be better,” “Then people also will not be skipping work

or not being able to go to work because they're not getting sick as frequent as how they're getting sick right now.” Lastly, workforce development support comments included: “An electrification path for [the state] and transportation and...the workforce is going to be a key component of how they're imagining this,” “If we can get people in the refugee communities to be involved in the employment sector, for instance, so that they can be a part of the workforce in developing the electric vehicles, that will help,” “It would be disingenuous of us to imagine a transition in our electric system that doesn't include workforce, that doesn't think about how it impacts people...we know that this has to be one of the areas that we start thinking deeply about,” “A lot of kids don't want to go to school, but they don't know what else is out there for them. And so, they end up just working menial jobs and not knowing where to go next.”

Some of the best practices distilled from the data include intentional engagement and follow through that respects community expertise, recognizes legacy impacts on community wellbeing, and seeks (not extracts) existing community information. Some suggested sources for this engagement are libraries, local news sources, community services, research institutes, educators, and nonprofits. Foremost, workforce development starts with building trust, dialogue with residents and local leaders, proactively reaching as many different groups as possible, partnering with local groups, and compensating individuals for their time and knowledge. Aim to retain economic benefits locally by providing information on jobs and training in accessible formats distributed through the local partners. To work effectively with the community, notice translation needs, consider dependent care, and provide tech access/assistance. Workforce development is founded on human relations and trust. Expect to navigate tensions between profit-based goals and community needs, so remember some dividends are not quantifiable.

Discussion and Recommendations

The data make more vivid what the literature review found about transportation needs being intertwined with other human concerns about employment, health and education [3], [22]. The calls to action at this time of a global electrification transition include improved public

transportation that affordably and efficiently gets people to work without cars; and listening, planning, and action to ensure all people benefit from improved air quality and jobs in the EV workforce. There was a clear assumption among interviewees that they did not expect individual EV ownership in their communities, since as Hathaway and others noted in the literature review, affordability is a tremendous barrier [31]. The interviews focused instead on public transportation improvements. Comments about community health resonated with Canepa et al. and others who wrote about improving air quality to improve environmental conditions in all communities [35]. Additionally, Finley-Brook and Holloman specifically suggested that energy parity should involve widespread benefits like cleaner air and more green jobs [12], which is the main point emerging from this research.

Expanding on the call for listening, planning, and action, this paper will next address a concrete list of EV workforce development best practices that have come from the community-engaged research. This begins with attention to basic needs such as multi-language translation, dependent care, technology access, proximity to familiar site location, public transportation access, and economy of time. To apply this, anyone planning a job fair should have interpreters on site and materials in languages beside English. The event could be at a school or elder daycare facility and coordinated around pick-up/drop-off times, or could have a family-friendly environment with small prizes for kids, healthy treats, or a play area. Job fairs must have free WIFI as well as computers and people available to assist interested applicants with online forms which may require getting an email address, password, and setting up an account. A quote from our data explained: “They have to attach a resume and fill out all of that information in an online application and have an email account and a text and a phone that text messages. It's really hard for people who have traditionally been left out.” When planning training or a job fair, it shows respect for people who are likely working more than one part-time job, if the event provides food and moves efficiently so that people can drop in and out as needed but still be able to connect in meaningful ways. One interviewee commented: “You're going to get a solid group of people that

are interested in being a part of this conversation, and yes, it does take child care and providing a meal...if you didn't provide a meal they still have to go home and cook and feed their children.”

Other advice from interview participants was to start early with support for kids still in school, echoing the research of Jeffrey and Jimenez [53]. “There's a lot of kids who are not suited for college and don't know where to go next and just lose their way. There's no one guiding them to apprenticeships or to other kinds of employment. And so, they get lost.” Another participant asked, “Can our schools, and can our community colleges, become feeders for these huge employers?” Part of this is sharing detailed information about how these job transitions can be possible. One person interviewed said, “Organizations that are hiring [can show communities], ‘Look, we have tuition reimbursement, we have benefits, we have insurance and we pay this much...’ These are incredible opportunities that are there, but sometimes my community don't see them, so we have to come to the community to show it to them.” In the case of this study, researchers compiled information on a wide variety of training and job opportunities with local contact information, costs, and benefits. This information was disseminated back to the community partners, school counselors, and study participants in brochure format with QR code for easy online access to links. These specific actions were all recommended from data collected in our community-engaged case study and are highly applicable to other locations. If governments, schools, and employers will adopt these best practices, all community members can benefit from electrification.

Conclusion

This paper has shared a review of literature relevant to electric vehicle adoption, infrastructure, and community impacts. The review can be useful to identify gaps in existing knowledge which can guide future studies. The review also foregrounds one case study reported here which was motivated by the discovery of a lack of community-engaged research on the subject of electric vehicles, and a lack of concrete solutions to the existing lack workforce development support. The research team seeks to amplify the voices of those participating in the

community study by sharing best practices to guide EV workforce development. Responding to concerns by elevating community knowledge and solutions has been the motivation behind this research. Many opportunities exist for researchers, educators, and policy makers to apply and expand upon what is reported here, supporting shared community growth that benefits everyone.

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APPENDIX A: Survey on Perceptions of Electric Vehicles

Thank you for taking the time to complete this five-minute survey! Please circle the response that indicates the extent to which you agree with each statement.

Electric Vehicles

1. Electric vehicles (freight trucks, buses, cars) can improve health in my community by reducing toxic air pollution.

Not at all A little A moderate amount A lot A great deal

2. Electric vehicles can benefit my community by helping the environment.

Not at all A little A moderate amount A lot A great deal

3. Electric vehicles can benefit my community by bringing new jobs.

Not at all A little A moderate amount A lot A great deal

4. Electric vehicles can harm my community by taking electricity that is needed for other purposes.

Not at all A little A moderate amount A lot A great deal

5. Electric vehicles can harm my community because there may be ugly wires or power stations needed to support them.

Not at all A little A moderate amount A lot A great deal

6. Electric vehicles can harm my community because legislators may raise taxes to support new roads or charging stations for them.

Not at all A little A moderate amount A lot A great deal

Charging Stations for Electric Vehicles

1. Public charging stations for electric vehicles can benefit my community by providing local people with access to charging.

Not at all A little A moderate amount A lot A great deal

2. Public charging stations can harm my community because they would bring unwanted traffic from people outside the community.

Not at all A little A moderate amount A lot A great deal

3. People in my community would use public charging stations if they offered a range of options (e.g., for e-bikes, scooters, small cars) for fast charging.

Not at all A little A moderate amount A lot A great deal

Wirelessly Charging Roads

Many states are installing roads that can charge electric vehicles as people are driving.

1. Wirelessly charging roads can benefit my community.

Not at all A little A moderate amount A lot A great deal

Background Information

1. Do you own a car or other vehicle (e.g., motorcycle, van)?

I own a vehicle.

I do not own a vehicle.

Prefer not to say

2. How do you identify in terms of race or ethnicity? (Circle all that apply)

African American or Black

Asian

Latina/o or Hispanic

Native American or Alaskan Native Native Hawaiian or Pacific Islander

White

Other : _____ Prefer not to say

3. What is the highest level of education you have completed?

Less than High School

Some High School

High School

Associates Degree

Bachelor's Degree

Graduate Degree

Trade School

Prefer Not to Say

4. Have you or your family participated in any events related to clean energy sponsored by [redacted] or another organization? Please circle all that apply.

Career Fair

Booth at Partners in the Park

Engineering Activities

Listening Session

Other (please specify):

No, none

5. Do you have other comments about how electric vehicles, charging stations, or wirelessly charging roads might benefit or harm your community?