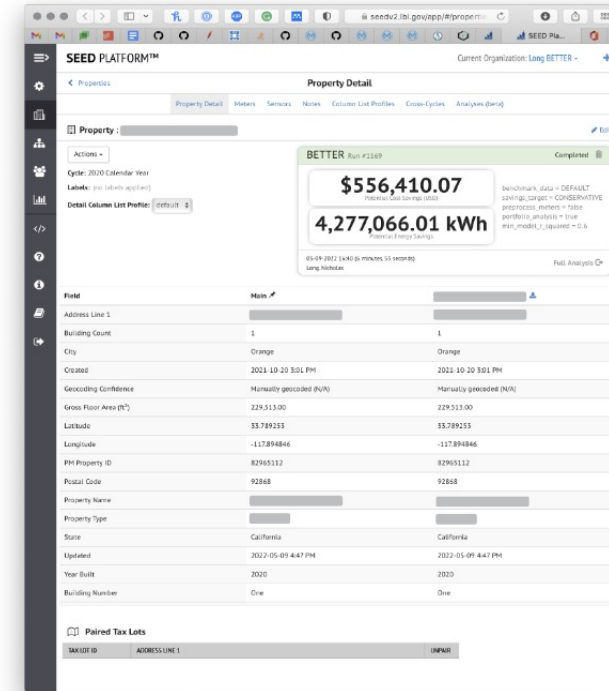# SEED Platform

NREL / LBNL
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WBS #: 2.5.2.04

Project Summary

Objective and outcome

The objective of the SEED Platform is to help lower the burden on cities implementing energy programs by streamlining the process of collecting and managing data from large groups of buildings. The software identifies which buildings must comply with a jurisdiction's program, organizes and cleans the data that comes in, and interfaces with other programs to provide energy recommendations to building owners and decision makers.

Team and Partners

Core team

    NREL, LBNL, and Dept Agency

Key Partners

    Earth Advantage / Green Building Registry

    NEEP / Clearly Energy / HELIX

    OPEN Technologies / Grid

Stats

Performance Period: (LBNL 2014 – 2017)
    (NREL start 2017, reviewing 2022 – 2023)
DOE budget: FY22 $762K, FY23 $1,225K, Cost Share: >$250K
Milestone 1: Update SEED to include tracking of building upgrades, measures implemented and history of building changes.
Milestone 2: Native Salesforce integration into SEED (currently an outdated 3rd party library enables the workflow)
Milestone 3: Integrate UBID service into SEED for matching records and update the matching functionality in SEED.

Problem

Many cities are passing benchmarking and building performance standards (**BPS**) to achieve the reduction of onsite energy use intensity in buildings by 30% and carbon emissions by 25% by 2035. The National Building Performance Standards Coalition represents about a quarter of all the buildings in the United States (~1.5 million commercial buildings + multifamily).

Many of these jurisdictions and communities do not have sufficient resources (time and money) to track their buildings in a consistent, robust, and equitable manner. To help reduce the cost of implementation, the SEED Platform was created to manage portfolios of building characteristic and energy data.

> "Impact from building and operational improvements … $124 billion cumulatively invested in building retrofits in coalition jurisdictions through 2040."
> – IMT, National BPS Coalition

Alignment, Impact, and Outcome

SEED is an enabling software platform for tracking energy and carbon. SEED also helps communities track building-related programs such as benchmarking and helps ensure program success.

Success is measurable reduction in energy and carbon over time. The SEED Platform tracks these metrics and goals. Several cities use SEED directly and another dozen use SEED as the backend to their solutions.

Washington, DC has been using SEED since 2017 and their programs have shown a steady decrease in energy and carbon. Outcomes directly impact the energy and carbon goals.

All data are backed by SEED Platform

https://opendata.dc.gov/apps/dc-energy-benchmarking/explore
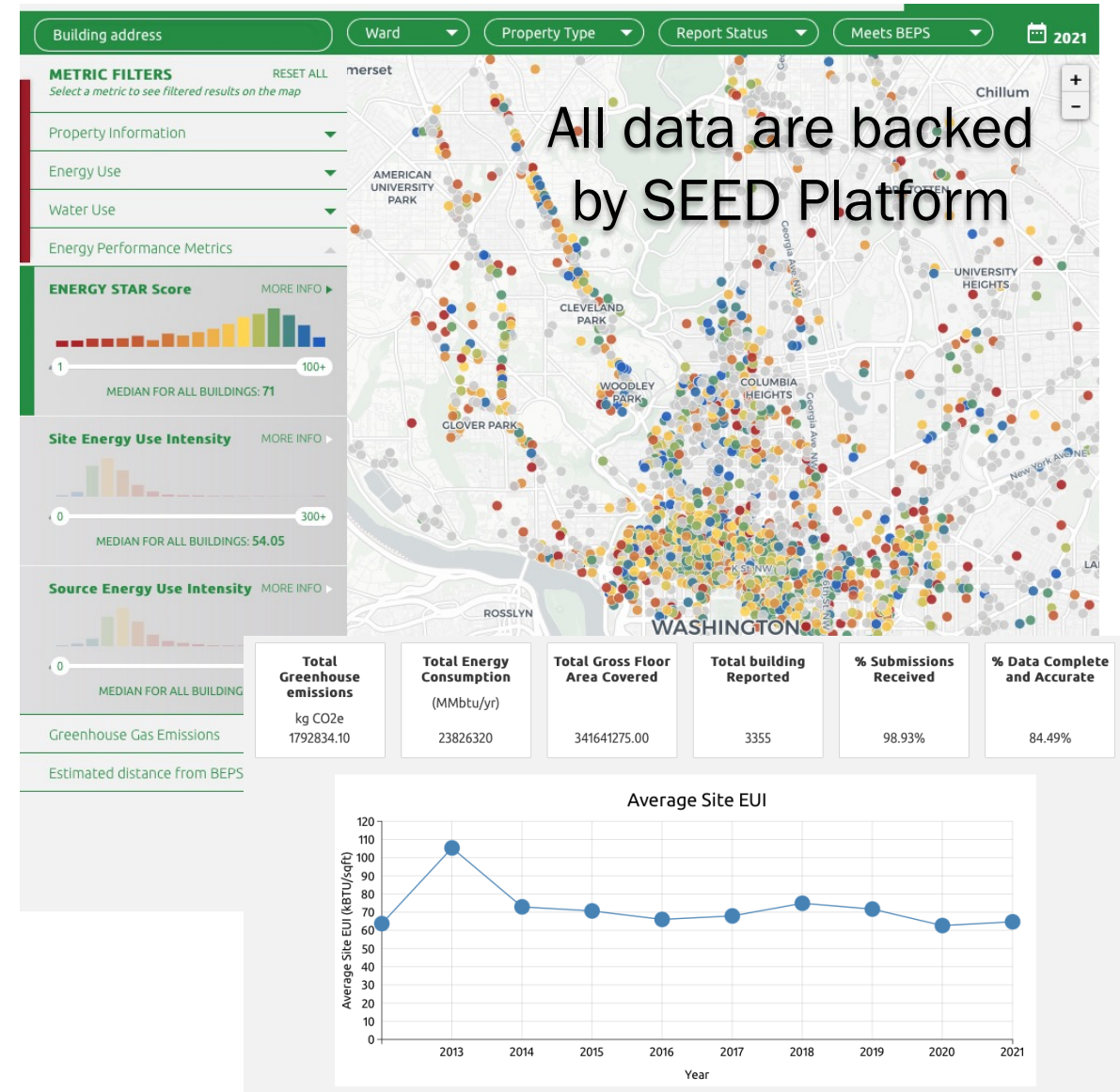
Alignment and Impact

25%
Reduction in time spent managing programs

500k Residential and commercial buildings in SEED

>15 Cities and organizations

~25% of U.S. ordinances use SEED or SEED-based

180 Registered users

"SEED is such a low-cost solution for a benchmarking program. Even when we paid to link it to Salesforce, it was still the lowest implementation cost of a benchmarking program that is effective and efficient."
— Ammon Raegan, City of Berkeley (previously San Francisco)

San Francisco Benchmarking

All data are backed by SEED Platform

770	279.2
# of Buildings	Average EUI (kBtu/sqft)
104,815,086	33.2
Total Floor Area	Median EUI (kBtu/sqft)
597,596	89
Total Emissions (Tons CO2)	Median ENERGY STAR Score

Energy Use Intensity for Consistently Complying Properties

Median EUI (kBtu/sqft): 49.0, 48.6, 48.5, 46.7, 44.2, 43.8, 35.9, 33.2 (2014–2021)

Additional Filters:
Square Footage Group: 10-25k | 25-50k | 50k+
Benchmark Year: 2021 | 2020 | 2019 | 2018

https://sfenvironment.org/energy/san-francisco-existing-buildings-performance-report

Impact and Overall Adoption

GHG emissions reductions
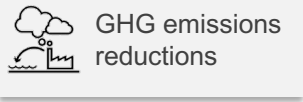
SEED and SEED-based Platform Adoption

Current (Known) Adoption

3 Benchmarking
13 BPS
2 Residential Programs
2 Analyses

Potential Adoption

24 Other communities in the process of piloting / evaluating the platform

Map of Benchmarking and BPS Jurisdictions

Benchmarking
BPS
Benchmarking and BPS
Using SEED or SEED-Based
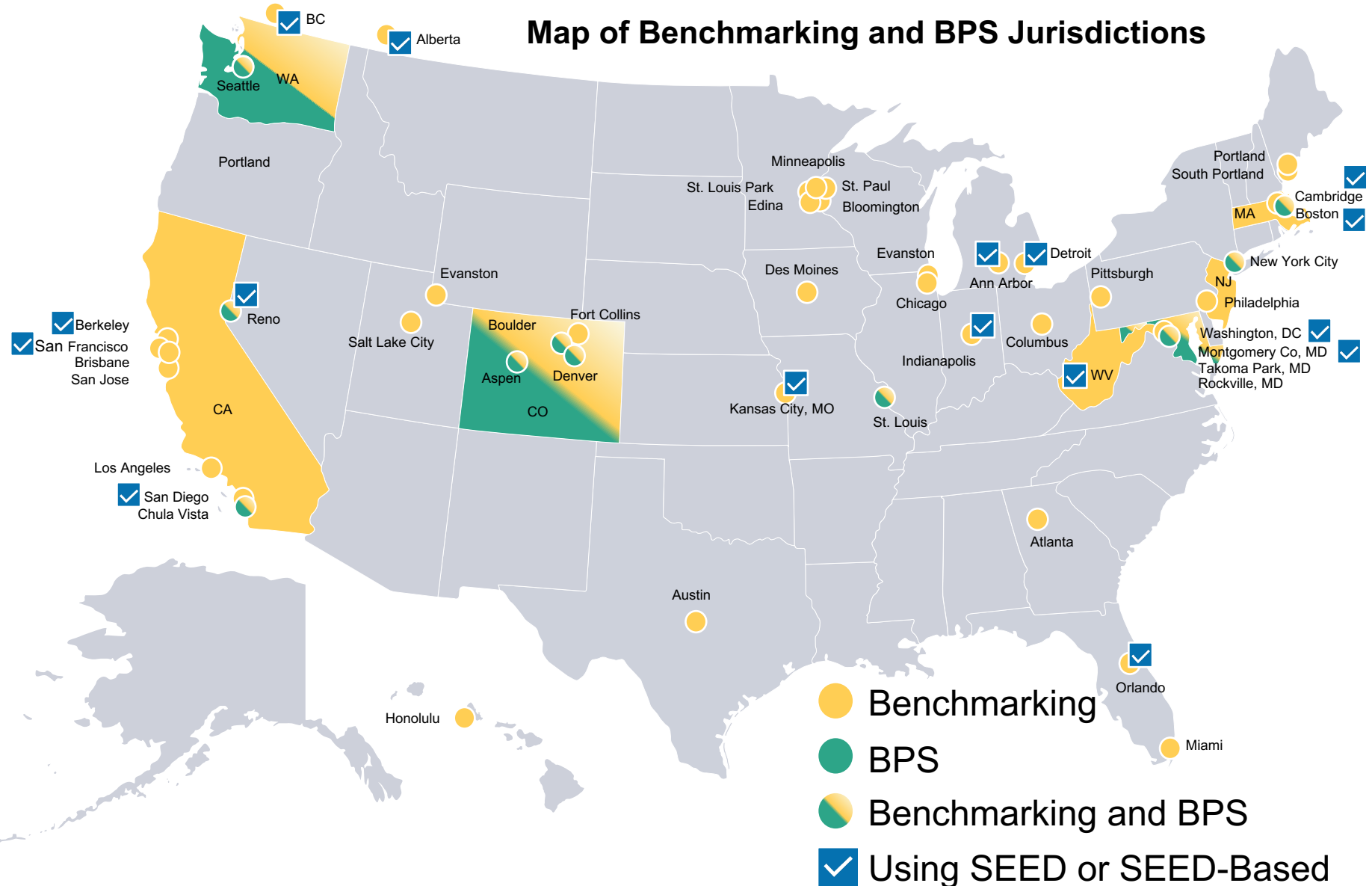
Approach

Current Approach

Many communities, jurisdictions, and cities are still managing data in Spreadsheets. This is a non-sustainable solution due to:

- Limited simultaneous access
- Limited data protection and user access controls
- Loss of functional knowledge upon staff turnover
- Lack of ability to easily integrate with other solutions
- Vendor lock-in

There are few commercial solutions. SEED has been integrated into a few other solutions to date.

> "In a program that deals so much in data, not having a competent data software program is unacceptable. SEED was the missing link we needed."
> – Andrew Held, Department of Energy and Environment, Washington, DC

SEED's Approach

Develop a platform that can be used as is (with core functionality) or extend to provide a comprehensive platform for managing building specific data. Core functionality includes:

- Handle the messiness of building data (properties and parcels/tax lots)
- Import data from various sources and map to known fields
- Automated data quality checks
- Automated merging, matching, and linking of data
- Web based with user access controls
- Visual reports for easy introspection

Approach – The Platform

SEED Platform as a Platform

- SEED has been adopted and extended by multiple entities. As an open-source project SEED has received bug fixes and features from several organizations!

- As Benchmarking and Building Performance Standards (BPS) scales at a national and international level, SEED must also scale. Develop a platform that many types of users can adopt!

- Data privacy, security, and overall usability are important and SEED adopts best practice security protocols.
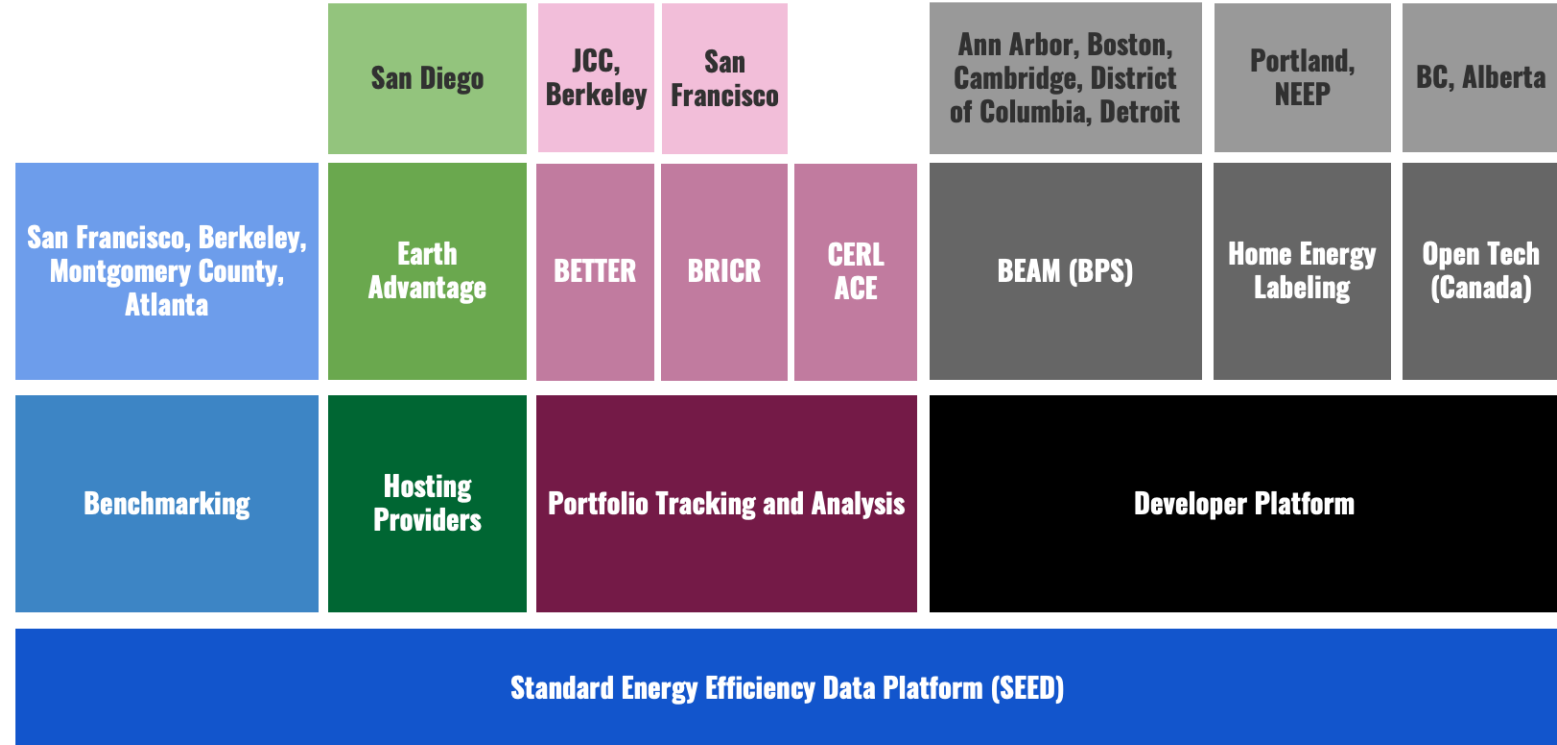
Adoption

Image shows applications and programs built on top of SEED, for example, the bottom layer is SEED and it has support for Benchmarking programs but also Hosting Providers.

Approach – Data Flow

Property Data:
Tax records, spreadsheets

Performance Data:
ESPM, Utility Data

ENERGY STAR® Portfolio Manager®

hpxml
data dictionary + transfer standard

BUILDING SYNC

BUILDING ENERGY AUDIT TEMPLATE
U.S. DEPARTMENT OF ENERGY

Other Audit Companies

SEED STANDARD ENERGY EFFICIENCY DATA **PLATFORM**™

SEED Matches Buildings to Parcels

Parcel 500 / Parcel 510 / Parcel 520 / Parcel 600 / Parcel 700 / Parcel 800

Imports Data

e.g., Building Characteristics

e.g., Tax Lot/Parcel Data

e.g., Meter Data

BPS Program Admins
Benchmarking Admins
Portfolio Owners
Building Analysts

BETTER BUILDING EFFICIENCY TARGETING TOOL FOR ENERGY RETROFITS

salesforce

BUILDING SYNC

OS

et EnergyPlus

Approach – Harmonizing Data

Barriers	Mitigation Strategies
Collecting building data is error prone, inconsistent, and sparse. Managing records over time is cumbersome.	Leverage data quality checks and visualizations to quickly find out of range errors. SEED leverages mapping profiles to save data in consistent formats.
Building addresses do not reliably identify the actual building.	Use UBID or City-defined unique identifiers, such as ESPM ID.
Many building records are tied to parcels/tax lots.	SEED is able to pair parcels/tax lots with properties in a many-to-many relationship.
Duplicate records.	Hashing method deployed to quickly identify which records are considered the same and the system automatically merges.
Cost of hosting.	The SEED Platform ships with a "plug-and-play" Amazon EKS configuration, ~$600/month per server.
Stability of integrated systems.	Continuous integration and nightly checks to ensure dependent systems are functional.
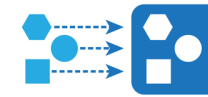
MAPPING
The mapping process maps the data into the known database column names in order to make a record

Data
Gross Floor Area   Address Line 1   Source EUI
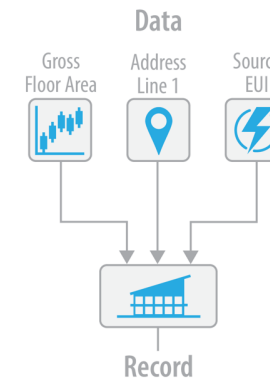
Record

MERGING
Merging refers to the act of combining exact matches of properties (or taxlots) into a single record

Properties   Tax Lots
Import 1   Import 1
Import 2   Import 2
Import 3   Import 3

1Record   1Record
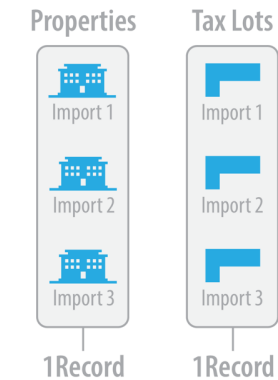
PAIRING
Pairing refers to the association between properties and tax lots within the same cycle

Taxlot A

Taxlot B

Progress – Program Tracking

- This FY we added the ability for users to define Energy and GHG Programs within SEED.

- Each organization can have multiple programs that span differing years/cycles.

- New visualizations were added to enable city managers to monitor progress and identify issues.

- Also, custom aggregation visualizations were added to help inspect data.

- Working on performance and improved visualization when datasets are large.

Progress – Intra-cycle Tracking

SEED traditionally works on 1-year cycles. There are cases where multiple building events (e.g., Building Audits) may occur within the cycle that need to be tracked, including:

- Proposed and actual Energy Conservation Measures (ECMs) implementation within a year and imported from Audit Template

- Notes applied

- Energy metrics updated

- Analyses ran ex-ante and ex-post interventions.

A "Timeline" view is being added to SEED to show a history of the building with respect to audit data, analyses, and notes.

Progress – Analysis Integration including BETTER

Exporting and analyzing SEED data with 3rd-party tools was improved with the addition of Analysis Pipelines

- This milestone added a framework for packaging SEED data and sending to an analysis engine to further "enrich" the data in SEED. The resulting analysis ends up as new columns within SEED.

- The initial integration was LBNL's Building Efficiency Targeting Tool for Energy Retrofits (BETTER).

Run Analysis (beta)

Name
BETTER Example

Type
BETTER

BETTER Analysis Inputs (Under active development)

Savings Target   Benchmark Data
NOMINAL   DEFAULT

Minimum Model R Squared   Preprocess Meters   Run Portfolio Analysis
0.6

Use All Meter Data   Select Meter Data Range

Create Analysis   Cancel

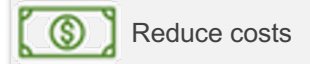**BETTER V1.0 Building Summary Report**
Barr Building
Generated at 2023-03-07

Overview

Building Type: **Office**	Gross Floor Area (m²): **10,693.5**
Building Location: **WASHINGTON, DC**	Closest Weather Station: **Station: 724050-13743 : Ronald Reagan Washington Natl Ap**
Potential Cost Savings: **$60,456** **31.2%**	Potential Energy Savings: **505,490 kWh** **29.5%**
Electricity Energy/Cost Savings: **32.1%**	Fossil Fuel Energy/Cost Savings: **0.0%**
GHG Emissions Reduction (tCO$_2$e): **165,083.0** **30.6%**	GHG Emissions Intensity Reduction (kgCO$_2$e/m^2) **15.4**

					PM Property ID	Property Type	Gross Floor Area (ft²)	Property Name	BETTER Potential Cost Savings (USD)	BETTER Potential Electricity Cost Savings (USD)
					1356880	Office	115,104.00	Barr Building	60456.63	60456.63
					1641990	Office	200,034.00	The Farragut Building	536.73	0
					1597342	Office	214,618.00	1750 K Street NW	45973.5	45973.5
					3016235	Office	374,766.00	Farragut Center	246372.42	246372.42
					6768	Office	256,839.00	1776 K Street NW	21031.64	
					1423276	Office	401,661.00	1700 K St NW	193773.71	193773.71
					4327667	Office	286,694.00	1775 Eye Street (ys10)	0	0
					2896787	Office	151,448.00	919 18th Street		

View by Property   **View by Tax Lot**

BETTER BUILDING EFFICIENCY TARGETING TOOL FOR ENERGY RETROFITS
U.S. DEPARTMENT OF ENERGY

Progress – Salesforce Integration

SEED provides a low-cost setup to add Customer Relationship Management (CRM) functionality to SEED.

- Previously the Salesforce functionality was a server-side configuration. In FY23, we have moved this to be user configurable.

- Data sync happens on a user-defined interval or can be run on demand

- Building benchmarking data is sync'd to a Salesforce object which is connected to a building and owner.
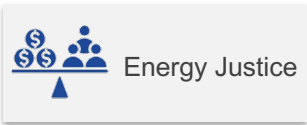

https://www.perfectviewcrm.com/what-is-crm/

Future Work – Energy & Environmental Justice Integration

Energy Justice

Ensuring 40% of investments flow to disadvantaged communities.

- In FY23, Energy & Environmental Justice (EEJ) metrics are being added to SEED platform.

- SEED users already know the building characteristics, location, and owner of building.

- Presenting EEJ information alongside energy savings potential will help decision makers ensure resources are allocated appropriately.

- In FY23, we will integrate the Building Energy Upgrade Tool (BEUT) [1] into SEED which supports EEJ metrics from other tools such as EJScreen[2], CJEST[3], and the National Housing Preservation Database[4].

[1]BEUT - https://www.energy.gov/eere/energy-equity-and-environmental-justice
[2]Environmental Justice Screening Tool (https://www.epa.gov/ejscreen)
[3]Climate & Economic Justice Screening Tool (https://screeningtool.geoplatform.gov)
[4]National Housing Preservation Database (https://preservationdatabase.org/)

Future Work – Accountability Hierarchy and Dashboarding

The Army Corp of Engineers and Better Buildings require more granular control over organization structure. In FY23, an Accountability Hierarchy is being added to enable:

- An admin can setup an organization with a configurable number of 'levels'. Each inheriting from the parent level. (SEED currently has a limited concept of org/sub-org.)

- A property and tax lot is attached to the 'leaf node' of the hierarchy.

- User access control is defined at each level.

- Dashboards and roll-up metrics will be available for each 'level' in the hierarchy.
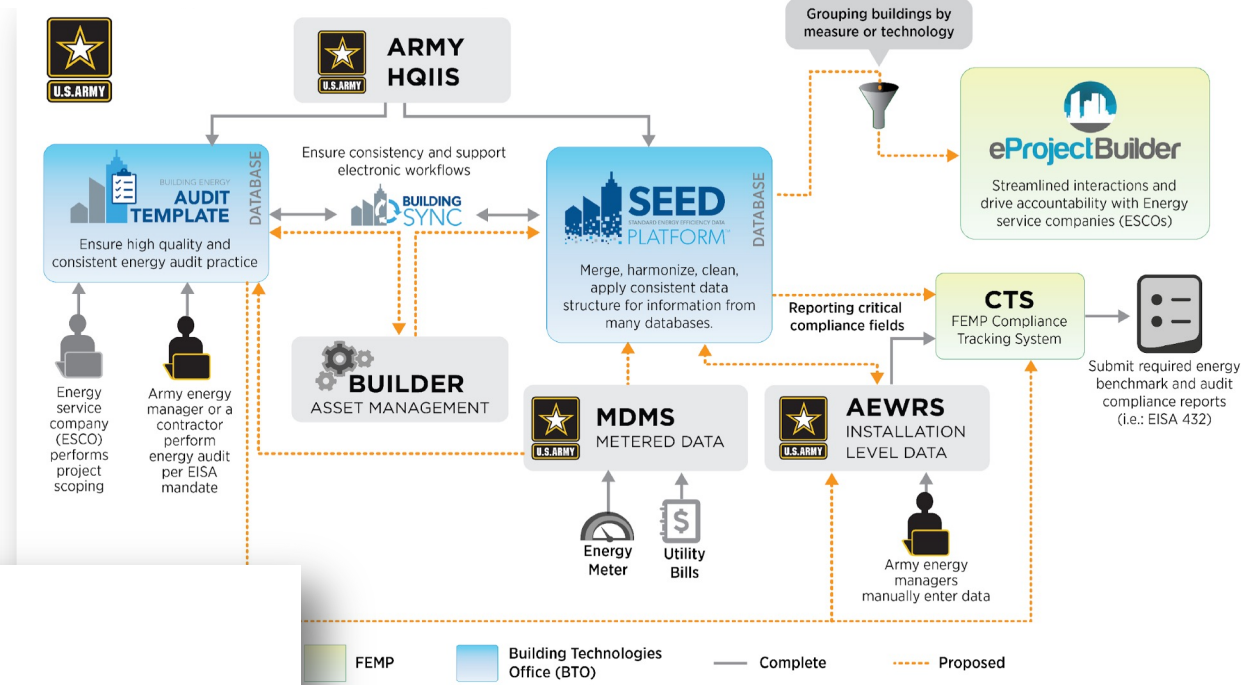
+ 500k Army Buildings

+ 300k Better Buildings

Future Work – Continuous Improvements

SEED undergoes continuous improvements and updates as users find issues or propose new features. The SEED team follows modern agile software project management principles and operates on biweekly sprints with quarterly feature development cycles.

- Security issues are patched as quickly as possible.

- SEED has a comprehensive unit testing and integration testing framework to ensure regressions are caught quickly.

- Monitoring software is in place to alert developers of potential bugs/issues on the production systems.

- Major underlying platform library upgrades are scheduled as needed.

- Ongoing maintenance is needed to keep the platform up to date with current versions. It is less expensive to keep libraries up to date than performing large refactors.

- All project planning and issue tracking is public.
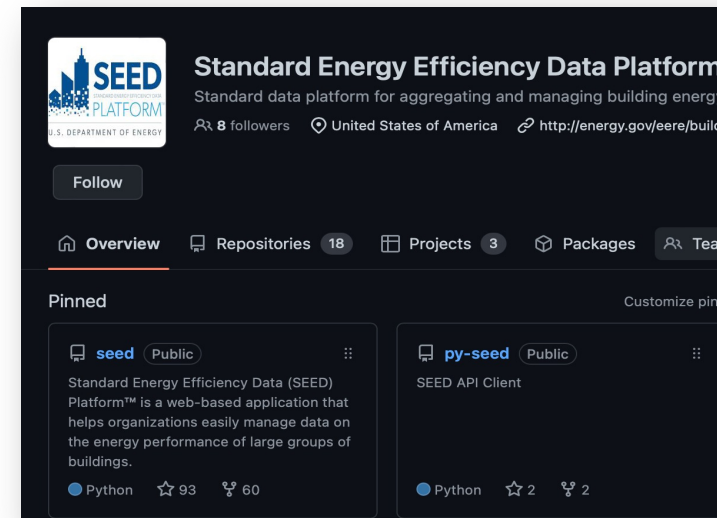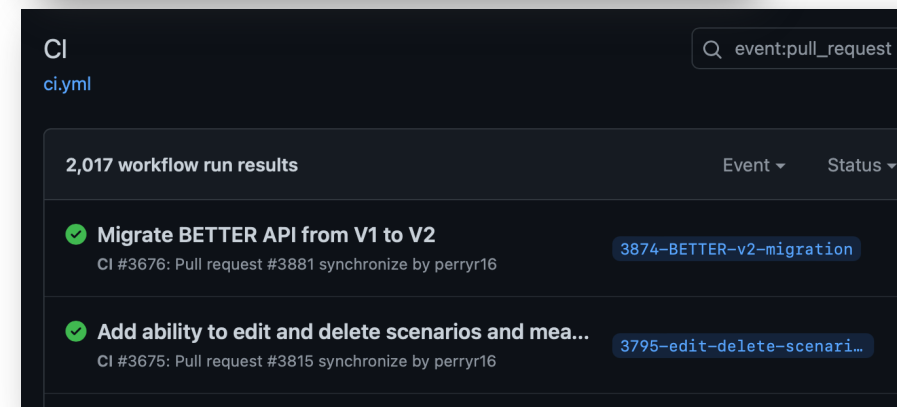
The latest ESPM update was caught by SEED's CI/CD workflow and patched within 2 days.

Thank You

NREL / LBNL

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WBS #: 2.5.2.04

REFERENCE SLIDES

Project Execution

	FY2022				FY2023				FY2024			
Planned budget	762K				718K				718K			
Spent budget	762K				718K							
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Past Work												
Q1 Milestone: SEED Version 2.13 – Carbon metric, AT, and BETTER integration improvements	◆											
Q2 Milestone: SEED Version 2.14 – Compliance season release, SEED as a Platform improvements to support BEAM, Earth Advantage, OPEN, and others		◆										
Go/No-Go: Demonstrate the adoption of SEED for additional cities and use cases.			◆									
Q4 Milestone: SEED Version 2.15 - SEED with Basic Program Tracking Support				◆								
Q1/Q2 Milestone: SEED Version 2.16-18 – Core Development and Analysis Integration, Tracking Intra-cycle Data						◆						
Current/Future Work												
Q2 Milestone: SEED Version 2.19 – SEED UBID General Use Tool							◆					
Q3 Go/No-Go: SEED Native Salesforce Integration							◆	🔴				
Q4 Milestone: SEED Version 2.20 – Maintenance Release												

Team

Team Member	Organization	Role
Nicholas Long	NREL	PI / Developer
Robin Mitchell	LBNL	PI / User Acceptance Tester and Technical Support
Katherine Fleming	NREL	Technical Deputy / Developer
Isabel Langlois-Romero	NREL	Project Controller / BPS Technical Assistance
Vanessa Stevens	NREL	Community Engagement Professional
Alex Swindler	NREL	QA Lead / Developer
Veronique Bugnion	Clearly Energy	Platform Developer
Daniel Eden	OPEN Technology	Platform Developer
Erik Cathcart	Earth Advantage	SEED Hosting Partner
Alex Chapin	NREL	Developer
Hannah Eslinger	NREL	Developer
Ross Perry	Dept Agency	Developer
Ryo Schulz	Dept Agency	Developer

And many more contributors, developers, engaged users, etc.

Publications and References

- Project website: https://seed-platform.org

- Source code: https://github.com/SEED-platform/seed

- EERE Websites: https://www.energy.gov/eere/buildings/standard-energy-efficiency-data-seed-platform, https://buildingdata.energy.gov

- Select references:

  - Bugnion, V., Long, N., Mitchell, R., Bergmann, H., Swindler, A., Beers, E. (2022). "Building Performance Standards to Drive Market Transformation". 2022 ACEEE Summer Study on Energy Efficiency in Buildings.

  - Long, N., Swindler, A., Bergmann, H., Reagan, A., Held, A., & Longley, J. (2020). "Standardizing City Benchmarking and Reporting: Use Cases in Consolidating Building Data with SEED", 2020 ACEEE Summer Study on Energy Efficiency in Buildings.

  - Taylor, C., Costa, M., Long, N. and Antonoff, J. "A National Framework for Energy Audit Ordinances", In 2016 ACEEE Summer Study on Energy Efficiency in Buildings, pp. 448–459. Pacific Grove, CA.

  - Beddingfield, E., Duer-Balkind, M., Levine, A., Alschuler, E., and Brown, R. "Putting Data to Work: Using Building Energy Performance Data to Expand the Market for Energy Efficiency in Buildings." In 2016 ACEEE Summer Study on Energy Efficiency in Buildings, pp. 324–335. Pacific Grove, CA.