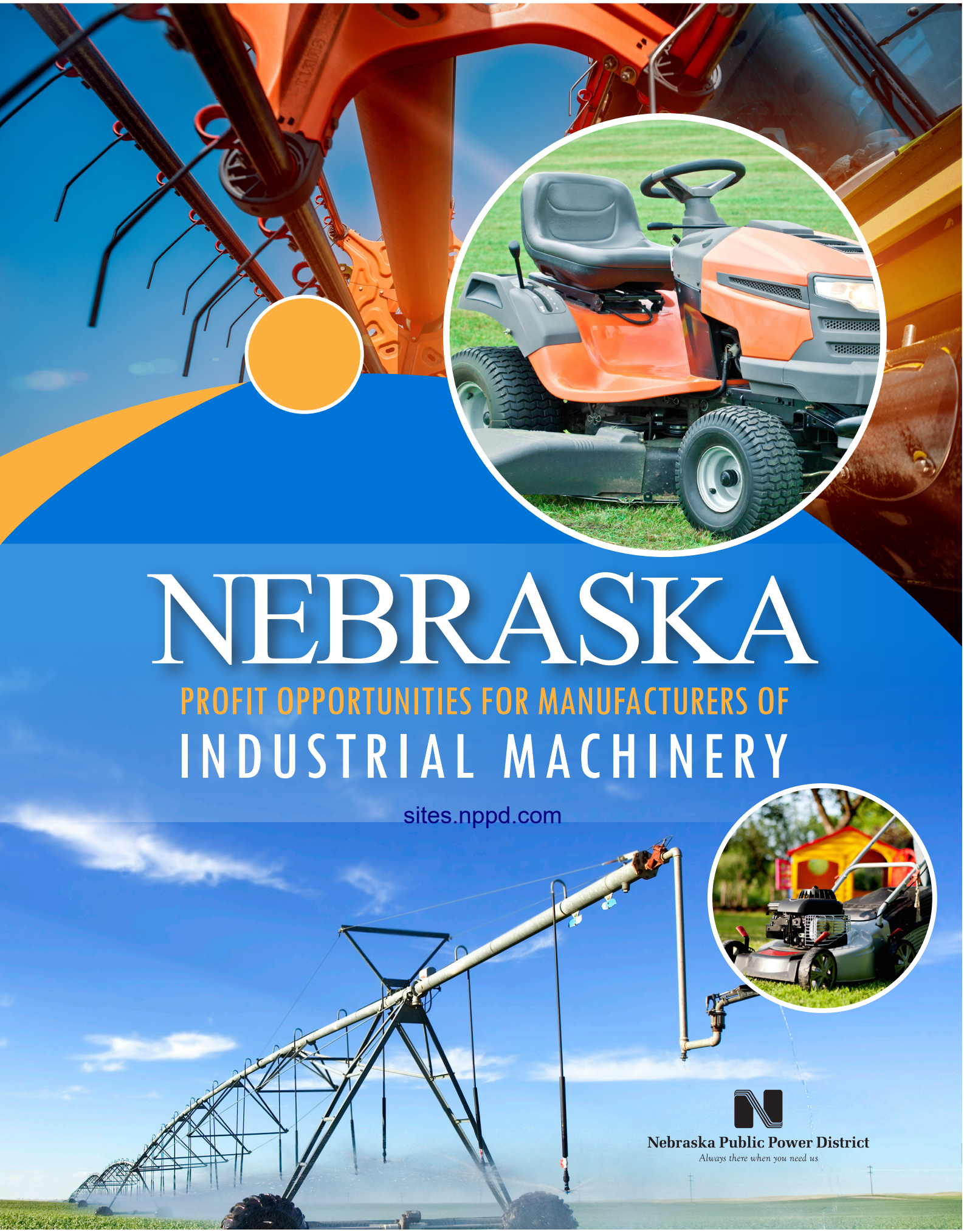

NEBRASKA

PROFIT OPPORTUNITIES FOR MANUFACTURERS OF INDUSTRIAL MACHINERY

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Nebraska Wins Governor's Cup for Second Consecutive Year.

Businesses are moving to Nebraska!
People are locating to Nebraska!

What worked for Nebraska in 2016 worked just as well in 2017, as the state successfully defended its claim to the Governor's Cup it won last year. The recognition is based on the number of projects per capita, and Nebraska gained 110.

Ask Gov. Ricketts why he thinks Nebraska won Site Selection's facilities race again in 2017, and he'll point first to the workforce.

"The main reason people want to invest in Nebraska is the people," Gov. Ricketts told Site Selection. "We consistently have one of the highest workforce participation rates. From personal experience, when you hire a Nebraskan, you know he or she is well-educated and has a great work ethic. They are customer-focused and loyal — they really want to work."

Parts of this article and photo courtesy Site Selection.

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EXECUTIVE SUMMARY

The "Machinery Manufacturing" subsector (NAICS 333) is the fourth largest manufacturing subsector, when measured by employment, in the United States. As machinery manufacturers continue to deal with increasing opportunities in domestic markets and growing uncertainity in global markets, they face a variety of challenges, including rapidly increasing foreign and domestic competition, and opportunities that include expanding national and global markets.

This study has been developed specifically for use by machinery manufacturers to show how a Nebraska plant location can help them better respond to market conditions and significantly improve their competitive positions. Discussed are the many locational advantages the state offers, including performance-based tax incentives that enhance the state's high-ranking business climate.

As the U.S. economy experienced two major recessions between 2000 and 2009, manufacturing employment in Nebraska outperformed the Plains Region and the nation. This suggests that companies with Nebraska manufacturing plants benefit from location and other competitive advantages associated with doing business in Nebraska.

Nebraska's attractive business climate, a productive and well-educated labor force, competitive labor and energy costs, and central location are among the wide range of advantages the state offers manufacturers.

For an industry characterized by many small- and medium-sized production facilities, Nebraska provides substantial advantages in reducing costs, expanding capacity, and otherwise becoming more competitive.

Included in this study are example companies that have recently expanded their operation in Nebraska. These companies have found Nebraska to be a place to grow their companies and their profits.

Also included in this study is an analysis of geographically variable labor and energy costs. The analysis makes cost comparisons among states on the basis of a model manufacturing plant. The model plant assumes employment of 50 production workers and the manufacture of a product representative of the "Machinery Manufacturing" subsector (NAICS 333).

Sixteen states are examined in the analysis. These states include the top twelve states in terms of value of shipments by the "Machinery Manufacturing" subsector NAICS 333) and other states near Nebraska with which it typically competes for industrial location projects.

In the model plant analysis, estimated labor-related costs include the direct wages paid to production workers and costs associated with workers' compensation insurance, unemployment insurance, social security, and fringe benefits. Compared to the 15 alternative states, Nebraska is found to offer an annual savings of $206,378 in labor-related costs, which is 5.8 percent less than the average labor costs for the other states.

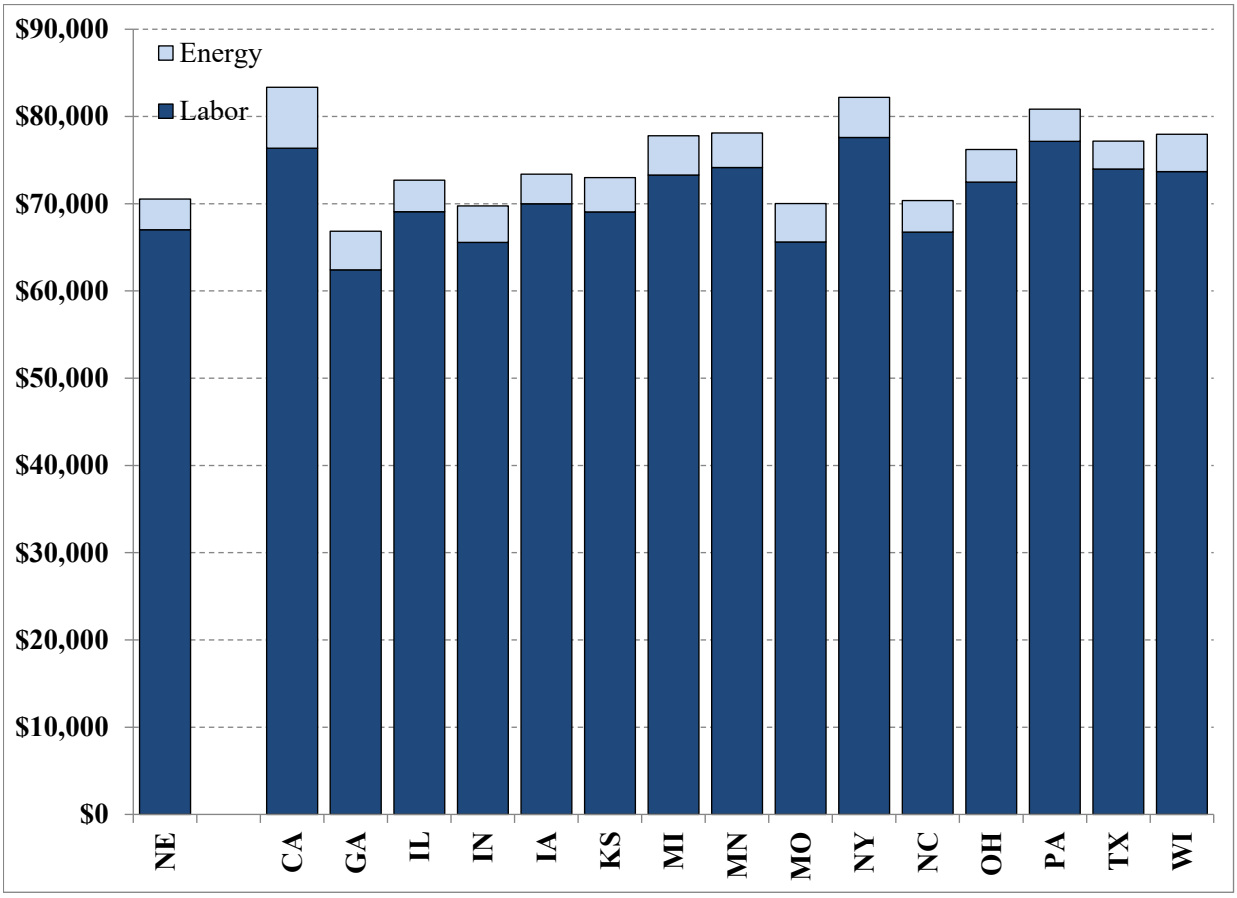
This study also concludes that a Nebraska plant location offers a significant energy cost advantage when compared to the average cost of the other 15 states. Industrial electric rates in the alternative states average 17.1 percent higher, and the average industrial gas rate is 26.7 percent more. Combining these advantages, Nebraska's energy cost for the model plant is 15.6 percent less than the average for the other 15 alternative locations.

Together, Nebraska's annual labor and energy costs for the model plant are $238,862, or 6.3 percent less than the average costs for the 15 alternative states. Conversely, the average labor and energy costs in the other 15 states are 6.8 percent more than the Nebraska labor and energy costs.

Figure 1 provides a summary of the labor and energy costs for the model plant for each of the 16 alternative states. These costs are shown on a per-production-worker basis.

Figure 1

Labor and Energy Costs per Production Worker for Machinery Manufacturing Subsector (NAICS 333)



Source: Table A-6.

Calculated labor (wages, workers' compensation insurance, unemployment insurance, social security, and fringe benefits) and energy (electricity and natural gas) costs for a "Machinery Manufacturing" subsector (NAICS 333).

Nebraska Tractor Test Laboratory

For nearly a century, tractor manufacturers from around the world have looked to the Nebraska Tractor Test Laboratory at the University of Nebraska–Lincoln for a seal of approval. Tractor performance is measured according to the Organization for Economic Co-operation and Development tractor test codes. Twenty-nine countries adhere to the codes, but the Nebraska Tractor (OECD) Test Laboratory is the only OECD tractor test lab in the U.S. According to Roger Hoy, Director for the Nebraska Tractor Test Laboratory, the university contributed significantly to writing the codes.

In 1919 it was more common for horses to work the fields than a piece of machinery. Early tractors were often oversold and underperforming. When state legislator and farmer, Wilmot F. Crozier from Osceola, purchased a few faulty tractors himself, he worked with state senator Charles J. Warner of Waverly to draft the Nebraska Tractor Test Law. In July of 1919 the Nebraska Tractor Test Law was passed, which stated that no new tractor could be sold in Nebraska without first being tested by the University of Nebraska's agricultural engineering department to prove that it would perform as advertised. The first successful tractor test was executed at the lab in April of 1920 and since then more than 2,100 tractors have been tested by the lab.

"In terms of performance testing, we're still the granddaddy of them all," Hoy said. "We're the only facility in the world capable of testing the largest tractors." As tractors have become more technologically advanced, the lab has kept up with the times. Joe Luck, Associate Professor in the Department of Biological Systems Engineering, recently conducted research at the lab to test the accuracy of tractor CAN, or computer-aided network, data. The data includes tractor operating conditions such as speed, engine performance, and accurate positioning from a Global Positioning Sensor attached to the tractor. Luck compared this data to what the lab gathers with separate instruments.

Four test engineers work in the lab full time, along with 30 part-time student workers. Most students are agricultural engineering or mechanized systems management majors. "Our first priority is to conduct tractor testing, but we also focus on preparing undergraduate students for real-world jobs," said Hoy, who also serves as a professor in the Department of Biological Systems Engineering.

Exerpts from the Institute of Agriculture and Natural Resources, University of Nebraska-Lincoln, October 2016 updated August 2018.

PART A

THE MACHINERY MANUFACTURING SUBSECTOR

The "Machinery Manufacturing" subsector (NAICS 333) is the fourth largest manufacturing subsector[1], when measured by employment, in the United States. The *2016 Annual Survey of Manufactures* indicates the machinery manufacturing sector accounted for 8.9 percent of total employment by U.S. manufacturers. In 2016, machinery manufacturing establishments produced 7.1 percent of total U.S. manufacturing value added and 6.5 percent of value of shipments.

As the data shown in Table 1 indicate, the value of shipments for the "Machinery Manufacturing" subsector (NAICS 333) in the U.S. totaled $348,445.9 million in 2016. Value added in the industry totaled $171,558.7 million, with total employees numbering 988,700 and production workers numbering 615,700. Capital expenditures for the subsector totaled $8,272.4 million in 2016.

Data for the 2002–2016 review period provided in Table 1 show declines in total "Machinery Manufacturing" subsector (NAICS 333) employment and the number of production workers from 2002–2004, increases in employment from 2004–2007, declines from 2007–2010, with dramatic employment declines from 2008–2009, increases from 2010–2012, and a small decline from 2012–2014. The declines in employment from 2002–2004 and from 2007–2010 are typical of the employment reductions in manufacturing following the recessions of 2001 and 2007–2009.

Table 1

The Machinery Manufacturing Subsector (NAICS 333), Characteristics and Trends, Selected Years, 2002–2016

Year	Total Employees	Production Workers	Value Added	Value of Shipments	Capital Expenditures	Avg. Hourly Earnings, Prod. Wrkrs.
	- - - - Thousands - - - -		- - - - (Millions $) - - - -			($)
2002	1,166.7	734.5	129,149.9	255,272.8	N/A	17.63
2003	1,097.6	697.7	126,706.2	257,374.6	N/A	17.64
2004	1,054.0	666.4	133,826.0	269,203.2	N/A	18.16
2005	1,065.9	685.2	143,471.6	302,650.2	6,657.5	18.63
2006	1,070.4	693.4	154,459.7	326,583.3	7,397.6	19.26
2007	1,154.4	746.5	166,351.7	351,531.0	8,072.8	19.38
2008	1,125.5	725.9	167,299.7	355,599.6	9,568.7	20.28
2009	962.1	597.1	133,056.6	287,634.2	7,279.5	20.78
2010	919.3	584.2	154,527.3	317,696.5	7,740.3	21.56
2011	964.7	621.4	177,486.2	365,734.8	10,613.8	22.39
2012	1,055.4	687.2	189,722.5	402,177.0	10,542.5	22.54
2013	1,050.8	680.6	186,459.1	393,531.1	11,188.9	22.78
2014	1,027.7	659.9	195,939.0	400,443.8	10,240.8	23.39
2015	1,042.7	657.5	184,216.8	377,546.5	9,222.1	23.79
2016	988.7	615.7	171,558.7	348,445.9	8,272.4	24.49

Sources: U.S. Bureau of the Census, *Census of Manufactures, Geographic Series 2002 and 2007; Industry Series: Detailed Statistics by Industry for the United States: 2012;* and *Annual Survey of Manufactures, 2006, 2009, 2011, 2013, 2014, 2015, and 2016.*
N/A: Not available

[1]The North American Industrial Classification System (NAICS)—used by the statistical agencies of the United States, Canada, and Mexico—employs a hierarchial classification structure consisting of: *"National Industries," "NAICS Industries," "Sectors," "Subsectors,"* and *"Industry Groups."* For example, the *"U.S. Industry"* Farm Machinery and Equipment Manufacturing (NAICS 333111) is part of *"NAICS Industry"* Agriculture Implement Manufacturing (NAICS 33311), *"NAICS Industry Group"* Agriculture, Construction, and Mining Machining Manufacturing (NAICS 3331), *"NAICS Subsector"* Machinery Manufacturing (NAICS 333), and *"NAICS Sector"* Manufacturing (NAICS 31–33).

Between 2002 and 2007, the value of "Machinery Manufacturing" subsector (NAICS 333) shipments grew by 37.7 percent while the number of production workers increased by only 1.6 percent. From 2007–2016, subsector shipments decreased by less than 0.9 percent and the number of production workers decreased by 14.4 percent. For the entire 14-year period from 2002–2016, the value of subsector shipments increased by 36.5 percent and the number of production workers declined by 15.3 percent.

Worker productivity increased significantly from 2002 to 2016, with output per production worker increasing 62.8 percent. During the 2002–2016 period, the value of shipments of machinery manufacturers adjusted for price changes[2] increased 2.5 percent and the average hourly wage of production workers adjusted for price changes[3] increased 4.1 percent. During the Recession of 2007–2010, the levels of employment and output in the "Machinery Manufacturing" subsector (NAICS 333) declined dramatically. From 2007–2010, the number of production workers declined by 15.7 percent, output declined by 9.6 percent, and output per worker increased by 15.5 percent.

I. Industry Structure

The *2012 North American Industrial Classification System (NAICS)* divides the "Machinery Manufacturing" subsector (NAICS 333) into seven 4-digit NAICS industry groups shown in Table 2. As a subsequent table will show, these seven 4-digit industry groups are further subdivided into eleven 5-digit NAICS industries.

The data presented in Table 2 provide a basic description of the "Machinery Manufacturing" subsector (NAICS 333) with further disaggregation into the major 4-digit NAICS industry groups. The table also provides insights into the relative sizes and growth in industry shipments of the industry groups.

For the "Machinery Manufacturing" subsector (NAICS 333) as a whole, industry shipments increased by 14.4 percent between 2007 and 2012 and declined by 13.4 percent between 2012 and 2016. "Commercial and Service Industry Machinery Manufacturing" (NAICS 3333) experience the largest increase among the industry subgroups (15.6 percent)

Table 2

The Machinery Manufacturing Subsector (NAICS 333), Value of Industry Shipments by Major Industry Group, 2007, 2012, and 2016

NAICS	Industry Subgroup	Value of Shipments			% Change		% of Total
		2007	2012	2016	2007–2012	2012–2016	2016
		- - - Millions ($) - - -			- - - (%) - - -		
333	**Machinery Manufacturing**	**351,531.0**	**402,177.0**	**348,445.9**	**14.4**	**-13.4**	**100.0**
3331	Agriculture, Construction, and Mining Machinery Manufacturing	88,280.2	117,204.3	75,305.5	32.8	-35.7	21.6
3332	Industrial Machinery Manufacturing	40,218.7	32,299.3	31,041.7	-19.7	-3.9	8.9
3333	Commercial and Service Industry Machinery Manufacturing	22,827.8	25,131.8	26,396.8	10.1	5.0	7.6
3334	Ventilation, Heating, Air-Conditioning, and Commercial Refrigeration Equipment Manufacturing	40,258.7	41,825.4	43,116.9	3.9	3.1	12.4
3335	Metalworking Machinery Manufacturing	29,056.7	29,475.9	29,850.0	1.4	1.3	8.6
3336	Engine, Turbine, and Power Transmission Equipment Manufacturing	43,308.5	54,052.0	44,037.7	24.8	-18.5	12.6
3339	Other General Purpose Machinery Manufacturing	87,580.5	102,188.3	98,697.2	16.7	-3.4	28.3

Sources: U.S. Bureau of the Census, *Census of Manufactures, Summary Series 2007 and 2012* and *Industry Series: Detailed Statistics by Industry for the United States, 2012* and *Annual Survey of Manufactures, 2016.*

[2]Values adjusted using U.S. Bureau of Labor Statistics, *Producer Price Index for Machinery Manufacturing*.
[3]Values adjusted using U.S. Bureau of Labor Statistics, *Consumer Price Index for All Urban Workers*.

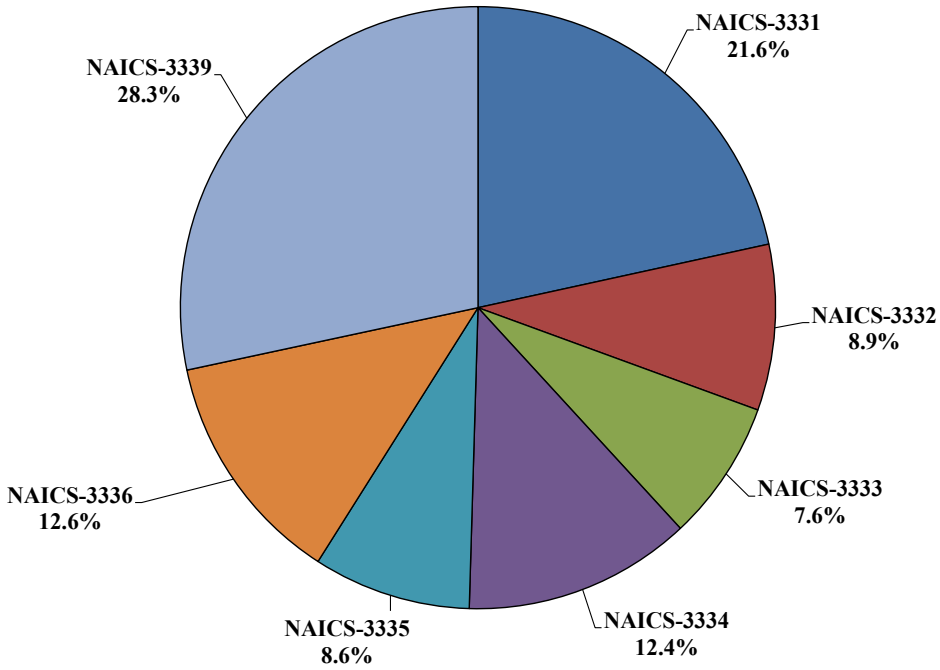
during the nine-year period, 2007 to 2016. "Other General Purpose Machinery Manufacturing" (NAICS 3339); the second fastest growing industry subgroup during the 2007–2016 period, grew 12.7 percent.

The data in Table 2 (previous page) and Figure 2 show the relative importance of "Machinery Manufacturing" subgroups, in terms of value of shipments for each industry group. "Other General Purpose Machinery Manufacturing" (NAICS 3339) is the largest industry subgroup, accounting for 28.3 percent of total industry shipments. "Agriculture, Construction and Mining Machinery Manufacturing" (NAICS 3331, 21.6 percent), is the second largest industry subgroup when measured by value of shipments, followed by "Engine, Turbine, and Power Transmission Equipment Manufacturing" (NAICS 3336, 12.6 percent); "Ventilation, Heating, Air-conditioning, and Commercial Refrigeration Equipment Manufacturing" (NAICS 3334, 12.4 percent); "Industrial Machinery Manufacturing" (NAICS 3332, 8.9 percent); "Metalworking Machinery Manufacturing" (NAICS 3335, 8.6 percent); and "Commercial and Service Industry Machinery Manufacturing" (NAICS 3333, 7.6 percent).

The data in Table 3 (Page 8) provide further detail for the "industry subgroups." Data showing the number of companies and establishments for 2012 and the number of employees, production

Figure 2

Value of Shipments by Industry Group, Machinery Manufacturing Subsector (NAICS 333), 2016



Total 2016 Shipments - $348,445.9 Million

NAICS 3331 Agriculture, Construction, and Mining Machinery Manufacturing

NAICS 3332 Industrial Machinery Manufacturing

NAICS 3333 Commercial and Service Industry Machinery Manufacturing

NAICS 3334 Ventilation, Heating, Air-Conditioning, and Commercial Refrigeration Equipment Manufacturing

NAICS 3335 Metalworking Machinery Manufacturing

NAICS 3336 Engine, Turbine, and Power Transmission Equipment Manufacturing

NAICS 3339 Other General Purpose Machinery Manufacturing

Source: Table 2.

workers, value added, value of shipments, and capital expenditures for 2016 are shown for the "Machinery Manufacturing" subsector (NAICS 333) as a whole and for NAICS 4-digit industry groups and 5-digit NAICS industries that make up the subsector. As noted previously, "Other General Purpose Machinery Manufacturing" (NAICS 3339) is the largest industry subgroup, in terms of industry shipments.

The data in Table 3 show that "Metalworking Machinery Manufacturing" (NAICS 3335) is the largest industry subgroup in terms of total employees, production workers, and capital investment. Also shown in Table 3, "Metalworking Machinery Manufacturing" (NAICS 33351) is the largest 5-digit NAICS industry in terms of number of companies, number of establishments, total employees, production workers, value added, and capital expenditures, while "All Other General Purpose Machinery Manufacturing" (NAICS 33399) is the largest NAICS industry in terms of shipments.

II. Industry Production Characteristics

The manufacture of machinery encompasses a very large and diverse industry. In 2012, 24,209 establishments were primarily engaged in machinery manufacturing, a decrease of 8.4 percent from 2007 (see Table 4, Page 9). It is interesting to note that the number of small establishments, as measured by employment, and the number of larger establishments both decreased during this period.

MetalQuest Utilizes Technology to Produce High Quality Products and Create a Productive Workplace Environment

MetalQuest was founded in January of 1996 by Scott Harms in Deshler, Nebraska. Three years later, the business was moved to a new building in nearby Hebron, a bustling small community of 1,400 in South Central Nebraska, to give the blossoming company more room to grow. MetalQuest specializes in producing high tolerance precision-machined parts for numerous companies in a variety of industries. Customers served by MetalQuest can be found in the agriculture, oil field, hydraulics, firearms, transportation, and the industrial machinery industries.

MetalQuest has implemented many new technologies into their plant over the years with the overall goal of producing a better product and more productive employees. "People are the most advanced tool we have and most decisions revolve around them," said Scott Volk, Vice President/COO of MetalQuest. "Many of the automation advances have been done in order to make every process performed by a worker more purposeful," Volk added. One such technology is the advanced automation work cells employed by MetalQuest that allows them to take lead times to another level. Every part of the cell is optimized, from reducing the individual machine cycle times to the footprint of the machines that allow the robotics to run multiple functions. Each advancement allows for the use of fewer machines and fewer people on each job.

MetalQuest has also made significant advancements in understanding the workflow throughout the company. Using software that has been programed in-house, the status of every job, machine, tool, raw material, coolant, and more can be checked from anywhere in the world. This fosters an environment that eliminates variability by making every part of the operation a consistent and repeatable process and ensures the accuracy of each transaction.

MetalQuest is constantly striving for improvement. Frequent investments are made in employees through continuous training and a culture of never being satisfied with the current process. Every two years, the company of 70 employees sends 10–20 employees to the International Machinery Technology Show in Chicago where they benefit from learning about the latest technologies in the industry and look for ways to bring ideas back home to implement in their own company. This investment in its employees has not only helped to produce higher quality products at a lower cost, but has also fostered a workplace that is enjoyable to be at with a low employee turnover rate.

Table 3

The Machinery Manufacturing Subsector (NAICS 333), Number of Companies and Establishments, , 2012 Employment, Value of Shipments, Value Added, and Capital Expenditures by Major Sector and Industry Subgroups, 2016

NAICS Code	Industry Description	Number of Companies	Number of Establishments	All Employees	Production Workers	Value Added	Value of Shipments	Capital Expenditures
						----- (Thousand $) -----		
333	**Machinery Manufacturing**	**21,831**	**24,209**	**988,688**	**615,740**	**171,558,659**	**348,445,946**	**8,272,426**
3331	Agriculture, Construction, and Mining Machinery Manufacturing	2,743	3,082	172,994	110,674	30,767,111	75,305,531	1,517,996
33311	Agricultural Implement Manufacturing	1,191	1,279	69,596	48,739	12,988,213	31,886,935	632,428
33312	Construction Machinery Manufacturing	696	781	54,363	34,448	12,027,369	28,275,724	470,432
33313	Mining and Oil and Gas Field Machinery Manufacturing	856	1,022	49,035	27,487	5,751,529	15,142,873	415,136
3332	Industrial Machinery Manufacturing	3,152	3,292	98,239	52,602	17,027,875	31,041,709	926,847
33324	Industrial Machinery Manufacturing	3,152	3,292	98,239	52,602	17,027,875	31,041,709	926,847
3333	Commercial and Service Industry Machinery Manufacturing	1,920	2,047	73,448	39,733	15,180,315	26,396,827	628,290
33331	Commercial and Service Industry Machinery Manufacturing	1,920	2,047	73,448	39,733	15,180,315	26,396,827	628,290
3334	Ventilation, Heating, Air-Conditioning, and Commercial Refrigeration Equipment Manufacturing	1,588	1,840	126,889	90,144	21,924,182	43,116,911	708,374
33341	Ventilation, Heating, Air-Conditioning, and Commercial Refrigeration Equipment Manufacturing	1,588	1,840	126,889	90,144	21,924,182	43,116,911	708,374
3335	Metalworking Machinery Manufacturing	6,566	6,727	143,531	97,242	18,275,676	29,850,024	1,259,513
33351	Metalworking Machinery Manufacturing	6,566	6,727	143,531	97,242	18,275,676	29,850,024	1,259,513
3336	Engine, Turbine, and Power Transmission Equipment Manufacturing	830	1,005	92,855	62,246	19,122,611	44,037,719	1,113,122
33361	Engine, Turbine, and Power Transmission Equipment Manufacturing	830	1,005	92,855	62,246	19,122,611	44,037,719	1,113,122
3339	Other General Purpose Machinery Manufacturing	5,704	6,216	280,731	163,098	49,260,889	98,697,225	2,118,284
33391	Pump and Compressor Manufacturing	736	883	61,141	33,513	13,233,376	24,926,729	640,585
33392	Material Handling Equipment Manufacturing	1,510	1,629	84,960	50,553	12,517,880	28,867,228	537,019
33399	All Other General Purpose Machinery Manufacturing	3,458	3,704	134,631	79,032	23,509,633	44,903,268	940,679

Sources: U.S. Bureau of the Census, *Census of Manufactures, Industry Series: Detailed Statistics by Industry for the United States, 2012* and *Annual Survey of Manufactures, 2016.*

The data presented in Table 4 compares selected characteristics of the "Machinery Manufacturing" subsector (NAICS 333) as a whole for 2007, 2012, and 2016. During the 2007–2016 period, total employment in the subsector declined by 14.2 percent. During the same 2007–2016 period, the number of production workers in the subsector decreased by 17.5 percent with production workers' hours declining 19.2 percent. For the 2012–2016 period, total employment in the "Machinery Manufacturing" subsector (NAICS 333) decreased by 66,700 or 6.3 percent and the number of production workers declined from 687,200 to 615,700, a reduction of 71,500 or 10.4 percent.

As shown in Table 4, between 2007 and 2012, the "Machinery Manufacturing" subsector (NAICS 333) experienced an increase in labor (6.6 percent) and material costs (15.1 percent) and a substantial decrease in the cost of purchased fuels (38.3 percent), while the value of shipments increased by 14.7 percent. During the same 2007 to 2012 period, the percent increase in electric energy costs increased slightly (1.2 percent).

Table 4

Production Characteristics for the Machinery Manufacturing Subsector (NAICS 333), 2007, 2012, and 2016

				Percent Change		
	2007	2012	2016	2007-2012	2012-2016	2007-2016
Establishments						
Number	26,415	24,209	N/A	-8.4	N/A	N/A
With 20+ Employees	9,472	9,024	N/A	-4.7	N/A	N/A
All Employees						
Number [thousands]	1,152.9	1,055.4	988.7	-8.5	-6.3	-14.2
Payroll [million $]	56,155.0	59,884.6	60,428.6	6.6	0.9	7.6
Production Workers						
Number [thousands]	746.7	687.2	615.7	-8.0	-10.4	-17.5
Hours [millions]	1,506.6	1,374.8	1,217.4	-8.8	-11.4	-19.2
Wages [million $]	29,272.0	30,982.7	29,813.3	5.8	-3.8	1.8
Average Hourly Wage [$]	19.43	22.54	24.49	16.01	8.65	26.04
Value Added by Manufacture [million $]	165,787.8	189,722.5	171,558.7	14.4	-9.6	3.5
Cost of Materials [million $]	185,869.7	214,001.0	174,872.7	15.1	-18.3	-5.9
Value of Shipments [million $]	350,499.5	402,177.0	348,445.9	14.7	-13.4	-0.6
Cost of Purchased Fuels and Electric Energy						
Electric Energy [million $]	1,922.0	1,944.3	1,947.7	1.2	0.2	1.3
Purchased Fuels [million $]	880.1	543.0	485.5	-38.3	-10.6	-44.8
Quantity of Purchased Electric Energy [million kWh]	30,884.4	24,513.3	24,381.4	-20.6	-0.5	-21.1

Sources: U.S. Bureau of the Census, *Summary Series 2007 and 2012* and *Annual Survey of Manufactures, 2016.*
N/A: Not available.

Table 5 provides data for selected additional production characteristics for "Machinery Manufacturing" for 2012. The industry data presented in Table 5 are for "Machinery Manufacturing" (NAICS 333) as a whole; the "Metalworking Machinery Manufacturing" industry subgroup (NAICS 3335) and the balance of the industry, excluding the "Machinery Manufacturing" industry subgroup.

As the data in Table 5 indicate, there were 21,831 companies and 24,209 establishments in the "Machinery Manufacturing" subsector in 2012. Establishments in the "Metalworking Machinery Manufacturing" industry subgroup (NAICS 3335) totaled 6,727 in 2012, or 27.8 percent of total sector establishments. Data on the distribution of manufacturing establishments by number of employees demonstrate that the industry consists of a large number of small establishments. In 2012, the average establishment in the "Machinery Manufacturing" subsector (NAICS 333) employed 28.4 production workers; 15,185 or 62.7 percent of the establishments had less than 20 employees; and only 9.7 percent had more than 100 employees.

Data in Table 5 show that, on average, establishments in the "Metalworking Machinery Manufacturing" industry subgroup (NAICS 3335) are much smaller than those in the balance of the "Machinery Manufacturing" subsector (NAICS 333). In 2012, 72.8 percent of "Metalworking Machinery Manufacturing" establishments had fewer than 20 employees, only 3.7 percent had more than 100 employees, and the average number of production workers per establishment was 14.9, 52.7 percent, of the subsector average. For the "Metalworking Machinery Manufacturing" industry subgroup (NAICS 3335), 2012 average value added per establishment, $2.6 million, was 33.3 percent of the subsector average and 2012 value of shipments per establishment, $4.3 million, was 26.4 percent of the subsector average.

Table 5

Establishment Characteristics for the Machinery Manufacturing Subsector (NAICS 333), Metalworking Machinery Manufacturing Industry Subgroup (NAICS 3335), and the Balance of Other Machinery Manufacturing Products, 2012

	NAICS 333 Machinery Manufacturing	NAICS 3335 Metalworking Machinery Manufacturing	Balance of Other Machinery Manufacturing
Number of Companies	21,831	6,566	15,265
Number of Establishments	24,209	6,727	17,482
Est. - with 20+ Employees	9,024	1,828	7,196
Est. - with 20+ Emp (% of Total)	37.3	27.2	41.2
Est. - with 100+ Employees	2,341	249	2,092
Est. - with 100+ Emp (% of Total)	9.7	3.7	12.0
Establishments per Company	1.11	1.02	1.15
Production Workers	687,172	100,563	586,609
Average Production Workers per Establishment	28.4	14.9	33.6
Value Added (Million $)	189,722.5	17,563.3	172,159
Per Establishment (Thousand $)	7,836.9	2,610.9	9,848
Per Production Worker ($)	276,091.7	174,649.8	293,482
Value of Shipments (Million $)	402,177.0	29,475.9	372,701
Per Establishment (Thousand $)	16,612.7	4,381.7	21,319
Per Production Worker ($)	585,264.0	293,108.8	635,348

Sources: U.S. Bureau of the Census, *Census of Manufactures, Industry Series: Detailed Statistics by Industry for the United States, 2012.*

III. Industry Location Characteristics

Showing the geographic distribution of the "Machinery Manufacturing" subsector (NAICS 333), Table 6 presents data on employment, wages, capital expenditures, and value of shipments for 16 selected states. As indicated in the table, the 16 states accounted for $244.4 billion or 64.7 percent, of the $377.2 billion of value of shipments by machinery manufacturers in 2016.

Included in these states are the top ten states in terms of value of shipments by the "Machinery Manufacturing" subsector (NAICS 333) and other states near Nebraska with which it typically competes for industrial location projects. The 16 states are included in this study as alternative sites for plant locations and are evaluated in Part B of this report using the geographically variable labor and energy costs.

In terms of employment, the "Machinery Manufacturing" subsector (NAICS 333) is largest in Michigan followed by Texas and Ohio. In terms of value of shipments, Texas ranked first followed by Michigan and Ohio. As the data presented in Table 6 indicate, the 16 states included in this study accounted for 65.1 percent of the production workers and 64.7 percent of the total value of shipments by the "Machinery Manufacturing" subsector (NAICS 333) in 2016. Texas, with 42,600 production workers, led the nation in machinery manufacturing in 2016. Texas' value of shipments of $27,661 million accounted for 7.3 percent of the U.S. total.

Table 6

Machinery Manufacturing Subsector (NAICS 333), Employees, Production Workers, Average Wages, Capital Expenditures, and Value of Shipments, Selected States and the U.S., 2016

State	Employees	Production Workers	Average Hourly Earnings	Capital Expenditures	Value of Shipments	% of U.S. Value of Shipments
	- - - (Thousand $) - - -		($)	- - - (Million $) - - -		(%)
Nebraska	**9.1**	**6.0**	**23.09**	**55.6**	**3,582.2**	**0.9**
California	62.2	35.7	25.94	553.6	19,513.9	5.2
Georgia	21.0	13.8	21.46	144.6	11,226.1	3.0
Illinois	58.1	37.0	23.63	551.8	20,516.1	5.4
Indiana	33.4	22.8	22.65	224.9	12,122.1	3.2
Iowa	36.6	24.9	23.97	310.6	15,272.0	4.0
Kansas	19.5	12.2	23.80	154.6	6,474.2	1.7
Michigan	74.0	45.4	25.18	609.0	21,957.3	5.8
Minnesota	33.0	19.7	25.43	267.2	10,872.9	2.9
Missouri	27.2	17.9	22.54	147.6	8,212.2	2.2
New York	38.3	23.5	26.45	259.4	14,124.6	3.7
North Carolina	32.2	19.9	22.91	304.8	15,864.8	4.2
Ohio	69.9	44.1	24.94	624.9	21,848.8	5.8
Pennsylvania	45.3	25.5	26.37	240.6	15,277.8	4.0
Texas	73.6	42.6	25.48	750.1	27,660.7	7.3
Wisconsin	59.9	36.8	25.24	473.6	19,867.8	5.3
Total Sel. States	**693.3**	**427.8**	**24.67**	**5,672.9**	**244,393.5**	**64.7**
Percent of U.S.	66.5	65.1	103.70	61.5	64.7	64.7
Total U.S.	**1,042.7**	**657.5**	**23.79**	**9,222.1**	**377,546.5**	**100.0**

Source: U.S. Bureau of the Census, *Annual Survey of Manufactures, Geographic Area Statistics, 2016.*

IV. Capital Expenditures and Industry Outlook

Capital investment in the "Machinery Manufacturing" subsector (NAICS 333) was $8,272.4 million in 2016, which was $251.1 million or 3.1 percent higher than in 2007 and $2,270.1 million or 21.5 percent lower than in 2012. As data in Table 7 demonstrate, the rates of change in capital expenditures varied significantly both among the industry groups and over the 2007–2012 and 2012–2016 time periods. "Other General Purpose Machinery Manufacturing" (NAICS 3339) recorded the greatest percent increase in capital expenditures (24.2 percent) between 2007 and 2016 followed by, "Commercial and Service Industry Machinery Manufacturing" (NAICS 3333, 20.5 percent); "Metalworking Machinery Manufacturing" (NAICS 3335, 16.1 percent); "Industrial Machinery Manufacturing" (NAICS 3332, 6.3 percent); "Engine, Turbine, and Power Transmission Equipment Manufacturing" (NAICS 3336, -6.7 percent); "Ventilation, Heating, Air-Conditioning, and Commercial Refrigeration Equipment Manufacturing" (NAICS 3334, -6.8 percent); and "Agricultural, Construction, and Mining Machinery Manufacturing" (NAICS 3331, -19.4 percent).

Economic growth of the "Machinery Manufacturing" subsector (NAICS 333) is dependent on many factors, including the overall performance of the U.S. economy, economic and business conditions internationally, and the competitive position of U.S. machinery manufacturers relative to their foreign competitors. Over the longer term, the "Machinery Manufacturing" subsector (NAICS 333) is expected to record slow, positive growth in output and a slow decline in employment.

As indicated by the data presented in Table 8 (next page), employment in the "Machinery Manufacturing" subsector (NAICS 333) is projected to decrease by 0.5 percent between 2016 and 2026. During the same period, real output is projected to increase 24.4 percent, which is about the same as the projected 19.4 percent increase for the entire manufacturing sector. The "Agriculture, Construction, and Mining Machinery Manufacturing" (NAICS 3331) is projected to experience the greatest growth in employment, 8.8 percent, and highest output growth, 36.0 percent, between 2016 and 2026.

Table 7

Capital Expenditures in the Machinery Manufacturing Subsector (NAICS 333), by Industry Subgroup, 2007, 2012, and 2016

NAICS	Industry Group	Capital Expenditures					2016 Cap. Exp. as Percent of Total
		2007	2012	2016	2007-2012	2012-2016	
		--- (Thousand $) ---			-- (% Change) --		(%)
333	**Machinery Manufacturing**	**8,021,318**	**10,542,489**	**8,272,426**	**31.4**	**-21.5**	**100.0**
3331	Agriculture, Construction, and Mining Machinery Manufacturing	1,883,628	3,851,144	1,517,996	104.5	-60.6	18.4
3332	Industrial Machinery Manufacturing	872,118	667,785	926,847	-23.4	38.8	11.2
3333	Commercial and Service Industry Machinery Manufacturing	521,255	586,639	628,290	12.5	7.1	7.6
3334	Ventilation, Heating, Air-Conditioning, and Commercial Refrigeration Equipment Manufacturing	760,431	563,724	708,374	-25.9	25.7	8.6
3335	Metalworking Machinery Manufacturing	1,084,508	1,198,307	1,259,513	10.5	5.1	15.2
3336	Engine, Turbine, and Power Transmission Equipment Manufacturing	1,193,440	1,707,225	1,113,122	43.1	-34.8	13.5
3339	Other General Purpose Machinery Manufacturing	1,705,938	1,967,665	2,118,284	15.3	7.7	25.6

Sources: U.S. Bureau of the Census, *Summary Series 2007 and 2012;* and *Annual Survey of Manufactures, 2016.*

Table 8

Employment and Output, Machinery Manufacturing Subsector (NAICS 333), by Industry Subgroup, and for All Manufacturing, 2006, 2016, and Projected 2026

		Part A -- Employment				
		Thousands of Jobs			Avg. Ann. Rate of Change	
NAICS	Industry Sector / Subgroup	2006	2016	2026	2006-2016	2016-2026
31-33	**Manufacturing**	**14,155.8**	**12,348.1**	**11,611.7**	**-1.4**	**-0.6**
333	**Machinery Manufacturing**	**1,183.2**	**1,080.3**	**1,024.4**	**-0.9**	**-0.5**
3331	Agriculture, Construction, and Mining Machinery Manufacturing	220.4	208.6	227.0	-0.5	0.8
3332	Industrial Machinery Manufacturing	123.8	113.6	97.8	-0.9	-1.5
3333	Commercial and Service Industry Machinery Manufacturing, Including Digital Camera	108.9	89.9	79.9	-1.9	-1.2
3334	Ventilation, Heating, Air-Conditioning, and Commercial Refrigeration Equipment Manufacturing	156.5	128.5	111.5	-2.0	-1.4
3335	Metalworking Machinery Manufacturing	199.9	180.2	167.9	-1.0	-0.7
3336	Engine, Turbine, and Power Transmission Equipment Manufacturing	100.4	99.1	94.8	-0.1	-0.4
3339	Other General Purpose Machinery Manufacturing	273.3	260.4	245.5	-0.5	-0.6

		Part B -- Value of Output				
		Billions of Chain-Weighted 2009 Dollars			Avg. Ann. Rate of Change	
NAICS	Industry Sector / Subgroup	2006	2016	2026	2006-2016	2016-2026
31-33	**Manufacturing**	**5,298.3**	**5,449.9**	**6,509.8**	**0.3**	**1.8**
333	**Machinery Manufacturing**	**362.9**	**361.0**	**449.0**	**-0.1**	**2.2**
3331	Agriculture, Construction, and Mining Machinery Manufacturing	80.8	102.1	138.9	2.4	3.1
3332	Industrial Machinery Manufacturing	41.7	30.9	37.0	-2.9	1.8
3333	Commercial and Service Industry Machinery Manufacturing, Including Digital Camera	27.9	23.4	28.8	-1.7	2.1
3334	Ventilation, Heating, Air-Conditioning, and Commercial Refrigeration Equipment Manufacturing	46.2	37.8	42.8	-2.0	1.3
3335	Metalworking Machinery Manufacturing	31.3	30.3	35.8	-0.3	1.7
3336	Engine, Turbine, and Power Transmission Equipment Manufacturing	47.3	46.6	55.9	-0.1	1.8
3339	Other General Purpose Machinery Manufacturing	87.8	89.4	109.1	0.2	2.0

Source: Employment Projections Program, U.S. Department of Labor, U.S. Bureau of Labor Statistics

On balance, the factors affecting firms producing machinery will depend to a great extent on the ability of companies to compete within their industry and in the markets for their products. While many external factors will influence the overall performance of the industry, the outlook for individual companies that can control costs and respond to emerging and changing market opportunities will be significantly enhanced. Part B of this study discusses how establishments producing machinery can better respond to market conditions and significantly improve their competitive positions with a Nebraska location.

University of Nebraska Innovation Campus: Spaces & Culture that Inspire

The University of Nebraska's Nebraska Innovation Campus (NIC) is connecting the talents of experts, companies, and the university to create a unique culture of innovation. NIC is a research campus designed to facilitate new and in-depth partnerships between the University of Nebraska and private sector businesses. NIC is adjacent to the University of Nebraska-Lincoln and strategically provides access to research faculty, facilities, and students. NIC was honored in October 2017 with the Engineering Research Park Award from the Association of University Research Parks.

At full build-out, NIC will be a 2.2-million square-foot campus with uniquely designed buildings and amenities that inspire creative activity and engagement, transforming ideas into global innovation. It is envisioned that up to 5,000 people could work on NIC at full build-out with one-third employed by the university and two-thirds employed by private business and non-university employers. The development at NIC will be a dense urban environment with multi-story buildings.

Currently, the campus features 380,000-square-feet of office, conference center, lab, pilot plant, and greenhouse space. In August 2017, construction began on a new 80,000-square-foot, multi-tenant building, with a planned opening of summer 2018. It will feature a planned business incubator and common spaces to encourage collaboration. A new restaurant was also recently opened, along with the Biotech Connector wet lab research space.

Housed at NIC is Nebraska Innovation Studio (NIS). Sometimes referred to as a makerspace, fab lab, hobby shop, or hacker space, this is a space where creators of all sorts can share ideas, tools, and knowledge that contribute to the creation of a final product. The primary focus is on creativity, interdisciplinary collaboration, entrepreneurship, and education. The space features a collaborative workspace and areas for woodworking, fine arts, rapid prototyping, and electronics. University faculty, students, staff, and community members are welcome to join Nebraska Innovation Studio for a monthly fee. Members take part in workshops, receive training on the studio's start-of-the-art machines, and ultimately, make things.

While building NIC, many aspects were taken into consideration including employing the newest and most creative technologies to heat and cool the buildings. The Centralized Renewable Energy System (CRES) uses reclaimed, non-drinkable water from the nearby Theresa Street wastewater treatment plant to heat and cool up to 1.8-million square-feet of offices and labs on NIC. This award-winning, closed-loop system transfers thermal energy in underground piping to the entire campus. The investment in this source of alternative energy will ensure that NIC buildings operate 30 percent more efficiently than ones with standard equipment and will lower the risks associated with fluctuating commodity prices. This system is even more efficient than a geothermal system because of the consistent water temperatures provided by the wastewater treatment facility.

NIC is committed to becoming a zero waste campus. The zero waste concept looks to change the way the campus thinks about waste, and transcends the design, production, and consumption processes. By reengineering systems in ways that reduce inefficiency, emulate sustainable natural cycles, and empower the local community, NIC's zero waste efforts promote environmental sustainability, economic opportunity, and social equity. NIC's zero waste strategy incorporates robust recycling and composting programs, sustainable purchasing policies, and fosters collaboration with our partners.

NIC also features a full-service conference center located in a historic building that has been reconstructed to provide multi-functional meeting and collaboration space. The NIC Conference Center includes:

- 400-seat auditorium with state-of-the-art audio and visual capabilities; each seat has a table and outlet
- 400-seat banquet room with state-of-the-art audio and visual capabilities
- 8 breakout rooms, each with projector and whiteboard
- Multi-day conference opportunities
- Individual event options

For more information about NIC, please visit: *innovate.unl.edu*.

Part B

Nebraska Advantages for Machinery Manufacturers

Nebraska offers a wide range of locational advantages to machinery manufacturers. In the continuing portion of this study, Nebraska resources and location attributes important to machinery manufacturers are discussed. An evaluation of geographically variable labor and energy costs for selected states using a model establishment for manufacturing machinery is included in Appendix A.

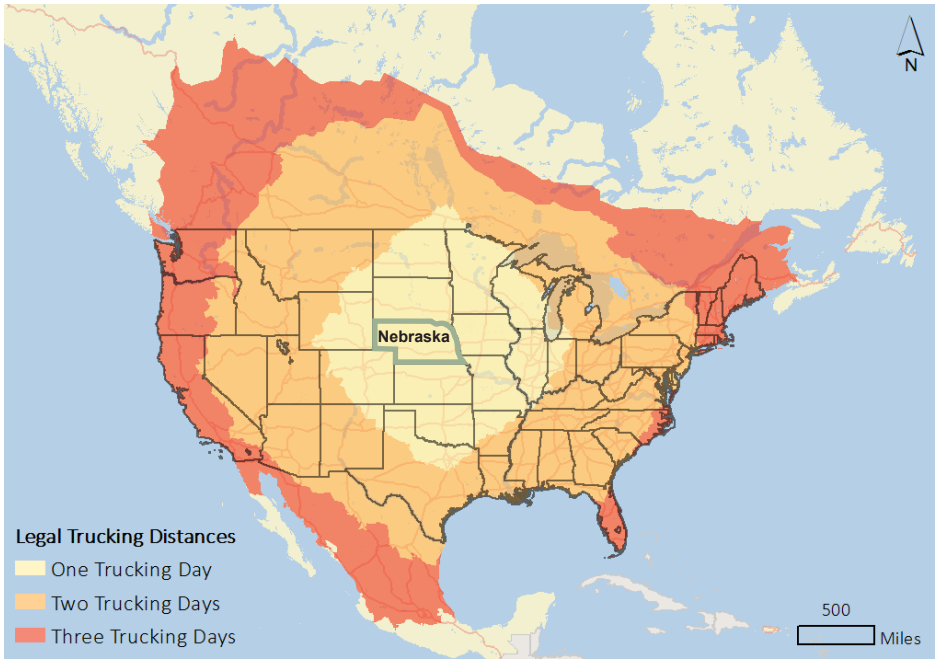
I. Nebraska Location Resources

Nebraska lies near both the population and geographic centers of the United States (Figure 3). The nation's population center moved across the Mississippi River for the first time in 1980 and continues to shift westward. The current population center is near Plano, Missouri, and the geographic center is in Butte County, South Dakota (the geographic center of the 48 contiguous states is Smith County, Kansas). Within one day, goods shipped by truck from Nebraska reach more than 25 percent of the U.S. population; add a second day and the percentage skyrockets to more than 90 percent.

In addition to being a prominent location for national markets, Nebraska is well situated to serve international markets, which are important to many machinery manufacturers. For example, the Union Pacific's main railroad line in central Nebraska is the busiest freight corridor in the world; many of the trains carry grain to West Coast ports for shipment around the world. Also, the state currently has operating Foreign Trade Zones in Omaha (Zone No. 19, Grantee: Greater Omaha Chamber of Commerce) and in

Figure 3

Truck Access to Regional and National Markets



Source: Nebraska Department of Economic Development. Legal Trucking Distances from Columbus, Nebraska [maps]. 2016: Melissa Trueblood; using ESRI Business Analyst Desktop.

Lincoln (Zone No. 59, Grantee: Lincoln Chamber of Commerce). Foreign trade zones reduce or eliminate duties and excise taxes by allowing domestic activity involving foreign items to take place as if it were outside of U.S. Customs territory.

Access to Markets - Transportation

Nebraska's central location is especially advantageous for transportation services. The state's communities are connected by a good highway system that includes 8,539 miles of interstate, freeway, and arterial roads. That system includes a 455-mile stretch of Interstate 80, the most traveled east-west transcontinental route of the interstate highway system. North-south interstate highways that add to Nebraska's market include Interstate 29, which passes along the state's eastern border in Iowa, and Interstate 25, which passes in close proximity to the state's western border.

More than 13,500 licensed motor carriers with worldwide connections are based in Nebraska and serve businesses throughout North America. Largely because of Nebraska's good interstate connections, one of the largest trucking companies in the country, Werner Enterprises, is headquartered in Omaha.

The nation's two largest rail companies—BNSF Railway Company and Union Pacific Railroad—provide rail service to many Nebraska communities. Ten freight railroads operate more than 3,200 miles of track throughout the state. No major city in the United States is more than five days by rail from Nebraska. Amtrak provides passenger service in Nebraska with stops in five communities.

The Union Pacific (UP) maintains headquarters in Omaha and is one of the largest railroads in North America with 32,000 miles of track in the western two-thirds of the country. UP operates more than 1,000 miles of track in Nebraska. The Harriman Dispatching Center in Omaha is the most technologically advanced dispatching facility in the country. Union Pacific's Bailey Yard in North Platte is the largest rail freight car classification yard in the world. The yard covers 2,850 acres, switches 10,000 rail cars daily, and has more than 300 miles of track. Union Pacific's main line in central Nebraska is the busiest rail freight corridor in the world, with more than 115 trains operating over the line every 24 hours.

BNSF Railway Company (BNSF) operates more than 1,500 route miles of track in Nebraska, is one of the state's primary railroads transporting two million carloads of freight in Nebraska each year, and employs more than 4,000 people in the state. BNSF has rail yards in Alliance, Lincoln, McCook, and Omaha; intermodal and automotive facilities in Omaha; and mechanical shops in Alliance and Lincoln.

Commercial airline service is available in six Nebraska cities, providing direct service to major hubs. Scheduled air freight service is provided to five additional communities with on-demand service available. A total of 81 public-use airports are located throughout the state.

With the Missouri River forming Nebraska's eastern border, the state is a western terminus for barge traffic. Barges have access to both the Gulf of Mexico via the Mississippi River and to the Atlantic Ocean via the Great Lakes and the St. Lawrence Seaway.

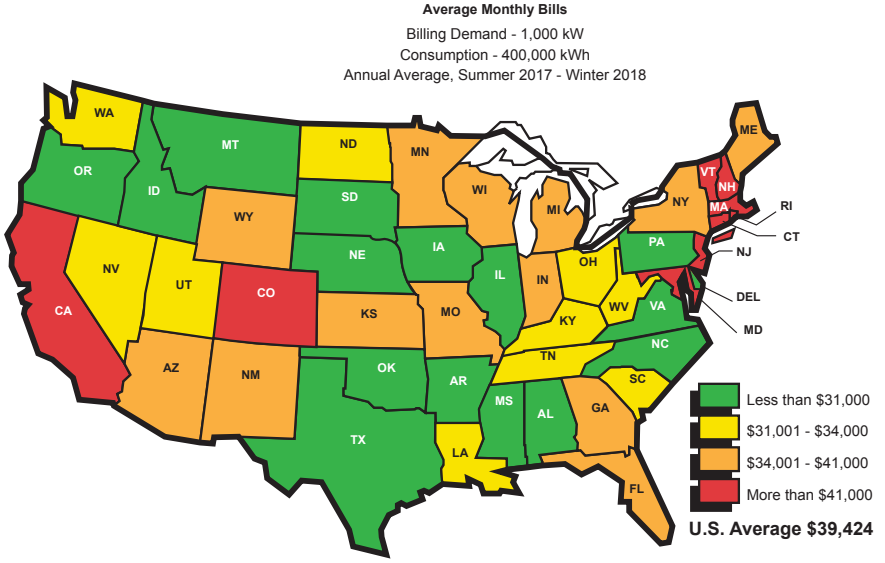
Low Cost Utilities

In providing a full range of reliable utilities with many cost advantages, Nebraska offers additional benefits to machinery manufacturers. Nebraska's electric rates for typical industrial customers are 19.1 percent less than the U.S. average and are among the lowest of the 48 contiguous states (Figure 4, next page). This benefit is of particular importance to the "Machinery Manufacturing" subsector (NAICS 333), with its high level of electricity use relative to total energy consumption. A statewide grid system with regional interconnections assures reliability of service and adequacy of supply.

One of the reasons for Nebraska's low electric rates is its close proximity to the vast low-sulfur coal fields of eastern Wyoming. It is also the only state in the nation with electric service provided entirely by public power. Nebraska's two largest utilities, Nebraska Public Power District (NPPD) and Omaha Public Power District (OPPD), have under their control an

Figure 4

Electric Costs for Industrial Service, Summer 2017 - Winter 2018



Source: Edison Electric Institute, "Typical Bills and Average Rates Report," July 1, 2017 and January 1, 2018. State averages are weighted using eight months of January 2018 data and four months of July 2017 data. Nebraska data represent the average for Omaha Public Power District, Lincoln Electric System, and Nebraska Public Power District using the same seasonal weighting.

efficient and dependable "mix" of generating systems to supply current and projected needs; the mix includes coal, nuclear, hydro, gas, oil, wind, and diesel sources.

Some major electric-generating facilities in Nebraska are:

- 1,300-megawatt (MW) NPPD coal-fired Gerald Gentleman Station near Sutherland, Unit No. 1 on-line in 1979 and Unit No. 2 on-line in 1982
- 1,330-megawatt OPPD coal-fired Nebraska City Station near Nebraska City, Unit No. 1 on-line in 1979 and Unit No. 2 on-line in 2009
- 800-megawatt NPPD Cooper Nuclear Station near Brownville, on-line in 1974

NPPD owns and operates a 59 MW wind generation facility near Ainsworth. NPPD has long-term agreements to purchase 122 MW of wind generated power from Nebraska facilities located near Bloomfield, 80 MW from a facility near Petersburg, 75 MW from a facility located in Custer County, and 75 MW from a facility near Steele City.

Nebraska utilities also operate 12 hydroelectric plants and receive a power allotment from the Western Area Power Administration (WAPA) hydroelectric facilities on the Missouri River. The utilities operate with a reserve capacity that protects users against voltage reductions and brownouts. Furthermore, the utilities are members of the Mid-Continent Area Power Pool (MAPP), the Southwest Power Pool (SPP), and the Western System Power Pool (WSPP).

Natural gas in Nebraska is also attractive to industry for service, supply, and price. A gas-producing state, Nebraska is close and well-connected by pipeline to the major gas fields of the central and southern plains. The state's average cost of industrial gas is less than both the regional and national averages.

The pipelines of two major companies, Northern Natural Gas and Kinder Morgan, provide an ample supply of natural gas to most areas of Nebraska. Depending on usage requirements, natural gas is offered both on a "firm" and "interruptible" basis.

High Quality Work Force

Any industry derives benefits from a productive and well-educated labor force. Nebraska's labor force has a strong work ethic and technical proficiency. The state was settled by individuals with the foresight and diligence to transform it into a world center of agricultural production. Their descendants maintain a work ethic and mechanical aptitude that carry over into the state's manufacturing sector. Contributing to Nebraska's high labor productivity are very low absenteeism and labor turnover rates. Furthermore, Nebraska employers pay among the lowest unemployment insurance and workers' compensation costs in the nation.

Nebraska's work force quality is also highly rated by the state's employers and by various national comparisons. In 2016, 90.9 percent of the state's population 25 years of age and older were high school graduates, compared to 87.5 percent nationally. In addition, the 2014–15 Nebraska public high school graduation rate was 90.0 percent. One reason for the high graduation rate is the state's comparatively low student-teacher ratio—13.60:1 in 2014–15 compared to 16.07:1 for the nation. Finally, Nebraska students consistently score above the U.S. average on both standardized achievement tests and college entrance exams. In 2017 Nebraska students averaged 21.4 on the ACT college entrance test, compared to 21.0 nationally. Moreover, Nebraska's average composite ACT score was achieved with 84.0 percent of graduates taking the exam, compared to 60.0 percent of graduates nationwide.

Higher Education Resources

As part of a growing and rapidly changing industry, machinery manufacturers can benefit greatly from flexible state-of-the-art educational resources. The University of Nebraska, state colleges, and the community college network are important elements in providing resources to assist manufacturers in maintaining an educated and trained work force.

The University of Nebraska, is comprised of four campuses: the University of Nebraska-Lincoln, the University of Nebraska Omaha, the University of Nebraska Medical Center, and the University of Nebraska at Kearney. It has the largest facilities among the state's 21 colleges and universities and offers advanced degrees in most professional fields. It is a major center for both basic and applied research and has a combined student enrollment of more than 52,500.

Founded in 1869, the University of Nebraska-Lincoln (UNL) is the state's land-grant university. Nebraska was the first university west of the Mississippi to establish a graduate college (in 1896). UNL boasts 22 Rhodes scholars and 2 Nobel laureates among its alumni.

Research

Research expenditures at the University of Nebraska-Lincoln totaled more than $294 million in 2016. This total included nearly $95 million in federal research expenditures. The National Science Foundation accounted for 30 percent of the university's federal research expenditures, followed by 23 percent from the U.S. Department of Agriculture, 17 percent from the Department of Health and Human Services, and 8 percent from the Department of Defense. UNL's goal is to achieve $300 million in research expenditures by 2018.

Engineering

The University of Nebraska-Lincoln College of Engineering offers programs on three campuses: City and East Campuses in Lincoln and Scott Campus in Omaha. Currently, the college has over 4,200 students enrolled and 300 permanent faculty and staff. A total of 12 undergraduate majors and numerous graduate programs are offered in the departments of Biological Systems Engineering (includes Agricultural Engineering), Chemical and Biomolecular Engineering, Civil Engineering, Computer Science and Engineering, the Durham School of Architectural Engineering and Construction, Electrical and Computer Engineering, and Mechanical and Materials Engineering.

Research at the College of Engineering is progressive and collaborative, supporting innovative research through two core facilities,

housing six areas of research, and more than 16 research centers and laboratories. The two core facilities are supported by the Nebraska Research Initiative funded by the Nebraska Legislature to significantly enhance the scientific and research capabilities at UNL in technological areas with commercial potential. The Advanced Electro Optics Engineering Core Facility houses state-of-the-art lasers for producing a range of novel materials, thin films, and coatings that can be deposited with atomic precision on nanometer- to millimeter-sized areas/volumes. The Advanced Manufacturing Engineering Core Facility has the unique capability of synthesizing biological products, nanocomposites, and nanomachined electrical components. The programs residing in the research centers/ laboratories include a $10-million program for transportation research, an organization developing the technologies for the next generation of bridges and pavement, and a facility developing vaccines against biological warfare agents and products that can be used as therapeutic countermeasures to treat people who have been exposed to biological agents.

The **Engineering and Science Research Support Facility (ESRSF)** is a dedicated, highly diverse technical facility with expertise in mechanical design, manufacturing, machining, fabrication, and technical services. The ESRSF technical staff combines high technical aptitude and background in hands-on instrument design, advanced machining, welding, fabrication, and materials testing. ESRSF will provide manufacturers with consulting services, prototyping, new part production runs, and other machining and construction services. Consulting services include: Workflow Management, Product/Process Design, Employee Technical Training, Machining Procedures, and Project Life Cycle Management.

- CNC & Conventional Machining, Welding, Fabrication, and Electroplating
- Flexible Machining
- Materials Testing Equipment

Equipment housed within the ESRS machine shop includes:

CNC Cincinnati-Milacron 1250 Sabre with Ab Acramatic 2100 Control

- has four-axis operation with a maximum of three-axis interpolation. This machine is used for a variety of drill system parts and components. Its large capacity allows for work pieces up to 50" x 30" x 26". This CNC machining center utilizes the latest computer technology for the machining of complex contours through parametric programming (equational programming), solid modeling programming through CAM software, and online quick programming of simple geometries. This feature enhances the technical staff's ability to accommodate a wide range of machining jobs.

BridgePort Series 1 CNC Milling Machines (2)

- provide additional resources for high volume machining and drastically cut delivery time to the customer. They are capable of machining smaller complex and simple 2-dimensional work pieces. Their conversational shop floor programming features allow tool makers to quickly program and machine the work piece.

CNC BridgePort Interact 412 Machining Center

- a three-axis, 12-tool station with a GE Fanuc Series O-Mate control that is available for multiple part production. Off-line part programming using a CAD workstation facilitates part design and production.

CNC Mazak Quick Turn ATC Lathe

- has a unique feature of live tooling on the turret. This feature allows the technical staff to perform turning and milling operations in one setup. The result is a high precision process that can be performed without ever having to remove the work piece from the chuck, which eliminates costly secondary machining processes. The Mazak CNC lathe has been used to machine drill system components for the past eight years.

Engis Lapping Machine

- for precision machining, is used to machine and polish work pieces of extreme tolerances (.000001 inch). Common applications are thin film polishing and material removal, sharpening to razor edges, and finish machining of hardened materials. This lapping machine is located in the clean room facility of the engineering machine shop. During and after machining, the work piece is inspected with precision inspection equipment.

25" x 18" Nardini Gap Bed Lathe

- where much of the large cumbersome work pieces that require turning operations are performed. Drill system equipment such as barrels, large pulleys, housings, winch hubs, etc. are currently machined on the Nardini Lathe. Other heavy applications include the machining of train axles and wheels for material science research projects.

Conventional BridgePort Milling Machines (3)

- used for such applications as milling, drilling, boring, key-way cutting, etc.

Conventional 15" x 50" Clausing Lathes (2)

- used for turning, threading, and boring of cylindrical work pieces. All of the conventional machining equipment contains state-of-the-art digital readouts and tooling.

Kent Automatic Surface Grinder

- used for grinding flat and angular surfaces. This grinder has been used for sharpening ice coring cutters, core dogs, reamers, and surface grinding precision drill system parts. An Oliver tool cutter grinder is used for the complex geometry grinding on double angle cutters, core dogs, and reamers.

Tig, Mig, Gas, and Arc Welders

- all have a capacity ranging from very intricate applications to heavy-duty. The Tig and Mig welders can accommodate a wide range of steel and non-ferrous alloys. The shop has an acetylene/oxygen gas torch for brazing and flame cutting, along with a plasma cutting unit.

Haas CNC Lathe

- allows technical staff to perform turning operations for high-precision machining.

Betenbender Heavy Duty Shear, Edwards 100-Ton Iron Worker, and Additional Hand Brakes and Foot Shears

- turn in-house fabrication and sheet metal work into routine services for the machine shop.

Materials Testing Bay

- the bay houses computer-controlled testing machines that can perform a variety of material and structural tests. The capacities of these testing machines are from 0 to 440,000 pounds. A torsion testing machine is available for testing barrels, well screens, drive shafts, gears, and more. Impact testing equipment is also accessible for impact tests on metals, plastics, and other materials.

A brief description of centers offering special expertise of interest to manufacturers of machinery follows.

Nebraska Center for Materials and Nanoscience (NCMN) is a multidisciplinary organization with more than 90 faculty members from UNL and other University of Nebraska campuses. The concern is with atomic manipulation, properties affected by nanoscale dimensions, self-assembly, ordered nanoarrays, quantum dots and wires, nanoelectronics, quantum computing, nanomechanics, nanooptics, molecular design, nanoelectro-mechanical systems, nanobiological function, and life sciences.

There are eight central facilities to support the NCMN's mission: Electron Microscopy, Materials Preparation, Mechanical and Materials Characterization, Scanning Probe Microscopy, X-Ray Structural Characterization, Nanofabrication, and Cryogenics. These facilities are available to all university faculty as well as companies in Nebraska and elsewhere.

Center for Nontraditional Manufacturing Research is dedicated solely to the examination of nontraditional manufacturing methods. Projects involve both basic and applied research on numerous nontraditional manufacturing processes such as EDM, ECM, and USM.

Along with research and development efforts at the University of Nebraska, Nebraska operates a state college system with campuses at Chadron, Peru, and Wayne. Undergraduate degrees are offered at these institutions in Industrial Technology and Industrial Management and teaching endorsements are offered in Industrial Technology Education and Trade and Industrial Education. A variety of private colleges and universities are also located in Nebraska including Creighton University in Omaha, Nebraska Wesleyan University in Lincoln, and others throughout the state (see Figure 5A) on page 23.

Another important facet of higher education in Nebraska is the statewide community college system that provides specialized training programs for new and expanding industries. As indicated in Figure 5B (page 23), the state has six community college areas, which provide services in 25 cities across the state. The colleges offer a full curricula of occupational courses, which provide a steady flow of skilled graduates to Nebraska industries. As examples, Hastings and Milford Community College Campuses offer vocational/technical training in more than 50 different one-year and two-year programs, including Associate of Applied Science degrees in "Machine Tool Technology," "Manufacturing Engineering Technology," "Nondestructive Testing Technology," and "Welding Technology." Training is accomplished through the extensive use of hands-on activities and is centered around practical application of technical knowledge gained in lecture and laboratory sessions.

Performance-Based Tax Incentives

In 2005 the Nebraska Legislature enacted the Nebraska Advantage Tax Incentive Program and amended the program in 2008 and 2010. The Nebraska Advantage package replaced and improved on Nebraska's existing tax incentive programs and created a business climate that makes Nebraska the preferred location for business start-ups and expansions. The Nebraska Advantage rewards businesses that invest in the state and hire Nebraskans. In this progressive, pro-business climate, corporate income and sales taxes are reduced or virtually eliminated. Further information about the Nebraska Advantage is summarized in this study and is available at **www.opportunity.nebraska.gov/why-nebraska/incentives.**

The legislative components of the Nebraska Advantage package include:

Nebraska Advantage Act (LB 312)

- Expanded incentives for six "tiers" of investment and/or job creation
- Small business advantage
- Research and development advantage
- Microenterprise tax credit advantage
- Rural development advantage
- State and local sales tax exemptions of manufacturing machinery, equipment, and related services

Qualified businesses for Tier One include scientific testing research and development, manufacturing, and targeted export services. Qualified businesses for Tiers Two, Three, Four, and Five include the above plus data processing, telecommunications, insurance, financial services, distribution, storage, transportation, and headquarters (administrative), and the production of electricity using renewable energy sources. All businesses other than retail qualify for Super Tier Six. Retail sales of tangible personal property to specified markets can also qualify under Tiers Two through Six.

Nebraska Agricultural Innovation Advantage (LB 90)

- Agriculture opportunities and value-added partnership act
- Building entrepreneurial communities act
- Ethanol production incentive cash fund enhancement

Other components in the Nebraska Advantage package are:

Nebraska Customized Job Training Advantage - Provides a flexible job training program with grants from $500 to $4,000 per job. Additional funds may be available for new jobs created in rural or high poverty areas. Companies can design their own training or a statewide training team can assist with training

The University of Nebraska's NEAT Lab Prints Plastics and Titanium with Three New 3-D Printers

With a recent investment of nearly $1.5 million for three unique hybrid 3-D printers, the College of Engineering at the University of Nebraska-Lincoln is positioning itself on the cutting edge of additive manufacturing technology, providing invaluable opportunities for faculty, students, and industry.

The Nebraska Engineering Additive Technology (NEAT) Labs was installed in the loading bay area in Scott Engineering Center on the university's City Campus. The printers – two from Japanese manufacturer Matsuura and one from Optomec in New Mexico – are each close to 500 cubic feet and are hybrid printers: they can add or subtract multiple materials.

The printers are adept at sculpting many different types of materials – such as plastics or titanium – into highly complex three-dimensional shapes by using less material than conventional technology.

"This is incredibly rare, unique equipment we're now able to access," said Michael Sealy, assistant professor of mechanical and materials engineering.

The labs allow for printing products using highly reactive materials such as magnesium, titanium, and aluminum and for a part to be machined as it's being built – a capability imperative for creating intricate geometries such as lattice structures and complex internal cooling channels for aerospace applications.

The printing possibilities could help transform many industries, especially paired with the quality control systems development research of Prahalada Rao, assistant professor of mechanical and materials engineering.

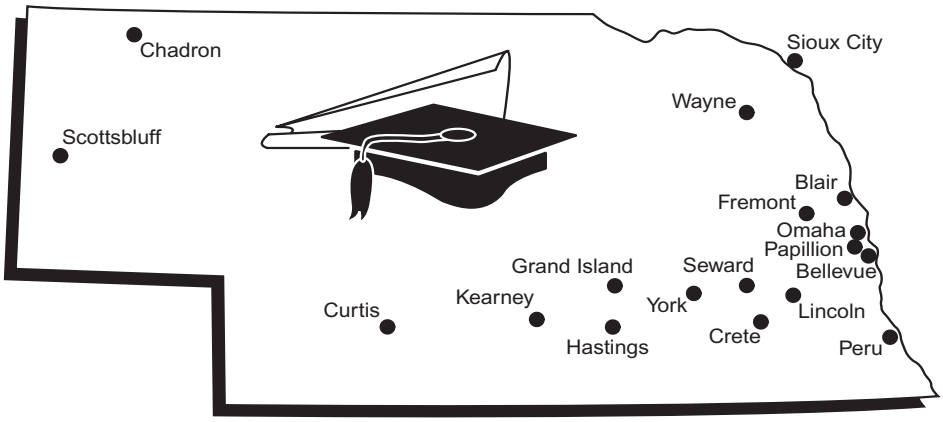
"Nebraska is working to become a hub for additive manufacturing in a variety of industries, including agricultural equipment, manufacturing, and biomedical applications," Rao said. "If this research is successful, it will have a huge impact on how quickly and reliably we can turn around new products and designs, spurring innovation in the state."

Companies and individuals interested in learning more about the printers' capabilities and the current research can find out more at **engineering.unl.edu/NEAT/**.

Article submitted by the Univerisity of Nebraska's Department of Engineering.

Figure 5A

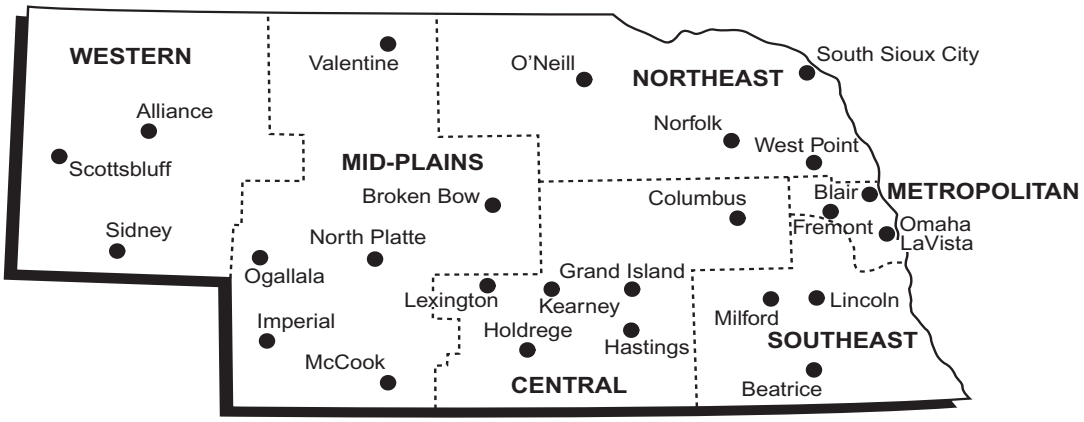
Location of Nebraska Area Colleges and Universities



Source: Nebraska Coordinating Commission for Postsecondary Education.

Figure 5B

Community Colleges in Nebraska



Source: Nebraska Community College System.

assessments, training plans, curriculum development, and instruction.

Nebraska Research and Development Advantage - Offers a refundable tax credit for research and development activities undertaken by a business entity. The credit is equal to 15 percent of the federal credit allowed under Section 41 of the Internal Revenue Code of 1986. The credit is increased to 35 percent of the federal credit allowed under Section 41, if the business firm makes expenditures on the campus of a Nebraska college or university or a facility owned by a college or university in Nebraska. An important feature—businesses with little or no income may take advantage of the tax credit by receiving a sales tax refund or a refundable income tax credit.

Nebraska Microenterprise Tax Credit Advantage - Provides a 20 percent refundable investment tax credit to micro businesses on a new investment in targeted communities. Applicants may qualify for a maximum $10,000 throughout the life of the program. The credit is geared to companies with five or fewer employees, including start-ups. Credits are approved through an application process with the Nebraska Department of Revenue and evaluated on expected local economic impacts. The credits are earned on new expenditures for

wages, buildings, certain expenses, and non-vehicle depreciable personal property.

Additional Tax Savings:

- Sales Tax Exemption On:
  - Manufacturing equipment
  - Manufacturing or processing raw materials
  - Common carrier vehicles
  - Utilities used in manufacturing
- No Tangibles Tax
- No Inventory Tax
- Sales Tax Refund on Pollution Control Equipment
- 100% Tax Exemption on Certain Personal Property

In a tax policy incentive, Nebraska determines the taxable income attributable to Nebraska operations using a single factor, or "sales only" formula. This method for determining corporate income tax allocation provides a significant advantage to multi-state unitary firms that sell products or services outside Nebraska. Nebraska also provides a capital gains exemption. State residents may elect, on a one-time basis, to subtract from their income tax liability the gain from the sale of capital stock of a corporation acquired during Nebraska-based employment with the corporation.

New Economic Development Initiatives

Nebraska has recently adopted several new legislative initiatives and programs designed to build Nebraska's innovation economy and foster new high-quality job opportunities. Additional information on all these initiatives can be viewed at **www.opportunity.nebraska.gov**.

Talent and Innovation Initiative (TI2) - The four-part TI2 was developed to enhance momentum in Nebraska's fastest growing industries, maintain Nebraska's world class workforce, and leverage private sector innovation.

Nebraska Internship Program (InternNE), LB 476, is a partnership with Nebraska businesses to create paid internship opportunities for full-time students who are in the eleventh or twelfth grade in a public or private high school, enrolled full time in a college, university, or other institution of higher education, or applies for an intership within six months following graduation from a college, university, or other institution of higher education.

Grant awards are capped at ten per business, five per location. Internships must pay at least minimum wage and have a duration of at least 160 hours. Applications are accepted continuously and reviewed for consideration bi-monthly. The program will reimburse a business 50 percent of their cost of wages paid, up to $5,000 per internship.

Business Innovation Act, LB 387, is intended to help businesses develop new technologies and leverage innovation to enhance quality job opportunities in the state. It will provide competitive matching grants for research, development, and innovation and will also help expand small business and entrepreneurial outreach efforts. Eligible grant activities may include: prototype development, product commercialization, applied research in the state, and support for small business and microenterprise lending.

Site and Building Development Fund, LB 388, makes state resources available to increase industrial site and building availability and support site ready projects. State funding will be focused initially on land and infrastructure development and building rehabilitation, with 40 percent of funding available to non-metro areas. Communities will provide matching funds. This program also makes funding available to assist with demolition of dilapidated residential and industrial buildings and offers direct support to communities that lose a major employer.

Angel Investment Tax Credit, LB 389, encourages investment in high-tech startup enterprises in Nebraska by providing a 35–40 percent refundable state income tax credit to qualified Nebraska investors investing in qualified early-state companies. Capped at $4,000,000 annually, the program requires minimum investment of $25,000 for individuals and $50,000 for investment funds. Eligible small businesses must have

fewer than 25 employees, with the majority based in the state.

Other Development Assistance Programs

Building on traditional advantages, Nebraska offers additional development assistance programs. Among those programs are the following:

Tax Increment Financing (TIF) - An additional incentive program of note is Nebraska's Tax Increment Financing. TIF is a method of financing the public improvements associated with a private development project in a blighted area by using the projected increase in property tax revenue that will result from the private development.

Community Development Block Grants (CDBG) - Eligible businesses may be able to qualify for CDBG through local governments so they may make improvements to the public infrastructure serving the project site. Performance based loans of up to $1,000,000 may be awarded to qualifying companies creating new investments and jobs. Fifty-one percent of the new jobs must be held by or made available to low- or moderate-income persons. Other federal requirements apply. The program is administered by the Nebraska Department of Economic Development. More details are available at **www.opportunity.nebraska.gov**.

Industrial Revenue Bonds - All Nebraska counties and municipalities, as well as the Nebraska Development Finance Fund, are authorized to issue industrial revenue bonds to finance land, buildings, and equipment for industrial projects. No general election is required for an issue.

Other Financing Assistance - Supplementing traditional sources, financing assistance is also available through the Nebraska Investment Finance Authority, the Business Development Corporation of Nebraska, and the local development corporations. The Nebraska Department of Economic Development also administers development finance services, with staff helping assemble government financing with conventional financing to put together the best comprehensive package.

It is important to recognize the Nebraska Advantage package replaces and significantly enhances Nebraska's previous performance-based tax incentive programs. Those earlier incentives, the first of which was passed by the Nebraska Legislature in 1987, had a profound effect in stimulating business investment, expansion, and job creation. Nebraska's previous tax incentive programs contributed to substantial investment and job creation, including total investment of more than $23.5 billion and 121,000 jobs.

The combination of many factors, including Nebraska's attractive business climate, tax incentives, labor productivity, and effective job training programs as well as other positive attributes, has resulted in Nebraska's manufacturing sector significantly outperforming both that of the surrounding states and the U.S. as a whole. Manufacturing employment in Nebraska grew by 17.1 percent between 1990 and 2000. As the U.S. economy experienced two major recessions between 2000 and 2010, manufacturing employment in Nebraska declined but outperformed the Plains Region and the nation (Figure 6, next page). These data suggest that companies with Nebraska manufacturing plants benefit from location and other competitive advantages associated with doing business in Nebraska.

Quality of Life

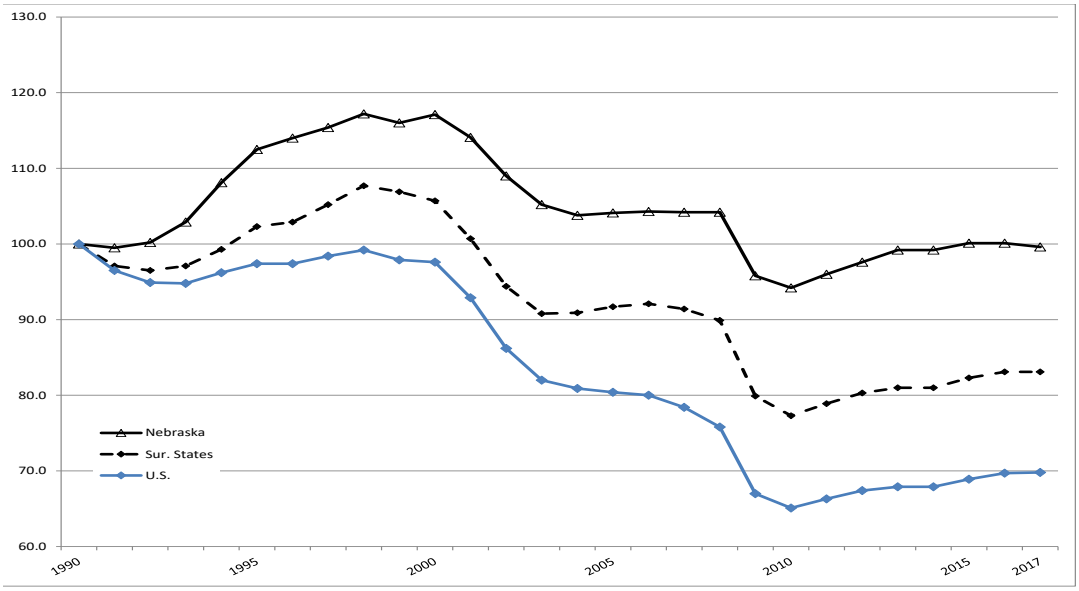
For a potential newcomer to Nebraska, the state's livability is obviously also a consideration. Nebraska ranks high in quality of life studies—and at or slightly above average in cost of living measures. The state's landscape is clean and spacious, both in urban and rural areas. Residents blend Midwestern values with Western enthusiasm for growth and change. This helps create a high degree of citizen participation in both neighborhood and community-wide activities.

The cost of living in Nebraska is consistently at or slightly below the national average. Data presented in Table 9 (next page) indicates on average, the cost of living

in Nebraska is 4.9 percent less than the U.S. average. Of particular interest is the cost of housing in Nebraska, which averages 14.3 percent less than for the U.S. as a whole for families owning a home.

Figure 6

Manufacturing Employment, Nebraska, Surrounding States, and the U.S., 1990–2017, 1990=100



Source: Bureau of Labor Statistics, **www.bls.gov**.
Surrounding states include data for states contiguous to Nebraska, as a group, including Colorado, Iowa, Kansas, Missouri, South Dakota, and Wyoming.

Table 9

Cost of Living in Nebraska, Compared to the National Average, July 1, 2018

	All Items Index [a]	Consum-ables	Transpor-tation [b]	Health Services	Monthly Rent [c]	Home Value [c]	Utilities	Income/ Payroll Taxes
U.S. Average	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Nebraska	95.1	95.4	102.2	103.0	92.0	85.7	75.6	84.9
Omaha, NE	95.3	96.3	94.0	99.4	116.2	85.9	86.4	84.9
Lincoln, NE	101.1	98.4	103.9	105.4	104.4	99.2	72.1	84.9
Nonmetro NE [d]	92.5	94.5	103.9	103.3	82.2	80.0	72.1	84.9

Source: Index values computed from cost-of-living data obtained from Economic Research Institute (ERI), Relocation Assessor Database as of July 1, 2018.

[a] Cost of living values computed for a family of three with an annual income of $50,000.

[b] Transportation costs assumes ownership of two cars valued at $14,312, which are driven a total of 20,000 miles annually.

[c] Assumes a house of 1,613 square feet for both rental assumption and home value.

[d] Nonmetro Nebraska data represent the average of 14 Nebraska cities outside of the Omaha and Lincoln metropolitan areas. These cities include Beatrice, Columbus, Dakota City, Fremont, Grand Island, Hastings, Kearney, McCook, Norfolk, North Platte, O'Neill, Scottsbluff, South Sioux City, and Valentine, Nebraska.

CONCLUSIONS

This study concludes the machinery manufacturing industry is desirable for Nebraska and a Nebraska location is desirable for the industry. The locational advantages Nebraska offers appear well-suited to machinery manufacturers. They cover a wide spectrum, ranging from an attractive business climate to a high quality of life at a relatively low cost. But, as the study's model plant analysis demonstrates, in Appendix A on the following page, the competitive advantages Nebraska offers in such important cost areas as labor and energy are particularly noteworthy. The state's well-educated and productive labor force is a long-standing asset, as are its very favorable electric and natural gas rates.

Essentially, the analysis presented in this study was based on state-to-state comparisons applicable to the machinery manufacturing industry generally. Individual manufacturers will therefore need to further consider the locational requirements of their particular kinds of machinery manufacturing as well as the merits of specific sites within states. Certainly in terms of general locational situation for machinery manufacturers, Nebraska has much to offer.

The three organizations cooperating in the preparation of this study can also assist machinery manufacturers in assessing advantages in Nebraska for a specific new location or expansion project. To obtain this assistance, write or call:

Economic Development Department
NEBRASKA PUBLIC POWER DISTRICT
PO Box 499
Columbus, Nebraska 68602-0499
(402) 563-5534
(877) 275-6773
Email: mmplett@nppd.com
sites.nppd.com

Nebraska Public Power District
Always there when you need us

NEBRASKA Advantage

Business Development Division
NEBRASKA DEPARTMENT OF ECONOMIC DEVELOPMENT
PO Box 94666
Lincoln, Nebraska 68509-9466
(402) 471-6513
(800) 426-6505
Email: jason.guernsey@nebraska.gov
www.opportunity.nebraska.gov

UNIVERSITY OF NEBRASKA-LINCOLN COLLEGE OF ENGINEERING
114 Othmer Hall
PO Box 880642
Lincoln, Nebraska 68588-6363
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engineering.unl.edu

COLLEGE OF ENGINEERING

APPENDIX A
LABOR AND ENERGY COST ANALYSIS

Nebraska offers a wide range of locational advantages for machinery manufacturers. In this Appendix, labor and energy production cost factors that have geographic variability are analyzed. Such analysis permits the identification of the plant site providing the best advantage on these important input factors.

In the analysis of geographically variable labor and energy costs, the following procedures are used:

1) Selection of alternative plant locations for evaluation of the geographically variable labor and energy costs.
2) Definition of a model manufacturing plant for identifying labor and energy inputs and costs.
3) Evaluation of labor-related costs associated with each alternative plant location.
4) Evaluation of energy costs for each alternative plant location.

Alternative Plant Locations

Sixteen alternative plant locations were selected for comparison in this analysis. The plant locations include the top ten states in terms of value of shipments by the "Machinery Manufacturing" subsector (NAICS 333) and other states near Nebraska with which it typically competes for industrial location projects. The sixteen states account for 64.7 percent of the value of shipments from the machinery industry (see Table A-1).

Table A-1

Alternative Locations for a Model Plant for the Machinery Manufacturing Subsector (NAICS 333)

State	Percent of Value Added by Manufacture [(a)]
Nebraska	**0.9**
California	5.2
Georgia	3.0
Illinois	5.4
Indiana	3.2
Iowa	4.0
Kansas	1.7
Michigan	5.8
Minnesota	2.9
Missouri	2.2
New York	3.7
North Carolina	4.2
Ohio	5.8
Pennsylvania	4.0
Texas	7.3
Wisconsin	5.3
Total Selected States*	**64.7**

Source: U.S. Bureau of the Census, *Annual Survey of Manufactures, 2016.*

[(a)] Percent of the 2016 U.S. total value added by manufacture for establishments in NAICS 333.

* Values may not sum due to rounding.

Table A-2

Characteristics of a Model Plant for the Machinery Manufacturing Subsector (NAICS 333)

	Total Model Plant	Per Production Worker
Production Workers	50	- - -
Value Added [dollars] [a]	13,931,100	278,622
Total Output [dollars] [b]	28,294,900	565,898
Energy Inputs [million BTUs] [c]	13,017	260

Source: Calculated from data presented in Table A-3 and from U.S. Bureau of the Census, *Annual Survey of Manufactures, 2016.*

[a] Estimated value added applies the 2016 value added per production worker for the "Machinery Manufacturing" subsector (NAICS 333) to the model plant (see Table 4).

[b] Estimated value of shipments derived by applying the 2016 value of shipments per production worker to the model plant (see Table 4).

[c] Estimated by applying the 2016 ratio of energy inputs per production worker to the model plant (see Table A-3).

The Model Plant

To facilitate the analysis of the comparative labor and energy costs for the alternative states, it is useful to define a model plant for which the geographically variable costs can be quantified. The model plant is assumed to manufacture a product representative of the machinery manufacturing industry as a whole. To specify the relevant labor and energy costs, information was obtained from the *2016 Annual Survey of Manufactures*.

Table A-2 presents industry characteristics used in developing the model plant, which is assumed to employ 50 production workers. Estimated production worker hours total 104,000 annually or 2,080 hours per worker. Value added by manufacture is estimated to be $13,931,100 and the total annual output (value of shipments) is estimated to be $28,294,900. Energy inputs are estimated at 13,017 million BTUs, with all energy inputs supplied by electricity and natural gas.

Energy Used in the Model Plant

The assumption that the model plant is representative of the industry as a whole leads to the assumption that energy used in the plant also should be characteristic of industry use patterns. Part A of Table A-3 (next page) presents data estimating energy use for the industry in 2016. The estimated energy use for the model plant was derived using the ratio of energy inputs to industry value added. It was further assumed all energy inputs for the model plant are derived from electricity and natural gas.

Part B of Table A-3 (next page) indicates the model plant, employing 50 production workers, will have annual energy inputs of 13,016.8 million BTUs. Electric energy inputs are estimated to be 6,755.7 million BTUs (1,979,974 kWhs), or 51.9 percent of the total energy inputs, while natural gas inputs are estimated at 6,261.1 million BTUs.

Table A-3

Energy Use in Machinery Manufacturing Subsector (NAICS 333)
Manufacturing Establishments

Part A
Estimated 2016 Industry Energy Inputs

	Trillion BTUs	Percent
Purchased Fuels and Electric Energy	160.3	100.0
Purchased Electric Energy	83.2	51.9
Purchased Fuels	77.1	48.1

Source: Energy use estimated from data from the U.S. Bureau of the Census, *Annual Survey of Manufactures, 2016* and U.S. Energy Information Administration, *2014 Manufacturing Energy Consumption Survey.*

Part B
Energy Inputs for the Machinery Manufacturing Model Plant

	Million BTUs	Percent
Purchased Electricity	6,755.7 (1,979,974 kWhs)	51.9
Natural Gas	6,261.1	48.1
Total Energy Inputs	13,016.8	100.0

Source: Calculated from data in Table A-2 and Part A of this table.

Labor-Related Costs

Labor costs in the machinery manufacturing industry are affected by several factors: wage rates, productivity of workers, fringe benefits, unemployment insurance, and workers' compensation costs. Estimated annual labor-related costs for a model, machinery manufacturing plant operating at a Nebraska location and in each of the 15 alternative state locations are presented in Table A-4 (next page) and Figure A-1 (page A-5).

Table A-4 also includes data on wage rates for the states identified as alternative plant locations.

An analysis of state wage levels indicates Nebraska's production workers have hourly wage rates significantly below the average for the alternative plant sites. For example, 2016 hourly wage rates for Nebraska production workers ($23.09) are 5.4 percent below the average wage rates for the other 15 states included as alternative plant locations.

The Nebraska costs for unemployment insurance and workers' compensation are significantly less than the other states. In the case of unemployment insurance contributions, the average cost per employee for the 15 alternative states is estimated at $315.74 or 66.4 percent greater than the Nebraska cost of $106.00. Insurance rates for workers' compensation average $1.89 per $100 of payroll for the 15 alternative states, 13.2 percent more than Nebraska's rate of $1.67.

If located in Nebraska, the model plant has a significant labor cost advantage over the alternative locations. The Nebraska labor cost advantage reaches as high as $528,265 in annual savings when compared to New York. When compared to the average labor costs for the 15 alternative locations, Nebraska's annual labor cost advantage is $206,378 or 5.8 percent lower.

Table A-4

Total Annual Labor-Related Costs for a Model Plant for the Machinery Manufacturing Subsector (NAICS 333)

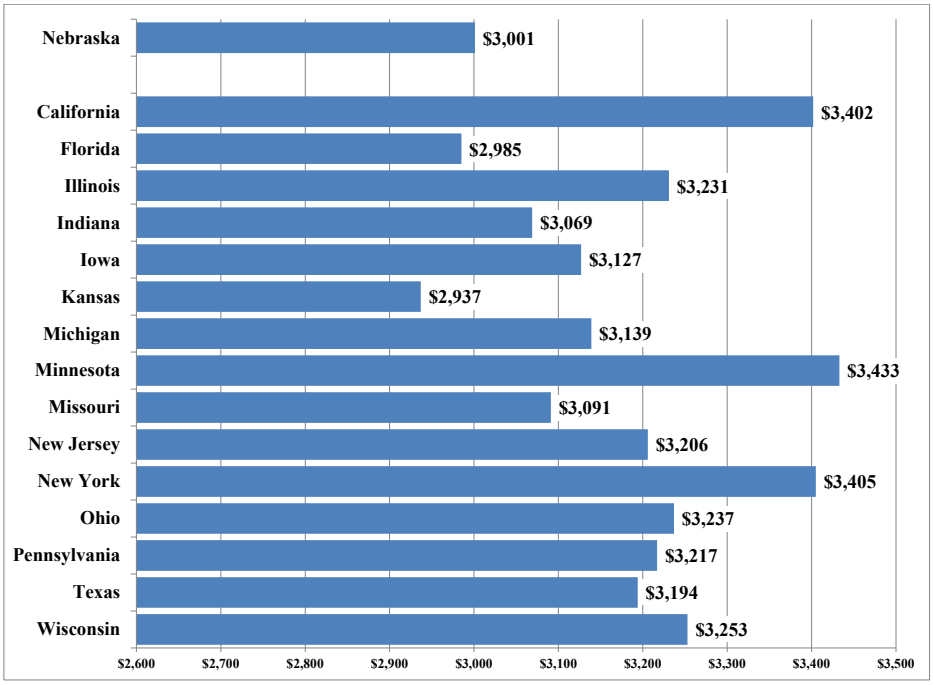
Plant Location	Hourly Wage Rate ($)	Number of Production Workers	Total Payroll ($)	Workers' Compensation Insurance ($)	Unemployment Insurance ($)	Social Security [a] ($)	Fringe Benefits[b] ($)	Total Labor Costs ($)	Cost Difference Other States (-) Nebraska ($)	Cost Relative Other States (/) Nebraska (/)
Nebraska	**23.09**	**50**	**2,401,400**	**40,103**	**5,283**	**183,707**	**720,420**	**3,350,913**	**0**	**100.0**
California	25.94	50	2,697,800	87,409	17,266	206,382	809,340	3,818,197	467,284	113.9
Georgia	21.46	50	2,231,800	40,172	8,481	170,733	669,540	3,120,726	-230,187	93.1
Illinois	23.63	50	2,457,500	54,802	16,957	187,999	737,250	3,454,508	103,595	103.1
Indiana	22.65	50	2,355,600	24,734	11,542	180,203	706,680	3,278,759	-72,154	97.8
Iowa	23.97	50	2,492,900	46,368	21,439	190,707	747,870	3,499,284	148,371	104.4
Kansas	23.80	50	2,475,200	34,900	11,138	189,353	742,560	3,453,151	102,238	103.1
Michigan	25.18	50	2,618,700	41,114	18,331	200,331	785,610	3,664,086	313,173	109.3
Minnesota	25.43	50	2,644,700	50,514	16,397	202,320	793,410	3,707,341	356,428	110.6
Missouri	22.54	50	2,344,200	45,009	9,611	179,331	703,260	3,281,411	-69,502	97.9
New York	26.45	50	2,750,800	77,848	14,854	210,436	825,240	3,879,178	528,265	115.8
North Carolina	22.91	50	2,382,600	45,508	11,675	182,269	714,780	3,336,832	-14,081	99.6
Ohio	24.94	50	2,593,800	37,610	16,082	198,426	778,140	3,624,058	273,145	108.2
Pennsylvania	26.37	50	2,742,500	50,462	32,087	209,801	822,750	3,857,600	506,687	115.1
Texas	25.48	50	2,649,900	38,424	13,514	202,717	794,970	3,699,525	348,612	110.4
Wisconsin	25.24	50	2,625,000	54,075	17,325	200,813	787,500	3,684,713	333,800	110.0

Sources: Oregon Department of Consumer & Business Services, *Oregon Workers' Compensation Premium Rate Rankings Calendar Year 2016, October 2016.*
U.S. Department of Labor, Bureau of Labor Statistics, August 2016.
U.S. Bureau of the Census, *Annual Survey of Manufactures, 2016*.
U.S. Department of Labor, Employment and Training Administration, *Unemployment Insurance Data, 2018*.

[a] Employer Social Security costs are 7.65 percent of payroll (wages).
[b] Fringe benefit costs are assumed to be 30 percent of payroll.

Figure A-1

Estimated Total Labor Costs* for a Machinery Manufacturing Model Plant, Alternative Plant Locations



Source: See Table A-4.

* Calculated labor costs include wages, workers' compensation insurance, unemployment insurance, social security, and fringe benefits.

Energy Costs

The availability and cost of energy are increasingly important factors in the industrial location process. Rates for industrial electricity and natural gas for the alternative plant locations are presented in Table A-5 (next page). For both energy sources, Nebraska's rates are generally less than the alternative states. The average electric rate for a 1,000 kW billing demand with monthly usage of 400,000 kWhs for the 15 alternative plant sites is $0.0891 per kWh or 17.1 percent more than the Nebraska rate of $0.0761.

In the case of industrial rates for natural gas, the average for the 15 other states is 26.7 percent more than the Nebraska rate of $4.04 per million BTUs.

Table A-5 and Figure A-2 (next page) provide an analysis of the energy costs for the operation of the model plant. The total energy costs for the alterative locations include the cost for the assumed level of electrical energy and natural gas inputs for the operation of the plant.

Nebraska provides a significant energy cost savings compared to the average of the alternative plant locations. When considering the California location, energy costs for the model plant are 98.7 percent more than the Nebraska energy costs. When compared to the average total energy costs for the 15 alternative states, Nebraska energy costs are 18.5 percent lower, translating into an average annual savings of $32,484.

Table A-5

Annual Energy Costs for a Model Plant for the Machinery Manufacturing Subsector (NAICS 333)

Plant Locations	Electricity Rate[a]	Electricity Cost	Natural Gas Rate[b]	Natural Gas Cost	Total Energy Cost	Cost Difference Other States (-) Nebraska	Cost Relative Other States (/) Nebraska
	($)	($)	($)	($)	($)	($)	(/)
Nebraska	**$0.0761**	**150,676**	**4.04**	**25,295**	**175,971**	**0**	**100.0**
California	0.1551	307,094	6.79	42,513	349,607	173,636	198.7
Georgia	0.0989	195,819	4.10	25,671	221,490	45,519	125.9
Illinois	0.0753	149,092	5.03	31,493	180,585	4,614	102.6
Indiana	0.0894	177,010	4.99	31,243	208,253	32,282	118.3
Iowa	0.0713	141,172	4.70	29,427	170,599	-5,372	96.9
Kansas	0.0876	173,446	3.69	23,103	196,549	20,578	111.7
Michigan	0.0959	189,880	5.75	36,001	225,881	49,910	128.4
Minnesota	0.0870	172,258	4.19	26,234	198,492	22,521	112.8
Missouri	0.0912	180,574	6.29	39,382	219,956	43,985	125.0
New York	0.0975	193,047	5.92	37,066	230,113	54,142	130.8
North Carolina	0.0747	147,904	5.43	33,998	181,902	5,931	103.4
Ohio	0.0790	156,418	4.81	30,116	186,534	10,563	106.0
Pennsylvania	0.0700	138,598	7.40	46,332	184,930	8,959	105.1
Texas	0.0718	142,162	2.65	16,592	158,754	-17,217	90.2
Wisconsin	0.0917	181,564	5.05	31,619	213,183	37,212	121.1

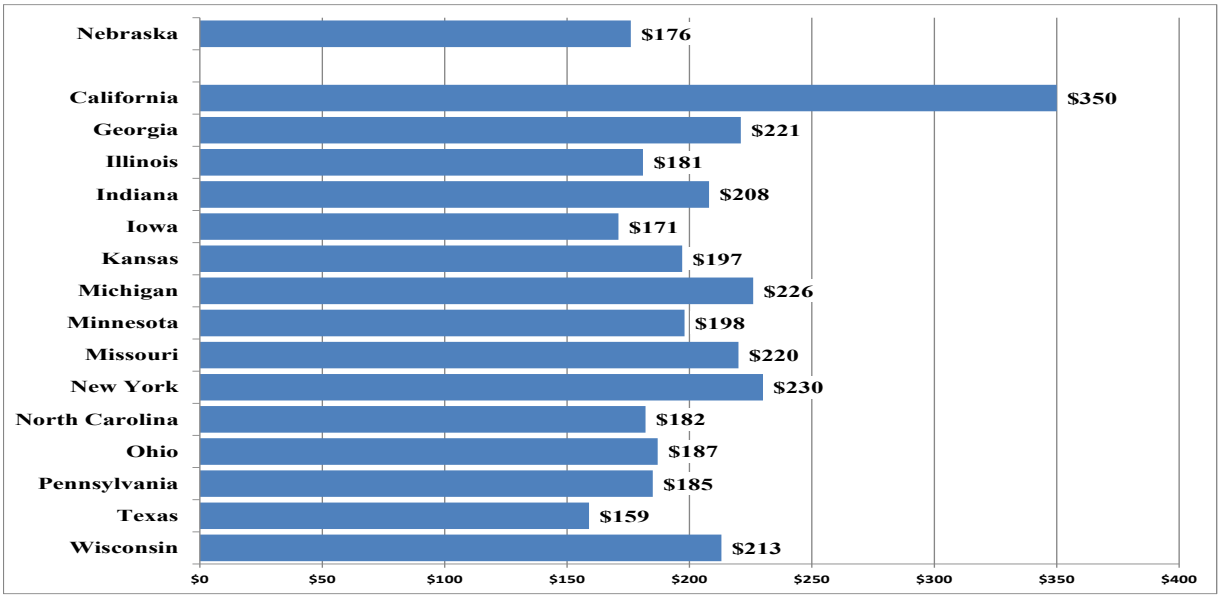
Sources:

[a] Electric rate is cost per kWh using the average per kWh cost for 1,000 kW monthly demand with 400,000 kWh of consumption. The model plant is assumed to use 3,556,990 kWh annually.

[b] U.S. Energy Information Administration, Natural Gas Data, available at http://www.eia.gov/dnav/ng/ng_pri_sum_a_epg0_prs_dmcf_m.htm. Accessed October 2016. Natural Gas rate is per million BTUs. The model plant is assumed to use 27,525.0 million BTUs annually.

Figure A-2

Estimated Total Energy Costs* for a Machinery Manufacturing Model Plant, Alternative Plant Locations



(Energy Costs in Thousands of Dollars)

Source: See Table A-5.

*Calculated energy costs include electricity and natural gas costs.

Labor and Energy Cost Summary

Combining the labor and energy cost findings, the results of the model plant analysis are summarized in Table A-6. As the table shows, a Nebraska location has a cost advantage over all of the 15 alternative states. When considering the average labor and energy costs for the 15 alternative states, the cost advantage of the Nebraska location is $238,862 annually, or 6.3 percent less than the average costs for the other 15 plant sites considered.

Conversely, the average labor and energy costs for the alternative states are 6.8 percent more than the costs associated with a Nebraska location. Inescapable from these results is the conclusion that, in terms of major labor and energy input costs, Nebraska machinery manufacturers have a clear competitive advantage over manufacturing establishments in the industry not so fortunately located.

Table A-6

Summary of Labor and Energy Costs for a Model Plant for the Machinery Manufacturing Subsector (NAICS 333)

Plant Locations	Total Labor Cost ($)	Total Energy Cost ($)	Total Labor and Energy Cost ($)	Cost Difference Other States (-) Nebraska ($)	Cost Relative Other States (/) Nebraska (%)
Nebraska	**3,350,913**	**175,971**	**3,526,884**	**0**	**100.0**
California	3,818,197	349,607	4,167,804	640,920	118.2
Georgia	3,120,726	221,490	3,342,216	-184,668	94.8
Illinois	3,454,508	180,585	3,635,093	108,209	103.1
Indiana	3,278,759	208,253	3,487,012	-39,872	98.9
Iowa	3,499,284	170,599	3,669,883	142,999	104.1
Kansas	3,453,151	196,549	3,649,700	122,816	103.5
Michigan	3,664,086	225,881	3,889,967	363,083	110.3
Minnesota	3,707,341	198,492	3,905,833	378,949	110.7
Missouri	3,281,411	219,956	3,501,367	-25,517	99.3
New York	3,879,178	230,113	4,109,291	582,407	116.5
North Carolina	3,336,832	181,902	3,518,734	-8,150	99.8
Ohio	3,624,058	186,534	3,810,592	283,708	108.0
Pennsylvania	3,857,600	184,930	4,042,530	515,646	114.6
Texas	3,699,525	158,754	3,858,279	331,395	109.4
Wisconsin	3,684,713	213,183	3,897,896	371,012	110.5

Source: Calculated from data presented in Tables A-4 and A-5.

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