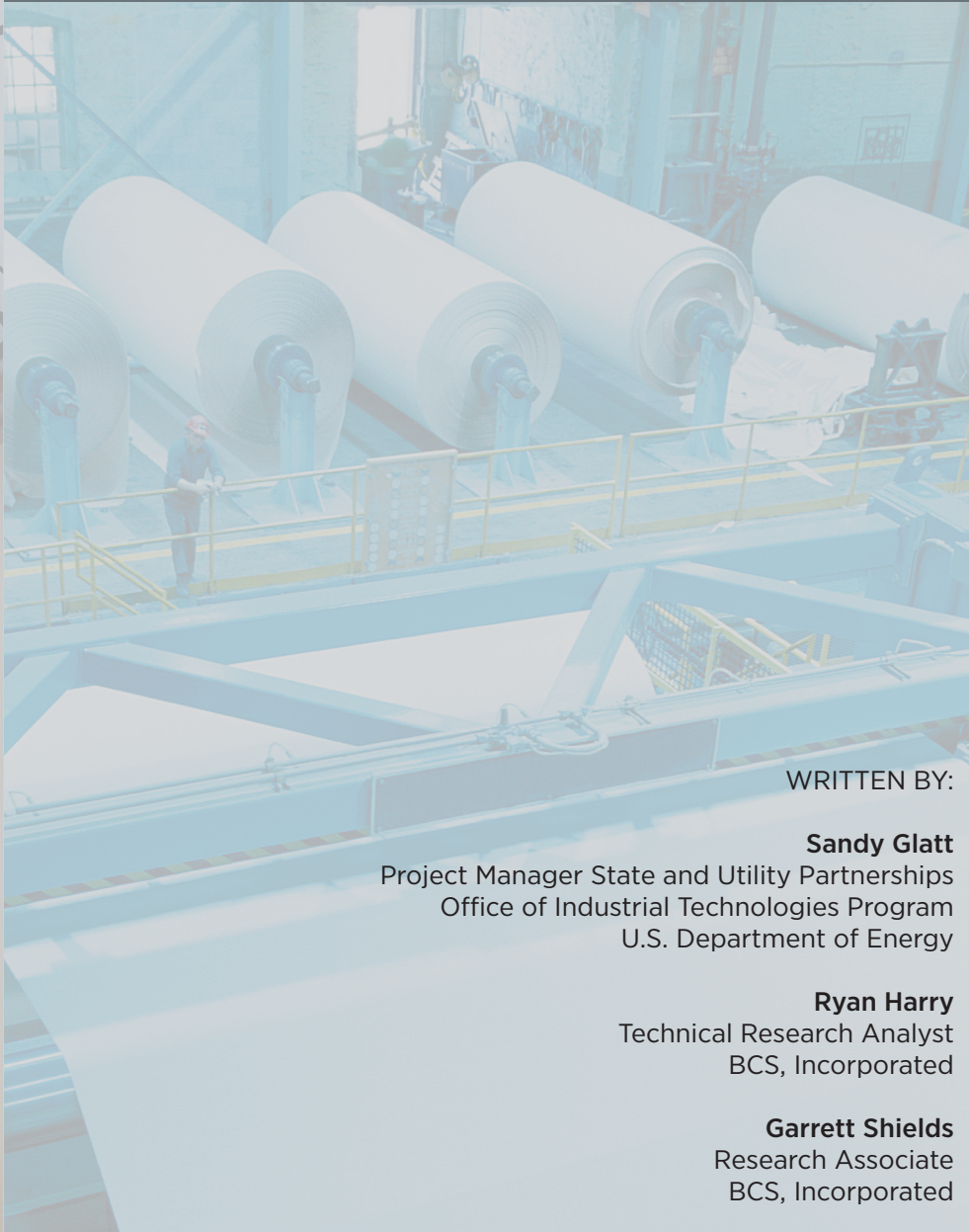


# Energy Efficiency as a Resource: West Region

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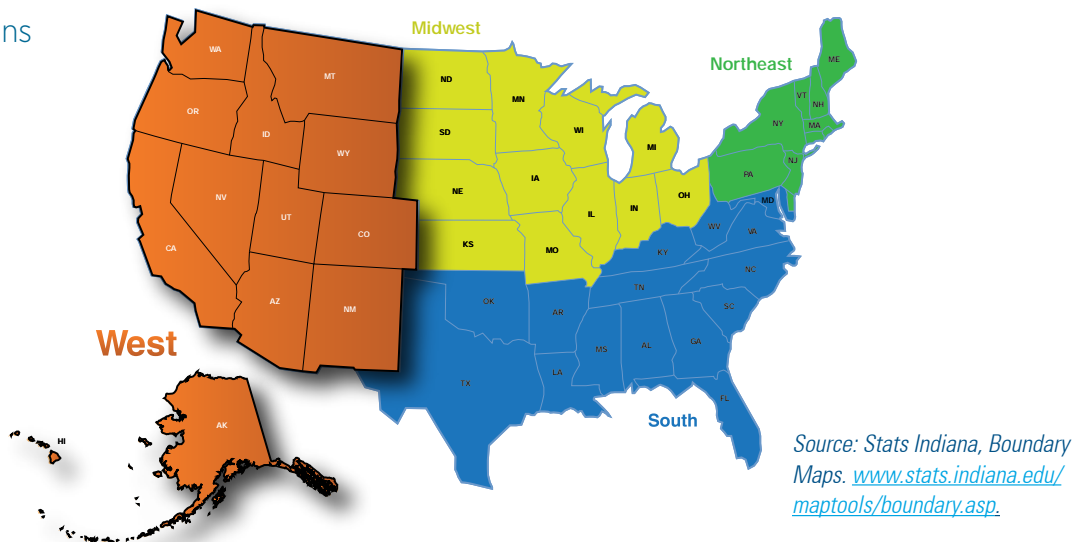
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Exhibit 1:  
U.S. Census Regions



Source: Stats Indiana, Boundary Maps. [www.stats.indiana.edu/maptools/boundary.asp](http://www.stats.indiana.edu/maptools/boundary.asp).

### 1. West Regional Energy Intensity

The Western United States is one of four regions defined by the U.S. Census Bureau (Exhibit 1). The West is composed of the following states:

- Alaska
- California
- Hawaii
- Montana
- New Mexico
- Utah
- Wyoming
- Arizona
- Colorado
- Idaho
- Nevada
- Oregon
- Washington

The West leads the nation in terms of value of shipments in a select number of manufacturing sectors. In 2006, these leading industries included apparel, computer and electronic products, and miscellaneous. Exhibit 2 provides value of shipment

data for the four census regions that make up the U.S. manufacturing sector. Highlighted rows are where the West led the nation in product shipments in 2006.

Unlike the Midwest and the South, where many of the leading industries experience relatively high energy intensities, the West’s energy intensity is below the national average for all of the industries in which it leads the nation in terms of value of shipments. This stems in part from the higher energy prices in the West in comparison to the South and the Midwest. Despite having lower-than-average energy intensities in many of its industrial sectors, the West still experiences significantly higher-than-average energy intensities in several important sectors and subsectors. The sectors and subsectors in which the disparity in intensity results in the greatest overuse of energy include dairy products, beverage and tobacco product manufacturing, animal slaughtering and processing,

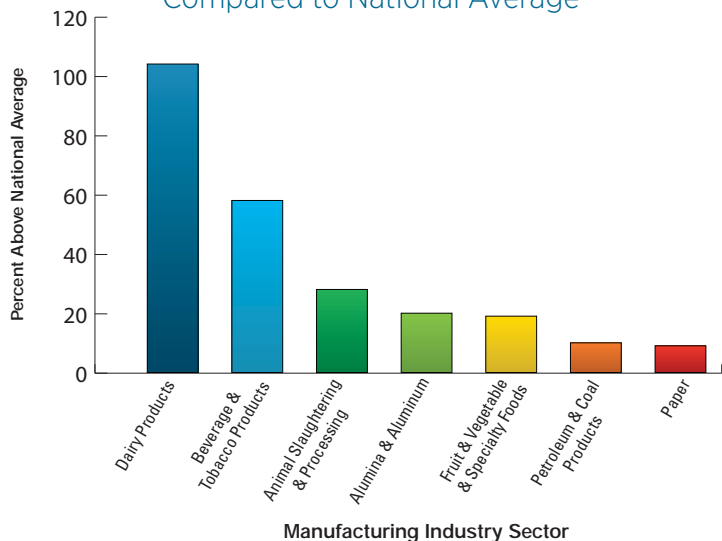
Exhibit 2: 2006 Value of Shipments across Each Census Regions

NAICS Code	Manufacturing Sector Description	Value of Shipments by Census Region (\$1,000s)			
		Midwest	Northeast	South	West
311	Food	\$204,666,920	\$65,793,261	\$167,671,682	\$98,574,804
312	Beverage & Tobacco Products	\$17,311,076	\$10,376,689	\$67,096,187	\$24,179,977
313	Textile Mills	\$1,098,299	\$4,963,887	\$27,712,405	\$1,970,605

NAICS Code	Manufacturing Sector Description	Value of Shipments by Census Region (\$1,000s)			
		Midwest	Northeast	South	West
314	Textile Product Mills	\$2,735,095	\$3,349,553	\$22,290,390	\$3,322,493
315	Apparel	\$1,613,014	\$6,799,668	\$9,979,108	\$10,774,562
316	Leather & Allied Products	\$1,416,708	\$1,144,563	\$689,199	\$832,329
321	Wood Products	\$23,771,713	\$11,108,678	\$48,983,012	\$28,098,923
322	Paper	\$47,115,379	\$28,350,897	\$69,716,583	\$20,686,685
323	Printing & Related Activities	\$35,013,054	\$21,770,053	\$25,769,420	\$16,141,181
324	Petroleum & Coal Products	\$81,870,541	\$46,307,975	\$275,272,040	\$91,124,660
325	Chemicals	\$138,746,405	\$122,465,240	\$342,698,414	\$51,185,822
326	Plastic & Rubber Products	\$75,452,678	\$29,422,093	\$79,933,459	\$26,167,217
327	Nonmetallic Mineral Products	\$32,037,818	\$17,491,499	\$50,065,523	\$25,597,119
331	Primary Metals	\$92,601,422	\$40,650,773	\$77,814,960	\$21,484,148
332	Fabricated Metal Products	\$118,929,503	\$52,537,662	\$99,115,323	\$46,303,596
333	Machinery	\$143,226,056	\$44,898,571	\$104,749,626	\$33,294,459
334	Computer & Electronic Products	\$62,566,287	\$64,150,714	\$118,927,414	\$144,802,804
335	Electrical Equipment & Appliances	\$43,387,114	\$19,417,128	\$44,584,064	\$11,071,376
336	Transportation Equipment	\$331,468,454	\$45,738,269	\$225,728,247	\$95,807,598
337	Furniture	\$27,548,271	\$10,243,628	\$32,353,880	\$14,888,967
339	Miscellaneous	\$37,948,982	\$37,022,053	\$34,738,984	\$39,342,698

Source: U.S. Census Bureau, 2006 Annual Survey of Manufactures, Stats for All Mfg by State. [http://factfinder.census.gov/servlet/DatasetMainPageServlet?\\_program=EAS&\\_tabId=EAS1&\\_submenuId=datasets\\_5&\\_lang=en&\\_ts=266925692376](http://factfinder.census.gov/servlet/DatasetMainPageServlet?_program=EAS&_tabId=EAS1&_submenuId=datasets_5&_lang=en&_ts=266925692376).

Exhibit 3: 2006 West Energy Intensity Compared to National Average



Sources: U.S. Census Bureau, 2006 Annual Survey of Manufactures, Stats for All Mfg by State. [http://factfinder.census.gov/servlet/DatasetMainPageServlet?\\_program=EAS&\\_tabId=EAS1&\\_submenuld=datasets\\_5&\\_lang=en&\\_ts=266925692376](http://factfinder.census.gov/servlet/DatasetMainPageServlet?_program=EAS&_tabId=EAS1&_submenuld=datasets_5&_lang=en&_ts=266925692376). Energy Information Administration, 2006 Manufacturing Energy Consumption Survey, Table 1.2. [www.eia.doe.gov/emeu/mecs/mecs2006/2006tables.html](http://www.eia.doe.gov/emeu/mecs/mecs2006/2006tables.html).

alumina and aluminum production and processing, fruit and vegetable and specialty food manufacturing, petroleum and coal product manufacturing, and paper manufacturing. Exhibit 3 details the relative energy intensity of these industries compared to the national average.

This lower-than-average energy intensity in the West is partly a result of higher-than-average energy prices across the West region (Exhibit 4). The West’s energy prices are \$1.87 per million Btu more than the average energy price in the Midwest and \$1.73 per million Btu more than the average price in the South. Higher energy prices tend to curb greater energy consumption, and energy-intensive industries will seek to operate in geographical regions where energy prices are low. This is because the industries that use large amounts of energy can significantly reduce their costs by simply locating near large sources of cheap energy. This helps to explain why many of the energy-intensive industries are not located in the West and why the West tends to have a lower-than-average energy intensity in most sectors. Despite

these tendencies, though, there are some anomalies where the West experiences higher-than-average energy intensities in spite of the higher energy prices. investing in these technologies. In addition, energy prices are the most significant point of reference in considering cost avoidance. Electricity and natural gas prices are especially important because these energy sources are the most widely used. These prices vary greatly depending on geographic location and must be considered on a regional and state basis. Energy costs will lower by reducing the amount of energy generation and transmission that occurs. Furthermore, pending carbon legislation in the United States also proposes the reduction of energy supply value compared to energy demand savings over the long term as the pending legislation would increase the price of energy and the cost of using energy.

Aggregating the short- and long-term energy savings means a more profitable and competitive Midwestern industrial manufacturing sector, both now and in the future. Additionally, investing in energy efficiency will insulate Midwest industry from fossil energy price volatility and shocks, such as Hurricane Katrina’s effect on natural gas prices in 2005 and 2006. For utilities, using energy efficiency instead of traditional energy supply means energy needs can be met by making small, incremental investments in

Exhibit 4: 2006 Regional Average Industrial Energy Prices

Region	Average Industrial Sector Energy Price (\$/Million Btu)
Midwest	\$10.85
Northeast	\$13.51
South	\$10.99
West	\$12.72

Source: Energy Information Administration, State Energy Data System, Tables S6 and S4a, November 2008. [www.eia.doe.gov/emeu/states/seds.html](http://www.eia.doe.gov/emeu/states/seds.html).

\* Energy intensity is the measure of energy consumed, in British Thermal Units (Btu), per dollar of gross domestic product (GDP) earned. GDP is equivalent to the value added to a manufactured good.

energy efficiency rather than large, risky investments in energy supply. Pending carbon legislation would further increase the need for non-emitting energy resources that would be increasingly expensive for utilities to own and operate. Meeting state and national energy consumption and greenhouse gas emissions goals will also become increasingly important.

This report will detail five Western manufacturing sectors that have higher-than-average intensities overall or have subsectors with significantly higher intensities. The first sector this report examines is food manufacturing, where the subsectors of dairy products, animal slaughtering and processing, and fruit and vegetable preserving and specialty food manufacturing have higher-than-average energy intensities. The other sections in this report will highlight petroleum and coal product manufacturing, beverage and tobacco product manufacturing, the subsector of alumina and aluminum production and

processing within primary metals production, and paper manufacturing. The report will provide detailed information on manufacturing industry subsectors and identify key energy-saving opportunities. Based on 2006 U.S. Census Bureau (Census) and Energy Information Administration (EIA) data, the five Western manufacturing sectors could have reduced energy consumption by approximately 144 trillion Btu<sup>¥</sup> and saved approximately \$1.83 billion<sup>+</sup> in energy costs during 2006 at the \$12.72-per-million Btu level. See Appendices A and B for detailed energy-consumption data.

### 1.1 Food Manufacturing (NAICS 311)

Although the food industry in the West, as a whole, is 4 percent below the national average in terms of energy intensity (shown in Exhibit 5), there are several subsectors<sup>1</sup> within the food industry in which the West has energy intensities that are significantly higher than the national average for those subsectors. These food subsectors include dairy products, animal

Exhibit 5: 2006 Western Food Production Summary

Description (NAICS Code)	Percentage of Total Shipments	Estimated West Energy Intensity (Btu/\$GDP)	Estimated National Energy Intensity (Btu/\$GDP)	Percent above or below National Average
Food Manufacturing (311)	100.0%	4,864	5,081	-4.3%
Grain and Oilseed Milling (3112)	3.0%	7,221	15,870	-54.5%
Foundries (3315)	20.1%	10,418	8,961	16.3%
Fruit and Vegetable Preserving and Specialty Food Manufacturing (3114)	18.2%	7,206	6,094	18.3%
Dairy Product Manufacturing (3115)	17.1%	11,001	5,391	104.1%
Animal Slaughtering and Processing (3116)	13.5%	5,882	4,300	36.8%

Note: Subsector percentages may not total to 100 percent due to census data withholding. Some subsectors with incomplete data have been omitted from the table. See Appendix A for more detailed West data and Appendix B for more detailed national data. Appendices A and B also contain additional notes on data.

<sup>¥</sup> Potential energy savings is determined by: Energy Consumed - Energy Consumed / (1 + Percent Difference of West Energy Intensity from National Average) = Energy Savings Potential. This estimate is used throughout the report.

<sup>+</sup> Potential cost savings are determined by: Energy Savings Potential x \$12.72 per Million Btu = Cost Savings. This savings assumes an average West energy cost of \$12.72 per million Btu as illustrated in Exhibit 4. This estimate is used throughout the report.

slaughtering, and fruit and vegetable preserving and specialty food processing and products. Exhibit 5 shows detailed information on energy intensity within the food industry, including details for the subsectors.

### 1.1.1. Dairy Product Manufacturing (NAICS 3115)

In 2006, the West was responsible for 24 percent of the nation’s dairy product manufacturing, making it the second largest in terms of value of shipments, after the Midwest (Exhibit 5). California had the largest share of the dairy industry within the West, accounting for over 62 percent of the region’s total dairy product manufacturing shipments.<sup>2</sup>

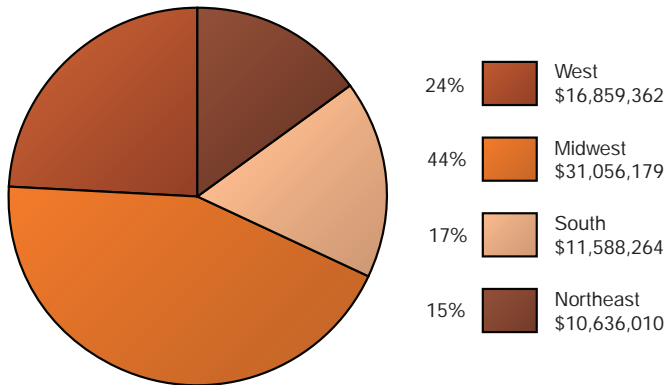
Exhibit 7 illustrates the dairy product industry in the West as having an energy intensity 104 percent above the national average. This is a surprisingly large difference when considering that dairy production

constitutes over 17 percent of the West’s food sector, and the food sector overall remains 4 percent below the national average energy intensity. This implies there are other food industry subsectors that have energy intensities significantly lower than their national average that counteract the effect of the dairy industry’s high energy intensity.

The data in Exhibit 7 implies that the dairy industry is significantly hampering the overall food industry in the West from achieving a lower energy intensity average. Improvements in energy intensity with dairy production would allow the West to further cement its position as a leader in energy efficiency with food manufacturing.

A portion of the high energy intensity is a result of the relatively low product value of Western dairy product shipments, which can be seen from the disparity between Western and national *GDP–Material Input* ratios (Exhibit 8). Even if the value of shipments were normalized to account for this, the West’s dairy

Exhibit 6: 2006 National Dairy Product Shipments  
(IN THOUSANDS OF DOLLARS)



Source: U.S. Census Bureau, 2006 Annual Survey of Manufactures, Stats for All Mfg by State. [http://factfinder.census.gov/servlet/DatasetMainPageServlet?\\_program=EAS&\\_tabId=EAS1&\\_submenuId=datasets\\_5&\\_lang=en&\\_ts=266925692376](http://factfinder.census.gov/servlet/DatasetMainPageServlet?_program=EAS&_tabId=EAS1&_submenuId=datasets_5&_lang=en&_ts=266925692376).

Exhibit 8: Dairy Products *GDP–Material Input Ratio*

Description (NAICS code)	West <i>GDP–Material Input Ratio</i>	National <i>GDP–Material Input Ratio</i>
Food Manufacturing (311)	0.78	0.77
Dairy Product Manufacturing (3115)	0.39	0.44

See Appendix A for more detailed West data and Appendix B for more detailed national data.

Exhibit 7: 2006 Western Dairy Production Summary

Description (NAICS Code)	Percentage of Total Shipments	Estimated West Energy Intensity (Btu/\$GDP)	Estimated National Energy Intensity (Btu/\$GDP)	Percent above or below National Average
Dairy Product Manufacturing (3115)	17.1%	11,001	5,391	104.1%

Note: Information taken from the table in Exhibit 5.

industry would still use significantly more energy to produce its products compared to the rest of the nation.

If the dairy subsector used energy at the same rate as the rest of the nation, the region could have reduced its consumption from 52 to 16 trillion Btu in 2006. This 27-trillion Btu energy-consumption reduction is approximately equal to the annual energy required to heat half a million households in the United States.<sup>3</sup> It also would have yielded approximately \$343 million in production-cost savings for the West's dairy industry.

### 1.1.2. Animal Slaughtering and Processing (NAICS 3116)

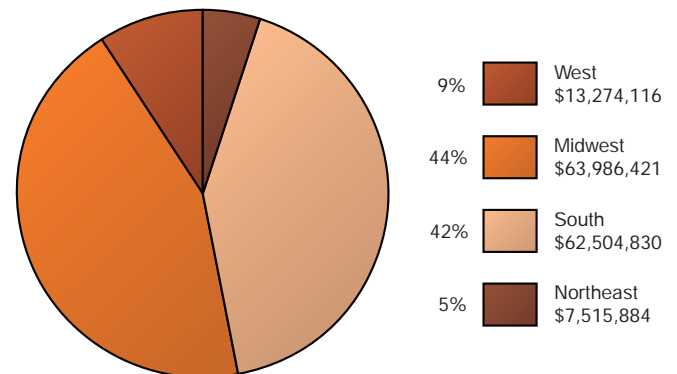
Although animal slaughtering in the West comprises only 9 percent of the national total, it is still valued at over \$13.2 billion in terms of value of shipments (Exhibit 9). California and Colorado led the region in 2006, accounting for 49 percent of the industry together.<sup>4</sup>

As noted in Exhibit 10, animal slaughtering and processing's energy intensity is almost 37 percent above the national average. This means the West uses 37 percent more energy to produce one dollar of GDP than the national average for this sector. As animal slaughtering and processing constitutes 13.5 percent of the West's food manufacturing in terms of value of shipments, improvements in energy intensity in this subsector could significantly improve the overall energy intensity of food manufacturing.

Although the *GDP–Material Input* ratio indicates the West has a relatively high product value for food manufacturing overall compared to the rest of the nation, Exhibit 11 shows the animal slaughtering subsector with a relatively low product value

### Exhibit 9: 2006 National Animal Slaughtering and Processing Shipments

(IN THOUSANDS OF DOLLARS)



Source: U.S. Census Bureau, 2006 Annual Survey of Manufactures, Stats for All Mfg by State. [http://factfinder.census.gov/servlet/DatasetMain-PageServlet?\\_program=EAS&\\_tabId=EAS1&\\_submenuId=datasets\\_5&\\_lang=en&\\_ts=266925692376](http://factfinder.census.gov/servlet/DatasetMain-PageServlet?_program=EAS&_tabId=EAS1&_submenuId=datasets_5&_lang=en&_ts=266925692376).

compared to the national average. It can also be noted from Exhibit 11 that the West's product value for animal slaughtering is nearly 30 percent below

### Exhibit 8: Dairy Products *GDP–Material Input* Ratio

Description (NAICS code)	West <i>GDP–Material Input</i> Ratio	National <i>GDP–Material Input</i> Ratio
Food Manufacturing (311)	0.78	0.77
Animal Slaughtering and Processing (3116)	0.39	0.55

See Appendix A for more detailed West data and Appendix B for more detailed national data.

### Exhibit 10: 2006 Animal Slaughtering and Processing Summary

Description (NAICS Code)	Percentage of Total Shipments	Estimated West Energy Intensity (Btu/\$GDP)	Estimated National Energy Intensity (Btu/\$GDP)	Percent above or below National Average
Animal Slaughtering and Processing (3116)	13.5%	5,882	4,300	36.8%

Note: Information taken from the table in Exhibit 5.



the national average. Even taking this into account, though, the West is still manufacturing with an energy intensity above the national average.

If the animal slaughtering subsector used energy at the same rate as the rest of the nation, the region could have reduced its consumption from 22 to 16 trillion Btu in 2006. This 6-trillion Btu energy-consumption reduction is approximately equivalent to the energy produced from 4 square miles of solar panels in Florida.<sup>5</sup> This 6 trillion Btu in energy savings would have yielded approximately \$76 million in production-cost savings for the West’s animal slaughtering industry.

### 1.1.3. Fruit and Vegetable Preserving and Specialty Food Manufacturing (NAICS 3114)

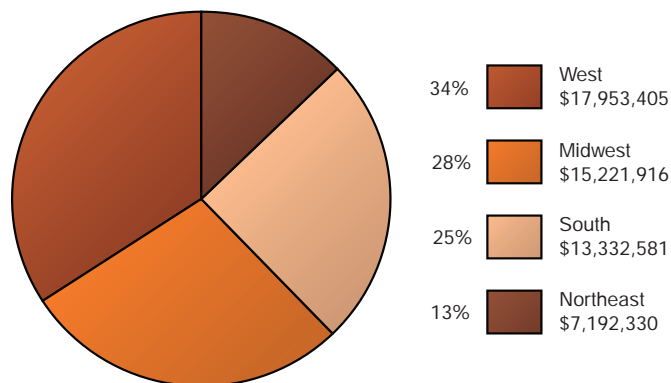
The West actually leads the nation in fruit and vegetable preserving and specialty food manufacturing in terms of value of shipments (Exhibit 12). The West’s shipments constitute 34 percent of the national total. Again, California led the region with 31 percent of the West’s total shipments.<sup>6</sup>

Fruit and vegetable preserving and specialty food manufacturing make up more than 18 percent of the West’s overall food manufacturing. This larger share helps to explain the significance of this subsector having an energy intensity that is 18 percent above the national average. The West’s 7,206 Btu-per-dollar of GDP energy intensity is an astonishing 240 percent above the Northeast’s 2,121 Btu-per-dollar of GDP.<sup>7</sup>

A portion of the high energy intensity is a result of the relatively low product value of Western product

Exhibit 12: 2006 National Fruits and Vegetable Preserving and Specialty Food Manufacturing Shipments

(IN THOUSANDS OF DOLLARS)



Source: U.S. Census Bureau, 2006 Annual Survey of Manufactures, Stats for All Mfg by State. [http://factfinder.census.gov/servlet/DatasetMain-PageServlet?\\_program=EAS&\\_tabId=EAS1&\\_submenuId=datasets\\_5&\\_lang=en&\\_ts=266925692376](http://factfinder.census.gov/servlet/DatasetMain-PageServlet?_program=EAS&_tabId=EAS1&_submenuId=datasets_5&_lang=en&_ts=266925692376).

Exhibit 14: Fruit and Vegetable Preserving and Specialty Foods GDP–Material Input Ratio

Description (NAICS code)	West GDP–Material Input Ratio	National GDP–Material Input Ratio
Food Manufacturing (311)	0.78	0.77
Fruit and Vegetable Preserving and Specialty Food Manufacturing (3114)	0.96	0.98

See Appendix A for more detailed West data and Appendix B for more detailed national data.

Exhibit 13: 2006 Western National Fruit and Vegetable Preserving and Specialty Food Manufacturing Summary

Description (NAICS Code)	Percentage of Total Shipments	Estimated West Energy Intensity (Btu/\$GDP)	Estimated National Energy Intensity (Btu/\$GDP)	Percent above or below National Average
Fruit and Vegetable Preserving and Specialty Food Manufacturing (3114)	13.5%	5,882	4,300	36.8%

Note: Information taken from the table in Exhibit 5.

shipments, which can be seen from the disparity between Western and national *GDP–Material Input* ratios (Exhibit 14). Even if the value of shipments was normalized to account for this, the West’s fruit and vegetable and specialty foods industry would still use significantly more energy to produce its products compared to the rest of the nation.

If the fruit and vegetable and specialty foods subsector used energy at the same rate as the rest of the nation, the region could have reduced its consumption from 63 to 53 trillion Btu in 2006. This 10-trillion Btu energy-consumption reduction would be approximately equal to the annual energy required to heat a quarter of a million household in the United States.<sup>8</sup> It also would have yielded approximately \$127 million in production-cost savings for the West’s fruit and vegetable and specialty foods industry.

## 1.2. Beverage and Tobacco Product Manufacturing (NAICS 312)

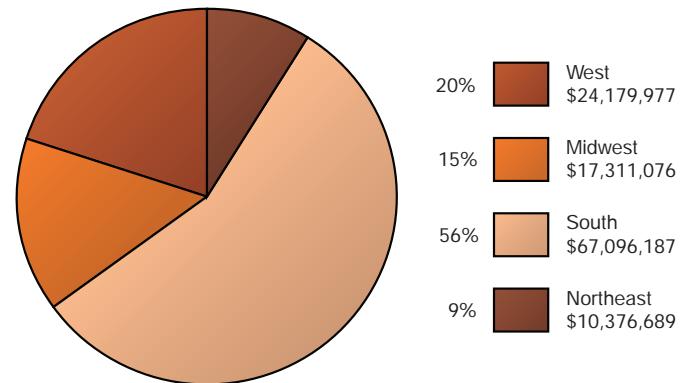
Beverage and tobacco product manufacturing in the West accounts for 20 percent of the national total, as shown in Exhibit 15. The West follows the South as the second largest manufacturing region with a total of more than \$24 billion in shipment values. In 2006, California’s share constituted almost 72 percent of the West’s total beverage and tobacco manufacturing.

Energy intensity of the West’s beverage and tobacco industry is 57 percent higher than the national average energy intensity. Although it would be helpful to know which subsector—beverage or tobacco production—is causing this large disparity, too much data in both subsectors has been withheld by key states. This makes a deeper analysis into

which subsector is having the most influence on the unusually high energy intensity impossible. Nevertheless, it is important to note this significant

### Exhibit 15: 2006 National Beverage and Tobacco Manufacturing Shipments

(IN THOUSANDS OF DOLLARS)



Source: U.S. Census Bureau, 2006 Annual Survey of Manufactures, Stats for All Mfg by State. [http://factfinder.census.gov/servlet/DatasetMain-PageServlet?\\_program=EAS&\\_tabId=EAS1&\\_submenuId=datasets\\_5&\\_lang=en&\\_ts=266925692376](http://factfinder.census.gov/servlet/DatasetMain-PageServlet?_program=EAS&_tabId=EAS1&_submenuId=datasets_5&_lang=en&_ts=266925692376).

disparity at the NAICS three-digit level to begin focusing on which sectors have room for energy intensity improvement.

A portion of the high energy intensity is a result of the relatively low product value of Western beverage and tobacco product shipments, which can be seen from the difference in Western and national *GDP–Material Input* ratios (Exhibit 17). Even if the value of shipments were normalized to account for this, the West’s energy intensity would still be significantly higher compared to the rest of the nation.

### Exhibit 16: 2006 Western Beverage and Tobacco Manufacturing Summary

Description (NAICS Code)	Percentage of Total Shipments	Estimated West Energy Intensity (Btu/\$GDP)	Estimated National Energy Intensity (Btu/\$GDP)	Percent above or below National Average
Beverage and Tobacco Product Manufacturing (312)	100.0%	2,160	1,377	56.9%

Note: Subsector percentages may not total 100 percent due to U.S. Census data withholding. Some subsectors may not be shown because of incomplete data. See Appendix A for more detailed West data and Appendix B for more detailed national data and additional notes.

Exhibit 17: Beverage and Tobacco  
GDP–Material Input Ratio

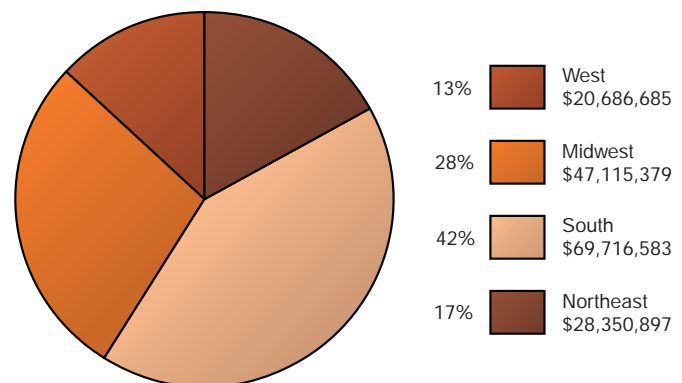
Description (NAICS code)	West GDP–Material Input Ratio	National GDP– Material Input Ratio
Beverage and Tobacco Product Manufacturing (312)	1.13	1.76

See Appendix A for more detailed West data and Appendix B for more detailed national data.

If the beverage and tobacco sector used energy at the same rate as the rest of the nation, the region could have reduced its consumption from 28 to 18 trillion Btu in 2006. This 10-trillion Btu energy-consumption reduction would be approximately equal to the annual energy required to heat a quarter of a million household in the United States. It also would have yielded approximately \$127 million in production-cost savings for the West's beverage and tobacco industry. reduction would be approximately equal to the annual energy required to heat a quarter of a million household in the United States.<sup>9</sup> It also would have yielded approximately \$127 million in production-cost savings for the West's beverage and tobacco industry.

### 1.3. Alumina and Aluminum Production and Processing (NAICS 3313)

The West has a historical association with aluminum production, because many aluminum smelting plants located in the upper Northwest to take advantage of the abundant, cheap energy available from the hydroelectric plants. Although the West's alumina and aluminum production only accounts for 13 percent of the nation's total in terms of value of shipments (Exhibit 18), its energy intensity is significantly higher than the national average.

Exhibit 18: 2006 National Alumina and  
Aluminum Manufacturing Shipments  
(IN THOUSANDS OF DOLLARS)

Source: U.S. Census Bureau, 2006 Annual Survey of Manufactures, Stats for All Mfg by State. [http://factfinder.census.gov/servlet/DatasetMainPageServlet?\\_program=EAS&\\_tabId=EAS1&\\_submenuId=datasets\\_5&\\_lang=en&\\_ts=266925692376](http://factfinder.census.gov/servlet/DatasetMainPageServlet?_program=EAS&_tabId=EAS1&_submenuId=datasets_5&_lang=en&_ts=266925692376).

Exhibit 19: 2006 Western Alumina and Aluminum Manufacturer Summary

Description (NAICS Code)	Percentage of Total Shipments	Estimated West Energy Intensity (Btu/\$GDP)	Estimated National Energy Intensity (Btu/\$GDP)	Percent above National Average
Primary Metal Manufacturing (331)	100.0%	9,230	20,393	-54.7%
Iron and Steel Mills and Ferroalloy Manufacturing (3311)	12.9%	25,090	33,229	-24.5%
Steel Product Manufacturing from Purchased Steel (3312)	3.7%	3,510	7,723	-54.6%
Alumina and Aluminum Production and Processing (3313)	9.3%	29,409	24,398	20.5%
Foundries (3315)	15.4%	4,165	9,244	-54.9%

Note: Subsector percentages may not total 100 percent due to U.S. Census data withholding. Some subsectors may not be shown because of incomplete data. See Appendix A for more detailed West data and Appendix B for more detailed national data and additional notes.

Exhibit 20: Alumina and Aluminum *GDP–Material Input Ratio*

Description (NAICS Code)	Midwest <i>GDP–Material Input Ratio</i>	National <i>GDP–Material Input Ratio</i>
Primary Metal Manufacturing (331)	0.86	0.55
Iron and Steel Mills and Ferroalloy Manufacturing (3311)	0.89	0.58
Steel Product Manufacturing from Purchased Steel (3312)	0.55	0.58
Alumina and Aluminum Production and Processing (3313)	0.33	0.39
Foundries (3315)	1.82	1.10

See Appendix A for more detailed West data and Appendix B for more detailed national data.

Despite having lower-than-average energy intensities in most of the subsectors for primary metal production, the West's energy intensity for alumina and aluminum production is more than 20 percent above the national average (Exhibit 19). This higher energy intensity could result from the lower energy prices the aluminum smelting plants receive from the hydroelectric stations. Cheaper energy such as this is a disincentive to companies for improving efficiency since it is cheaper to consume more energy rather than implement efficiency tools.

Exhibit 20 shows a GDP–Material Input ratio for the West that is slightly less than the nation as a whole. This relatively low product value in the West has a small impact on the higher energy intensity, but it is not enough to justify the 20 percent that the West experiences.

If the West were able to manufacture alumina and aluminum products using the same energy intensity as the national average, its energy consumption would have been reduced from 22 to 18 trillion Btu. This would result in a 4-trillion Btu energy savings that is approximately equal to the energy produced by 2 square miles of solar panels in Florida.<sup>10</sup> The 4 trillion Btu would also have yielded approximately \$50.9 million in production-cost savings for the West's alumina and aluminum industry.

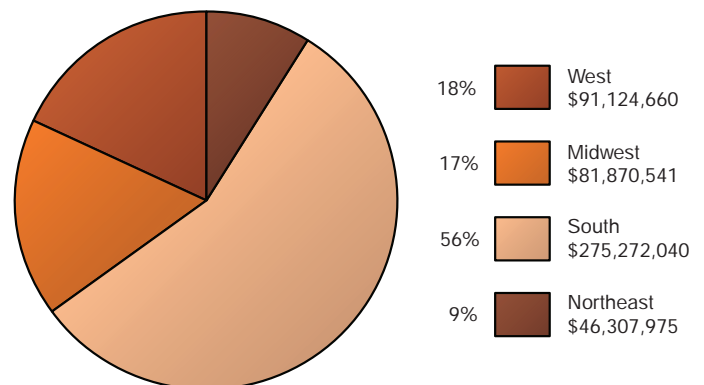
#### 1.4. Petroleum and Coal Products Manufacturing (NAICS 324)

The West has the second largest petroleum and coal products industry after the South. The West's

18-percent share of the sector in terms of value of shipments is worth more than \$91 billion, as seen in Exhibit 21.

Exhibit 21: 2006 National Petroleum and Coal Shipments

(IN THOUSANDS OF DOLLARS)



Source: U.S. Census Bureau, 2006 Annual Survey of Manufactures, Stats for All Mfg by State. [http://factfinder.census.gov/servlet/DatasetMain-PageServlet?\\_program=EAS&\\_tabId=EAS1&\\_submenuId=datasets\\_5&\\_lang=en&\\_ts=266925692376](http://factfinder.census.gov/servlet/DatasetMain-PageServlet?_program=EAS&_tabId=EAS1&_submenuId=datasets_5&_lang=en&_ts=266925692376).

Despite making up nearly one-fifth of the nation's industry, the West has a surprisingly high energy intensity. Exhibit 22 shows the West's energy intensity as almost 10 percent above the national average energy intensity for manufacturing petroleum and coal products. Whereas the West's energy intensity is 61 percent above the national average, it is 22 percent above the South's estimated energy intensity of 24,490 Btu-per dollar of GDP.<sup>11</sup>

Exhibit 22: 2006 Western Petroleum and Coal Production Summary

Description (NAICS Code)	Percentage of Total Shipments	Estimated West Energy Intensity (Btu/\$GDP)	Estimated National Energy Intensity (Btu/\$GDP)	Percent above or below National Average
Petroleum and Coal Product Manufacturing (324)	100.0%	29,994	27,386	9.5%

Note: Subsector percentages may not total 100 percent due to U.S. Census data withholding. Some subsectors may not be shown because of incomplete data. See Appendix A for more detailed West data and Appendix B for more detailed national data and additional notes.

Exhibit 23 shows the West’s *GDP–Material Input* ratio for petroleum and coal products as higher than the national average, indicating the West has a relatively high product value. A high product value would make the energy intensity seem lower than it actually is, meaning this difference in product values cannot explain any part of disparity in energy intensity.

Exhibit 23: Petroleum and Coal Products *GDP–Material Input* Ratio

Description (NAICS code)	West <i>GDP–Material Input</i> Ratio	National <i>GDP–Material Input</i> Ratio
Petroleum and Coal Product Manufacturing (324)	0.39	0.30

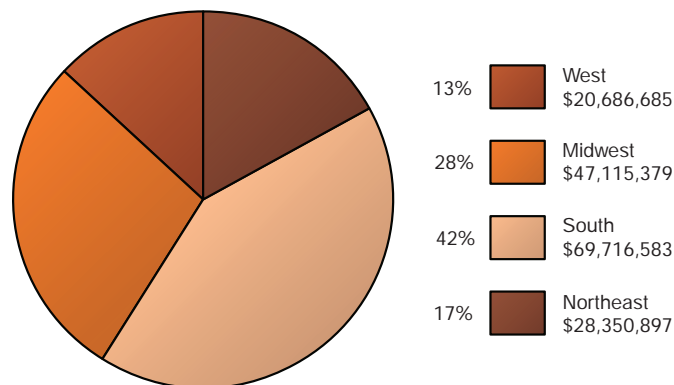
See Appendix A for more detailed West data and Appendix B for more detailed national data.

If the West were able to manufacture petroleum and coal products using the same energy intensity as the national average, its energy consumption would have been reduced from 774 to 707 trillion Btu. This would result in a 67-trillion Btu energy savings that is approximately equivalent to the annual heat required to heat 1.2 million households in the United States.<sup>12</sup> The 67-trillion Btu would also have yielded approximately \$852 million in production–cost savings for the West’s petroleum and coal products industry.

### 1.5. Paper Manufacturing (NAICS 322)

The West’s paper manufacturing constitutes the smallest regional share at 13 percent of the nation’s total value of shipments (Exhibit 24). Despite this small share, the West has the potential for notable savings by improving its energy efficiency. California and Washington led the region in shipment values in 2006, constituting 45 percent and 26 percent, respectively, of the region’s totals.<sup>13</sup>

Exhibit 24: 2006 National Paper Manufacturing Shipments (IN THOUSANDS OF DOLLARS)



Source: U.S. Census Bureau, 2006 Annual Survey of Manufactures, Stats for All Mfg by State. [http://factfinder.census.gov/servlet/DatasetMain-PageServlet?\\_program=EAS&\\_tabId=EAS1&\\_submenuId=datasets\\_5&lang=en&\\_ts=266925692376](http://factfinder.census.gov/servlet/DatasetMain-PageServlet?_program=EAS&_tabId=EAS1&_submenuId=datasets_5&lang=en&_ts=266925692376).

The West has an energy intensity that is almost 8 percent above the national average in this sector. Although this may not seem like a large amount, the value of shipments is large enough (over \$20 billion, as seen in Exhibit 24) that the potential energy and



Exhibit 25: 2006 Western Paper Manufacturing Summary

Description (NAICS Code)	Percentage of Total Shipments	Estimated West Energy Intensity (Btu/\$GDP)	Estimated National Energy Intensity (Btu/\$GDP)	Percent above or below National Average
Paper Manufacturing (322)	100.0%	31,708	29,468	7.6%

Note: Subsector percentages may not total 100 percent due to U.S. Census data withholding. Some subsectors may not be shown because of incomplete data. See Appendix A for more detailed West data and Appendix B for more detailed national data and additional notes.

economic savings are significant. The paper industry is composed of two subsectors: pulp, paper, and paperboard mills and converted paper products. Pulp, paper, and paperboard mills accounts for over 44 percent of the paper industry in terms of shipment values, and converted paper products constitutes over 43 percent.<sup>14</sup>

A portion of the high energy intensity is a result of the relatively low product value of Western dairy product shipments, which can be seen from the disparity between Western and national GDP–Material Input ratios (Exhibit 26). If the West were able to improve energy intensity through energy efficiency measures, this would reduce the production cost since energy is

part of the overall cost. This reduction in cost would allow the West to become more competitive in the paper industry.

If the paper sector used energy at the same rate as the rest of the nation, the region could have reduced its consumption from 287 to 267 trillion Btu in 2006. This 20-trillion Btu energy-consumption reduction is approximately equal to the annual energy required to heat nearly half a million households in the United States.<sup>15</sup> It also would have yielded approximately \$254 million in production-cost savings for the West's paper industry.

Exhibit 26: Paper GDP–Material Input Ratio

Description (NAICS code)	West GDP–Material Input Ratio	National GDP–Material Input Ratio
Paper Manufacturing (322)	0.78	0.90
Pulp, Paper, and Paperboard Mills (3221)	1.02	1.11
Converted Paper Products (3222)	0.56	0.74

See Appendix A for more detailed West data and Appendix B for more detailed national data.

## 2. Moving Forward

The West has a significant energy resource in its efficiency potential. The nation-leading industries discussed in this report could reduce operating costs significantly by lowering energy intensities to national average levels. A summary of additional benefits is in the box to the right.

It should be emphasized that the energy and economic savings estimated in this report are based on the West merely lowering its energy intensities in these sectors and subsectors to the national average that existed in 2006. These estimates do not include further improvements that would make the West an energy intensity leader in these sectors. As mentioned earlier, if the West's energy intensities were at parity with the national average in these five industries, the West would have reduced energy consumption by 144 trillion Btu and saved approximately \$1.83 billion in the process. Exhibit 27 shows the 2006 energy consumption of each of the five sectors detailed in this report, along with the potential energy savings and energy consumption if these sectors operated with energy intensities equal to the national average for each sector. Additional savings can be realized by moving lower-than-national average levels to become leaders in energy efficiency, as well as product shipments.

### ADDITIONAL BENEFITS

- Reducing short-term manufacturer energy costs by lowering energy bills through conservation
- Increasing manufacturer competitiveness through reduced operating costs
- Reducing long-term manufacturer energy costs by reducing spending on generation and transmission
- Insulating Western manufacturing sectors from fossil energy price volatility and shocks
- Reducing utility investment risk by using energy efficiency instead of traditional energy supply
- Meeting state and national utility goals for energy resource and greenhouse gas emissions.

The West can further strengthen its role as a national leader in energy intensity by making changes to the way it consumes energy in these sectors and subsectors. Utilities, government organizations, nongovernmental organizations, and energy consumers must make an effort to support programs that reduce energy consumption, save money, and increase industry competitiveness. Improving processes and reducing energy consumption will help the West enhance its position as a leader in energy efficiency.

Exhibit 27: 2006 Potential Energy and Economic Savings with National Average Energy Intensities

Manufacturing Sector Description	Energy Saved in Trillion Btu, if at National Average	Economic Savings in Millions
Dairy Products (NAICS 3115)	27	\$343
Animal Slaughtering and Processing (NAICS 3116)	6	\$76
Fruit and Vegetable Preserving and Specialty Foods (NAICS 3114)	10	\$127
Beverage and Tobacco Products (NAICS 312)	10	\$127
Alumina and Aluminum Production and Processing (NAICS 3313)	4	\$51
Petroleum and Coal Products (NAICS 324)	67	\$852
Paper (NAICS 322)	20	\$254

### 3. Appendices

#### Appendix A: Western Manufacturing Sector and Subsector Details

NAICS Code	Region	NAICS Code	Material Inputs (\$1,000)	Value of Shipments (\$1,000)	GDP (\$1,000)	Energy Consumed (Trillion Btu)	Energy Intensity (Btu/\$GDP) ***	GDP–Material Input Ratio
311	West	Food Manufacturing	\$55,399,045	\$98,574,804	\$43,174,896	210	4,864	0.78
3112	West	Grain and Oilseed Milling	\$1,801,688	\$2,911,660	\$1,107,875	8	7,221	0.61
3114	West	Fruit and Vegetable Preserving and Specialty Food Manufacturing	\$9,152,125	\$17,953,405	\$8,742,238	63	7,206	0.96
3115	West	Dairy Product Manufacturing	\$12,191,848	\$16,859,362	\$4,726,962	52	11,001	0.39
3116	West	Animal Slaughtering and Processing	\$9,543,883	\$13,274,116	\$3,740,379	22	5,882	0.39
312	West	Beverage and Tobacco Product Manufacturing	\$11,431,255	\$24,179,977	\$12,961,590	28	2,160	1.13
3121	West	Beverage Manufacturing	\$2,001,378	\$4,334,012	\$2,335,679	28	11,988	1.17
322	West	Paper Manufacturing	\$11,667,697	\$20,686,685	\$9,051,406	287	31,708	0.78
3221	West	Pulp, Paper, and Paperboard Mills	\$4,503,947	\$9,117,065	\$4,607,113	--	--	1.02
3222	West	Converted Paper Product Manufacturing	\$5,828,981	\$9,053,159	\$3,277,357	--	--	0.56
324	West	Petroleum and Coal Products Manufacturing	\$65,611,743	\$91,124,660	\$25,805,029	774	29,994	0.39
331	West	Primary Metal Manufacturing	\$11,689,792	\$21,484,148	\$10,075,700	93	9,230	0.86



NAICS Code	Region	NAICS Code	Material Inputs (\$1,000)	Value of Shipments (\$1,000)	GDP (\$1,000)	Energy Consumed (Trillion Btu)	Energy Intensity (Btu/\$GDP) ***	GDP–Material Input Ratio
3311	West	Iron and Steel Mills and Ferroalloy Manufacturing	\$1,471,004	\$2,779,525	\$1,315,267	33	25,090	0.89
3312	West	Steel Product Manufacturing from Purchased Steel	\$514,599	\$789,350	\$284,903	1	3,510	0.55
3313	West	Alumina and Aluminum Production and Processing	\$2,254,425	\$1,969,296	\$748,059	22	29,409	0.33
3314	West	Nonferrous Metal (except Aluminum) Production and Processing	\$1,155,086	\$2,084,735	\$913,220	26	28,471	0.79
3315	West	Foundries	\$1,184,968	\$3,299,540	\$2,160,714	9	4,165	1.82

\*\*\* Values are estimates and may be slightly over or understated due to Census and EIA data availability.

Sources: U.S. Census Bureau, 2006 Annual Survey of Manufactures, Stats for All Mfg by State. [http://factfinder.census.gov/servlet/DatasetMainPageServlet?\\_program=EAS&\\_tabId=EAS1&\\_submenuId=datasets\\_5&\\_lang=en&\\_ts=266925692376](http://factfinder.census.gov/servlet/DatasetMainPageServlet?_program=EAS&_tabId=EAS1&_submenuId=datasets_5&_lang=en&_ts=266925692376). Energy Information Administration, 2006 Manufacturing Energy Consumption Survey, Table 1.2. [www.eia.doe.gov/emeu/mecs/mecs2006/2006tables.html](http://www.eia.doe.gov/emeu/mecs/mecs2006/2006tables.html).

## Appendix B: National Manufacturing Sector and Subsector Details

NAICS Code	Description	Material Inputs (\$1,000)	Value of Shipments (\$1,000)	GDP (\$1,000)	Energy Consumed (Trillion Btu)	Energy Intensity (Btu/\$GDP) ‡	GDP–Material Input Ratio
311	Food Manufacturing	\$304,156,757	\$536,939,160	\$233,406,940	1,186	5,081	0.77
3111	Grain and Oilseed Milling	\$37,328,017	\$56,978,067	\$19,974,377	317	15,870	0.54
3112	Fruit and Vegetable Preserving and Specialty Food Manufacturing	\$28,395,046	\$56,160,818	\$27,731,755	169	6,094	0.98
3113	Dairy Product Manufacturing	\$51,205,998	\$75,251,632	\$22,444,828	121	5,391	0.44

NAICS Code	Description	Material Inputs (\$1,000)	Value of Shipments (\$1,000)	GDP (\$1,000)	Energy Consumed (Trillion Btu)	Energy Intensity (Btu/\$GDP) ‡	GDP–Material Input Ratio
3116	Animal Slaughtering and Processing	\$96,862,515	\$149,576,741	\$52,793,268	227	4,300	0.55
312	Beverage and Tobacco Product Manufacturing	\$44,986,194	\$124,032,571	\$79,167,757	109	1,377	1.76
3121	Beverage Manufacturing	\$39,666,621	\$82,443,196	\$42,905,835	96	2,237	1.08
3221	Paper Manufacturing	\$89,293,248	\$169,032,996	\$79,951,815	2,356	29,468	0.90
3222	Pulp, Paper, and Paperboard Mills	\$37,463,210	\$78,925,576	\$41,530,653	--	--	1.11
324	Converted Paper Product Manufacturing	\$51,830,038	\$90,107,420	\$38,421,161	--	--	0.74
331	Petroleum and Coal Products Manufacturing	\$423,264,761	\$546,811,206	\$125,792,029	3,445	27,386	0.30
3311	Primary Metal Manufacturing	\$152,498,998	\$234,384,209	\$84,343,146	1,720	20,393	0.55
3312	Iron and Steel Mills and Ferroalloy Manufacturing	\$59,488,392	\$93,327,526	\$34,367,111	1,142	33,229	0.58
3313	Steel Product Manufacturing from Purchased Steel	\$12,610,146	\$19,594,560	\$7,251,050	56	7,723	0.58
3314	Alumina and Aluminum Production and Processing	\$30,886,848	\$42,311,838	\$11,927,211	291	24,398	0.39
3315	Nonferrous Metal (except Aluminum) Production and Processing	\$33,442,761	\$45,692,844	\$13,165,477	145	11,014	0.39
332	Foundries	\$16,070,849	\$33,457,440	\$17,632,297	163	9,244	1.10

‡ Values are estimates and may be slightly over or understated due to Census and EIA data availability.

Sources: U.S. Census Bureau, 2006 Annual Survey of Manufactures, Stats for All Mfg by State. [http://factfinder.census.gov/servlet/DatasetMainPageServlet?\\_program=EAS&\\_tabId=EAS1&\\_submenuId=datasets\\_5&\\_lang=en&\\_ts=266925692376](http://factfinder.census.gov/servlet/DatasetMainPageServlet?_program=EAS&_tabId=EAS1&_submenuId=datasets_5&_lang=en&_ts=266925692376). Energy Information Administration, 2006 Manufacturing Energy Consumption Survey, Table 1.2. [www.eia.doe.gov/emeu/mecs/mecs2006/2006tables.html](http://www.eia.doe.gov/emeu/mecs/mecs2006/2006tables.html).

## 4. Endnotes

- <sup>1</sup> U.S. Census Bureau, 2006 Annual Survey of Manufactures, Stats for All Mfg by State. [http://factfinder.census.gov/servlet/DatasetMainPageServlet?\\_program=EAS&\\_tabId=EAS1&\\_submenuId=datasets\\_5&\\_lang=en&\\_ts=266925692376](http://factfinder.census.gov/servlet/DatasetMainPageServlet?_program=EAS&_tabId=EAS1&_submenuId=datasets_5&_lang=en&_ts=266925692376).
- <sup>2</sup> U.S. Census Bureau, 2006 Annual Survey of Manufactures, Stats for All Mfg by State. [http://factfinder.census.gov/servlet/DatasetMainPageServlet?\\_program=EAS&\\_tabId=EAS1&\\_submenuId=datasets\\_5&\\_lang=en&\\_ts=266925692376](http://factfinder.census.gov/servlet/DatasetMainPageServlet?_program=EAS&_tabId=EAS1&_submenuId=datasets_5&_lang=en&_ts=266925692376).
- <sup>3</sup> Energy Information Administration, Annual Energy Outlook, Table 4. [http://www.eia.doe.gov/oiaf/aeo/pdf/aeotab\\_4.pdf](http://www.eia.doe.gov/oiaf/aeo/pdf/aeotab_4.pdf).
- <sup>4</sup> U.S. Census Bureau, 2006 Annual Survey of Manufactures, Stats for All Mfg by State. [http://factfinder.census.gov/servlet/DatasetMainPageServlet?\\_program=EAS&\\_tabId=EAS1&\\_submenuId=datasets\\_5&\\_lang=en&\\_ts=266925692376](http://factfinder.census.gov/servlet/DatasetMainPageServlet?_program=EAS&_tabId=EAS1&_submenuId=datasets_5&_lang=en&_ts=266925692376).
- <sup>5</sup> NREL U.S. Solar Radiation Resource Maps, [http://rredc.nrel.gov/solar/old\\_data/nsrdb/redbook/atlas/](http://rredc.nrel.gov/solar/old_data/nsrdb/redbook/atlas/). Average annual radiation received by a flat-plate solar panel tilted south at latitude in Florida.
- <sup>6</sup> U.S. Census Bureau, 2006 Annual Survey of Manufactures, Stats for All Mfg by State. [http://factfinder.census.gov/servlet/DatasetMainPageServlet?\\_program=EAS&\\_tabId=EAS1&\\_submenuId=datasets\\_5&\\_lang=en&\\_ts=266925692376](http://factfinder.census.gov/servlet/DatasetMainPageServlet?_program=EAS&_tabId=EAS1&_submenuId=datasets_5&_lang=en&_ts=266925692376).
- <sup>7</sup> U.S. Census Bureau, 2006 Annual Survey of Manufactures, Stats for All Mfg by State. [http://factfinder.census.gov/servlet/DatasetMainPageServlet?\\_program=EAS&\\_tabId=EAS1&\\_submenuId=datasets\\_5&\\_lang=en&\\_ts=266925692376](http://factfinder.census.gov/servlet/DatasetMainPageServlet?_program=EAS&_tabId=EAS1&_submenuId=datasets_5&_lang=en&_ts=266925692376).
- <sup>8</sup> Energy Information Administration, Annual Energy Outlook, Table 4. [http://www.eia.doe.gov/oiaf/aeo/pdf/aeotab\\_4.pdf](http://www.eia.doe.gov/oiaf/aeo/pdf/aeotab_4.pdf).
- <sup>9</sup> Energy Information Administration, Annual Energy Outlook, Table 4. [http://www.eia.doe.gov/oiaf/aeo/pdf/aeotab\\_4.pdf](http://www.eia.doe.gov/oiaf/aeo/pdf/aeotab_4.pdf).
- <sup>10</sup> NREL U.S. Solar Radiation Resource Maps, [http://rredc.nrel.gov/solar/old\\_data/nsrdb/redbook/atlas/](http://rredc.nrel.gov/solar/old_data/nsrdb/redbook/atlas/). Average annual radiation received by a flat-plate solar panel tilted south at latitude in Florida.
- <sup>11</sup> U.S. Census Bureau, 2006 Annual Survey of Manufactures, Stats for All Mfg by State. [http://factfinder.census.gov/servlet/DatasetMainPageServlet?\\_program=EAS&\\_tabId=EAS1&\\_submenuId=datasets\\_5&\\_lang=en&\\_ts=266925692376](http://factfinder.census.gov/servlet/DatasetMainPageServlet?_program=EAS&_tabId=EAS1&_submenuId=datasets_5&_lang=en&_ts=266925692376).
- <sup>12</sup> Energy Information Administration, Annual Energy Outlook, Table 4. [http://www.eia.doe.gov/oiaf/aeo/pdf/aeotab\\_4.pdf](http://www.eia.doe.gov/oiaf/aeo/pdf/aeotab_4.pdf).
- <sup>13</sup> U.S. Census Bureau, 2006 Annual Survey of Manufactures, Stats for All Mfg by State. [http://factfinder.census.gov/servlet/DatasetMainPageServlet?\\_program=EAS&\\_tabId=EAS1&\\_submenuId=datasets\\_5&\\_lang=en&\\_ts=266925692376](http://factfinder.census.gov/servlet/DatasetMainPageServlet?_program=EAS&_tabId=EAS1&_submenuId=datasets_5&_lang=en&_ts=266925692376).
- <sup>14</sup> U.S. Census Bureau, 2006 Annual Survey of Manufactures, Stats for All Mfg by State. [http://factfinder.census.gov/servlet/DatasetMainPageServlet?\\_program=EAS&\\_tabId=EAS1&\\_submenuId=datasets\\_5&\\_lang=en&\\_ts=266925692376](http://factfinder.census.gov/servlet/DatasetMainPageServlet?_program=EAS&_tabId=EAS1&_submenuId=datasets_5&_lang=en&_ts=266925692376).
- <sup>15</sup> Energy Information Administration, Annual Energy Outlook, Table 4. [http://www.eia.doe.gov/oiaf/aeo/pdf/aeotab\\_4.pdf](http://www.eia.doe.gov/oiaf/aeo/pdf/aeotab_4.pdf).

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