Economic Impacts of an Electric Vehicle Charging Network in Northeast Iowa

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INTRODUCTION

The adoption of electric vehicles (EVs) is rapidly increasing in the U.S. and across Iowa. As the transition from internal combustion engine vehicles (ICEVs) to EVs intensifies, there is concern about whether the charging infrastructure will develop quickly enough to serve EV drivers and reduce range-anxiety.

There is a significant "chicken-egg" problem with EVs that regional planners need to consider. A dense network of charging stations makes EVs more valuable, so if there is a "critical mass" of EVs and charging stations then a high level of EV adoption is much more likely (Li and Zhou, 2015). More EVs induces more charging station owners to supply more charging stations. More charging stations make EVs more valuable, further increasing EV adoption, causing more charging stations to be installed, and so on. If, on the other hand, this critical mass is not met, then the opposite occurs and the EV market is more likely to struggle. This interdependence between the demand for EVs and the supply of charging stations has important implications for EV markets and policy (Springel, 2020; Li and Zhou, 2015).

A collaboration of organizations in Northeast Iowa, as part of the *Driving Electric in NE Iowa: An Analysis, Planning, Workforce, and Major Employer Partnership*, is thinking about the best ways to develop an EV charging infrastructure while simultaneously increasing the use of EVs in the region. The purpose of this study, which is a piece of the overall project, is to estimate the economic impact of EV and charging infrastructure growth in the Northeast Iowa region.

The development of EV charging infrastructure, and the corresponding adoption of more EVs, will have far reaching impacts on the economy and environment of NE Iowa. There are two primary avenues by which the region will be impacted. First is through the charging infrastructure itself. The construction of the charging infrastructure will have a one-time impact at the time it is built, and the maintenance of the charging infrastructure will have an ongoing impact. The second is through additional EV use by residents and visitors. It is not accurate to say that additional EV infrastructure will *cause* increased adoption of EVs, but increasing the availability of EV charging should encourage EV ownership, just as greater EV adoption will increase the need for charging infrastructure. The analysis that follows estimates the magnitude of these impacts.

METHODS

The area of interest in this study is a five country region in Northeast Iowa comprised of Allamakee, Clayton, Fayette, Howard, and Winneshiek counties. The question is, "What are the regional economic impacts from the development of an EV charging corridor in the region?"

There are several ways to measure economic impact. This study will focus on two:

- **Output**. Output is the value of production in a year. For example, a $1 million increase in regional output means that an additional $1 million worth of goods and services were produced in the region in that year.

- **Employment**. This study uses the Bureau of Economic Analysis definition of employment, which counts full time and part time jobs and then adjusts for seasonality. Under this system a twelve month job equals one job, a six month job equals one-half of a job, etc. This method does not take hours into account, so there is no difference between a full time and a part time job and, consequently, this measure of employment is not equal to full-time equivalent (FTE). In most instances, the change in labor income associated with a regional change in employment is also calculated.

Every measure of economic impact is the sum of the effect of some initial spending plus the ripple effects of subsequent spending that occurs as money is recirculated through the local economy. These impacts – the first round of spending as well as the ripple effects of that spending – are more formally broken down into three distinct effects:

- **Direct effects.** The direct effect is the initial change in spending in NE Iowa. In this case, direct effects will include the cost of new charging stations, the labor expense to install them, and any associated costs of construction. It also includes changes in consumption patterns, such as reductions in spending on gasoline and increases in spending on electricity due to the adoption of more EVs.

- **Indirect effects.** A change in demand for a business's goods and services will cause that business to change its purchase of inputs from other businesses. These additional business-to-business impacts on the local supply chain are called indirect effects and are one of the ripple effects from a change in economic activity. When, for example, an electrician is hired to install a new EV charger, there is an indirect effect when the electrician purchases tools or supplies from a local business in order to complete the job.

- **Induced effects.** Another ripple effect occurs when increased economic activity generates additional labor income that increases households' demand for local goods and services. The electrician in the previous example may need an employee to help with the charger installation. That worker will, in turn, spend some of those additional wages at local businesses, further increasing the demand for local goods and services. Induced effects capture this impact.

The direct effects in this study are calculated by estimating changes in local spending due to:

1. The construction of an EV charging network.
2. Maintenance of the EV charging network.
3. Local drivers converting from ICEVs to EVs.
4. Visitors to the region driving EVs rather than ICEVs.

The specific cost estimates used to calculate direct effects are described in the "Results" section that follows.

The economic impacts were estimated using IMPLAN, an input-output modeling software that uses government data to map the relationships between buyers and sellers of goods and services in a region in order to estimate the total effects of some change in economic activity. Input-output models such as IMPLAN rely on multipliers to do their work. A multiplier calculates how much economic activity results from some original spending. For example, an output multiplier of 1.5 says that each dollar of additional output results in an increase in total economic output of $1.50 – the original dollar of new output plus $0.50 of secondary output (the ripple effect). The multipliers in IMPLAN are based upon what each industry needs to make its product (including inputs and labor) and what each type of household purchases. IMPLAN also includes information about which goods are produced locally and which are imported from outside the region.

RESULTS

This section describes the economic impact of an EV charging network. The economic impacts fall into four categories:

1. The construction of an EV charging network.
2. Maintaining the EV charging network.
3. Local drivers converting from ICEVs to EVs.
4. Visitors to the region driving EVs rather than ICEVs.

The first category, the construction impacts, differ from the others because the charging network is only constructed once, so those effects have a one-time impact on the region. The other three categories have an ongoing, annual impact on the region.

Construction Impacts

The cost of installing EV charging stations can vary widely depending on the location, the proximity to utilities, the amount of work needed to prepare the site, and other factors. This study uses estimates that fall near the middle of the range.

The Level 2 charging station costs were estimated based upon the recent installation of EV chargers in the City of Decorah. The costs reflect the installation of two dual-port Level 2 chargers in an existing parking lot (a total of four charging ports), and these are summarized in Table 1.

Table 1: Estimated Costs of Level 2 Charging Station

Item	**Cost**	
Equipment (two dual-port level 2 chargers)	$10,000	($5000 per unit)
Installation (electrical contractor)	$5,400	
Related construction (concrete work, signs, paint, bollards)	$2,000	
Total	$17,400	

Sources: Bril; Alliant Energy

Table 2: Estimated Costs of Level 3 Charging Station

Item	**Cost**
Equipment (one 150 kW fast charger)	$55,500
Installation (electrical contractor)	$35,000
Related construction (concrete work, signs, paint, bollards)	$35,000
Total	$125,500

Source: University of Minnesota Extension

The Level 3 charger estimates were based upon a recent study conducted by University of Minnesota Extension. The costs reflect the installation of a single 150 kW fast-charging EV charger. The “related construction” costs reflect an average value but can vary widely depending on the site chosen and the amenities installed (*e.g.,* canopies, picnic tables, bathrooms). The estimated costs are summarized in Table 2.

This study assumes the need for an additional 332 level 2 charging ports and 31 level 3 chargers in the region in order to accommodate the expected number of EVs by 2040.[1] It is assumed that the level 2 charging locations consist of two dual-port units (for a total of four ports), so a total of 83 charging locations are necessary to provide 332 level 2 ports.

Finally, most new EV owners will also install home charging stations. There are currently 165 EV’s registered in the NE Iowa region (Iowa DOT) and, given the estimate of 7,785 EVs in the region by 2040 (see ftnt. 1), there will be the need for 7,620 additional home charging stations. The estimated cost of a home charging station is $1,200 ($700 for the unit plus $500 for installation).

The construction impacts are modeled as if they all occurred in a single year. This, of course, is unrealistic, so the results should be interpreted as one-time impacts that are spread out over time. A summary of the economic impact of construction is found in Table 3.

Table 3: Economic Impact from the Construction of EV Infrastructure

	Output	Employment	Labor Income
Direct Impacts	$8,692,863	49.62	$3,134,223
Indirect Impacts	$1,557,554	9.42	$466,588
Induced Impacts	$1,404,097	10.36	$367,220
Total	$11,654,514	69.09	$3,968,031

The construction of charging stations results in significant economic output ($11.65 million) and employment (69 jobs). However, the total impact is actually less than the total cost of constructing the charging stations ($14.4 million) because the charging equipment is produced outside of NE Iowa and, as a result, the economic impact of producing those units falls outside of the region. The direct effects result primarily from electricians, concrete work, landscaping, and other local contractors. Table 4 shows how most of the economic impact falls on the local construction industry.

Table 4: Top Industry Construction Impacts by Output

Industries with greatest output gain	Change in Output
Construction	$6,594,200
Wholesale machinery	$2,193,492
Owner-occupied dwellings	$261,667

[1] The estimate of future charger need was calculated by Upper Explorerland Regional Planning Commission. The estimate was derived by multiplying the estimated number of EVs in Iowa by 2040 (450,000 vehicles) by the percent of EVs in the NE Iowa region (1.7%) to estimate 7785 EVs in the region by 2040. The Electric Vehicle Infrastructure Projection (EVI-Pro) was then used to estimate that 205 workplace ports, 164 public level 2 ports, and 31 level 3 fast-charging ports would be needed to support the 7785 EVs.

The employment impacts (approximately 69 jobs) are mainly in the construction industry. The remaining jobs that result from indirect and induced effects are spread thinly across many industries that cater to residents of the region such as restaurants, retail, and health care.

Maintenance Impacts

EV charging infrastructure requires annual maintenance and fees associated with storing and transmitting data. The cost estimates used in this study are described in Table 5.

Table 5: Estimated Annual Maintenance Costs

Level 2 (dual port)	**Cost per charger**	
Warranty and general maintenance	$1,200	
Network fees	$600	($300 per port)
Total Cost	$1,800	
Level 3	**Cost per charger**	
Warranty and general maintenance	$6,000	
Network fees	$300	
Total Cost	$6,300	
Home Charging	**Cost per charger**	
General maintenance	$100	

Source: Electric Vehicle Charger Selection Guide

The impact of this activity, based on 166 dual-port level 2 chargers, 31 level 3 chargers, and 7,620 home chargers is summarized in Table 6.

Table 6: Economic impact of Maintaining EV Infrastructure

	Output	**Employment**	**Labor Income**
Direct Impacts	$868,100	6.81	$318,839
Indirect Impacts	$95,243	0.78	$31,096
Induced Impacts	$138,112	1.028	$36,120
Total	$1,101,456	8.61	$386,055

The impacts of this activity fall predictably on the equipment repair and computer service industries.

Table 7: Top Industry Maintenance Impacts by Output

Industries with greatest output gain	**Change in Output**
Equipment repair	$660,874
Computer related services	$210,282

Adoption Impacts

A denser network of EV chargers should go hand-in-hand with an increase in EV ownership by residents of the region. This section summarizes the economic impact of 7,620 ICEVs being replaced by an equal number of EVs.

A shift by local residents away from ICEVs and toward EVs affects the local economy through several distinct avenues:

- A shift from gasoline to electricity consumption.
- Changes in the quantity and nature of repair and maintenance.
- Differences in insurance costs.
- Different fees and taxes.
- Finance charges for loans to purchase the vehicles. (The EV purchase price does not have a local economic impact because the EVs used in this study are not currently sold at any dealerships in NE Iowa.)

The exact economic impact per household can vary greatly depending on the EV purchased and type of vehicle being replaced. The cost of ownership estimates used in this study are contained in Tables 8 and 9.

Table 8: Estimated Annual Cost of EV Ownership

Type of Cost	2022 Nissan Leaf	2022 Tesla Model 3	Average
Fuel	$651	$556	$603
Maintenance/repair	$855	$981	$918
Insurance	$1,081	$1,454	$1,267
Fees and taxes	$(88)	$494	$203
Finance charge	$918	$1,879	$1,399
Total	$3,417	$5,364	$4,391

Sources: AAA, Edmunds

Assumptions: 15K miles per year, electricity price of 0.147 per kWh, and a 55/45% city to highway driving ratio

Table 9: Estimated Annual Cost of ICEV Ownership

Type of Cost	2019 Ford F-150	2019 Toyota Camry	Average
Fuel	$2,501	$1,665	$2,083
Maintenance/repair	$2,210	$2,194	$2,202
Insurance	$1,005	$1,109	$1,007
Fees and taxes	$701	$497	$599
Finance charge	$1,057	$763	$910
Total	$7,474	$6,129	$6,801

Sources: AAA, Edmunds

Assumptions: 15K miles per year, gas price of $3.29 per gallon, and a 55/45% city to highway driving ratio

To estimate an aggregate impact, this study used the average of estimates of the cost of automobile ownership from AAA and Edmunds. The cost of owning the "average EV" is calculated as the average of the costs of owning a 2022 Nissan Leaf S 4D Hatchback and a 2022 Tesla Model 3 Long Range 4D Sedan, two of the best-selling EVs on the market. The average cost of owning an ICEV is based upon a 2019 Ford F-150 XLT 2.7L Ecoboost Supercab 4WD 145 and 2019 Toyota Camry SE 4D Sedan. Again, these are two of the best-selling ICEVs on the market. It is assumed that a new EV will replace a three year old ICEV, so cost of ownership estimates for 2019 models of the ICEVs were used.

This study accounts for the fact that the Alliant electric power plant in Lansing, Iowa was shut down at the end of 2022 by modifying IMPLAN to eliminated the industry "Electric power generation – fossil fuels" from the study region. Without this modification, the increase in electricity usage from greater EV adoption would increase output in that industry and result in positive economic impacts in the region. The results in Table 10 reflect the more accurate assumption that most of the electricity used by additional EVs will now need to be imported into the region (although the impact of increasing local, renewable electricity production is discussed below).

Table 10: Economic Impact of 7620 Drivers Switching from an ICEV to an EV

	Output	**Employment**	**Labor Income**
Direct Impacts	$(7,097,323)	(124.14)	$(4,932,307)
Indirect Impacts	$210,202	(4.90)	$(248,185)
Induced Impacts	$6,154,974	46.31	$1,668,945
Total	$(732,147)	(82.73)	$(3,511,546)

The direct effects are negative because the cost of fueling and maintaining an EV is generally less than an ICEV. The switch to an EV reduces local purchases of gasoline[2] and auto repair services, which has a negative impact on economic activity. Importantly, the magnitude of this effect is highly dependent on the price of gasoline. However, the induced effects are positive because the lower cost of EV ownership (about $2,411 per year) is enjoyed by households who can then spend that money on other things.

As a result, the net effect on economic output is modest, but the shift toward EVs will have a disparate impact on local industries. Gas stations and auto repair businesses will see the largest decline in output. Insurance and banking will see the greatest positive impact, in part due to the added costs of insurance and borrowing for the EVs, but also because the greater household savings from EV ownership generates economic activity that benefits these industries.

[2] The study assumes, however, that there is no impact on the sale of goods other than gasoline at gas stations and convenience stores.

Table 11: Top Industry Adoption Impacts by Output

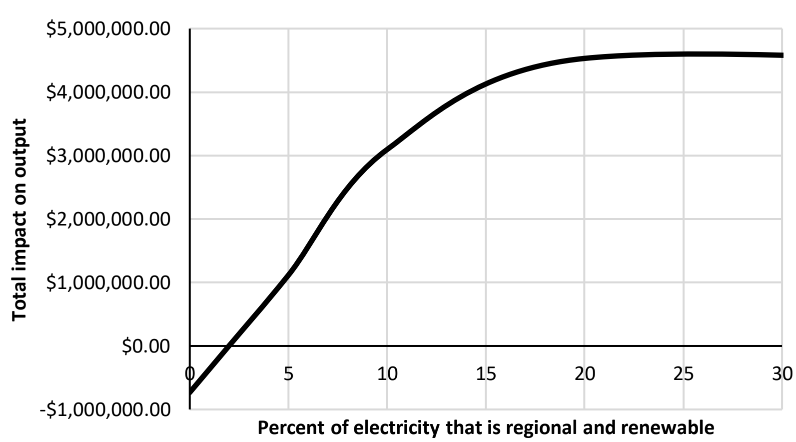
Industries with greatest output gain	Change in Output
Banks	$4,094,067
Insurance agencies and carriers	$3,432,012
Industries with greatest output loss	**Change in Output**
Auto repair and maintenance	$(9,661,817)
Retail gas stations	$(4,029,740)

Table 12: Top Industry Adoption Impacts by Employment

Industries with greatest employment gain	Change in Employment
Banks	15.81
Insurance agencies and carriers	3.38
Industries with greatest employment loss	**Change in Employment**
Auto repair and maintenance	(109.82)
Retail gas stations	(31.08)

The region is currently increasing its production of renewable energy and it is expected that this trend will continue. The graph below shows the total impact on output from the local adoption of EVs as different percentages of Alliant's former electricity production are replaced by regional, renewable energy (in this case, it is assumed that half of the renewable energy is produced by solar and half by wind). As the graph shows, the negative output impacts described in Table 10 go to zero when approximately 2% of Alliant's production is replaced by renewable energy. As renewable energy production increases, the net economic impact of replacing ICEVs with EVs becomes positive and continues to increase until about 20% of Alliant's former production is replaced by renewables. At this point, the regional renewable energy is sufficient to power the new EVs.

Graph 1: Adoption Output Impacts with Changes in Regional Renewable Energy Production



Visitor Impacts

The availability of more EV charging stations in NE Iowa is also likely to change the behavior of visitors to the region in ways that could have economic impacts.

The economic impacts described in Table 14 rely on two important assumptions. First, this study assumes no increase in the level of tourism to the region due to the development of additional EV charging infrastructure. Second, this study assumes there is no increase in local spending that results directly from the installation of new charging stations. However, there are realistic circumstances where these assumptions would not hold so the effect of relaxing these assumptions will be analyzed toward the end of this section.

The main impact on tourism results from the change in fuel used by drivers who visit the region. Travel Iowa estimates that tourists in Iowa spent $910 million on gasoline in 2021. The five counties' shares of Iowa's tourism spending that year were: Allamakee (0.3%), Clayton (0.4%), Fayette (0.2%), Howard (0.1%), and Winneshiek (0.6%). These percentages were applied to $910m to estimate gasoline expenditures by tourists in NE Iowa. This study assumes one-third of tourists to the region will switch to EVs by 2040, so annual gasoline expenditures are expected to drop by one-third and will be replaced by electricity which, based upon calculations in the previous section, is assumed to cost approximately 3.3 times less than gas. The net change is summarized in Table 13.

Table 13: Assumptions About Visitor Fuel Expenditures

Fuel Type	**Change in Annual Expenditures**
Gasoline	$(4,855,333)
Electricity	$1,470,707

Based on these assumptions, the estimated impact of tourists adopting EVs is summarized in Table 14.

Table 14: Economic Impact of Tourists Switching to EVs

	Output	**Employment**	**Labor Income**
Direct Impacts	$(908,755)	(9.30)	$(248,930)
Indirect Impacts	$(268,539)	(2.43)	$(98,686)
Induced Impacts	$(132,786)	(0.98)	$(34,785)
Total	$(1,310,080)	(12.71)	$(382,401)

The net economic impact is negative. As the production of local renewable energy increases the net economic impacts are likely to become positive, just as in the earlier discussion of adoption impacts.

As Table 15 demonstrates, the drop in economic activity is primarily due to reduced sales of gasoline at local gas stations.

Table 15: Top Industry Visitor Impacts by Output and Employment

Industry with greatest output gain	Change in Output	Change in Employment
Electric utilities	$364,153	0.38
Industry with greatest output loss	**Change in Output**	**Change in Employment**
Retail gas stations	$(1,254,075)	(9.67)

The results in Table 14 are heavily dependent on that assumptions that more EV charging stations will: (1) not result in a change in the level of tourism and (2) not change the amount of local spending. If these assumptions do not hold, the predicted economic impact could change significantly.

No strong research has been found to support the idea that additional EV charging stations increase the amount of tourism. However, since the availability of EV charging is becoming an expectation, the absence of a robust charging network is likely to discourage EV drivers from visiting. To get a sense of the possible magnitude of this effect, assume the lack of EV chargers causes tourism in the region to fall by 1,000 people per year. Also assume each visitor would have spent 2.5 days in the region and spent the following amounts:

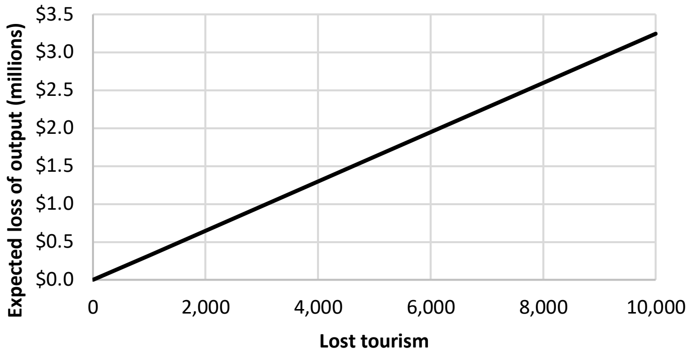
Table 16: Visitor Spending Estimates by Type (per person per day)

Lodging	$52.5
Restaurant	$30
Grocery	$15
Electricity	$2
Retail	$10
Entertainment	$7

Sources: U.S. GSA; Silos and Smokestacks

Under these circumstances, regional economic output would fall by $324,445 for every 1,000 tourists that do not visit. In addition, an estimated 3.5 local jobs would be lost. The main impact would fall on hotels and restaurants. Graph 2 shows the estimated effect on regional economic output if tourism were to drop by different levels. It is worth noting that the $1.3 million loss of output that results from visitors switching away from gasoline (Table 14) is roughly offset if the presence of a charging network prevents the loss of approximately 4,000 tourists.

Graph 2: Impact of lost tourism



It is also worth noting that EV driving tourists are more likely to stay at hotels that offer charging stations. The shift in demand toward hotels that offer EV charging would not have a regional economic impact, since it shifts spending from one type of hotel to another, but it is likely to shift tourism spending within the hotel industry (Qian and Zhang, 2022).

The second assumption, that an EV charging network will not increase tourism spending, is based on the proposed location of NE Iowa EV chargers. There is some evidence that EV drivers go to businesses near charging stations while their EV is charging, spend more time in those businesses than the typical customer, and spend more money while they are there (Northeast Iowa RC&D, 2022). However, increased spending at local businesses requires that the EV chargers be located near those businesses. In this case, only a small number of the recommended EV charging locations in the Northeast Iowa Electric Vehicle Tourism Study (Northeast Iowa RC&D, 2022) are located near businesses. For good reason, most are located near natural areas, parks, museums, hotels or other locations where charging will take place while the tourist does something they would have done anyway. Under these circumstances, it is reasonable to assume no increase in tourism spending.

However, it is worthwhile to consider the economic impact of locating some of the proposed EV chargers near businesses. A New Hampshire study found that 70% of EV drivers shopped at local businesses while using level 2 chargers and spent between $20-40 during each visit (NEIA RC&D). Assuming that a single EV charger near a business would generate 2,190 visits per year[3] and that 70% of those visits would increase tourism spending by $30, the annual economic impact of a level 2 charger being located near a business is described in Table 17.

[3] The frequency of charging at the public chargers in downtown Decorah is about 6 charges per charger per day (Bril) x 365 days = 2190 visits per charger per year.

Table 17: Economic Impact of a Level 2 Charger Located Near a Business

	Output	Employment	Labor Income
Direct Impacts	$14,941	0.19	$6,597
Indirect Impacts	$2,803	0.02	$876
Induced Impacts	$2,814	0.02	$738
Total	$20,558	0.23	$8,211

The results in Table 17 scale proportionately for increases in the number of EV chargers. For instance, if ten level 2 chargers were located near businesses, the expected increase in economic output would be about $205,580 and 2.3 jobs.

SUMMARY AND CONCLUSION

This study estimates the regional economic impacts from the development of a charging network that adds 332 level 2 chargers and 31 level 3 chargers to the five county region of NE Iowa.

The one-time impacts from the construction of the charging network are summarized in Table 18.

Table 18: One-time Economic Impacts

	Output	Employment	Labor Income
Direct Impacts	$8,692,863	49.62	$3,134,223
Indirect Impacts	$1,557,554	9.42	$466,588
Induced Impacts	$1,404,097	10.36	$367,220
Total	$11,654,514	69.09	$3,968,031

The ongoing, annual impacts from charging infrastructure maintenance, the adoption of EVs by local residents, and the use of EVs by visitors, are summarized in Table 19.

Table 19: Annual Economic Impacts

	Output	Employment	Labor Income
Direct Impacts	$(7,137,978)	(126.63)	$(4,862,398)
Indirect Impacts	$36,906	(6.55)	$(315,775)
Induced Impacts	$6,160,300	46.36	$1,670,280
Total	$(940,771)	(86.83)	$(3,507,892)

The negative economic impacts described in Table 19 would be mitigated, and could become positive, if local renewable electricity replaced imported electricity and/or if more charging stations were located near local businesses.

The shift from ICEVs to EVs will impact industries in different ways. Gas stations and automobile repair shops are likely to be harmed by a shift toward EVs. The construction, technology, banking, and insurance sectors are likely to be the biggest beneficiaries of a shift toward EVs. Households are also likely to have more disposable income, since EVs are less expensive to own than ICEVs, which benefits households and leads to significant spillover impacts in the local economy.

This overview of the economic impacts of an EV charging corridor raises additional questions for future study.

For example, surveys could provide more detailed information about whether additional charging stations would *cause* an increase in EV adoption and by whom (*e.g*., Would we see more adoption by people in certain locations or those with access to home or workplace chargers?) Surveys might also allow more careful analysis of the types of EVs purchased and ICEVs replaced, since these choices have a large effect on both economic and environmental impacts.

There are also interesting equity issues raised by the switch to EVs. In this region, EV adoption rates could vary substantially by income level. Similarly, the subsequent cost savings from EV adoption and the impact on a household's energy burden will have vastly different impacts on low-income and high-income households. To understand this, we need a better understanding of which households are most likely to adopt EVs and how that decision could be affected by the location and type of charging infrastructure.

The impact on local commodity markets from regional adoption of EVs will be tiny, but widespread nationwide adoption of EVs will reduce ethanol consumption and have a potentially significant impact on the region. Similarly, macro-level changes in electricity and gas prices will impact local households. These impacts are beyond the scope of this study, which focuses on the regional impact of local behavior changes, but may be worth exploring as national EV adoption rates gain speed.

Finally, the switch to EVs has an impact on greenhouse gas (GHG) emissions. IMPLAN has the capacity to calculate changes in industrial GHG emissions in the region, but since GHG emissions are a pollutant with a global impact this local analysis can be misleading. For instance, a shift toward EVs will reduce GHG emissions from automobiles in the region, but some of those emissions will be exported to the areas outside of NE Iowa where the electricity is produced. The net global effect on GHG emissions from a charging corridor in NE Iowa is a complicated analysis that will depend not only on the factors discussed in this study but also on the location and fuel sources used to generate electricity for the new EVs.

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