

Methodology for Creating a Matrix to Assess the Domestic Content of a Vehicle by Make and Model

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All statements, findings, and conclusions in this report are those of the authors and do not necessarily reflect those of the American Automotive Policy Council Inc.

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Center for Automotive Research

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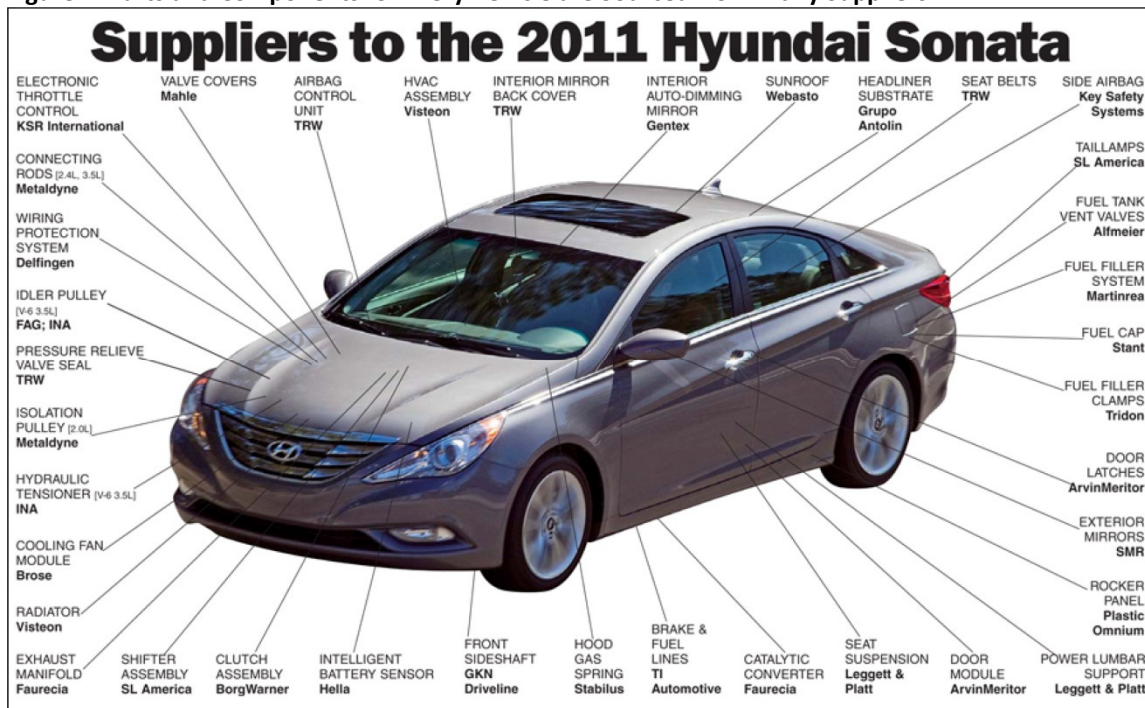
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INTRODUCTION

The contemporary automotive supply chain is long and complex, convoluting the seemingly simple question of where a vehicle was built. The typical vehicle is composed out of approximately 15,000 parts which can be sourced from all over the world.¹ Generally automakers combine automotive systems to produce a vehicle. These systems are provided by automakers themselves, as well as from Tier 1 suppliers who buy parts and components for the systems from Tier 2 suppliers, who purchase parts and components from Tier 3 suppliers and so on. For example, the 2011 Hyundai Sonata pictured in Figure 1 has many of its systems labeled with their suppliers.

Figure 1: Parts and Components for Every Vehicle are Sourced from Many Suppliers



Source: Automotive News 2010

The automakers and their many suppliers are often international companies with facilities spread across the world, making it difficult to discern how much of a vehicle is truly domestically produced. Even vehicles produced by the same automaker have different degrees of domestic content, as can be seen in Table 1, which shows examples of Ford vehicles built in the United States, Canada, and Mexico, along with the portion of their content that was derived from the United States and Canada. Neither the company nor country of assembly is indicative

¹ Klier, Thomas and James Rubenstein. (2008). "The Parts of Your Vehicle." In *Who Really Made Your Car? Restructuring and Geographic Change in the Auto Industry*. W.E. Upjohn Institute for Employment Research. Pages 1-30. <http://research.upjohn.org/up_bookchapters/2>.

of domestic content² in a particular vehicle. For example, the U.S.-built Mustang and the Canadian-built Flex both have 65 percent domestically-sourced content, while the Mexican-built Fiesta has only 10 percent domestic content.

Table 1: Domestic Content in Selected Ford Vehicles, 2011

Vehicle	% Content US/Canada	Final Assembly Country
Ford Explorer	85%	United States
Ford Crown Victoria	75%	Canada
Ford Mustang	65%	United States
Ford Flex	65%	Canada
Ford Fusion	20%	United States/Mexico
Ford Fiesta	10%	Mexico

Note: AALA data are used to estimate domestic content
Adapted from: Jones and Platzer 2011

This report develops one methodology for evaluating the domestic content of a vehicle, based on the vehicle’s make and model. Establishing the domestic content of a motor vehicle is not a straightforward matter. The complexity of the motor vehicle and the complexity of the motor vehicle industry have a combined effect that makes determining the percentage of a vehicle’s domestic content an approximation. This is an effort worth undertaking, however, as the origins of a motor vehicle affect society in a variety of ways. Consumer decisions to purchase imported motor vehicles impact employment in the U.S. industry. Automakers import parts and assemblies from which to produce locally-made vehicles, strategic business decisions that also impact employment in the U.S. industry. Furthermore, depending on the country of origin, tariff fees are collected by the government. Finally, motor vehicle fuel economies are established according to whether the vehicle is considered to be part of a domestically-produced fleet or an import fleet. To address these issues, various branches of the U.S. government have established different programs and regulations to determine a vehicle’s domestic content. These three programs are:

- 1) The North American Free Trade Agreement (NAFTA)
- 2) The American Automobile Labeling Act (AALA)
- 3) The Passenger Car Two-Fleet Rule of the Corporate Average Fuel Economy (CAFE) standards

The methodologies used by these programs provided some useful guidance in formulating the matrix methodology discussed in this report. In addition, the AALA program served as an

² The AALA classifies parts as domestic if at least 70% of their value results from production in the US or Canada.

excellent source of data that was used to develop the methodology proposed in this report. The programs employ methodologies that significantly vary in regards to the following:

- a) how domestic content is determined
- b) what geographical areas are considered to be “domestic”
- c) the availability of source data used by the program or vehicle content results information

Because of these variations, none of the programs offers a comprehensive method for determining the domestic content of a vehicle. The methodology developed in this report will use data collected through the AALA program for part of the proposed matrix. The AALA data was selected as it is more widely available than other data.

SECTION 1: VEHICLE ASSEMBLY VALUE CHAIN

The assembled value of a vehicle, as shown in Figure 2, serves as the basis for developing a matrix that can be used to determine the domestic content of a vehicle. This figure was created using a top down methodology. First, an overall estimate for the average parts and components cost per vehicle was developed. This estimate was based on U.S. NAICS production information, U.S. automotive parts trade data, and total U.S. light vehicle production. Next the distribution of those costs across vehicle subsections was estimated. To determine the distribution of component costs across the vehicle, CAR leveraged similar studies that had been conducted in the past and adjusted vehicle cost distribution results for ongoing vehicle cost trends.³

The percentages of contribution to vehicle value for the variables used in Figure 2 are not constant percentages for every automaker or vehicle model. For example, luxury cars typically offer greater profit margins for automakers than do economy cars.⁴ The variables and values listed in the figure represent overall industry averages for 2010.

Figure 2 does not include all consumer costs to purchase a new vehicle. Consumer costs that are excluded are transportation costs, dealership costs, and profits. Because the majority of cars purchased by consumers are sold by dealers located in the U.S., dealership fees that are paid by consumers do not impact the domestic content calculation of a vehicle.⁵

³ McAlinden, Sean P. and David J. Andrea. (2002). "Estimating the New Automotive Value Chain." Center for Automotive Research, Altarum. Prepared for the Original Equipment Supplier Association. November 2002. <http://centerforautomotiveresearch.com/pdfs/CAR2002_7.pdf>.

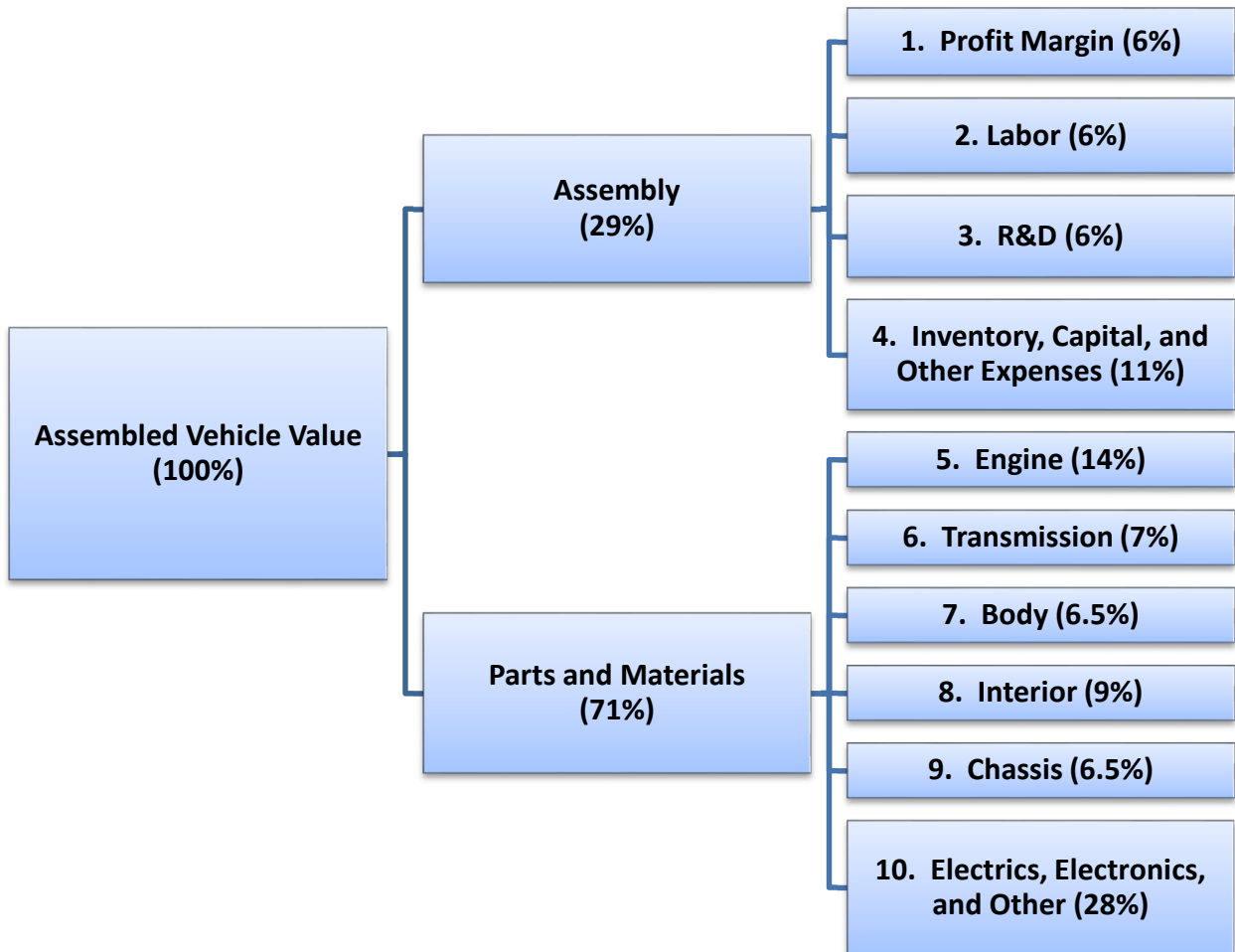
CAR (2010). Unpublished Report. Center for Automotive Research.

⁴ Anecdotal evidence prior to 2009 suggested that large SUVs – popular at the time – provided the automakers with profits per vehicle of \$10,000+ while some economy models were sold at a loss.

Maranger Menk, Debbie; Mark Birmingham; Yen Chen; Richard Li; Bernard Swiecki; and Sean McAlinden. (2008). "Country of Origin: Is this Vehicle Domestic or Import? The U.S. Domestic Content Measurement Programs." Center for Automotive Research. April 2008. <<http://acp.cargroup.org/images/stories/Publications/8Study-Part-1-White-Paper-FINAL.pdf>>.

⁵ Some cars are imported directly by their new owners or sold directly by niche automaker companies, but the majority of new vehicles sold in the U.S. are sold through franchised dealerships.

Figure 2: Vehicle Value Chain



Source: Center for Automotive Research 2012

Item 1. Assembly – Profit Margin

Share of Vehicle Value: 6%
Variable used to determine domestic content share: Location of company headquarters

Source: Annual reports, U.S. Economic Census

Assigning the value of the profit margin based on the assembler’s headquarters location recognizes that a certain percentage of the vehicle’s price goes to the producer’s headquarters. Actual profit margins vary from year to year and from company to company. This report recommends 6% as a benchmark profit margin, but this percentage does not represent, in particular, any individual model or company’s profit margin.

Item 2. Assembly – Labor

Share of Vehicle Value: 6%

Variable used to determine domestic content share: Final assembly plant location
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Source: AALA; Vehicle VIN

Labor costs associated with the assembly of vehicles are tied to the vehicle’s final assembly plant location. Assembly labor cost includes production workers’ wages, overtime and paid absences, employer-paid healthcare insurance costs, employer-paid pension contributions, employer-paid defined contributions, and other fringe benefits and labor costs. All of these expenditures tend to be specific to the location of the assembly plant.

Item 3. Assembly – Research and Development

Share of Vehicle Value: 6%

Variable used to determine domestic content share: R&D headquarters location and R&D regional facility locations
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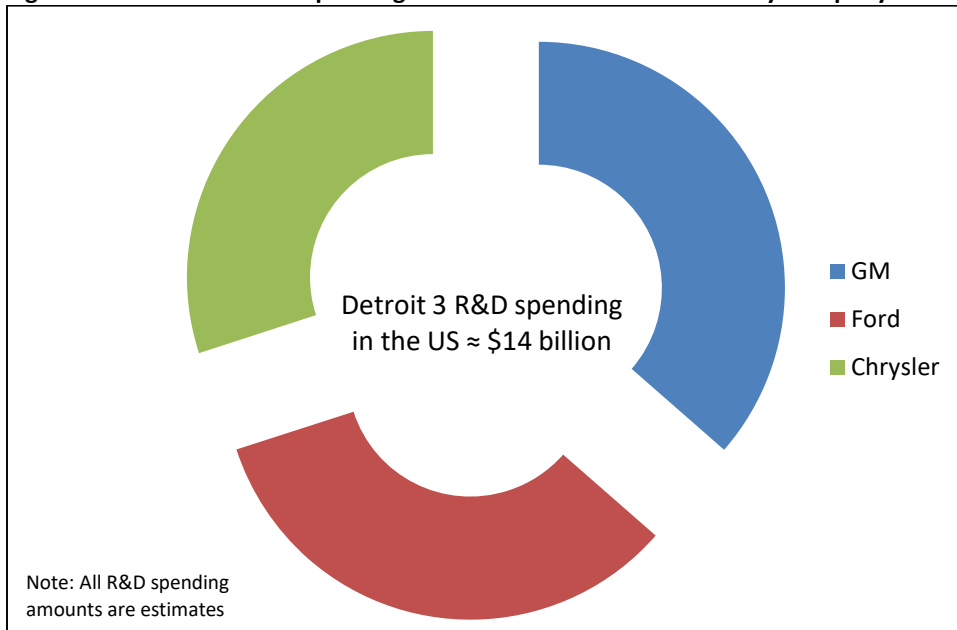
Source: Annual reports; Company 10-K filings

For a model built on a global platform, the majority of R&D spending attributed to that model should be attributed the automaker’s R&D headquarters. For a model built on a regional platform, the majority of R&D spending attributed to that model should be attributed the automaker’s regional R&D facility. For instance, the three domestic automakers, Chrysler, Ford, and General Motors, spend the bulk of their R&D budget in the United States. The three companies perform approximately 80 percent of all R&D (which amounts to about \$14 billion) and 60 percent of global platform R&D in the United States.⁶ The graphic shown in Figure 3 displays estimates for R&D spending within the U.S. for domestic automakers. Table 2 displays global and U.S. R&D spending estimates for 2008.

⁶ LFI. (2009). “American Auto Jobs Matter: The Facts You Need to Drive the Message Home.” Level Field Institute. 2009. <http://www.levelfieldinstitute.org/files/champion_kit.pdf>.

CAR. (2012). Internal Research.

Figure 3: Automotive R&D Spending Estimates in the United States by Company



Sources: NSF 2009, LFI 2009, Center for Automotive Research 2012

Table 2: Estimates of Global and U.S. Detroit Three Automotive R&D Spending, 2008

Company	Global R&D (billions)	US R&D (billions)
GM	\$6.0	\$5.1
Ford	\$4.9	\$4.7
Chrysler	\$4.7	\$4.2

Source: NSF 2009, LFI 2009, Center for Automotive Research 2012

Item 4. Assembly – Inventory, Capital, and Other Expenses

Share of Vehicle Value: 11%
Variable used to determine domestic content share: Final assembly plant location

Source: AALA; Vehicle VIN

Assembler inventories, capital, and other expenses are mainly tied to a vehicle’s final assembly plant location. Inventories include finished goods, work-in-process goods, materials and supplies. Capital expenditures include investments in buildings, structures, machinery, equipment, transportation equipment, computers, software, and other equipment. Other expenses include depreciation, rents, purchased services, repair and maintenance, interest,

advertising, taxes, licenses, and other expenses. All of these expenditures tend to be specific to the location of the assembly plant.

Item 5. Parts and Materials – Engine

Share of Vehicle Value: 14%
Variable used to determine domestic content share: Engine plant location

Source: AALA

Based on research performed by CAR and the Original Equipment Suppliers Association (OESA), the engine represents approximately 14 percent of the value of an assembled vehicle and the price that is paid to the vehicle producer.⁷ Because this percent represents the value paid to the producer, it does include a profit margin. The profit most likely accrues to the producer’s headquarters location, so for engines made in the U.S. by international companies, the domestic value of the engine may be overstated. As with all of the other values recommended, this percentage is an industry average and does not represent a specific vehicle model or automaker company.

Item 6. Parts and Materials – Transmission

Share of Vehicle Value: 7%
Variable used to determine domestic content share: Transmission plant location

Source: AALA

Based on research performed by CAR and the Original Equipment Suppliers Association (OESA), the transmission system represents approximately 7 percent of the value of an assembled vehicle and the price that is paid to the vehicle producer. Because this percent represents the value paid to the producer, it does include a profit margin. The profit most likely accrues to the producer’s headquarters location, so for transmission systems made in the U.S. by international companies, the domestic value of the transmission system may be overstated. As with all of the other values recommended, this percentage is an industry average and does not represent a specific vehicle model or automaker company.

⁷ Andrea, David J. (2011). “The Automotive Recovery – Why This Time is Different (or not)” Original Equipment Suppliers Association. Presentation at the University of Michigan Economic Outlook Conference. November 18, 2011. <<http://rsqe.econ.lsa.umich.edu/>>.

McAlinden, Sean P. and David J. Andrea. (2002).

Items 7 – 10. Parts and Materials – Body, Interior, Chassis, Electrics, Electronics, and Other

Share of Vehicle Value: 50%

Variable used to determine domestic content share: AALA domestic content percentage

Source: AALA

The parts and material that are used by the assembly plant to make a vehicle, excluding the engine and transmission system, consist of approximately 50 percent of the vehicle's value as it leaves the assembly plant. Major parts and component systems include: vehicle body and stamping parts, interior trim, electronic equipment, chassis, brakes, wheels, tires, electrical systems and all other purchased parts and material. Most of these parts and materials are purchased from independent suppliers. The AALA has specific reporting guidelines for each supplier, each component system and each part. The AALA label information can be used to assign domestic content value for all of the parts and materials that comprise the vehicle. The caveat with AALA data is that Canadian-made components, parts and materials are considered to be "domestic".

SECTION 2: SAMPLE MATRIX FOR DETERMINING DOMESTIC CONTENT

This section provides an example of how the proposed matrix could be used to determine the domestic content of various vehicle models. Table 3 below shows the results of calculating the domestic content of a vehicle for a sampling of vehicles using actual data from the 2011 AALA database.

Table 3: Sample Matrix Using 2011 AALA Data

Vehicle				Assembly				Parts and Materials			Total
Company	Make/Model	Country of Assembly	AALA % 2011	Profit Margin	Labor	R&D	Inventory, Capital, Other Expenses	Engine	Transmission	Body, Interior, Chassis, Electrical and Electronics, Other	Domestic Content
				6%	6%	6%	11%	14%	7%	50%	100
Toyota	Avalon	USA	85	0	6	3	11.0	14.0	7.0	42.5	83.5
Honda	Crosstour	USA	80	0	6	3	11.0	14.0	7.0	40.0	81.0
Ford	Expedition	USA	80	6	6	6	11.0	14.0	7.0	40.0	90.0
GM	Acadia	USA	76	6	6	6	11.0	14.0	7.0	38.0	88.0
Chrysler	Jeep Liberty	USA	76	6	6	6	11.0	14.0	7.0	38.0	88.0
VW	Routan	CAN	75	0	0	1	0.0	14.0	7.0	37.5	59.5

SECTION 3: DATA CAVEATS AND LIMITATIONS

This section covers several limitations related to the use of the AALA data to estimate domestic content of parts in the proposed matrix. The limitations discussed include the inclusion of Canadian-manufactured parts, aftermarket parts, and engine and transmission parts.

Canadian-Manufactured Parts

In 2010, the U.S. produced \$168.3 billion in motor vehicle parts. In the same year, the U.S. exported \$25.8 billion (15.3% of the total value of automotive parts manufactured in the U.S.) of these parts to Canada. In particular, Canada constituted a major trade partner in regards to automotive parts. The U.S. also imported \$14.5 billion in parts from Canada in 2010, resulting in a bilateral trade surplus in net exports of \$11.2 billion. Given this trade surplus, the inclusion of Canadian-made parts in the AALA data should have minimal impact on the determination of actual domestic (meaning U.S. only) content.

Aftermarket Parts

A further consideration in analyzing the data is that all production data, whether for total production of parts or trade data, includes parts produced for after-market sales in retail stores and at dealership repair centers. Since parts produced for the after-market are not inputs for the manufacture of motor vehicles, their inclusion in the underlying data sources could skew the estimate of the proportion of parts that are both domestically-produced and used in the assembly of motor vehicles. For example, if the U.S. primarily exported auto parts to Canada for after-market sales, but imported primarily parts to be used in assembling new motor vehicles, then it would be incorrect to assume that having a trade surplus in parts should mean that the AALA domestic parts content percentage represents largely U.S. made parts. The proportion of aftermarket parts involved in U.S.-Canada auto trade is not known, but given that vehicles are assembled in both countries, it is unlikely that a majority of uni-directional trade is for aftermarket use.

Engine and Transmission Parts

The data used by the proposed matrix to estimate domestic content for parts is provided through automaker compliance with the AALA. In theory, the percent content portion of the label provides the domestic content percent value for parts only, excluding the engine and transmission, and does not include value added by vehicle assembly.⁸ As a component-by-component breakdown is not readily available, CAR researchers have been unable to determine

⁸ Maranger Menk, Debbie; Mark Birmingham; Yen Chen; Richard Li; Bernard Swiecki; and Sean McAlinden. (2008).

whether or not parts and components used in engine and transmission production were included in the AALA domestic content estimate for parts.

As engine and transmission content are calculated separately under AALA, the assumption in this paper has been that engine and transmission components are not included in the domestic content estimates for parts. This section, however, examines the effect that including engine and transmission parts in the estimate would have on the accuracy of the proposed matrix. While the format of the AALA implies that the domestic content figure should be based upon the value of parts and components, excluding those used in the engine and transmission systems, this is not explicitly stated. As such, there is a possibility that some manufacturers are including the engine and transmission components in their percent domestic content figures, while other manufacturers are not doing so.

To account for this possibility, CAR researchers have prepared some estimates of how domestic content figures may change based upon the inclusion or exclusion of engine and transmission components. For an average vehicle, the engine represents 18.7 percent of the total parts value of the vehicle, while the transmission accounts for 7.6 percent. Together, the engine and transmission account for 26.4 percent of the total parts value.⁹ For an average vehicle, the total value of all its parts and components is \$14,950; the value of its engine is \$2,800 (18.73 percent of the total parts value); and the value of the transmission is \$1,140 (7.63 percent of the total parts value). When the engine and transmission are excluded, the value of the remaining parts is \$11,010 (73.65 percent of the total parts value). A summary of these values can be seen in

Table 4 below.

Table 4: Per Vehicle Average Parts and Components Costs

Parts Category	\$ Value	Percentage of Total Parts Value
Engine and Transmission	\$3,940	26.35%
Engine	\$2,800	18.73%
Transmission	\$1,140	7.63%
Remaining Parts	\$11,010	73.65%
Total	\$14,950	100.00%

As previously stated, it has otherwise been assumed for this study that AALA values do not include engine and transmission parts and components. If, counter to this assumption, engine and transmission parts were included, the content of these parts could affect overall domestic

⁹ Census (2012). "2007 Economic Census" United States Census Bureau, U.S. Department of Commerce. Accessed April 26, 2012. <<http://www.census.gov/econ/census07/>>.

content of parts. For instance, if a vehicle had engine and transmission systems that were primarily domestically sourced, and these systems were included in the percentage of domestic content figures submitted for the AALA, the true domestic content of its remaining parts (excluding engine and transmission parts) might be much lower than the domestic content reported to AALA. Conversely, if a vehicle had engine and transmission systems that were primarily imported, and these systems were included in the percentage of domestic content figures submitted for the AALA, the true domestic content of its parts (excluding engine and transmission parts) might be much higher than the domestic content reported to AALA.

To illustrate the potential effect that the inclusion of engine and transmission parts could have on AALA reported domestic parts content, CAR researchers generated potential upper and lower bounds for the true domestic content of parts, excluding engine and transmission parts compared to the AALA reported values. As the figures used to generate these bounds represent an average vehicle, adjustments have been only applied to fleet averages, as adjusting the domestic content figures of individual vehicles would likely result in extreme bias. The upper and lower bounds for three automakers can be seen in Table 5.

Table 5: Potential Upper and Lower Bounds for True Domestic Content of Parts

Manufacturer	2011 Model Year, Fleet Average AALA Domestic Parts Content	Lower Bound	Upper Bound
Ford	52.05%	34.89%	70.68%
GM	57.83%	42.74%	78.52%
Toyota	25.00%	0%	33.95%
Overall (Ford+GM+Toyota)	45.52%	26.02%	61.81%

The lower bound of the resulting interval indicates the minimum domestic parts content for parts (not including engine and transmission parts), if the automaker is actually including engine and transmission parts in the AALA estimate and all engine or transmission parts are produced domestically. The upper bound indicates the maximum domestic parts content for parts (not including engine and transmission parts), if the automaker is actually including engine and transmission parts in the AALA estimate and no engine or transmission parts are produced domestically.

The bounds shown in Table 5 demonstrate that if the assumption that all automakers are excluding engine and transmission parts from their domestic content estimates is incorrect, that AALA domestic content values for parts could be dramatically affected. While an automaker’s inclusion of engine and transmission parts in the AALA estimates could potentially affect domestic content values for parts dramatically, a more detailed breakdown is not currently available.

SECTION 4: DOMESTIC CONTENT PROGRAMS

This section discusses programs that are already in place to measure domestic content of vehicles. The three domestic content regulation programs that have been discussed in this report include NAFTA, AALA, and CAFE.

The entry of international automakers into the U.S. market, combined with the North American production of international automakers' products, has had a large effect on the domestic content of vehicles sold in the United States. At the same time, the D3 have engaged in international activities complicating the determination of domestic content. These activities include establishing partnerships with international automakers, purchasing entire overseas companies, selling international automakers' products under their own brands, and buying imported parts.

The evolution of the industry is not limited to automakers. Like their customers, automotive suppliers have undergone a tremendous transformation. The automotive supplier sector has undergone a major consolidation. Suppliers have grown through mergers and acquisitions to become large, global companies able to follow their customers to manufacturing locations around the world. Consequently, tracing the origin of the components in a given vehicle has become much more complex.

The ever-growing role of suppliers in motor vehicle manufacturing further complicates the process of determining the domestic content of a given vehicle. The shift to broader use of modular sourcing, which requires Tier 1 suppliers to deliver complex modules that include a high percentage of parts made by other suppliers, has made it significantly more difficult to track the origin of automotive content. Since a vehicle contains between ten and fifteen thousand discrete parts, the tracking this information would require considerable effort.

As cars become more complex, they require more engineering and development. The various locations in which a car is developed, engineered, and designed further convolute efforts to determine the domestic content of the car. These complications are not addressed by the regulations discussed in this report. Furthermore, many of the components that make up a vehicle require significant value added in processing (e.g., machining, etc.). The three domestic content regulation programs (NAFTA, AALA, and CAFE) use different approaches to determine the value these processes add to different motor vehicle models.¹⁰

¹⁰ Maranger Menk, Debbie; Mark Birmingham; Yen Chen; Richard Li; Bernard Swiecki; and Sean McAlinden. (2008).

Table 6: Comparison of Three Sets of Regulations Used in Determining Domestic Content

REGULATION	AALA	NAFTA	CAFE/EPA
Rule applies to:	Parts only	Entire vehicle	Entire vehicle
Vehicle is considered domestic if:	>70%	62.5% NAFTA origin	75.0% NAFTA origin
Method for content determination:	Transaction value	Net cost basis (excl selling, mktg, shipping)	Cost to manufacturer, all-in
Domestic Content may be sourced from:	US and Canada	US, Canada, and Mexico	US, Canada and Mexico
Data publically available?	Yes	No	Limited
Reporting requirements:	Data must be submitted to NHTSA by date first vehicle of carline is offered for sale to ultimate purchaser.	Upon import to Customs	Filed 30 days before Model Year begins as part of fuel economy reporting. Also provided as part of product plan filed by manufacturer with U.S. Dept. of Transportation.
Other:	Separate, less detailed, labeling rules for assembly, engine, and transmission		

North American Free Trade Agreement (NAFTA)

Under NAFTA, a motor vehicle must have at least 62.5 percent regional value content to cross national borders between Canada, the U.S. and Mexico without paying a tariff. Motor vehicle parts must have at least 60.0 percent regional value content to qualify for duty-free status. Regional value content is the value of content produced or added in Canada, Mexico or the United States.

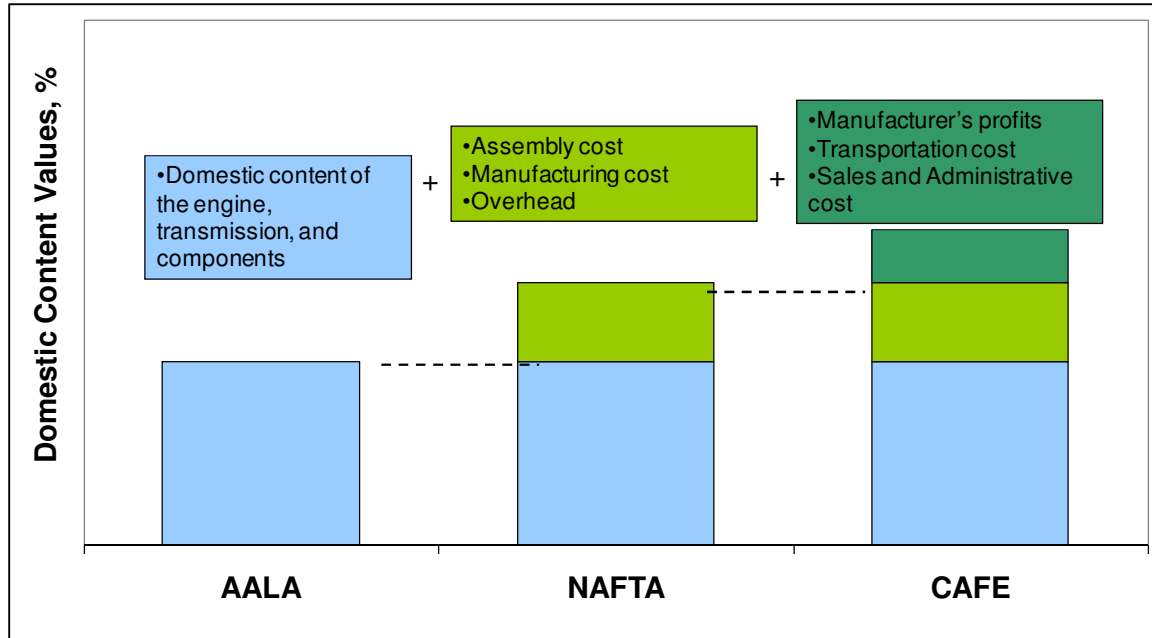
American Automobile Labeling Act (AALA)

The American Automobile Labeling Act requires that the vehicle be labeled with its domestic content percentage as well as the percentage of foreign-made content. Domestic content is considered to be content added or produced in Canada or the United States, but not Mexico.

Passenger Car Two-Fleet Rule of the Corporate Average Fuel Economy (CAFE) Standards

Each manufacturer must divide its vehicle lines into two fleets – domestic and foreign – for the purpose of meeting current minimum CAFE standards. For a carline to be considered domestic, it must have a minimum of 75.0 percent of domestic content. Domestic content (in this case) is content that is produced or added in Canada, Mexico or the United States.

Figure 4: Theoretical Domestic Content Percentages for the Same Vehicle, As Measured by the Three Sets of Domestic Content Regulations



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APPENDIX A: ACRONYMS AND ABBREVIATIONS

AAALA – American Automobile Labeling Act

CAFE – Corporate Average Fuel Economy

CAR – Center for Automotive Research

NAFTA – North American Free Trade Agreement

OESA – Original Equipment Suppliers Association