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Electrical Contractors' Perception on Electric Vehicles and Potential Opportunities from Infrastructure Investment and Jobs Act

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This study evaluates the Infrastructure Investment and Jobs Act's (IIJA) impact on Electric Vehicle (EV) opportunities for Electrical Contractors (ECs), highlighting the disparity between ECs' expectations and the actual opportunities available. Employing survey methodologies and analysis of IIJA project data, the research addresses ECs' perceptual gap. The survey results, combining qualitative and quantitative approaches, particularly for open-ended questions, are juxtaposed with a quantitative analysis of IIJA data to extract financial insights. Key findings reveal a significant mismatch: while 75% of ECs view EVs as major future revenue sources, anticipating considerable opportunities from IIJA's EV projects, only 1% of IIJA funding is dedicated to EV-related initiatives. Despite 64% of ECs expecting substantial benefits from the IIJA for their businesses, only 7.5% of the total funding (approximately \$15 billion) is allocated to sectors relevant to ECs, including broadband, clean energy, power, and EV infrastructure. The Clean Energy and Power sector, however, emerges as a potential area of opportunity, especially given that 92% of these projects are valued under \$2 million, suggesting broader participation possibilities for ECs. The study's limitations include a small sample size of 54 survey participants and the evolving nature of IIJA projects. Future research will expand the participant base, explore regional differences, and continuously update IIJA project data to better understand the Act's long-term implications for ECs.

Key Words: Electrical Contractors (ECs); Infrastructure Investment and Jobs Act (IIJA); Electric Vehicles (EVs)

Introduction

The rise of electric vehicles (EVs) in the transportation sector is a well-documented transition that the United States is currently undergoing, influenced by multiple factors, including technological advancements, evolving consumer preferences, and targeted government support, notably the Infrastructure Investment and Jobs Act (IIJA) (White House, 2023). Among the stakeholders in this transformation, electrical contractors (ECs) are seen as central agents, especially when it comes to the infrastructure adaptations required (Sage et al., 2015). Historically, electrical contractors have been integral to the U.S. electrical infrastructure, serving residential, commercial, and industrial sectors

(Barman et al., 2023). The advent and proliferation of EVs imply a diversification of their roles, necessitating comprehensive grid modifications, large-scale deployment of charging infrastructure, and modifications in residential and commercial environments (Patil, 2020). Thus, capturing the perceptions and preparedness levels of ECs towards the opportunities and challenges presented by the IJJA is paramount (Erlach, 2023).

The IJJA is not merely a financial provision; it's a strategic endeavor by the U.S. government to rejuvenate and future-proof the nation's infrastructure (White House, 2023). The act, while encompassing conventional infrastructure elements, prominently emphasizes a shift towards a sustainable future, with a clear spotlight on EVs (Konstantinou et al., 2022). Bridging the gap between the IJJA's vision and tangible outcomes necessitates a well-coordinated effort between policy-level directives and on-the-ground industry stakeholders, like ECs. Given the extensive scope of the IJJA, dissecting its nuanced implications for ECs, particularly in the context of EVs, is an exercise in granularity. The act introduces a variety of projects, each with unique impacts and potential. A thorough analysis that delves into the intricate interplay between these projects, the overarching goals of the IJJA, and the needs of the electrical contracting industry is critical. Undoubtedly, the IJJA introduces challenges alongside opportunities. ECs will be tasked with rapidly assimilating new standards, addressing the unique needs of EV-centric projects, optimizing workforce training, and maintaining competitiveness in an evolving landscape. The IJJA's vast remit, encompassing regional disparities, varied project scales, and the sheer diversity of initiatives, further amplifies this complexity. The rapid emergence of electric vehicles (EVs) coupled with the provisions of the Infrastructure Investment and Jobs Act (IJJA) presents both opportunities and challenges for electrical contractors, yet a comprehensive understanding of their perceptions and potential revenue streams remains unexplored.

Addressing this, there is a pressing need to comprehensively assess electrical contractors' perceptions of the EV surge and the IJJA to optimize infrastructure investments and harness potential revenue opportunities. In this paper, the current state and potential revenue generation capabilities of IJJA and EV for electrical contractors are investigated. To achieve the objective, this study conducted a survey distributed through the National Electrical Contractors Association, collection and categorization of IJJA project data from the White House, and a comprehensive analysis to correlate ECs' expectations with actual funding and project opportunities in various infrastructure categories. The study revealed that while electrical contractors (ECs) in the U.S. anticipate significant opportunities from electric vehicle (EV) infrastructure under the Infrastructure Investment and Jobs Act (IJJA), the actual allocation for EV-related projects is considerably lower than expected, with broader opportunities emerging in other infrastructure categories like clean energy and power. This study provides critical insights into aligning electrical contractors' expectations with actual market opportunities under the Infrastructure Investment and Jobs Act, facilitating more informed business strategies and contributing to the effective advancement of the U.S. infrastructure in the era of electric vehicles.

Literature Review

The transportation sector has been undergoing a seismic shift with the accelerating adoption of electric vehicles (EVs). According to Chen et al (2023), the surge in EV adoption can be attributed to a combination of technological advancements, changing consumer preferences, and proactive governmental policies. With the promise of reduced carbon emissions and the potential to lessen the dependence on fossil fuels, EVs are often hailed as the future of transportation. However, their widespread adoption presents challenges for the existing electrical infrastructure. Rehman et al. (2023) underscored the strain EV charging could place on local electricity grids, especially during

peak hours. Moreover, Omase et al. (2023) emphasized the need for substantial investment in charging infrastructure, both in urban and rural settings, to ensure seamless EV operations.

Electrical contractors (ECs) historically have been the linchpins of electrical infrastructure development and maintenance. Their roles have predominantly revolved around residential, commercial, and industrial electrical needs. However, with the evolving energy landscape, especially with the introduction of renewable energy sources and EVs, the scope of ECs has been widening. As Barman et al. (2023) pointed out, ECs are now deeply involved in large-scale grid modifications to accommodate renewable energy integration. Further, with the rise of EVs, there is a growing demand for charging infrastructure—spanning homes, commercial establishments, and public spaces. This has thrust ECs into the spotlight, tasking them with the dual responsibility of upgrading existing infrastructure and deploying new, EV-centric solutions.

The U.S. government's commitment to fortifying and modernizing the nation's infrastructure came to the fore with the introduction of the IIJA (White House, 2023). The act is not just about renovating traditional infrastructure, but it's a strategic step towards ensuring a sustainable future (Zeitler, 2022). A significant portion of the IIJA is earmarked for projects that foster the growth of EVs, including charging stations and grid reinforcements. From an EC's perspective, this act heralds a slew of opportunities. Erlich (2023) discussed how the IIJA could be a potential goldmine for ECs, given the extensive electrical works it entails. However, the act also poses challenges. The varied nature of IIJA projects—encompassing regional differences and varied project scales—requires ECs to be versatile, updated, and ready for rapid deployments.

Moreover, the interplay between IIJA's provisions, the burgeoning EV market, and the role of ECs is intricate. Zeitler (2022) has elucidated the need for a seamless collaboration between policymakers, industry stakeholders, and ECs to realize the IIJA's vision. This is especially pertinent given the act's broad spectrum, which includes not just EV-centric projects but also other infrastructural endeavors that might require EC expertise (Erlich, 2023). In conclusion, the literature underscores the pivotal moment the electrical contracting industry finds itself in. The convergence of the EV revolution and the ambitious IIJA offers both opportunities and challenges. While the potential for growth and revenue is significant, it's contingent on the industry's ability to adapt, innovate, and collaborate.

Methodology

The study employed three major steps to investigate the current state and potential revenue generation capabilities from IIJA and EV for electrical contractors. These steps are surveys, IIJA data collection, and analysis. The study requests the electrical contractors across the United States to respond to structured survey questions through the National Electrical Contractors Association. The next step is to collect the data for IIJA and its approved projects by July 2023. The approved project data was recovered from the White House, and the collected data undergoes categorization by regions, project size, and type of project for further analysis. Lastly, the aggregated data undergoes data analysis to find significance. The analysis of the data intends to discover ECs perception, EV related fundings from IIJA, relatability of IIJA project to ECs, and funding size of the projects. The overall processes taken for the study is demonstrated in Figure 1, and further detail is discussed below.

The researchers distributed the survey to nearly 4,000 electrical contractors across the United States through the National Electrical Contractors' Association (NECA). The survey consisted of 22 questions which asked the topics including but not limited to the region of operation, perceive future opportunities, new market opportunities in their region, and size of revenue. This study utilized industry focused questions to gain insights from a business and market perspective (ECA, 2021).

Survey result data undergoes both qualitative and quantitative analysis to obtain a simplified view of the responses. The qualitative analysis produces simplified answer using keywords from survey responses; meanwhile, the quantitative analysis produces the results from numerical data, such as size of revenue, region of operation, and so on. The response rate for the survey was low with only 54 respondents. However, this study aimed to not only assess ECs perceptions of the IIJA but to triangulate their understanding of the increased funding and project opportunities against the appropriations.

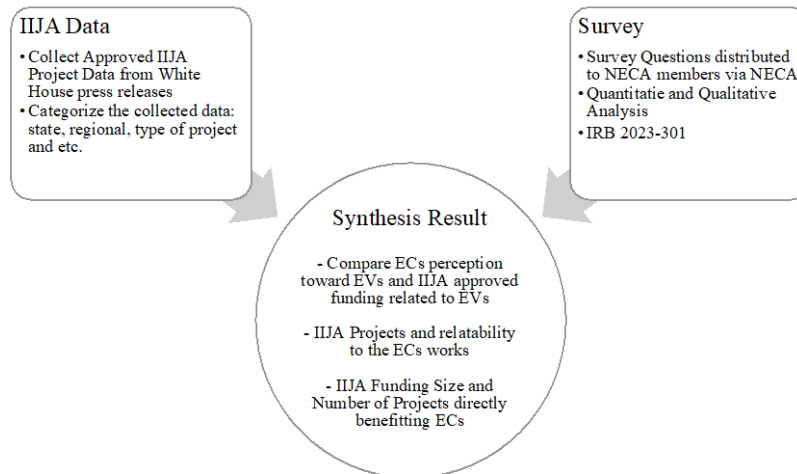


Figure 1. Three major steps taken to investigate the Electrical Contractors and IIJA

The next step was to investigate the Infrastructure Investment and Jobs Act. The study investigates the total allocated funding from IIJA with government press releases. The primary source of the information was from the White House. The initially collected data undergoes simple categorization by number of factors: state, regions, size of project and type of project. The projects data are categorized by state and collected to be combined as regional data. The type of project category sorted the projects into following categories: airports; broadband; clean energy and power; EVs, busses and ferries; environmental remediation; ports and waterways, public transportation, resilience; roads, bridges and major projects; safety; water; and others.

As a part of synthesis result, the researcher sought to find relations between the IIJA project data and survey results from the ECs. The analysis will focus on three major subjects: the ECs' expectation regarding the EVs; IIJA project categories that is most related to the ECs' work and funding opportunities; and most beneficial project categories that could provide more opportunities for ECs compared to EVs. The first subject compares the ECs' response regarding the future relations between EVs and ECs by delving into the EV funding from IIJA. Second subject analyzes the type of works done in the IIJA project categories, such as road and determine what types of projects can have positive impact to the ECs and find the number of projects and funding size. Lastly, the researcher analyzes the funding size and number of projects of selected project types to determine whether other projects could benefit the ECs more than the EVs could.

Results

The initial analysis of IIJA data showed that the number of available projects was numerous across the field. The analysis of IIJA project data based on the type of project showed that out of \$210 billion

approved funds; \$2.8 billion is allocated for broadband, \$10 billion for clean energy, and \$2.5 billion was allocated for EVs, buses and ferries. Approximately \$115 billion was allocated for the roads, bridges and other mega projects. The aggregated data demonstrated that total number of projects available for Eastern US is 3502 projects with funding of \$52.3 billion Dollar, US Southern Region receives 5803 projects with 64.9 billion USD, West receives 6305 projects with 47.1 billion USD, and Midwestern Region is granted 4523 projects with funding totaling up to 45.1 billion USD. The summary of approved projects from IIJA is represented in Figure 2.

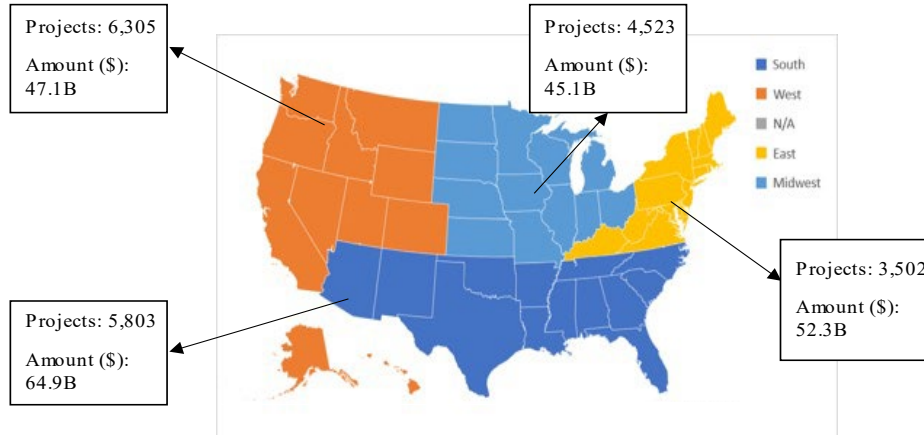


Figure 2. Map Summary of Total Number of Approved Projects and Funding from Infrastructure Investments and Jobs Act

The investigation of IIJA projects showed that a number of projects and funding were directly beneficial to the electrical contractors. There were three major categories of projects that can be beneficial to Electrical Contractors. The categories are as follows: broadband; renewable energy and power; and electric vehicles. Out of these, the Clean Energy and Power categories demonstrated the highest number of projects available totaling 3734 projects available as of July 2023. The EV-related projects numbered 529 projects. Lastly, the broadband related projects numbered 289 projects. The vast majority of the projects have a size of less than 2 million which is particularly noticeable in the Clean Energy and Power category, and it is concentrated in the West Region. With the size of the project concentrated at less than 2 million, the projects can include more ECs. But each Clean Energy and Power are more likely to have less value than the projects from broadband and EV, buses, and ferries.

Table 1 Number of Projects Approved for Broadband Infrastructure IIJA

BROADBAND	East Region	Midwest Region	West Region	South Region	Region N/A	Percentage
less than \$2 million	19	24	39	18	7	37%
\$2 million to \$10 million	19	23	20	40	0	35%
\$10 million to \$20 million	0	11	12	10	0	11%
\$20 million to \$50 million	1	7	12	16	2	13%
\$50 million to \$100 million	0	0	6	3	0	3%
over \$100 million	0	0	0	0	0	0%
Totals	39	65	89	87	9	

Table 2 Number of Clean Energy and Power related IJA Projects

Clean Energy & Power	East Region	Midwest Region	West Region	South Region	Region N/A	Percentage
less than \$2 million	545	541	1514	790	45	92%
\$2 million to \$10 million	51	48	39	56	4	5%
\$10 million to \$20 million	8	6	7	8	0	1%
\$20 million to \$50 million	4	4	9	15	0	1%
\$50 million to \$100 million	4	5	3	4	0	0%
over \$100 million	5	5	6	8	0	1%
Totals	617	609	1578	881	49	

Table 3 Number of EV, Buses, and Ferries related IJA Projects

EV, Buses & Ferries	East Region	Midwest Region	West Region	South Region	Region N/A	Percentage
less than \$2 million	66	120	25	78	1	55%
\$2 million to \$10 million	53	29	38	60	0	34%
\$10 million to \$20 million	8	8	6	15	0	7%
\$20 million to \$50 million	7	7	1	4	0	4%
\$50 million to \$100 million	0	0	2	2	0	1%
over \$100 million	0	0	0	0	0	0%
Totals	134	164	72	159	1	

Survey Response Analysis

Out of 54 responders, the specific regions where the responders are from are as follows: 5 from Eastern US; 12 from Midwest; 15 from Western US, and 12 from mixed operation. As much as the contractor’s origin differs, so does the revenue size. Approximately 9% of electrical contractors raised less than \$1M; 16% replied as between \$1M to \$5M; 11% responded between 5M to 10M; 27% generated between 10M to 25M revenue; 25M to 250M 27%; and only 9% of the survey participants responded as raising more than 250M as a revenue.

- Less than \$1M
- Between \$1M - \$5M
- Between \$5M - \$10M
- Between \$10M - \$25M
- Between \$25M - \$250M
- More than \$250M

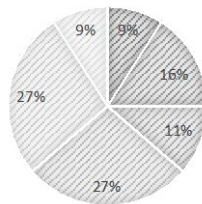


Figure 3. Electrical Contractors' Annual Revenue Categorized by the Size of Revenue

On the other hand, the source of revenue differed minimally, and the electrical contractors’ revenue was heavily dependent on commercial construction, having more than 38% of the revenue generated from commercial construction followed by Industrial projects that generate 17% of the total revenue. The contractors’ response regarding the new market opportunity demonstrated that the majority (75%) showed interest in the market associated with EVs. The enthusiasm is also reflected in the responses

regarding the opportunities stemming from IJJA with 45% of responders replying that EVs would become the main opportunities for electrical contractors. The electrical contractors' response toward the IJJA was not overwhelmingly positive. 27% of the responses were negative, 20% were no comment, and 14% on neutral. 39% of the responses were composed of positive responses regarding IJJA.

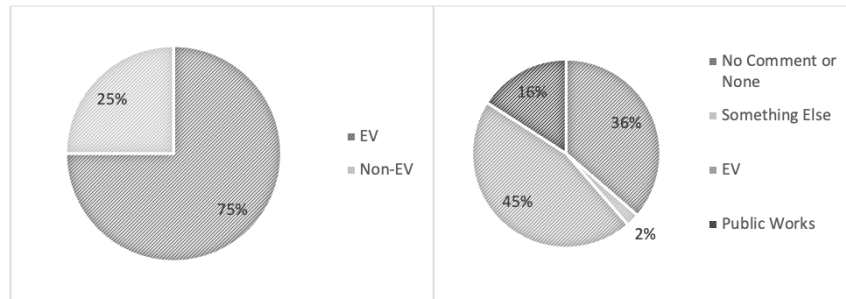


Figure 4. Survey Result of ECs' Perception on Major Future Revenue Source (Left) Survey Result Analysis Regarding the ECs' Perception on Major Opportunity from IJJA (Right)

Synthesized Results

Unlike the expectations of the ECs shown in Figure 4 that states 75% of the ECs perceive the EVs as the major future revenue source and 45% of the participants responded as EV would be the major opportunities from IJJA, the analysis of the approved IJJA projects data demonstrated that only \$2.5 billion or approximately 1% of the total approved funding is related to the EVs as of July 2023. This data demonstrates that there is a gap between the expectation of the ECs regarding the EV projects and actually approved projects regarding EV from IJJA.

Compared to the ECs perception, which is that there are major opportunities from IJJA, the IJJA project funds are \$15 billion funding for broadband, clean energy and power, and EVs compared to total budget of \$210 billion which results in approximately 7.5% of the total approved funding. Most of the approved projects are related to the transportation related infrastructure, such as bridges and roads, and these projects account for approximately \$115 billion. Meanwhile, the expectations of the ECs expressed in the survey results showed that 64% of the responses expressed that major opportunity would be available for ECs from IJJA projects.

From the IJJA projects, the Clean Energy and Power could provide more opportunities for ECs as the number of projects available are up to 6 times that of EV related projects, and 92% of the projects are less than 2 million, which can be inferred as more electrical contractors can participate to be benefitted when the 25% of the ECs responded to the survey raised less than \$5 million revenue. Furthermore, the funding for Clean Energy and Power is four times that of EV related projects from IJJA at \$10 billion and \$2.5 billion respectively. This is a major contrast to the ECs perception on future opportunities from IJJA which stated only 16% responded to have found major opportunities from IJJA at public works sector.

Discussion

The Infrastructure Investment and Jobs Act (IJJA) has undoubtedly allocated considerable funding across a wide range of projects, from broadband and clean energy to transportation and electric

vehicles (EVs). A notable insight from our study reveals a disconnect between the perceptions of Electrical Contractors (ECs) and the reality of IIJA allocations. While 75% of the surveyed ECs perceive EVs as a major future revenue source and 45% envision EV-related projects as the main opportunities from the IIJA, the actual allocation for EV projects stands at a mere \$2.5 billion or roughly 1% of the total approved funding. This conspicuous discrepancy suggests a potential need for re-education and alignment of expectations within the EC community concerning the IIJA.

While the fervor for EV projects was palpable among the respondents, the bulk of IIJA allocations, approximately \$115 billion, are targeted toward transportation infrastructure such as bridges and roads. Interestingly, the research results indicate that Clean Energy and Power projects may present a golden opportunity for ECs. With 3734 projects available as of July 2023 and the vast majority (92%) being valued at less than \$2 million, a larger pool of ECs, particularly those with lower annual revenues, could engage and benefit. This is significantly higher than the 529 EV-related projects, underscoring the broader potential within the clean energy sector.

It's also worth noting that the general perception of ECs regarding IIJA was polarized. While 39% of respondents expressed a positive outlook, 27% were negative, revealing a potential lack of comprehensive understanding or apprehension about the Act's actual implications. This underscores the importance of targeted information dissemination and training to better prepare ECs for leveraging opportunities under the IIJA. Furthermore, the geographic distribution of projects presents an interesting narrative. The West Region, for example, is notably dense with Clean Energy and Power projects, especially those valued under \$2 million. This regional skew might suggest that electrical contractors based in the West could stand to gain more from IIJA than their counterparts in other regions, provided they align their strategies and resources accordingly.

In conclusion, while the IIJA holds promise for the growth of electrical contractors across the US, it's imperative for these professionals to calibrate their expectations and strategies based on actual allocations and opportunities. The prominence of Clean Energy and Power projects, in particular, could be a game-changer for many, potentially offsetting the leaner prospects within the EV sector. For the industry to truly capitalize on this federal initiative, a deeper understanding of the IIJA and its nuances is paramount.

Conclusion

The main contribution of this work to the body of knowledge is to offer insights from the electrical contracting industry that are lacking in existing literature and EV discussions. This study investigated the current state and potential revenue generation capabilities of IIJA and EV for electrical contractors. This study conducted the following methods to collect data: survey questions and approved IIJA project data. The analysis of the collected survey responses and IIJA project data was conducted. The qualitative and quantitative data analysis was conducted for survey response to extract the information from open-ended questions. The IIJA project data undergoes mostly quantitative analysis to find the quantitative information of the project. The analysis of aforementioned data is conducted independently, and the gathered to find the relations to each other at synthesis finding. The finding shows that the ECs expect the EVs to be the most profitable projects in the future and from IIJA, but the funding information from IIJA differs as only 1% of the total funding is allocated for EV related projects. The ECs expectation for IIJA is also not likely to be met as 64% of the ECs responded positively to IIJA's role in their business, but only 7.5% or \$15 billion is allocated for broadband, clean energy and power, and EVs, Buses and Ferries. Therefore, ECs opportunities from EV is limited in number, but Clean Energy and Power could provide funding and projects to the ECs at lower unit cost of the project compared to EVs. The limitations are present in the study as the

number of the survey participants is only 54 and the IJA projects are continuously updated as the new projects are approved. To address these issues, the future research will incorporate more responses from the electrical contractors to further analyze the data, such as regional differences, and continuously update form of approved IJA project data to seek for changes over time which will demonstrate the changes occurred to the IJA over time.

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References

1. Barman, Pranjali, Lachit Dutta, Sushanta Bordoloi, Anamika Kalita, Pronamika Buragohain, Swapna Bharali, and Brian Azzopardi. "Renewable energy integration with electric vehicle technology: A review of the existing smart charging approaches." *Renewable and Sustainable Energy Reviews* 183 (2023): 113518.
2. Chen, D., Kang, K., Koo, D. D., Peng, C., Gkritza, K., & Labi, S. (2023). Agent-Based Model of Electric Vehicle Charging Demand for Long-Distance Driving in the State of Indiana. *Transportation Research Record*, 2677(2), 555-563.
3. Congress. H.R.3684 - 117th Congress (2021-2022): Infrastructure Investment and Jobs Act. Congress.gov. <https://www.congress.gov/bill/117th-congress/house-bill/3684>. Accessed May 2, 2023.
4. Electrical Contractors' Association [ECA]. (2021). 2021 Vision: The Future of the Electrical Contracting Industry. <https://www.eca.co.uk/search-results?query=2021+Vision+>. Accessed May 2, 2023.
5. Erlich, M. (2023). *The Way We Build: Restoring Dignity to Construction Work*. University of Illinois Press.
6. Konstantinou, T., Chen, D., Flaris, K., Kang, K., Koo, D. D., Sinton, J., ... & Labi, S. (2022). A strategic assessment of needs and opportunities for the wider adoption of electric vehicles in Indiana.
7. Omase, N., Mittal, S. K., Palaniraja, S., Guchhait, P., Patil, M., & Mundra, P. (2023). A comprehensive review of electric vehicle charging infrastructure and associated challenges. *International Journal of Science and Research Archive*, 10(1), 834-840.
8. Patil, P. (2020). The Future of Electric Vehicles: A Comprehensive Review of Technological Advancements, Market Trends, and Environmental Impacts. *Journal of Artificial Intelligence and Machine Learning in Management*, 4(1), 56-68.
9. Rehman, A. U., Ullah, Z., Shafiq, A., Hasanien, H. M., Luo, P., & Badshah, F. (2023). Load management, energy economics, and environmental protection nexus considering PV-based EV charging stations. *Energy*, 281, 128332.
10. Sage, Daniel, Indraneel Sircar, Andrew Dainty, Pete Fussey, and Chris Goodier. "Understanding and enhancing future infrastructure resiliency: a socio-ecological approach." *Disasters* 39, no. 3 (2015): 407-426.
11. U.S. EIA. Over One-Quarter of U.S. Households Use Electricity as the Only Source of Energy. U.S. Energy Information Administration. <https://www.eia.gov/todayinenergy/detail.php?id=52999>. Accessed May 7, 2023.
12. Zeitler, E. (2022). Opportunities for Energy and Climate Sectors in the Infrastructure Investment and Jobs Act. *Climate and Energy*, 38(10), 10-15.