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Energy Learning Exchange Report

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Contents

Tables

Figures

Introduction

The Illinois Pathways Initiative is a component of the state's plan to enhance postsecondary attainment and meet workforce needs. Under Illinois's Race to the Top grant, the state expressed a goal of helping 60 percent of Illinois residents attain a high-quality academic degree or industry-recognized certificate or credential by 2025. The centerpiece of this initiative is the development of Illinois STEM Learning Exchanges (LEs), a set of statewide public-private partnership networks that support local P-20 STEM programs of study (POS) from early learning to college or career education. These networks are intended to create capacity between partners across eight STEM application areas that are organized around career clusters. Stakeholders include employers and employer-led organizations, professional associations, and secondary, postsecondary and research institutions. The Pathways Initiative has established five LEs to provide these supports to advance school-based career programs for the following career clusters:

- Agriculture, Food, and Natural Resources (AFNR)
- Health Science
- Information Technology (IT)
- Manufacturing
- Research and Development (R&D)

These five entities are referred to as implementation LEs. In addition, planning funds were provided to establish LEs for the following career clusters:

- Energy
- Finance
- Transportation, Distribution, and Logistics (TD&L)

These three entities are referred to as planning LEs. Funding for all LEs began in fiscal year 2013 (July 1, 2012). The critical elements of the LEs incorporate STEM POS with postsecondary articulation and individual learning plans for students. While a main focus is on secondary and early postsecondary education, some attention is given to the academic needs of the elementary and middle school students regarding STEM that provides a foundation for learning experiences through POS at the secondary level. These POS provide opportunities such as real-world connections with adult mentors, education and career guidance systems, and credentials to students. The postsecondary partnerships are intended to provide students access to dual credit as well as supporting college- and career-ready students' transitions.

The LEs were charged with pursuing three broad strategies associated with nine specific functions. First, the exchanges were intended to **manage system design and track performance**. This strategy is associated with one function—namely, to review and report on performance of STEM POS and to work with school partners to improve their performance. This function requires the LEs to aggregate student data and assessments and consider the talent pipeline benchmarks established by the Illinois Pathways Interagency Committee. Second, the

exchanges were meant to **deliver resources and supports for local pathway systems**. This strategy involves six functions: career development and outreach resources, e-learning curriculum resources, access to classroom and laboratory space and equipment, professional development resources for teachers and administrators, support for career-related student organizations, and tools and resources for personalized education plans and postsecondary transitions. Finally, the exchanges were intended to **support student organizations** by expanding quality work-based learning opportunities (including internships and other forms of work-based learning) and by sponsoring challenges and project management resources for students.

Purpose and Organization of This Report

The external evaluation of the Pathways Initiative, conducted by American Institutes for Research (AIR), examines the implementation of strategies and functions of LEs, considers preliminary information about the impact of these functions on career programs available across the state, and provides considerations about the sustainability of the initiative and recommendations to consider in pursuit of supporting career programs in the future. AIR will issue separate evaluation reports for each LE, along with a report that examines the initiative as a whole. The current report focuses on the **Energy Learning Exchange (ELE),** which is made up of major corporations and laboratories, research universities and other postsecondary institutions, and nonprofits. Drawing on a variety of data sources, the report describes the LE's support for POS within the Research and Development career cluster through the nine functions. It also describes the LE's progress in addressing additional deliverables such as securing 100 percent cash or in-kind matching funds, communicating progress to stakeholders, and planning for sustainability.

This report has the following sections:

- **Data Sources** describes the participants and response rates for interviews and surveys, along with extant data sources and documents analyzed.
- **Overview of LE Organization and Activities** describes the organizational history of the LE and its partners, and summarizes the major activities undertaken by the LE.
- **Budget and Funding** describes the total Race to the Top funds expended for each contract year, as well as sources of matching funds and in-kind contributions.
- **Performance of Key Functions** describes, for each of the nine functions, the planned and actual activities conducted, including level of participation of school districts.
- **LE Communication** reports findings regarding LE communication to its stakeholders.
- **Summary of LE Impact** summarizes the LEs major accomplishments and provides any evidence of impact on school districts, teachers, and students.
- **Sustainability** discusses factors to consider when analyzing the potential for continuation of LE activities

Data Sources

Stakeholder Interviews. On July 10, 2015, AIR interviewed the three leaders of the Energy Learning Exchange from ISU and conducted a follow-up interview with one of these same leaders in August 2015. These two interviews determined the scope and trajectory for evaluating the LE moving forward. Because *Energy* is not currently an established Career Cluster in the National Career Clusters Framework, or within the state of Illinois' career and technical education (CTE) programming, Energy POS are not currently available to schools in Illinois. Therefore, AIR decided not to include school-level interviews as part of the data collection, but rather on other sources of information as described below.

CTE Program Leader Survey. We developed a CTE program leader survey mainly to understand the experiences of schools implementing POS in respective career programs as a part of Race to the Top. Because no Race to the Top districts could select Energy as a program of study to develop, we decided not to administer an Energy-specific CTE leader survey.

Other data sources. AIR identified several extant data sources through conversations with ELE staff and stakeholders. These sources were analyzed to provide context to the activities the LE leaders described undertaking and how they were funded. AIR also reviewed and analyzed primary source documents provided by the LE as a part of our evaluation. These materials included monthly and annual reports, external evaluation reports, and other digital content created through the LE activities. A full list of these extant data and primary source documents are available in Appendix A.

Overview of LE Organization and Activities

In 2012, the Illinois State Board of Education (ISBE) announced Illinois State University (ISU) as the managing entity of the Energy Learning Exchange (ELE). Originally established as a teacher education institution, the ISU campus currently offers more than 160 undergraduate majors and minors and 41 graduate programs.

Within ISU, three organizations provided the primary leadership and support for the ELE: the Institute for Regulatory Policy Studies, the Center for Renewable Energy, and the Center for Mathematics, Science, and Technology (CeMaST).

- The mission of the Institute for Regulatory Policy Studies is to educate, communicate, and conduct research on issues related to the electricity, natural gas, and telecommunications industries in Illinois and throughout the United States. The Institute is Illinois' leading energy and regulatory policy organization, and hosts two energy policy conferences each year.
- The Center for Renewable Energy sponsors and manages several energy-related projects, including the K–12 Illinois Innovation Talent program and the Illinois Wind Working Group, in addition to hosting a variety of training workshops, seminars, and conferences each year. The organization also leads the Illinois Wind for Schools program, where faculty and staff from ISU work with high schools throughout Illinois to integrate energy and wind energy-related material into classroom curricula.
- The CeMaST's primary goal is to develop and support projects and activities that seek to improve the teaching and learning of science, technology, and mathematics. The organization facilitates a number of outreach programs in STEM areas and manages several teaching initiatives.

Faculty from within these three organizations worked collectively to lead the development and implementation of ELE activities. Faculty and staff from each of these three organizations within ISU also provided leadership and support for the broad coalition of partners involved with the ELE.

Description of Activities

During its strategic planning process, ISU leveraged its energy education network and relationships to create an infrastructure that would provide student academic support and career development in the field of energy. As written in its strategic plan, ELE's ultimate goal and vision was, "to support the development of an energy workforce that can be competitive and successful in tomorrow's economy by focusing on the connections between work-based learning and successful employment outcomes for Illinois students[1]." (pg.1)

With this vision in mind, the ELE developed several immediate and long-term priorities that guided its scope of work and activities. The immediate priorities identified by the ELE included: expanding curriculum and information, expanding internship opportunities, supporting real-

[1] Energy Learning Exchange – Strategic Plan Priorities Summary. (11/14/2013). Accessed July 2015.

world challenges, and providing teacher professional development and career awareness. The ELE intended to leverage its membership network to create activities and structures that built momentum toward its longer-term priorities. The longer-term priorities identified included: delivering resources and supports to local pathway systems by increasing access to instructional resources, providing students with personalized education plans, and improving access to classroom equipment and e-learning opportunities. In addition, the ELE intended to expand work-based learning opportunities for students, and analyze the performance of energy pathways. In pursuit of these priorities, the ELE coordinated and implemented several activities throughout the period of the Pathways Initiative. These activities are summarized below.

Smart Grid for Schools

The ELE received a grant from the Illinois Science and Energy Innovation Foundation (ISEIF) to develop an interactive experience (with associated curricular materials) to educate students about the transition to a new electric grid. The program developed by the ELE, called Smart Grid for Schools, is a traveling exhibit that offers an opportunity for students to learn about new Smart Grid[2] technologies that are currently being rolled out by utility companies in the state. The program is designed to engage K–12 students with Smart Grid concepts using lessons developed by the ELE that are aligned with the Next Generation Science Standards (NGSS).

The ELE provided professional development training sessions for teachers to become Certified Smart Grid Educators. These sessions included instruction on how teachers can implement Smart Grid lesson plans and curriculum in their classroom, and how they can bring the Smart Grid for Schools traveling exhibit to their school. This exhibit includes tabletop models of an electric grid with Smart Grid functionality, and life-size models of rooms (kitchen, bedroom, bathroom, and utility room) in a house with appliances to explain how the Smart Grid works and how it will benefit consumers. Since its launch in the 2014–15 school year, the interactive, hands-on exhibit visited more than100 schools in Illinois, and more than 275 teachers were trained.

Workshop for Teaching Next Generation Energy Concepts with Next Generation Science Standards (WIP 5 NGSS Workshop)

In the summers of 2013 and 2014, ISU's Center for Renewable Energy and CeMaST coordinated the *Teaching Next Generation Energy Concepts with Next Generation Science Standards* workshop. This workshop was a part of the U.S. Department of Education- and ISBE-funded Illinois Math and Science Partnership Workshop Institute Grant Program (WIP 5).

The workshop provided 15 Illinois teachers with a 2-week training on energy concepts and the incoming NGSS. Using this new knowledge, teachers developed curricular resources on energy-related concepts for students. These new resources, now aligned with the NGSS, were collected and subsequently made available online for all teachers across the state to access.

[2] The *grid* refers specifically to the *electrical grid*, which is the network of transmission lines, substations, and transformers that delivers electricity from power plants to people's homes and businesses. The *Smart Grid* is the new technology that will be used to monitor and efficiently distribute electricity. This technology includes the sensors, controls, computers, automation, and other equipment that will work with the electrical grid to respond to changing electric demands.

As a part of this workshop, teachers received training on these energy-related concepts through their participation in field trips to energy industry laboratories and workplaces. These field trips provided teachers with the opportunity to meet with industry professionals, use new technology and equipment, and expand their content knowledge of energy fields and careers. Industry partners providing these field trip opportunities included: Grand Ridge Energy Center, Wind Technician Program at Danville Area Community College, Ameren, Exelon, Solar House, Nicor Gas, and Prairie State Generating Company.

Careers in Energy Week

ISU, as the lead entity for the ELE, is a member of the Illinois Energy Workforce Consortium (IEWC), which works with schools, companies, and organizations as part of the Center for Energy Workforce Development's (CEWD) nationwide effort to promote careers in the energy field. The CEWD originated the idea of a "Careers in Energy Week" on the national level in 2010, and has encouraged states to embrace this initiative.

In 2013, Illinois Governor Pat Quinn declared the third week in October as the inaugural Careers in Energy Week. As described in his proclamation, teachers across the state were encouraged to share a variety of resources about energy careers with their students, and energy industry representatives were invited to present to classrooms on the need for a strong and growing energy workforce in the state. In understanding that not all teachers have content knowledge in energy or have direct connections to individuals in the energy workforce, the ELE facilitated a coordinated effort from among its members to support schools to implement Careers in Energy Week activities.

Beginning in fall 2013 and continuing through the current 2015–16 school year, the ELE coordinated with industry organizations, employers, and schools to provide students with detailed information about energy directly from those who are working in the field. They developed and shared physical and digital materials, including: classroom curricular materials, videos, presentations, and energy career data. In addition, the ELE coordinated industry speakers at schools for teachers who requested a speaker to present on a specific energy topic relevant to their classroom activities.

STEM Energy Challenges

The ELE partnered with the Research and Development Learning Exchange (RDLE) to sponsor the STEM Challenges where high school students work collaboratively in groups to solve an authentic energy problem. Each challenge was developed by an industry organization (in this case ISU) that reflected an issue facing their industry.

ISU's STEM Challenge asked students to design a prototype or plan for an energy-efficient system, or improvements to an existing system that could provide reliable power to a community to meet basic energy needs during or after a weather-related power outage. In 2015, four Illinois high schools participated in the energy-specific challenge and then presented their solutions at a year-end culminating event called the STEM Summit. Industry professionals from within the ELE membership served as mentors to student groups participating in the energy-specific challenges.

Estimate of LE Staff Time Spent on Activities

AIR evaluators asked the leader of the ELE to estimate the proportion of staff time spent on the aforementioned activities in the years since the start of the Illinois Pathways Initiative. Table 1 displays these percentages across each of these activities. According to these estimates, staff dedication to these activities was relatively stable across all years. After completing a majority of their planning and coordination activities during their first year, the ELE shifted some of their staff time towards organizing and implementing Smart Grid for Schools.

Table 1. Estimate of Staff Time Spent on ELE Activities

	July 1, 2012-June 30, 2013	**July 1, 2013 – June 30, 2014**	**July 1, 2014-June 30, 2015**	**July 1, 2015-Dec 31, 2015**
Smart Grid for Schools	n/a	15%	25%	35%
WIP-5 NGSS Teacher Workshops	n/a	10%	10%	n/a
E-curriculum Resources (IOER)	5%	10%	10%	5%
Careers in Energy Week/ Career Awareness (Career Fairs, Social Media, Etc)	20%	20%	20%	20%
Sponsor STEM Challenges	10%	10%	10%	15%
Conference Participation	25%	15%	15%	15%
Other: Planning and Coordination (Incl. Ill. Energy Workforce Consortium)	40%	20%	10%	10%
Total	**100%**	**100%**	**100%**	**100%**

LE Budget and Funding

For the years covering its funding as a planning LE, the ELE also received financial support from its partners in the form of cash and in-kind donations, such as staff time, access to facilities, or other noncash support. Table 2 outlines the Race to the Top funding received through the Pathways Initiative in each fiscal year. Table 3 displays the cash and in-kind contributions received from ELE partners.

Table 2. Race to the Top Funding Through Pathways Initiative by Year

FY 2013	**$50,000**
FY 2014	-
FY 2015	-
FY 2016	-
Total	**$50,000**

Table 3. Summary of Additional Funding Sources and Matching Funds

Source	Title	Years Active	Amount ($)	Type	How Funds Were Used
US Dept. of Education	NGSS WIP5	2012-2013	$159,901	Grant	Curriculum and Teacher Professional Development
IL Dept. Commerce and Economic Opportunity	Solar for Schools	2013-2014	$66,072	Grant	Curriculum and Teacher Professional Development
IL Dept. Commerce and Economic Opportunity	Wind for Schools	2010-2014	$111,752	Grant	Curriculum and Teacher Professional Development
US Dept. of Education	NGSS WIP5 (Year 2)	2013-2014	$159,954	Grant	Curriculum and Teacher Professional Development
US Dept. of Education	NGSS WIP5 (Year 2 Add.)	2014	$63,960	Grant	Curriculum and Teacher Professional Development
IL Science and Energy Innovation Foundation	Smart Grid for Schools	2014-2015	$451,701	Grant	Curriculum and Teacher Professional Development
IL Science and Energy Innovation Foundation	Smart Grid for Schools 2015	2015-2016	$400,000	Grant	Curriculum and Teacher Professional Development
ISU Center for Math Science & Technology	ELE Fund	2013	$30,000	Gift	ELE Support
Nicor Gas	ELE Fund	2013-Present	$50,000	Gift	ELE Support
Nicor Gas	ELE Fund	2014-Present	$50,000	Gift	ELE Support
Exelon Corp.	-	2013	$2500	Sponsor	Student Challenge with Ag. Exchange – FFA Conference
Ameren Corp.	-	2013	$500	Sponsor	Student Challenge with Ag. Exchange – FFA Conference
Nicor Gas	-	2014	$2500	Sponsor	Careers in Energy Week
Exelon Corp.	-	2015	$2500	Sponsor	Careers in Energy Week
Total			**$1,551,340**		

For the period encompassing the Pathways Initiative (2012–13 through 2014–15), the ELE generated **$1,601,340** in cash and in-kind funding from across its membership to support its activities.

Performance of Nine Key Functions

At their inception, the STEM LEs were designed to serve schools through fulfilling nine key functions outlined by ISBE. These nine functions were intended to summarize the types of resources and support that LEs should supply to assist schools effectively in advancing their related career programs and specific POS. In their applications and throughout the strategic planning process, some LEs identified existing resources or information from industry partners that led them to focus their support in particular functions based on what they assessed to be the greatest need or priority for use of the resources. The following sections describe the actions and activities performed by the ELE that align to these nine functions and provide evidence of implementation and fulfillment of the functions gathered by the research team from the specified data sources.

Provide e-Learning Curriculum Resources

This function required LEs to provide e-learning curriculum resources. Examples of e-learning curriculum resources include: online courses, assessments and feedback systems, reference materials, databases, and software tools. LEs had the opportunity to coordinate with the staff at the Center for Workforce Development at Southern Illinois University who support the Illinois Shared Learning Environment to include these tools and resources in the Illinois Open Educational Resources (IOER) online collection library.[3]

The ELE created its own library collection of resources on IOER for use by teachers, students, and others interested in energy. Its library included 154 total resources, many of which were created during the WIP 5 NGSS Workshop. Figure 1 depicts, for the ten most viewed resources on IOER, the number of views by resource, by quarter, since the introduction of each resource.

The ELE uploaded most of the resources to the IOER platform during the first quarter of 2015, with the exception of the Smart Grid for Schools materials. Those resources were developed and uploaded by the ELE in final quarter of 2014. The most viewed resource, the WIP5 NGSS Energy Lessons, is a collection of lessons that teachers created during the 2-week workshop in summer 2013. The ELE digitized and uploaded these lesson plans to IOER.

Table 4 provides detail on these same 10 most viewed resources, including the total number of views each resource had during the contract period. The top two most widely viewed resources were directly related to activities that the ELE conducted; namely, the WIP5 NGSS Workshop, and Smart Grid for Schools.

[3] http://IOER.ilsharedlearning.org/resource/585456/Illinois_Pathways

Figure 1. Number of IOER Resource Views per Quarter

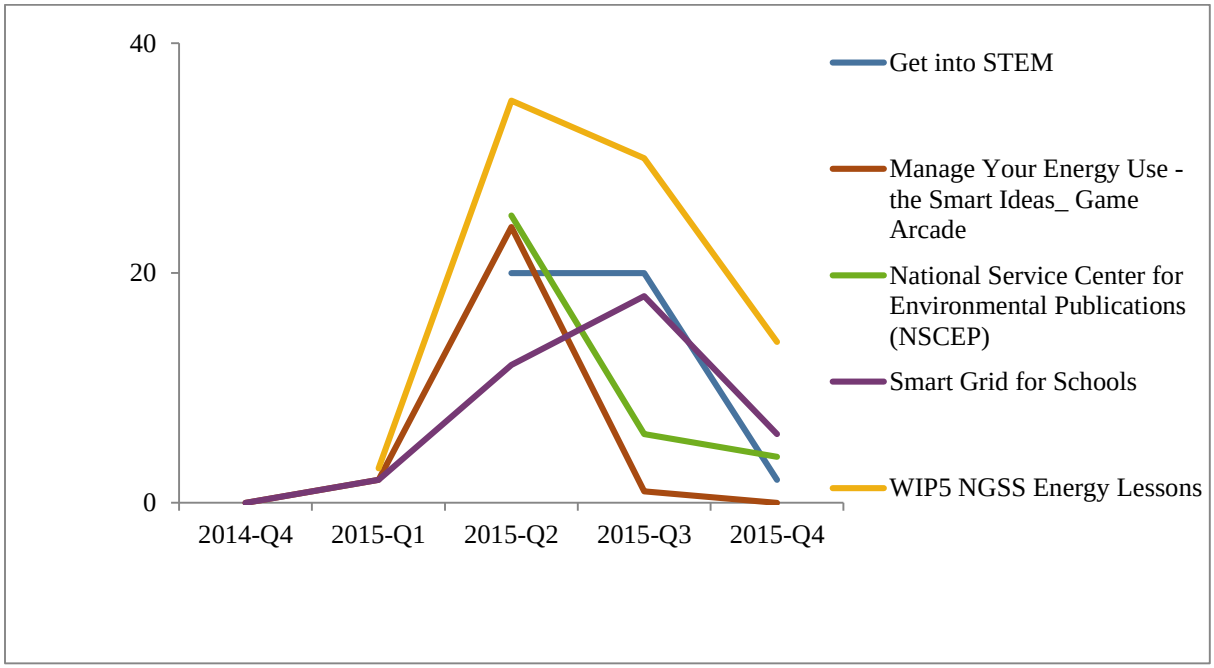


Table 4. Ten Most Frequently Viewed Resources in the ELE's Library

Resource Title	Contributor	Purpose	Total Views
WIP5 NGSS Energy Lessons	Energy Learning Exchange	Collection of lesson plans on integrating energy concepts	119
Smart Grid for Schools	Energy Learning Exchange	Information on the Smart Grid for Schools exhibit	52
Get into STEM	Center for Energy Workforce Development	Series of lesson plans for teachers to get students interested in energy	51
National Service Center for Environmental Publications (NSCEP)	Environmental Protection Agency	Catalogue for EPA-recommended classroom materials	46
Manage Your Energy Use—the Smart Ideas_ Game Arcade	Commonwealth Edison (ComEd)	A game platform for introducing Smart Grid to students	45
Hands-on Activities and Other Resources on Air Quality and Climate Change for Teachers	Environmental Protection Agency	Website providing ideas for "do-it-yourself" activities	43
PG&E Yerba Buena Microgrid Overview	(none listed)	YouTube video exploring California's power grid	41
Build a Roller Coaster	Energy Learning Exchange via Museum of Science and Industry Chicago	Lesson plan for building a model roller coaster using marbles and PVC piping	38
Cook Food Using the Sun	Energy Learning Exchange via Museum of Science and Industry	Lesson plan for cooking food using solar energy	38
Forms of Energy	Illinois State University	Presentation slides on the different forms of energy	31

ELE Activities Focused on Curriculum Development

In 2013, ISU's CeMaST and the Center for Renewable Energy collaborated to develop a summer workshop for middle and high school STEM teachers called the WIP 5 NGSS Workshop, which was funded through a grant from ISBE and the Illinois Mathematics and Science Partnership. The workshop focused on energy concepts within the framework of the NGSS, with the goal of developing instruction on energy-related lessons for students that aligned with the standards.

As a part of the workshop, the ELE provided and supported classroom activities and field trips to industry workplaces and postsecondary labs to support teachers' comprehension of major energy principles, and the real-world applications being used in the state of Illinois. This activity began with a 2-week session in July 2013, with several 1-day follow-up sessions throughout the 2013–14 school year. The same cohort of teachers met again in July 2014 to finalize lesson plans that

they created in alignment with the NGSS standards. Those lessons are now a part of the library collection on IOER that any teacher from the state of Illinois, or from other states who want to access the site via the Internet, can access. As was presented in Figure 1, the collection of lesson plans created during this workshop is the most viewed resource on the Energy Learning Exchange's IOER Library. Within its library of resources, lesson plans are organized into modules; each contains a set of individual files categorized by lesson topic and grade level. These topics included Science; Science and Math; Chemistry and Environmental Science; Chemistry and Physics; Physical Science; Integrated Environmental Science; and Technology, Engineering, and Science.

In addition to the lesson plans developed through the WIP 5 NGSS grant, the ELE also provided e-curriculum resources related to their Smart Grid for Schools traveling exhibit. The associated resource listed on IOER links directly to www.smartgridforschools.org/. This site is hosted on CeMaST's homepage within Illinois State University's main website. On this site, teachers have access to lessons, categorized by grade level, for use with the exhibit when it is available to their school site. Although these Smart Grid lessons are available to anyone who accesses the site, they are useful only in the context of using the Smart Grid for Schools exhibit, provided that the school made this arrangement with the ELE.

Expand Access to Space, Equipment, and Resources

As a part of their work to advance career programs and POS in schools, LEs were expected to expand access to classroom and laboratory space, equipment, and related educational resources necessary to support POS through regional partnerships and other strategies.

Electricity producers and distributors in Illinois have started rolling out plans for implementing Smart Grid technologies across the state. To facilitate this transition to the Smart Grid, the Illinois Science and Energy Innovation Foundation (ISEIF) awarded ISU with a grant. With this grant funding, ISU created a traveling exhibit and NGSS-aligned lesson plans to help educate students and teachers about the benefits of moving to these Smart Grid technologies.

To educate the public on this transition to the Smart Grid, ISU developed a life-size, traveling exhibit that allows participants to engage in hands-on activities. As mentioned in the previous Provide e-Curriculum Resources section, these activities come in the form of grade-level-appropriate lesson plans that are listed on www.http://smartgridforschools.org/.

The ELE conducted targeted and general outreach to schools, districts, and specific teachers regarding to this program. The teachers who expressed an interest in bringing a Smart Grid for Schools exhibit to the their classrooms attended a 1-day workshop that introduced them to and provided them with the Smart Grid lesson plans aligned to NGSS standards. At the end of this workshop, teachers became Certified Smart Grid Educators and can schedule a visit from the Smart Grid for Schools exhibit at their school.

In its year-end report, the ELE indicated that more than 275 teachers were deemed *Smart Grid Certified* through the trainings offered by ISU. In addition, ISU took this traveling exhibit to more than 40 events in the state of Illinois, with more than 110 schools participating in Smart Grid for Schools activities.

Support Student Organizations

As a part of their charge within the nine functions, LEs were expected to support student organizations and their major activities, including conferences, internships, and professional networking experiences; competitions; and community projects that build leadership, communications, and interpersonal skills, as well as provide professional and peer support networks.

The ELE's support of student organizations came largely through its partnership with the RDLE's STEM Challenges and its participation in workshops coordinated by Project Infinite Green. These organizations and activities are not student organizations themselves, but recruited students involved in student organizations to participate in their events. For example, ISU sponsored and mentored student teams at four schools to participate in the STEM Energy Challenge: Glenbrook South High School, Urbana High School, Washington Community High School, and Williamsfield High School. This energy-specific challenge was structured as an afterschool extracurricular activity for 1 or 2 hours per week in the spring semester under the guidance of a teacher advisor. Further details about this challenge is included in the Sponsor Challenges and Project Management Resources section below.

The ELE also participated in workshops coordinated by Project Infinite Green, an externally organized afterschool program that focuses on introducing students to the scientific and business aspects of creating clean energy solutions to the challenges facing the industry. The ELE's specific participation in Project Infinite Green focused on a single presentation and activity on wind energy technologies. After a 45-minute lecture and PowerPoint presentation by a member of ISU's Center for Renewable Energy, students designed, built, and tested a model wind turbine.

Schools that participated in Project Infinite Green signed up for a 15-week sequence of presentations and activities, covering topics, such as U.S. energy policy, nuclear power, and renewable energy sources, to name a few. This series occurred over the 3 school years covering the Pathways Initiative at four different high schools: Lockport High School, Lemont High School, Joliet Central High School, and Joliet West High School.

Provide Internships and Work-Based Learning Opportunities

LEs were expected to assist school districts in making connections with local employers to provide internships and other work-based learning opportunities that connect students with adult mentors.

Based on our interviews with the ELE leaders and the documents provided, it is not clear what internship opportunities were made available or expanded by the ELE under its planning contract. The ELE, however, did publicize a job shadow and training opportunity that was developed by ComEd, one of its member organizations. ComEd, an electric utility company, offers an 8-week program called CONSTRUCT, which provides a cohort of up to 60 students with the training, information, and guidance necessary to compete for entry-level jobs in construction-related fields. It was designed to address the need for increasing the pool of qualified minority candidates for construction jobs in Illinois by strengthening the job readiness

and life skills among students. The program also focused on preparing students for industry-required testing that is often an employment prerequisite. The program included various job shadowing opportunities to give candidates an up-close view at the many career paths available to them in the energy field. The ELE advertised this opportunity with its school partners to facilitate greater familiarity with and access to the program.

Sponsor Challenges and Project Management Resources

Within this function, the LEs were expected to facilitate challenges and project management resources for students to work in collaborative teams addressing real-world interdisciplinary problems. The ELE leaders leveraged their existing relationships with ISU and with their member organizations to sponsor four major activities: the STEM Challenges, the Illinois State Region Science Bowl, the Future Farmers of America Science Bowl competition, and ISU's High School Research Symposium.

- As previously mentioned, the ELE partnered with the Research and Development Learning Exchange (RDLE) to create challenges for high school students to work in groups to solve a real-world energy problem that the industry is facing. To complete this energy-specific challenge, students were asked to design a prototype or plan for an energy-efficient system, or improvements to an existing system, which can provide reliable power to a community to meet their basic energy needs during or after a weather-related power outage.
- In February 2014, the ELE sponsored the Illinois State Region Science Bowl, which is a part of the U.S. Department of Energy's Science Bowl academic competition. In this competition, teams of four students (with a student alternate and teacher advisor) faced off against each other in a fast-paced question-and-answer style competition. The questions tested student teams on a range of scientific disciplines, one of them being energy. The ELE's sponsorship of the Science Bowl competition contributed to the award prize, a fully paid trip to the National Science Bowl Finals in Washington, DC, later in the semester.
- In 2013, 2014, and 2015 the ELE partnered with the Agriculture, Food, and Natural Resources Learning Exchange to sponsor student challenges at the Future Farmers of America State Convention that is held annually in June. The ELE leaders coordinated the participation of two of their member organizations, Exelon and Ameren, to sponsor the partnership and provide judges for the energy-related projects that competed in the AgricScience Fair at the convention. A portion of the sponsorship fees went to student award winners in the form of travel stipends to compete at the nation event. Examples of student topics presented at this challenge event included: *From Trash to Bio-Gas* and *What Substance Generates the Most Electricity in an MFC?*

- In addition, CeMaST sponsors an annual High School Research Symposium at ISU. This event encourages high school students to showcase their STEM-related research projects through a poster presentation and competition. For the 2015 symposium, the ELE worked with Agriculture teachers through Future Farmers of America to create an Energy category for research projects. Of the 200 total research projects, 15 were energy-related. Other categories included animal sciences, chemistry, environmental science, and medicine and health sciences to name a few.

In summary, the ELE coordinated and sponsored four major activities throughout its funding period that provided students with the opportunity to analyze industry problems, test their science knowledge, and present their independent research in statewide competitions. Primarily, the ELE publicized these events to its school networks through newsletters and targeted outreach from the ELE leaders and provided monetary sponsorship to support the implementation of the activities associated with these events.

Provide Professional Development Resources

As a part of this function, the LEs were expected to provide professional development resources for teachers and school administrators that are integrated and aligned across middle school, high school, and community college instruction. These resources were also to include materials that addressed STEM externships, support for Web-based networks, and integrated professional development for academic and CTE instructors. LEs also were expected to work with existing networks such as EFE systems to provide teachers in Race to the Top districts with these resources.

Overall, the ELE concentrated much of its efforts on providing professional development and training opportunities for teachers to become more familiar with emerging energy concepts. To organize these professional development opportunities, the ELE hired a full-time professional development coordinator. Broadly, its efforts focused on providing teachers with opportunities to learn about emerging energy concepts and develop lesson plans aligned with NGSS standards.

Because Energy POS are not currently offered in Illinois schools, teachers who wished to have access to professional development or training opportunities on energy-related concepts must seek them from outside their typical school-based CTE network. The ELE's efforts to meet the professional development function are evident in two of its major activities: Smart Grid for Schools and the WIP 5 NGSS Workshop for teaching next-generation energy concepts. As described previously, the ELE's played a coordinating role in the implementation of these professional development opportunities.

- According to the ELE's 2014–15 Year End Report, more than 275 teachers received training on the Smart Grid for Schools exhibit. These trainings incorporated the use of already-created lesson plans and how to best help students interact with the Smart Grid exhibit. In addition, at the start of the 2014–15 school year, more than 100 energy educators from across Illinois to participated in a 1-day workshop ISU that focused on energy literacy, career awareness, and Smart Grid technologies.

- The ELE also provided professional development and training to teachers during its IBSE- and Illinois Math and Science Partnership (IMSP)-funded Workshop for Teaching Next Generation Energy Concepts with Next Generation Science Standards (WIP 5 NGSS Workshop). This workshop included a total of 15 teachers from seven different schools, who took part in an extensive 2-week summer program in 2013 and 2014 (with several follow-up sessions throughout the 2013–14 school year). Some of the activities provided in this workshop included: building an electric grid diorama, designing an electric vehicle, and designing formative assessments, to name a few. Fields trips to industry sites included: Danville Area Community College Wind Technician program, Ameren Urbana-area substation, and Clinton Nuclear Generation station, to name a few.

In summary, the ELE supported teacher professional development through the coordination of two grants: the WIP 5 NGSS Workshop grant for the creation of an energy curriculum and the ISEIF-funded Smart Grid for Schools program. Both of these activities provided hundreds of teachers with the opportunity to integrate emerging energy concepts into their classroom curriculum.

Provide Career Development and Outreach Resources

The LEs were expected to provide career development and outreach resources to expand awareness of STEM-related programs and careers to K–12 students. The LEs were also expected to assist existing regional delivery systems for CTE, including regional EFE systems.

The ELE conducted a majority of its work related to providing career development and outreach resources during Careers in Energy Week.[4] As noted earlier, Careers in Energy Week has been in place in Illinois since 2013, and occurs every October. During this week, students and teachers are encouraged to learn about how energy companies operate, what types of careers exist within the energy industry, and the importance of energy companies to local economies.

To celebrate Careers in Energy Week, the ELE provided materials to teachers and their classrooms in both physical and digital formats. The ELE pooled resources from across its membership to provide classroom grants to three teachers in the amount of $200. These grants were awarded to teachers who successfully highlighted careers in energy within their classroom.

In both 2013–14 and 2014–15 school years, the ELE sent information packets to more than 1000 teachers to build awareness about Careers in Energy Week. These information packets that teachers received from the ELE encouraged teachers to request speakers on specific energy topics to talk to their students. The ELE also provided classroom kits to more than 300 classrooms. These kits included: shirts, posters, notebooks, and pencil sets that promoted energy careers.

For the 2013 activities, the ELE solicited nine different industry professionals from its membership network to speak in classrooms, engaging more than 500 students. Organizations providing speakers and other support for Careers in Energy Week in 2013 included: Nicor Gas, AGL Resources, Ameren Illinois, Association of Illinois Electric Cooperatives, ComEd and

[4] http://energy.illinoisstate.edu/careers/

Exelon Generation, Mt. Carmel Public Utility, People's Gas, Primera, Itegrys, S&C Electric Company, College of DuPage, Illinois Energy Association, and Illinois State University.

In 2014, the ELE solicited 13 different speakers from its membership network to speak in classrooms, based on the requests they received from teachers. These 13 speaking events engaged more than 500 students. Industry groups who participated in these speaking activities included: the Illinois Commerce Commission, StraightUp Solar, Dynegy, Invenergy, ComEd, Exelon, Utilivate Technologies, and Illinois State University; with several other organizations providing additional support through funding or advertising.

Furthermore, ELE coordinated with several other industry groups within its membership to host other Careers in Energy Week activities. Nicor Gas hosted a careers oriented webpage for educators, parents, and students, and also participated in several events during the week. These events included: exploring energy careers at Joliet Junior College, a career fair at Moraine Valley Community College, and other events at Prairie State College, Northern Illinois University, and the Museum of Science and Industry. The Association of Electric Cooperatives supported Careers in Energy Week through a social media campaign that included video interviews with its employees. Exelon and ComEd visited schools to talk to students about the many opportunities in their organizations for students studying in the STEM fields, and also featured a social media campaign. Other participating organizations included Ameren, Peoples Gas and North Shore Gas, Prairie State Generating Company, Primera Engineers, and S&C Company. These organizations promoted Careers in Energy Week on their websites.

Support Partnerships with Postsecondary Education

Within this function, the LEs were expected to provide tools and resources to assist students and schools with implementing personalized education plans and transitions to postsecondary academic and training programs, including establishing course articulation and dual credit opportunities.

As noted earlier in this report, energy POS are not currently offered in the state of Illinois, nor recognized as a part of the National Career Cluster Framework. In addition, there is no industrywide recognized credential in the state of Illinois. Because this structure does not exist, course articulation agreements and dual-credit opportunities between K–12 schools and postsecondary institutions were not pursued under funding from this planning contract.

In its 2014–15 Year End Report, the ELE highlighted the fact that the CEWD partnered with other states and various community colleges to offer the Energy Industry Fundamentals Certificate. Although this certificate is currently not recognized in Illinois, the ELE leaders stated that they intend to continue working with industry partners and schools to leverage opportunities to further the adoption of a credential that matches the need of the energy workforce in Illinois.

Review Performance of STEM Programs of Study

The LEs were expected to review performance of STEM POS through assessments and work with school partners to continuously improve performance. It should be noted that the Pathways Resource Center provided coaches to work directly with Race to the Top school districts on

setting up POS, and LEs were not expected to directly engage individual districts with POS development in this way.

Because energy POS are not currently offered in the state of Illinois, nor recognized as a part of the National Career Cluster Framework, the expectation to review the performance of any POS offered in schools was not an applicable activity for this LE.

LE Communication

Each LE was expected to develop a clear, systematic communication plan for reporting its milestones and accomplishments to ISBE, its users, and its larger stakeholder groups in Illinois.

The ELE held quarterly meetings with its member organizations to discuss progress toward meeting goals, the development of activities related to the nine functions, and to share resources.

The ELE set up an events calendar on the Energy Learning Exchange homepage that highlights emerging energy career- and education-related events from across the state for students and teachers. The calendar is also integrated into the Illinois Shared Learning Environment's (ISLE) calendar of events, so that any web user who accesses the IOER website can view this energy events calendar of events as well. The ELE actively solicits energy-related events from tits membership that are of interest to its partner schools.

Summary of LE Impact

Across all of their activities, the ELE had the clearest impact in four key functions: curriculum development, providing teacher professional development, supported student challenges, and generating awareness of energy careers.

The ELE facilitated the development of e-curriculum materials through the two-year WIP 5 NGSS grant, as well as through the development of lesson plans to support the Smart Grid for Schools Program. The former brought together 15 teachers for two workshops, each two weeks in duration, which occurred during the summers of 2014 and 2015. In these workshop, teachers created a series of lesson plans aligned to the NGSS that were posted on IOER for any teacher to use. The latter involved the development of curricular materials to support the interactive exhibit about the transition to a new, smart electric grid.

To support both the WIP 5 and Smart Grid for Schools lessons, the ELE organized professional development opportunities in the form of guest lecturers from energy professionals, and off-site visits to energy-related businesses to learn about emerging energy concepts. The ELE also provided professional development for teachers to become Smart Grid-certified. Through their grant-funded Smart Grid for Schools program, more than 275 teachers from over 110 schools became trained on Illinois' transition to the smart grid; reaching thousands of students.

The ELE partnered with the RDLE to create challenges for high school students to work in groups to solve a real-world energy problem that the industry is facing. To complete this energy-specific challenge, students were asked to design a prototype or plan for an energy-efficient system, or improvements to an existing system, which can provide reliable power to a

community to meet their basic energy needs during or after a weather-related power outage. ISU's Center for Renewable Energy (the ELE lead entity) sponsored four high schools for their participation in the STEM Challenges. This year-long activity provided several opportunities to work with teachers on integrating energy concepts and problem-based learning techniques and activities into their classroom.

To generate awareness of energy careers, the ELE organized and facilitated activities for Careers in Energy Week. The ELE sent over 1000 informational packets to Illinois schools, supplied classroom grant awards to teachers, and leveraged their membership network in order to provide speakers from industry to speak in classrooms on energy-related topics selected by their teacher.

It is difficult to estimate any long-term impacts of the ELE activities given that the initiative has been in existence for just over two years. However the ELE laid the groundwork for the future development of energy-related activities for schools in the state of Illinois.

Sustainability

This section reviews the sustainability potential for each of the ELE's major activities by reviewing the resources that are necessary to conduct each activity and the ways in which these activities can be sustained in the future after Race to the Top funding ends.

Smart Grid for Schools

The Smart Grid for Schools traveling exhibit is a five-year grant funded program by ISEIF that began in the 2013–14 school year. The impetus behind this program is to ease the transition of the Smart Grid being rolled out by energy companies in the state of Illinois through training and educational activities for students and teachers. When this five-year grant period ends, the ELE may wish to continue providing these Smart Grid activities; however, doing so will require additional funding for staff time, travel, and professional development. The future demand for this activity is uncertain and will depend on the extent to which energy companies deem successful the Smart Grid technologies currently being rolled out.

Teaching Next-Generation Energy Concepts with Next-Generation Science Standards

The WIP 5 NGSS Workshop concluded in summer 2014; however, the outputs of this workshop, including the creation of the energy curriculum, will remain for the foreseeable future on the IOER website. Although funding from ISBE and IMSP has ended, the lesson plans created as a part of this workshop remain useful and relevant to teaching energy concepts in the classroom. To ensure the sustained use of these materials, the ELE will require funding for staff time to advertise the availability of these resources to teachers who are interested in integrating energy concepts into their classroom curricula. By facilitating this outreach and connections with teachers, the ELE would have the opportunity to further build awareness of energy concepts and careers.

Careers in Energy Week

In 2013, the governor of Illinois proclaimed the first Careers in Energy Week. ELE has supported Careers in Energy Week activities by sending materials and resources about energy careers in Illinois to schools, coordinating energy career-based speakers to talk at school sites, and generating participation in school-level activities from among its membership group. This annual week of building student awareness in energy careers is a low-cost, but far-reaching activity for the ELE. To sustain this activity, continuing to pay for materials and staff time for the coordination of member organizations will be necessary. The amount of time that ELE staff dedicated to this activity in the past has been significant, and will require funding for staff to maintain their current level of participation.

STEM Energy Challenges

The ELE partners with the RDLE to sponsor an energy-specific challenge for students groups to explore a real-world, energy-related problem facing the industry. The ELE contributes financial and labor hour support for this activity, but does not serve as the lead coordinator of these challenge events. As a result, the continuation of these STEM Challenges depends on commitments from the RDLE and its membership. According to RDLE leaders, the STEM Challenges have high sustainability potential because of the active engagement and involvement from many of its member organizations, for which ISU is one. The ELE sponsored and mentored student groups from different high schools. Any further expansion into additional high schools may require soliciting additional mentors from its membership. Because these STEM Challenges require a sponsorship fee and staff time for mentoring activities, the ELE will require continued funding to maintain its involvement.

Appendix A. List of Data Sources Provided by the Energy LE

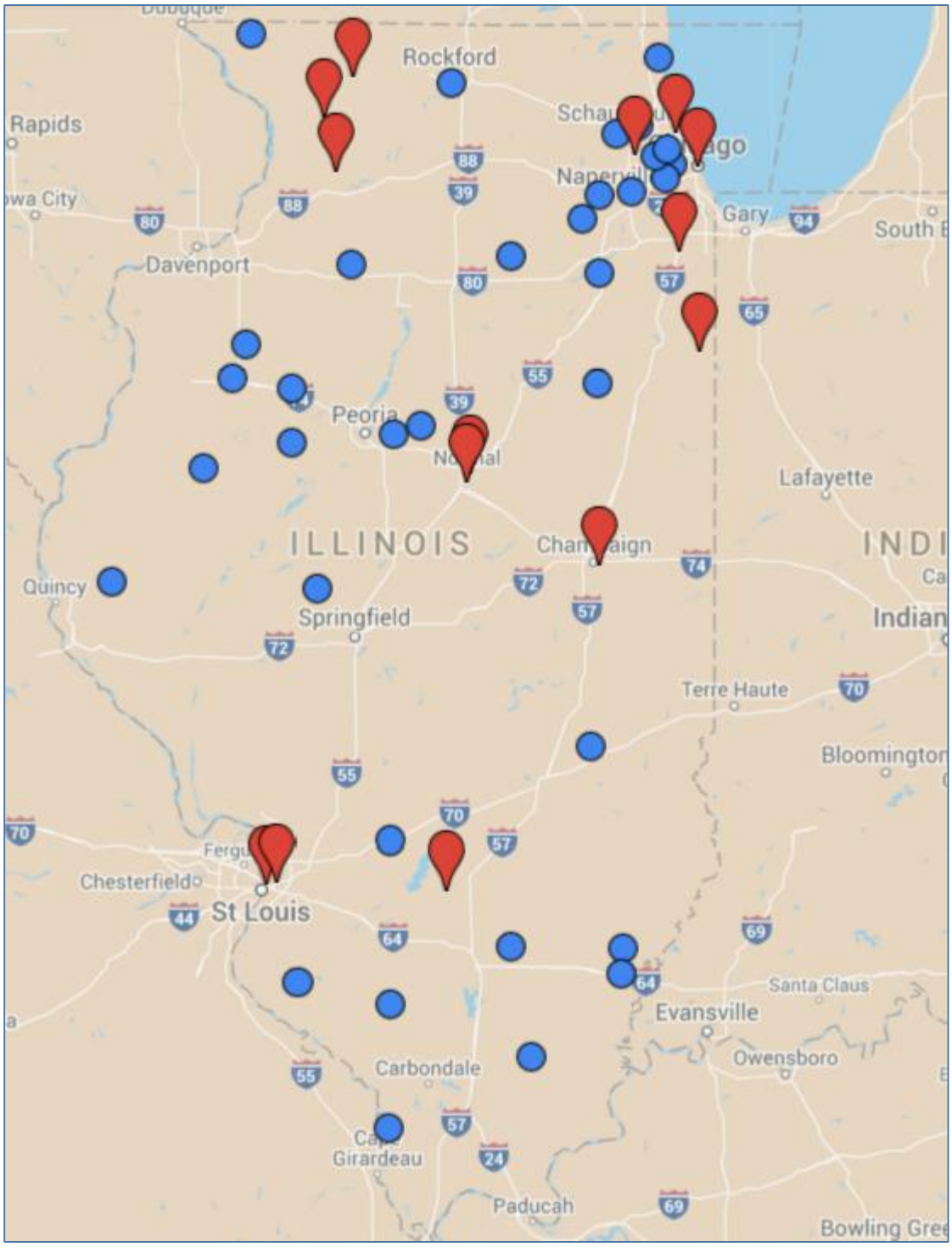
Document/Data Source Name	Purpose/Comments
2013 112713 Summary of Reports from teachers and speakers.xlsx	Careers in Energy Week 2013 reports from teachers and speakers
2014 ELE Mailing Careers in Energy Week.xlsx	Mailing and e-mailing contact list for Careers in Energy Week
2014 IEWC Mailing Careers in Energy Week	Mailing and e-mailing contact list for Careers in Energy Week
2014 What IEWC Members Did	Summary of activities that industry partners did during Careers in Energy Week
a 2014 ELE Website Tracking for Careers in Energy Week	Website hits during Careers in Energy Week 2014
b 2014 vs 2013 ELE Website Tracking for ELE Careers in Energy Week	Website Hits during Careers in Energy Week 2013 vs. 2014
NGSS WIP5 Energy Proposal Part 1	Original proposal for WIP Summer Institute for Teaching Next Generation Energy Concepts
NGSS WIP5 Energy Proposal Part 2	Original Proposal for WIP Summer Institute for Teaching Next Generation Energy Concepts
2Q15 Trained and Events—Smart Grid for Schools	Schools visited and attendance list for Smart Grid for Schools exhibit
Projected Hard-to-Reach Demographics Based on Current SGFS Schools	Demographic breakdown by schools for the Smart Grid for Schools
SGFS 1Q15 Grant Report	Summary of SGFS activities for Q1 2015
SGFS 2Q15 Grant Report	Summary of SGFS activities for Q1 2015
SGFS 4Q14 Update JW	Summary of SGFS activities for Q1 2015
Smart Grid for Schools Events Geomap and URL	Map of all schools visited by SGFS
Smart Grid for Schools Project Tracking Methodology	Methodology and location for all schools and service areas (ComEd & Ameren) for the SGFS
Teachers Trained as of 070115	List of teachers trained for SGFS—Smart Grid for Schools Certified"
ELE Meeting Notes (multiple)	Notes from meetings of the various ELE subcommittees; can see evidence of brainstorms, progress
IEWC Meeting Notes (multiple)	Notes from the meetings of the Illinois Energy Workforce Consortium
2013 111413 After Janet Edits ELE_StrategicPlan_Summary_Final.pdf	Strategic Planning Document
031715 School District Engagement Level	List of involved school districts ranked by level of involvement

Document/Data Source Name	Purpose/Comments
071715 ELE Members	List of Learning Exchange members
071715 IEWC Members	List of Illinois Energy Workforce Consortium
102714 ELE Year End Report 2013–14 FINAL	2013–14 End of Year Report (August 14)
ELE Involvement 2014–15 Overview	Activities listed by month (2014–15)
ELE Planning Grant Proposal 06262012	Original proposal
ELE Schools 072015	List of schools and teachers involved in any way in the ELE
Garcia HS ISU Tour Dates	Tour agenda for students from UNO Major Hector P. Garcia M.D. High School for Years 2014 and 2015
Illinois Solar for Schools Program	Workshop dates for Illinois Solar for Schools Program
JJC-Renewable-Energy-Flyer	Flyer for Renewable Energy Workshop 2015
Renewable Energy for Educators Session Evaluation Completed	Scanned upload of several evaluation sheets with handwritten feedback
Renewable Energy for Educators Sign-In Sheet	Attendance sheet for the Renewable Energy Workshop
UNO Garcia Tour Schedule 042415	UNO Garcia Tour schedule
2011–12 WfS Participants	Participating schools in Illinois Wind for Schools 2011–12
2013 082713 WIP5 Energy Workshop Roster	Attendance sheet for the WIP5 NGSS Workshop (2-week workshop)
2013 WIP5 NGSS Agenda	Agenda for the 2-week WIP5 NGSS Workshop
2013–14 School Contact List POCs	List of four schools and their contact information; unclear what activities these contacts participated in
2014 071414 WIP5 Energy Workshop Roster	Attendance sheet for the WIP5 NGSS Workshop (2-week workshop)
2014 071814 Nicor Gas Tour Agenda and Directions	Agenda for the Nicor Gas Tour for 15 teachers
2014 072214 PSGC Tour Agenda	Agenda for teacher tour of Prairie State Generating Company
2014 WIP 5 NGSS Agenda	Agenda for the 2-week WIP5 NGSS Workshop
Contacts for Field Trips WIP 5 NGSS	List of contacts that provided field trips
Illinois Renewable Energy for Schools Program Workshop Dates	Illinois Renewable Energy for Schools Program 2015; two workshops
Illinois Solar for Schools Program	1-day teacher workshop dates on Illinois Solar for Schools
Illinois Wind for Schools Program Workshop Dates	1-day teacher workshop dates on Illinois Wind for Schools
IOER Stats and Activity	Instructions on how to download IOER resources

Document/Data Source Name	Purpose/Comments
REFS Applications by 05012015	List of those who applied for the Renewable Energy for Schools activity
Solar for Schools Contacts 2013–14	List of contacts for Solar Energy for Schools
Solar Schoolhouse Catalog	Catalogue of solar energy-related tool kits/lab kits
WfS 2012–13 School Contact List POCs	List of four schools and their contact information; unclear what activities these contacts participated in
Various Pictures and Image Files (multiple)	Various images and pictures of participation in the Student Challenges
2014 E-mail About Partnership	E-mail exchange between Janet (ELE) and Al (FFA)
2014 Energy Concepts Provided to Teachers for Student Competition	List of concepts for the student competition
2014 Promo E-mail About Partnership	E-mail showing commitment of the Energy LE to support the AFNR LE and the FFA Agri-Science fair. ELE committed to supporting $1,000 for top five winners
Matt Alderman Project Infinite Green November 2013 and January 2014	Slideshow about wind energy and turbine construction
Project Infinite Green Workshop Dates	1-day workshop agenda for Project Infinite Green
R+D Challenge Information	Information on the ELE's outreach to involve four schools with the R&D STEM Challenges with Industry Partner-Motorola Mobility
ILIT WIU ISU Challenge 2011, 2012	Planning and outreach document for the ELE to reach out to schools regarding the development of renewable energy-related educational materials
Project Infinite Green Workshop Dates	1-day workshop agenda for Project Infinite Green

Appendix B. Energy LE Districts

Figure B-1. Map of Districts Affiliated with the Energy Learning Exchange



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