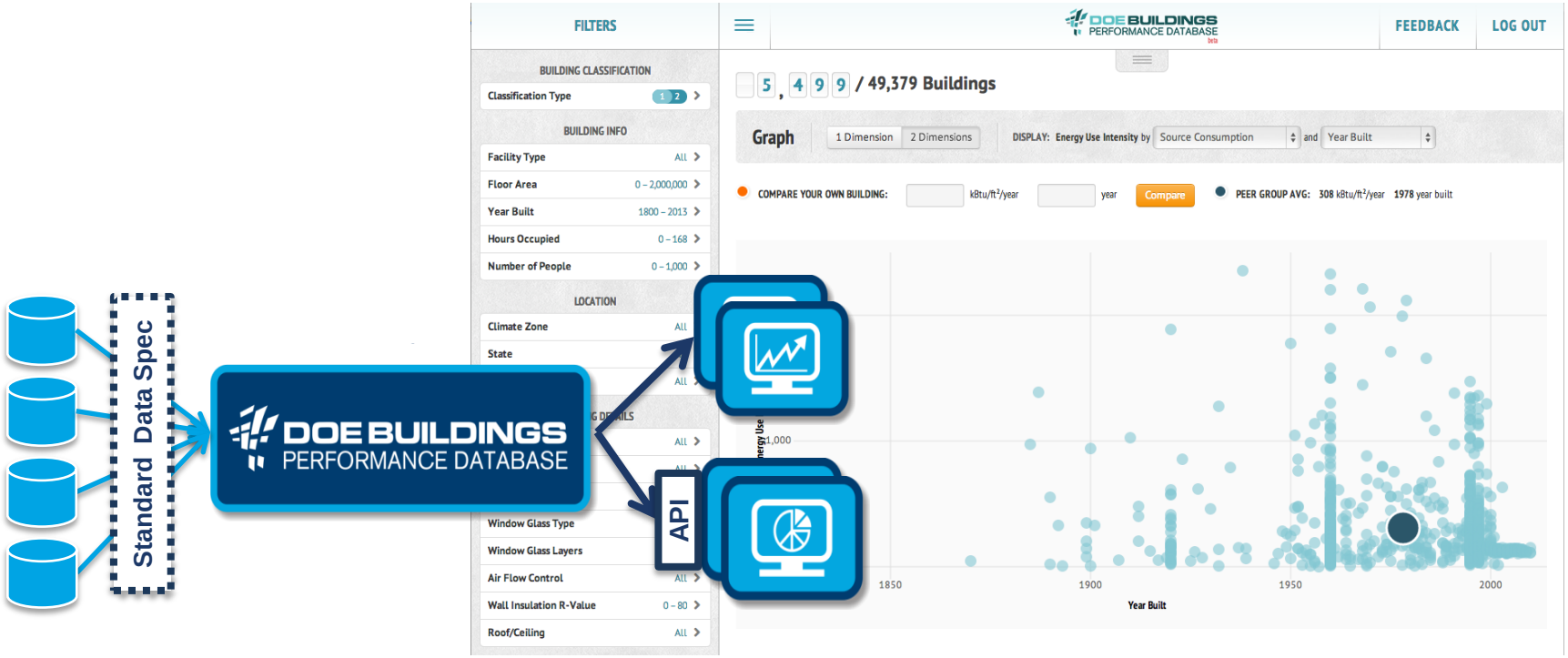
U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy



DOE Buildings Performance Database

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Purpose & Objectives

Problem Statement:

- Large-scale high-quality empirical data on building energy performance is critical to support decision-making and increase confidence in energy efficiency investments.

- While there are a many potential sources for such data, they:
  - are dispersed and not easily obtainable;
  - do not have a common data definitions;
  - vary widely in scope, formats and data quality.

Purpose & Objectives

Building Owners & Managers, Service Providers

Assess opportunities	• Identify high or low performing buildings, and identify improvements that will likely have a significant savings impact
Understand performance risk	• Analyze the range of likely returns from an investment
Evaluate investment performance	• Compare efficiency project performance to similar projects

DOE BUILDINGS PERFORMANCE DATABASE
FUELING INVESTMENT IN ENERGY EFFICIENCY

Purpose & Objectives

Federal, State & Local Governments

Assess opportunities	• Identify high or low performing buildings, and identify improvements that will likely have a significant savings impact
Understand performance risk	• Analyze the range of likely returns from an investment
Evaluate investment performance	• Compare efficiency project performance to similar projects
Influence local real estate markets	• Enable public access to general statistical information about buildings, without sharing building-level information

DOE BUILDINGS PERFORMANCE DATABASE
FUELING INVESTMENT IN ENERGY EFFICIENCY

Purpose & Objectives

Energy Efficiency Program Administrators

Help participants assess opportunities	• Help building owners, managers, and contractors identify improvements that will likely have a significant savings impact
Target program design	• Identify buildings and efficiency measures with the greatest savings potential
Support M&V	• Optimize M&V requirements based on measured savings uncertainty and persistence

DOE BUILDINGS PERFORMANCE DATABASE
FUELING INVESTMENT IN ENERGY EFFICIENCY

Purpose & Objectives

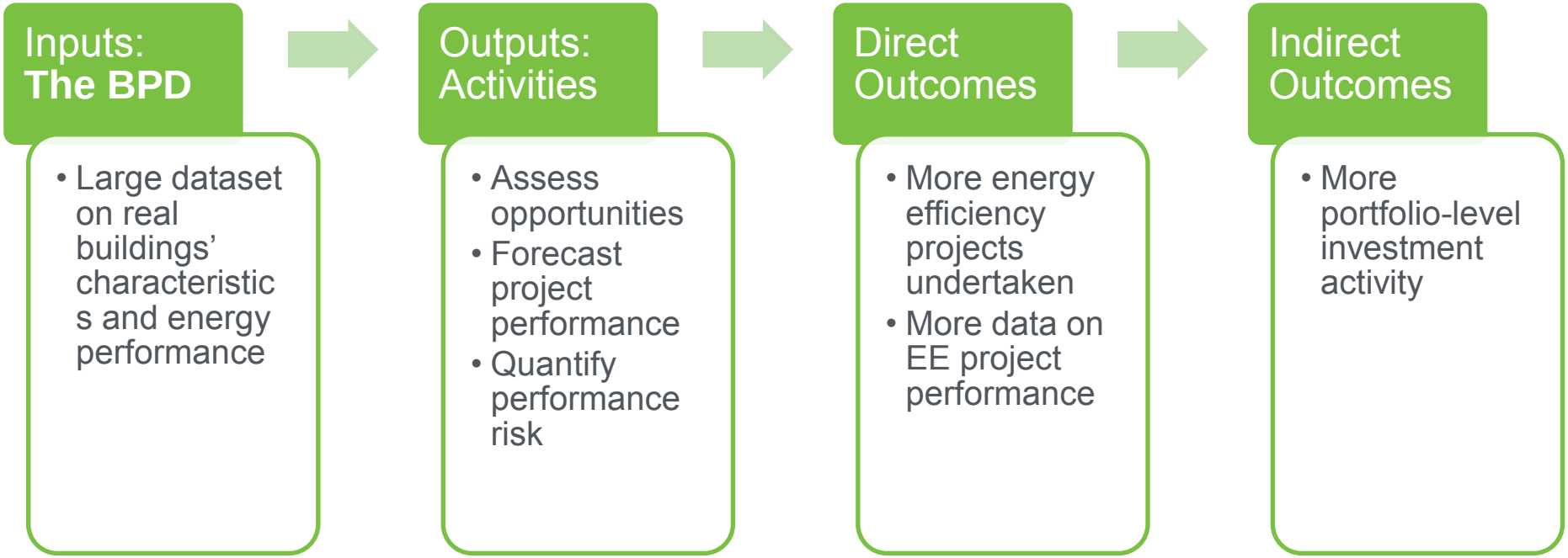
Lenders and Investors

Assess opportunities	• Identify high or low performing buildings, and identify improvements that will likely have a significant savings impact
Increase confidence in returns	• Analyze actual building performance (as opposed to modeled or predicted performance)
Conduct performance risk analysis	• Quantitatively distinguish between expected returns and performance risk
Support portfolio-level investment strategy	• Diversify risk by investing in a range of buildings and measures

DOE BUILDINGS PERFORMANCE DATABASE
FUELING INVESTMENT IN ENERGY EFFICIENCY

Impacts

The BPD can analyze trends in the energy performance and physical and operational characteristics of commercial and residential buildings.



Impacts

- The target market is all commercial and residential buildings.
- The BPD is an enabling technology that provides information to support energy efficiency investment decision-making.

- *If we assume that information from the BPD enables an additional 5% of investments to be made, increasing the floor area retrofit by 5% in the residential and commercial sectors, the annual energy savings attributable to BPD would amount to about 20 trillion Btu site energy savings.*

Purpose & Objectives

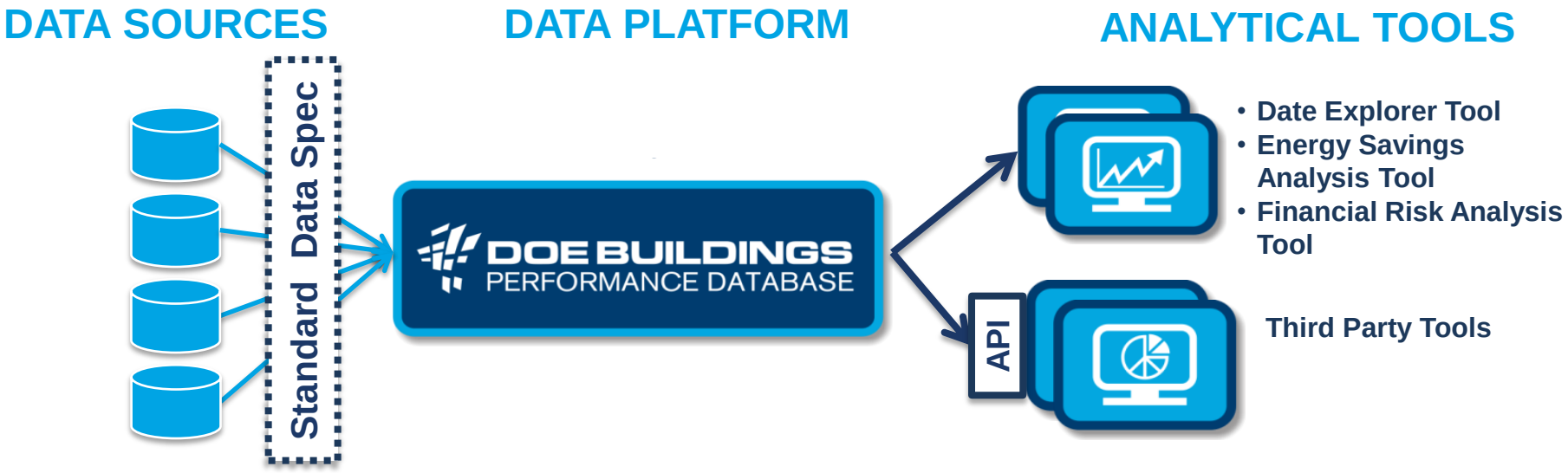
Alignment with EERE and BTO goals

- BPD is a key component of the DOE and White House Energy Data Initiative.

- BPD directly addresses three strategies identified in the BTO multi-year plan:
  - Increase transparency of energy use by allowing comparisons of energy efficiency between buildings to encourage owner/occupier action and drive demand
  - Increase awareness among commercial building owners and operators of opportunities to cost-effectively save energy ...
  - Reduce investment risk to increase financing for commercial retrofits

Approach

- The BPD contains data about the physical and operational characteristics and energy consumption of real buildings.
- The BPD enables statistical analysis without revealing information about individual buildings.
- The BPD cleanses and validates data from many sources and translates it into the standard data spec.
- In addition to the BPD's analysis tools, an API will enable third parties to create applications using the database.



Approach – Key Issues

- Data acquisition, mapping & cleansing
  - Identify and acquire large datasets that include actual energy use and characteristics data; Provide incentives for data providers and address any legal concerns;
  - Mapping rules to transform source data to standard data spec;
  - Data cleansing protocol, including out-of-range and in-range checks for each data field and record.

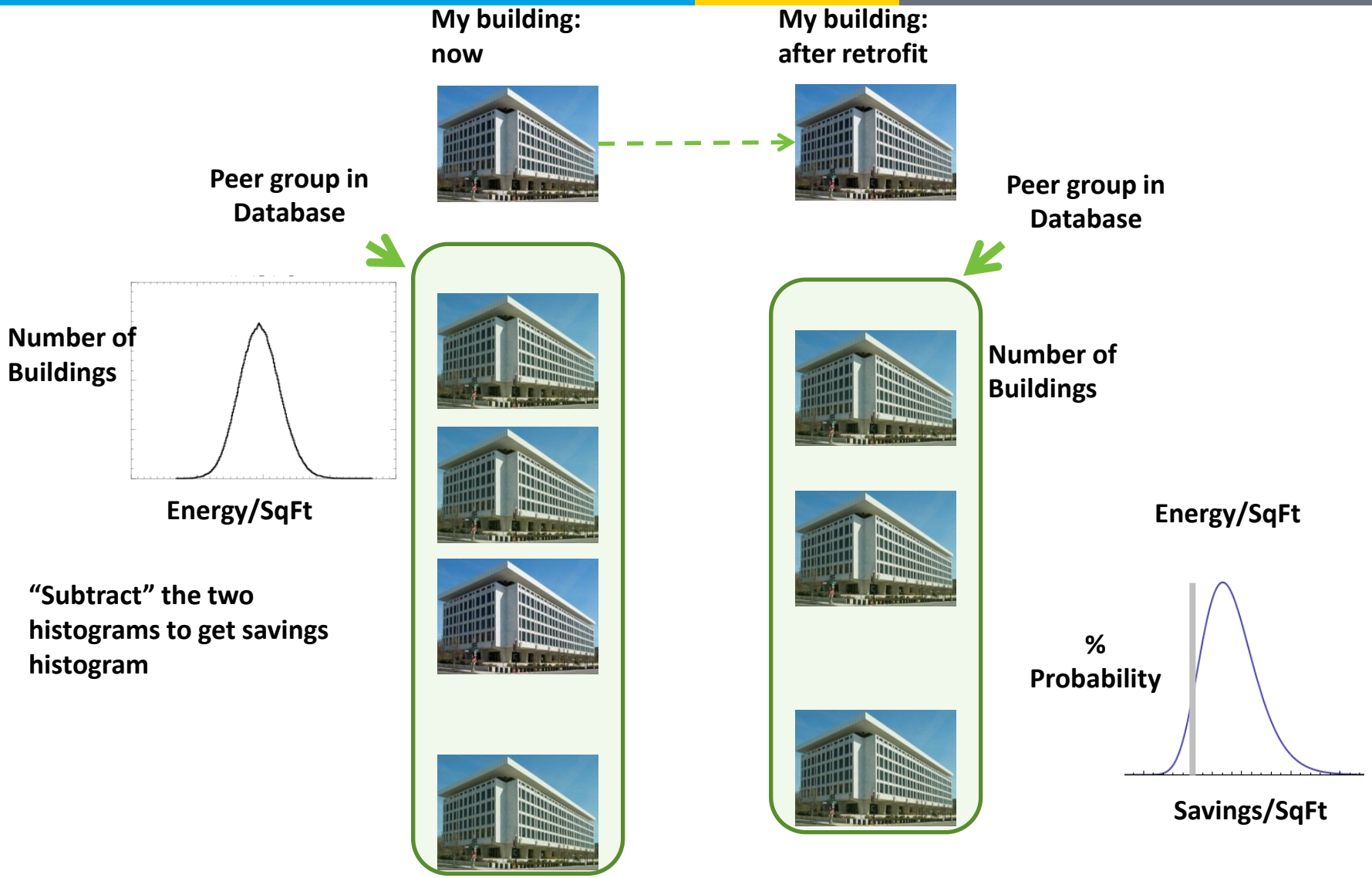
- Standard data specification
  - Must be flexible enough to accommodate a wide range of current and anticipated analysis use cases;
  - Must support a wide range of existing data sources while anticipating future richer datasets.

Approach – Key Issues

- Data platform
  - Software solutions suited to building performance data – relational and time series.
  - “Agile” development approach to accommodate changing data spec, new tools.
  - API for third party tools.

- Tools
  - Develop and evaluate various algorithms suited to building energy analysis use cases and data.
  - Develop a basic set of tools to explore data and analyze energy performance of efficiency measures.
  - Encourage development of third party tools via API.

"Actuarial" Method for Retrofit Savings Analysis



Approach – Project Management

Initial effort (Jan 2011 – Sep 2012)

- Booz Allen Hamilton – overall project management and software implementation.
- National labs (ANL, LBNL, NREL, PNNL) – technical approach, methods, data.

Current effort (Oct 2012 – Sep 2013)

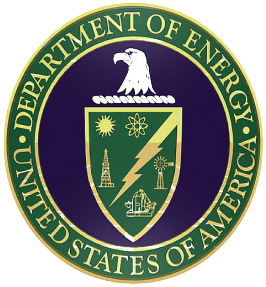
- LBNL is primary performer
  - Software implementation by BuildingEnergy (sub contractor to LBNL).
  - Support from PNNL for analysis methods.

Accomplishments - Highlights

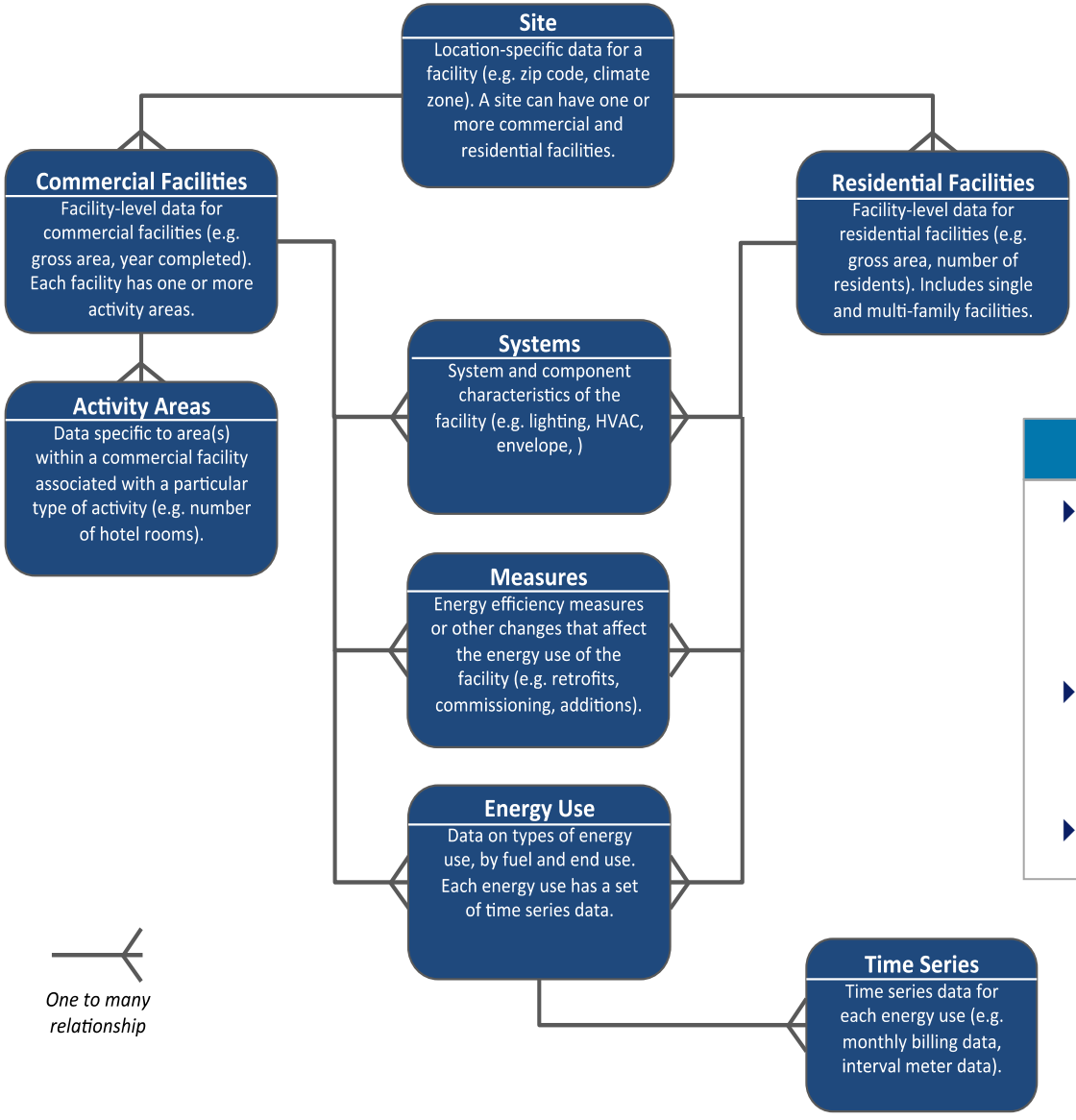
- *Data acquisition*
- *Data exchange specification*
- *Software implementation*
  - *Beta*
  - *Version 1*

BPD's Current Data Sources

- Acquired more than 70,000 buildings from 18 public and private sector data sources (as of March 20, 2013).
  - Data continually being mapped, cleansed and imported into BPD.
  - System level data (lighting type, HVAC efficiency, etc.) more limited.
  - Active outreach to more than 30 additional data sources



Data Exchange Specification



Key Characteristics

- *Overall scheme consists of 8 major entities with data fields for building and system characteristics, efficiency measures and energy use*
- *Data fields prioritized into three levels: Priority 1 (~100 fields), Priority 2 (~200 fields), Supplementary (~180 fields).*
- *Available as XML Schema Definition*

Review and Mapping of Related Data Specs and Taxonomies

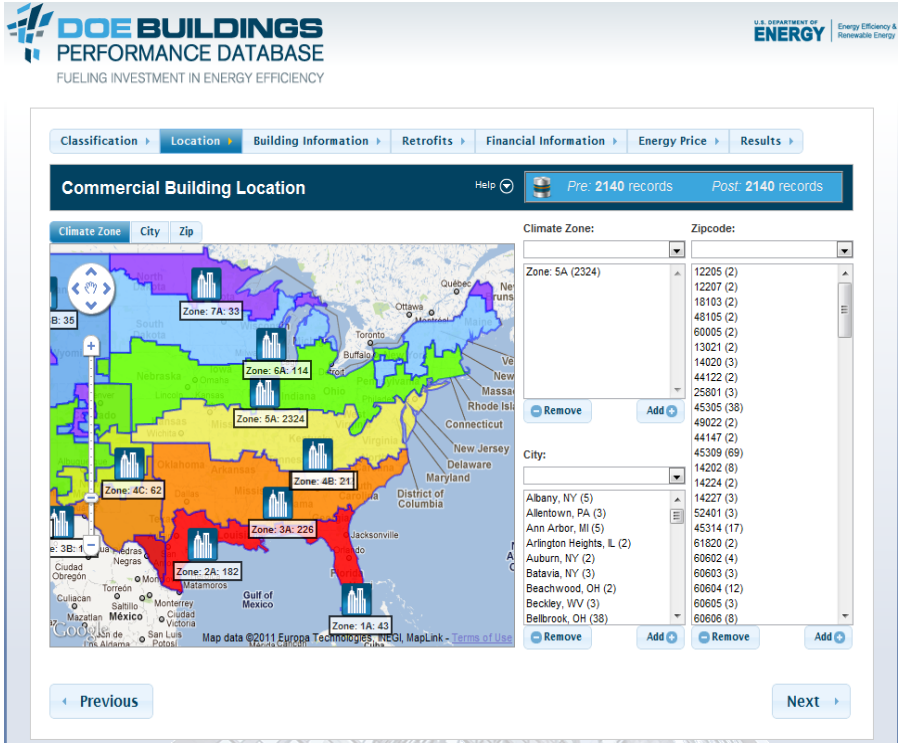
Several related data specs /taxonomies were reviewed and mapped to BPD data spec.

ASHRAE Audit procedures
ASTM BEPA
GRI Reporting Protocols
SkyFoundry Haystack
Home Energy Saver
HPXML
HVAC Data Model
IEP
Industry Foundation Classes
ISO Standard 12655
NAESB PAP10
Omniclass
OpenADE
…

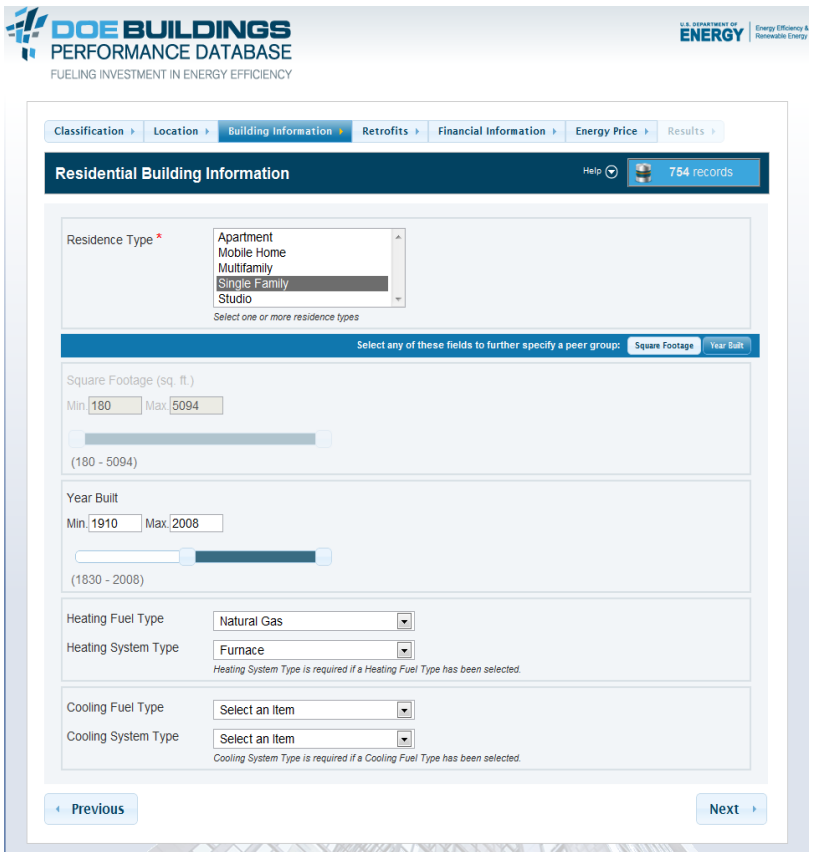
How do these vary?

1. Overall scope.
   e.g. Is water use, IEQ data included?
2. How a feature is defined.
   e.g. qualitative vs. quantitative description of air tightness
3. Classification of building system types.
   e.g. types of heat pumps
4. Granularity.
   e.g. multiple lighting types in each space vs. predominant lighting type for building.

Selecting a Comparison Dataset (location, size, use, equipment type,…)



Building Location



Building Characteristics

BPD Beta

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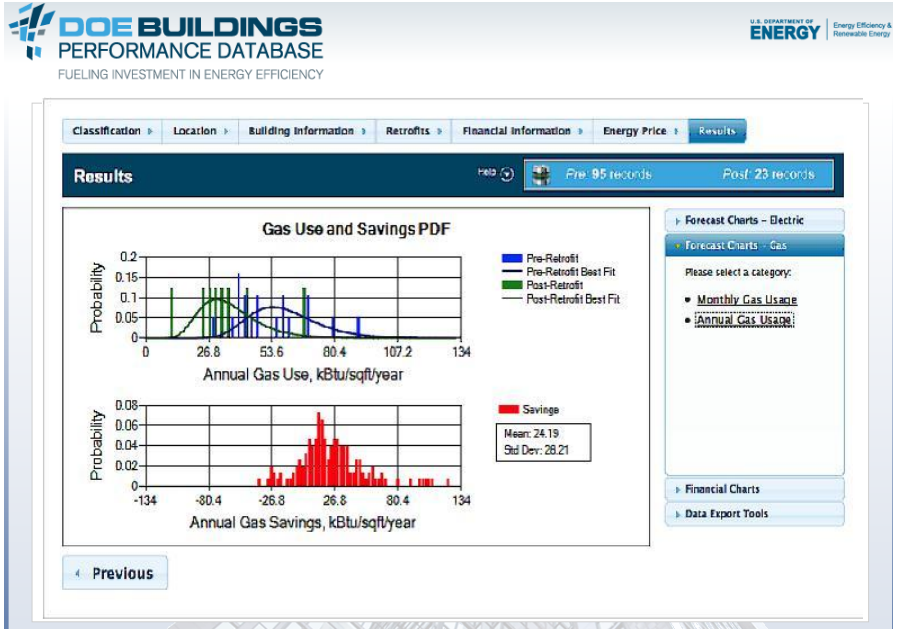
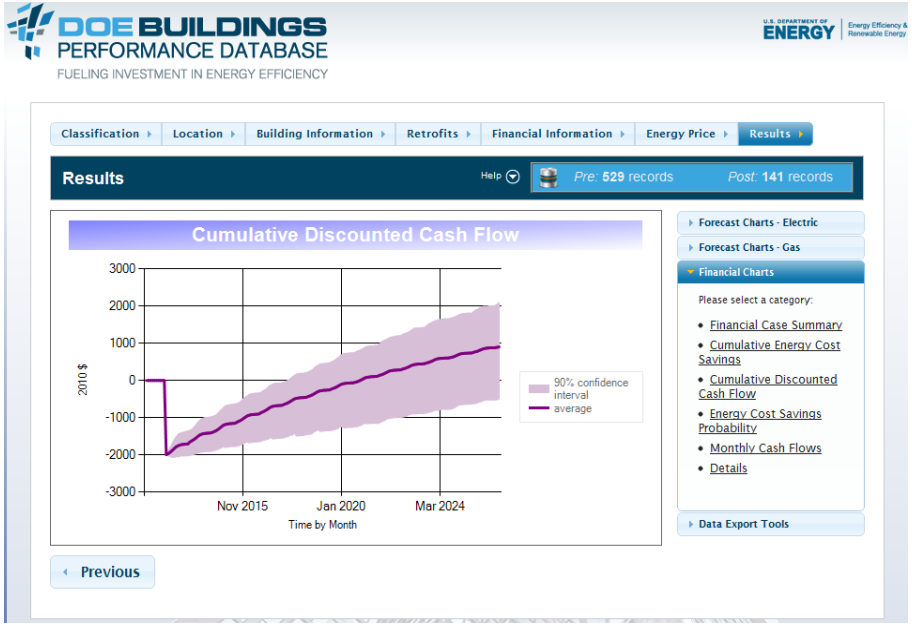
Analytical tools quantify energy use, financial performance, and risk





BPD Version 1: Data Explorer Tool

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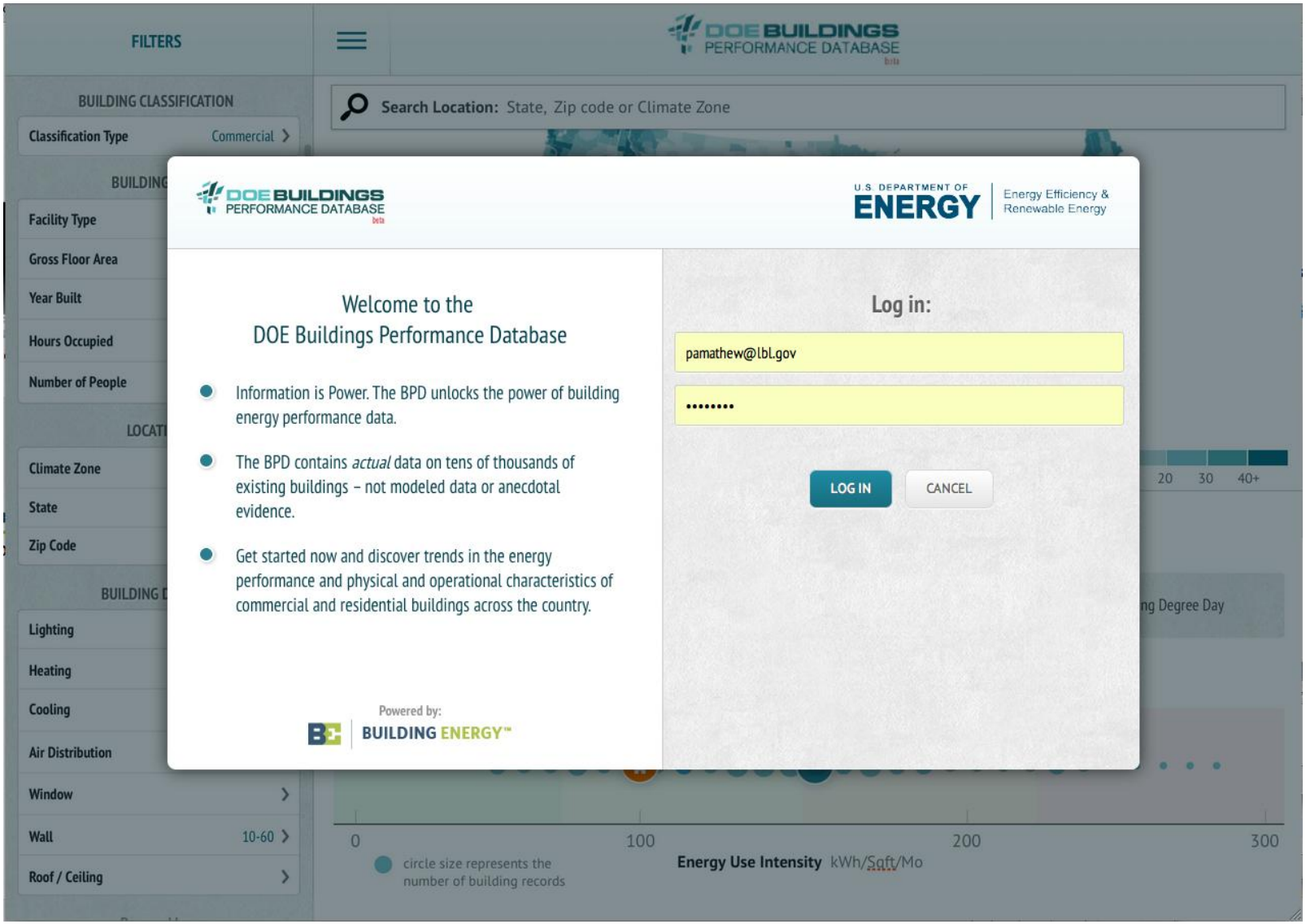

BPD Version 1: Data Explorer Tool

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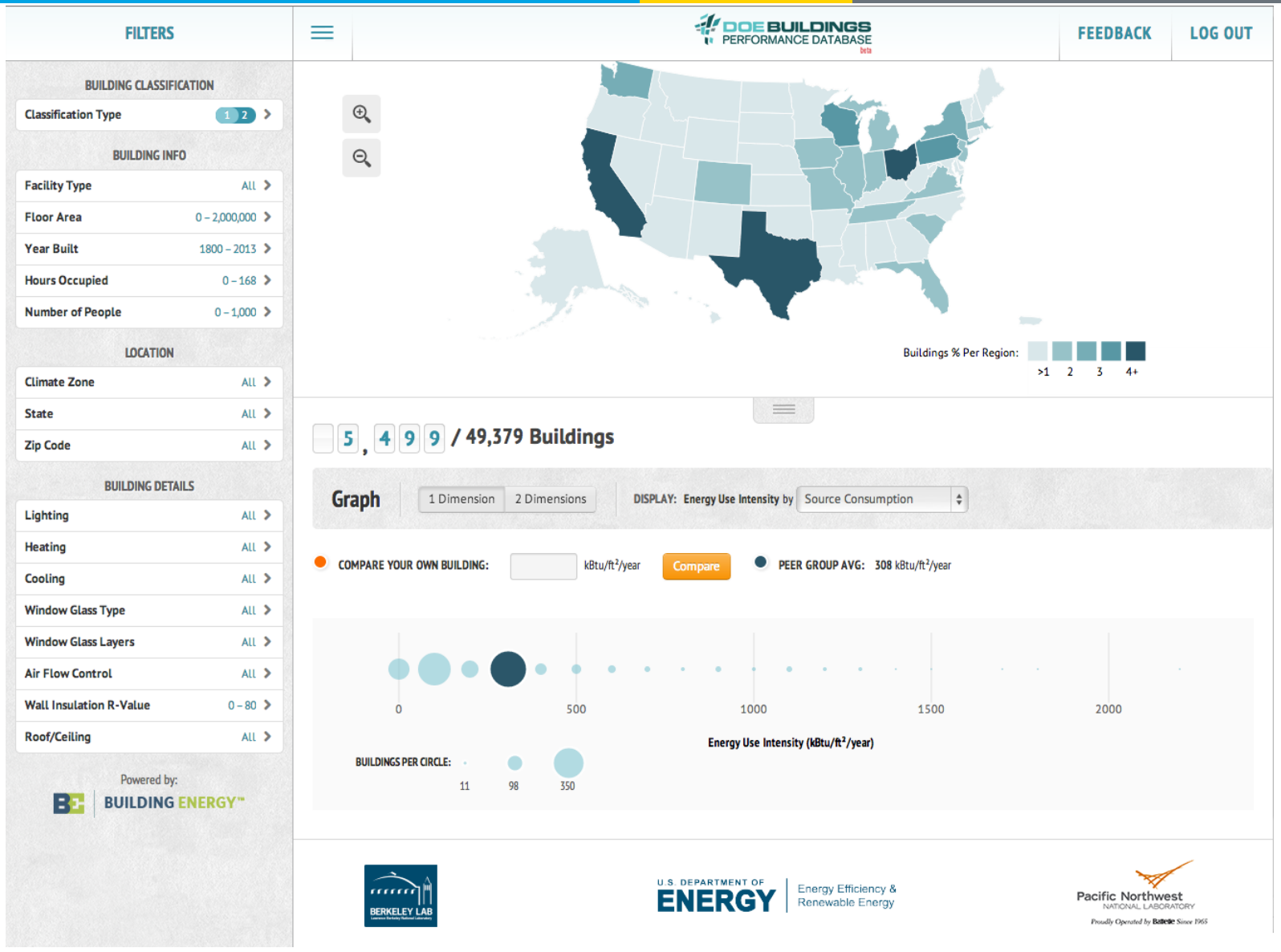

BPD Version 1: Data Explorer Tool

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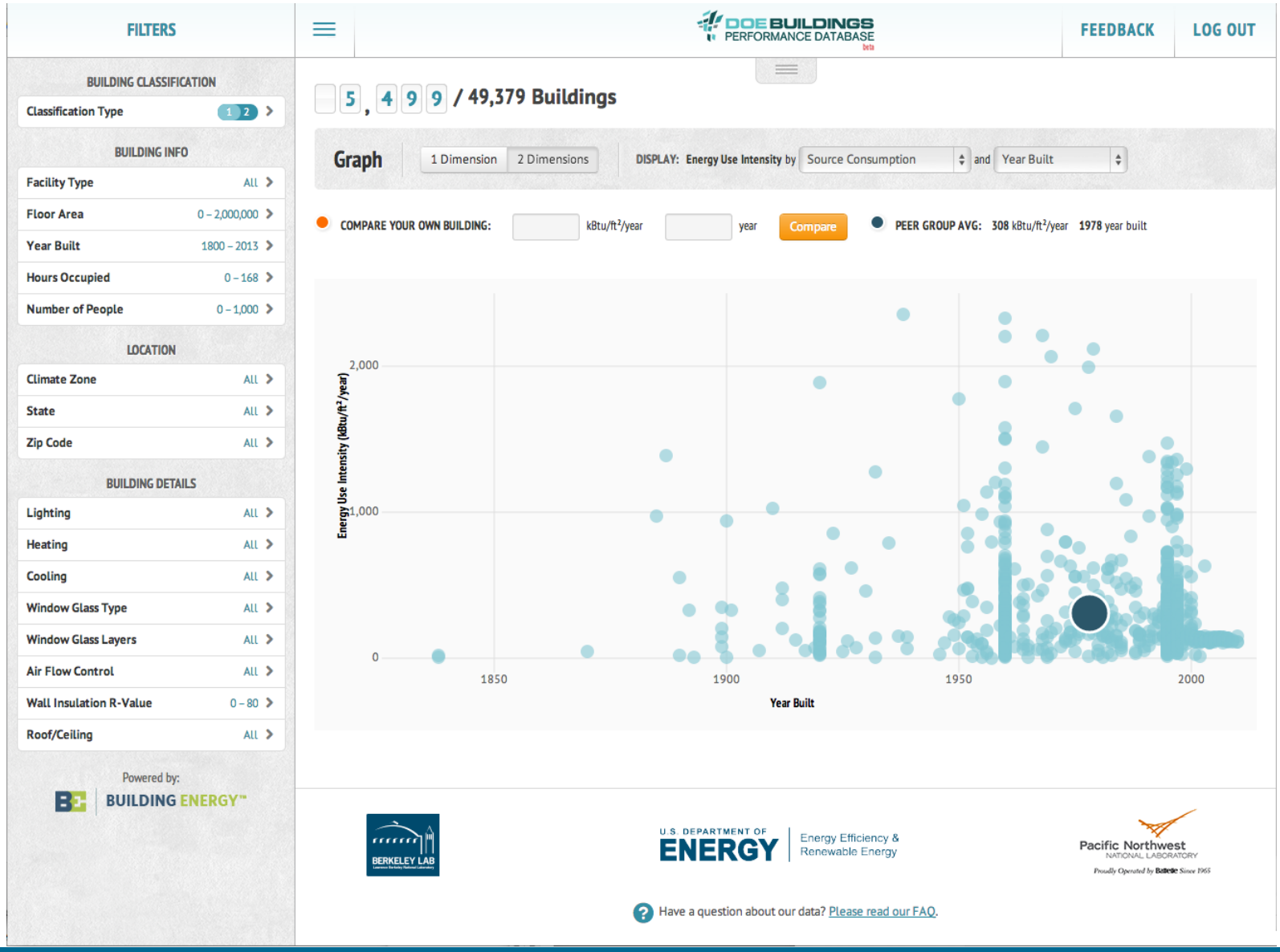
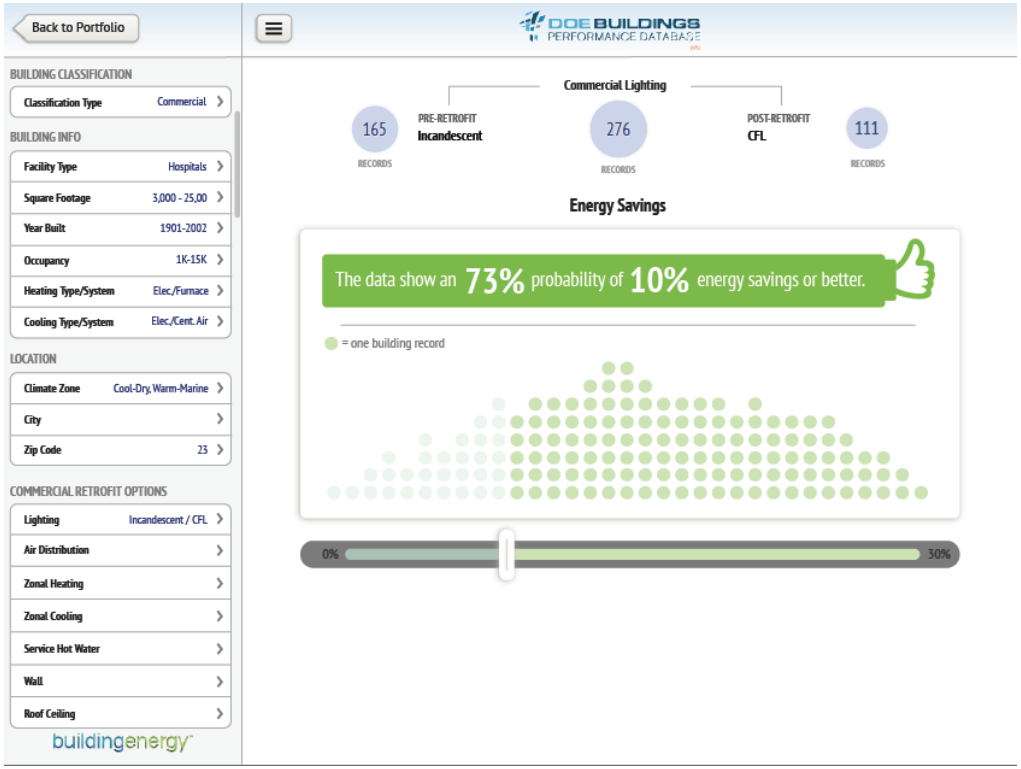


BPD Version 1: Retrofit tool (in development)

- Retrofit app will allow user to evaluate savings from various energy efficiency measures
- Tool features and designs were tested with potential users.
  - In-person interviews
- Currently being implemented.
  - Expected May 2013



Project Plan & Schedule (FY2013)

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ID	Deliverable	Due date	Status
Task 1: Acquire and map new data sources into the BPD			
LBNL-FY13-12-01	Updated data acquisition plan	11/1/2012	Completed
LBNL-FY13-12-02	Working list of data sources	ongoing	Regularly updated
LBNL-FY13-12-03	Acquisition, mapping and cleansing of at least 6 new data sources, with collective total of 200,000 buildings	9/30/2013	More than 6 acquired and mapped. On schedule.
Task 2: Software Development for BPD version 1			
LBNL-FY13-12-04	BPD version 1: - Data explorer tool - Retrofit analysis tool - Financial analysis tool	 2/15/13 4/30/13 7/31/13	 Completed Expected May 15. On schedule
Task 3: Support implementation of load-shape benchmarking algorithms			
LBNL-FY13-12-05	Load shape benchmarking (LSB) implementation	4/30/2013	On schedule. Click through version completed
LBNL-FY13-12-06	Convene LSB industry technical advisory committee and compile summary report	6/30/2013	On schedule
LBNL-FY13-12-07	Reference dataset for LSB	7/31/2013	On schedule

Project Plan & Schedule (FY2013)

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

ID	Deliverable	Due date	Status
Task 4: Development of enhanced actuarial analysis approaches			
LBNL-FY13-12-08	Documentation of actuarial analysis methods, their application use cases with examples using BPD data	3/30/2013	On schedule
LBNL-FY13-12-09	Software specification for actuarial analysis approaches selected to be implemented in BPD tools	4/30/2013	On schedule
Task 5: Development of Standard Building Energy Performance Data Specification			
LBNL-FY13-12-10	At least two revisions in XML format and natural language documentation	6/30/13 9/30/13	Updated version released 2/15/13. On schedule
LBNL-FY13-12-11	Stakeholder assessment including the following: interview questions, assessment report, options for finalizing data specs, Implementation plan.	4/30/13	On schedule

Project Budget

Project Budget: $1,005K (FY13)

Variances: 55K added Jan 2013 for conducting data spec stakeholder review.

Cost to Date: 288K spent (29%) as of Feb 28, 2012.

Additional Funding: N/A

Budget History (LBNL)					
FY2010		FY2011		FY2012	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
$0	$0	$264	$0	$343K	$0

Project Integration, Collaboration & Market Impact

Partners, Subcontractors, and Collaborators:

- BuildingEnergy is software implementation partner.
- PNNL supports analysis methods.
- ~200 stakeholders engaged in BPD development as advisors, data providers, and beta testers

Technology Transfer, Deployment, Market Impact:

- "Soft launch" approach – users invited in phases.
- Over 400 on pending request list (as of 3/20/13)

Communications:

Presentations at ASHRAE Conference, Better Buildings Alliance meetings, Consortium for Energy Efficiency, EE Finance Forums, Regional Energy Efficiency Orgs, SEED user group, White House CEQ.

Future plans: An iterative strategy for taking the BPD to scale

- Use data and tools available today to demonstrate the value of empirical building energy performance data.
- As stakeholders begin to collect and contribute richer data, the BPD will be able to conduct more advanced analyses.
- Promote standard data spec to facilitate data collection and aggregation at scale.

Short term	- Basic building data - Monthly energy consumption data	- Compare similar buildings - Identify high/low performers
Long term	- Asset and equipment data - Interval meter data	- Statistical analyses of likely retrofit performance