



BUILDING *performance* LAB

FY2015 Annual Report

CUNY The City
University
of
New York

The City College
of New York

CIUS



BPL staff and research partners at the June 2015 meeting of the Sustainably Integrated Buildings and Sites Center, hosted by the City College of New York

The 2015 fiscal year was one of exciting growth for BPL. We moved into not one but two new offices – located at the City College of New York and the CUNY School of Professional Studies– and we added four staff members as well as more than a dozen interns. Our three primary initiatives – building systems research, continuing education for building professionals, and immersive training opportunities for CUNY students – experienced significant growth.

And the BPL family grew in other ways, too – many staff members traveled to Baltimore for Administrative Manager Krystyna Horn’s October 2014 wedding, and in November, Communications Director Nora Sherman had the first “BPL baby.” This report is an overview of our team’s achievements in 2015, as well as a look ahead to where we are heading in FY16 – our tenth anniversary year.



The first “BPL baby” visits the office at the School of Professional Studies



BPL and its parent organization, the CUNY Institute for Urban Systems, are based at the City College of New York

CIUS BUILDING PERFORMANCE LAB: IN BRIEF

The City University of New York Building Performance Lab (BPL) was founded in 2006 at the City College of New York with a prescient mission: to establish a center at CUNY dedicated to the emerging high-performance building sector, including research, workforce training, and student education. Since then, as city, state, and national interest and investment in building efficiency has grown, so has BPL – leveraging the initial two-year seed grant we received from NYSERDA, winning support from more than a dozen local, regional, and federal sources, and greatly expanding our research and workforce development capacities.

Parent Organization: CUNY Institute for Urban Systems (CIUS), based at the City College of New York (CCNY)

CIUS Director: Dr. Robert “Buz” Paaswell, a nationally-recognized infrastructure expert, former president of CCNY, and a distinguished professor of civil engineering in the Grove School of Engineering at CCNY

BPL Director: Michael Bobker, an energy engineer with more than 40 years of experience in New York City buildings

BPL Associate Director: Nicholas Madampolous, Associate Professor of the Grove School of Engineering, CCNY, and a leading lighting researcher

Number of staff at close of FY15: 12

Number of student interns over FY15: 15

Major Partners and Supporters: ASHRAE, Association of Energy Engineers: New York Chapter, concept3D, CUNY School of Professional Studies, Environmental Defense Fund, International Union of Operating Engineers Locals 94 & 89, Johnson Controls, Inc., National Institute of Standards & Technology, National Science Foundation, NYC Department of Citywide Administrative Services, NYC Department of Education, New York State Energy Research and Development Association (NYSERDA), Sallan Foundation, Service Employees International Union Local 32BJ, Syracuse Center of Excellence, U.S. Department of Energy, U.S. Environmental Protection Agency, Vornado Realty Trust



Robert “Buz” Paaswell, CIUS Director

INTRODUCTION

With nearly a decade of experience in NYC building performance research and training, we have found that systems-level improvement – and even micro-level retuning – can lead to measurable performance results. Since buildings represent nearly 80% of the city’s carbon emissions, our focus on worker-by-worker, system-by-system improvement – while labor-intensive – has made an impact on the City’s effort to reduce carbon in municipal and large-scale commercial properties.



Director Michael Bobker addresses industry research partners in June 2015

Continuing education for building professionals is one of our most important linkages to the building operations and management sector. With our partner, the CUNY School of Professional Studies (SPS), we have trained more than 2,500 building operators, energy managers, sales professionals, and auditors in proven performance improvement techniques – 700 in the 2015 fiscal year alone – helping to ensure America’s largest city remains ahead of the urban energy curve. More than 200 building professionals have taken advantage of a two-year NYSERDA incentive awarded to BPL and SPS in 2014, which allows us to offer courses at heavily discounted rates.



Director of Technology Honey Berk with members of the BPL tech team, including staff and interns, at the 2014 holiday party

Our alliance with SPS and the NYC Department of Citywide Administrative Services (DCAS) Energy Management division is stronger than ever. In the past year, more than 400 City of New York facility managers participated in training programs offered through the DCAS Energy Management Institute. Skills learned in class are supported back at the job site through a multi-layered approach that includes a YouTube series that spotlights successful energy-saving projects spearheaded by the City’s “Heroes in the Basement” and a coaching pilot that teamed up Paul Reale, BPL’s Senior Technology Project Manager, with seven facility managers who had completed energy training offered by CUNY with the support of DCAS.



Intern Joe Silver sets up a solar radiation sensor for a research project at John Jay College of Criminal Justice

Internships and educational opportunities for CUNY students have long been a cornerstone of BPL's mission. The paid internships available to CUNY undergraduate and graduate students – on average we have 12-15 student interns at any given time – are truly a two-way street. Our research projects and other initiatives could not succeed without the efforts of these students, drawn from dozens of academic programs within the diverse CUNY community, who receive advanced training in building systems and energy data, an area of study that is still new to many experienced building professionals. Interns have gone on to work for the NYC Department of Transportation, Vornado Realty Trust, Jones Lang LaSalle, and Bright Power, to name just a few. In addition to internships, BPL is mentoring teams of CCNY Master of Engineering students focused on key research topics including operator effectiveness and energy dashboards.

Systems-level building research and technology development is a major focus of BPL's technology research team. Since 2011, BPL's Energy Data Lab – run by CUNY researchers and student interns with the support of NYC

DCAS – has closely studied the energy performance of City facility retrofits, improving upon existing energy modeling protocols and developing new ones in order to assess results and make recommendations.

Continuing on the theme of systems-level improvement is our Building Automation System (BAS) program, which includes research and training elements aimed at solving problems associated with an incomplete understanding of the BAS (on the part of the operator) or underperformance of the BAS (an all too common phenomenon).

Based on research in a range of buildings – from New York City public schools to class A commercial buildings – the BPL technology team, led by Director of Technology Honey Berk, has developed BASAT (BAS Assessment Tool), a software application for assessing BAS infrastructure that was granted a provisional patent by the U.S. Patent and Trademarks Office. BASAT is publicly available on the BPL website, and we are actively seeking out projects where we can partner with building owners or managers to implement the tool in their properties in order to improve their BAS performance, thus informing and improving future versions of the tool itself.



City agency personnel attend a Building Operator Certification class

Operator behavior is another area of research that BPL has explored in recent years. Our training partner SPS found evidence of a “world class” rate of skills transfer resulting from the energy courses we have offered to thousands of New York City agency facility personnel with the support of DCAS. This year, we began work on a NYSERDA-supported project to assess adoption rates among a population of public school custodial engineers of a mobile application designed to streamline basic facility and systems maintenance tasks; the project is scheduled for completion in FY16.



Felix Rodriguez, BPL Equipment Specialist, installs data loggers at a Department of Environmental Protection facility as part of a DCAS-supported research project

Last, but certainly not least, **public service** is a major focus of our work. As a CUNY initiative that is almost entirely supported by public institutions, it can be said that everything we do is in the service of the collective effort to improve energy performance, reduce New York City’s greenhouse gas emissions (nearly 80% of which come from our buildings), and train our building and energy services workforce – including incumbent workers and those studying for their degrees – in the skills their jobs will demand in the next five to 10 years. The Field Equipment Lending Library, Benchmarking Help Center, and technical support for IDEA (Innovative Demonstrations for Energy Adaptability), DCAS DEM’s technology testbed, are initiatives that directly support the City’s efforts to reduce municipal energy use and greenhouse gas emissions, and lead the commercial real estate market by example.

The Year Ahead for BPL

Our cornerstone initiatives – the Energy Data Lab, BASAT and associated work with building automation systems, and continuing education for building professionals – are all continuing to grow as we enter FY16. In September 2015, we will have more than 15 paid interns working on various research projects, recruited from the three-day Energy Boot Camp held in May 2015 as well as in partnership with the CUNY Service Corps initiative. Since the beginning of 2015 we’ve added two experienced technology and facility experts, Paul Reale and Da-Wei Huang, who are both working to promote and develop our Building Retuning and BAS efforts, while Katherine Careddu, who joined our team in 2013, is strengthening our relationships with members of the building performance industry while forging new collaborations and partnerships.



The BPL team at the October 2015 staff retreat

BPL Advisory Board: In the summer of 2015, we began laying the foundation for a new Advisory Board, convening a four-person planning committee drawn from BPL's community of trusted advisers. All four were members of BPL's Stakeholder Consortium, an initiative that BPL helped from 2007 to 2012, with funding from our initial supporter, NYSERDA. The Consortium was made up of about 70 building professionals with a stake in the energy efficiency and performance of New York City's existing real estate; they met two to three times a year to discuss developments in the sector and gaps in building worker skills and technologies, and to offer recommendations for the direction that BPL's training development and research should take.



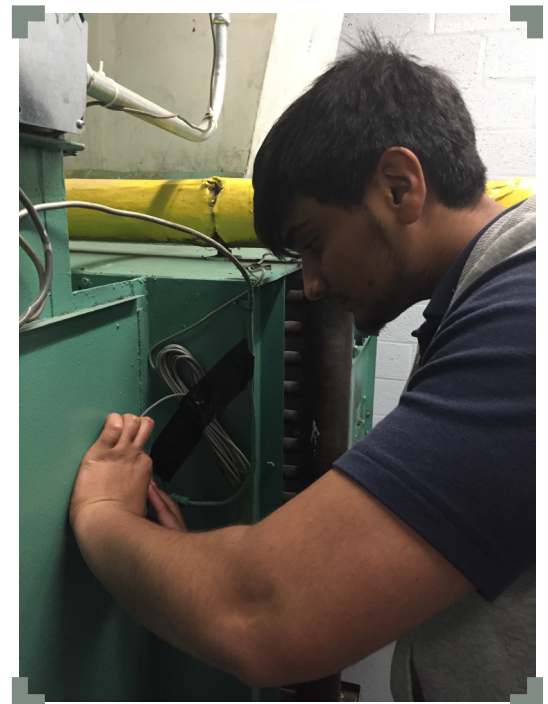
New staff members Da-Wei Huang and Paul Reale and intern Sudhir Patel at BPL's new office at the City College of New York

As we imagine it, the Advisory Board will have a similar function – it will serve as BPL's conduit to the industry, providing intelligence on emerging trends and gaps and helping to elevate BPL's profile as a local leader in building systems research and training. We expect to convene the first meeting of the Board in the first quarter of the 2016 calendar year.

noBAS BRT: Over the past few years, we've had success teaching and implementing the Building Re-tuning protocol (BRT), originally developed by the Pacific Northwest National Lab (PNNL), which uses data from a facility's BAS for energy optimization and measurable improvement in performance. In FY16, together with our partner NYC DCAS, we are developing a "noBAS BRT" protocol and training curriculum that is aimed at bringing these results to buildings without BAS – a category of buildings that we have repeatedly found to be underserved in the energy optimization space.

Under the umbrella of the SIBS Center, we will develop and pilot-test various low-cost data acquisition approaches and technologies in NYC agency building systems common to the "noBAS" building stock – selected for their re-tuning potential – integrating instrumentation from the Field Equipment Lending Library as well as a protocol developed in-house to extract, visualize, and analyze data. We expect to pilot the new training curriculum in spring 2016 with NYC agency personnel.

Data Extraction Tools: Big data's potential to improve the energy performance of existing buildings is only as strong as our ability to collect it, and so our research and technology work will increasingly focus on improving field data collection processes and devices.



Research Associate Manorge Joseph installs monitoring equipment during a field test of the noBAS BRT optimization protocol

In FY16, concept3D will join the SIBS Center as an industry sponsor, and will test their web-based audit and energy project management tool, simuwatt Energy Auditor, in a selection of NYC agency buildings with the goal of customizing the app according to the specific needs of NYC agency energy managers. As part of this project, the research team will produce a review of other energy audit methodologies, including standardized baseline procedures such as those under continuing development by ASHRAE, improved data acquisition, and remote “no-touch” approaches – all of which are enjoying considerable interest in the sustainable buildings sector.



BPL interns at the June 2015 SIBS Center meeting in New York

Operator Behavior Research: Because building systems need expert attention to operate at peak, we have long understood that building operator and engineer behavior is one of the most impactful aspect of facility operations and maintenance. With the support of NYSERDA and the NYC Division of School Facilities, we launched a project in FY15 that, for the first time in our research, directly addresses this timely issue. As the 2015-2016 school year begins, we will be distributing iPad minis loaded with LogCheck, a mobile app designed to streamline basic maintenance recordkeeping functions, to 50 public school custodial engineers.

At the conclusion of heating season, we will analyze facility efficiency and related factors.



Krystyna Horn, BPL's Administrative Manager, is leading the NYSERDA-supported operator behavior study

Building on our interest in operator behavior, and building automation system and Building Re-tuning research, this year, with the support of NYSERDA, we are researching the specific impact of “big data control application” products designed to extract building system data and provide feedback for operational decision-making. The project, “BAS Operator Decision Support for Commercial Buildings,” will define essential key performance indicators, investigate various formats for data visualization and presentation to building operators, and establish a “minimum standard of care” representing best practice guidelines.

Building Operator Field Support Tool mobile application: In FY16, our training partner, the School of Professional Studies, will develop a mobile app that puts training content drawn from the Building Operator Certification curriculum into the hands of NYC agency building engineers, part of SPS's overall mission to support skills transfer among City trainees long after they leave the classroom.

The project builds on the FY15 Building Operator Field Support Tool pilot, which featured the development of a mobile-accessible website featuring cooling season content, and tested how graduates of the City's BOC program utilized it in their day-to-day activities. The new support tool will be a hybrid mobile application/website product, and will allow BOC graduates to pick and choose the content they want access to in the field, such as checklists, lessons, and training videos. In early spring 2016, the SPS team, led by Edwina Nunez-Gordon, will pilot the app with a small cohort of City agency personnel; by late spring 2016, all holders of the BOC credential within the City's personnel population, as well as current trainees, will have access to the tool.



Our operator behavior research seeks to measure the impact of technology tools on energy-efficiency behaviors

CCNY Master's Team: In the 2016-2017 academic year, BPL Director Michael Bobker will convene a Master's Team of CCNY environmental engineering students that will study passive house technologies and protocols for multifamily buildings in collaboration with the Environmental CrossRoads Initiative, a project of the CUNY Advanced Science Research Center. This represents a crucial advancement of CCNY's success in developing passive house capabilities for single-family homes, a project that has brought CCNY students to the annual Solar Decathlon in Washington, DC, to build and demonstrate a single-family passive home.

Re-establishment of the Benchmarking Help Center: In fall of 2015 the NYC Mayor's Office of Sustainability engaged BPL to relaunch the Benchmarking Help Center, a free Q&A service staffed by trained student interns designed to help property owners and managers comply with newly established annual energy benchmarking requirements. Originally launched in 2012 to coincide with Local Law 84, a key component of the NYC Greater, Greener Buildings Plan, the service helped New York City owners and managers of buildings 50,000 square feet and above reach an approximate 80% compliance rate – an impressive rate for a new city ordinance. The relaunch of the Help Center is timed to coincide with a new Local Law that will extend the extend the benchmarking requirement to buildings 25,000 square feet and above, a population of buildings that includes a wider scope of both commercial and multifamily buildings.



In the years ahead, the Benchmarking Help Center will serve many buildings currently underserved in the sustainability sector

CONTINUING EDUCATION

Operated in partnership with CUNY's School of Professional Studies since 2011, the BPL continuing education program has trained more than 2,550 building operators, energy managers, auditors, and sales professionals, with a focus on maximizing the potential already in their buildings and implementing cost-effective retrofit projects. Our research on building operator behavior has consistently indicated that building systems of every type, from lighting to BAS, require a skilled hand at the wheel to perform at their peak. The objectives of our continuing education program are to deliver those skills, bolster learners' confidence to undertake performance projects, and support New York City's greenhouse gas emissions reduction targets and energy-related building legislation.

Building Operator Certification

Our most popular offering, the Building Operator Certificate program (which includes Levels I and II), developed by the Northwest Energy Efficiency Council, is designed to teach building engineers and superintendents how to master the complexity and interconnections of existing building systems, improve O&M practices, assess and plan potential retrofits, and analyze results.

With a client roster that includes labor unions, real estate management companies, hospitals, and – most notably – DCAS Energy Management (DEM), the central energy management office of all buildings owned and occupied by City of New York agencies, BPL/SPS is the leading provider of BOC training in the country. DEM has underwritten the training and certification of more than 2,000 City agency employees – over 1,500 Department of Education custodial engineers alone.

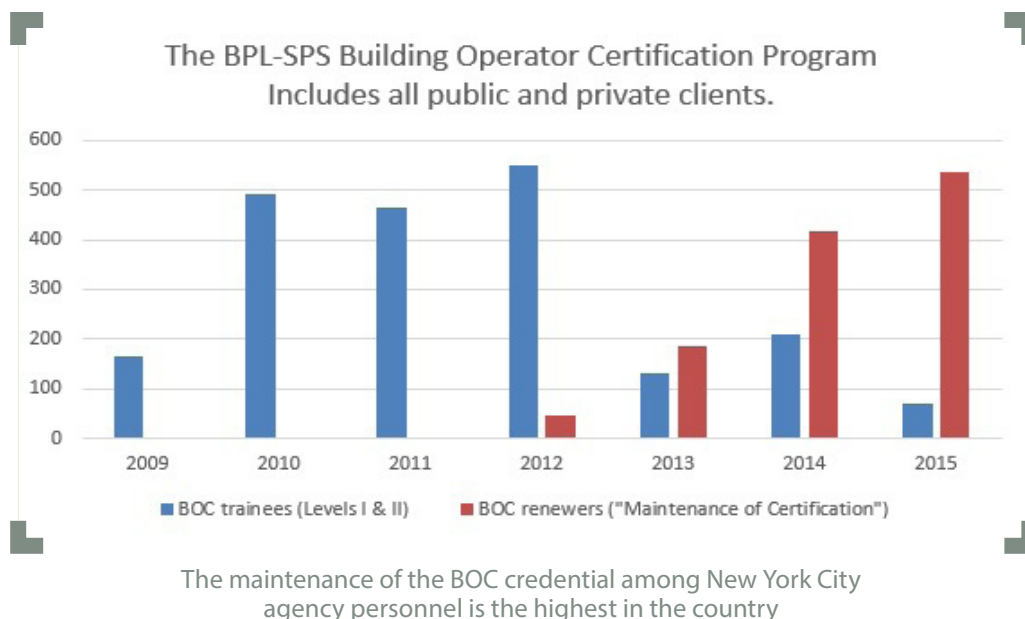
Perhaps one of the strongest indications of the effectiveness of the BOC program is the high maintenance of certification (MOC) rate – roughly twice the national average – as illustrated in the graph on the following page. With DEM support, BPL and SPS have offered annual MOC Fairs (two-day learning opportunities) as well as standalone classes; in the last four years, more than 1,100 of the City's building operators have participated.

2014-2015 NYSERDA TRAINING INCENTIVE

In 2014, NYSERDA awarded BPL/SPS with a grant aimed at incentivizing the New York City buildings workforce to invest in energy efficiency training; the grant allowed us to offer our core training programs – Building Operator Certification and Building Re-tuning – at a 70% discount in 2014 and a 60% discount in 2015.

Led by BPL Manager of Training and Compliance Programs, Daniella Leifer, we've expanded our training offerings to new audiences, notably institutions such as schools and hospitals, and we've partnered with EnvirolutionOne to offer Small Commercial Energy Audit Training – popular with energy service companies looking to branch into this emerging market – and with the Energy Efficiency Funding Group to offer their popular Learning to S.E.E. (Sell Efficiency Effectively) training – a two-day seminar focused on improving sales and marketing success for energy efficiency program managers, consultants, and service providers.

To date, more than 270 building professionals have taken advantage of these incentives.



This ongoing commitment by DEM is a testament to the investment that the City of New York has made in energy efficiency education for its building operators, part of the City's overarching "80 by 50" mission to lead by example in the effort to reduce greenhouse gas emissions.

Building Re-tuning and the Future of the noBAS Protocol

Developed by the Pacific Northwest National Lab, Building Re-tuning (BRT) is a protocol for building energy optimization and monitoring that takes as its inspiration the annual tune-up every car requires to ensure peak performance. Since 2013, more than 50 people have participated in BPL's BRT course, where they have learned to utilize their building automation system (BAS) to collect and analyze actionable data.

In its original form, the protocol is aimed at large commercial buildings with installed BAS; however, only a small percentage of New York City's building stock belongs to this group (though it does represent a large percentage of the city's total square footage). From City agency facility operators in particular, we've heard a demand for a re-tuning protocol that can be applied to buildings without a BAS. At the semi-annual SIBS meeting in June, we proposed a project to develop and pilot a "noBAS BRT" protocol. SIBS industry member DCAS pledged its support for the project, and in FY16, BPL researchers, led by Paul Reale, will work with a selection of City agency facilities to develop the protocol, integrating data-collection instrumentation (existing or to be purchased) from BPL's Field Equipment Lending Library and potentially developing application software that can extract and/or visualize data from noBAS facilities. The training product will be piloted to eligible City agency personnel in spring 2016, and may be publicly available through BPL in the coming years.



BPL's Paul Reale teaches an Intro to Building Re-tuning class to City agency personnel

DCAS Energy Management Institute

In 2012, DCAS Energy Management partnered with the CUNY School of Professional Studies to develop the Energy Management Institute (EMI) to centralize training opportunities offered to NYC Agency Employees. Courses offered through the DCAS Citywide Training Center provide a clear and proven ladder of energy-related education and professional development. Trainees begin with an introductory video about saving energy in NYC and progress through a series of trainings that culminate in the Association of Energy Engineers Certified Energy Manager (CEM) training.

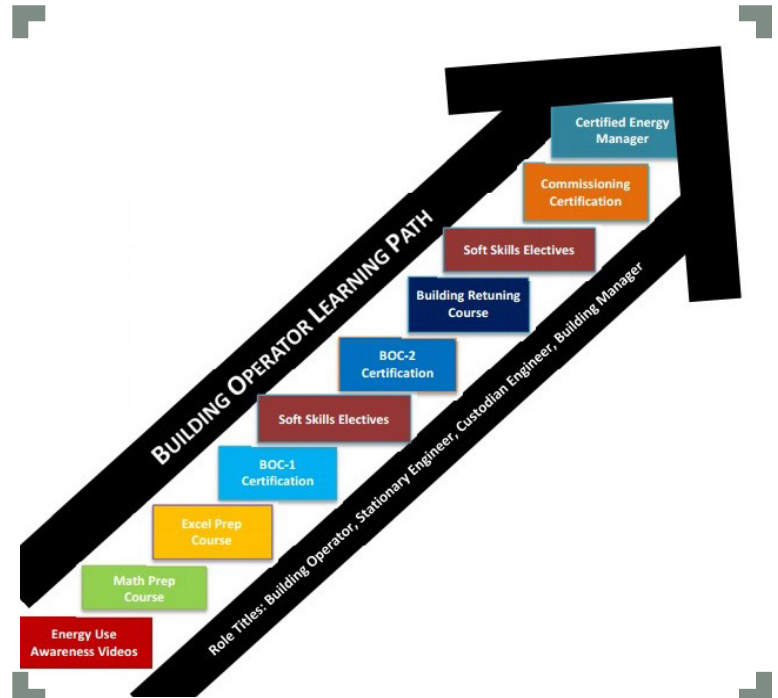
Today, NYC's facilities – including schools, police stations, firehouses, water treatment plants, and municipal offices – are well on their way to achieving the City's goal for greenhouse gas emissions reductions from government buildings – in no small part because of the training that these facility operators receive through EMI.

In FY15, EMI launched five trades-specific courses to provide in-depth learning on controls, HVAC, electric, piping, and plumbing systems. Looking ahead to fall 2015, EMI is adding the Association for Energy Engineers' Certified Energy Auditor prep course to the lineup.



Instructor Moreno Tagliapietra teaches a class on data loggers to City personnel at the annual MOC Fair

a 2006 study by Saks and Belcourt found that Learning and Development professionals from 150 different companies predicted that 32% of training is applied on the job one year later.)



The Energy Management Institute learning path

BOC Training Program Impact Evaluation: In FY14-FY15, SPS researchers, with the support of DCAS, conducted a longitudinal study of the impact of BOC training on long-term energy efficiency behavior among participants in the EMI program between 2009 and 2014. Working with an Evaluation and Measurement consulting firm, they collected survey data and conducted individual interviews and focus groups.

After crunching the data, the team found that, back at their workplace, 45% of participants practiced the key skills they learned in BOC training – an application rate that the team deemed “world class.” (In comparison,

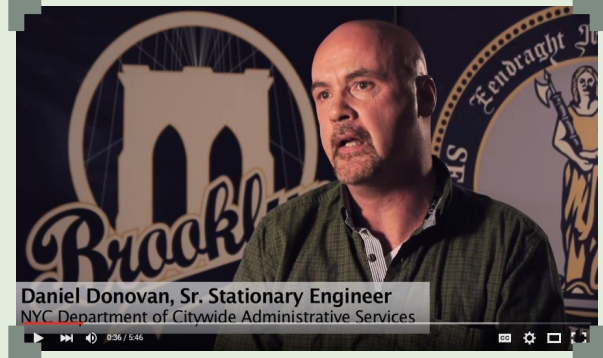
Furthermore, the team found that operators whose managers and supervisors also held the BOC credential were 24% more likely to perform the desired energy management practices, once again underscoring the importance of collective organizational attitudes to energy efficiency in motivating operator behavior.

Finally, the research confirmed the existence of overarching organizational support and buy-in for the sustainability goals of the City of New York; it is not an understatement to say that EMI, and the BOC program in particular, form the foundation for this commitment for many, if not most, of the City's O&M employees.

FY15 Coaching Pilot: EMI is not simply a series of courses; it is a full-service institute designed to support the implementation of energy-reduction projects at municipal facilities. To this end, in FY15, EMI piloted an initiative to coach building operators on specific energy conservation measures (ECMs). Paul Reale, BPL's Senior Technology Project Manager, coached seven building engineers – all individuals who had completed an EMI course – in developing and implementing an assortment of ECMs ranging from lighting retrofits and steam trap replacements to one project that assessed the viability of using combined heat and power (CHP, or cogeneration) for a dozen swimming pool facilities managed by the Department of Parks and Recreation. Coaching activities included help with navigating funding options and the development a system to regularly report project progress. The program underscored the importance of creating a culture within an organization that emphasizes not only energy and greenhouse gas emissions reduction, but general systems performance improvement and support for operators on the project level.

Building Operator Field Support Tool: In FY15, SPS staff, led by Program Manager Edwina Nunez-Gordon, developed and piloted the "Building Operator Field Support Tool." The tool is a mobile-accessible website that features cooling season material excerpted directly from training material covered in BOC Level I, putting these practical and timely topics at the fingertips of facility personnel. Ms. Nunez-Gordon demonstrated the tool at the March 2015 BOC Maintenance of Certification Fair and, based on the feedback and success of the pilot, the SPS team will develop a hybrid mobile application/website in FY16.

Department of Environmental Curriculum Project: Finally, in FY15, at the request of the City's Department of Environmental Protection, BPL and SPS created four half-day customized classes for agency personnel that focus on how to operate their facilities' HVAC systems in an energy efficient manner; as well as how to use Measurement and Verification and energy data analysis to support the City's energy efficiency goals.



THE EMI DIGITAL STORYTELLING INITIATIVE

Over the past two years, as part of EMI's effort to support general energy efficiency awareness, as well as building performance skills transfer among City facility personnel, the EMI team has worked closely with DCAS DEM Deputy Commissioner Ellen Ryan to produce a web video series called "Heroes in the Basement." The videos, uploaded to YouTube and posted to the DEM website and Facebook page, highlight City agency employees who have undertaken operations and maintenance improvements at their facility, from balancing cooling systems in too-cold office environments to diagnosing energy wastage resulting from rooftop exhaust fans that were not installed correctly.

UNDERGRADUATE & GRADUATE STUDY PROGRAMS

Since its very beginning, BPL has been a resource for CUNY students interested in building energy research and looking to gain a foothold in building engineering and energy service careers. We offer paid internships that give students front-line experience with a variety of interrelated topics, including energy data collection and analysis, building operator behavior, and building performance protocols such as PNNL's Building Re-tuning.

As the City's only public university, CUNY is an essential career training ground for a large population of students that frequently hail from underserved populations. Many students are immigrants or the first in their family to attend higher education, and the hands-on training opportunities that BPL provides give them access to a ladder of professional opportunities, and we take this responsibility very seriously.

We work with students to place them in internship assignments that align with their skills and career goals, and we offer informal – yet effective – job placement services after graduation. We've helped students find jobs at energy service firms such as Steven Winter and Associates, public agencies such as the Mayor's Office of Long-Term Planning and Sustainability, and property owners and managers such as Vornado Realty Trust.

Energy Boot Camp Training

Since 2013, BPL has offered free Energy Boot Camp training for CUNY students interested in BPL internships. We've found that a three-day intensive format is an excellent model for teaching technical topics not frequently covered in students' regular course load, and it affords us the opportunity to get to know the potential new crop of interns and lay an early foundation for team-building among them.

The curriculum provides students with an overview of key technical skills, such as using benchmarking energy data with EPA Portfolio Manager and using diagnostic and data collection tools, while putting the work of BPL in a larger context. On the first day of boot camp, a facilitator leads the group in the Stabilization Wedges Game, a team-based exercise that teaches participants the scale of the greenhouse gas problem. Students are asked to look at carbon emissions on the societal level, make tough hypothetical decisions about how to reduce them, and defend and discuss their choices with the group.

At the other end of the scale, students participate in a three-hour interval data workshop with energy specialist Lindsay Audin that teaches them the impact of micro-level energy use modeling and improvement



Students at the 2015 Boot Camp participate in the Stabilization Wedges game

on a building's overall performance. In evaluation forms, Boot Camp participants frequently cite Mr. Audin's class as one of the most interesting topics covered – good news, since it serves as an excellent introduction to our cornerstone internship initiative, the Energy Data Lab.

Energy Data Lab

The Energy Data Lab (EDL), run in partnership with DCAS, is our most prominent internship program. We recruit and train EDL interns from CUNY's programs in engineering, architecture, facilities management, mathematics, information technology, and other technical disciplines. Students gain experience in technical skills and methods that complement and supplement the classroom, with real-world application focused on energy efficiency. EDL interns are exposed to the field of energy management and skills such as:

- Utility bill data analysis
- Measurement and verification of energy savings
- Complex data analysis techniques – statistical models
- Reading energy audits and retro-commissioning reports and understanding energy conservation measures and their impacts
- Understanding HVAC, lighting and other building systems



EDL interns Katiushka Freeman and Marcus Henderson review findings at the June 2015 SIBS Center meeting

A number of EDL interns also focus on developing skills in programming, with languages such as Visual Basic for Applications (VBA), R and Python; and in data visualization, with applications like Tableau. Program skills extend beyond the technical, with the understanding that communication and other skills areas are essential for learning and practice. To this end, interns also receive instruction and practical experience in:

- Independent research
- Oral and written communication
- Formal presentation of work
- Collaboration and sharing of information in a team-based context
- Leadership skills

In addition to multiple formal instructional opportunities to prepare the interns for their work, including the annual Energy Boot Camp, BPL also makes available to the students self-paced online technical lessons originally developed for BOC Level I learners.

CUNY Service Corps

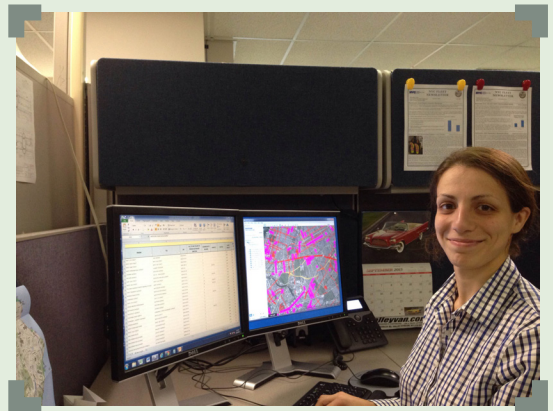
For the past two years, we have worked with a new cross-CUNY initiative, CUNY Service Corps, to place students from a wide variety of backgrounds in internships at BPL and with our partners that are aimed

at supporting the resiliency of the city as a whole (CUNY Service Corps was created in part as a response to the devastation of Hurricane Sandy). We've placed students at a number of partner institutions, including Enterprise Community Partners, an organization that works to improve the sustainability of New York's affordable housing stock, the New York City Housing Authority (NYCHA), and the Brooklyn Navy Yard; while, students placed in-house have worked on BPL's Building Re-tuning and Energy Data Lab initiatives.

BPL INTERNS: WHERE ARE THEY NOW?

BPL interns have gone onto exciting careers in the building and energy services sectors. Our alumni include Dan Egan, who interned for BPL and our partner Vornado Realty Trust while getting his MBA at the Zicklin School of Business at Baruch College. Today, Dan is a Vice President and Head of Sustainability and Utilities at Vornado. Vanessa Joseph, who as an intern co-authored a paper with Michael Bobker about operator behavior as a driver of building performance, is now a managing agent with Newcastle Realty Services; and Tristan Schwartzman, a graduate student who helped train the next generation of interns at the first Energy Boot Camp, is now leading the energy department at Goldman Copeland, a consulting engineering firm. Former intern Phillip Parris is working in marketing and sales for James Hardie Building Products, skills he honed helping to promote a career development workshop that BPL hosted for students interested in green building careers.

Armenoush Aslan-Persico is another proud success story. Armenoush interned with BPL while studying in the Civil Engineering Technology associate degree program at City Tech, on projects including an equipment inventory initiative at CCNY and providing technical assistance to NYC Department of Education engineers enrolled in the Building Operator Certification (BOC). Today, Armenoush works for the NYC Department of Transportation's Division of Transportation Planning and Management, coordinating construction projects and road improvements on NYC streets. This is her second job with a City agency – previously she worked for DCAS's citywide fleet service. Her interest in serving New York was piqued at BPL. "I find all City agencies fascinating," she said, "and it's great to be able to help the City improve processes, save money, and be more efficient. Those are values that BPL emphasizes."



Former BPL intern Armenoush Asian-Persico at her desk at the Department of Transportation

While at BPL she took advantage of opportunities to expand her learning even further, participating in BOC classes, and earning a LEED Green Associate certification with BPL's support. "A lot of skills I learned at BPL and in the BOC program were so helpful," she said. "My experience with BPL emphasized the need to see multiple perspectives, everyone from end-users – the public – to technicians, project managers, and other workers. The ability to see how they all work together is so valuable." Armenoush remembers her time at BPL fondly, especially getting to know and work with fellow interns. "Vanessa, Tristan, Phillip – I had so many colleagues at BPL who were all very impressive and who I've enjoyed watching become effective young professionals." We couldn't agree more.

APPLIED RESEARCH & TECHNOLOGY DEVELOPMENT

While there is a great deal of interest and activity in the building technology and operations area – especially since the City of New York set major carbon reduction goals in 2006 – what sets BPL's work apart is that our focus is on the facility or systems level, with an emphasis on the key nexus between the building operator or engineer and the building he or she is tasked with managing.

Our applied research focuses on a number of key areas, including:

- Utilizing energy data to model, measure, and verify energy savings as a result of retrofits or operational enhancements
- Developing software tools to analyze and model the performance of building systems, particularly HVAC and associated controls
- Studying the impact of energy training and technology use on building operator behavior

Student interns are integral to our research activities. They not only collect data – sometimes going out in the field to manually download data from a building automation system, a system we affectionately call our “sneakernet” – but they also run energy modeling software, develop visualizations of energy consumption and demand, and in notable cases, they have developed new energy modeling procedures and written the code to bring those procedures to life. Interns have become leading local experts in the Building Re-tuning protocol, described below – several have worked with facility operators taking our Building Re-tuning training course to develop, implement, and measure the success of class projects implemented at their facilities.

Led by Director of Technology Honey Berk, our core research programs include:

- The Energy Data Lab, a student-led energy modeling initiative run in partnership with the NYC Department of Citywide Administrative Services, Energy Management division
- BAS research, which includes the development and testing of BASAT (the BAS Assessment Tool) as well as research on operator use and interpretation of BAS data
- Application and expansion of the Building Re-tuning (BRT) protocol, first developed by the Pacific Northwest National Laboratory, and development of the ensuing noBAS BRT protocol
- Research into the effects of technology tools applications on energy efficiency behaviors among NYC building operators



BPL researchers on a site visit to a Dept. of Environmental Protection facility

Sustainably Integrated Buildings & Sites Center

Most of the research outlined in this section is carried out under the umbrella of the Sustainably Integrated Buildings and Sites Center (SIBS), a National Science Foundation Industry/University Collaborative Research Center (I/UCRC). The I/UCRC model brings together industry partners and academic talent to collaboratively address gaps in research for the good of a particular sector.

Founded in 2012 and led by the University of North Carolina at Charlotte, SIBS focuses on interrelated systems in existing commercial, institutional, and municipal facilities, including controls, lighting, and water. BPL serves as the City College of New York's primary liaison to SIBS. In FY15, CCNY's industry partners – DCAS and Vornado Realty Trust – supported several research projects that are described below in detail.



Members of the SIBS Center meet at the CUNY Graduate Center

The SIBS Industry Advisory Board (IAB) meets face-to-face twice a year to review and vote on research proposals, assess results, and weigh in on the overall direction of the buildings sectors' research needs.

In FY16, NYSERDA is joining as a SIBS industry partner and will be supporting BPL Associate Director Nicholas Madamopoulos' lighting research. concept3D is also joining in FY16, and will be supporting research into the applicability of a web-based audit tool such as theirs for use in targeted surveys of the City's municipal facilities.

Energy Data Lab

The Energy Data Lab (EDL) was launched in 2012 as a BPL project under sponsorship by the NYC Department of Citywide Administrative Services Energy Management division (DEM), with the goal of demonstrating how students of the City's public university could play a useful role in the City's energy management efforts. Originally called the Open Collaborative Lab, the initiative was renamed after the second year to reflect its special focus on energy data as it relates to a validated Measurement and Verification (M&V) program for DEM's energy efficiency and greenhouse gas reduction activities in municipal buildings.

SIBS CENTER INDUSTRY ADVISORY BOARD MEMBERS, PAST & PRESENT

- Bank of America
- concept3D
- Johnson Controls
- Ingersoll Rand
- NYC Department of Citywide Administrative Services Energy Management
- NYSERDA
- Vornado Realty Trust
- Wells Fargo

The objectives of the EDL program include both direct programmatic contribution to DEM and development of student experiences that contribute to personal career development and the workforce as a whole. From year to year, EDL's program design is intentionally experimental and open-ended, retaining flexibility to find approaches that will meet agency needs as they are articulated.

A basic tenet informing EDL work is to learn from energy data in ways that can usefully be fed back into the program, and in its third year (FY15) this translated to a focus on automating data analysis processes that were developed in

the first two years. These automation tools enabled the EDL team to model and analyze the FY14 energy consumption of 214 facilities in FY15 – a vast leap over the 33 facilities the team analyzed in its first year – and it is expected that FY16 will see an even more significant advance in capabilities.



Interns receive specialized, intensive training to prepare them for EDL analysis and modeling

Background: The DCAS DEM team administers the heat, light and power budget and manages energy efficiency initiatives for City's government facilities – representing 80 agencies and more than 4,000 buildings. DEM is charged with planning and overseeing most of the efforts the City is undertaking to reduce municipal energy use and greenhouse gas emissions, a large portion of which occur in City-owned buildings.

EDL builds on the experience of predecessors such as the Energy Systems Lab at Texas A&M University, which served for many years as the performance monitor of projects in the Texas Loan Star program for state and municipal energy retrofits. Their multi-year work led to important findings about the use of rigorous monitoring to achieve portfolio performance goals and also to the development of an industry-leading technique, "Continuous Commissioning®." Many other state and federal programs have followed this model in instituting measurement and verification (M&V) programs for their energy investments.

Notable FY15 Results: In FY15, the EDL team had the opportunity to automate and refine the methodology and procedures developed during the program's first two years, and to add new types of analysis and facility types. The most significant outcomes that the team have achieved are:

- Automation and batch processing of energy consumption baselines for facilities and savings calculations for retrofit and retrocommissioning projects using industry-standard software applications paired with a custom, Excel-based tool developed in-house that generates energy consumption models and validates their results.
- Using this process to generate baseline models for all of the NYC public hospitals, courthouses and repair service/garage facilities (138 facilities), and verified savings for 76 retrofitted facilities across a range of NYC agencies.

- Development of a prototype of BEMA (Building Energy Modeling and Analysis), a software tool based in Python, an advanced programming language, that will eventually replace other applications and seamlessly export models and associated data to Excel for further manipulation.

In late spring 2014, the EDL team re-engaged the Energy Systems Laboratory (ESL) at Texas A&M University to review the FY15 work. Working with ESL's Associate Director, Dr. Charles Culp, and two of his researchers, Kevin Christman and Mitchell Paulus, the EDL team was able to validate its methodologies and procedures and garner a number of valuable insights for improvements to be implemented in FY16.

What's Next for EDL: In FY16, work will continue on the BEMA tool, with the goal of arriving at a fully-functional application and associated methodology. Parallel to this effort, the EDL team will be working to develop baseline models for additional categories of facilities, including office buildings and schools. In addition, the program will be focusing heavily on M&V for a set of retrofit and retrocommissioning projects to be identified by DEM, including 24 solar photovoltaic installations at NYC public schools.

Building Automation Systems Research

Building Automation Systems (BAS) were installed in great numbers in large commercial buildings in the 1990s and 2000s, at no small cost to owners and managers, but they have commonly underperformed, rarely hitting the targets promised at the time of installation. In New York City, many buildings with BAS are leased as Class A office space and are managed by highly skilled operators who maintain buildings that are comfortable, safe, reliable, and reasonably energy-efficient – but they are not nearly as efficient as they could be. This is a direct consequence of the fact that the building systems – and the automation system designed to control them – are not performing at peak. This performance gap, so commonly associated with building systems and BAS, is one of our primary areas of research at BPL, encompassing several related research initiatives.

BASAT: A Tool for Continuous BAS Improvement

You can't improve what you can't first measure, and so a primary focus of our BAS work has been to develop BASAT (BAS Assessment Tool), publicly available software that establishes a baseline of system performance. The goal of BPL's

The image displays a series of overlapping software screens for the BASAT (BAS Assessment Tool). The screens are color-coded and organized into sections:

- DEMAND RESPONSE** (Yellow header): Includes a "Generate Results" button and a "Reset Selections" button. Below is a table for "COOLING PLANT" with columns for "CHILLERS" and "CHILLED WATER LOOP".
- COOLING PLANT** (Blue header): Includes a "Generate Results" button and a "Reset Selections" button. Below is a table for "AIR HANDLER UNITS" with columns for "TEMPERATURES" and "COILS / VALVES".
- AIR HANDLER UNITS** (Green header): Includes a "Generate Results" button and a "Reset Selections" button. Below is a table for "GENERAL BUILDING DETAILS" with columns for "BUILDING INFORMATION", "FACILITY INFORMATION", and "CONTROL SYSTEM INFORMATION".
- GENERAL BUILDING DETAILS** (White header): Includes a "Next Section" button, a "Clear Information" button, and a "Clear All" button. Below is a table for "BUILDING INFORMATION" with columns for "Building Name", "Building Address", "Building Type", and "Description".
- BUILDING INFORMATION** (Green header): Includes a "Next Section" button, a "Clear Information" button, and a "Clear All" button. Below is a table for "FACILITY INFORMATION" with columns for "Name", "Company", "Contact Phone Number", "Contact Email Address", and "Visit Date".
- FACILITY INFORMATION** (Green header): Includes a "Next Section" button, a "Clear Information" button, and a "Clear All" button. Below is a table for "CONTROL SYSTEM INFORMATION" with columns for "Manufacturer", "Software/Version", "Year Installed", and "Installer".

The BPL logo is visible in the bottom right corner of the screens.

Sample BASAT input screens

BASAT project is to support widespread adoption by the commercial building operating industry of “advanced functionalities” that are available from common control systems but are dramatically underutilized.

BASAT, which BPL holds a provisional patent for, is designed to help building owners, consultants, and contractors uniformly assess BAS infrastructure by classifying the availability of system capabilities based on specific combinations of sensors, actuators, and points found during a survey of the BAS interface. The concept for BASAT was first set forth in a white paper, “Enabling Advanced Building Automation in Existing Buildings: The Role of a Building Automation System Assessment Tool (BASAT)” that BPL published in April 2012 with the support of NYSERDA and in collaboration with Terrapin Bright Green Consulting and students in the CCNY Master’s Program in Urban Sustainability.



Research Associate Manorge Joseph presents Phase 2 findings of the SIBS Johnson Controls project to industry mentor Lou Rugulo



The BPL Technology team makes a presentation on BASAT

In FY14, a prototype of BASAT was field-tested in collaboration with Johnson Controls, a former SIBS industry member. The team focused on assessing BASAT’s effectiveness as a tool for structured field follow-up of potential energy-reduction measures identified by Johnson Control’s energy analysis protocol. The findings indicated that BASAT, when integrated with the JCI energy analysis protocol, is effective at highlighting retrocommissioning applications and can serve as a “no-touch guide” for verification of equipment performance.

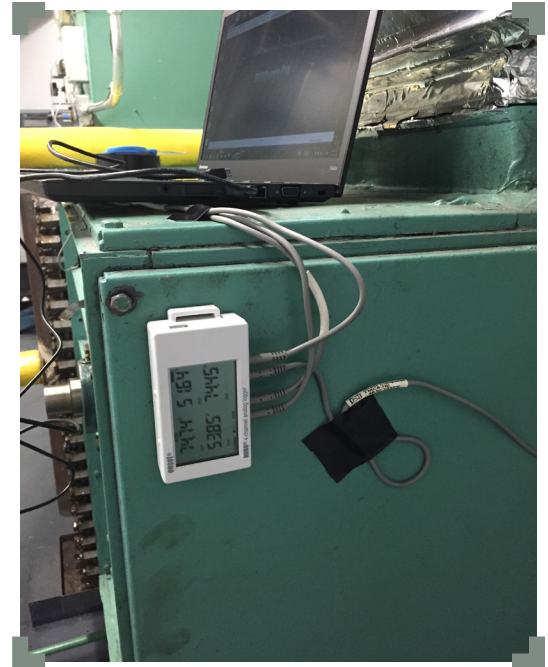
Data Needs Assessment for the City of New York: Beginning in FY14 and continuing into FY16, we are conducting research with NYC DCAS, investigating the relationship between building operators, BAS data, and HVAC systems with the goal of identifying the City’s BAS-related workforce training needs and ways to improve building efficiency using existing control systems. BASAT and BRT are key tools in this research.

Building Re-tuning Research

Developed by the Pacific Northwest National Laboratory (PNNL), Building Re-tuning (BRT) is a protocol that leverages the wealth of performance data available via building automation systems (BAS) to optimize building system performance. Operators tend to focus on ensuring comfort, though comfort is not always achieved efficiently. A deep dive on issues such as ventilation, occupancy scheduling and AHU controls can identify opportunities for substantial energy savings. Since 2013, more than 50 people have participated in BPL’s BRT course, learning how to capture and make better use of the actionable data in their BAS.

In FY15, a team of BPL researchers led by Director of Technology Honey Berk developed a new, expanded BRT process that incorporates BASAT and LEAN Energy Analysis – a methodology for assessing building energy modeling developed by University of Dayton researcher J. Kelly Kissock.

And yet, the world is chock full of buildings that don't have BASs. To address this issue, at the close of FY15, we proposed a project to develop a "noBAS BRT" solution at the semi-annual SIBS meeting aimed at this class of building stock, which represents most of the square footage in medium to large commercial buildings NYC. SIBS industry member DCAS pledged its support for the project, and in FY16 we will be researching and piloting technologies and techniques that enable a modified version of the BRT protocol to be used in buildings without a BAS. The effort will first look to package instrumentation from the BPL Field Equipment Lending Library (FELL) into specific kits that enable system performance data to be captured and trended without a BAS (hence "noBAS"). BPL will develop a noBAS BRT curriculum to be piloted with City agency building operators in the spring of 2016.



noBAS BRT researchers set up data loggers at a City agency facility in May 2015

Behavior and Facility Performance Among NYC Public School Building Operators

Because building systems need expert attention to operate at their peak, we've long known that building operator and engineer behavior is potentially the most impactful aspect of Operations and Maintenance (research conducted on O&M energy efficiency improvements have found savings ranging from 5-40% of a facility's total energy use). With the support of NYSERDA, we launched a project in FY14 that directly addresses this timely issue.

The study, "Behavior and Facility Performance among NYC Public School Building Operators," seeks to contribute to significant generalizable knowledge about the effect of building operations and maintenance (O&M) on building energy efficiency. While many studies have researched general practices that can lead to energy efficiency, very few have sought to capture actual data about the behavior of building operators. As a corollary, little is known about the processes needed to encourage positive behavior change toward energy efficiency in large institutional settings. Filling these gaps in knowledge will be an important factor in reducing greenhouse gas emissions.

With this study, we seek to determine whether or not regular prompting through a new software tool called LogCheck can help building operators increase best-practice behaviors for energy efficiency. LogCheck is a mobile app designed to streamline best-practice maintenance record-keeping functions and other energy efficiency tasks. To measure behavior change, in FY15 we sent initial surveys asking about current O&M

practices to 334 school Custodial Engineers (building operators) whose schools were between 100k and 200k square feet. As the 2015-2016 school year begins, we will distribute iPad minis loaded with LogCheck to a sample of those engineers. A final O&M survey will be sent at the end of the heating season, and the responses from the pilot group that was using LogCheck will be compared to the responses from the rest of the school building operators to measure LogCheck's impact.



The LogCheck project examines the impact of mobile applications on operator behavior outside of the classroom

PUBLIC SERVICE

Central to the mission of BPL is support for the City's resiliency and greenhouse gas emissions reduction efforts – and in this sense, everything we do is a form of public service, from workforce educations to development of publicly-available energy analysis tools. But several initiatives emphasize service above all else, and these are described in this section.

Field Equipment Lending Library

Started in 2013, the Field Equipment Lending Library (FELL) is a project supported by the NYC DCAS Energy Management Division that supplies diagnostic and measurement tools for a wide range of energy efficiency projects. City agency personnel can access FELL via an online catalogue, which also includes training videos and instruction manuals, and can schedule a one-on-one consultation with FELL Equipment Specialist Felix Rodriguez.



Honey Berk demonstrates an infrared thermometer, one of the tools available through FELL

The Field Equipment Lending Library now has more than 1,000 pieces of equipment, ranging from thermal imaging scanners to wireless data collection devices to a MakerBot 3D printer, which allows for the development of custom-built devices for M&V, data collection, and other energy efficiency-related projects. Rodriguez and the BPL Technology

team have used the printer to produce customized tools such as a device that can be used to measure mean radiant temperature, air flow, relative humidity, and CO2.

Unlike conventional loggers, this device can be set up in the middle of a room or right next to a workspace, giving a much better picture of thermal comfort in the room as occupants actually experience it. In fall of 2015, the devices were deployed at a John Jay College facility for a study of thermal comfort.



The FELL Workshop: Beginning in spring 2015, City employees who renew their Building Operator Certification through BPL can take a three-hour FELL workshop for renewal credit. The class, developed by Rodriguez and BPL Director of Technology Honey Berk, emphasizes the use of FELL equipment to troubleshoot common problems found in various facilities, based on a survey of actual issues encountered by building operators. Students learn how to choose the right tools to test, measure, and diagnose building system operations, and to evaluate results.

Felix Rodriguez has taught the FELL Workshop to both CUNY students and City personnel

M&V Support for Innovative Demonstrations for Energy Adaptability (IDEA)

DCAS is the New York City agency responsible for achieving the energy usage savings in City buildings to help meet the City's highly publicized goal of 80% reduction in City greenhouse gas emissions by 2050.

To fulfill its mandate, DCAS is implementing a number of ambitious programs, one of which is Innovative Demonstrations for Energy Adaptability (IDEA), a program aimed at testing innovative and underutilized energy efficiency-related technologies in City agency facilities. Through IDEA, DCAS is testing the effectiveness of these energy-saving technologies and planning for replicability of the most successful ones. At the same time, IDEA provides a public demonstration of the effective technologies to the commercial and institutional real estate markets, thus accelerating their widespread adoption and improving the City's energy performance as a whole. In March of 2014, as an extension of BPL's collaborative work with DCAS – most notably through the Energy Data Lab – DCAS DEM engaged BPL to provide technical assistance to IDEA.

IDEA has a number of overlapping phases. Phase I of the program began in early 2014 with products in the building controls area. Phase II, which focuses on energy storage technologies, began its research and planning in spring 2015 and will likely be installing in 2016. Phase III, HVAC optimization, begins in the fall of 2016. In FY15, the BPL team – made up of both staff and interns – assisted DCAS in the implementation of this program through a number of tasks.

The IDEA team analyzed historical energy data for each of the facilities where controls systems were installed. Using this data, the team created baseline energy use models, and identified site-specific issues that could hamper performance success. The team thoroughly reviewed vendor M&V plans and issued evaluation

reports advising DCAS as to whether those plans would be able to effectively measure energy savings and, where needed, recommending alternate strategies. Further, staff and interns attended the vendor trainings, which provided valuable building system experience. We evaluated interim reports issued by several vendors and reviewed data on portals provided by others. Finally, the team has presented preliminary feedback on the replicability of Phase I technologies, which will be further developed in the next fiscal year.

Benchmarking Help Center

Launched in 2012 with the NYC Greater, Greener Buildings Plan, the Benchmarking Help Center is a free service led by BPL staff and a team of interns designed to support the adoption of Local Law 84 (LL84), which requires that all buildings 50,000 square feet and above submit energy benchmarking data on an annual basis, beginning with 2012 data. Students received specialized training in EPA Portfolio Manager and acted as coaches to property managers, helping them develop internal benchmarking processes and steering them to benchmarking service providers as needed.

In 2015, as LL84 matured and building owners no longer needed assistance reaching their benchmarking reporting milestones, the Help Center was not currently active, but the City has initialized plans with BPL to staff up again with the passage of a new Local Law that would extend the benchmarking requirement to buildings 25,000 square feet and above. These buildings, both commercial and multifamily, are generally considered underserved by current sustainability initiatives and service providers. The NYC Mayor's Office of Sustainability, one of the project's stakeholders, views the Benchmarking Help Center as an effective way to onboard this new population of property owners to the energy reporting requirements, which will help ensure high rates of compliance with the mandate.



A Brooklyn firehouse that is participating in IDEA Phase I



Help Center interns received specialized training in EPA Portfolio Manager

BUILDING PERFORMANCE LAB

STAFF

Michael Bobker, Director

Michael is a seasoned energy services professional with over 30 years of experience in NYC buildings and energy management organizations, performing building equipment evaluation, energy analysis, engineering and construction management, technology application, and technician training. He is a Certified Energy Manager (CEM) through the Association of Energy Engineers and holds Master's degrees from Oberlin College and the New York Institute of Technology. He worked with CIUS Director Robert Paaswell, PhD, to develop the proposal to NYSERDA that resulted in initial seed funding for BPL in 2006.

Nicholas Madamopolous, Associate Director

Nicholas received the B.S. degree in Physics (with honors) from the University of Patra, Greece, in 1993 and the Ph.D. degree in Optical Science and Engineering from CREOL/ College of Optics and Photonics, University of Central Florida, Orlando, in 1998. His Ph.D. specialization was in photonic information processing systems, where he introduced novel photonic delay lines for phased array antenna applications, as well as photonic processing modules for fiber-optic communications. He is an Associate Professor at the Department of Electrical Engineering, City College of CUNY, since October 2007.

Honey Berk, Director of Technology

Honey is a LEED AP O&M specializing in operations and maintenance, with a strong background in technology, data analysis and web communications. Honey joined BPL in 2011 to develop an online curriculum and framework for a professional certificate program funded by the US DOE. Now, as the BPL's Director of Technology, Honey is responsible for identifying new ways to utilize technology, online and mobile applications in research, training and fieldwork initiatives, as well as instructing student interns in energy data collection and analysis methods. She holds an undergraduate degree from New York University, with a focus in psychology and computer science.

Nora Sherman, Director of Communications

Nora came to BPL with a background in community organizing and web communications. She holds degrees from Tulane University and Trinity College Dublin. Since

2007, Nora has overseen BPL's communications and events, including conferences and the annual Energy Boot Camp. Currently she serves as BPL's liaison to the SIBS Center, oversees BOC Maintenance of Certification activities for the NYC Department of Citywide Administrative Services, and works with other staff members to promote BPL's continuing education program and research efforts.

Daniella Leifer, Manager of Training & Compliance Programs

Daniella has been with BPL since February 2008, starting out as an intern and research associate while enrolled in the MBA program at Baruch College. She completed her master's in 2010 and started full-time with the Lab in January 2011. As Manager of Training & Compliance Programs, her work primarily encompasses the Lab's workforce training and development activities and student internships as well as curriculum development projects in partnership with the US Department of Energy and the Pacific Northwest National Laboratory. She holds an undergraduate degree from Cornell University, where she graduated in 2000 with a focus on sustainable development and environmental studies.

Patrick Dail, Senior Training Consultant

Patrick serves as the City University of New York's School of Professional Studies' Director of Workplace Learning. He was crucial to development of SPS's partnership with the NYC Department of Citywide Administrative Services, and helped create the DCAS Energy Management Institute, in close coordination with BPL. He has worked with adult learners for more than a decade, leading workforce-oriented training projects to improve employee performance or prepare men and women for their next career move. Patrick earned his B.A. in European History from McDaniel College in Westminster, Maryland, and his Master's in Business Administration from the University of Phoenix's online campus.

Krystyna Horn, Administrative Manager

Krystyna graduated from the University of Maryland, Baltimore County in 2011 with a B.A. in Biology and Linguistics. She manages financial tracking documents and provides administrative support for BPL projects. She is leading the NYSERDA behavior study among NYC public school building operators.

Katherine Careddu, Senior Project Manager

Katherine came to BPL in 2014 after eight years managing teams of engineers and other specialists providing energy efficiency and LEED certification services for new construction and existing buildings. She manages BPL's work for the DCAS Innovative Demonstrations for Energy Adaptability (IDEA) program. She is also deeply involved in BPL's training program offerings, both as our outreach leader for the non-government market and as project manager for the development of a customized energy efficiency curriculum for the City's Department of Environmental Protection. Katherine has a B.A. in Economics from Oberlin College and an M.I.A in Economic Development from Columbia University. She is credentialed as LEED AP and as a Business Energy Professional (AEE).

Paule Reale, Senior Technology Project Manager

Paul manages projects with key enabling technologies that improve building operational energy efficiency. Before joining BPL, Paul's private consulting practice involved a wide range of issues regarding building sustainability and energy efficiency, including specific building projects, free cooling of electronics, green leasing techniques and extensive work as an instructor. Among many audiences and topics, Paul has taught building operators about sustainable and energy efficient practices, as well as having taught architects and engineers about energy code. He also guides teachers in enhancing their instruction techniques, and over the years he has spoken publicly on related issues and at countless venues.

Da-Wei Huang, Senior Applied Research Associate

Da-Wei comes to BPL with extensive experience leading the retro-commissioning process in Local Law 87 projects, conducting ASHRAE Level II energy audits, and providing energy assessments and recommendations. He holds a master's degree in mechanical engineering from Columbia University, is a Certified Energy Manager (CEM), and is an Existing Building Commissioning Professional (EBCP). Previously Da-Wei was a Senior Energy Engineer with the Association for Energy Affordability and Director of Energy Management for FS Energy/First Service Residential, where he used his technical expertise to help guide building managers and owners in planning for and implementing energy efficiency projects, with a particular focus on utility incentive programs.

Marco Ascazubi, Technology Specialist

As technology specialist at BPL, Marco Ascazubi is involved in the development of various methods and tools used in the analysis and visualization of building energy data and surveying of building systems. His latest projects involve BAS assesment, the development of a methodology to asses and

implement datacenter energy efficiency practices in existing CUNY campuses, and the development of a procedure for linking building energy use linear change-point models to Pacific Northwest National Lab's Building Re-tuning (BRT) protocol. Marco holds an M.S. in Urban Sustainability from the City College of New York and a Bachelor's in Telecommunications Engineering Technology from the New York City College of Technology.

Felix Rodriguez, Equipment Specialist

Felix was introduced to BPL in March 2011 through an Energy Benchmarking Workshop, which led to his work on the BPL Benchmarking Help Desk. Currently, he manages the Field Equipment Lending Library, overseeing equipment procurement, training and communications with City personnel who use the equipment to diagnose energy issues at their facilities. Felix holds a Bachelor of Technology in Architecture from New York City College of Technology.

Manorge Joseph, Research Associate

Manorge graduated from the CCNY Environmental System Engineering department in 2013. In summer 2012, he was one of two CUNY students selected to attend a BRT certification course hosted by Pacific Northwest National Laboratory. In October of that year, he began interning with BPL on the NIST Building Construction Technology Extension Program pilot project; upon graduation he joined BPL as a staff member. In addition to his fieldwork and database management and analysis, Manorge has teaches BRT to CUNY students as part of BPL's Energy Boot Camp.

Danielle Brannon, Administrative Assistant

Danielle graduated from the City University of New York-Hunter College in 2010 with a Bachelor of Arts in Film Studies. She provides administrative support for BPL projects.

Adjunct Faculty

Bill Broadhurst, PE, CEM, Princeton Facilities
Robert Bryce, RA
Lawrence Cassidy
Dakers Gowans, PE, CEM
Saverio Grosso, PE, Eneractive Systems
Bill Horan, RA, LEED AP
Marty Levine, MA
John Nettleton
Asit Patel, CEM
Joe Puglisi, PE, NYC DCAS
Lou Rugulo, PE, Johnson Controls
Zach Stern, EBC Systems
Moreno Tagliapietro

FUNDING & PARTNERSHIPS

