Better Buildings®
U.S. DEPARTMENT OF ENERGY

BUILDING ENERGY DATA ANALYSIS ACCELERATOR
SUMMARY REPORT (FY19-20)

September 8, 2020

Harry Bergmann (DOE)

PNNL Team:

Nora Wang, Mark Borkum, Kevin Keene, Sarah Newman

PNNL-30388

U.S. DEPARTMENT OF ENERGY

Summary

To facilitate city and local governments, energy service companies, building data aggregators, and researchers to fully utilize UBID, DOE launched the two-year Building Energy Data Analysis (BEDA) Accelerator in 2018, which focuses on the testing and application of UBID to resolve real problems. The Accelerator serves as a training and collaboration group for early UBID adopters to develop and share best practices, which are refined and tracked by the DOE Data Tools team as UBID becomes more broadly implemented.

Accelerator Partners

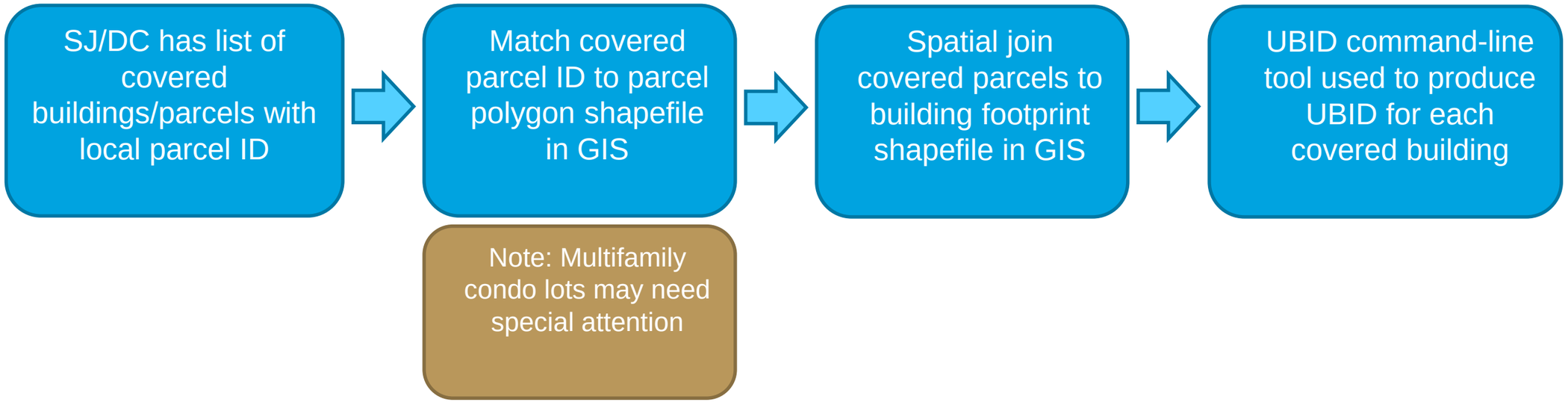
- Association for Energy Affordability
- California Energy Commission
- Environmental Protection Agency
- Institute for Market Transformation
- Miami-Dade County
- San Francisco, CA
- San Jose, CA
- St. Paul, MN
- Telecommunications Industry Association
- University of North Carolina/Commercial Real Estate Data Alliance
- U.S. Green Building Council
- Washington, D.C.

Use Cases

- **Energy benchmarking**
  - Create UBIDs for covered buildings and track building energy use and floor area more accurately
- **Green building certification**
  - Create UBIDs for a building, a portion of a building, or a group of buildings to better document what is being certified
- **Real estate data management**
  - Add UBIDs to buildings, properties, or parcels when storing or exchanging building data for real estate transactions
- **Smart cities** (Future expansion area)
  - Use UBIDs to combine building data from multiple databases to gain insight into existing building stock for 5G, IoT, etc.

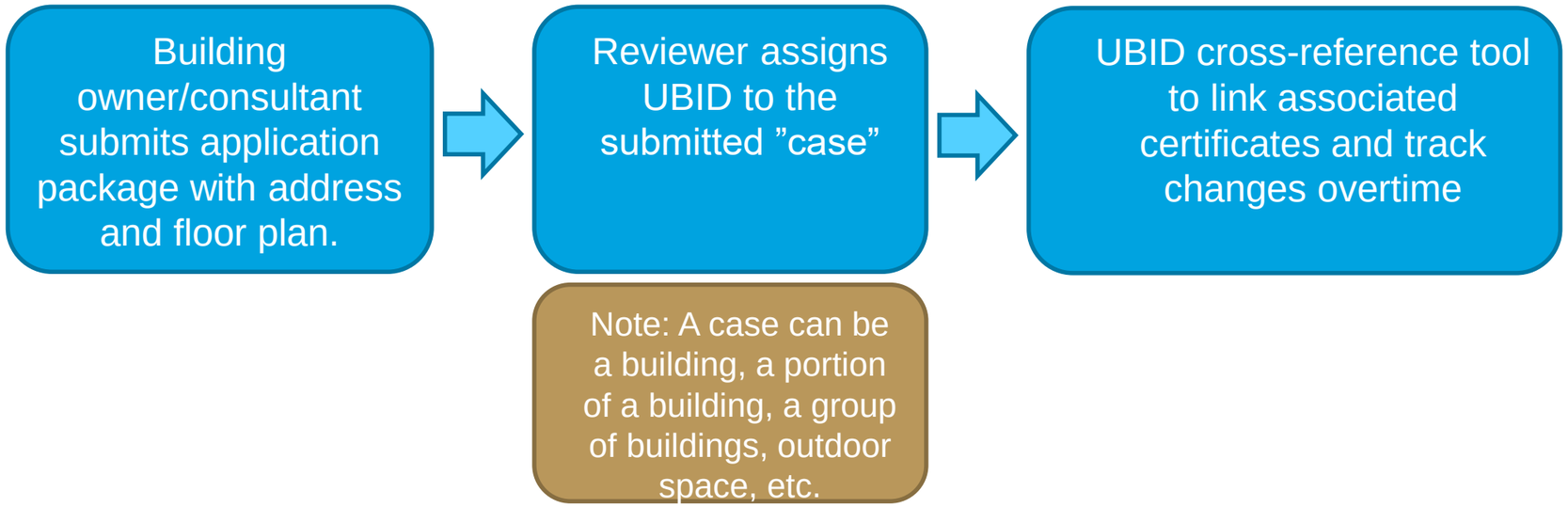
Energy Benchmarking Use Case

- Example: San Jose, CA (new benchmarking program) and Washington D.C. (existing benchmarking program)



Building Certification Use Case

- Example: US Green Building Council

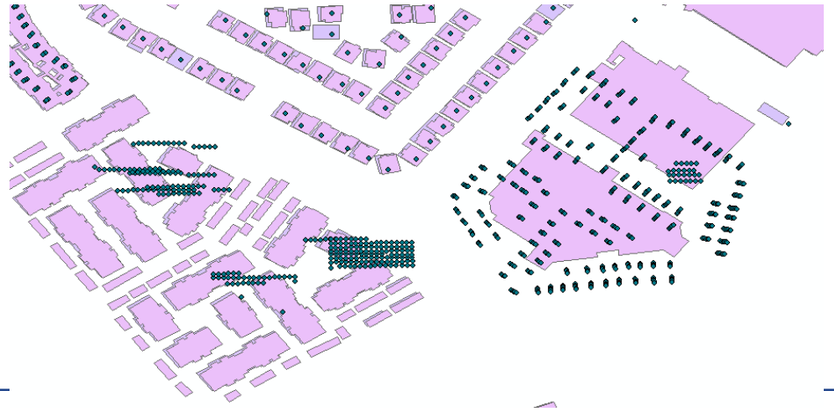


Real Estate Use Case

- Ran the subset of dataset in San Jose, CA
- Purpose is to be able to assign UBIDs to real estate datasets that only have address information

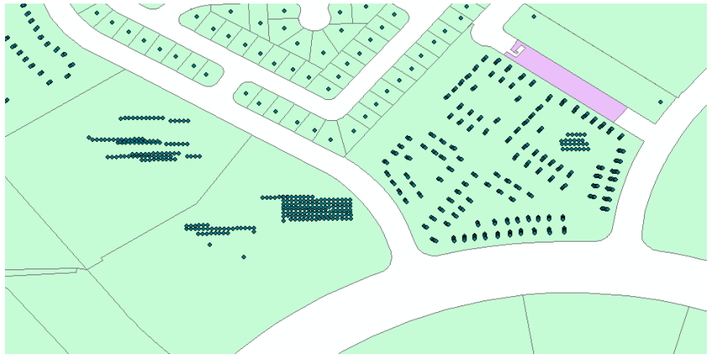
Geolocate addresses from dataset → Assign UBID to parcel and footprint data and $UBID_0$ to addresses to conduct UBID cross-reference between the datasets → Compare results to GIS matching (GIS not perfect but best possible)

- Parcel matching (94% success) better than buildings (84%), but real estate data usually stored at parcel level → initiates question of “Parcel UBID”



← Addresses matching to buildings

Addresses matching to parcels →



Activities and Accomplishments

Partner	Accomplishments
Affordable Energy Association	• UBID visualization with and without building footprint geometries. • Investigated use cases for building/property matching.
California Energy Commission	• Assigned UBIDs to 5,639 covered buildings in 5 CA cities.
Environmental Protection Agency	• UBID added to ENERGY STAR Portfolio Manager as new “Standard ID” input field.
Institute for Market Transformation	• Facilitated private interviews with participating cities. • Developed UBID “implementation guide” document.
Miami-Dade County, FL	• Assigned UBIDs to 565,995 buildings and identified corresponding records in Microsoft building footprints dataset using GIS matching (82% similarity). • Performed same analysis using UBID cross-reference tool (99.1% success rate).
San Francisco, CA	• Assigned UBIDs to 117,023 buildings.
San Jose, CA	• Assigned UBIDs to 9,023 covered buildings and identified corresponding records in Microsoft building footprints dataset using GIS matching (58% similarity for covered buildings greater than 50,000 sq. ft.). • Performed same analysis using UBID cross-reference tool (98.1% success rate for covered buildings greater than 50,000 sq. ft. and 90.2% success rate for all covered buildings) • Investigated street address to parcel matching using UBID cross-reference tool (95% success rate).

Activities and Accomplishments

Partner	Accomplishments
St. Paul, MN	• Thought leadership in covered building list development.
Telecommunications Industry Association	• Thought leadership in applications of UBID to smart buildings.
University of North Carolina/Commercial Real Estate Data Alliance	• In collaboration with LightBox, developed and demonstrated UBID-based methodologies for building/parcel data normalization, data regularization, data de-duplication and cross-reference.
U.S. Green Building Council	• Incorporated UBID into USGBC web application.
Washington, DC	• Assigned UBIDs to 163,467 buildings and joined to common ownership lot data using UBID cross-reference tool. • Assigned UBIDs to 3,463 covered buildings and joined to benchmarking data using UBID cross-reference tool. • Replicated parcel to building matching with in-house GIS expertise

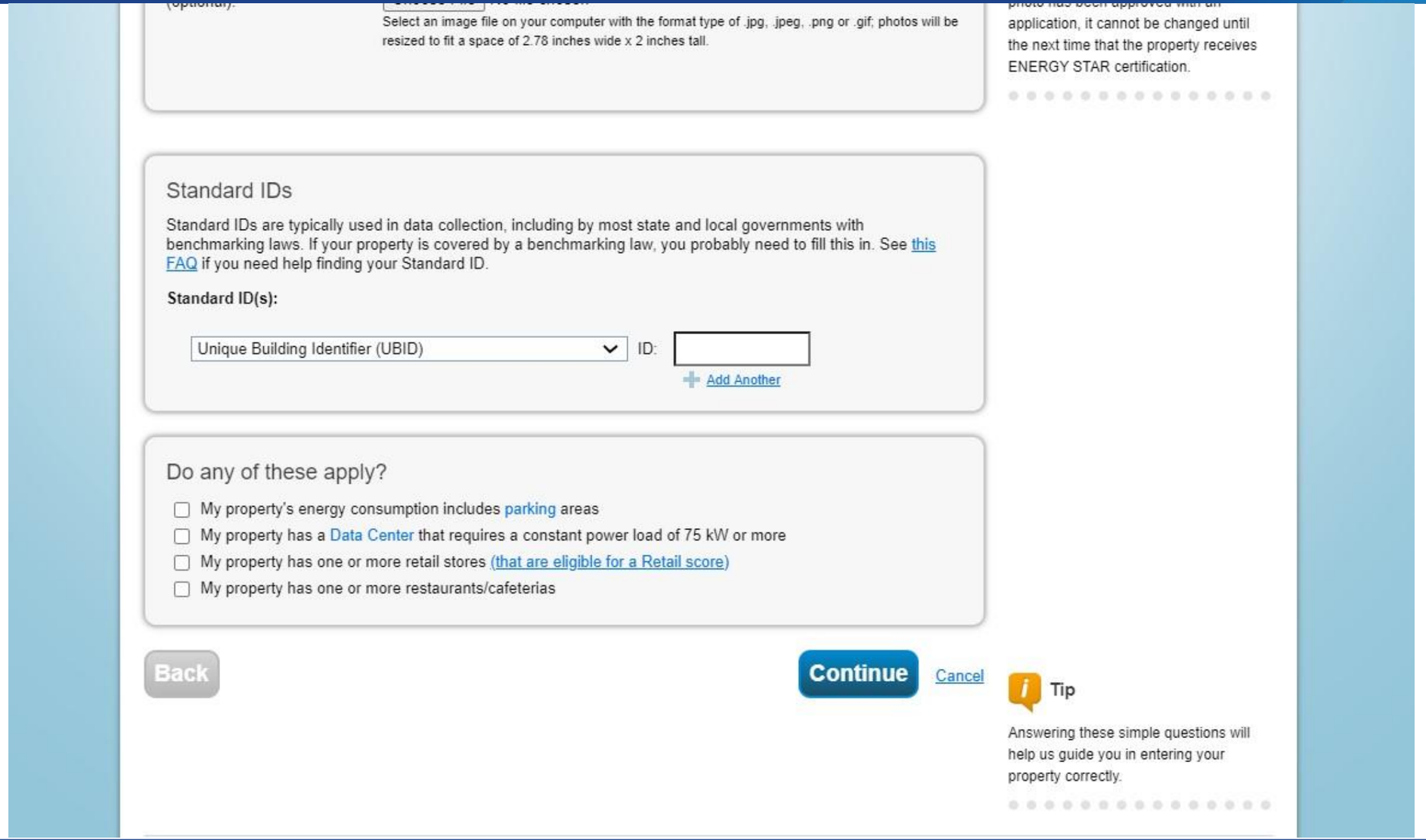
UBID in ENERGY STAR Portfolio Manager

- UBID added as new “Standard ID” in Portfolio Manager
  - https://portfoliomanager.energystar.gov/pm/glossary

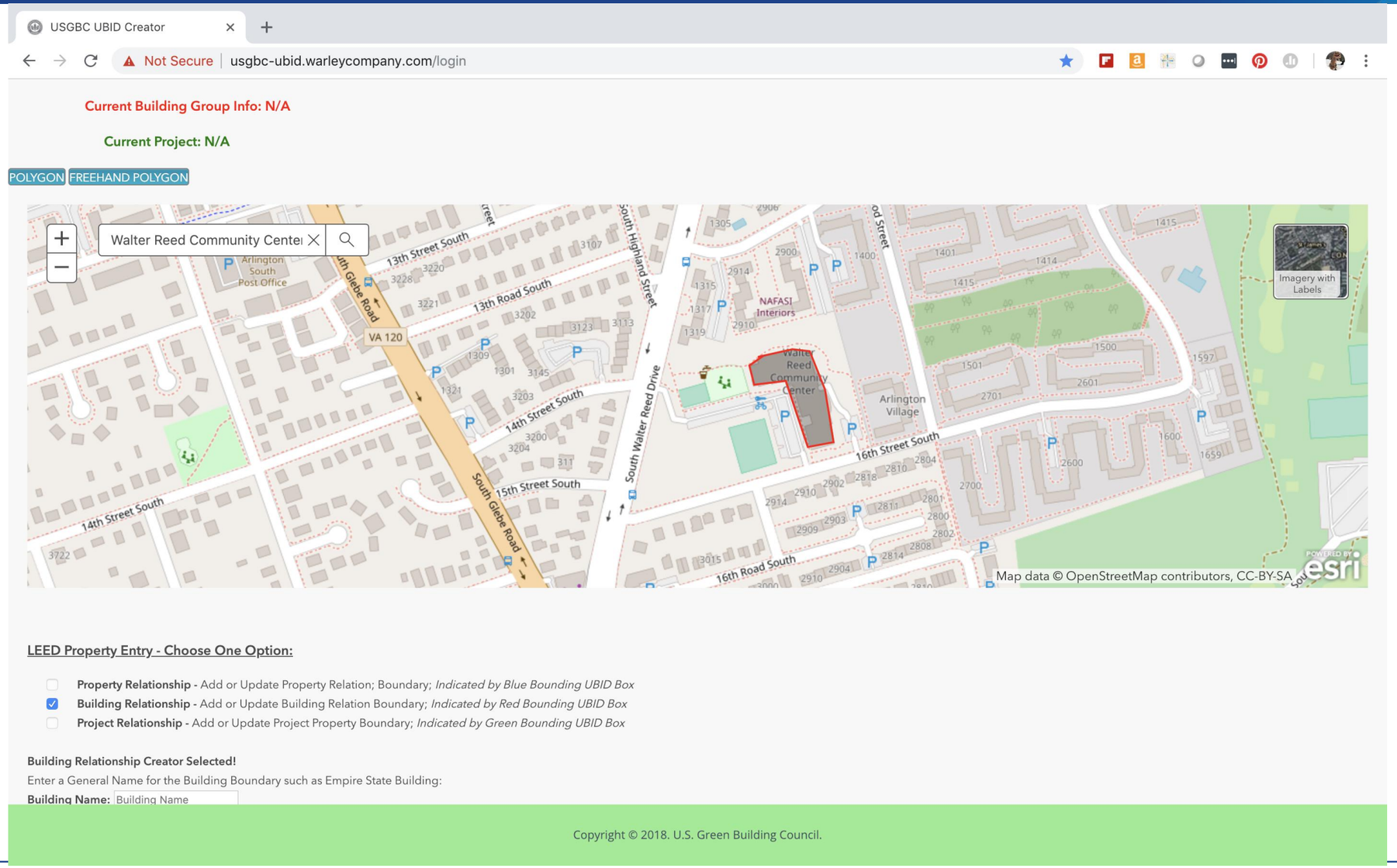
- **Unique Building Identifier (UBID)** - A geospatial identifier that allows for the identification of every unique building across the U.S. in a consistent format, similar to the Vehicle Identification Number (VIN) on a motor vehicle. It is used by some US cities for local benchmarking ordinances, as well as for other reporting to third parties. If your property contains multiple individual buildings, enter the corresponding UBIDs into this field separated by semicolons, or enter a single UBID if it’s a single-building property. Example: 849VQJH6+95J-51-58-42-50. More information: https://buildingid.pnnl.gov

https://portfoliomanager.zendesk.com/hc/en-us/articles/360020768011-What-Standard-IDs-are-in-Portfolio-Manager-

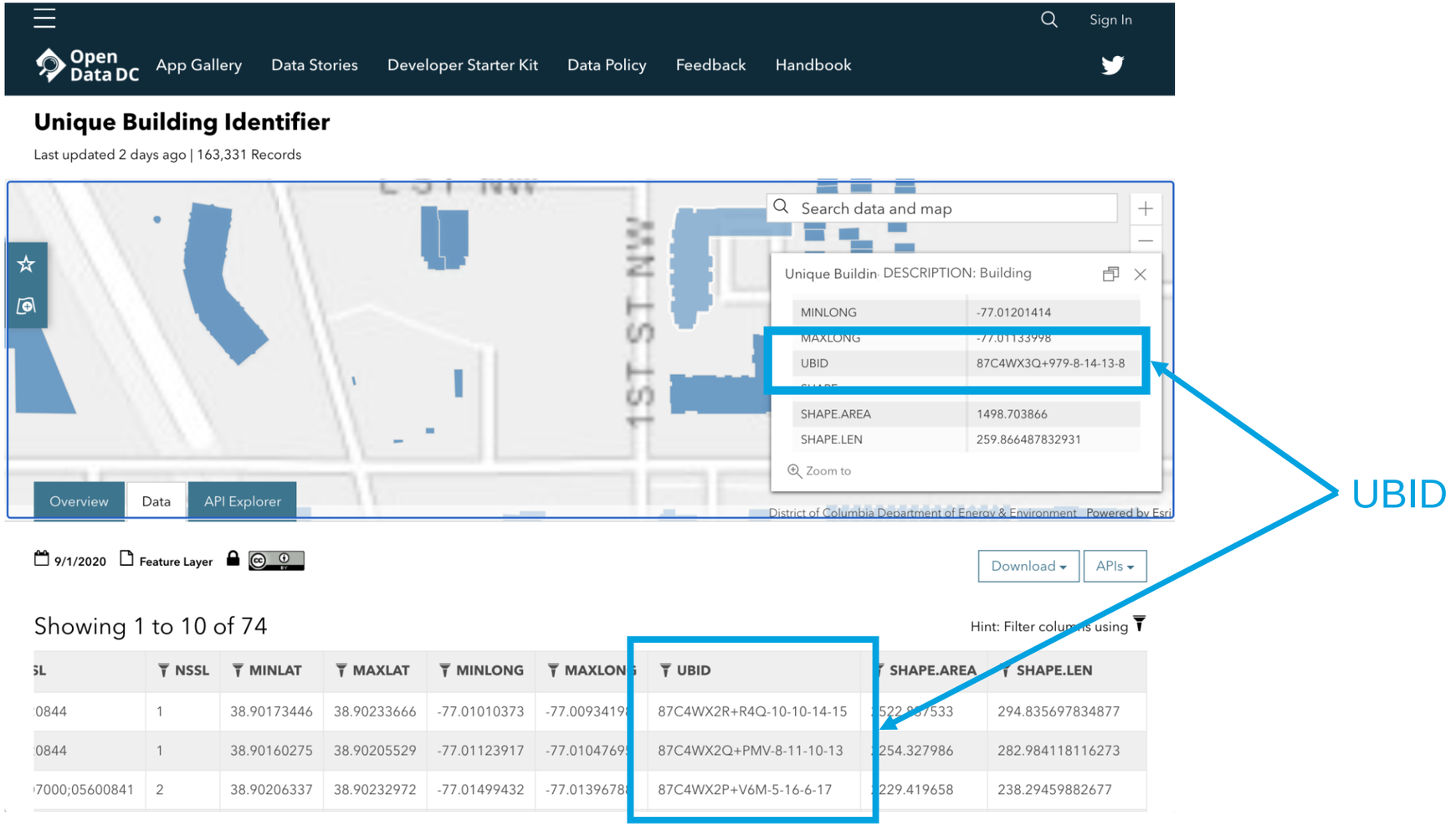
UBID in ENERGY STAR Portfolio Manager



UBIDs for GBCI Certification



“Unique Building Identifier | Open Data DC”



https://opendata.dc.gov/datasets/unique-building-identifier/data

Lessons Learned and Takeaways

1. **Inter-departmental collaboration in cities is a common thread**
    a. Building energy and carbon program teams (benchmarking, climate action, performance requirement etc.) have been taking the lead. Approach other departments through plans to integrate with existing data management systems.
    b. Benchmarking teams need to find the right counterpart(s) in other departments and be strategic. Adoption will take time.
    c. Inter-departmental data management systems is a topic that comes up frequently.

Lessons Learned and Takeaways

- **2. In-house skillsets vary. Initial UBID generation does NOT seem to be difficult. A procedure to maintain and manage UBIDs overtime is still lacking.**

- **3. Challenges of implementation and adoption of UBIDs include UBID governance (mandates, centralized database), building footprint data availability and quality, UBID usability and value for building owners.**

- **4. The UBID value proposition is more compelling for those who manage large datasets, it's less valuable for small entities. The overall value of UBID is easy to convey, however, without a UBID management system in place, the perceived technical challenge outweighs its value.**

Lessons Learned and Takeaways

- **5. Third-party services can help UBID adoption and open-source tools are preferred. An add-on to the existing products/services that cities have already subscribed to is better than a new service.**

- **6. UBID tooling development needs**
  - a. The existing UBID tooling is beyond what most stakeholders would be comfortable dealing with
  - b. It would be valuable to investigate a tool that can correct UBIDs that are created from faulty polygons or that relate to retired buildings/properties
  - c. A tool that doesn't require building owners to directly deal with UBIDs would be helpful

Graphical User Interface (GUI) Requirements

A. **Data File Manager with Data Editor:** create, read, update and destroy UBID-assigned records in tabular data files; visualize UBIDs on an interactive map; sort and filter UBIDs using user-provided criteria.

B. **UBID Matching:** cross-reference UBIDs in different data files; switch between one-to-one, one-to-many, many-to-one and many-to-many UBID matching on the fly; sort and filter matches using user-provided criteria; import and export previous matches as data files.

C. **UBID workflow orchestration:** combine A and B to manage complete UBID lifecycle (from creation to destruction). Use cases include, but are not limited to:

   I. User reassigns UBID for data record by editing erroneous vector geometry for building footprint.

   II. User selects “correct” UBID from set of “duplicate” data records.

   III. System automatically captures and stores provenance information for all UBID assignments, selections and user-provided criteria.

UBID Software Packages

- Available at: https://github.com/pnnl/buildingid

- Open source implementations for 4 programming languages
  - Source code includes comments and documentation

Language	API	CLI
C#	Y	N
Java	Y	N
JavaScript	Y	N
Python	Y	Y

- Command line interface (CLI) capabilities:
  - Assign UBIDs to records in tabular data files.
    - Minimum data requirements (any combination of):
      - ✓ Vector geometry in Well-known Text (WKT) or Well-known Binary (WKB) format
      - ✓ Latitude and longitude coordinates for centroid of geometry
      - ✓ Latitude and longitude coordinates for axis-aligned, minimum bounding box for geometry
  - Cross-reference UBIDs in 2 tabular data files

Websites

- DOE site

  https://www.energy.gov/eere/buildings/unique-building-identifier-ubid
- BEDA site

  https://betterbuildingssolutioncenter.energy.gov/accelerators/building-energy-data-analysis
- PNNL site

  https://buildingid.pnnl.gov
- GitHub

  https://github.com/pnnl/buildingid
- PNNL Demo site

  https://buildingid.github.io

DOE Site

https://www.energy.gov/eere/buildings/unique-building-identifier-ubid

BEDA Site

BUILDING ENERGY DATA ANALYSIS ACCELERATOR

While a massive amount of building-related energy data exists, it can be unwieldy and dispersed, hampering our ability to leverage it for energy-saving efforts and research. Building owners, utilities, cities, ESCOs, and researchers are unable to match energy use data with other building data sets, making it hard to identify opportunities to save energy or advance the development of new energy-efficient technologies. This Accelerator will focus on the development and testing of a unique building identifier (UBID) that enables spatial tagging to reduce the barriers to and cost of joining datasets. This will improve how building energy data can be used for research and cost-effective investment decisions, leading to stronger, more competitive energy infrastructure and systems.

https://betterbuildingssolutioncenter.energy.gov/accelerators/building-energy-data-analysis

PNNL Site

About UBID

- Home
- Benefited Parties
- Participate & Contact Us
- Downloads

Related Links

- Energy & Environment Directorate
- Electricity Infrastructure & Buildings Division

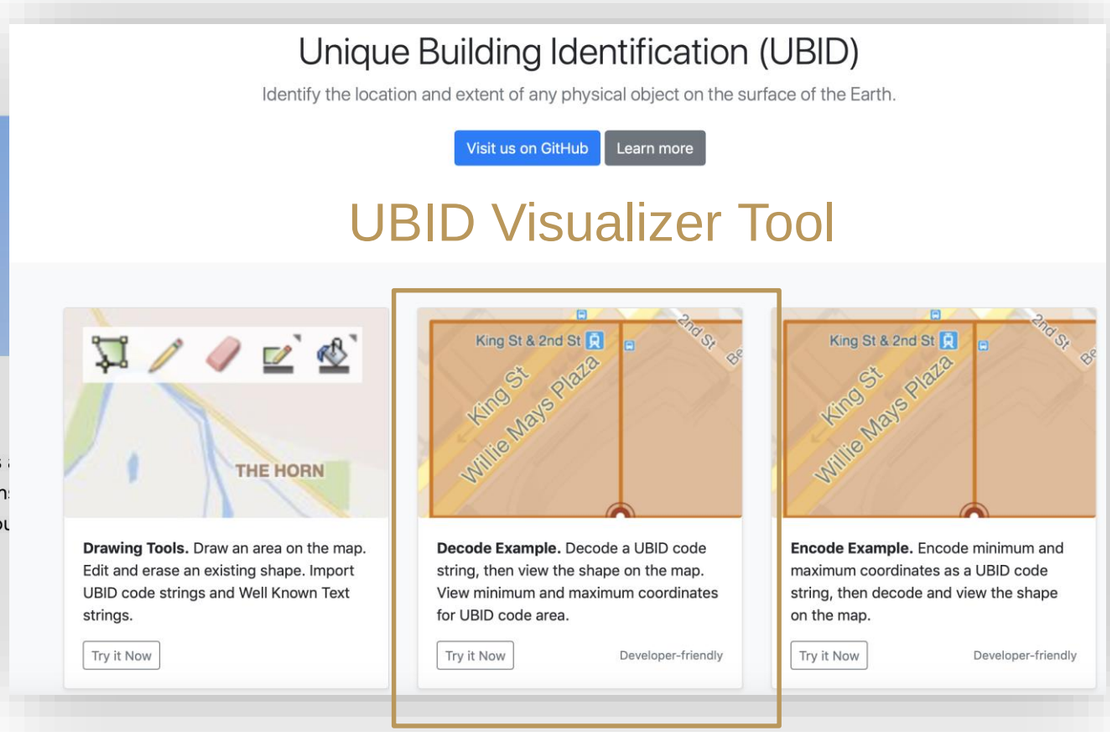
Contacts

- Webmaster

Unique Building Identification

City agencies, commercial real estate, and others keep track of a numerous
United States developed local building identification (ID) numbering system
but these local systems are inadequate for the rising needs of connecting bu
sources.

- Project Overview (Office of Energy Efficiency & Renewable Energy)
- GitHub Repository
- UBID Apps and Examples Website



Market Needs

As public and private entities collaborate to gain a better understanding of building assets through a variety of tools and services, a major obstacle presents itself across the board: the difficulty of joining various types of data from disparate sources in a single location. Typically, that effort is based solely on address matching strategies—an outdated strategy which often yields low match rates and leaves significant portions of the building stock unaccounted for across multiple data sources.

Value Proposition

A unique identification system for buildings will provide a standardized framework under which a unifying field is used to match building data from various sources to a single object. It will facilitate data management and sharing by reducing the risk of mismatching or duplicating building data, and it will ease the burden of data exchange.

Better Buildings U.S. DEPARTMENT OF ENERGY

https://buildingid.pnnl.gov

U.S. DEPARTMENT OF ENERGY

GitHub

Unique Building Identifier (UBID)

Website: https://buildingid.pnnl.gov/

UBID Documentation

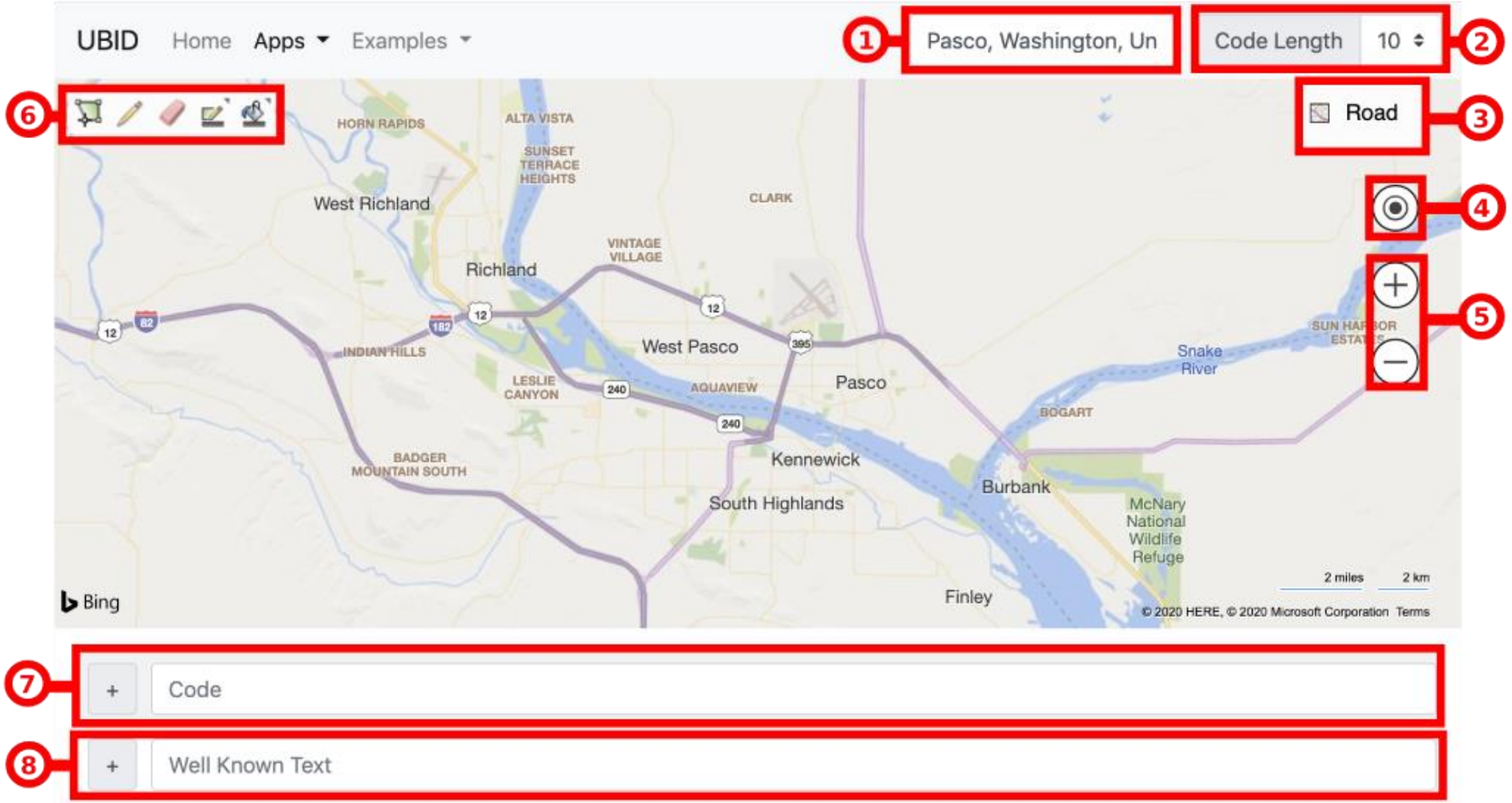
- UBID Specification
- UBID Visualization
- UBID Data Flow
- Frequently Asked Questions

UBID Implementations

Programming Language	Repository	Features
C#	https://github.com/pnnl/buildingid-csharp	API
JavaScript	https://github.com/pnnl/buildingid-js	API
Python	https://github.com/pnnl/buildingid-py	API, CLI
Ruby	https://github.com/pnnl/buildingid-rb	API

https://github.com/pnnl/buildingid

PNNL Demo Site



https://buildingid.github.io "Search by Location" feature developed by Prit Thakkar

Key Documents

- Factsheet
- Technical paper on methodology

  Wang, N., Vlachokostas, A., Borkum, M., Bergmann, H., & Zaleski, S. (2019). Unique Building Identifier: A natural key for building data matching and its energy applications. *Energy and Buildings*, 184, 230-241.
- City Government - Implementation Guide for Unique Building ID (by IMT)
- Case Studies

Better Buildings®
U.S. DEPARTMENT OF ENERGY

Thank you!

U.S. DEPARTMENT OF ENERGY