



# Manufacture: Pain or Gain?

The EV Options in  
Indiana & Beyond

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# Manufacture: Pain or Gain?

**Is your business ready for the disruption of the rapid transition to Electric Vehicles (EV)? Remember what happened to Kodax, Blockbuster, and Taxicabs. Don't be left behind; start planning now to be part of the solution.** This paper provides an insight on how businesses can develop strategies to survive and thrive during this transition.

### Summary:

We present the challenge faced by local small and medium sized manufacturers caused by the upcoming transition from Internal Combustion to Electric Vehicle in the automotive industry. A 'do nothing' strategy has the potential to decimate sales in 25% of the local companies, and reduce the fraction of product sales across all the companies by 32%. A collaborative strategy can decrease the risk down to 29.4%. But, an expansion across other

industries can decrease the risk further, down to just 3.8%. We also explore the opportunity for local companies to supply buyers with products that they currently import, but which have high supply risks. **When all of these strategies are explored, the EV transition of the auto industry becomes an opportunity to create a vibrant economic future for the region.**

The automotive industry is in the midst of a transition - replacing the Internal Combustion (IC) engine based cars with a new energy source - battery powered Electric Vehicle (EV). Figure 1 (GSCM CMI report) below shows the possible US market size for EVs, from 1.45 million to 6 million vehicles by 2030, a significant opportunity, albeit highly uncertain, and a function of automaker choices. This shift from IC to EV is forecasted to correspondingly decrease the volumes of IC

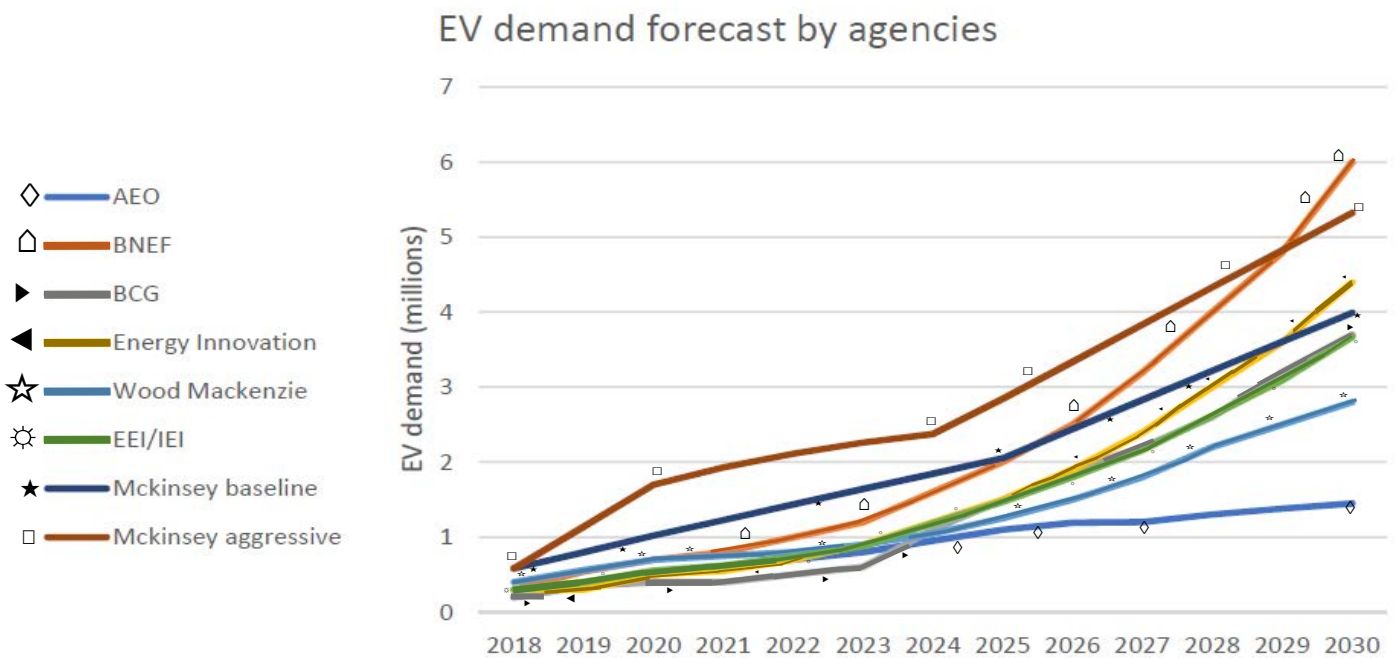


Figure 1: Electric Vehicle Forecasted Demand

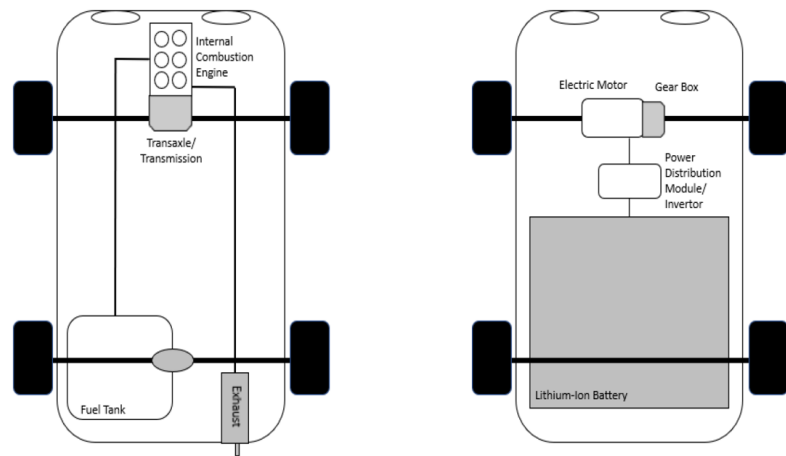


Don't be left behind, start planning now to be part of the solution.

cars, thus changing the mix of parts required; there are fewer parts in an EV (at 40% less compared to an IC car) and predicted reduction of labor required impacted negatively, by 30% ([2]). But as we will show, the shift to EV promises an opportunity – to think holistically, collaborate, enable global resilience, build capabilities and deploy agility to manage competitive risk. This report provides clear pathways towards deploying such strategies and quantifies their impact in ameliorating competitive risk.

Figure 2 shows differences between the IC and EV cars ([1]), with the fuel tank, engine and transmission replaced by a battery, power distribution unit and an electric motor. Figure 3 provides a more detailed summary of changes in part/component needs.

Figure 2: IC (left) vs EV (right) from a UAW Report([1])



Vehicle System	ICE Parts & Components	EV Parts & Components
Power system	Engine block, pistons, valves, cylinder sleeves, camshafts, fuel, and exhaust systems ☆	Energy storage, batteries, and ultracapacitors 🏠
Drivetrain	Transmission components and axles ☆	Motors, electrical components and wiring harnesses 🏠
Instrument Panel	Gauges, Navigation, Radio, etc. ▶	Replace dashboard with computer type screen ▶
Braking System	Mechanical: disc or drum brake ▶	Mechanical: disc or drum brake plus regenerative braking ▶
Tires & Wheels	Traditional tire and wheels ▶	EV tires also aim to minimise noise as much as possible so tranquil drive experience of an EV would be ruined ▶
Frame/Infrastructure	Frame based infrastructure to support engine and powertrain as well as body ▶	Battery pack is very heavier, much heavier than the internal combustion engine is. ▶
Body	Body parts including bumpers, grill, doors, etc. ▶	Grill parts will not be needed for cooling engine ▶
Driving Assist	Self Driving sensors/cameras ★	Self Driving sensors/cameras ★
Fuel System	Fuel Tank, filling cap, sensors, gauges ☆	Cables and charging components 🏠
Climate Control	Air conditioning, Blowers, Heater, temperature control systems ▶	Air conditioning, Blowers, Heater, temperature control systems. Air Some impact due to no radiator or heat from engine ▶
Electrical and electronics components	Lighting, sound systems ▶	Lighting, sound systems/Power electronics and control equipment and software, including thermal management for battery packs ▶
Interior Trim	Seats, seat belts, leather, fabric ★	Seats, seat belts, leather, fabric ★

**Legend**

- Eliminated ☆
- New 🏠
- Still needed but may have significant changes ▶
- Still needed with minor changes ★

Figure 3: Parts in the IC and EV – some eliminated, some new, some requiring changes

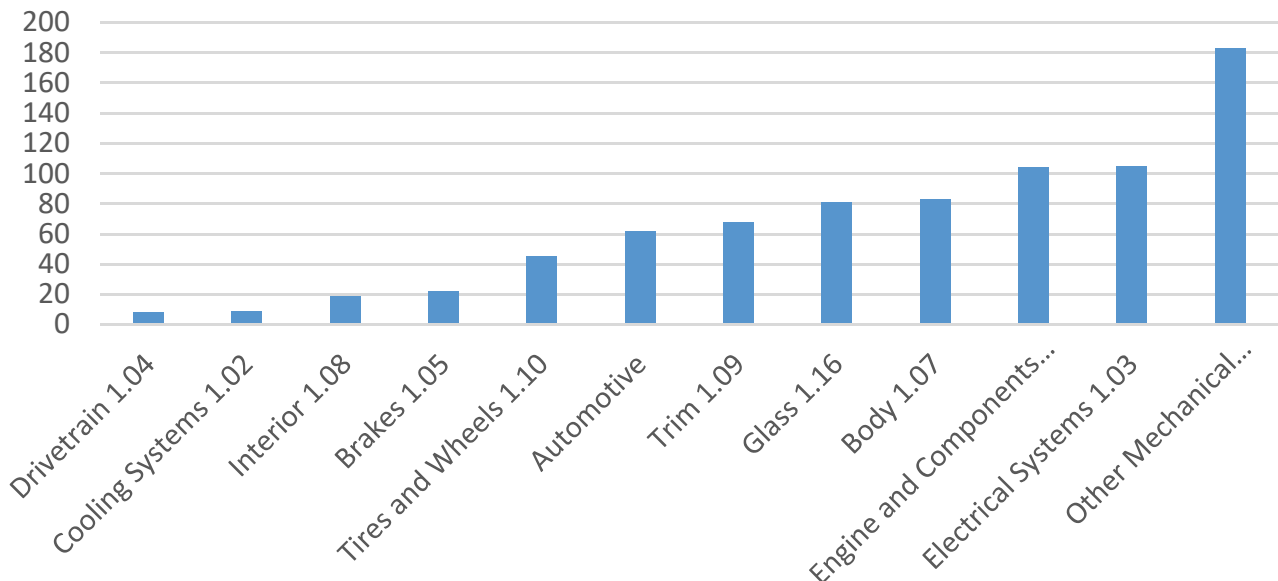
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An examination of Figure 3 shows that all aspects of the car will require some change, with several parts eliminated and replaced by different components, and even existing parts requiring some degree of re-design. The challenge for Indiana, as we will see, is the large number of companies who participate in the auto supply chain in the State. We obtained descriptions of company activities from the firm websites, from LinkedIn profiles for the companies and from Dun and Bradstreet descriptions. We searched this data for production of automotive parts and found 528 companies in a 14 county region in Indiana (counties shown in Figure #7) who are members of the auto supply chain. These 528 companies employ over 46,000 people and have total revenues of over \$10.41 billion. The same data was used to identify specific parts produced by these companies. Figure 4

shows the distribution of the 528 companies as component providers for the IC auto supply chain. A key takeaway is the large number of suppliers of mechanical components, engine and body related components. While some of this demand will persist in the EV supply chain, these companies can be expected to experience the largest negative impact to their business, for State revenues and for jobs.

*Figure 4 : # Companies by component in the IC auto supply chain (across 14 counties in Indiana) with total revenues of \$10.41 billion and employing 46,000 people*

## # Companies by component



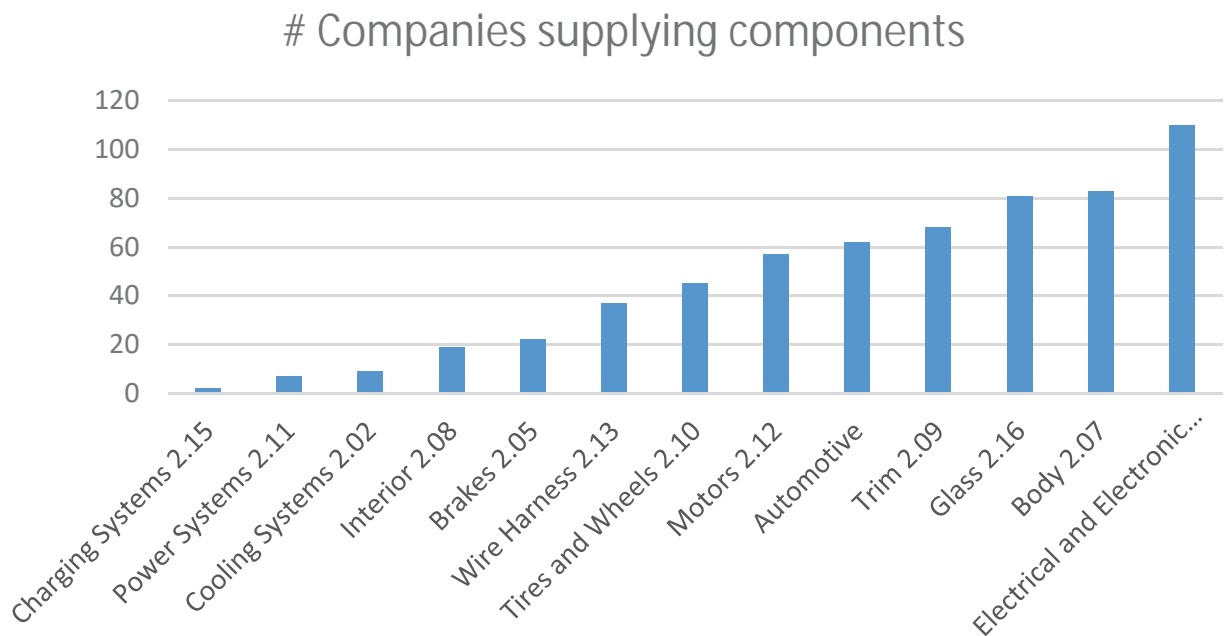


“As a Tier 2 Supplier of transmission components for IC vehicles, we are actively pursuing new directions and opportunities as the EV market advances and begins to scale.”

Robert Bierwagen, VP of Digital Strategy, MPI Corporation

Figure 5 shows the 418 companies in the EV supply chain, with opportunities for companies that make electrical and electronic components, wire harnesses etc., and at the same time, the significant loss of opportunity for mechanical components for engines, transmissions etc. We expect this industry change from IC to EV to manifest itself in dramatic shifts in revenues and employment numbers at both corporate and county levels.

*Figure 5 : # Companies by component with the potential to participate in the EV auto supply chain (across 14 counties in Indiana) with total revenues of \$ 9.47 billion and employing 40,691 people*



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The Venn diagram in Figure 6 shows the set of companies who, (1) can participate in both the IC and EV supply chains, but also, (2) companies who do not have any opportunities in the EV supply chain as well as, (3) new supply chain participants in the EV supply chain. Given the associated number of companies, their employment and their revenues, one perspective is that this transition will impact 25% of the companies severely (i.e.,  $130/(130+398)$ ) with significant loss of revenues of up to 10% of total region revenues or roughly \$1 Billion from just 14 counties. But this perspective does not capture

the details of specific components that will no longer be needed and the associated risk faced by individual companies. Similarly, it does not frame the transition as associated with adjustments in strategies of firms to deal with this transition. We will explore these ideas next.

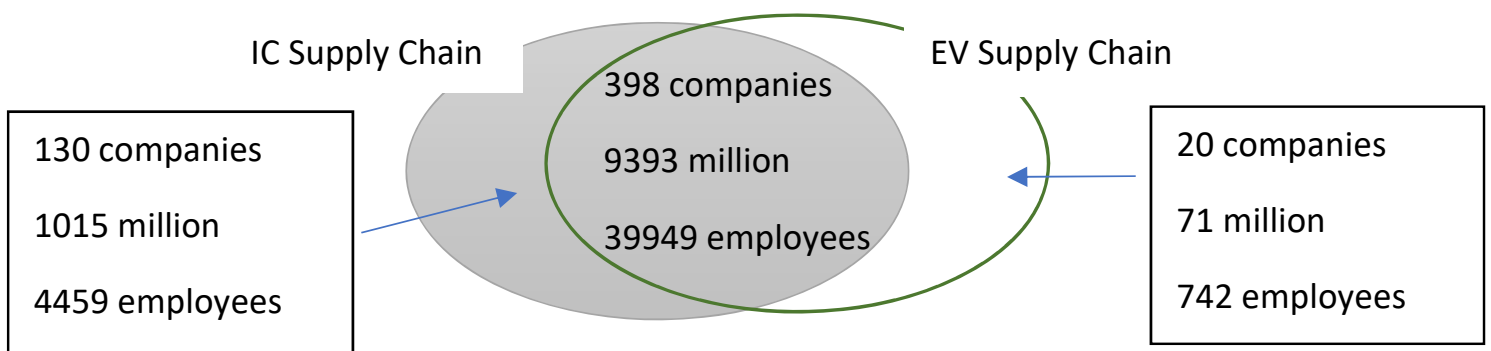


Figure 6



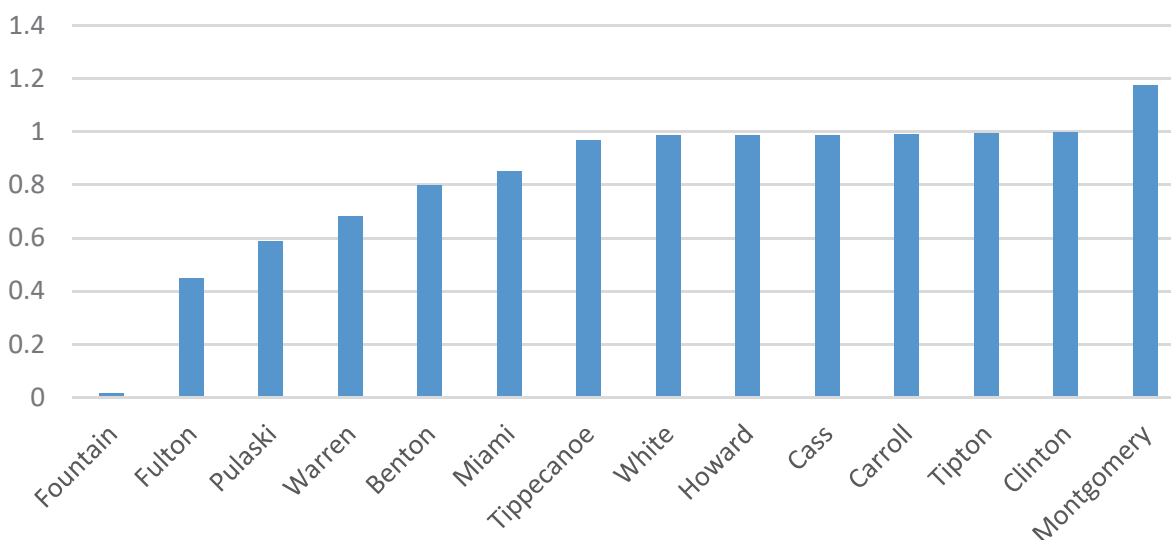
The counties with a larger extent of diversification of industry across electrical, electronic components and mechanical components are less impacted than those less diversified.

Figure 7 shows the ratio of revenues for companies potentially in the EV industry and those currently in the IC supply chain. A ratio above 1.0 promises the opportunity for growth; a ratio below 1.0 shows the threat of business loss. Note the significant impact on six of the 14 counties. This figure shows that the impact across counties is very likely to be heterogenous and may need significant effort in some counties to maintain employment and revenues that impact both quality of life and the tax base. The counties with a larger extent of diversification of industry across

electrical, electronic components and mechanical components are less impacted than those less diversified. One county, Montgomery, actually sees an increase in revenues, due to the new components required by the EV supply chain. The largely negative revenue impact clearly creates a negative employment impact. Figure 7 shows that in the absence of a strategy to deal with the transition, there is a potential for significant dislocation of employment in select counties.

*Figure 7: The revenue impact of the shift from IC to EV by county*

### Ratio of Company EV/IC revenues in Counties



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## Understanding and Managing Risk Factors to Create Opportunities

Seizing the opportunity presented by the EV transition will require strategic choices at the stand-alone company level, but we suggest that local economic development officials can assist in this transition. The remainder of this report quantifies the benefit from several strategies that can be chosen, using an assessment of the opportunities to mitigate risk by expanding the market served. Our conceptual picture of risk mitigation is best represented by Figure 8 below. In this figure, each individual firm is represented as a circle, the links between firms initiated by the LEDOs suggest collaboration opportunities, and

the imports into the region suggest parts that can be targeted for local production and dollar margins. Our approach was to create a Supply Chain Tool that characterized the over 1,279 firms along 150 attributes (including certifications, products, machines, finances etc), and an Import Analysis tool that includes every container imported into the local region (its shipping manifest, country of origin, ship-per details, importer details, volumes etc). As already described earlier, we started with a company level description to identify products they were making currently. We next took the product descriptions from Wikipedia to identify other industries that used the same product. We examined the HS

"Do nothing" risk across companies

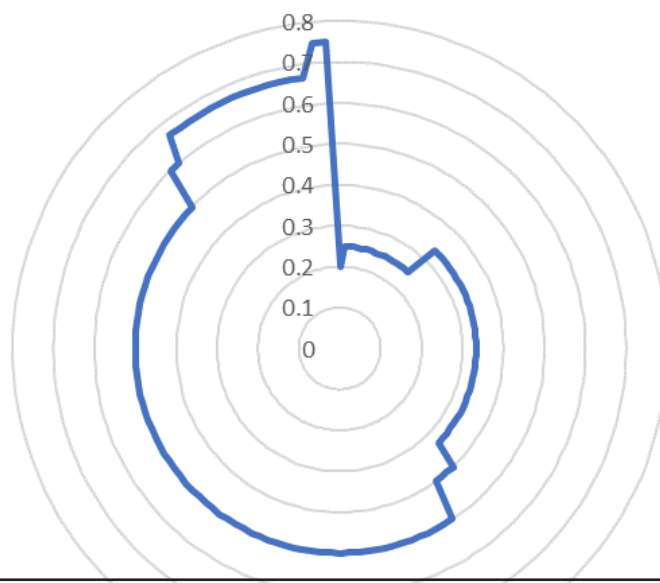


Figure 8: The "do nothing" risk across companies in the region (the companies with 0 or 100% risk have been left out to provide a sense of the distribution)





“The collaboration and help that Purdue University offers is second to none and will be a vital component in our strategies and implementations of our future transitions.”

Douglas A. Mansfield, Chairman Advisory Board, Kirby Risk Corporation

code for imports and linked them to parts to identify imported component opportunities for firms that already have the capabilities to produce them locally. Finally, we considered the opportunity for firms to expand their capabilities and thus sell more parts to the EV supply chain. Each of these steps will impact both individual company and county level risk but provides a roadmap to reduce the risk. These details will be described next.

### The “Inertia or Do Nothing” Strategy

What if companies ignored the EV transition and kept making the parts they currently make with no change in strategy? We already know from Figure 1 that the speed of transition to the EV is unknown. But regardless of the timing of the transition, a ‘do nothing strategy’ will result in fewer of the current IC components being required by the industry. We use this reality to create a risk measure for individual firms that is defined:

$$\text{Do Nothing Company } i \text{ Risk} = 1 - \frac{\text{Parts for EV industry by company } i}{\text{Total Auto Parts produced by company } i}$$

$$\text{Do Nothing County } j \text{ Risk} = 1 - \frac{\sum_i \text{EV Parts by company } i \text{ in county } j}{\sum_i \text{Total Auto Parts by company } i \text{ in county } j}$$

This risk-measure treats companies that continue to deliver to the EV industry as having 0 risk, but companies whose parts get eliminated completely as having a risk level of 100%. Leaving out the companies with 0 or 100% risk, we get a spider diagram of the risk across companies in the region

as shown in Figure 8 below. The circles show increasing risk as you move along the radius from the center. A key takeaway is that doing nothing risk is significant across the companies, with an average value of 33%, suggesting a potential 33% drop in revenues (c. \$1 Billion) and employment across companies in the region (c. 4,500). This is a sizable risk, but, as we shall show, can be managed as an opportunity. Next, we show the risks at a county level, with a county now described as an amalgam of the companies in the county. Figure 9 shows the “do nothing” risk across counties. The average value across the counties for companies who currently serve the auto supply chains is 0.32, suggesting that 32% of the parts on average will be lost in the transition to EVs. For the avoidance of doubt, a figure of 0.3 on the y-axis represents a 30% loss from doing nothing. Note again that the impact varies across counties, as seen earlier in Figure 7, ranging from 25 to 50% reduction in parts supplied.

This risk perspective provides a different view of the impact, suggesting that **even if companies remain in the auto supply chain, in the absence of mitigating strategies, they may face revenue declines and thus regions would face employment de-clines of up to 32% of total employment.**

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Given the impact on reduced parts sold to the EV auto supply chain, Figure 9 suggests that all counties are likely to feel negative impacts on both employment and revenues associated with the EV transition. The risks suggest the need to look more closely at the parts being produced and not just participation in the industry.

### An Agile Strategy to Manage Risk

We collected information about all individual companies including over 150 attributes that characterize their capabilities. Given that a company is capable of doing a lot

more than the set of products it is making currently, we explore the option of using the mix of resources of a company to expand the parts footprint within the auto industry. This approach can provide management with potential business strategies to ameliorate the threats and to take advantage of prescribed business strategies that we put forward to preserve the businesses, revenues and thousands of jobs. To do this we started by tracking the set of parts within each of the categories described in Figure 4. As an example the following figure shows details of the parts that are included in each of the categories.

"Do Nothing" risk

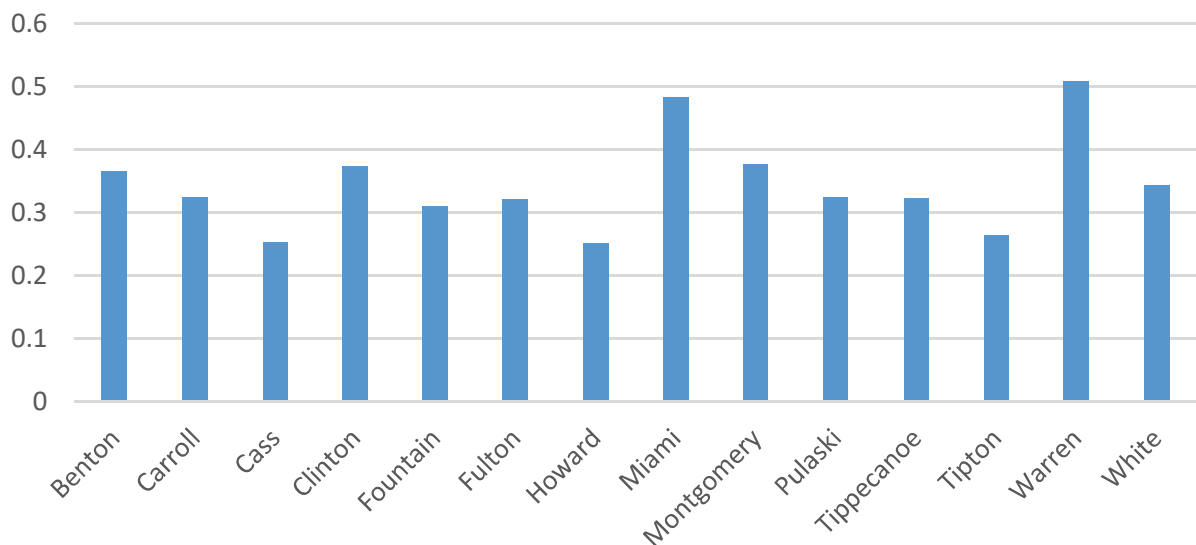
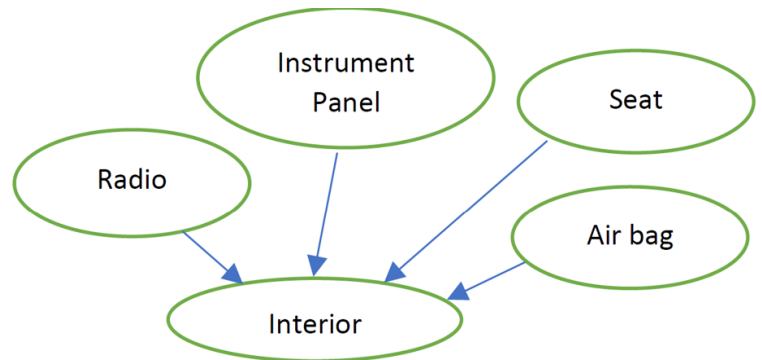
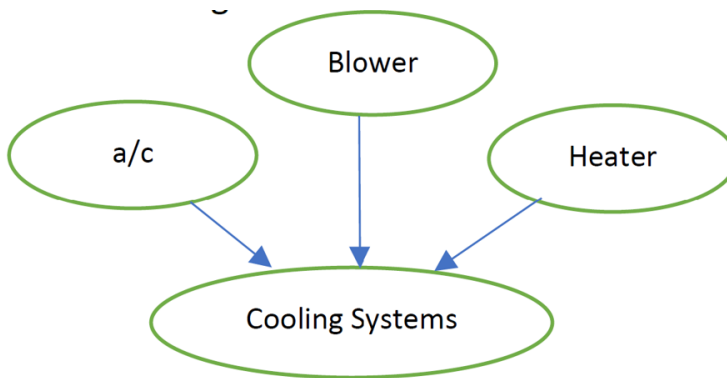


Figure 9: The do nothing risk across counties, averaging 32% across counties.



“Rea Magnet Wire, Inc sees the transition to Electric Vehicles as a huge opportunity for our company to realize inorganic growth from these new and old automakers.”

Dennis Rausch, VP of Information Technology  
Rea Magnet Wire Company, Inc.



Consider a strategy that involves collaborating with other companies who all supply components for a category, say Cooling Systems. A company supplying heaters could then work with others who produce blowers, air conditioning systems etc., to find ways to participate in select processes so that the overall system and business venture are competitive.

This would increase the number of different parts that the company would be involved in, thus decreasing the risk measure. Let 'Parts Expansion' refer to the new parts that a company can participate in.

The revised risk measure would then be:

$$\text{Collaborative Risk} = 1 - \left( \frac{\text{New Parts} + \text{Parts for EV}}{\text{New Parts} + \text{Initial Parts Produced}} \right)$$

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Figure 10 below shows the reduction in average risk at the county level associated with collaboration in making new parts suggesting that the average risk decreases from 32% down to 29.4%.

While expanding the parts footprint helps decrease some level of risk, it has no impact on the 130 firms who had no parts supplied to the EV supply chain. These 130 companies remain at very significant risk without fresh strategies enacted now to shift to opportunity. We will thus explore a different strategy to decrease risk for those 130 firms.

## An Agile Strategy

Consider the companies who supply parts to the Internal Combustion (IC) supply chain. We took the parts descriptions and other industries that could be targeted by these companies to produce new sales. A comprehensive search helped us categorize a number of other industries who also use, for example, rotors. We considered all of the parts supplied by a company, all of the other industries that use the same part, and developed a set of other industries (i.e., other than automobiles) who could also be targeted. Assuming a single part is supplied to each of these new industries, we use these potential additional parts, called New Industry parts, to calculate the revised risk measure as follows:

Risk reduction through collaboration

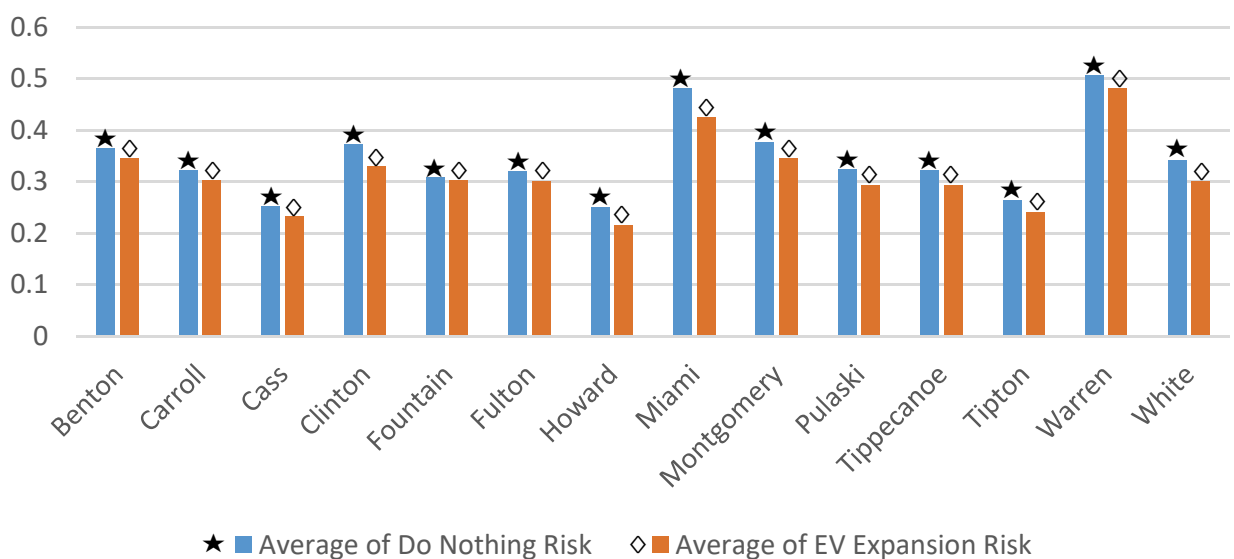


Figure 10: County level risk reduction through collaboration strategies



Being successful in these efforts requires leveraging the agility of the workforce and the equipment.

$$\text{Agile Risk} = 1 - \left( \frac{\text{New Industry Parts} + \text{Parts for EV}}{\text{New Industry Parts} + \text{Initial Parts Produced}} \right)$$

The impact of such an expansion of industry targeting potentially impact the 130 companies who were shut out of the EV industry. These companies can now target other industries using parts that belong to their part category. The corresponding impact at the county level is shown in Figure 11. Notice that the expansion into other industries dramatically reduces

the average risk down to just 3.8%, a very substantial impact from strategic business re-direction. While we do not expect every company to be successful in their efforts, our search did reveal a number of other industries who could be targeted by companies left out in the EV transition. Being successful in these efforts requires leveraging the agility of the

Risk Reduction with strategies

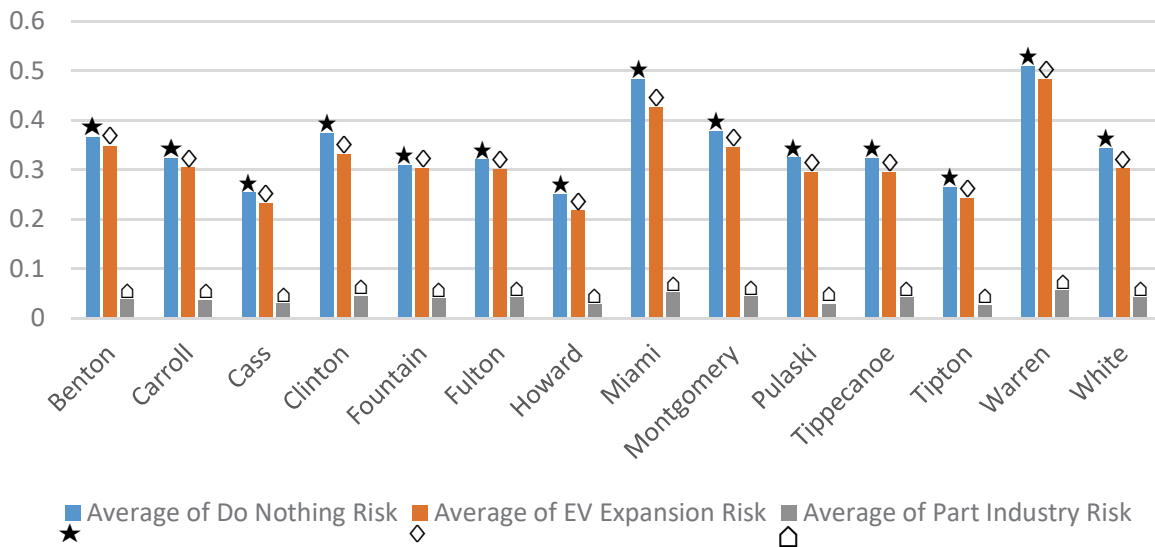


Figure 11: Risk reduction due to part expansion to serve other industries

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workforce and the equipment, perhaps including networks of relationships between companies. But it also suggests a significant role for educating the workforce, leveraging connections with universities, leadership by local economic development officials. From a business perspective, there are of course multiple factors in establishing strategic business direction that must be informed by market research data. The information will also include financial data concerning the new markets in terms of available margins, competitive downward pressure on pricing (and future margins) and, on the bonus side, potential reductions in supply-side costs due to the volume business that is targeted.

## A “Dual Source” Strategy Leading to Manufacturing Opportunity

We focused on the global flows of imported containers (TEUs or twenty foot equivalent units) into Indiana, tracking exporting country, importing company in Indiana and the item type (described as an HS code, that are invariably ‘parts’ but including some complete sales items also). The choice of a source for a part or product depends on many factors. But purchasing all of these parts/products from a single source is a potential source of risk, due to weather or pandemic disruptions, or political issues. In such cases local production, albeit often at a higher price point, can be an effective dual source strategy that would enable supply chain resilience, ameliorate the overhead costs and lower revenue streams due to reduced productive capability during



supply shortages. Offering a company’s domestic production capabilities to serve as a “dual source” may well be another approach to tangibly expand the footprint to other industries and to decrease risk. Figure 12 plots the Herfindahl–Hirschman Index or HHI, as a measure of country concentration of supply sources for a product, with the measure calculated for every unique imported product (HS code) . The HHI measure is defined for a product as the square of the fraction of imports from each country, and is expressed as: *Imported Country Risk = HHI=*

$$\sum_i \left( \frac{\text{Product Imports from Country}_i}{\text{Total Product Imports across Countries}} \right)^2$$

The data in Figure 12 shows that 22% of the products have an HHI value of greater than or equal to 0.8, which suggests a large concentration of imports from a single country.



Ignoring the threats and inaction will lead to tragic reductions in revenues and jobs.

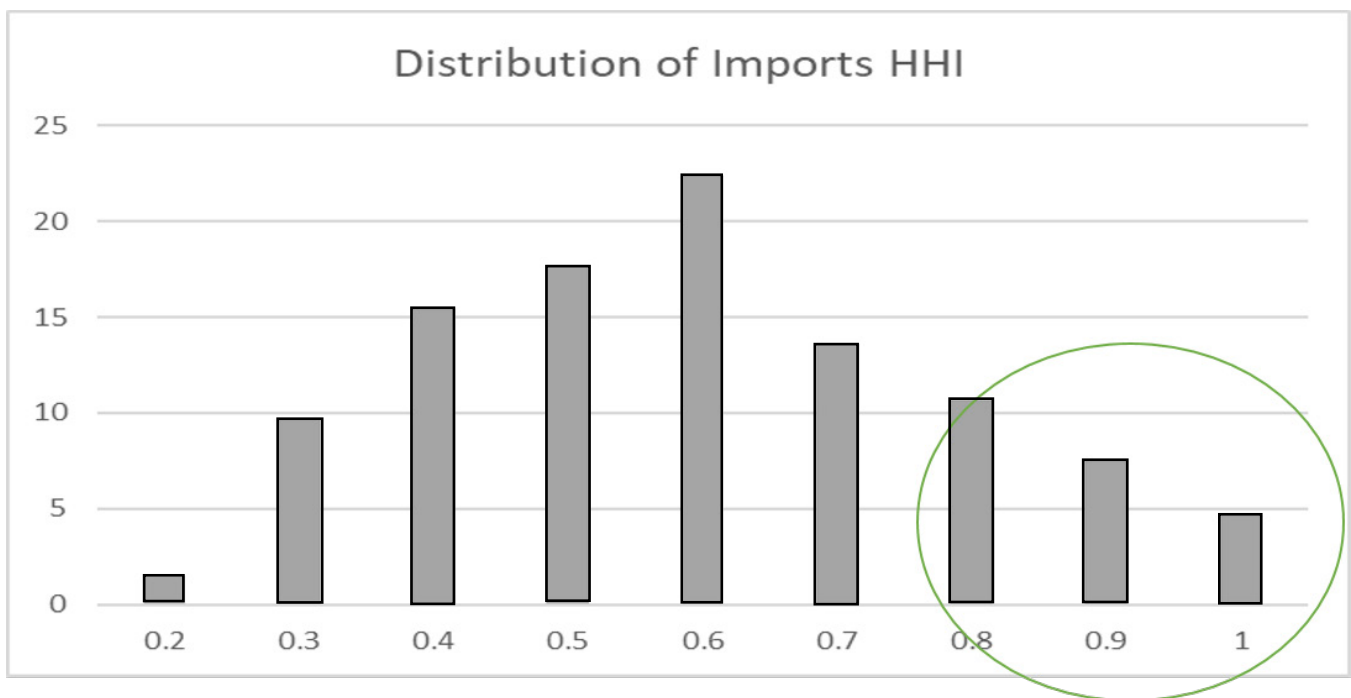


Figure 12: Distribution of the extent of country concentration of imported items - 1 refers to sourcing from 1 country, closer to 0 is a diversified sourcing strategy

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## Conclusions

Where you have 14 counties (with widely varying revenues in manufacturing in each county) that show potential losses of \$1 Billion and about 4,500 jobs, the significance for Indiana and more widely the nation, becomes galvanizing. This report provides both the top level threat in revenues and jobs as well as drilled down data at the part, county, and even individual company levels. We also provide a number of success strategies where strategic action by managements, supported by economic advice and investment at county and State levels, can shift the potential for pain towards opportunities for gain. Some of the take aways for action must include:

- Companies that produce IC components need to start planning now to replace future business losses as result of EV transition. For example: consider reshoring imported parts and components
- Companies that produce EV components at low volume now, need to plan for rapid ramp up in production volumes

- Companies currently not in the automobile business should consider diversification into EV related businesses such as: Charging stations and/or Recycling
- LEDOs and State level economic agencies should actively work with companies to assist in taking advantage of the opportunities that the EV transition offers.

Ignoring the threats and a lack of action will lead to tragic reductions in revenues and jobs.

**Managements that take action now can rescue their individual companies and avert dire county situations; in some counties, such actions may lead to increased revenues and jobs.**

## References

- 1) *Taking the High Road: Strategies for a fair EV Future*, UAW International, 8000 E. Jefferson Av-enue, Detroit, MI 48214, 2021



# Engaging to Assist Companies

“

As a Tier 2 Supplier of transmission components for IC vehicles, we are actively pursuing new directions and opportunities as the EV market advances and begins to scale. While our own research is critical to our strategy, having the resources and expertise of Purdue University and its team members available to our planning is invaluable. The ability of the Purdue Team to quantify the changes that are underway, assemble multiple points of view and expertise, bring together stakeholders that are or need to be invested in EV, and to quantify the need for planning transitional directions and steps today – these are critical value add functions that will ensure the continued success of Indiana manufacturing as we move into the future. We are excited to be part of that future, and most appreciative of the partnerships and resources available through Purdue University that will assist us in achieving it.”

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***Robert Bierwagen***  
***VP of Digital Strategy***  
***MPI Corporation***



## Manufacture: Pain or Gain?



Rea Magnet Wire, Inc sees the transition to Electric Vehicles as a huge opportunity for our company to realize inorganic growth from these new and old automakers. Magnet wire is a necessary component in the traction motor of the electric vehicle, so we are keenly focused on expanding our manufacturing capabilities to meet the needs of the EV automakers. The collaboration that we hope to gain from Purdue and the local government and other local manufacturers is perhaps the extra edge that we need to keep magnet wire production in the US and most importantly to keep all these manufacturing

opportunities in Indiana. Not only is magnet wire used in the traction motor of the electric vehicle, it is used in the many types of transformers that are required to deliver electricity to your home or charging station. The early research suggests that the nation's electrical grid is undersized to serve the charging requirements for a large number of home chargers. It is difficult to predict how this will impact Rea, but we

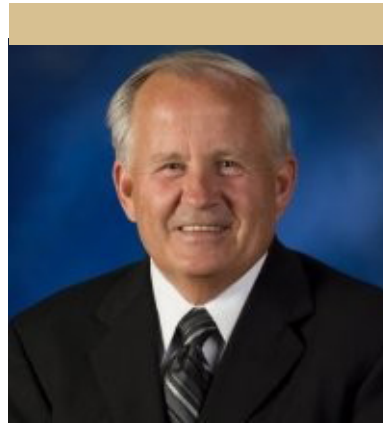
are paying attention to all of these dynamics that the EV market is affecting."



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**-- Dennis Rausch**  
**Vice President of Information Technology**  
**Rea Magnet Wire Company, Inc.**

# Engaging to Assist Companies



**-- Douglas A. Mansfield  
Chairman Advisory Board  
Kirby Risk Corporation**

**A**s a local supplier to large OEM's that make internal combustion engines, we need a vision on how in the future we will replace that important business. The collaboration and help that Purdue University offers is second to none and will be a vital component in our strategies and implementations of our future transitions."

**A**s Director of R&D for a company that has manufactured transmission clutches for over 100 years, the upcoming transition to EV has essentially been a looming threat to our business, weighing heavy on my mind for a few years now. This report has changed the way I view the EV transition, from a threat to an opportunity. It helps

lay out some available resources and potential pathways, along with the reasoning behind it, to pursue taking our manufacturing capabilities and resources to the new EV level."

**-- Angie Petroski  
Director of Research &  
Development  
Gearbox Holdings Inc.**

## Our Team



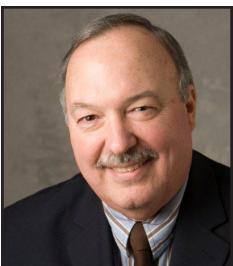
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