Economic Development
RESEARCH GROUP

Economic Impacts of Intelligent Infrastructure: Green Buildings in Louisville

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Stimulus Effect from Local Spending:

During project implementation, investment in building systems and energy optimization efforts directly and indirectly supported $26 million in business sales and over 600 jobs in the Louisville metropolitan area.

Economic Impacts of Cost Savings:

Through the end of 2013, technology and energy optimization improvements have generated $5.2 million in savings beyond the amount owed in annual debt service payments. Reinvesting these savings in university operations and additional energy efficiency projects has supported 71 jobs and $9.3 million in business sales in the Louisville metropolitan area economy.

1.1 Overview

The University of Louisville (UofL) engaged the Building Technologies Division of Siemens Industry, Inc. (Siemens) in two Energy Savings Performance Contracts (ESPCs) that significantly improved various building technologies and energy optimization efforts across its campuses. Siemens offers energy performance contracting to help its customers renew their energy infrastructure while paying for the cost of these improvements with guaranteed future savings. Siemens provides an investment grade audit of all building systems and then based on the results provides a turnkey installation of energy efficient facility improvements. Typically, the upfront cost of this work is financed, and Siemens will provide a guarantee that savings will exceed all cost over the term of the contract.[1]

Based on the performance contracting model, UofL committed to a program of energy savings projects for its Belknap, Health Sciences, and Shelby campuses in 2009. The program was planned with two driving goals in mind: to reduce greenhouse gas emissions associated with University operations and to achieve cost savings within its utility budget. Like many public entities, the University faces continual downward pressures on their budget, all while continuing to grow in terms of campus expansion, increased enrollment, increased residence life, and new programmatic initiatives. The ESPCs remove some of the burden of utilities from the school's general fund. Savings can be redirected to support additional energy efficiency projects and to enhance educational and research programs.

[1] Siemens. Energy performance contracting. Retrieved from: http://www.siemens.com/about/sustainability/en/environmental-portfolio/products-solutions/building-technology/energy-performance-contracting.htm

The two-phase UofL ESPC with Siemens involved $46 million in improvements (nominal dollars) to 88 buildings, and covered 6.2 million square feet of space.[2] These improvements have resulted in significant savings to date, spanning electricity, gas, coal, water, and sewer utilities. In the first three years of Phase I plus the construction period, utility and operational savings exceeded performance guarantees by 22%. In the construction period and first year of Phase II, savings exceeded performance guarantees by 35%. Over the lifetime of the performance contracts, these savings will not only pay for the initial technology and optimization investments, but will also provide additional savings that can be reinvested and reallocated by the University.

Beyond the financial benefits described above, energy-savings projects like those implemented by UofL also generate important economic impacts.

First, local spending on energy-related equipment and services stimulates economic activity. Based on a detailed analysis of project spending and modeling in the Louisville metropolitan economy (detailed in Section 1.5 below), it is estimated that $26 million in business sales and 613 jobs were supported during construction by the various investments associated with these projects. These are short-term impacts experienced for the duration of project implementation.

Second, savings above and beyond the cost of the investments (net savings) can be redirected to support additional university activity, thus generating further economic impact. To date, the two phases have generated $5.2 million in savings beyond the amount owed for annual debt service payments (2014 dollars).[3] Savings in excess of the guarantee and project contingencies have funded university initiatives and additional UofL energy efficiency projects (detailed in Section 1.5). Based on economic modeling, it is estimated that a total of 71 additional jobs and $9.3 million in business sales were supported by the projects in just over four years. These impacts only capture the first few years of validated savings data. As savings accrue in the future there will be opportunities for additional economic impacts from reinvestment.

This chapter is divided into four additional sections. The first section describes the economic context of Louisville and the surrounding metropolitan area, and introduces UofL and its sustainability initiatives. The second section provides details on implemented technologies and optimization efforts, and the performance contract used to finance the Siemens projects. The third section provides detailed information on the performance impacts of implemented technologies and optimization efforts, including energy and operational savings. The fourth section provides analysis of the projects' economic impacts.

[2] Siemens. University of Louisville Energy Performance Contract Overview. Presentation. June 6, 2014. Equivalent to $50 million on 2014 dollars.

[3] $4.8 million in nominal dollars in the period 2010-2013, $5.2 million in 2014 dollars.

1.2 Community Character and Project Context

The Louisville Metropolitan Area

Louisville, Kentucky has a population of 610,000 and anchors a 12-county metropolitan area of 1.3 million people. In the period between 2010 and 2013, this area grew by 2 percent. The Louisville metropolitan statistical area (MSA) is the 44th largest in the US.[4]

As of 2013, Louisville's metropolitan area economy accounts for $64.6 billion of GDP. The area's roughly 750,000 jobs are concentrated in manufacturing and across various service sectors.[5] Automobile and automotive parts manufacturing has traditionally played a significant role in the area. As in many places across the United States, the metropolitan area has experienced diversification of its economic base with shifts towards professional and business services, tourism, and high-tech sectors.[6] Unemployment in the area is close to the national average: In August 2014, the area's unemployment rate was 6 percent. During this same period, the unemployment rate in the United States was 6.1 percent.[7] Median household income is also close to the value for the US as whole, standing at $50,905 in 2013 compared with $52,250 nationally.[8]

UofL is a major driver of the Louisville economy. The University has a student body of 22,500 with 76 percent of its enrollment from in-state. Additionally, UofL has an annual operating budget of $1.2 billion, of which more than half a billion goes to salaries and $350 million to operating expenses.[9] These expenditures generate returns in the local economy. A study released in 2010 by economist Manoj Shanker estimated that between 2003 and 2009, 9,764 jobs were added to the state economy due to various activities at UofL. According to UofL President James Ramsey, the study results show how higher education plays an important role in sustaining economic growth, even in a period of difficult economic conditions.[10] The Siemens projects analyzed in this study are specific examples of how the University continues to support sustainable growth in the Louisville metropolitan area.

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[4] 2013 American Community Survey 1-Year Estimates, U.S. Census Bureau

[5] Bureau of Economic Analysis. Regional Data: Total full-time and part-time employment by NAICS industry.

[6] Dufrene, Uric. Indiana Business Review. Louisville Forecast 2013. Retrieved from: http://www.ibrc.indiana.edu/ibr/2012/outlook/louisville.html ; City-Data.com. Louisville Economy. Retrieved from: http://www.city-data.com/us-cities/The-South/Louisville-Economy.html

[7] U.S. Bureau of Labor Statistics.

[8] 2013 American Community Survey 1-Year Estimates, U.S. Census Bureau

[9] University of Louisville. Profile. Retrieved from: http://louisville.edu/about/profile

[10] UofL Today. Study shows UofL is major economic driver. 14 January 2010. Retrieved from: http://louisville.edu/uofltoday/campus-news/study-shows-uofl-is-major-economic-driver

Sustainability at the University of Louisville

UofL is a state-funded research university with three campuses.[11] The Belknap Campus houses the majority of the University's departments, including Arts & Sciences, Education & Human Development, and the Speed School of Engineering.[12] The Health Sciences Campus is located in downtown Louisville's medical complex. It houses the School of Medicine, School of Nursing, School of Public Health & Information Sciences, and the School of Dentistry, along with a number of specialty hospitals and research facilities. The Shelby campus is located east of the city and houses the University's continuing education program, a research facility for predictive medicine, and an office park currently under development.[13]

In 2008, the University established a Sustainability Council comprised of faculty, staff, and students to guide efforts aimed at achieving sustainable development. As defined by the often-quoted Brundtland Commission report, "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."[14] UofL has adopted this definition, and views sustainability in terms of the three pillars of social, economic and environmental stewardship.[15] Since establishment of the Council, UofL has worked to set targets for reducing green-house gas emissions, with the ultimate long-term goal of carbon neutrality. Energy conservation and efficiency is viewed as a critical piece of this strategy and the Energy Savings Performance Contracts (ESPCs) with Siemens have served as the cornerstone of the University's sustainability program.

1.3 Project Details

Implemented Technology

Technology implemented in Phase I and II of the ESPCs included a variety of heating, ventilation and air conditioning system upgrades; building automation improvements; lighting upgrades and lighting controls; water conservation strategies; and electrical system upgrades on the various campuses. Electrical savings are derived from improvements to lighting technologies and lighting controls (e.g. more efficient fixtures including exterior induction lighting and occupancy sensors) and the installation of two large capacitor banks

[11] University of Louisville. About UofL. Retrieved from: http://louisville.edu/about/

[12] University of Louisville. Schools & Departments. Retrieved from: http://louisville.edu/academics/schools-depts.html

[13] University of Louisville. Lifelong Learning. Retrieved from: http://www.ed2go.com/uofloptions/about_us.html

[14] United Nations. Our Common Future: Report of the World Commission on Environment and Development. Retrieved from: http://www.un-documents.net/wced-ocf.htm

[15] Mog, Justin. UofL Green Scene: What is sustainability? UofL Today. 4 October 2011. Retrieved from: http://louisville.edu/uofltoday/campus-news/uofl-green-scene-what-is-sustainability

on the Belknap Campus for power factor correction on the University's utility bill. 'Power factor' is a measure of efficiency; by improving the power factor, the University achieves reductions in amperage loads and avoids penalty fees related to excess current loads (or demand on the system) from Louisville Gas & Electric, the local utility. Various project upgrades also reduced the use of chilled water and the electricity required to provide heating and cooling to the UofL buildings.

Natural gas and coal savings have been enabled by improvements to campus steam systems, conservation efforts related to hot water, boiler replacements, and improved controls. In particular, the University made a strategic decision to move away from coal by replacing two large coal-fired boilers with new natural gas steam boilers (one in each phase of the project). Water savings were also achieved by various conservation efforts, including measures that reduced the gallons per flush on toilets.[16]

Performance Contract and Project Financing

UofL views the Siemens performance contracting model as highly successful for sustainability initiatives, and envisions using it even more in the future.[17] The associated funding mechanism is an important tool because it enables significant upfront capital investment be made all at once, instead of being piecemealed over time. Savings are validated by a series of annual reports from Siemens. Any shortfall in guaranteed savings is reimbursed by Siemens. The performance contract structure applies to a period of 13.5 years for Phase I and 15.5 years for Phase II.

The initial capital costs for Phase I were financed using a municipal lease. Phase II was financed using a combination of Build America Bonds (BABs) and Qualified Energy Conservation Bonds (QECBs), which are subsidized by the federal government. Kentucky has been a lead adopter of the QECB funding mechanism, and has pushed to quickly utilize its state-allocated funding.[18] The federal subsidy effectively lowers the financing costs of energy projects like those implemented by Siemens. Debt service for Phase I and II is paid over time using savings from UofL's utility budget.

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[16] Siemens. University of Louisville Energy Performance Contract Overview. Presentation. June 6, 2014; University of Louisville Phase I Energy Savings Performance Contract Measurement and Verification Report. April 8, 2014; University of Louisville Phase II Energy Savings Performance Contract Measurement and Verification Report. March 18, 2014.

[17] University of Louisville Sustainability. UofL Climate Action Plan. September 2010. Retrieved from: http://rs.acupcc.org/site_media/uploads/cap/700-cap_4.pdf

[18] SIFMA. Build America Bonds Fact Sheet, Q4 and Full Year 2010. Retrieved from: http://www.sifma.org/research/item.aspx?id=22881 ; and Energy Program Consortium. Qualified Energy Conservation Bonds (QECBS). December 2013. Retrieved from: http://energy.gov/sites/prod/files/2014/06/f16/QECB_memo_12-13-13.pdf

1.4 Project Performance Impacts

Utility and Operational Savings

To date, three years of Phase I and one year of the Phase II operational and energy savings have been realized and validated. In addition, both phases have generated rebates from Louisville Gas & Electric (the local utility) based on implementation of energy-savings improvements. Phase I generated energy rebates totaling $373,280 while Phase II generated $354,589 (nominal dollars). As can be seen in Table 0.1, both phases are thus far performing above the guaranteed level as prescribed in the Siemens contracts.

Table 0.1: Guaranteed and Actual Utility and Operational Savings for Phase I and II of the Siemens Performance Contract (nominal dollars)[19]

	Guaranteed	Actual	Percent Over Guarantee
Phase I			
15-Month Construction	$859,552	$1,040,345	21%
Year 1 (Jan-Dec 2011)	$2,342,929	$2,820,212	20%
Year 2 (Jan-Dec 2012)	$2,342,929	$2,982,087	27%
Year 3 (Jan-Dec 2013)	$2,342,929	$2,814,828	20%
Savings to Date	$7,888,339	$9,657,472	22%
Phase II			
17-Month Construction	$398,033	$1,142,259	187%
Year 1 (Nov-Oct 2013)	$1,979,129	$2,071,299	5%
Savings to Date	$2,377,162	$3,213,558	35%

Utility savings comprise the largest portion of savings realized by UofL. In year three of Phase I, for example, only five percent of total savings were attributed to operational savings. In year one of Phase II, three percent of total savings are associated with reductions in operational costs. These operational savings are associated with the elimination of coal-handling operations and the replacement of certain maintenance intensive equipment such as older air handlers and chillers. Savings accrue across multiple utility budgets, but electricity has accounted for a plurality of savings in both phases (Figure 0.1). This has important implications for greenhouse gas emissions in Kentucky where a majority of energy is generated using coal.[20] Compared with natural gas, coal generates approximately

[19] Siemens. University of Louisville Phase I Energy Savings Performance Contract Measurement and Verification Report, April 8, 2014; and Siemens University of Louisville Phase II Energy Savings Performance Contract Measurement and Verification Report, March 18, 2014.

[20] Kentucky Department for Energy Development & Independence. 2012 Energy Profile. Retrieved from: http://energy.ky.gov/Documents/2012%20Kentucky%20Energy%20Profile.pdf

70 percent more carbon dioxide per kilowatt hour of electricity produced.[21] In terms of building systems, control upgrades are the largest contributor to cost savings, followed by lighting upgrades (Figure 0.2).

Figure 0.1: Actual Utility Savings from Phase I, Year 3 and Phase II, Year 1 of the ESPC with Siemens, by Type

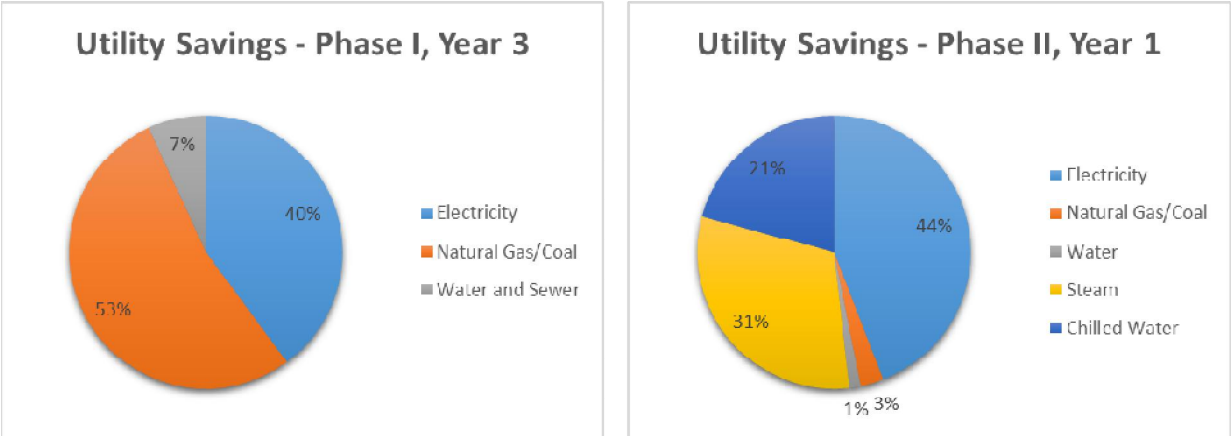
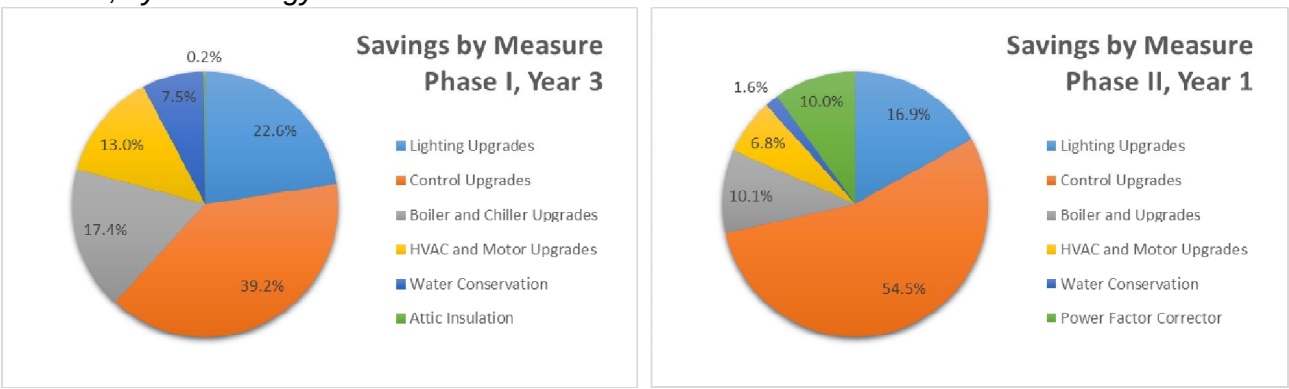


Figure 0.2: Actual Utility Savings from Phase I, Year 3 and Phase II, Year 1 of the ESPC with Siemens, by Technology



Additional Benefits beyond Savings

In addition to the outlined cost savings, there are also anticipated but less quantifiable reliability effects associated with building upgrades. In particular, the university reports that the move to natural gas boilers from coal achieves reliability improvements both because of operational redundancy (with multiple variable capacity boilers used to replace a larger, high capacity boiler) and because the coal handling system was previously subject to occasional failures. The natural gas supply is both simpler and more stable. Similarly,

[21] U.S. Energy Information Administration. Frequently Asked Questions: How much carbon dioxide is produced per kilowatthour when generating electricity with fossil fuels? Retrieved from: http://www.eia.gov/tools/faqs/faq.cfm?id=74&t=11

upgrades to air systems and additional automation are also expected to improve the reliability of building systems. An estimated 90% of the ESPC expenditures addressed deferred maintenance issues for which funds had not otherwise been identified.

On top of these benefits, the transition from coal to natural gas also allowed the University to avoid future expenditures associated with anticipated environmental regulatory changes. Continued operation of a coal-fired steam system would have required the purchase and installation of an air pollution control device called a bag house. UofL obtained a cost estimate for the required system from a Kentucky engineering company in the amount of $8 million. This cost was avoided by making the decision to install the new natural gas boilers.

Finally, the energy efficiency upgrades have had a direct impact on emissions. In total, the improvements are expected to reduce annual greenhouse gas emissions by 92.4 million lbs. of carbon dioxide, 152,175 lbs. of nitrogen oxides, and 463,175 lbs. of sulfur dioxide. This is equivalent to removing 7,690 cars from the road each year.[22]

1.5 Economic Impacts

There are two key mechanisms by which economic impacts can result from projects like UofL's energy savings performance contracts: 1) Local spending on energy-related equipment and services can stimulate economic activity; and 2) Savings above and beyond the cost of the projects can be redirected to support additional university activities (that otherwise might not have occurred because of budget limitations), which in turn stimulate additional job growth and local business sales. Total economic impacts within a local area are a combination of direct expenditure effects (i.e. spending on project implementation or redirected spending from project savings) and "spinoff" effects associated with the re-spending of dollars from the direct impact.[23] For example, when an environmental consultant is hired to help analyze and implement a new building system, the spending to hire the consultant appears in the economy as a direct business sales impact. That consultant's contract in turn generates demand for goods and services necessary to support the consultant's activities. This effect appears in the economy as additional sales in supplier industries. In addition, wages earned by workers generate local sales when they are re-spent locally on consumer goods such as foods, housing, health care, and retail purchases. The following sections present the estimated economic impact of the Siemens projects on the Louisville metropolitan area.[24]

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[22] Siemens. University of Louisville Energy Performance Contract Overview. Presentation. June 6, 2014.

[23] Comprised of the indirect and the induced effects.

[24] Defined as the Louisville MSA which includes the following counties: Clark County, IN; Floyd County, IN; Harrison County, IN; Scott County, IN; Washington County, IN; Bullitt County, KY; Henry County, KY; Jefferson County, KY; Oldham County, KY; Shelby County, KY; Spencer County, KY; Trimble County, KY.

Local Spending Impacts

Local spending impacts accrue during the period of project implementation and derive from a) the purchase of goods within the Louisville MSA, and b) payment of wages to workers involved in equipment installation or other related services such as engineering, testing, and environmental remediation. This analysis addresses spending for materials and services included in the Siemens performance contracts directly, as well as additional spending by the university to support the project (e.g. testing by the UofL Department of Environmental Health and Safety).

Equipment and materials used in the project were for the most part purchased locally through the wholesale distribution channel. Wholesalers source from manufacturers located all over the county (and the world). Local revenue comes from the wholesalers markup over the direct-from-manufacturer costs. Therefore, while a sizeable portion of spending (related to the manufacturing cost) does "leak" outside the area, some is also retained in the local economy. Labor costs, on the other hand, tend to be stronger drivers of local impacts. The majority of workers employed for project implementation were from the Louisville metropolitan area, with a smaller percentage from outside of the area. Local wage-earners drive local economic impact through consumer spending.

Phase I of the project, which cost $24 million to implement (in 2014 dollars),[25] supported an estimated $11.6 million in new local business sales, 286 jobs, and $15.6 million in associated labor income during project implementation. Phase II, with its slightly larger investment of $26 million (2014 dollars),[26] supported around $14.2 million in additional business sales in the Louisville metropolitan area, as well as 327 jobs and $17.9 million in new labor income. All told, implementation of the two phases of energy efficiency projects supported $25.8 million in business sales and 613 jobs in the Louisville metropolitan area (Table 0.2).[27] These impacts include both direct and spinoff effects of investment in new building systems.

[25] $21 million in 2009 dollars, based on the terms of the Siemens contract, converted to 2014 dollars

[26] $25 million in 2011 dollars, based on the terms of the Siemens contract, converted to 2014 dollars

[27] Impacts are total direct, indirect, and induced impacts based on IMPLAN modeling for the Louisville MSA; inputs are detailed spending data from Siemens and the University of Louisville. All dollar impacts are in 2014 dollars.

Table 0.2: Estimated Total Economic Impact – Business Sales, Labor Income, and Jobs Supported by Spending in the Louisville Metropolitan Area (2014 dollars)[28]

Phase	Business Sales	Labor Income	Jobs[29]
Phase I	$11.6 M	$15.6 M	286
Phase II	$14.2 M	$17.9 M	327
Total	$25.8 M	$33.5 M	613

Redirected Spending Due to Cost Savings

As explained earlier, Siemens performance contracts are financed up front, with the debt service paid back over time using guaranteed savings that accrue from the improvements. Any savings above and beyond the amount owed in annual debt service can be used to implement additional energy efficiency projects and support other discretionary expenditures.

For the three years of Phase I and one year of Phase II (plus construction) that have already been measured and verified, it is possible to compare actual savings to the amount spent by the university to pay back project financing. To date, total savings accrued in Phase I (including energy and operational savings, as well as utility rebates) surpasses the amount owed in that same period for municipal lease payments by $3.9 million (2014 dollars).[30] Redirected to other UofL initiatives, this amount is estimated to directly support the equivalent of 31 local jobs and to indirectly generate spinoff effects of $3.7 million in additional business sales and the equivalent of 27 jobs. In total, the first three years of savings from Phase I, plus savings accrued during construction, served to support approximately 58 jobs and $7.6 million in business sales in the Louisville metropolitan area.

To date, Phase II has resulted in savings to the University above and beyond payments owed for bonds in the amount of $1.3 million (2014 dollars).[31] Savings from Phase II are estimated to directly support 7 jobs in the community—some associated with university operations and others at firms engaged in building contract work for additional energy efficiency projects. The savings also indirectly contribute to an additional $800,000 in local business sales and 6 jobs from spinoff effects. Combining direct and spinoff effects, the first year savings from Phase II supported the equivalent of 13 jobs in the Louisville economy, along with $1.7 million in additional business sales.

[28] Includes total direct, indirect, and induced impacts of expenditures during project implementation.

[29] Siemens provided data on local expenditures on labor for project implementation. The relationship between direct labor income and direct jobs was estimated using study area data from the IMPLAN model on the relationship between labor income and employment for the "Maintenance and repair construction of nonresidential structures" sector.

[30] $3.6 million in nominal dollars in the period 2010-2013, $3.9 million in 2014 dollars.

[31] $1.2 million in nominal dollars in the period 2012-2013, $1.3 million in 2014 dollars.

Table 0.3: Estimated Total Economic Impact of Redirect Spending Due to Cost Savings (2014 dollars)

Phase	Direct Revenue	Direct Jobs	Spin-off Sales	Spin-off Jobs	Total Jobs	Total Sales
Phase I	$3.9 M	31	$3.7 M	27	58	$7.6 M
Phase II	$0.9 M[32]	7	$0.8 M	6	13	$1.7 M
Totals	$4.8 M	38	$4.3 M	33	71	$9.3 M

The per-dollar local effects of the Phase II spending are smaller because the majority of the savings are directed towards additional investments in building system upgrades at the university. These types of investments tend to source more materials and services from outside the Louisville MSA and thus have a lower relative contribution to the local economy than does general spending within a university budget. Not accounted for in this analysis, however, are additional savings derived from the building system upgrades pursued with the savings from the Siemens projects. Just as the Siemens projects involve up-front costs to achieve long-terms savings, these additional projects are expected to generate further savings in the future that can then support overall university budget expenditures. Thus the savings from the Siemens building system improvements and energy optimization efforts support a virtuous cycle of investment in sustainability initiatives and long-term energy conservation.

[32] Direct revenue accrued within the Louisville MSA ($0.9 million) is less than the Phase II net savings ($1.3 million) because some goods and services are procured from outside the area.

APPENDIX

Glossary of Terms

Jobs represent the total number of individuals employed – not full time equivalent positions.

Labor Income are the full payroll expended for employees from the employers' perspective, including all taxes and benefits.

Business Sales represent output or additional economic activity. For government, or non-profit entities, output represents their annual budget.

Value Added represent the additional "economic gain" or value produced. Value added equals Business Sales minus cost of inputs (e.g. materials).

Using the IMPLAN Economic Impact Modeling System

Regardless of whether economic impacts are measured in terms of jobs, income or business sales, impacts can be classified into three categories:

- *Direct economic effects* are the activities directly supported by the investment program.
- *Indirect economic effects* are the broader effects on business activity for locally-based off-site suppliers to the directly-affected businesses. This can include production, distribution and transportation for suppliers of goods and services.
- *Induced economic effects* are further shifts in spending on locally-sourced food, clothing, shelter and other consumer goods and services, as by the spending of the after-tax payroll by employees of directly and indirectly affected businesses.

To estimate the indirect and induced ("multiplier") economic effects of the University of Louisville energy savings performance contracts with Siemens, this study utilized the IMPLAN economic impact modeling system. This system uses industry- and region-specific economic data to translate direct effects into "spinoff" or "multiplier" effects.

IMPLAN is the most widely used input-output economic modeling system in the US, with a client list that includes over 500 public and private agencies including the Federal Reserve,

the Environmental Protection Agency (EPA) and the American Recovery and Reinvestment Act (ARRA) program.[33]

The model utilizes U.S. Commerce Department ("National Income and Product Accounts") data on inter-industry technology relationships (also known as input-output structural matrices), county employment and income data from the Bureau of Economic Analysis (BEA) and Bureau of Labor Statistics (BLS), and its own industry and county-specific estimates of local purchasing rates ("regional purchase coefficients"). It is enhanced over most other input-output models in that it also includes coverage of public sector activity and consumer activity (reflected in its "social accounting matrix"). The model includes industry detail at the level of 440 industries, based on categories of the US Bureau of Economic Analysis (BEA), which correspond to 2 to 5 digit groups in the North American Industry Classification System (NAICS).

Direct local-sourced material expenditures (e.g. purchases of equipment) for the Siemens project implementation were documented and assigned to industry sectors, based on data provided by the Building Technologies Division of Siemens Industry, Inc. and by the Department of Physical Plant at the University of Louisville. For example, most equipment was purchased locally through the wholesale distribution channel. Wholesalers source from manufacturers located all over the county (and the world). Local revenue comes from the wholesalers markup over the direct-from-manufacturer costs. The IMPLAN model for the "Wholesale trade business" sector is used to margin the customer paid price into the portion of the total cost the wholesaler keeps for their operational expenses and the portion that covers the cost of the production and transportation, which "leaks" outside of the local area. Direct local labor expenditures were also documented based on input from Siemens.

For Louisville, the relationship between direct labor income and direct jobs was estimated using study area data from the IMPLAN model on the relationship between labor income and employment for the "Maintenance and repair construction of nonresidential structures" sector. In the case of the savings analysis for a public institutional energy customer, net savings (above the amount owed in debt service payments for the cost of installation) were assumed to support additional spending by the campus and thus were mapped to specific industry sectors, based on information about how funds were reinvested from the Office of the Vice President for Business Affairs and the Department of Physical Plant at the University of Louisville.

This study employed the IMPLAN model calibrated for the 12-county Louisville metropolitan area.[34] The model was run using the direct effects described above as inputs. The result was

[33] For more information on IMPLAN and its history, visit https://implan.com and click on the "About Us" tab.

[34] Defined as the Louisville MSA which includes the following counties: Clark County, IN; Floyd County, IN; Harrison County, IN; Scott County, IN; Washington County, IN; Bullitt County, KY; Henry County, KY; Jefferson County, KY; Oldham County, KY; Shelby County, KY; Spencer County, KY; Trimble County, KY.

an estimate of the indirect and induced (and overall) job, business revenue and labor income activity supported in the Louisville metropolitan area by the energy savings performance contracts (including both the energy retrofit activity, and activity supported by redirected savings).