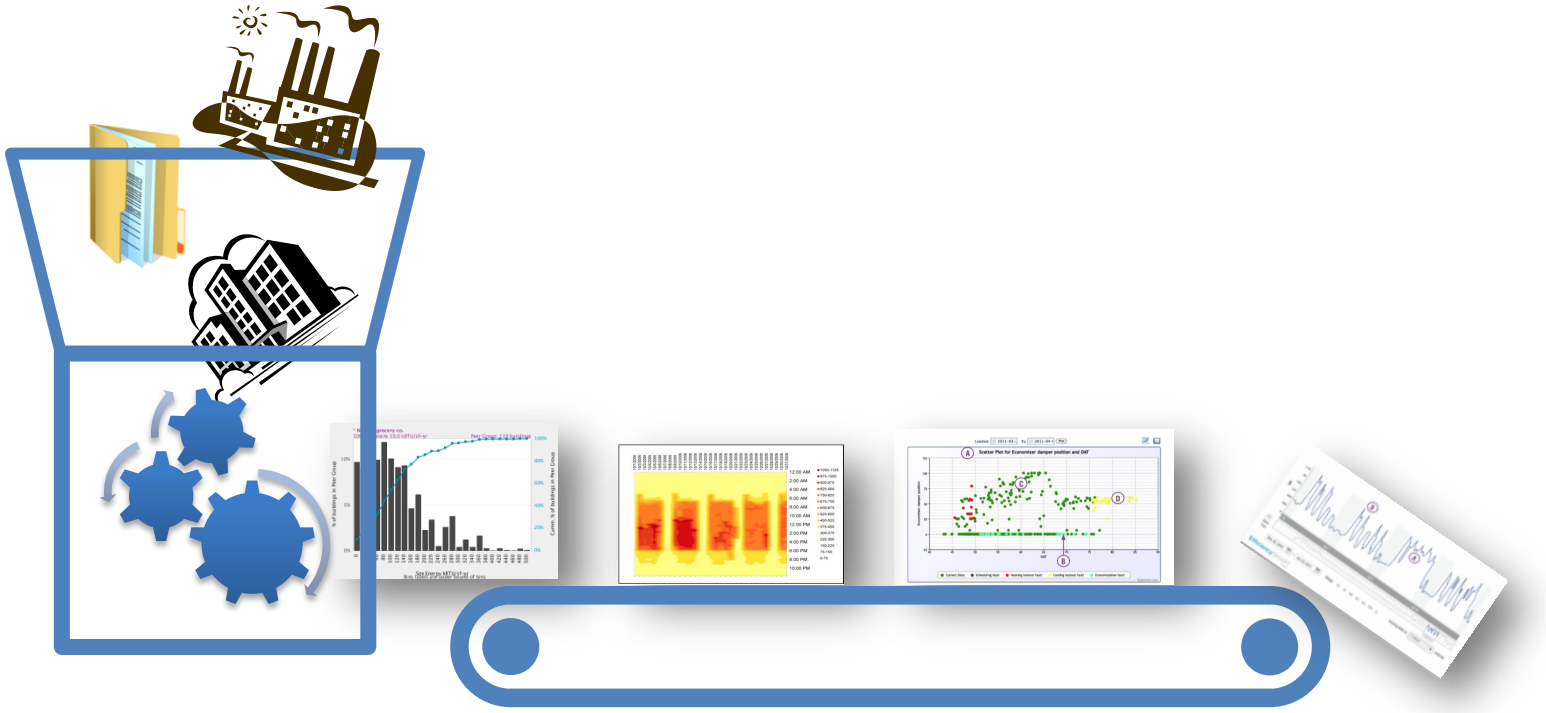
OpenEIS (energy information system)

2014 Building Technologies Office Peer Review



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

Jessica Granderson, JGranderson@lbl.gov
Lawrence Berkeley National Laboratory

Project Summary

Timeline:

Start date: November 2012

Planned end date: October 2014

Key Milestones:

1. Release of reference code for v1 algorithms, September 2013
2. Completion of Software Requirements Specification, November 2013
3. OpenEIS v1.0 released as open source; October 2014

Budget:

Total DOE $ to date: $1.56M

Total future DOE $: FY 15 funding TBD

Target Market/Audience:

Market = commercial buildings under 100ksf

Audience = new/existing service providers, owners and managers of small commercial buildings and portfolios.

Key Partners:

PNNL	Navigant

Project Goal:

Deliver an open-architecture platform to upload and analyze building energy operational data

Create market pull for existing commercial solutions, and lower the transaction cost for new and existing service providers

Provide a standard platform to deliver Lab-developed analytical and control algorithms to the public, for deployment and adoption

Purpose and Objectives

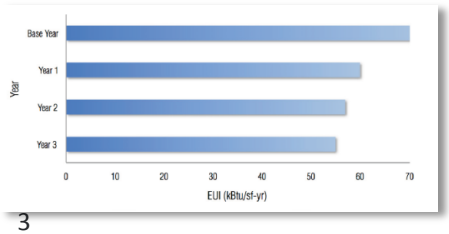
Problem Statement: Advanced algorithms and analyses can enable 5-40% savings, yet are rarely adopted; 3 relevant barriers include:

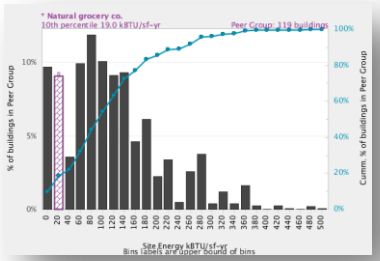
1. Lack of awareness that simple analytics can be used to generate valuable insights and actionable information, without further training
2. Risk averseness
3. Prohibitive costs, particularly for small commercial buildings

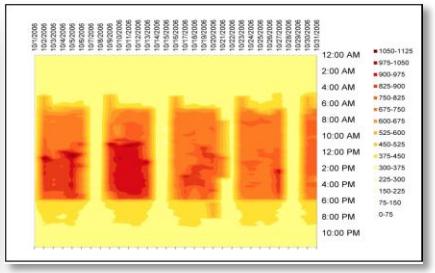
Target Market and Audience:

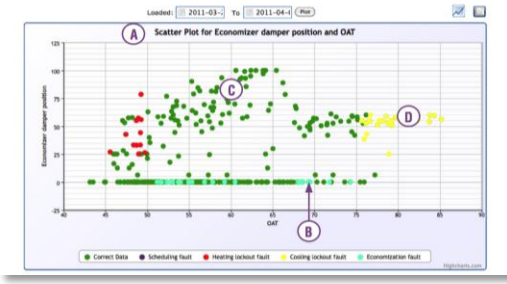
Market - commercial buildings under 100ksf, representing 3400 Tbtu, 3.4 quads total energy use

Audience - new/existing service providers, owners and managers of small commercial buildings and portfolios.









Purpose and Objectives

Impact of Project: Based on CBECS data, and assuming 15% average savings, adoption of analytics throughout the target market would enable 500 TBtu (.5 quads); total commercial consumption is 5800 TBtu, or 5.8 quads (excluding malls)

1. Project's endpoint and final products
   - Open-source platform and associated algorithms for small commercial
   - Documentation for end-users and developers who wish to adapt, add to, or white-label for further deployment

2. Measuring of achievement towards the goal
   a. Near-term - alpha and beta testing confirm functionality in compliance with platform technical and performance specifications; number of downloads, unique users, application launches in first year of release
   b. Intermediate-term – early adoption by key enterprises service providers; number of providers delivering OpenEIS-based solutions
   c. Long-term – total size of user base, increase in use of analytics in small commercial market

Approach

Approach:

1) LBNL, PNNL and Navigant team knowledge + stakeholder workshops, to integrate subject matter expertise into OpenEIS requirements and implementation specifications
2) Build-out according to specifications
3) Alpha and beta versions for testing and engagement of early adopters

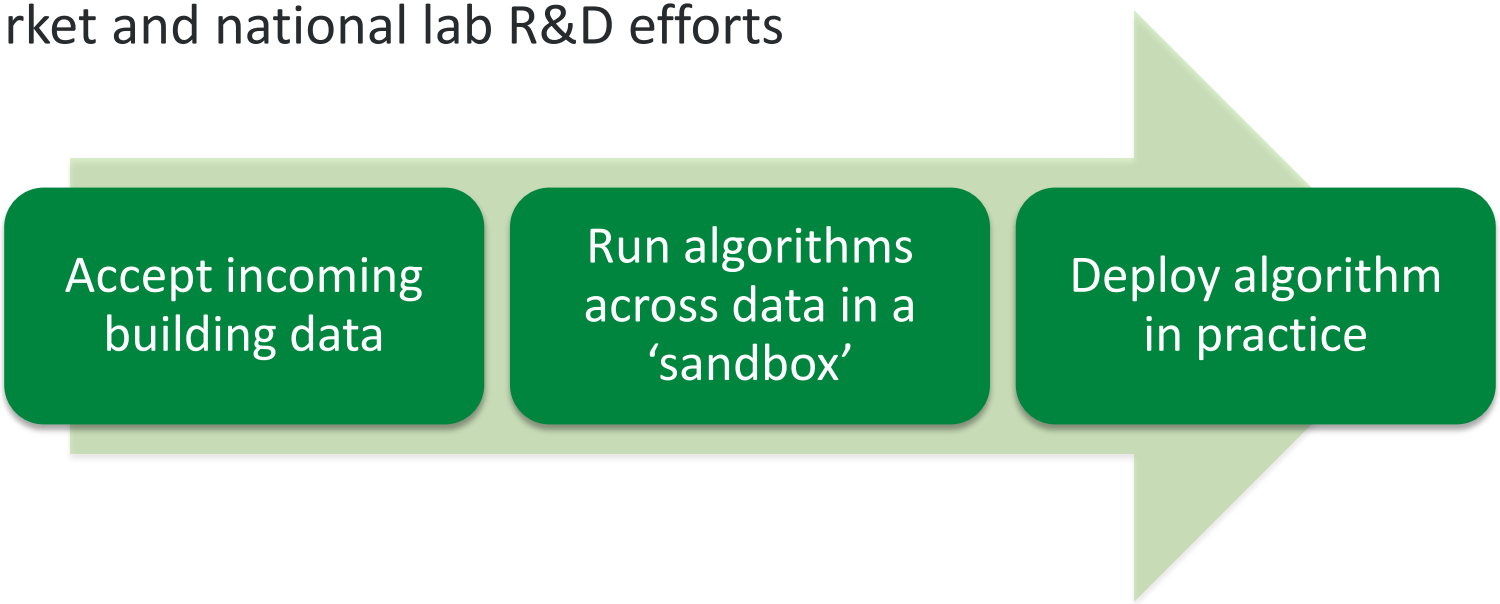
Key Issues: Early and frequent engagement of vendor, owner, practitioner community for concept awareness, technical input

Approach

Distinctive Characteristics:

Increases demand by providing a 'sandbox' to illustrate benefits *prior to* investment in products and services increasing market awareness, and reducing risk

Cross-cutting effort to organize best and emerging practices in market and national lab R&D efforts



Progress and Accomplishments

Lessons Learned: No barriers encountered to-date during course of project work

Accomplishments:

1) Engagement of 50+ industry domain experts in two workshops to identify high-priority algorithms, data formats/types storage requirements

maximum value to target market and audience

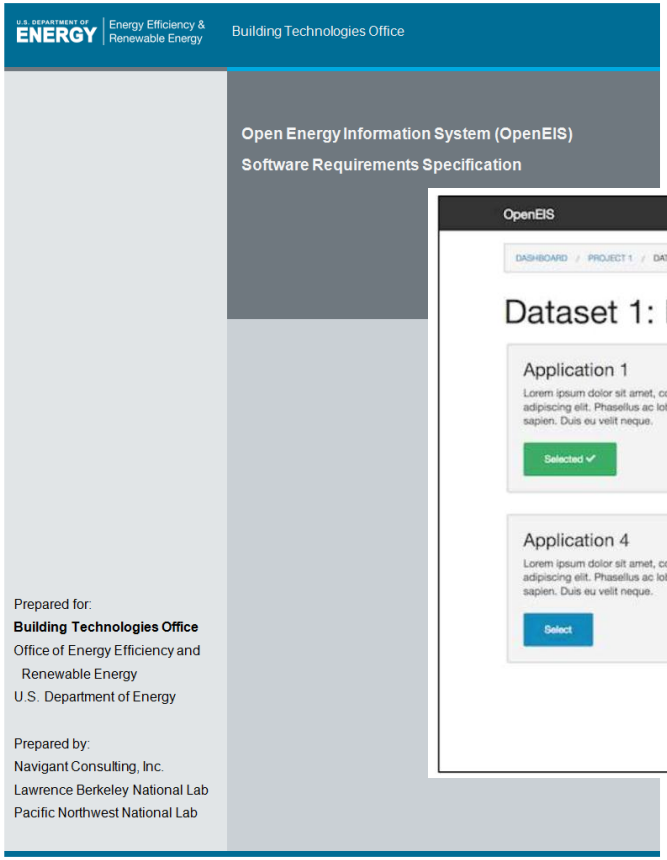
concept awareness and industry buy-in

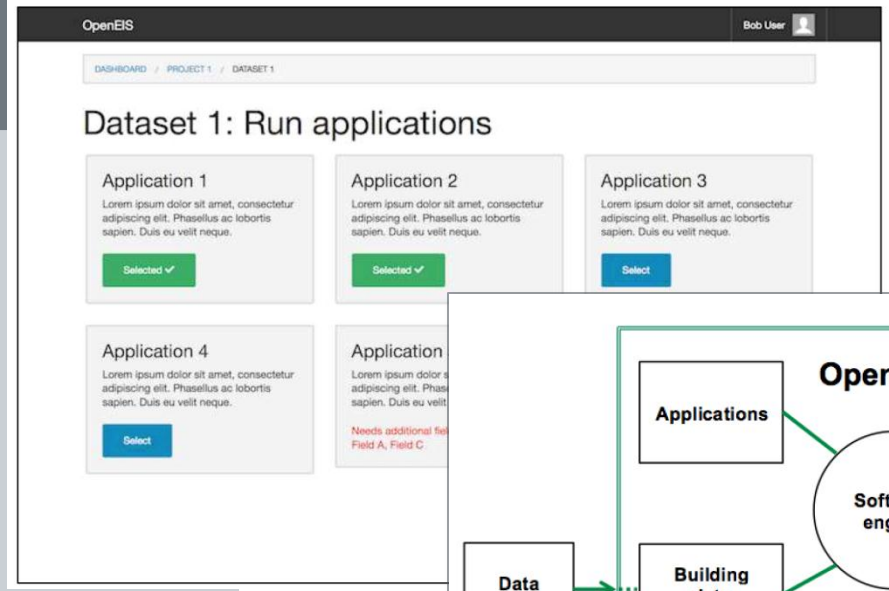
Progress and Accomplishments

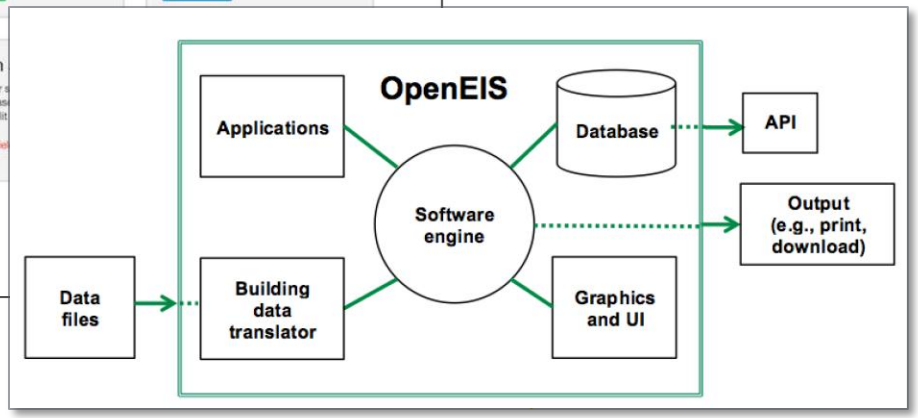
Lessons Learned: No barriers encountered to-date during course of project work

Accomplishments:

2) Completion of software requirements spec and implementation spec stakeholder feedback incorporated into design of OpenEIS solution







Progress and Accomplishments

Lessons Learned: No barriers encountered to-date during course of project work

Accomplishments:

3) Release of reference code and user guide for high-priority algorithms
   rigor in building science underlying applications delivered in v1 OpenEIS
   open-source code, pseudo code and user/developer guide for immediate
   industry use


User Guide: OpenEIS Reference Code

Jessica Granderson
David Lorenzetti
Claudine Custodio

Lawrence Berkeley National Laboratory

Srinivas Katipamula
Hung Ngo
Robert Lutes

Pacific Northwest National Laboratory

BERKELEY LAB
Lawrence Berkeley National Laboratory

Pacific Northwest
NATIONAL LABORATORY

Prepared for:
George Hernandez
DOE Building Technologies Office
February 10, 2014

Accomplishments – Publicly Available Reference Code

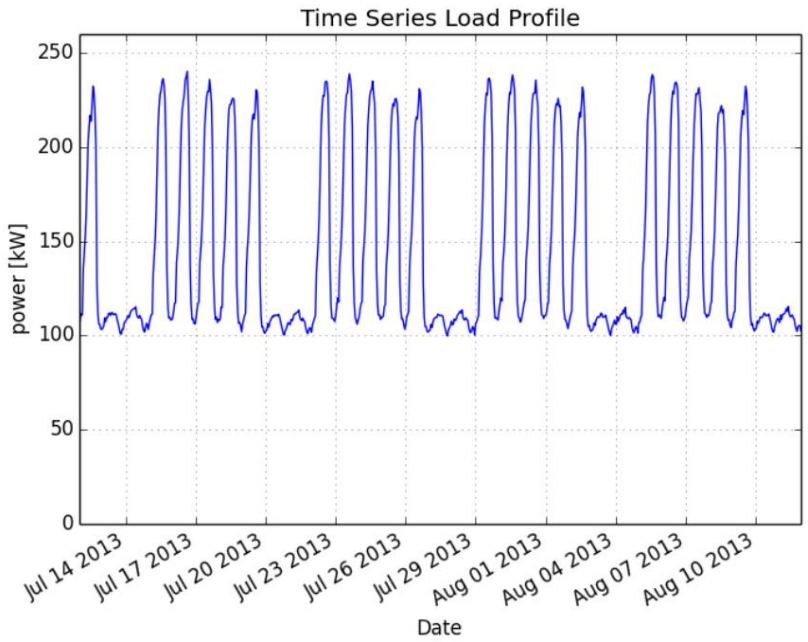
OpenEIS Algorithm Results

Summary Load Metrics

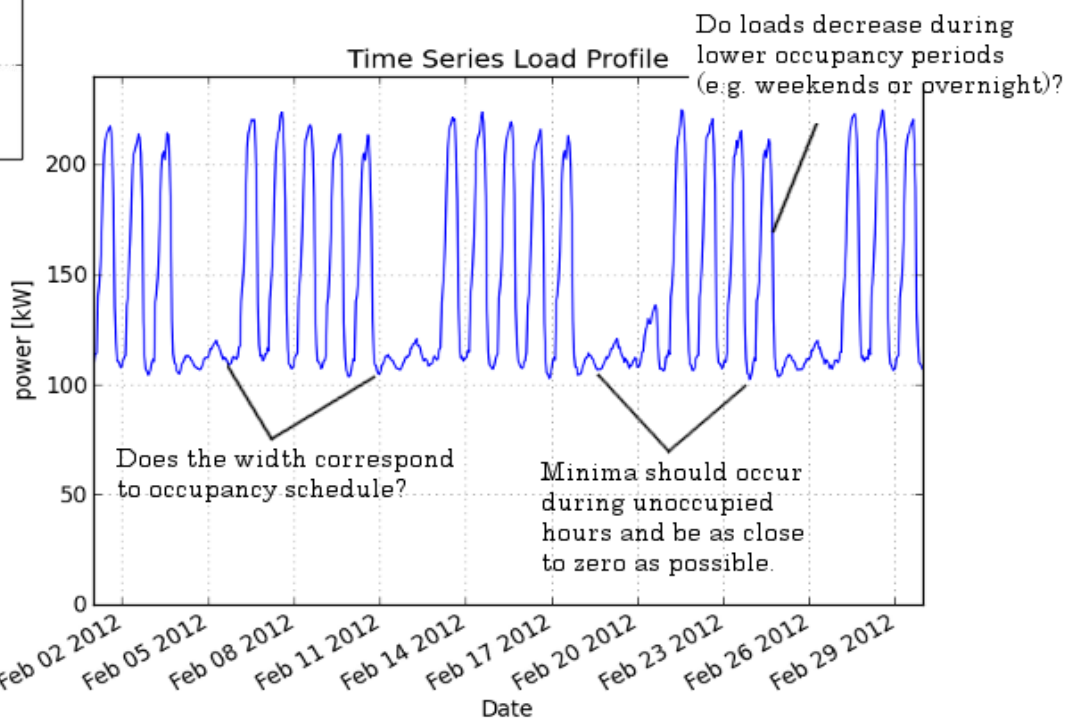
Metric	Value
Peak Load Benchmark [W/sf]: This is the absolute maximum electric load based on all of your data. The median for commercial buildings under 150,000 sf is 4.4 W/sf. Values much higher than 4.4 therefore indicate an opportunity to improve building performance.	3.70
Average daily max [kW]: The daily maximum usage could be dominated by a single large load, or could be the sum of several smaller ones. Long periods of usage near the maximum increase overall energy use.	192.32
Average daily min [kW]: Minimum usage is often dominated by loads that run 24 hours a day. In homes, these include refrigerators and vampire loads. In commercial buildings, these include ventilation, hallway lighting, computers, and vampire loads.	105.19
Average daily range [kW]: This is a rough estimate of the total load turned on and off every day. Higher values may indicate good control, but could also indicate excessive peak usage.	87.13
Base-to-peak load ratio: Values over 0.33 indicate that significant loads are shut off for parts of the day. To save energy, look to extend and deepen shutoff periods, while also reducing peak energy use.	0.61
Load variability metric: This metric is used to understand regularity of operations, and the likelihood of consistency in the building's demand responsiveness. It represents a coefficient of variation that ranges from 0 to 1, which can be interpreted based on rule of thumb guidelines. For example, variability above 0.15 is generally considered high for commercial buildings.	0.16

Accomplishments – Publicly Available Reference Code

Time Series Load Profile



How to read this chart

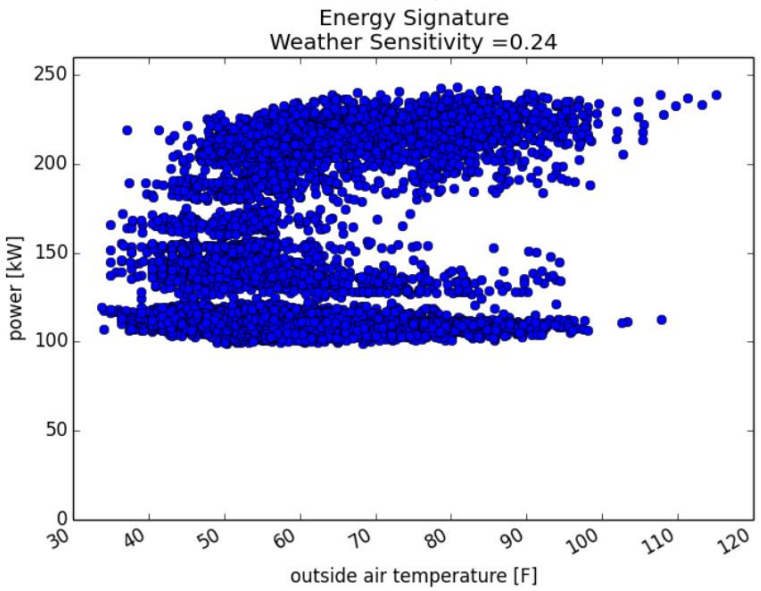


Does the weekly profile correspond to occupancy and use for each day for a typical week?

Accomplishments – Publicly Available Reference Code

Energy Signature

Analyze the relationship of power intensity to outdoor temperature



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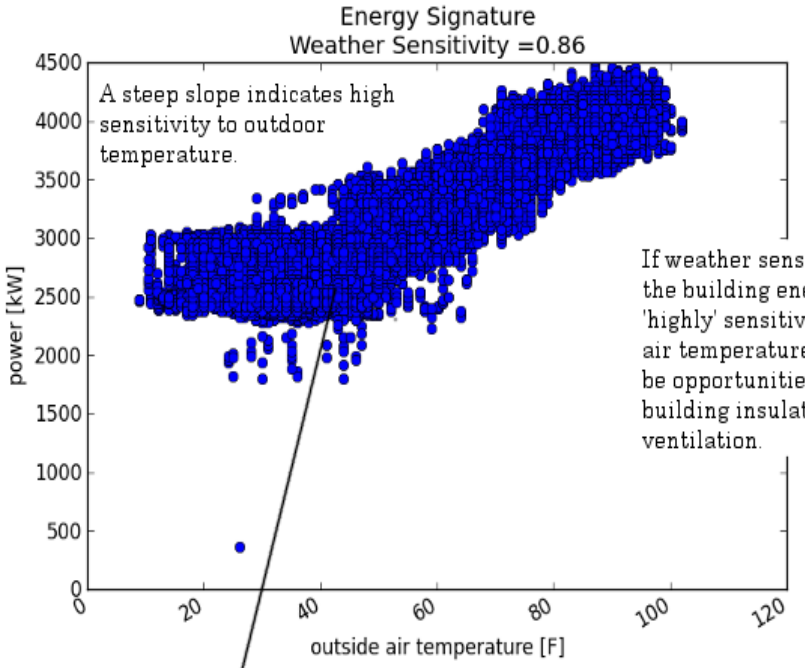

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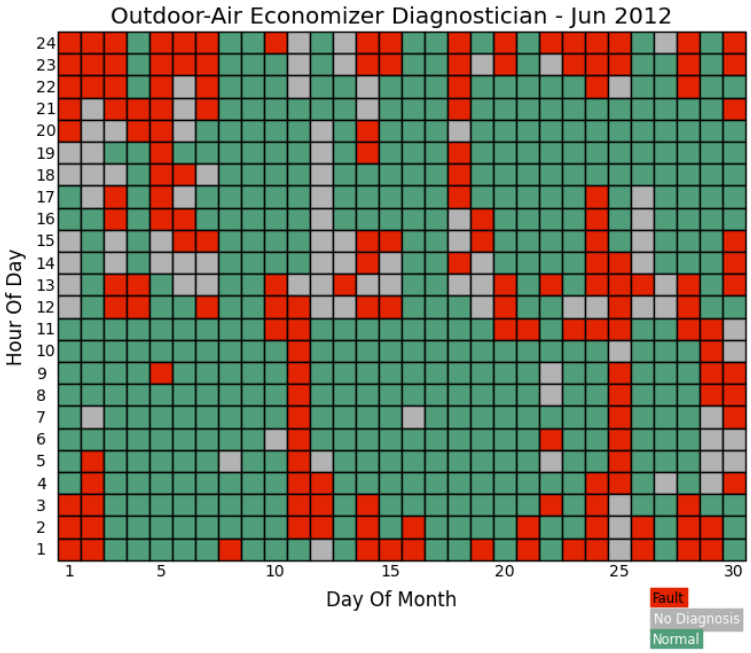
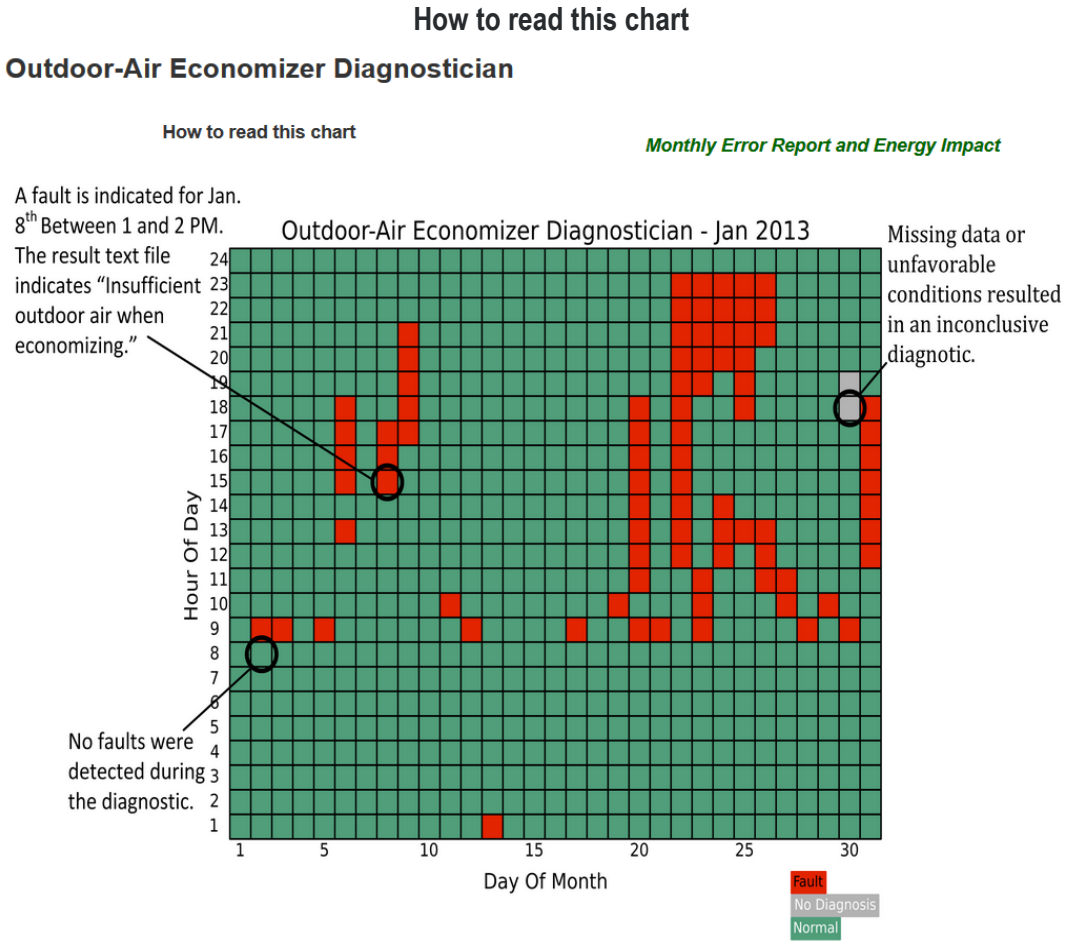




Progress and Accomplishments

Market Impact:

- Increased adoption of analytics with proven market value
- Expansion of efficiency services into small commercial sector
- Common platform to transfer lab-developed algorithms to industry

1. Beta testing with early adopters planned for Fall 2014
2. Download and platform usage information of v1 upon release
3. Efforts to ensure/accelerate impact = DOE in discussion with potential early adopters

Awards/Recognition: N/a

Project Integration and Collaboration

Project Integration: Extensive industry engagement to raise awareness, inform platform design and ensure delivery of high-impact algorithms; BTO project lead in communication with potential early adopters

Partners, Subcontractors, and Collaborators:
Navigant Consulting Inc, workshop support, led SRS development
Pacific Northwest National Laboratory, workshop and SRS input, v1 platform design specs and build-out
Industry, early input on key v1 algorithms, functionality, and supported data types/formats

Communications: Proposed Session for ASHRAE Summer Conference, OpenEIS, Green Button, OpenADR – open platforms, protocols, and communication systems, platforms for enhanced operations and control

Next Steps and Future Plans

June:

First set of algorithms ported from reference code onto OpenEIS platform

August:

Pre-release alpha versions completed, cloud and stand-alone implementations

September:

Initiate user-level testing of alpha versions

October:

V1.0 open source release

REFERENCE SLIDES

Project Budget

Project Budget: $1,555K

Variances: None

Cost to Date: $855K, through April 2014

Additional Funding: N/A

Budget History

November 2012 – FY2013 (past)		FY2014 (current)		FY2015 (planned)	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
$555K	$0K	$1,000 K		TBD	

Project Plan and Schedule

Project original initiation date & project planned completion date

- Project kicked off in FY2013
- Planned completion is Q1 FY2015

Schedule and Milestones

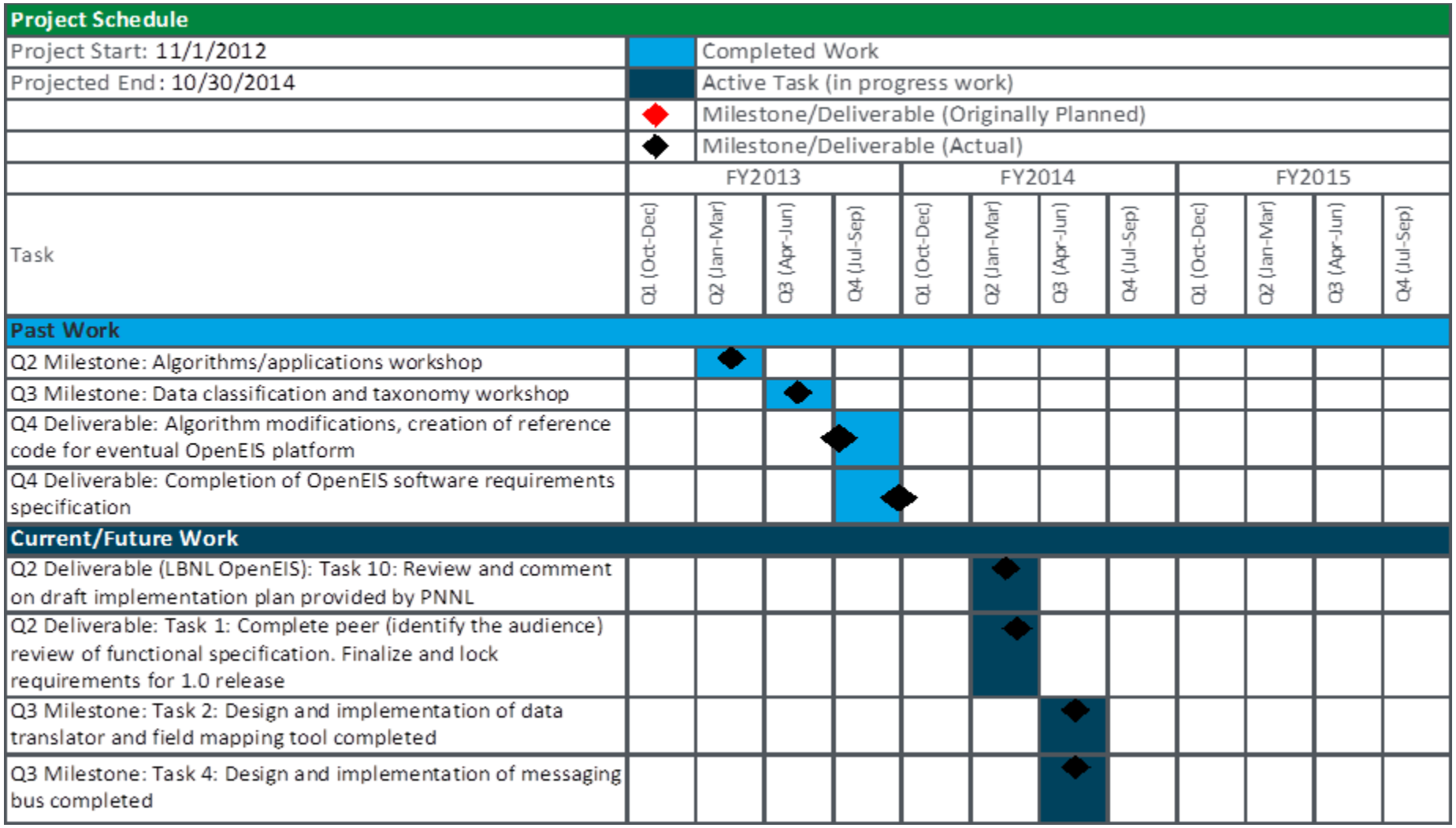
- All FY2013 deliverables and milestones have been completed
- Work is underway on the FY2014 scope

No slipped milestones or slips in schedule

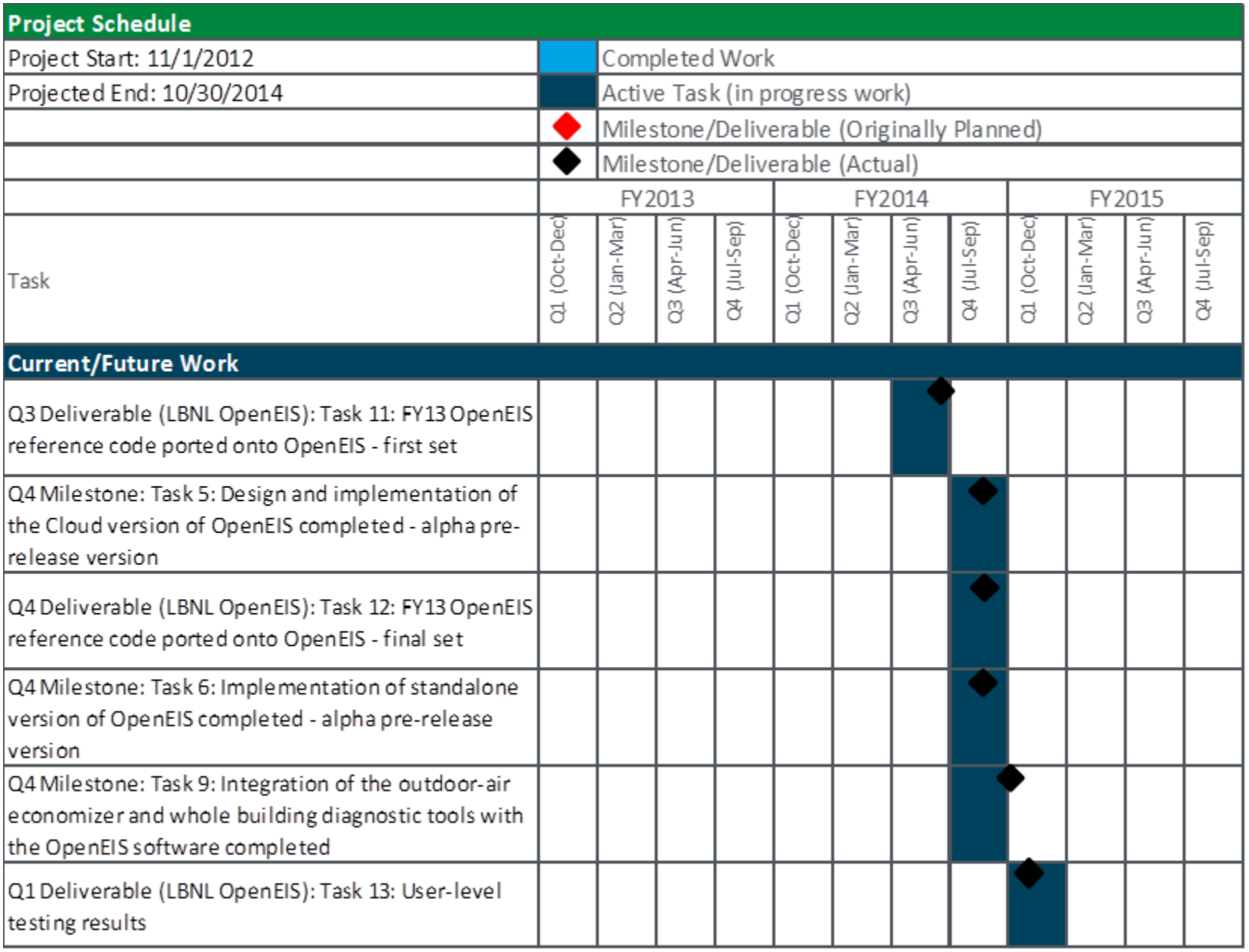
Go/no-go decision points, not applicable

Past, current, and future work described in Gantt charts on following slides

Project Plan and Schedule



Project Plan and Schedule



Project Plan and Schedule

Project Start: 11/1/2012		Completed Work											
Projected End: 10/30/2014		Active Task (in progress work)											
		Milestone/Deliverable (Originally Planned)											
		Milestone/Deliverable (Actual)											
	FY2013				FY2014				FY2015				
Task	Q1 (Oct-Dec)	Q2 (Jan-Mar)	Q3 (Apr-Jun)	Q4 (Jul-Sep)	Q1 (Oct-Dec)	Q2 (Jan-Mar)	Q3 (Apr-Jun)	Q4 (Jul-Sep)	Q1 (Oct-Dec)	Q2 (Jan-Mar)	Q3 (Apr-Jun)	Q4 (Jul-Sep)	
Current/Future Work													
Q1 Milestone: Task 7: Test, validate and refine OpenEIS thru limited deployment completed									◆				
Q1 Deliverable: Task 8: Deliver documentation and training materical, including recorded webinars on how to install OpenEIS, how to use OpenEIS and how to develop applications in OpenEIS									◆				