EERE Demonstration for Advanced Retro-commissioning Technology: Predictive Energy Optimization (PEO) and Automated Demand Response for Commercial Building HVAC

2015 Building Technologies Office Peer Review

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

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Project Summary

Timeline:

Start date: October 1, 2014

Planned end date: September 30, 2017

Key Milestones

1. Stage 1 Site Qualification; 2/28/15
2. Stage 2 Site Qualification; 4/15/15
3. Stage 1 Sites Deployment; 6/30/15

Budget:

Total DOE $ to date: $ 354,054

Total future DOE $: $ 624,521

Target Market/Audience:

~16 Buildings, ~7.5M SF of space

Commercial Real Estate (REIT and Owner/Operator), Hospital, Federal, City and Municipal, Higher Education

Key Partners:

New City Energy	GSA – US Govt.
DGS-Washington, DC	
Schneider Electric	
Siemens	
Portal CM	

Project Goal:

Demonstrate PEO (Predictive Energy Optimization) performance in multiple and diverse buildings, monitor their performance, analyze the energy and peak power savings, overall economics and verify with specific tests for performance of the application to deliver energy savings.

Purpose and Objectives

Problem Statement: PEO still faces real market barriers:

- Relatively unproven as a concept
- Requires a new approach to how building operators manage their HVAC
- Target market is largely risk-averse, skeptical and resource-constrained

Target Market and Audience:

- Target market is the 37,000 commercial buildings in the US
- Office, Government, Health Care and Higher Education
- Covers ~12B SF and spends ~$30B in energy costs per year
- HVAC systems in these buildings consume 8% to 12% of total US energy usage
- Commercial buildings typically represent over 50% of peak demand

Impact of Project:

- Delivery across diverse building types with minimal disruption
- Showcase the no capex business model and validate savings/ cash flow impact
- Demonstrates the potential for cost-effective autoDR
- Verify that PEO provides leverage to building staff rather than adding to workload

Approach

Approach: Software overlays existing BAS:

- Automatically adjusts set points
- Based on a learned, building-specific thermal model
- Incorporates predictive algorithms and advanced control strategies
- Utilizes weather forecasts, utility tariffs, event signals and occupant schedules, and adapts to changes.

Key Issues:

- Requires a diverse set of commercial buildings
- Validation that deployment can be done cost-effectively and without the need for capital investment or highly skilled engineers
- Validation that PEO delivers sufficient savings and other benefits
- Integration with applicable utilities or aggregators to bring DR
- Strong leadership, project management and good working relationships

Distinctive Characteristics:

- Measurable and immediate impact on energy use and peak load
- Reduces the need for staff intervention to achieve savings
- Generates positive cash flow – all without upfront capital

Progress and Accomplishments

Lessons Learned: Independent analysis of buildings for 3rd party M&V added a level of complexity to the building recruitment process.

Accomplishments:

- Completion of the site qualification checklist
- Completion of the site recommendations template
- Recruitment of more than six (6) sites for Stage 1 deployment
- Finalization of the M&V plan and baseline analysis of sites

Market Impact: As we just into deployment stage with our first set of sites, results will be forthcoming. It is expected that we'll achieve:

1. In excess of 10% reduction in HVAC related energy costs by year end 2015
2. In excess of 10% reduction in HVAC related load costs by year end 2016

Awards/Recognition: At this point due the initial start of the project, awards and recognition have not targeted at this stage of the project.

Project Integration and Collaboration

Project Integration: Identify how the project staff collaborate and or coordinate with industry and other relevant stakeholders to accelerate impact.

Partners, Subcontractors, and Collaborators: We are working with two key potential channels for our technology:

- Schneider-Electric's regional branches
- Siemens national Energy Services business

We are also working with the City of Washington DC, a highly visible leader in sustainability and building energy performance. Government buildings are a very attractive market for PEO and therefore this Partner is a great vehicle for marketing results to city, state and federal customers going forward.

Communications: At this point since this is a new project, there have not been any presentation of results and benefits – still underway.

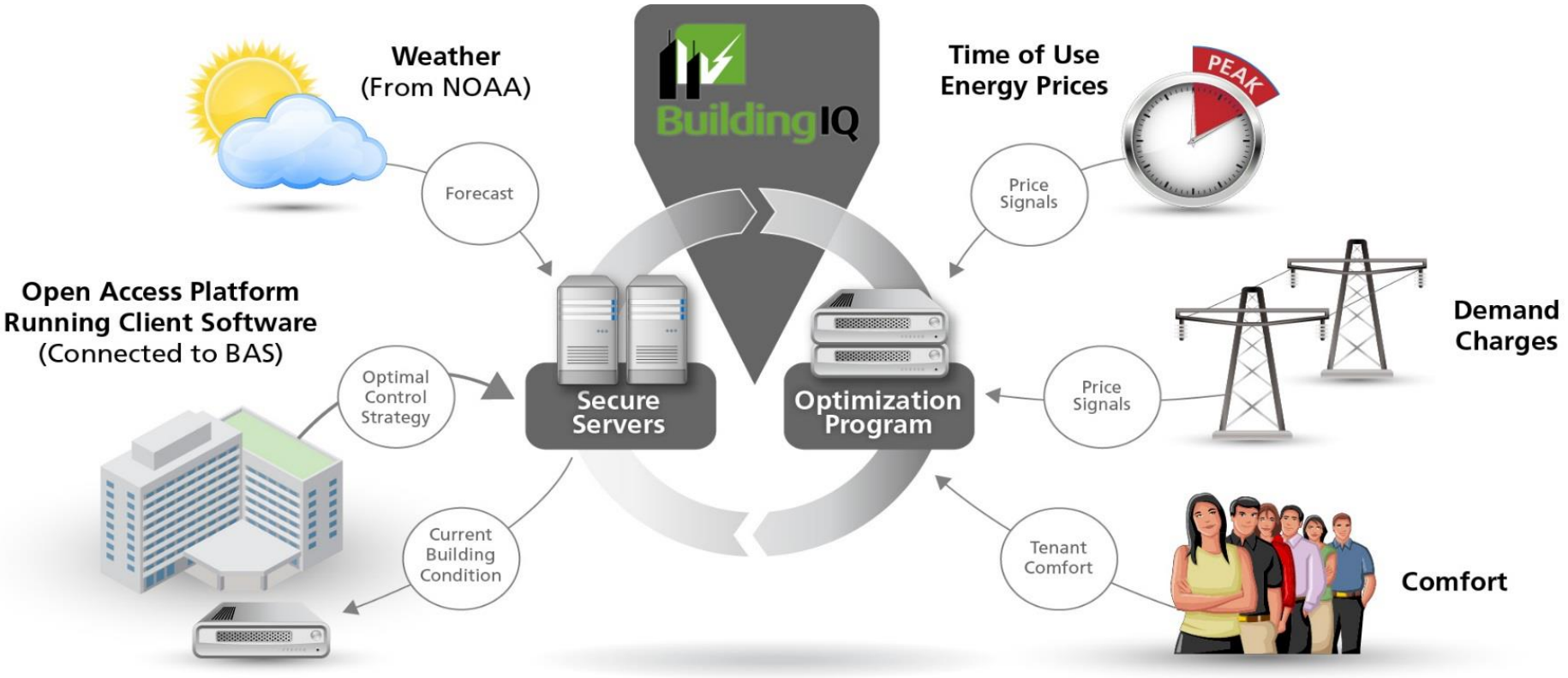
Next Steps and Future Plans

Next Steps and Future Plans:

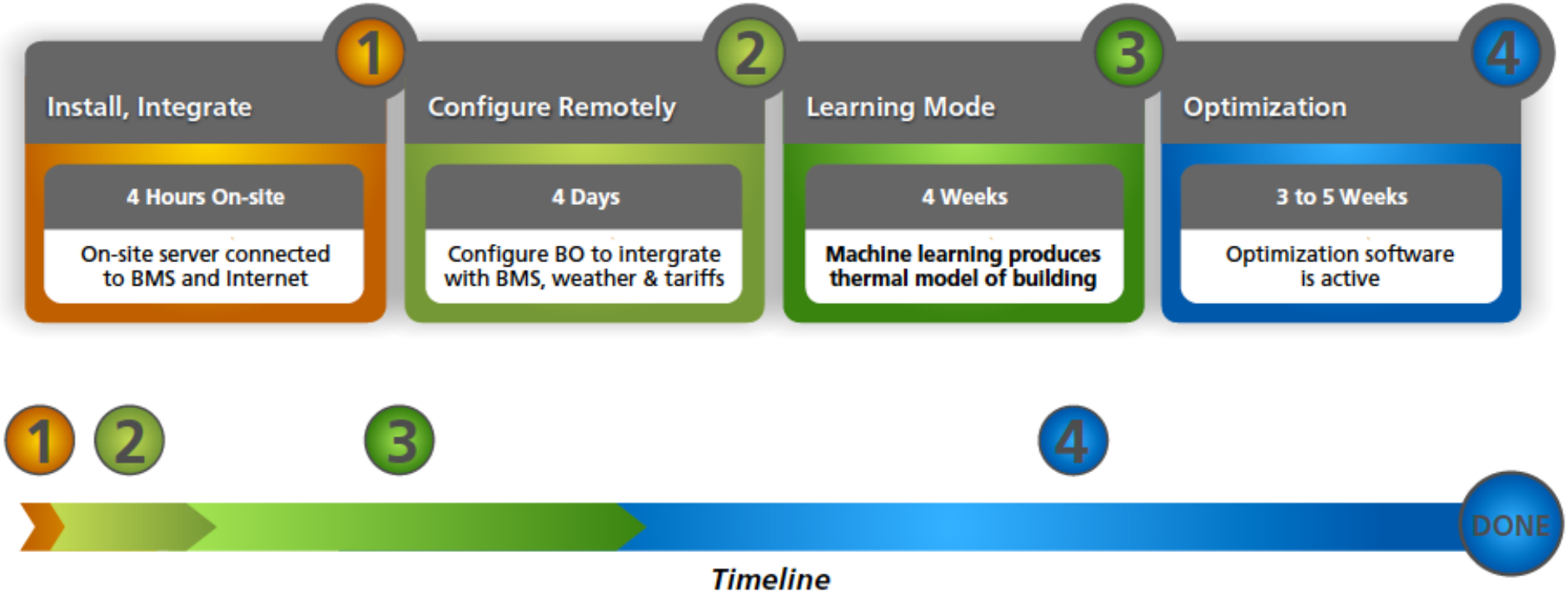
- Full deployment of configuration of PEO on six (6) Stage 1 sites that will drive HVAC consumption reduction (Kwh) by 12% - 25%
- Completion of Recruitment for Stage 2 Sites – additional ten (10) sites
- Completion of M&V (Measurement and Verification) plan and baseline analysis of sites
- Target sites for HVAC load reduction (demand response) milestone – June 2016

REFERENCE SLIDES

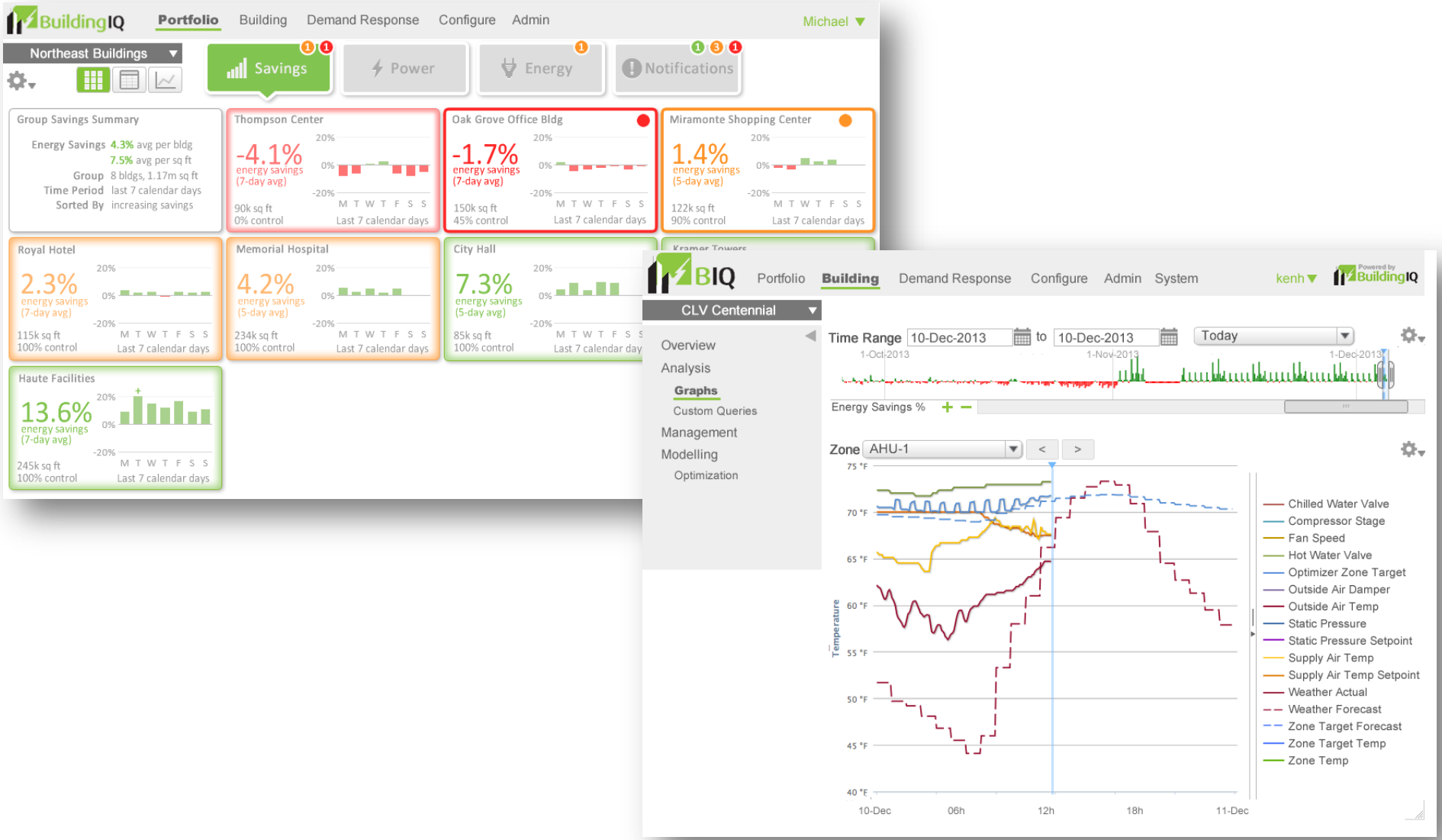
Predictive Energy Optimization



Implementation Process



Portfolio and Building View



Continuous M&V and Alerting

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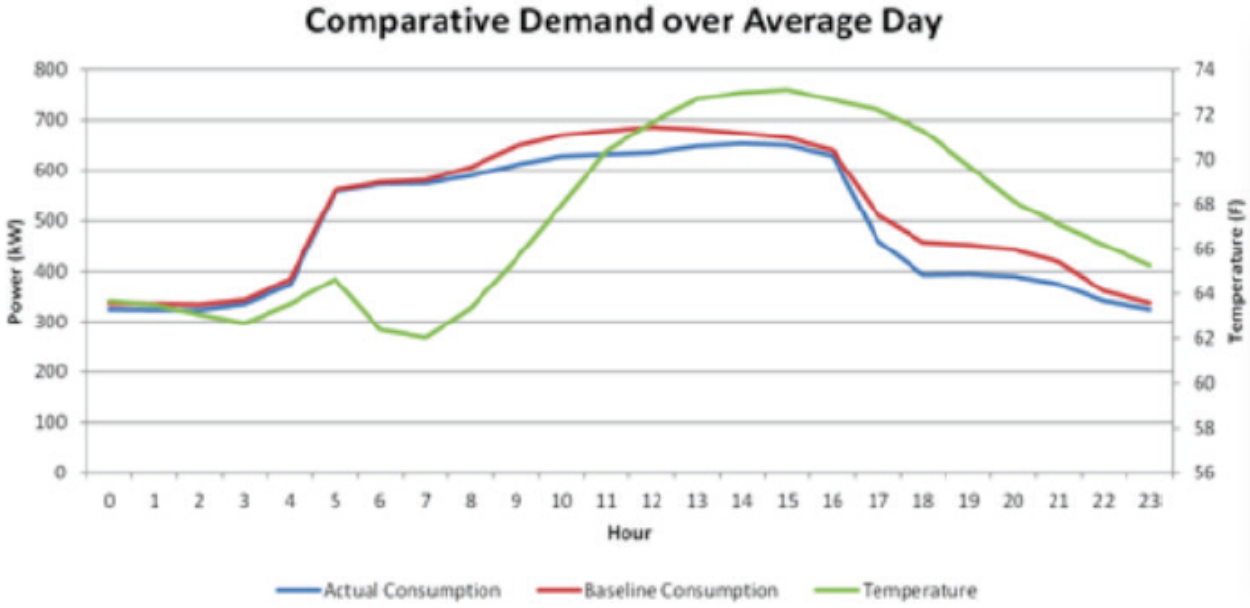
Case Study

- High-security, Government building
- 125,000 sq.ft.
- Trane Tracer BMS
- Building's design provided additional challenges to overcome

- 15% HVAC energy savings
- Building gained 6 Energy Star points



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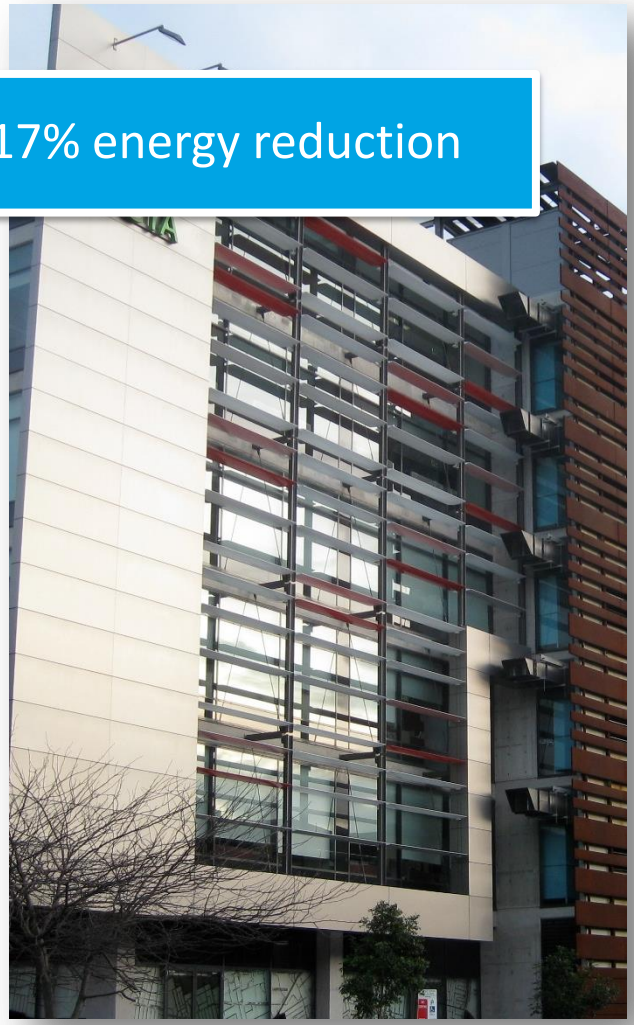
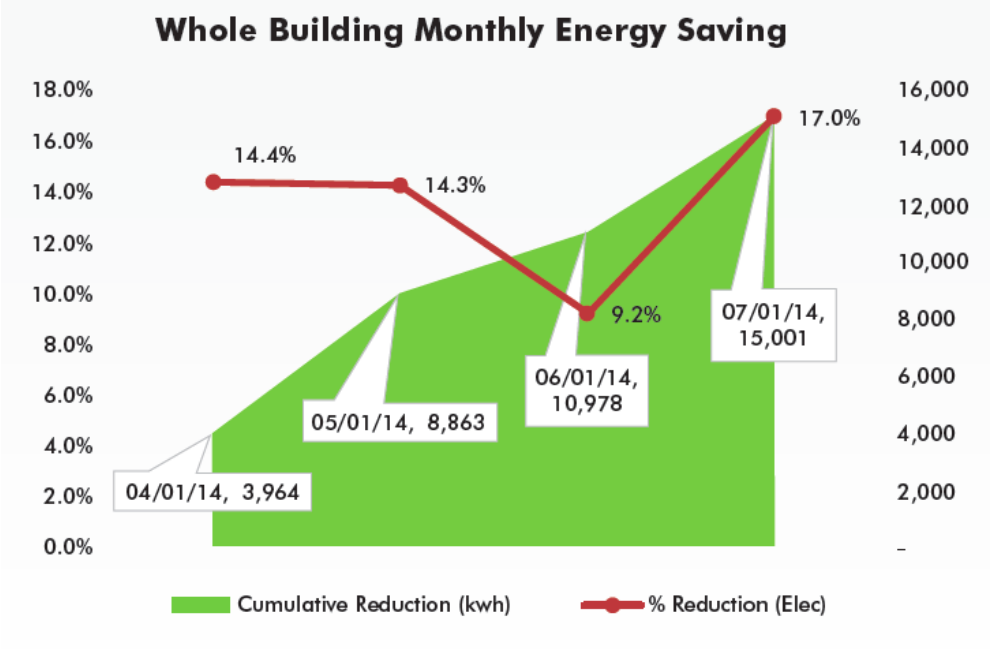
Case Study



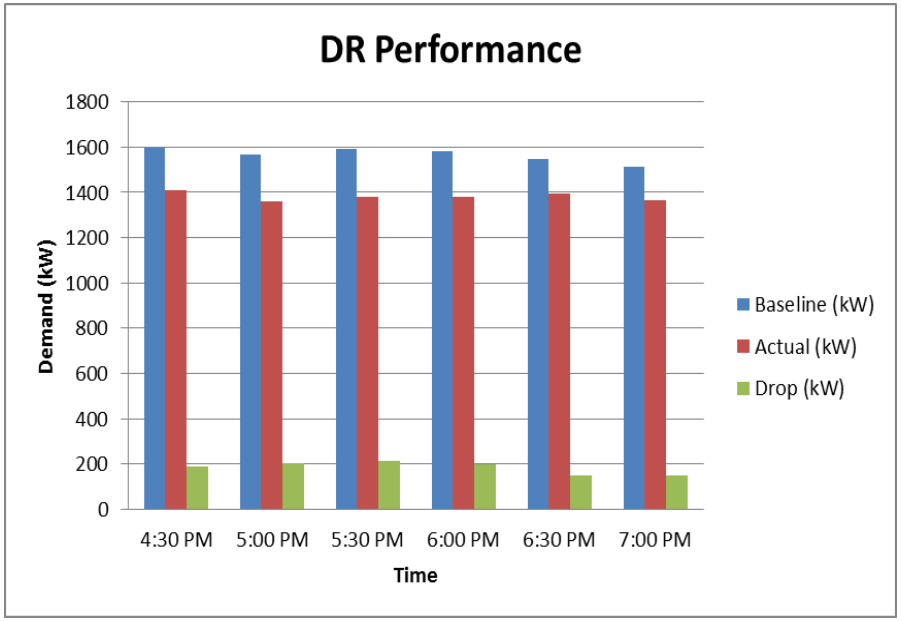
- 120,577 sq.ft. (11,202 sq.m.)
- 5 year-old construction – highly efficient
  - 5.5 NABERS score
- Delta Control BACnet System



Case Study

- 527,000 Sq. Ft.
- Casino + restaurant + retail + conference
- Delta Controls BMS
- Advanced control strategies already in place
  - Highly efficient

- 12% HVAC energy savings
- 13% HVAC peak load reduction



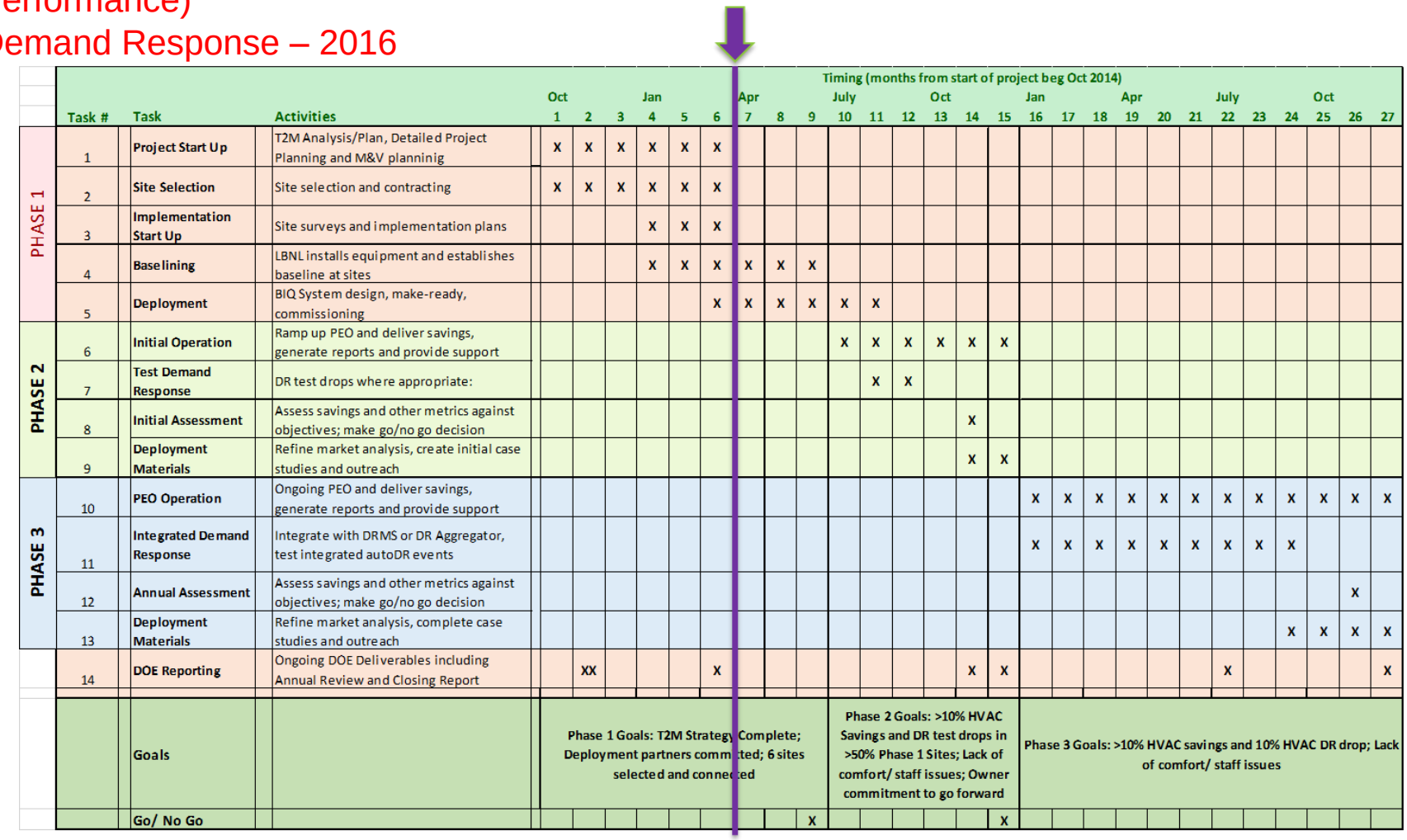
Project Budget

Project Budget: Site Selection / Recruitment Began October 2014, Three (3) Year Project, Total Budget of $3.4M
Variances: No variations to report at this time and none are expected
Cost to Date: ~22% of the budget costs at this point - $354K
Additional Funding: Potentially additional lab funding (separate budget) to accommodate full M&V plan for remaining sites.

Budget History					
October 1, 2014 – FY2014 (past)		FY2015 (current)		FY2016 – September 30, 2017 (planned)	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
$130,396	$130,396	$1,527,754	$1,527,754	$108,988	$108,988

Project Plan and Schedule

- Project Initiation Date of October 1, 2014 – Completion Date of September 30, 2017
- Three (3) Main Phases – Phase 1: Deployment, Phase 2: Energy Efficiency (Kwh) and Phase 3: Demand Response (KW)
- Go/No Go Decision Points – June 2015 (Deployment); December 2015 (EE Performance)
- Demand Response – 2016



	Task #	Task	Activities	Timing (months from start of project beg Oct 2014)																									
				Oct			Jan			Apr			July			Oct			Jan			Apr			July			Oct		
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
PHASE 1	1	Project Start Up	T2M Analysis/Plan, Detailed Project Planning and M&V planninig	X	X	X	X	X	X																				
	2	Site Selection	Site selection and contracting	X	X	X	X	X	X																				
	3	Implementation Start Up	Site surveys and implementation plans				X	X	X																				
	4	Baselining	LBNL installs equipment and establishes baseline at sites				X	X	X	X	X	X																	
	5	Deployment	BIQ System design, make-ready, commissioning						X	X	X	X	X	X															
PHASE 2	6	Initial Operation	Ramp up PEO and deliver savings, generate reports and provide support										X	X	X	X	X	X											
	7	Test Demand Response	DR test drops where appropriate:											X	X														
	8	Initial Assessment	Assess savings and other metrics against objectives; make go/no go decision														X												
	9	Deployment Materials	Refine market analysis, create initial case studies and outreach														X	X											
PHASE 3	10	PEO Operation	Ongoing PEO and deliver savings, generate reports and provide support																X	X	X	X	X	X	X	X	X	X	X
	11	Integrated Demand Response	Integrate with DRMS or DR Aggregator, test integrated autoDR events																X	X	X	X	X	X	X	X	X		
	12	Annual Assessment	Assess savings and other metrics against objectives; make go/no go decision																									X	
	13	Deployment Materials	Refine market analysis, complete case studies and outreach																								X	X	X	X
	14	DOE Reporting	Ongoing DOE Deliverables including Annual Review and Closing Report		XX				X								X	X						X					X
		Goals		Phase 1 Goals: T2M Strategy Complete; Deployment partners committed; 6 sites selected and connected									Phase 2 Goals: >10% HVAC Savings and DR test drops in >50% Phase 1 Sites; Lack of comfort/ staff issues; Owner commitment to go forward						Phase 3 Goals: >10% HVAC savings and 10% HVAC DR drop; Lack of comfort/ staff issues										
		Go/ No Go										X						X												