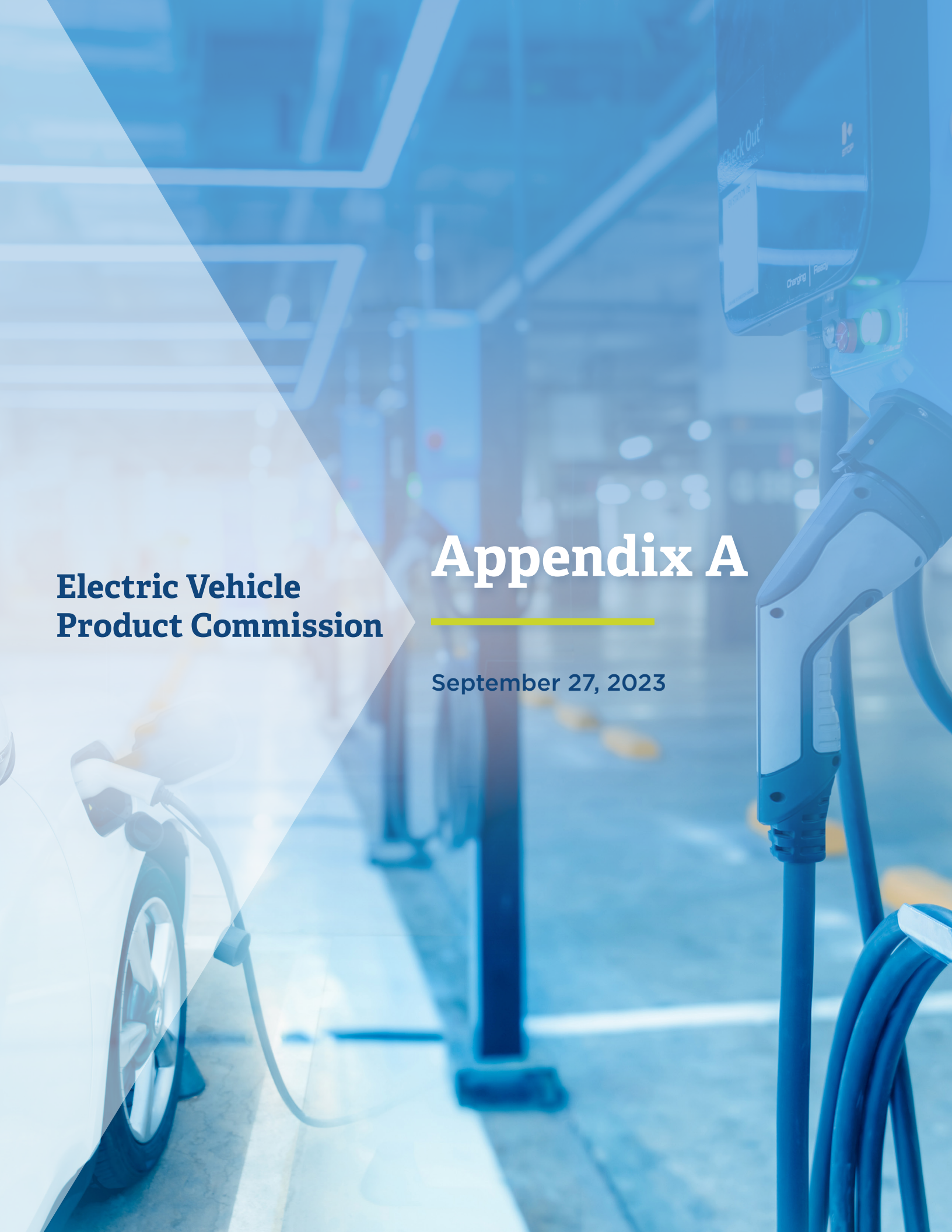


Electric Vehicle Product Commission

Appendix A

September 27, 2023

1. ICE & EV Component Categorization

The team performed location analysis in year 1 project[1] where the part categories and subsystem components were defined as part of the inventory analysis for ICE and EV sectors. The definition for ICE categories and associated components is provided in Table 1.1 while the definition for EV categories and associated components is presented in Table 1.2. The category is the primary set while the components are the secondary set.

Table 1.1: ICE Category and Components

Category	**Components/Parts**
Automotive, Motor	Automotive, Motor
Engine and Engine Components	Pistons, valves, cylinder sleeves, camshafts, fuel, and exhaust systems
Cooling Systems	Air conditioning, Blowers, Heater
Electrical Systems	Electrical and electronics components
Drivetrain	Transmission components and axles
Brakes	Disc, Rotors, pads
Body	Stamping Parts
Interior	Instrument panel parts, seat belts, radio, seats, air bags
Trim	Leather, Fabric
Tires & Wheels	Tires, Wheels, Air Pressure Sensors
Glass	Windshields, side glass, roof glass

[1] https://www.iedc.in.gov/docs/default-source/iedc-assets/evp-commission_report-(3).pdf?Status=Master&sfvrsn=2402fd1_3

Table 1.2: EV Category and Components

Category	Components
Cooling Systems	Air conditioning, Blowers, Heater
Power systems	Energy storage, including battery R&D, manufacturing and assembly, and ultracapacitors
Motors	Motors or motor components
Wire Harnesses	Wire harnesses or wire materials
Braking	Braking system components
Electronic Controls	Power electronics and control equipment and software, including thermal management for battery packs
Recycling	Recycling of Battery components
Body	Stamping Parts
Charging systems	Home, business, Parking Lots, Apartment/condo complexes, Rest areas
Interior	Instrument panel parts, seat belts, radio, seats, air bags
Trim	Leather, Fabric
Tires & Wheels	Tires, Wheels, Air Pressure Sensors
Glass	Windshields, side glass, roof glass

2. Risk Analysis

Our team performed risk analysis to understand and manage the risk posed to the manufacturing companies in Indiana. This analysis can be used to explore the opportunities created in the face of these risks. Seizing the opportunity presented by the EV transition will require strategic choices at the stand-alone company level, county-level, as well as the region-level. The team investigated the most imminent risk the auto manufacturing companies will face if they do nothing.

2.1. The" Do Nothing" Strategy or Inertia Risk

What if companies ignored the EV transition and kept making the parts they currently make with no change in strategy? We already know 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 ICE components being required by the industry. We use this reality to create a risk measure for individual firms aggregated in a county.

$$Inertia\ Risk = 1 - \frac{\sum_i EV\ Parts\ by\ company(i)\ in\ county(j)}{\sum_i Total\ Auto\ Parts\ by\ company(i) in\ county(j)}$$

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%.

Another consequence of ICE suppliers doing nothing and thus potentially being disrupted, is the negative impact on the ICE OEMs' ability to continue to produce ICE vehicle even in smaller volumes. OEMs must monitor their supply chains and suppliers at all tiers to evaluate the risk and develop contingency plans to maintain critical parts suppliers.

Inertia risk provides the worst-case scenario where the auto companies refuse to transition at all to the EV sector and also where the world transitions completely away from the ICE vehicles. Even a little step towards the EV sector reduces the exposure to this risk.

3. Region-wise Risk Analysis

To provide a better insight about the auto manufacturing in Indiana, the approach to analyze based on Economic Growth Regions was used. All the 92 counties are divided into 11 regions based on economic growth[2], as shown in Figure 3.1. This categorization was defined by the Indiana Department of Workforce Development in 2016. Though certain patterns hold true for most regions, there is a considerable amount of variation in employment, wages, and growth[3] among the 11 different regions.

[2] https://nonprofit.indiana.edu/community-profiles/egr.html
[3] https://nonprofit.indiana.edu/doc/publications/msa-egr/introduction-egr.pdf

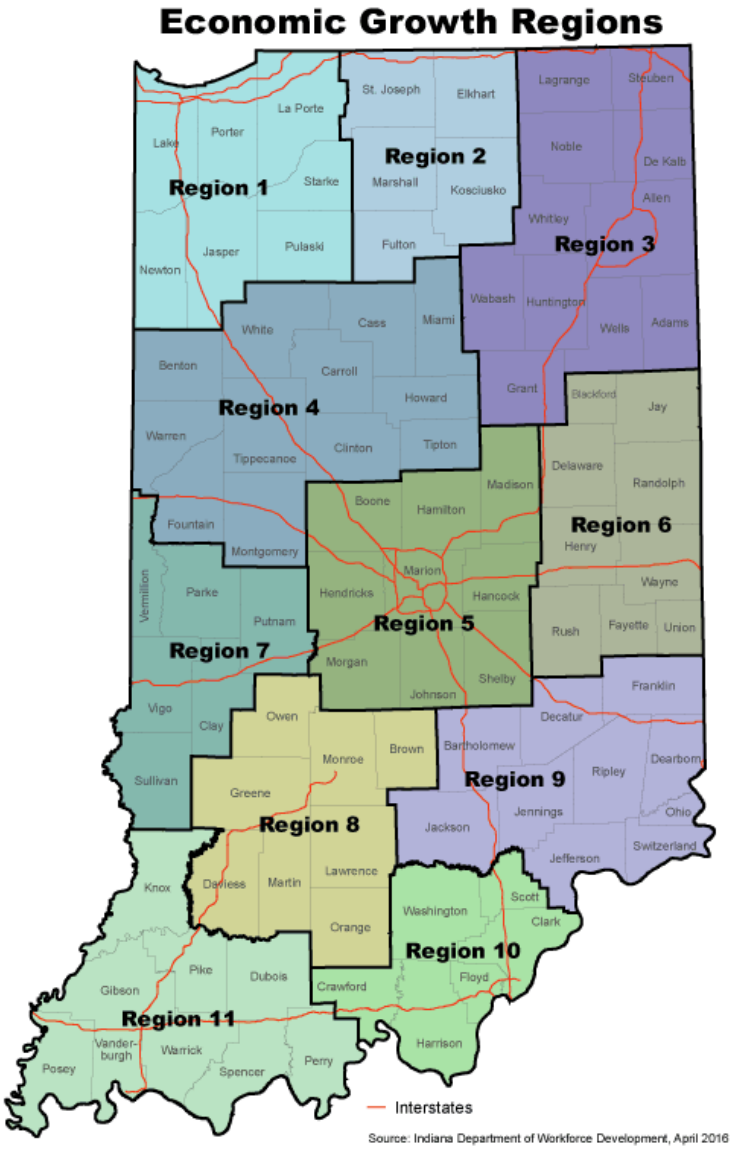


Figure 3.1: Economic Growth Regions in Indiana

Table 3.1 shows the different counties that belong to the individual Economic Growth Regions.

Table 3.1: List of Counties in each Economic Growth Region

Regions	Counties
Region 1 – Northwest IN	Jasper, Lake, La Porte, Newton, Porter, Pulaski, Starke
Region 2 – North Central IN	Elkhart, Fulton, Kosciusko, Marshall, St. Joseph
Region 3 – Northeast IN	Adams, Allen, DeKalb, Grant, Huntington, LaGrange, Noble, Steuben, Wabash, Wells, Whitley
Region 4 – Northwest Central IN	Benton, Carroll, Cass, Clinton, Fountain, Howard, Miami, Montgomery, Tippecanoe, Tipton, Warren, White
Region 5 – Central IN	Boone, Hamilton, Hancock, Hendricks, Johnson, Madison, Marion, Morgan, Shelby
Region 6 – East Central IN	Blackford, Delaware, Fayette, Henry, Jay, Randolph, Rush, Union, Wayne
Region 7 – West Central IN	Clay, Parke, Putnam, Sullivan, Vermillion, Vigo
Region 8 – South Central IN	Brown, Daviess, Greene, Lawrence, Martin, Monroe, Orange, Owen
Region 9 – Southeast Central IN	Bartholomew, Dearborn, Decatur, Franklin, Jackson, Jefferson, Jennings, Ohio, Ripley, Switzerland
Region 10 – Southeast IN	Clark, Crawford, Floyd, Harrison, Scott, Washington
Region 11 – Southwest IN	Dubois, Gibson, Knox, Perry, Pike, Posey, Spencer, Vanderburgh, Warrick

There are many other region/cluster classification systems that the team explored. Some of them are Michael Porter's clusters, Interstate Regions, Workforce Regions, and IARC cluster. Out of the many, the team selected Economic Growth Regions since they align better with the goal of the project – understanding the growth of EV sector in automotive industry.

Region	Total number of Companies	Total number of Employees	Average Inertia Risk
Region 1 (Northwest IN)	583	24,828	0.611
Region 2 (North Central IN)	1,070	42,396	0.644
Region 3 (Northeast IN)	909	50,053	0.661
Region 4 (Northwest Central IN)	339	24,606	0.675
Region 5 (Central IN)	1,493	46,600	0.689
Region 6 (East Central IN)	291	11,904	0.638
Region 7 (West Central IN)	124	6,247	0.643
Region 8 (South Central IN)	140	2,845	0.638
Region 9 (Southeast Central IN)	319	28,000	0.622
Region 10 (Southeast IN)	174	6,047	0.626
Region 11 (Southwest IN)	430	23,449	0.585

The above table provides the total count of companies, total count of employees, and the average inertia risk for each EGR. It is evident that the average inertia risk across all regions is comparable, being in the range of 0.585 to 0.689.
The Central IN region faces the highest average inertia risk while also contributing to highest number of manufacturing companies and second highest number of employees. While the Southwest IN region faces the lowest average inertia risk. The region contributes fairly to the count of companies and count of employees involved in ICE and EV auto manufacturing.

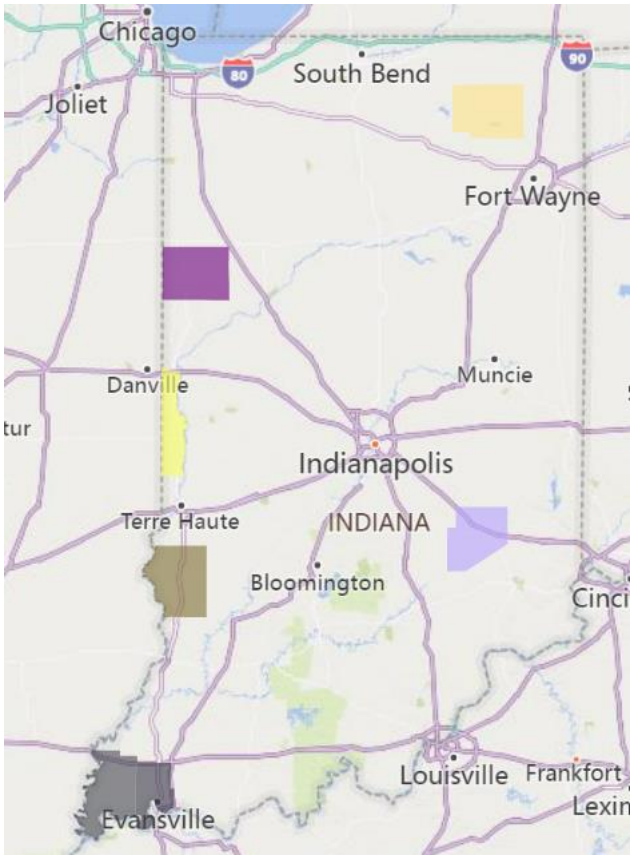
Considering the top 3 regions (Central IN, Northwest Central IN, and Northeast IN) with the highest average inertia risk (more than 0.65), there are 32 counties affected by this. This contributes to almost 50% of ICE and EV auto manufacturing employees (45%) and companies (47%).

According to the analysis, this means that if the auto companies in the three regions do nothing to transition from ICE to EV sector, they are at a more than 65% risk of being disrupted.

County-level Risk

We analyze some counties in the regions in depth. Benton County in Northwest Central Indiana, Sullivan County in West Central Indiana, and Vermillion County in West Central Indiana all have a total of less than 1,000 employees engaged in automotive manufacturing but all have a high inertia risk – greater than 75%. Decatur County in Southeast Central Indiana and Posey County in Southwest Indiana employ between 1,000 to 5,000 employees and have a moderate to low inertia risk – 37 to 59 percent. While Noble County in Northeast Indiana and Vanderburgh County in Southwest Indiana employ more than 5,000 employees and less than 10,500 employees. These counties have a moderate to high inertia risk – 46 to 71 percent. Similarly, different counties have different levels of inertia risk and have a corresponding impact on the number of companies engaged in ICE auto manufacturing and the number of employees associated with these companies. In depth, county-level analysis for all counties in Indiana will be developed and presented in the upcoming (2024) report.

Region	County	Number of Companies	Number of Employees	Inertia Risk
Northwest Central IN	Benton	10	156	0.78
Southeast Central IN	Decatur	26	3,270	0.59
Northeast IN	Noble	92	8,384	0.71
Southwest IN	Posey	16	1,910	0.37
West Central IN	Sullivan	17	144	0.81
Southwest IN	Vanderburgh	265	10,423	0.46
West Central IN	Vermillion	5	354	0.75


Chicago
South Bend
Joliet
Fort Wayne
Danville
Muncie
Indianapolis
Terre Haute
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Bloomington
Louisville
Frankfort
Evansville
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