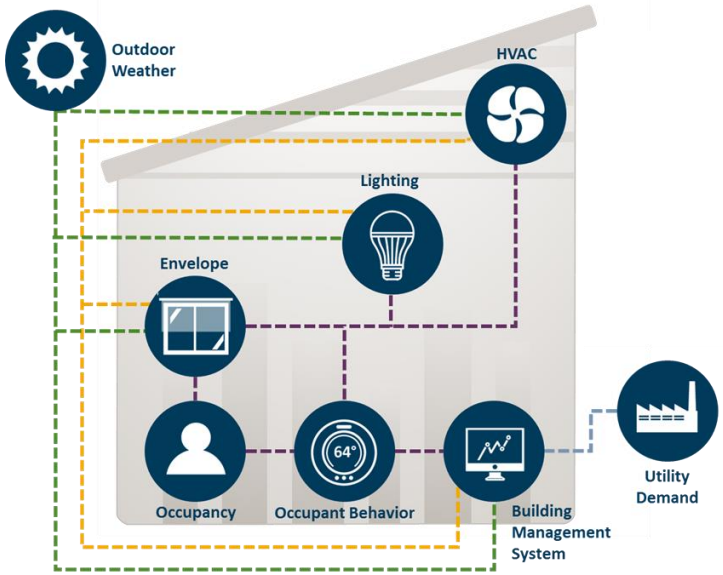
U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

Integrated Solutions for Optimized Performance (ISOP)



TRC

Rupam Singla, Technical Project Manager

rsingla@trcsolutions.com

Project Summary

Timeline:

Start date: September 1, 2017

Planned end date: April 30, 2021

Key Milestones

1. Milestone 2.1: Identify Technology Packages; Completed 12/5/2018
2. Milestone 3.1: Technology Package Installation; Began 2018
3. Milestone 4.1: Performance Analysis; BP2

Budget:

Total Project $ to Date:

- DOE: $139,734
- Cost Share: $151,131

Total Project $:

- DOE: $699,826
- Cost Share: $709,000

Key Partners:

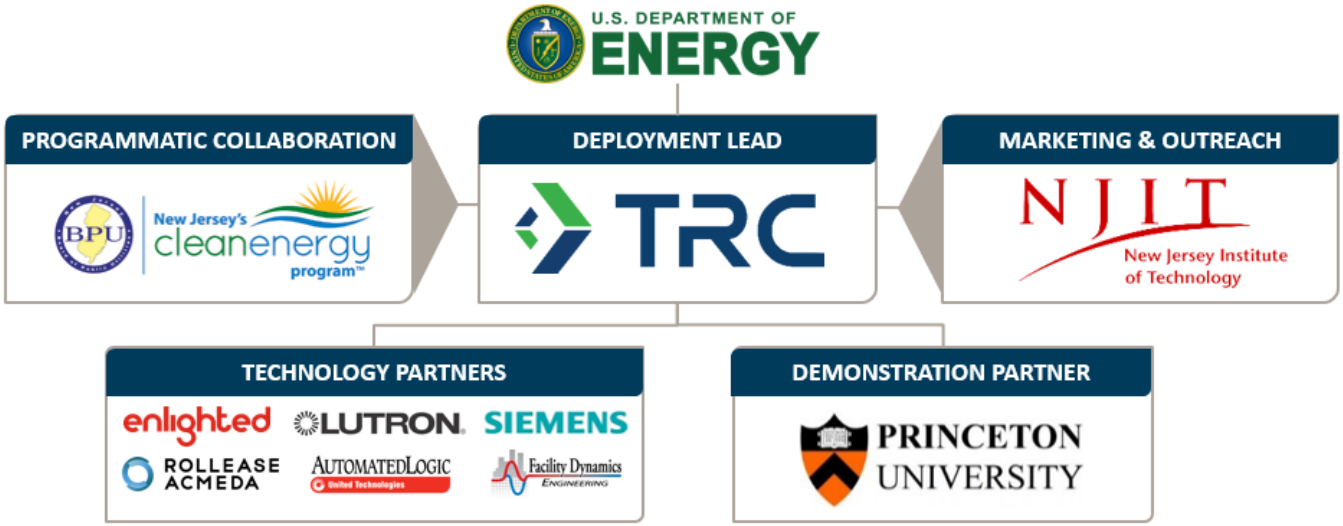
New Jersey Institute of Technology (NJIT)- Marketing and Outreach
Princeton University- Deployment Partner
New Jersey Board of Public Utilities- Program

Project Outcome:

To validate the Integrated Solutions for Optimized Performance (ISOP) package in sites representing 250,000 sq.ft.; and;

To develop technology data and knowledge transfer vehicles to support the roll out of a utility rebate program in New Jersey.

Team



Team Entity	Site Selection	Project Design	Tech. Installation	Project Evaluation	Market Transformation
TRC	●	●	●	●	●
NJIT	○	◑	◑	●	●
NJCEP	○	○	○	○	●
Princeton University	●	●	●	◑	◑
Technology Partners	○	◑	●	◑	○

● Lead Role ◑ Support Role

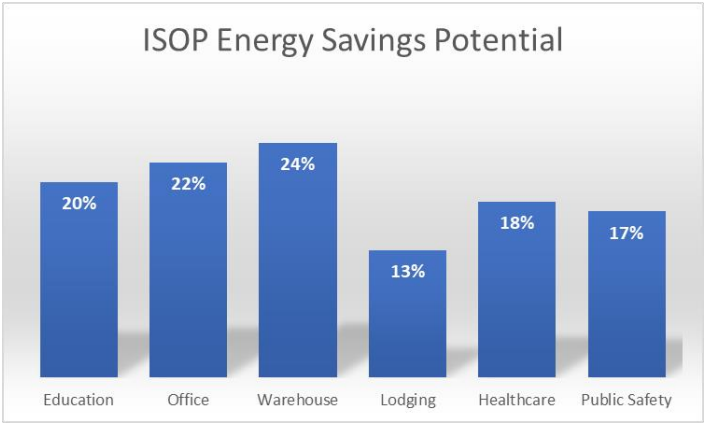
Challenge

Problem:

- Conventional retrofit projects focus on individual technologies and/or products
- Not designed to optimize the building performance as an integrated system- therefore missing deeper energy saving opportunities

Solution:

- Unlock the potential of deep whole building retrofits by design, deployment, **optimization and assessment** of integrated replicable and standardized packages
- Combine multiple technologies and smart communicating controls to maximize energy efficiency
  - ISOP Package address energy use across multiple building types
  - Impacts end uses that represent >60% of the energy consumption



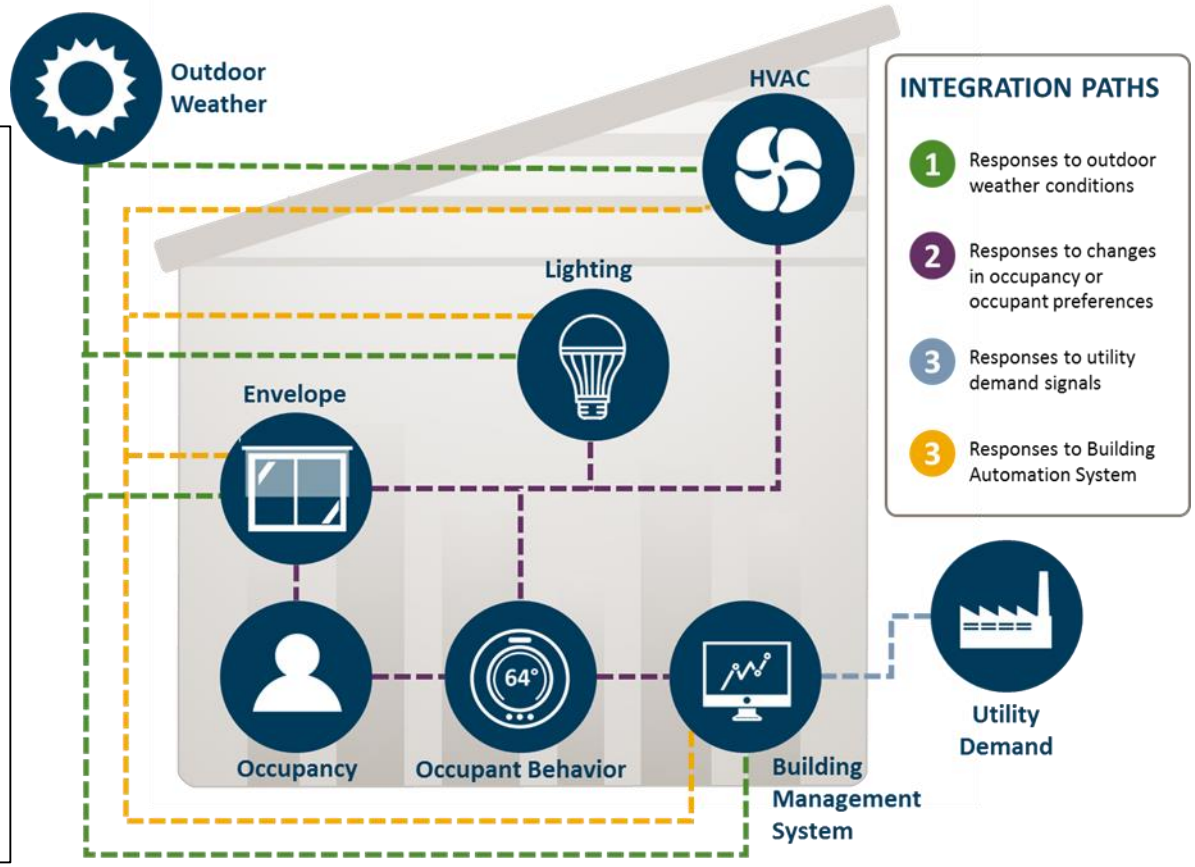
Approach - Overview

I. Advanced lighting & controls

II. Daylight harvesting through automated self-powered shades

III. HVAC controls upgrade and advanced controls sequences (ASHRAE Guideline 36)

IV. Fault detection and diagnostics (FDD) and continuous commissioning (CCx) using advanced analytics



Integrated Solutions for Optimized Performance (ISOP)

Each demonstration site will integrate at least two measures and validate savings through measurement and verification (M&V) 2.0 protocols.

Approach – Technology Innovation

	CURRENT MARKET STATE	PROPOSED INNOVATION
Lighting	Increasing adoption of LED's but lost saving opportunities due to lack of integration with other building systems	ALCS combines the advanced LED and aggressive controls strategies integrated with the HVAC operations
Daylight	Not typically a focus of existing building retrofits and rarely integrated with HVAC	Integration of automated shades with lighting and HVAC provides an easy and cost-effective method of optimizing daylighting and energy use with minimal operational disruptions.
HVAC	Lack of standardized control sequences results in software, hardware, and human error deficiencies that result in energy wastage.	ASHRAE GDL36 offers standardization of controls sequences based on industry best practices that reduce cost and operational errors
CCx & FDD	Rarely used in buildings	Sophisticated analytical techniques analyze building operations, diagnose and prioritize system faults for efficient decision-making.
M&V 2.0	Limited market availability	Automated M&V 2.0 will streamline the savings estimation process, provide continuous feedback for operational efficiency, and provide performance validation results for future utility program

Approach - Problem Solving

Key Project Tasks	Challenges- Current and/or Anticipated	TRC Problem Solving Approach
Funding	• DOE required demonstration partner to become grant sub-recipient as part of BP2 application • This changed the project from a 'energy' project to a 'sponsored project' for our demonstration partner	• TRC worked with Princeton to develop bid specifications for a competitive bid (as opposed to sole source justification originally in the plan) • TRC provided savings analysis with budgetary pricing to Princeton. Princeton approved savings analysis and is soliciting bids. • Once bids are received and savings analysis is updated, Princeton will sign on as a grant sub-recipient.
Site Selection	• One site demonstration partner dropped out of project due to funding limitations	• TRC worked with other demonstration partner to get more demonstration buildings/spaces
Project Design	• Technological: Incompatibility between existing technology and ISOP solutions • Funding: Meeting cost effectiveness criteria of demo institutions • Procurement: Lack of ability of demo sites to sole-source technology vendors	• TRC included preliminary technology screening in the site selection criteria • TRC leveraging relationship with demo sites, and contributing cost share (building auditing) • TRC leveraging the NJ utility rebate and incentive programs to meet cost effectiveness • TRC helps identify additional vendors as-needed

Approach - Problem Solving

Key Project Tasks	Challenges- Current and/or Anticipated	TRC Problem Solving Approach
Technology Installation	• **Installation schedule** affected by need to do competitive bid.	• TRC requested BP1 no-cost extension and was granted extension by DOE • TRC working with Princeton and technology vendors to develop installation and procurement schedule based on competitive bid
Project Evaluation	• **Building Data:** Inadequate data for pre and post retrofit evaluation • **Other concurrent projects**: Might impact ISOP results	• TRC worked with Princeton to get access to historical energy use, BMS trends and real time access to campus/building management dashboard. • TRC worked with building owners to identify sites that do not have any other planned retrofits during the demo timeframe • TRC developed an MOU which details building owner responsibilities and alerting TRC to any operational or building modifications during the project timeline.

Impact

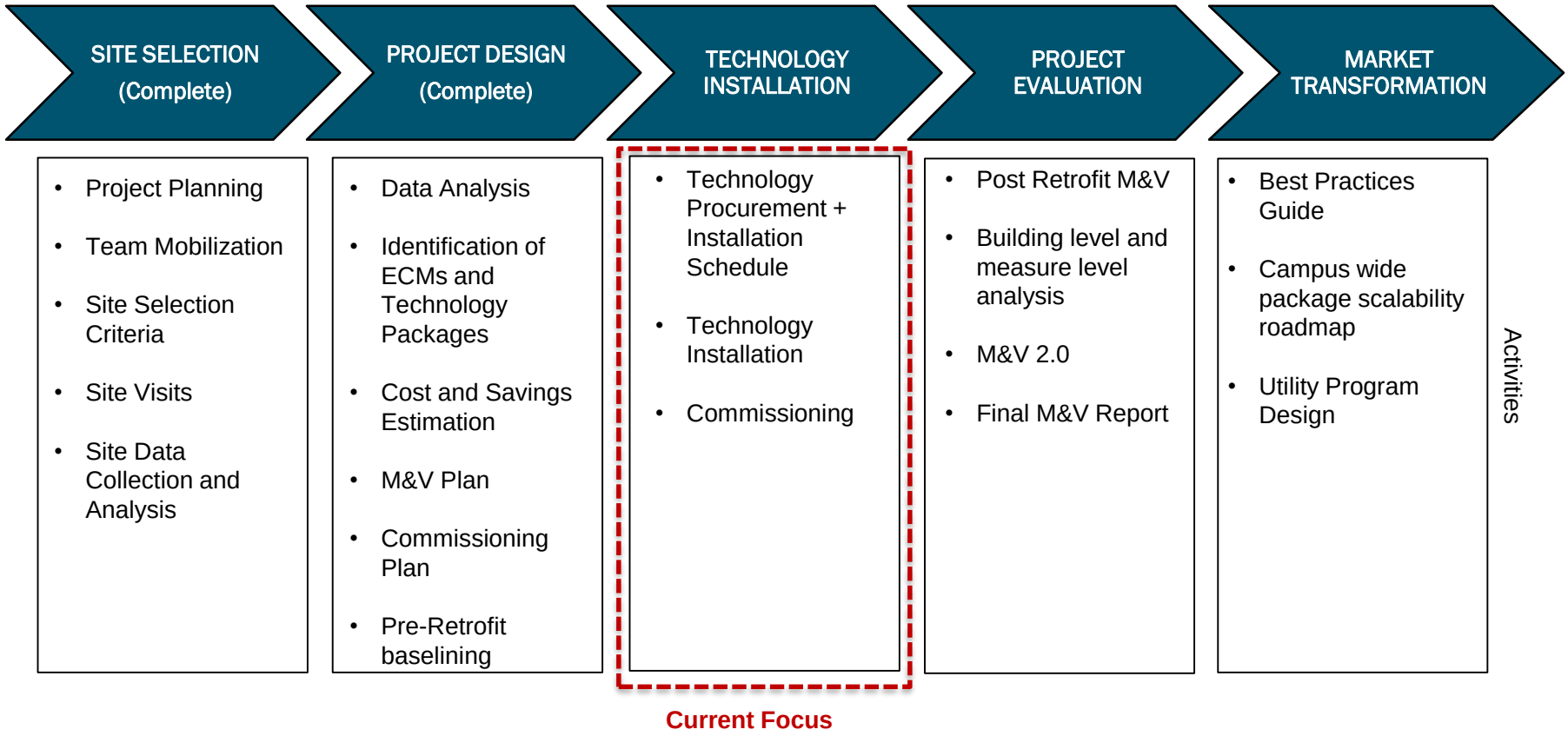
- Integrated ISOP package is estimated to save a total of 765 TBtu/Yr of energy reduction nationwide
  - 60% lighting energy
  - 25-30% HVAC
  - 10% plug load energy

- Project is expected to result in energy and cost savings and the following non-energy, benefits
  - Improved indoor lighting and visual quality
  - Improved thermal comfort
  - Health and wellness benefits
  - Increased productivity

- Project successes, outcomes and lessons learned will inform the design of utility incentive program focused on deploying pre-packaged integrated efficiency solutions

Progress

Mid Stage Project



Progress

- **Mid stage of project.**
  - BP1 had to be extended to account for change in contract arrangement with our demonstration partner.
  - Schedule impacted in terms of BP but work continued.
- **Key achievement: scalable package with ~5yr payback**
  - Developed technology packages per building
  - Developed savings analysis
  - Got budgetary pricing from vendors
  - Princeton approved payback analysis and wants to go out to bid
  - Developed performance specifications for bid packages

Stakeholder Engagement

- **Coordination with other research efforts:**
  - Cross-cutting collaboration with similar CEC EPIC projects
  - ASHRAE GDL 36 project database in development

- **Industry and Market Engagement:**
  - Technology partners engaged through multiple projects
  - Leveraging market surveys for CEC EPIC projects
  - HVAC industry engagement for GDL 36

- **Program Partner Engagement:**
  - New Jersey Board of Public Utilities (NJBPU) brief on project initiation
  - NJBPU incentive programs identified to support DOE ISOP demonstrations

- **BTO Peer Group Engagement:**
  - Seventhwave
  - LBNL
  - NREL

Remaining Project Work

Project Next Steps:

- Finalize bid documents and go out to bid
- Evaluate bids and revise savings analysis as-needed
- Princeton becomes grant sub-recipient

2019 Q3 Plan:

- Revise technology procurement and installation schedules
- Complete technology installations
- Begin post-retrofit savings assessment

Year 2 & 3 Plan:

- Project Evaluation
- Market Transformation

Thank You

TRC
Rupam Singla, Technical Project Manager
rsingla@trcsolutions.com

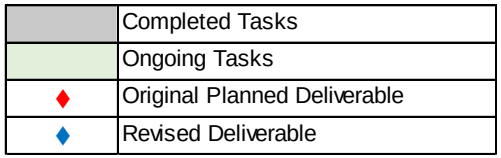
REFERENCE SLIDES

Project Budget

Project Budget: Federal : $699,826 ; Cost Share: $709,000
Variances: NA
Cost to Date: Federal 20%; Cost Share 21%
Additional Funding: NA

Budget History					
9/2017 - FY 2018 (past)		FY 2019 (current)		FY 2020 – 4/2021 (planned)	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
$139,734	$151,131	$416,422	$414,769	$143,671	$143,100

Project Plan and Schedule



Major Task Schedule		Budget Period 1										Budget Period 1 Extension								Budget Period 2												Budget Period 3											
Phase	SOPOTask #	Oct-17	Nov-17	Dec-17	Jan-18	Feb-18	Mar-18	Apr-18	May-18	Jun-18	Jul-18	Aug-18	Sep-18	Oct-18	Nov-18	Dec-18	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20	Oct-20	Nov-20	Dec-20	Jan-21	Feb-21	Mar-21	Apr-21
1. Project Selection	1.1: Project Team Planning Meeting			♦																																					
	1.2 Site Selection Critiera, Site Visits and Data Collection							♦																																	
	1.3 Site Assessment and Selection							♦				♦																														
2. Project Design	2.1 Identifiy Technology Packages								♦						♦																												
	2.2 Savings Analysis of Proposed Packages								♦						♦																												
	2.3 Technology Procurement and Installation Schedule									♦					♦																												
	2.4 ISOP Tecnology Procurement												♦		♦																												
	2.5 Development of a Draft M&V Plan											♦			♦																												
3A. Field Demonstration Initiation	3.1A Field Demonstration Initiation												♦			♦																											
	3.2A Building Commissioning Plan												♦			♦																											
	3.3 A Performance Measurement Plan											♦				♦																											
3B. Field Demonstration Completation	3 B Field Demonstration Completion																♦			♦			♦		♦			♦			♦												
4. Performance Analysis	4.1 A Begin Continuous Performance Measurement																♦			♦			♦		♦			♦			♦												
	4.2 Annual Site Performance Measurement																							♦							♦												
	4.3 Comprehensive Technology Package Impact Analysis																										♦							♦				♦				
5. Best Practices Guide and Program Development	5.1 Final Verification Report																														♦								♦			
	5.2 Best Practices Guide																																	♦							♦	
	5.3 Package Roadmaps																																	♦							♦	
	5.4 Utility Program Design																																			♦						♦