COMMONWEALTH OF KENTUCKY
BEFORE THE PUBLIC SERVICE COMMISSION

IN THE MATTER OF: THE APPLICATION OF KENTUCKY UTILITIES COMPANY FOR AN ADJUSTMENT OF ITS ELECTRIC RATES	:	**Case No. 2014-00371**
IN THE MATTER OF: THE APPLICATION OF LOUISVILLE GAS & ELECTRIC COMPANY FOR AN ADJUSTMENT OF ITS ELECTRIC RATES	:	**Case No. 2014-00372**

DIRECT TESTIMONY AND EXHIBITS

OF

PAUL A. COOMES

ON BEHALF OF THE

KENTUCKY INDUSTRIAL UTILITY CUSTOMERS, INC.

MARCH, 2015

DIRECT TESTIMONY OF PAUL A. COOMES

Q. Please state your name, address, and profession.

A. My name is Paul A. Coomes. My address is 3604 Trail Ridge Road, Louisville KY 40241. I am a consulting economist. I have a Ph.D. in economics from the University of Texas. I am also an emeritus professor of economics at the University of Louisville.

Q. Have you testified before the Kentucky Public Utility Commission?

A. Yes, I have testified and submitted testimony several times before the Kentucky Public Service Commission to present studies I have performed for utilities, and utility customers such as the Kentucky Industrial Utility Customers, Inc. ("KIUC").

Q. What is the purpose of your testimony?

A. I am providing testimony in support of a study that I conducted entitled, *The Differential Economic Importance and Electricity Usage of Industries in Kentucky (March 4, 2015).* This study attempts to quantify the economic impact of Kentucky's industrial sector compared to other Kentucky industries and is attached to my Direct Testimony as Attachment 1. My study demonstrates that the most important industries, in terms of economic growth, are those that export their goods and services to customers around the US and the world. Firms in these industries bring new dollars into Kentucky and thereby lift firms in other linked industries, as well as the incomes of Kentucky households. As household incomes grow, so do sales and employment in support industries (and governments) that provide goods and services to local households. The export-based

industries are the engines of growth, and therefore have been the target of economic development agencies, while retail and most service businesses are essentially captive and require no special incentives to operate in the state.

Q. Can you explain why economists and economic development agencies value export-based industries more than businesses that service the local population?

A. Economists and economic development agencies value export-based industries because they have large "employment multipliers", thereby lifting economic activity in other industries and raising household incomes statewide. They also usually provide many high paying direct jobs because, say, a sophisticated manufacturing plant requires skilled workers and highly sought-after plant managers. North American Stainless, for example, not only employs 1,300 highly-trained steel workers at its factory in Ghent, Kentucky, but also employs hundreds of people (engineers, accountants, attorneys, executives, etc.) at its on-sight office complex.

Q. What is an "employment multiplier"?

A. An employment multiplier is one of the measures used to determine the impact a particular industry will have upon a regional economy when it arrives or departs. In its simplest terms, the employment multiplier measures the indirect and induced jobs created (or lost) in the area for each direct job at a facility. Direct jobs are related to the specific industry, while indirect jobs are those that support the industry. Induced jobs are those that are a result of direct/indirect employee's spending money in the community. Generally, industries with a higher multiplier are more desirable.

Q. What is an "export industry" and why are they so important to a local economy?

An "export industry" is a business that primarily sells its goods or products outside of the area in which it is located. The importance of export industries can be easily illustrated with a real-world example. Consider the difference between a store like Target that sells household goods to local residents, and a manufacturing plant like Georgetown's Toyota that makes Camrys and sells them around the world. Regional economists classify businesses like Toyota as export industries, as they serve primarily out-of-state customers. Businesses like Target serve the residential market, and their sales ebb and flow with the population and their disposable incomes. Toyota's sales bring new dollars into the state, where they are used to purchase goods and services to make the cars, and to pay their employees. Those employees, and the employees of their suppliers, spend their paychecks on many local goods and services, thus lifting the economy further.

By contrast, Target provides clothing and other merchandise in return for the disposable incomes of residents, absorbing not adding dollars to the economy. If Toyota were to close its Kentucky plant, disposable incomes of Kentuckians would fall predictably. If a Target were to close, other stores like Kohl's or perhaps smaller locally owned businesses would expand to meet the demand and there would be no net impact on the economy.

Additionally, while a business like Target may have many direct employees at a local store it does not necessarily increase the net employment or net wages in a local area. When a Target moves into an area it often displaces smaller businesses that are not able to compete with the lower prices and wider selection offered by such a larger retailer.

Q. Do states compete for export industries?

A. Yes, state and local governments, as well as private economic development groups, use a lot of resources to help spawn, grow, retain, and attract firms in export industries. Common tools include tax incentives, land assembly, public infrastructure investments, and worker training programs. Most industries that export their product out of state could feasibly locate in a number of other states, and hence companies are in a position to negotiate public incentives in return for locating in a given state. The calculation from the public side is that the other jobs and taxes generated by an exporting firm (and its vendors and their employees) more than offset any incentives granted to the firm. By contrast, retail and personal service industries are rarely subsidized because they essentially have no choice of location. If they want to sell groceries, cars, haircuts and dental services to Kentucky residents they will have to set up business in Kentucky.

Q. How do you identify businesses that have large employment multipliers?

A. Since no person or agency knows the customer (or vendor) base for all Kentucky companies, I rely on well-developed theories and models to predict the relative economic importance of different industries in the state. As explained in my attached Report, the most richly developed and widely used regional modeling system is called *Implan.*[1] I have recently constructed a custom *Implan* model of Kentucky. The model begins with national input-output tables, essentially detailed production recipes for everything in the economy, and is calibrated to Kentucky using detailed county-level data on employment and wages for 470 industries. It is capable of predicting how a change in activity in any industry impacts output, employment, wages and other variables in all the other

[1] For a description and documentation of the IMPLAN modeling system, see http://implan.com/v3/

industries. The modeling system is the primary tool used to evaluate economic development incentives around Kentucky.

Q. Can you summarize the results of the Implan modeling system that you customized for Kentucky?

A. I used the *Implan* model of Kentucky to identify 83 industries that have significant levels of employment *and* have relatively high interindustry job multipliers. These 83 industries, directly employ 276,000 persons (out of 2.4 million total statewide in all industries), but their impact on the economy is much greater than just their direct employment. Most of the industries listed are classified as manufacturing.

My report shows that petroleum refineries, animal processing, chemical manufacturing, iron and steel manufacturing, paper mills and automobile manufacturing have high employment multipliers, that is they have deep supplier linkages with other industries around Kentucky. One conclusion supported by this report is that a fraction of industries in Kentucky directly or indirectly support most of the employment in the state.

Q. How important is reliable, low-cost electricity to export-based industries?

A. Low and reliable electricity costs are very important to Kentucky export-based industries. Kentucky's historically low electricity costs are one of the factors that has attracted energy-intensive businesses such as aluminum and steel manufacturers, auto-makers, chemical manufacturers and paper mills. This is reflected in public economic data. Kentucky ranks third highest among states in terms of electricity purchases per

manufacturing employee, and ranks first in kilowatt-hour purchases per dollar of manufacturing shipments. My attached Report illustrates the differential economic importance of various industries in Kentucky.

Q. How do the conclusions reached in your Report relate to KU and LG&E's request to increase electric base rates by a total of $184 million?

A. While I do not have any specific recommendation regarding the level of rate increase the Commission should approve for the Companies, the Commission should be mindful of the economic impact that large rate increases may have on the energy-intensive export industries that are engines of the Kentucky economy. Low industrial electric rates helped to attract these manufacturers to Kentucky and maintaining low electric rates is important to both retain and attract new manufacturers to the Commonwealth.

Q. Does this conclude your testimony?

A. Yes.

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ATTACHMENT 1

OF

PAUL A. COOMES

The Differential Economic Importance and Electricity Usage of Industries in Kentucky

a report for the
Kentucky Industrial Utility Customers

by
Paul Coomes, Ph.D.
Consulting Economist
March 4, 2015

Economic activity in Kentucky is classified under hundreds of different industries, but some are much more important than others in terms of overall growth and prosperity in the state. The most important industries, in terms of economic growth, are those that export their goods and services to customers around the US and the world. Firms in these industries bring new dollars into Kentucky and thereby lift firms in other linked industries, as well as the incomes of Kentucky households. As household incomes grow, so do sales and employment in retail and service industries (and governments) that provide goods and services to households. The export-based industries are the engines of growth, and hence the target of economic development agencies, while the retail and service industries are essentially captive and require no special incentives to operate in the state.

From this perspective, the most important industries are in the manufacturing, distribution, mining and agricultural sectors, and the least important industries are those in the retail, financial services, real estate, health care, legal, education and personal services sectors. In terms of export-based industries with significant employment in Kentucky, those with the greatest spin-off impacts are nearly all manufacturers: petroleum refining, beef and pork slaughtering and processing, animal food, organic chemicals, milk production, tobacco products, aluminum, trucks, iron and steel, soap, paper, automobiles and trucks, plastics, distilleries, inorganic chemicals, poultry, sawmills, and motor vehicle parts.

These important industries are also among the largest consumers of electricity in Kentucky. Primary aluminum producers, for example, spend around $137,000 per employee on electricity, whereas the typical retail or service business spends only a few hundred dollars per employee annually on electricity – primarily for lighting and air conditioning, rather than for the production processes. Indeed, Kentucky has a strong presence of many of the most energy-intensive industries in the United States, attracted here partly because of our historically competitive electricity rates. I have identified at least ten key manufacturing industries in Kentucky that purchase more than $20,000 of electricity per employee. These industries also

have large employment multipliers, thereby lifting economic activity in other industries and raising household incomes statewide. Kentucky ranks third highest among states in terms of electricity purchases per manufacturing employee, and ranks first in kilowatt hour purchases per dollar of manufacturing shipments. In this report I organize the most recent data to illustrate the differential economic importance of various industries in Kentucky[1].

Example: Toyota vs. Target

It is not well understood among the public that certain industries in Kentucky are much more important than others in terms of our economic prosperity. I will explore this in some detail later in the report, but the basic idea can be illustrated with a simple example.

Consider the difference between a store like Target that sells apparel to local residents, and a plant like Georgetown's Toyota that makes Camrys and sells them around the world. Toyota's sales bring new dollars into the state, where the company purchases goods and services to make the cars, and to pay their employees. Those employees spend their paychecks on many local goods and services, thus lifting the economy further. By contrast, Target provides clothing and other merchandise in return for the disposable incomes of residents, absorbing not adding dollars to the economy. If Toyota were to close its Kentucky plant, disposable incomes of Kentuckians would fall predictably. If a Target were to close, other stores like Kohl's would expand to meet the demand and there would be no net impact on the economy.

Regional economists classify businesses like Toyota as export industries, as they serve primarily out-of-state customers. Businesses like Target serve the residential market, and their sales ebb and flow with the population and their disposable incomes. Hence, state and local governments, as well as private economic development groups, use a lot of resources to help spawn, grow, retain, and attract firms in export industries. Common tools include tax incentives, land assembly, public infrastructure investments, and worker training programs. Most industries that export their product out of state could feasibly locate in a number of other states, and hence companies are in position to negotiate public incentives in return for locating in a given state. The calculation from the public side is that the other jobs and taxes generated by an exporting firm (and its vendors and their employees) more than offset any incentives granted to the firm. By contrast, retail and personal service industries are rarely subsidized because they essentially have no choice of location. If they want to sell groceries, cars, haircuts and dental services to Kentucky residents they will have to set up business in Kentucky.

The distinction between firms that export and firms that just sell to residents is not always so clear. Humana, for example, has a huge national business but also sells health insurance

[1] This updates my report of April, 2010, using fresh detailed economic data and models that have become available over the last several years.

services to Kentuckians. Some of our major law firms have specialty practices that attract national clients, thus bringing new dollars into our regional economy, even though the bulk of their revenues are from serving local companies and households. Kentucky's hotels and restaurants serve a mixture of destination tourists and convention-goers, pass-through interstate travelers, family visitors, business travelers, and local residents.

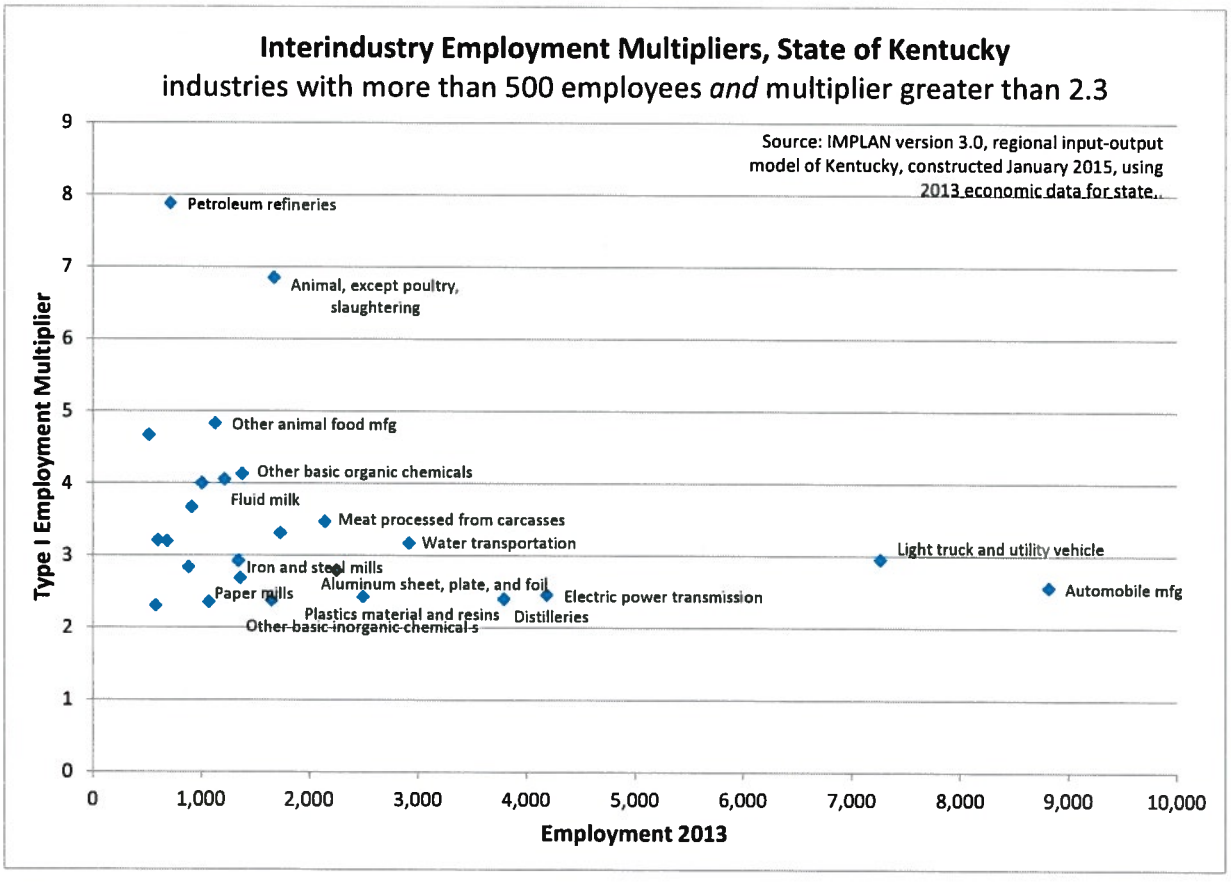
No person or agency knows the customer (or vendor) base for all Kentucky companies, and hence we rely on well-developed theories and models to predict the relative economic importance of different industries in the state. Probably the most richly developed and widely used regional modeling system is Implan, which came out of research at the University of Minnesota[2]. I have recently constructed a custom Implan model of Kentucky. The model begins with national input-output tables, essentially detailed production recipes for everything in the economy, and is calibrated to Kentucky using detailed county-level data on employment and wages for 470 industries. It is capable of predicting how a change in activity in any industry impacts output, employment, wages and other variables in all the other industries. The modeling system is the primary tool used to evaluate economic development incentives around Kentucky.

[2] For a description and documentation of the IMPLAN modeling system, see http://implan.com/v3/

Employment Linkages by Industry

I have used the Implan modeling system to organize detailed economic estimates on industrial activity in Kentucky. I sorted the estimates to reveal which industries have the most employment and which have the most employment spinoff impacts. As a measure of spinoff, I use what are called 'Type I employment multipliers'. These measure how much total employment in Kentucky would rise per new job in the reference industry, due to vendor linkages among industries. The Type I multipliers exclude the additional household spending impacts (Type II), and allow us to focus clearly on industrial linkages that drive the overall economy.

I started by plotting employment and the inter-industry job multipliers for all 470 industries represented in the Implan model. Then I zoomed in on industries that have significant employment *and* have relatively high job multipliers. I looked for the top 25 industries in terms of job multipliers, screening for those with more than 500 employees. This filtering clearly reveals the relative economic importance of industries in Kentucky. Note that the industries with the highest job multipliers are mostly in manufacturing. One can see that auto and truck manufacturing have the highest inter-industry employment multipliers, reflecting their deep linkages with suppliers in the state. Steel, aluminum, chemicals, paper, and distilled spirits manufacturing also stand out. Meat processing and other food production have strong linkages



with the rest of the economy as, for example, livestock require grain and hay which is grown in the state, which in turn requires purchases of farm equipment, fertilizer, trucks, banking, insurance, and so on.

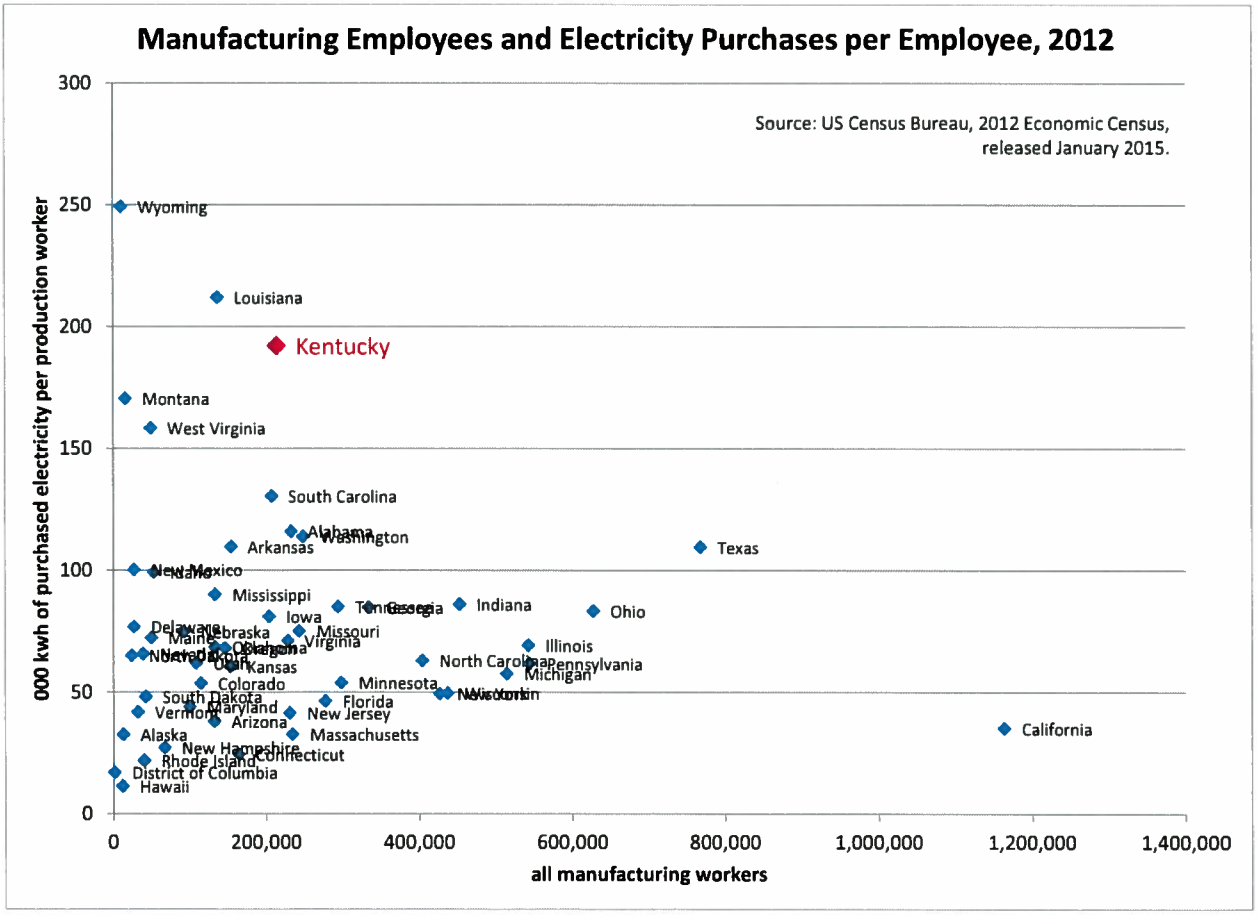
A larger list of export-based industries with greater than 500 employees and with an employment multiplier above 1.65 is provided in Appendix A. There are 83 industries, directly employing 276,000 persons (out of 2.4 million total statewide in all industries), that meet these criteria. Most of the industries listed are classified as manufacturing. The highest job multiplier is for petroleum refineries, followed by beef and pork slaughtering, federal electric utilities, other animal manufacturing, and tobacco products manufacturing. By contrast, industries with very large employment tend to have relatively low employment multipliers: insurance, R&D, wholesalers, banking, and home construction. These industries mainly purchase intermediate products made elsewhere. That is, compared to the manufacturing industries, they do not need to purchase of lot of materials in Kentucky to support their output. For example, consider an insurance operation. Insurance is by nature an intangible item, not requiring a lot of physical inputs to production. An insurance company employee is basically using a computer and a set of rules to match insurance buyers (those avoiding risk) with investors (those taking risk). Insurance agents often do not even have an office, and they purchase very little from other regional businesses in the course of selling a policy. Real estate firms and agents, with an interindustry employment multiplier of 1.48, are similar. The real estate industry is one of the largest employers in Kentucky, supporting about 70,000 jobs, but is generally not bringing new dollars into the state. Rather, the industry primarily absorbs dollars by providing a service to households and firms statewide.

The reader should not focus so much on the magnitudes of the industry multipliers as on the ranking of the multipliers. For example, it is unlikely that the true (unknown) employment multiplier for petroleum refining is as high as 7, but it is likely that the industry has one of the highest job multipliers in Kentucky. Given the measurement challenges inherent in these regional analyses, the input-output modeling tools can generate extremely high (unrealistic) multipliers, especially for smaller industries with strong linkages to the rest of the economy. The main conclusion supported by this list is that a fraction of industries in Kentucky directly or indirectly support most of the employment in the state.

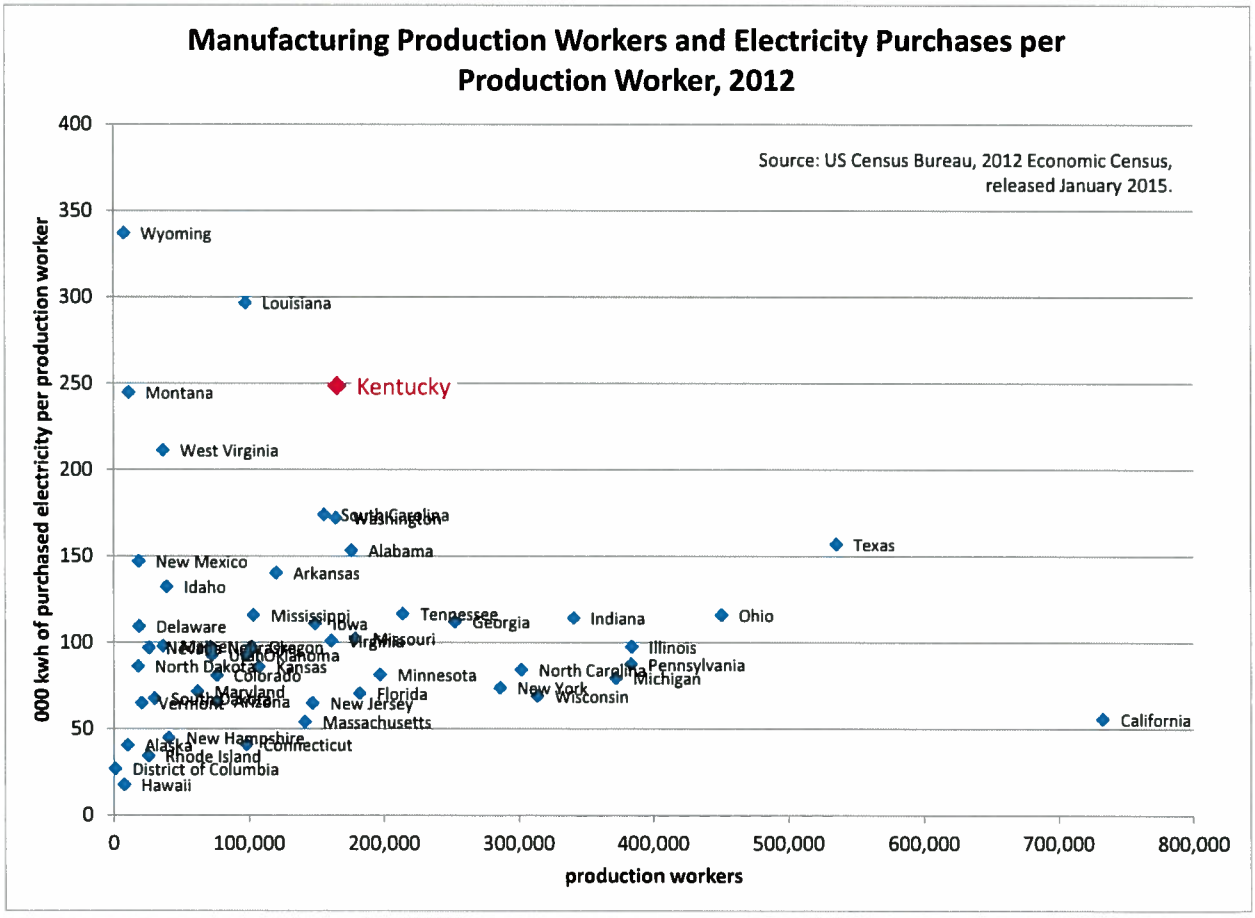
Energy-Intensiveness of Industries

Many of the industries I identify as having great employment impacts in Kentucky also are among the most energy-intensive. Whereas a household or a small business may spend a few thousand dollars annually on electricity and natural gas, an aluminum smelter, for example, will purchase tens of millions of dollars of electricity. Larger retail and commercial firms, hospitals, and the like purchase energy for heating, air conditioning and lighting, with annual energy expenditures per employee of perhaps a few hundred dollars. Many manufacturing operations use energy as part of their production processes, and companies producing aluminum may purchase over one hundred thousand dollars of electricity per employee annually.

Indeed, the recently released 2012 Census of Manufacturers shows that Kentucky has one of the most energy-intensive portfolios of manufacturing industries in the US. The next chart plots electricity purchases per employee against total manufacturing employment in each state. Kentucky had 214,000 manufacturing employees, ranking 21st highest. However, Kentucky manufacturing firms purchased 192,200 kilowatt hours per employee, ranking 3rd highest. Moreover, Kentucky has many more manufacturing employees than the two states with higher electricity intensity – Wyoming and Louisiana.

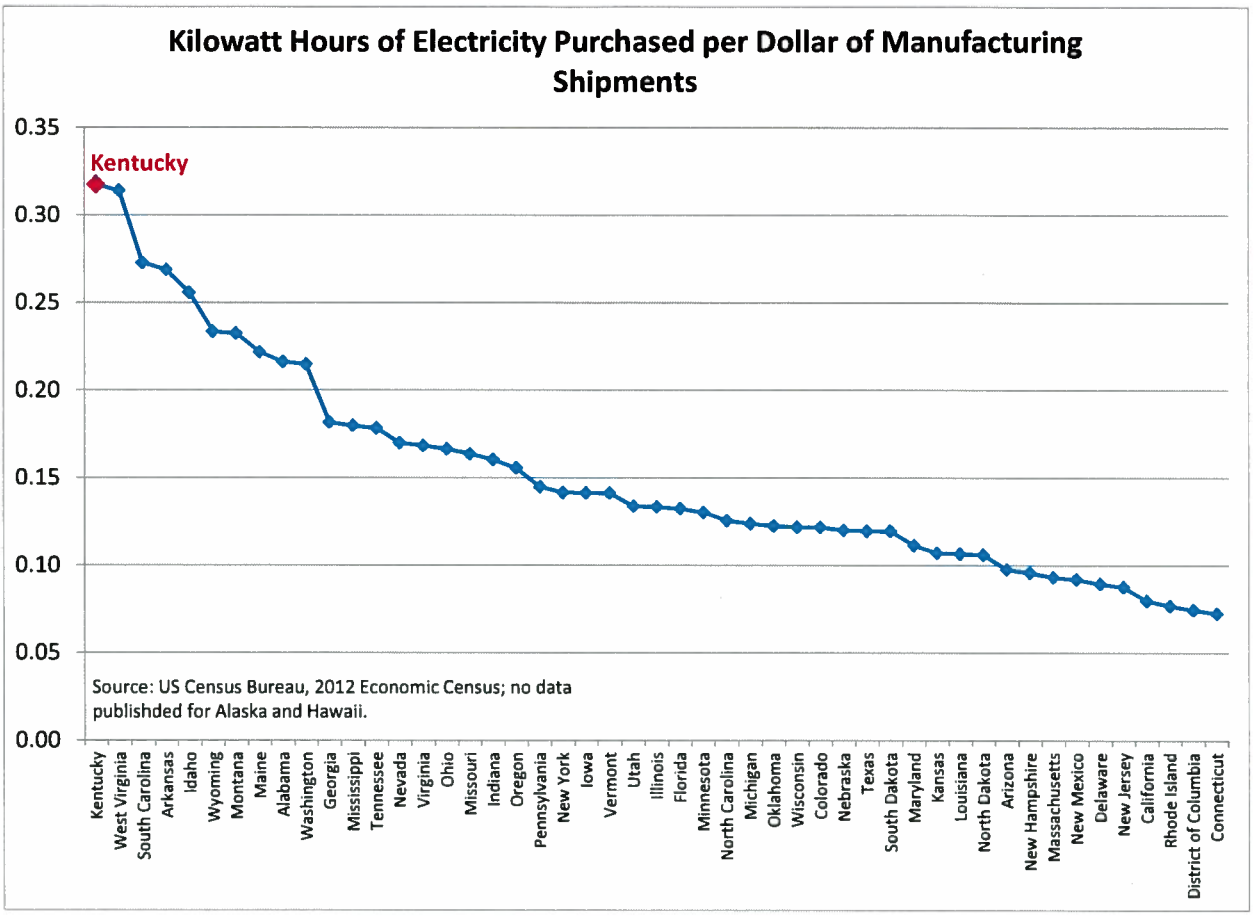


The pattern holds up when we zoom in on just production workers in manufacturing, as opposed to the total. Note that managers, engineers, lawyers, accountants, and other office-oriented employees of a manufacturing firm get counted in federal statistics under the manufacturing industry. For example, perhaps half the employees at Louisville's Appliance Park are now white collar workers. The Census Bureau provides separate estimates for production workers versus all employees, and these are shown for all states in the accompanying chart. Kentucky had 165,000 production workers, with an average of 248,600 kilowatt hours per employee. Again, Kentucky ranks 3rd in electricity intensity per employee. And Kentucky ranks 4th highest in the concentration of production workers, with 77 percent of all manufacturing employees engaged in production. California, by contrast, has the most manufacturing employees, but ranks 46th in the share that are production workers (at 63 percent), reflecting the high degree of management, research, development, and other professional jobs associated with the technology industries located there.



One further way to sort the data is to look at the quantity of electricity purchased by manufacturers divided by the value of their shipments. Here Kentucky ranks highest among US

states, with 0.32 kilowatt hours per dollar of shipments. Clearly, Kentucky has an extremely energy-intensive portfolio of manufacturing industries.



The Census Bureau does not publish state-level data on electricity usage for detailed manufacturing industries. However, they do publish details for 365 industries at the national level, and we can see that Kentucky has a disproportionate concentration of industries that are energy intensive. In Appendix B I display the top 50 manufacturing industries nationally, in terms of electricity purchases per employee, and also show purchases per business establishment for these detailed industries. The listing is particularly interesting since many of the top energy using industries are prominent in Kentucky. The highest electricity purchases per employee ($136,566) are in the primary aluminum industry, and Kentucky represents a large share of this national industry[3]. Other prominent Kentucky industries in the list include petroleum refining, steel, secondary aluminum, paperboard, soybean processing, plastics, wood

[3] According to the US Geological Survey, the two Kentucky smelters (at Hawesville and Sebree) accounted for 17 percent of the primary aluminum capacity of the US in 2013: 457 thousand metric tons out of a total of 3,500 metric tons. See Table 2, 2013 *Minerals Yearbook*, http://minerals.usgs.gov/minerals/pubs/commodity/aluminum/myb1-2013-alumi.pdf

pulp, paper, and aluminum sheet, plate, and foil. These industries all purchase more than $8,000 of electricity per employee. And a majority purchase more than $1 million in electricity per plant. Indeed, access to Kentucky's historically inexpensive electricity is the reason many of these industries are located in the state.

Other examples, drawn from our list of high employment multipliers above, illustrate the distinction between a manufacturing operation and a service operation. The average electricity purchases annually for a poultry processing plant purchases is over $800,000, for a fluid milk plant over $500,000, and for a meat processing plant over $230,000, driven largely by their massive refrigeration requirements. The average petroleum refinery purchases $15.9 million per year in electricity. The average truck manufacturing plant purchases $2.6 million in electricity annually, automobile manufacturing plants purchase $1.2 million, and motor vehicle parts plants purchase $225,000.

Finally, I have matched across the three databases to see what particular industries stand out in Kentucky. That is, what detailed industries have (a) large employment in Kentucky, (b) high Kentucky employment multipliers, and (c) high national electricity purchases per employee. The top ten industries are shown in the table below, ranked by their employment multiplier. The list includes petroleum and chemical manufacturing, food processing, and metal production.

Industries with Significant Employment, Dense Industry Linkages, and High Electricity Purchases

Industry description	Kentucky Employment	Kentucky Employment multipler - Type I (interindustry)	Purchases of Electricity per Employee, US
Petroleum refineries	717	7.877	$44,577
Other basic organic chemical mfg	1,383	4.123	$40,894
Rendering and meat byproduct processing	915	3.664	$9,049
Secondary smelting and alloying of aluminum	604	3.201	$15,564
Iron and steel mills and ferroalloy mfg	1,346	2.920	$28,593
Aluminum sheet, plate, and foil mfg	2,249	2.794	$15,438
Plastics material and resin mfg	2,488	2.427	$19,433
Other basic inorganic chemical mfg	1,654	2.374	$40,894
Rolled steel shape mfg	932	2.247	$9,118
Alumina refining and primary aluminum production	1,454	2.028	$136,566

Sources: employment and employment multipliers from Implan model discussed above. Electricity purchases per employee from the 2012 Economic Census.

Conclusion

I have documented the relative economic importance of manufacturing operations in Kentucky, due to the fact that they bring in new dollars to the state by exporting products around the world, and also to the dense linkages with supporting industries. I have also shown that many important manufacturing industries in Kentucky purchase large amounts of electricity as part of their production processes. Indeed, as a whole, Kentucky has the most electricity-intensive manufacturing sector of any state.

Appendix A

Industries with Dense Industry Linkages and Significant Employment, Kentucky 2013

Industry description	Employment	Employment multipler - Type I (interindustry)
Petroleum refineries	717.2	7.877
Animal, except poultry, slaughtering	1,678.2	6.848
Other animal food mfg	1,132.4	4.822
Internet publishing and broadcasting and web search portals	522.2	4.658
Other basic organic chemical mfg	1,382.6	4.123
Fluid milk mfg	1,217.5	4.052
Tobacco product mfg	1,006.8	4.000
Rendering and meat byproduct processing	915.4	3.664
Meat processed from carcasses	2,140.9	3.464
Wireless telecommunications carriers (except satellite)	1,734.5	3.305
Secondary smelting and alloying of aluminum	604.0	3.201
Roasted nuts and peanut butter mfg	688.9	3.190
Water transportation	2,910.9	3.167
Light truck and utility vehicle mfg	7,262.0	2.950
Iron and steel mills and ferroalloy mfg	1,346.1	2.920
Soap and other detergent mfg	887.7	2.832
Aluminum sheet, plate, and foil mfg	2,249.3	2.794
Paper mills	1,363.5	2.686
Automobile mfg	8,819.6	2.562
Electric power transmission and distribution	4,187.9	2.458
Plastics material and resin mfg	2,488.1	2.427
Distilleries	3,791.2	2.398
Other basic inorganic chemical mfg	1,653.6	2.374
Bottled and canned soft drinks & water	1,074.3	2.352
Tire mfg	582.6	2.303
Construction machinery mfg	940.5	2.275
Construction of other new residential structures	15,747.5	2.270
Rolled steel shape mfg	932.0	2.247
Poultry processing	5,243.0	2.209
Other federal government enterprises	1,825.6	2.204
Sawmills	2,725.2	2.197
Data processing, hosting, and related services	7,216.8	2.195
Other local government enterprises	13,955.9	2.146
Insurance carriers	23,157.6	2.118
Book publishers	575.6	2.101
Motor vehicle gasoline engine and engine parts mfg	2,488.3	2.087
Sanitary paper product mfg	876.7	2.061
Oilseed farming	1,973.7	2.035
Alumina refining and primary aluminum production	1,453.7	2.028

Appendix A (cont)

Industries with Dense Industry Linkages and Significant Employment, Kentucky 2013

Industry description	Employment	Employment multipler - Type I (interindustry)
Other financial investment activities	5,841.1	2.024
Federal electric utilities	839.0	2.021
Motor vehicle transmission and power train parts mfg	1,696.9	2.004
Adhesive mfg	628.6	2.001
Computer storage device mfg	534.1	1.999
Periodical publishers	621.0	1.997
All other food mfg	1,927.6	1.974
Radio and television broadcasting	3,536.1	1.964
Dry pasta, mixes, and dough mfg	846.4	1.958
Farm machinery and equipment mfg	639.9	1.954
Construction of new multifamily residential structures	2,454.9	1.949
Copper rolling, drawing, extruding and alloying	1,377.3	1.945
Other miscellaneous chemical product mfg	674.9	1.939
Tobacco farming	994.7	1.914
Maintenance and repair construction of residential structures	7,021.8	1.903
Wired telecommunications carriers	8,228.0	1.868
Flat glass mfg	679.5	1.866
Iron and steel forging	1,199.6	1.855
Electronic computer mfg	1,115.8	1.838
Other motor vehicle parts mfg	7,660.2	1.834
Paint and coating mfg	1,110.1	1.817
Motor vehicle steering, suspension (except spring), brake systems mfg	7,349.6	1.814
Veneer and plywood mfg	650.5	1.795
Insurance agencies, brokerages, and related activities	18,331.5	1.788
Pump and pumping equipment mfg	530.6	1.771
Other major household appliance mfg	2,135.3	1.765
Frozen specialties mfg	2,354.0	1.754
Electric lamp bulb and part mfg	2,165.9	1.749
Cookie and cracker mfg	2,484.8	1.743
Paperboard container mfg	2,918.8	1.743
Canned fruits and vegetables mfg	1,034.5	1.741
Motor vehicle electrical and electronic equipment mfg	1,603.2	1.740
Scientific research and development services	17,731.4	1.739
Aircraft mfg	1,608.7	1.734
Custom computer programming services	10,532.6	1.733
Iron, steel pipe and tube mfg from purchased steel	612.3	1.731
Ready-mix concrete mfg	1,481.9	1.711
Rail transportation	3,982.3	1.697
Independent artists, writers, and performers	582.4	1.690
Fluid power pump and motor mfg	615.0	1.688
Motor vehicle seating and interior trim mfg	4,279.4	1.681
Grain farming	11,514.7	1.667
Industrial truck, trailer, and stacker mfg	860.5	1.656
subtotal	276,456.6	

Appendix B

Top 50 US Manufacturing Industries, Electricity Purchases per Employee and Establishment, 2012

2012 NAICS code	Meaning of 2012 NAICS code	Purchased Electricity per Employee	Purchased Electricity per Establishment
331313	Alumina refining and primary aluminum production	$136,566	$27,827,698
325120	Industrial gas manufacturing	$107,318	$2,320,566
322122	Newsprint mills	$94,956	$20,811,167
325193	Ethyl alcohol manufacturing	$60,392	$2,818,395
311221	Wet corn milling	$48,797	$5,152,855
327310	Cement manufacturing	$45,403	$2,367,347
325110	Petrochemical manufacturing	$44,577	$6,890,321
325180	Other basic inorganic chemical manufacturing	$40,894	$2,367,321
331410	Nonferrous metal (except aluminum) smelting and refining	$38,904	$2,058,345
324110	Petroleum refineries	$37,241	$15,870,589
325311	Nitrogenous fertilizer manufacturing	$31,094	$921,211
322130	Paperboard mills	$30,295	$6,820,538
331110	Iron and steel mills and ferroalloy manufacturing	$28,593	$7,365,553
311212	Rice milling	$28,475	$1,672,388
325194	Cyclic crude, intermediate, and gum and wood chemical manufacturing	$24,618	$1,616,209
327410	Lime manufacturing	$23,158	$1,096,239
321219	Reconstituted wood product manufacturing	$20,899	$1,269,288
311224	Soybean and other oilseed processing	$20,361	$1,042,624
325211	Plastics material and resin manufacturing	$19,433	$1,133,238
322121	Paper (except newsprint) mills	$17,780	$6,605,726
311211	Flour milling	$17,095	$605,480
325130	Synthetic dye and pigment manufacturing	$16,198	$952,654
327213	Glass container manufacturing	$15,841	$3,838,100
331314	Secondary smelting and alloying of aluminum	$15,564	$750,000
325312	Phosphatic fertilizer manufacturing	$15,522	$1,287,156
331315	Aluminum sheet, plate, and foil manufacturing	$15,438	$2,487,728
327993	Mineral wool manufacturing	$15,087	$768,896
325220	Artificial and synthetic fibers and filaments manufacturing	$15,074	$1,656,893
327211	Flat glass manufacturing	$14,393	$2,154,746
312112	Bottled water manufacturing	$14,057	$419,832
327420	Gypsum product manufacturing	$13,619	$485,570
325199	All other basic organic chemical manufacturing	$13,181	$1,049,450
326160	Plastics bottle manufacturing	$12,514	$897,514
313110	Fiber, yarn, and thread mills	$12,211	$943,250
327992	Ground or treated mineral and earth manufacturing	$12,203	$348,821
313230	Nonwoven fabric mills	$11,971	$837,954
322110	Pulp mills	$10,951	$2,460,129
325212	Synthetic rubber manufacturing	$10,925	$535,781
335991	Carbon and graphite product manufacturing	$10,692	$617,231
332431	Metal can manufacturing	$10,653	$1,076,901
331511	Iron foundries	$9,936	$959,392
324121	Asphalt paving mixture and block manufacturing	$9,801	$102,102
312113	Ice manufacturing	$9,786	$105,741
326113	Unlaminated plastics film and sheet (except packaging) manufacturing	$9,354	$573,254
324199	All other petroleum and coal products manufacturing	$9,145	$287,819
331221	Rolled steel shape manufacturing	$9,118	$358,220
327212	Other pressed and blown glass and glassware manufacturing	$9,080	$305,527
311613	Rendering and meat byproduct processing	$9,049	$387,213
325613	Surface active agent manufacturing	$8,778	$329,363
331420	Copper rolling, drawing, extruding, and alloying	$8,641	$746,843

Source: US Census Bureau, 2012 Economic Census, Table EC123111: Manufacturing: Industry Series: Detailed Statistics by Industry for the United States: 2012