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Multifamily Utility Usage Data: Issues and Opportunities

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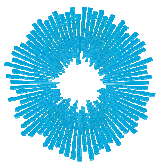

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About Living Cities

Living Cities is an innovative philanthropic collaborative of 22 of the world's largest foundations and financial institutions that is focused on improving the lives of low-income people and the urban areas in which they live. Living Cities seeks to take an integrative approach to addressing the challenges faced by our nation's cities and leverage the collective power of the public, private and philanthropic sectors especially through new and innovative ways of aggregating capital. Over the past 18 years, Living Cities' members have collectively invested over $600 million which has, in turn, leveraged more than $16 billion in tangible community assets. This funding has helped build homes, stores, schools, child care, health care and job-training centers, and other community assets.

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1. Executive Summary

Over 34 million American renters, or about one-third of all households, reside in multifamily rental housing.[1] These properties tend to be older structures, with many built in the 1970s or earlier, as new multifamily development has dropped from long-term historical averages of roughly one quarter to one third of all new housing constructed to only about 10%-15% since 1990.[2] The great majority of all existing multifamily rental properties were built before the adoption of statewide energy building codes beginning around 1980.

Not surprisingly, many of these older buildings are energy inefficient. There is a growing awareness in the industry that efforts to reduce energy and water consumption throughout multifamily should be directed at these existing properties given the modest pace of new construction and the potential for substantial energy savings through retrofit. Understanding the operating histories of these existing properties – how they use energy and water – is an important element of designing retrofit protocols and setting strong, appropriate standards for reduced utility consumption.

The primary purpose of this paper is to identify the major utility usage databases currently in use or being developed for privately-owned multifamily rental housing, both market-rate and affordable. We have also explored how these databases and associated analytic tools interact (or do not interact) with the simulation models most commonly used to predict multifamily energy usage for retrofits, as well as the intersection of national green building standards and usage data. Finally, we have surveyed opinions on the desirability, feasibility, and key obstacles to creating a more conducive environment for the collection, use, and leveraging of multifamily utility usage data.

Our review included a limited literature review, web-based research, and in-person or telephone interviews with forty technical experts and key opinion leaders in the industry (see Exhibit 1). Our principal findings include:

- Given the age of the stock and the long operating histories of the assets, there is surprisingly little industry data available regarding utility usage of multifamily rental properties - perhaps only 2%- 3% of the existing stock is represented in current databases. Yet this data is critical and has important implications for many key decisions – from the property level on up to questions of national energy policy. Many of the most significant data collection efforts began less than five years ago.

- Perhaps since data collection efforts are so new, there is no industry consensus around which data variables should be collected for existing multifamily rental properties or the best methods for obtaining and aggregating this information. As a result, individual efforts to build databases have been largely duplicative in creating the basics. The lack of industry standards and best practices for data collection hinders the development of large datasets -- without a common set of protocols and definitions, seemingly similar data may not be interoperable and may not engender the confidence required for the databases to be broadly useful.

[1] Data from the National Multi Housing Council (NMHC) based on a definition of multifamily rental as "structures with 5 or more units" and excluding condominium and cooperative housing. If buildings with "2 to 4 units" are included, the number of multifamily residents increases to 52.5 million.
[2] Data from the U.S. Census, American Housing Survey for the United States: 2009.

- Getting good whole building usage data is far too difficult. This is due to the inherently complicated nature of multifamily buildings and their operations, as well as other factors such as how utilities are provided and resident privacy considerations. In particular, organizations report great difficulty in working with utility companies to access data, as each utility sets its own policies and requirements governing the sharing of data.

- Multifamily utility usage data has only an indirect relationship with the primary simulation models used to evaluate potential energy savings for existing properties and the green building standards that influence construction, redevelopment, and retrofit of multifamily properties. The lack of a direct connection between actual utility usage data and commonly used tools and standards limits the power of the data that is collected.

- Despite the lack of consensus around the specifics of data collection, the potential value of utility usage data is recognized by many and is inspiring meaningful cooperation among stakeholders. It remains to be seen whether this will result in more robust datasets that can be used in various ways throughout the industry and for purposes beyond basic asset evaluation, such as retrofit financing.

- To some extent, general calls for more and better utility data can be misleading. Organizing around desired outcomes could be more helpful and may be most productive. Clearly the type and amount of data to be collected and analyzed will vary based on the prerogatives of its end users. This argues against a one-size-fits-all approach and comes into tension with the desire to standardize data efforts.

- Significant obstacles remain to building large utility usage databases for multifamily rental housing. Some of the primary barriers include privacy concerns, data integrity issues, and the costs and resources associated with the effort. While these problems lend themselves to coordinated industry-wide solutions, parties who have already invested significant time and effort to create their own databases, tools, and standards will need to see greater value in collaboration and interconnectivity to contribute their ideas and expertise to a broader effort.

Throughout this paper, we have attempted to represent the current state of play as of June, 2011, as well as the future aspirations of some important players and partnerships. Given the rapidly changing environment and the limited scope of our engagement, our findings are best viewed as a useful departure point for continued discussion and potential collaboration among stakeholders.

2. Typology and Definitions

The energy efficiency and broader ‘green’ industries are innovative, dynamic, and rapidly evolving. Many products and services are being created for the real estate sector, and new offerings are beginning to fill existing gaps in the marketplace. Increasingly, existing multifamily rental housing is being recognized as a distinct market rather than being included in broader ‘commercial’ programs or avoided altogether due to its complexity.

There are a variety of tools available to measure, analyze, project, and optimize energy and water usage for existing multifamily rental properties. As of yet, there is no universally accepted terminology for similar programs, products, or services. For purposes of our

report, we have characterized each of the offerings we reviewed into one of three major categories:

- Databases/Analytic Tools
- Simulation Models, and
- Green Building Standards

To some extent, these offerings are associated with different points in a property's life cycle. Green building standards, or certification programs, are generally associated with the design phase. Simulation models can be used (but are not always used) in both building design and retrofit design. Databases and related analytical programs are used in understanding the performance of existing properties both pre- and post-retrofit, if indeed a building will be retrofit. However, these tools do not operate in isolation. For example, some of the green certification programs we surveyed require data collection during building operation, and the power of simulation models is greatly improved by validation using utility data.

As one product or program may cross into multiple areas, and as stakeholders do not always use the same terminology, some of our distinctions may be imprecise or differ from those that market participants might themselves make. However, it is useful to adopt a basic typological framework to understand the larger context. In addition to the typology, and to further aid to defining the space, we have created a glossary of terms and a list of abbreviations and acronyms used in our report. These are included in Exhibit 2 and Exhibit 3, respectively.

2. A. Databases/Analytic Tools

Numerous organizations collect utility usage data for multifamily rental housing at the whole building or individual apartment level. Typically, the four major utilities (electricity, gas, water, and oil) are tracked although sometimes water or oil is excluded. The databases generally do not capture consumption of water if it is not provided through a utility, or energy used from self-generated power sources.

At the outset, it should be noted that few of the resulting databases are purely repositories for data – in fact, all of the databases described in our report contain analytical or reporting elements that can help users make sense of the data. For example, some programs can be used to benchmark properties against similar assets, or alert property owners to tell-tale changes in utility usage that might indicate system failure or degradation. The most sophisticated of these offerings are online software services.

Indeed, most of the entities associated with database efforts view the quality and sophistication of their data analytics – not pure data aggregation - as their primary purpose and value-add. For this reason, rather than referring to their products as 'databases', we use the term 'Databases/Analytic Tools' throughout this paper.

To further define the landscape and convey a sense of the multiple objectives behind the data collection efforts, we've made further divisions into three sub-categories:

- Federal
- Private, and
- Mission-Driven

2. A. 1. ***Federal***

Several federal agencies collect utility usage information and maintain this data in large databases. For the most established of these, users are able to access data in limited ways (for example, to view reports or get a rough sense of a property's relative performance) without membership or fees. These databases are primarily used to track usage for single family residences or commercial buildings; there is little data on multifamily rental properties. Nevertheless, these databases are used in some ways to inform multifamily green building standards and certification programs.

Pilot programs are now emerging at the federal level that would increase the amount of data collected for existing multifamily properties. The motivation behind these efforts is generally to better understand the performance of a set of properties with which the collecting agency is involved. The collecting agencies may or may not choose to make the data more broadly available to outside parties or industry stakeholders.

2. A. 2. ***Private***

Some for-profit entities have created databases that include a substantial amount of information from clients owning or managing multifamily rental properties. These databases typically are not a core business for the provider, but rather operate as a separate business line that augments the firm's other energy-related businesses. Access to the data is usually closely guarded and considered proprietary. The data is intended to be used with complementary analytic tools (also proprietary) for property evaluation, benchmarking, or predictive purposes.

2. A. 3. ***Mission-Driven***

Mission-driven entities focused on affordable housing are gathering detailed data on a limited set of multifamily properties. This is sometimes in the context of a collective effort by a trade association or network organization, or under the leadership of a philanthropic or mission-driven organization. These efforts are motivated by the interests of the sponsoring entities, and the data is generally not shared with others outside of the network or data collaborative. These initiatives are only recently emerging, in response to the limitations of data pools held by public agencies or private businesses. However, these organizations are generally storing their information in databases/analytic tools created by private firms rather than developing their own systems.

2. B. Simulation Models

Simulation models are among the tools used by professionals to design new buildings or potential retrofits for existing buildings. These models permit the user to estimate the impact of specific physical improvements or operational changes on a property's utility usage, and for existing buildings are often informed by an energy audit.

These tools rely largely on building science and engineering assessments of buildings and their components in order to project future savings. A property's utility usage data has limited application in the model. Such information is typically used only to calibrate the initial projections that serve as a baseline for the modeling, with a simulation engine rather than usage datasets driving the estimates of future energy and water consumption.

2. C. Green Building Standards

Green building standards are objective sets of criteria that are used to judge the physical components, construction methods, and increasingly, other 'soft' elements in the

development or renovation of a building. 'Soft' elements might include the provenance of components and the imputed energy used to bring them to market, or management and resident training commitments. Some standards offer a 'Prescriptive' path and include minimum threshold criteria for energy and water usage that must be satisfied in order to be compliant. Others provide flexibility, or a 'Performance' path, allowing the applicant to choose from a wide set of options in order to achieve a target level of expected energy conservation and thereby earn the certification.

Many certification programs include a rating system that reflects a continuum or degree to which properties achieve the goals of the standards (e.g. silver, gold, or platinum). Although not necessarily intended by the organization offering the certification, private or public funders may require compliance with a standard or rating system in order to access new financial resources. At the property and ownership levels, certification can also have significant marketing cachet.

The primary databases/analytic tools, simulation models, and green building standards for multifamily rental housing are identified and discussed in Sections 3, 4, and 5 below. Our review was limited by design to identify and discuss up to six of each of the most relevant databases, simulation models, and building standards; however, we encountered several new and existing initiatives that merited inclusion in our analysis in order to paint an accurate picture of trends in the industry. Supporting information, including At a Glance summaries of selected initiatives, is provided in the Exhibits.

3. Multifamily Databases/Analytic Tools

This section summarizes our review of the most significant multifamily databases/analytic tools. We also discuss the nature of data collection and analysis more generally.

3. A. Databases/Analytic Tools Included In Our Review

Most of the databases relevant for multifamily rental housing are recent initiatives and have been collecting usage data for less than five years. This is surprising given the age of the multifamily housing stock in the United States but generally attributed to the complexity of the assets, potential privacy concerns related to resident data, and lack of strong owner incentives for reducing utility consumption (insufficient motivation to collect and analyze data). The databases we chose to include in our scan generally either include utility data on a minimum of 700 multifamily properties or are dedicated exclusively or primarily to multifamily rental properties. The only exceptions are the federal surveys of commercial buildings and single family residential (the Commercial Building Energy Consumption Survey (CBECS) and the Residential Energy Consumption Survey (RECS), respectively), which were included because they are referenced by many other tools and models that in some way bear on the multifamily rental housing sector.

The databases or data collection efforts we explored are listed in the table on the following page. A more detailed comparison chart is included as Exhibit 4. Additional information on specific initiatives is provided in the At a Glance summaries in Exhibit 5.

Database / Analytic Tool Profiles

	Year launched	Name	Properties included and percentage multifamily <500	500-5,000	5,000-50,000	50,000-200,000	200,000+
Federal	1979	DOE Commercial Building Energy Consumption Survey		0%			
	2012	MF Energy Data Initiative (Fannie Mae/EPA)			100%*		
	2007	HUD Mark to Market/Retrofit Initiative	100%				
	1999	Portfolio Manager – Commercial and existing MF (EPA)					<1%
	1995	Energy Star Homes and new or substantially retrofitted MF in the MFHR pilot (EPA)	100% MFHR				<1%
	1978	DOE Residential Energy Consumption Survey			~18%		
Private	2006	Building Performance Compass		~5%			
	2006	EnergyScoreCards		99%			
	2007	Sustainable Real Estate Manager				3-5%	
	2010	WegoWise		99%			
Mission	2009	SAHF Green Retrofit Program and DOE Energy Weatherization Innovation Pilot Program		100%			
	2008	Deutsche Bank Found. Energy Efficiency Report	100%				
	2008	Enterprise Communities Data program	~80%				

*Future projection

At most, perhaps 8,250 multifamily properties are currently captured by these databases (to the extent that a particular property is represented in more than one database, the figure is overstated). The 34 million renters living in buildings with 5 or more units represent roughly 16.5 million households[3]. While precise nationwide averages are unavailable, based on census data and our own experience we estimate that the average size of a multifamily property is at most 50 units and is probably closer to 35 units. On this basis, we believe that the properties included in the databases we reviewed represent only about 2%- 3% of the multifamily rental stock nationwide.

3. B. Business Models

We've organized the databases/analytic tools in our review according to the typology presented in Section 2, which reflects the drivers of their creation and use. This is a helpful way to understand how the motivations and activities of the stakeholders differ, and how differing objectives may bear on questions of future collaboration.

3. B. 1. ***Federal***

Federal agencies or government-sponsored entities including the Department of Housing and Urban Development (HUD), Rural Development at the Department of Agriculture (RD), Fannie Mae, and Freddie Mac extensively support the development, finance, and operation of privately-owned rental housing. However, most of the utility information readily available to these agencies pertains only to the dollars spent on energy and water at developments in their respective portfolios - these organizations do not currently collect utility usage data on a large scale or a regular basis.

[3] Data from NMHC.

Federal databases/analytic tools which do track utility usage include CBECS, RECS, and Portfolio Manager. CBECS and RECS are Department of Energy (DOE) initiatives. The primary motivation of these efforts is to gather and store a random representative nationwide sampling of data to inform national projects and to directly or indirectly serve as a public resource. The data is verified but, as noted above, CBECS and RECS contain very little information on multifamily rental properties – CBECS has none and only 18% of the properties in RECS are believed to represent individual units within apartment developments. In effect, multifamily rental housing falls between the cracks of CBECS and RECS. Yet, despite the lack of information, these databases serve as reference points for activities in the multifamily space time and time again.

Portfolio Manager was developed by the Environmental Protection Agency (EPA). It is not a database, but rather an energy management tool that allows property owners and operators to store their own historical energy, water, and greenhouse gas data and track improvements in performance over time. Users cannot utilize Portfolio Manager to compare their buildings to properties owned by others, and cannot view data for other properties unless they choose to share information with another account holder. The data is confidential and it is not verified, aggregated, or otherwise used by EPA. It is estimated that currently only about 1% of buildings using Portfolio Manager are multifamily rental properties.

CBECS, RECS, and Portfolio Manager are all ongoing efforts with semi-permanent commitments for funding allocations. Access to the raw data in CBECS and RECS is free of charge, and the Portfolio Manager tool is made available at no cost through EPA's website. Compared to others active in the space, DOE and EPA have a long history of data collection or of offering analytic tools to owners and operators. While this contributes to robust resources, it may mean that that processes or systems may be difficult to change or improve in the future. In and of themselves, these efforts currently have limited analytic functionality for evaluating or benchmarking multifamily properties.

In recognition of this, there are some new pilot or limited data collection programs emerging at the federal level which are much more focused on multifamily rental housing. Examples include data collection by HUD for properties retrofit through its 'Mark 2 Market' and other programs, and an effort by EPA, supported by Fannie Mae, to develop a large database of building level consumption data that could potentially be used to develop an ENERGY STAR rating for multifamily. Both of these efforts, as well as an EPA pilot program for new construction or substantially rehabilitated Multifamily High-Rises, hold significant promise for those interested in utility usage for multifamily properties. However, these programs are very limited at the moment. It remains to be seen whether these initiatives will receive the resources necessary to develop large and powerful databases, and if so whether these will become available to the public.

There are also a number of new DOE initiatives that, while not focused on multifamily properties, should advance the discussion about utility usage data collection and analysis. These include plans for a public database for the BetterBuildings program, which aims to retrofit 170,000 buildings (most of which will be commercial buildings or single-family dwellings), the development of an "energy data warehouse" that would introduce a taxonomy intended to serve as a national standard for energy efficiency data, and a national evaluation of results achieved under the Weatherization Assistance Program (WAP), which included a significant number of multifamily rental properties. The progress and results of these efforts, particularly the energy data warehouse, should be very relevant to the multifamily industry and data collection efforts for rental housing.

3. B. 2. ***Private***

Private data efforts have emerged in the past half-decade in response to demand from property owners for clear and reliable products to help understand, monitor, and improve the energy efficiency of their holdings. These owners have turned to for-profit, third party consulting firms to collect, aggregate, and analyze utility usage data. The resulting databases/analytic tools are available on a subscription basis, accessible to registered users only, and typically cost several hundred dollars per year per property. While the private firms may not yet have recovered their initial investments in creating these products, they anticipate that providing data access and analytic capacity to users will ultimately be good and profitable business. These products may also generate opportunities for other energy-related businesses operated by these companies or their principals.

The private products that are most relevant to the multifamily rental housing industry currently include EnergyScoreCards and WegoWise. Both are web-based services that analyze (and to some extent begin to predict) property performance based on datasets drawn almost exclusively from multifamily properties. Other products such as Building Performance Compass (BPCo) and Sustainable Real Estate Manager (SRM) promise similar functionality, but are not as focused on multifamily. While all of these initiatives are operated on a for-profit basis, a non-profit organization and a community-oriented lender are among the owners of WegoWise.

3. B. 3. ***Mission-Driven***

Several noteworthy data collection efforts have emerged in response to gaps observed between the public and private initiatives. These efforts have been sponsored by mission-driven or philanthropic organizations or associations. These entities and their partners have recognized the value of utility usage tracking to guide their other program activities, including asset management, financing, and retrofits. The best examples include the Deutsche Bank – Living Cities Building Energy Efficiency Report (EER), the utility performance data effort at Enterprise Community Partners, and a data gathering effort organized by the Stewards of Affordable Housing for the Future (SAHF) with support from the MacArthur Foundation.

Mission-driven efforts may rely in whole or in part on grant funding to support the development of their multifamily database. For some, such as the efforts from SAHF and Enterprise, the database was established with the goal of directly improving the performance of the multifamily housing portfolio associated with their organization. For others, such as the EER initiative, the very process of creating the database helps develop local expertise and establish market knowledge in an area of potential future investment. Mission-driven organizations typically engage private firms as contractors to create their databases and analytic tools. For example, Steven Winter Associates is building the database and HR&A Associates is developing the analytics for the EER initiative, and SAHF maintains its data and analyzes its portfolio through EnergyScoreCards. Although initiated by mission-driven entities, these decisions have the effect of contributing data points on hundreds of properties to database/analytic tool products controlled by private firms.

In general, participants in the mission-driven efforts described themselves as custodians or stewards of the utility usage data. While the data will not necessarily be shared with others outside the group, none of the mission-based database developers expressed any plans to market their database or tools for commercial purposes.

Much of the utility usage data being collected and analyzed industry-wide pertains to a subsector of the multifamily business – affordable rental housing. All of the mission-driven organizations promote affordable housing and significant percentages of the HUD, WegoWise, and EnergyScoreCard datasets are associated with affordable housing. Energy efficiency efforts are very important to affordable housing owners, as retrofits can relieve pressure on rising utility costs that might otherwise result in rent increases for tenants. Additionally, affordable housing owners tend to hold properties for the long term, and therefore can invest in improvements that have longer payback periods. Market-rate property owners planning to refinance or sell an asset periodically (typically every five to seven years) will not necessarily make the same investments.

3. C. Importance of Data to the Business

As noted above, the most established of the federal data collection efforts (CBECS and RECS) have limited analytic functionality for multifamily properties. The private and mission-oriented databases that have more recently emerged offer greater capacity for evaluation and comparative analysis. Most of the organizations associated with these efforts were previously involved in energy efficiency or more general real estate and community development activities prior to engaging in utility data gathering and analysis. Typically, this involvement was the impetus for building a database and analysis platform, which could be spun off. The focus of the original business or mission informed the shape and purposes of the initial data effort, which continues to evolve over time.

While assembling data typically requires a great deal of effort, the value propositions of these databases/analytic tools rest heavily on the potential use of the data, not the mere possession of it. Most of the private firms we interviewed identified working with the complexities of multifamily utility usage data as a core competency; the database and analytics are perceived as only one offering within a larger suite of services promoting energy efficiency and/or property improvement. Plans for future expansion into more and related lines of business are common. This may well mean that databases will become more integrated with other energy efficiency products and services over time.

An obvious difference exists between entities which sell their data or access to a benchmarking pool and those that collect data primarily to inform their own internal projects or model-building. Yet there are several instances of collaboration between the private data firms and the mission-driven organizations, and ongoing conversations among some of the private firms and federal agencies collecting data. Throughout our interviews, numerous individuals brought up their hopes for greater data interoperability and process standardization, and offered that many would likely benefit if data were to become more openly shared and available. If such sharing were enabled, it would certainly test the assertion that analysis rather than underlying data is the most important value-add.

3. D. Data Collection and Methodology

Raw data on utility usage is converted into information useful for decision-making through a series of actions. Challenges and critical decisions arise at every step in the process. This section will highlight a few of the most important according to those that we interviewed.

3. D. 1. ***Step 1: Data Selection***

The process of accessing and assembling utility usage data for multifamily begins with questions surrounding what data to collect. Multifamily properties are inherently more complex than single family or commercial structures and these difficulties contribute to basic disagreements over fundamental questions such as the type of data that it is critical to gather.

The question of which variables to collect and track is driven by considerations including:

- *What is feasible or easiest to gather?* Some data that is very important may be difficult to obtain; data that is easy to obtain is not necessarily valuable in analyzing a building's consumption.

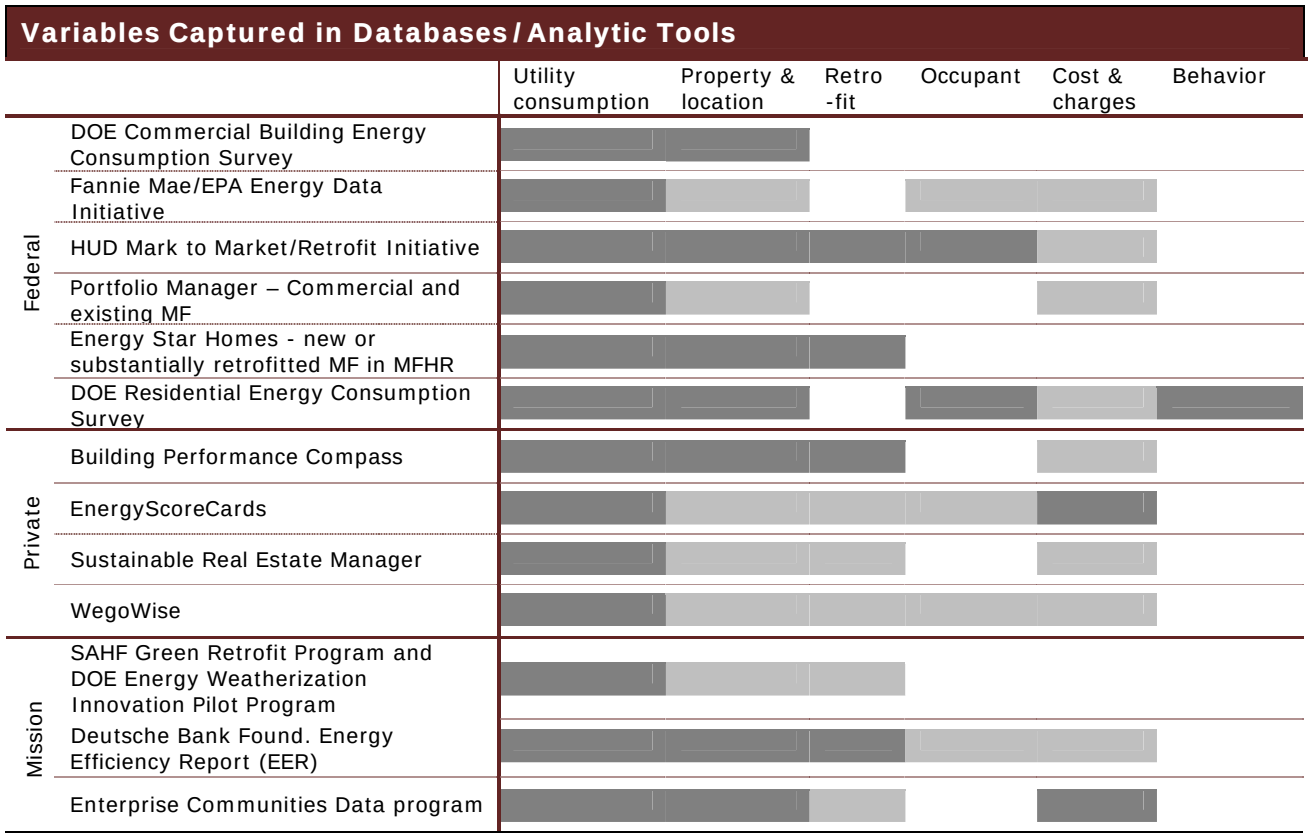
- *What is the usefulness of the variable in producing meaningful analysis?* Not all data is equally valuable. Even if a variable is collected, it may not end up being used in meaningful analysis. It is important to focus on data which offer the highest correlation to actual building performance.

- *How important is the variable relative to others?* Data analysis is often iterative and some variables are more useful than others in developing analytics.

- *How often will the data be collected?* Will the information be gathered only once, or will the variable be tracked over time?

Beyond some basic core information, there is little agreement on methodology or the specifics of what should be collected. There is no industry standard or universally accepted protocol for data collection for multifamily rental housing.

The table on the following page summarizes the major categories of variables that are collected by databases included in our scan. The headings in our table correspond with the basic information gathered by most entities, although different groups may use different names for data fields and may gather more or less information in a given category than others. Please see Exhibit 6 (In Depth Discussion of Variables; Utility Consumption and Other) for more information about data collection.



Light shading indicates that Basic data is captured; darker shading indicates more Detailed data is gathered (see Exhibit 6 for more information). In several cases the database has capacity to capture more detail; shading is best representation for majority of buildings.

3. D. 2. ***Step 2: Gathering the Data***

The majority of database/analytic tools we reviewed favor a 'whole building' approach for energy efficiency analysis, meaning that data is collected for all apartment units and common areas.[4] Metering and billing systems in place at the property level can make this information difficult to obtain. Multifamily buildings may have either individually-metered utilities or master meters -- or sometimes both but for different utilities. The way that utilities are provided and billed for common areas can also add complexity.

Current database strategies for addressing this complexity vary, and include:

- *Exclusion*. Some databases choose to exclude all data which is not already present on a whole building basis, typically because of organizational resource constraints.

- *Sampling and modeling*. Information from a minimum percentage of apartments[5] is set as the baseline, and whole building usage is extrapolated from that unit data. Sometimes common area data is also taken into account.

[4] The RECS survey, which includes very little multifamily data, collects information strictly on a dwelling unit basis and does not include any common area information.
[5] Some entities have developed in-depth protocols for determining the sample of the units.

- *Aiming for 100% participation.* Rather than extrapolating, several entities 'knock on doors' to acquire tenant releases and to ensure whole building participation. This is difficult to achieve in practice.

For almost all of the entities we interviewed, quality and availability of existing data is a more important issue than adding more variables to the analysis. Ease of access and standardization of existing variables is critically important to stakeholders.

3. D. 3. ***Step 3: Data Entry***

Once the data variables are defined and the data is collected, entering the data into the database is not necessarily an easy process. Some databases are moving towards automation and standardized entry protocols, but this requires significant time and resource investment. Most of the federal and mission-oriented entities rely on 'user-entered' data. In its best form, this consists of a spreadsheet sent in by a property owner. However, hand-filled forms that are then transferred to an electronic database also are common. Manually-entered data remains the norm, especially among programs attempting to collect retrospective data from property managers.

'Scraping', or automated collection of utility data directly from a utility company, is increasingly popular and used by many of the market-driven databases. Scraping programs typically have to be developed for each utility company that is represented in the database, as their data formats vary. This also requires the individual of record on the utility bill to establish an online account if they have not yet done so. A few utilities do not yet provide online access, and as a result 'scraping' is not viable in all geographies.

Interviewees suggested that data collection issues could best be overcome if utilities were required to provide aggregated whole building data to building owners, in a format that would not jeopardize resident privacy (privacy concerns are further explored in Section 7). In general, interviewees reported a wide range in the degree of difficulty in acquiring data from the utility providers. The ease of access to data corresponded with the capacity and policies of the specific utility provider; utility companies have varying abilities to separate individual utility usage from identifying personal information. This may be due to a physical constraint of their data systems, or that the utility company does not have sufficient human or financial resources to provide reports without customer identifying information. The federal mandate for utility companies to send data to RECS and CBECS is of little benefit given that very little of the data in RECS or CBECS pertains to multifamily.

For most engaged in data collection and analysis, the process remains challenging. One respondent said "cooperative relationships with utilities is an oxymoron". While there were exceptions to this sentiment, they were rare. 'Smart Metering' (use of meters to record utility consumption in real time and transmit that data directly to a utility) could potentially make the collection process much easier, but none of the usage databases we surveyed currently offers any analytical tools built around Smart Meter data or the smart grid concept. Smart Metering and scraping would require far less labor than manual data entry but still necessitate some human oversight to comb the data for errors and reporting anomalies.

The table below summarizes data gathering methods currently in place for many of the databases we evaluated.

Primary Data Input Methods for Databases/Analytic Tools						
Method of data input	Manually-entered or scanned	Spreadsheet from owner, manager	Scraped	Spreadsheet from utility	Data protocol established, semi-automated	Smart Meter direct transmission
Entity	-Enterprise -SAHF -DB/EER	-Portfolio Mgr -Enterprise -SRM -BPCo	-EnergyScoreCards -SAHF -WegoWise	-SRM -BPCo	-RECS	-HUD M2M (2011 launch)

The majority of entities interviewed use a simple spreadsheet program to store their data, but a few use a more sophisticated database format, including .Net and Access. One entity reported exploring a cloud-based database for their future storage. Future data interoperability does not appear to have been given much, if any, consideration in the decisions made to date regarding data storage formatting. Software used by the tools varies but the majority of interviewees use off-the-shelf packages (such as Stata, SAS, or Excel) to run their analyses.

3. D. 4. ***Step 4: Analysis of Property Performance***

Some of the federal databases, specifically RECS and CBECS, have as their primary purpose the gathering and holding of data. Their analytic functions are limited to descriptive reports that document trends in the data. For instance, with RECS one can discover how utility consumption varies by number of people in a household. Portfolio Manager, an energy management tool offered by EPA, permits owners to track and analyze energy and water data on their own properties but not against other buildings.[6]

The private and mission-driven databases/analytic tools we reviewed generally provide a greater degree of peer comparison analysis, indexing, or benchmarking to permit users to understand how a single property's energy consumption compares to other properties in a given cohort. Some of these models also offer the option to compare actual consumption of a property with what it 'should be', based on a pool of peer data. Their developers have assembled their own database of properties that form a benchmarking pool. New properties added to the initiative become part of the pool and improve the utility of the analytic tool.

The interfaces for these tools are unique and designed to meet the specific needs of their intended users. Ratings and score-like outputs are becoming increasingly popular as a way for building owners to assess the performance of their property with easy-to-read results. However, the process for developing these ratings is not standardized across the private databases, and the firms creating these metrics are not selling ratings or issuing any certification that a particular standard has been met. For these analytical tools, in contrast to the Green Building Standards discussed in Section 5 below, there seems to be no formal external (industry) protocol that guides the process of defining or developing these scores.

Most of the private and mission-driven entities we interviewed indicated that understanding and analyzing data is the core component of their value-add for their constituents. All mentioned that significant time and capital had been invested in building the initial version of their data analysis tool, which is then typically tested and refined on regular intervals.

[6] Portfolio Manager users may not access data entered by others into the system, unless particular account holders specifically elect to share data with each other.

There are limits to the analysis that may be performed -- there are relatively few properties captured by these databases, and the data may not be nationally representative or statistically valid for some purposes. Also, there is little retrospective information contained in these databases, and this problem is compounded by the fact that some databases gather large amounts of data on properties for a 12-month period but do not require properties to continue contributing information. Therefore, there are potentially significant fluctuations in the comparative value of their data over time.

4. Simulation Models for Multifamily Retrofits

Simulation models differ from the reporting and benchmarking tools embedded in most databases/analytic tools we reviewed, in terms of when and why they are sought out by users and by their relationship to utility data. This section of the report describes the role of these models in analyzing and projecting utility consumption for multifamily properties and highlights those tools that are most relevant for existing properties. We have also outlined the modeling process and discussed its relationship to utility usage data.

4. A. The Role of Simulation Models

Simulation models are computer-based programs that allow an energy auditor or other qualified professional to create a detailed model of an existing or to-be-constructed building and then simulate future energy usage. These tools provide additional functionality for users who have already collected project-specific consumption data and who wish to develop projections regarding the potential performance of their property under new scenarios, such as changes in equipment or physical improvements.

At the heart of each of these tools is a simulation engine. The engine is a complex series of algorithms that models energy usage over a period of time based on the user's assumptions. These programs do not retain an intrinsic repository of usage data, nor is utility consumption the primary variable in their analytics package. Instead, consumption is typically used to set a baseline of operations at the start of the modeling process. In this way, like some of the more limited databases referenced in Section 3.B.1 and the green building standards discussed in Section 5.C, there is only a remote and indirect relationship between utility usage data and the simulation models.

Many of the simulation models are based on DOE-2 (developed by DOE) or BLAST (developed by the U.S. Department of Defense). The tools offer different forms of user interface, ranging from DOS-based prompts with text-based data uploads to fully-integrated front-end Graphical User Interfaces (GUIs). The type of user interface has a substantial effect on the usability of the system, time spent to create an accurate model, and training required. Tools without GUIs are significantly more cumbersome to manipulate. All of these simulation models are intended for use by trained specialists rather than property owners or staff.

4. B. Simulation Models in Our Scan

The table on the following page summarizes the simulation models most relevant to our review. It is intended to reflect a sampling of the primary tools used in the industry and more specifically whole-building simulation tools that facilitate modeling of retrofits in multifamily properties. Some but not all of these tools (for example TREAT and EA-QUIP) have specifically been approved by DOE for use in multifamily retrofits using WAP funds.[7]

[7] Other tools, not listed in the table, have been approved for WAP for multifamily properties with less than 25 units where the apartments are individually heated or cooled. In such cases, the analysis must be supplemented by an audit to evaluate mechanical measures. Examples of such tools include AKWarm, EA-4, EASY 2.1, HomeCheck, and REM/Rate.

Simulation Models Overview

Name	Company	Simulation Engine	Cost	Graphical User Interface
EnergyPlus (e+)	Lawrence Berkeley Nat'l Laboratory	Based on DOE-2 and BLAST	Free	No*
DOE-2	US DOE	Proprietary	Free	No*
TREAT	Performance Systems Development Inc	Proprietary	License, annual fee	Yes
NEAT	Oak Ridge National Laboratory	Proprietary	Free	Yes
EA-QUIP	Association for Energy Affordability Inc	Proprietary	Per model	Yes
eQUEST	Energy Design Resources	DOE-2.2	Free	Yes
Visual DOE	Architectural Energy Corporation	DOE-2.1E	License	Yes

*Third-party interface available

Additional information for the most relevant simulation models is provided in the chart in Exhibit 7 and the At a Glance Summaries found in Exhibit 8.

4. C. Modeling Process and Role of Data

The first step in developing a simulation model for an existing property is to input building design data from a field inspection, a review of design drawings and plans, and/or other sources to accurately capture the building's geometry and physical characteristics in the tool. The auditor will then input various data into the simulation model that is drawn from a review of the property's operating history and typically an energy audit and diagnostic testing. Some of these inputs overlap with data that would typically also be captured by the databases/analytic tools discussed in Section 3. However, the simulation models place more emphasis on building science, the physical characteristics of a given property, and the changes expected to result from a potential retrofit. This requires substantial additional unique inputs. Examples of these are listed in the table below.

Additional Data Collection Points Associated with Simulation Models

Property component and retrofit data	Occupant and behavior data
▪ Orientation of building and components ▪ Volume of conditioned and unconditioned spaces ▪ Heating and cooling systems (types, delivery/return temperatures, efficiencies) ▪ Domestic hot water systems (types, efficiency) ▪ Lighting (types) ▪ Wall, floor, ceiling, and roof types and respective R-Values ▪ Doors (types, locations, R-Values) ▪ Windows (types, locations, U-Factors) ▪ Air infiltration	▪ Occupied heating and cooling temperatures ▪ Temperature set points ▪ Gallons/person/day ▪ Hours of usage ▪ Tenant type ▪ Population size

Once the data is entered in, the simulation model will retrieve detailed weather data for the property's location and the dates covered by the historical usage information. The calculated energy loads are compared to actual historical usage to ensure that the model is an accurate representation of the existing building. Following calibration, the auditor can change one or more components of the building and rerun the simulation to predict energy savings.

For example, the auditor may replace the existing boilers with high-efficiency boilers and upgrade the U-Factor of the windows to simulate a potential retrofit. The modified model will project changes in utility consumption and savings may be projected accordingly. The results should take into account interactivity of the various measures to avoid overstatement of potential energy savings.

5. Green Building Standards for Multifamily

The purposes of 'green' building include increasing the efficiency of buildings, optimizing their consumption of energy, water and materials, and lowering their negative impacts on human health and the environment. Green building standards assist this process by providing a framework for practical and measurable improvements in the siting, design, construction, operations, maintenance, and even demolition of properties. Energy and water efficiency are fundamental principles of all green building standards.[8]

In this section of the report, we review a sample of green building standards for multifamily rental housing. We also characterize the nature of standards currently used in green building in the US more generally and their relationship to utility usage data.

5. A. Standards Included in Our Scan

In our scan, we focused on national-level green building standards but have highlighted a few state-wide standards to illustrate the phenomenon of regionally tailored standards.

Most of these standards are ratings systems. That means that they are points-based guidelines. Most are used, or intended for use, nationally but make allowances for regional variations or compliance with regional or local building codes. Nearly all involve third party certification systems, which offer credibility that buildings were built as proposed and are therefore more likely to perform as claimed. However, in some cases, structures may be 'built to standard' without committing to the cost and inconvenience of actual certification.

The primary green building standards for multifamily housing are highlighted below. A tabular summary of key characteristics of these standards is included as Exhibit 9 and At a Glance summary for selected standards are provided in Exhibit 10.

Primary Green Building Standards for Multifamily	
ENERGY STAR	A joint program of the DOE & EPA, ENERGY STAR is the country's oldest program focused on energy efficiency practices and products. These federal agencies launched ENERGY STAR for Qualified Homes in 1995, now the most widely used energy efficiency standard in the US. ENERGY STAR Multifamily High-Rise was subsequently launched as a separate program pilot. This standard is under development and due for roll-out in the near future.
Leadership in Energy & Environmental Design (LEED)	Introduced by the US Green Building Council (USGBC) in 1998, LEED has become a nationally, as well as internationally, recognized green building standard with residential applications in countries as varied as Canada, Mexico, Brazil and India.

[8] The term "standard" is used informally in our report, as it is throughout the rental housing industry. The certification and labeling systems we describe have not necessarily been formally approved by a recognized standards-setting body.

Green Globes	Imported from Canada by the Green Building Initiative (GBI), Green Globes entered the U.S. market in 2005. It was the first online standard, meaning that a building could be assessed and recommendations could be given through a web-based tool. Since then, web-based options have been offered by most others. Green Globes is based on the British Research Establishment Environmental Assessment Method (BREEAM), which has been adopted and adapted worldwide. The US system has been modified to reflect US measurement systems, climate, and other factors.
Enterprise Green Communities Criteria	Started in 2005 by the Enterprise Community Partners, Inc., the Green Communities Criteria is the only national green building program concentrating on affordable housing including both for-sale and rental properties.
ICC 700 National Green Building Standard (NGBS)	Developed through the efforts of the National Association of Home Builders (NAHB), NMHC, the International Code Council (ICC), and others, the NGBS was launched in 2007 as the first code-based residential green building rating system approved as an American National Standard by the American National Standards Institute (ANSI). Certification is administered by the NAHB Research Center, an independent organization.
Standard 189.1 for the Design of High- Performance Green Buildings (ASHRAE 189.1)	This standard was co-developed by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), the Illuminating Engineering Society of North America (IES), and the USGBC. It is written in code language for ready use by professionals and public inspectors. It is also incorporated into the International Green Construction Code (IGCC) as an alternate path of jurisdictional compliance.

5. B. Green Building Standards in the United States

There are numerous green building standards programs in use throughout the United States. Several of the best known standards are veritable household names that are recognized by the general public - even if the meaning of the certification isn't quite clear. Increasingly, regional standards are emerging as completely new efforts or as a result of tailoring national standards systems to reflect regional variations in climate, building types, common equipment, and desired interventions.

5. B. 1. ***Provenance and Development***

In the mid-1990's, ENERGY STAR was developed as the first national standard by EPA. Since then, numerous private organizations and trade groups have developed their own standards and rating systems. For instance, GBI (which oversees Green Globes) is backed by the Wood Promotion Network and the National Green Building Standard was promoted by the NAHB and NMHC. The development of these standards has often been a collaborative effort and in most cases includes some formal consensus or even public comment process. For example, the 2005 Enterprise Green Communities Criteria were drafted with significant input from, among others, the Natural Resources Defense Council, the American Institute of Architects, the American Planning Association, the USGBC, the National Center for Healthy Housing, and Southface, among others. CALGreen, a statewide building standard for California, was the result of a group effort among state agencies, model code organizations, environmental organizations, the construction industry, and the general public.

The frequency and timing of revisions are very important for the standards systems. Changes are made as technologies, practices, associated codes and cross-referenced standards are updated. For instance, LEED is tied to ENERGY STAR and is updated according to the latter's revision schedule. These revisions can dramatically increase the projected efficiency of the buildings. For example, a DOE analysis showed that the minimum set of prescriptive recommendations of ASHRAE 189.1 led to additional projected

energy savings of between 10% and 41% when compared to older ASHRAE standards. It is important to note that the savings are projected and theoretical in all cases.

5. B. 2. *How the Standards Work*

All standards are basically a product purchased by the user through a fee[9] paid directly to the administering agency. In some limited cases, these fees are reduced for members of affiliated organizations. In exchange for this fee, the user gains access to the standard. In all cases that we studied, this is now available as an online interface that allows the user to evaluate their design elements, product choices, etc. with varying levels of interactivity. Some standards include a certification by the administering agency and may involve separate fees. In order to be certified, some standards require review and analysis by the agency, field verification, or even testing. This typically requires additional fees to the agency or third-party consultants.

Many administering entities have ancillary lines of business which relate to the standard. These may include technical support for direct clients, training or certification of third-party consultants who work with the end user, or (to a much more limited extent) database or financing activities. Users or clients of green building standards include architects, planners, developers, property owners and managers, third party verifiers, appraisers, auditors, and municipalities.

5. B. 3. *Evolution of Standards into Multifamily and Retrofit*

Most standards were originally developed for single family homes or commercial buildings. In the absence of tailored standards, multifamily projects have been evaluated through ill-fitting inclusion into existing evaluation systems. In some cases, this has been carried out by categorizing the property by size or number of floors - with 'low-rise' multifamily buildings often included with single family homes and 'high-rise' with commercial buildings.

Complicating matters, different standards may categorize similar buildings differently. For example, LEED for Homes Multifamily Midrise, which commenced in 2011, covers new buildings from four to six floors, above which the commercial standard LEED for New Construction applies. The EPA's pilot program to be launched this year, called Multi Family High Rise, will be applicable to the construction of multifamily projects of four floors or more, and to mixed-use building where 50% or more is residential.

Until very recently, all standards assumed that the property under consideration was either new construction or substantial rehabilitation. This is partly due to the complexity of existing building rehabilitation and the fact that new construction lends itself to simpler evaluation: not having a 'blank slate' from which to start makes the application of a standard much more difficult. It requires an understanding of the existing building condition and ideally baseline utility usage.

Historically, green 'upgrades' to existing buildings have been the province of weatherization programs or local code-based initiatives. However, growing recognition that multifamily new construction or substantial rehabilitation properties account for only a very small percentage of all the building stock (and a disproportionally small fraction of energy consumption) is leading to greater interest in setting standards for retrofits. Currently, Enterprise Green Communities Criteria is the only standard that addresses 'moderate rehab' as a distinct activity.

[9] ENERGY STAR is an exception to this, as it does not require a fee.

5. B. 4. *Standards at the State Level*

Most multifamily green building standards are intended to be national. For several years now, states have encouraged the use of these standards by directing significant financial and other resources to properties meeting these criteria. For example, when last surveyed in 2007, nineteen State Housing Finance Agencies had adopted the Enterprise Green Communities Criteria in full either as a threshold or incentive item in funding allocations. Over a dozen states offered specific incentives to projects that met other applicable standards.

Generally states have encouraged the use of national standards in lieu of adopting state-specific guidelines. However, there are some examples of states creating their own standards in order to raise the profile of green building in their jurisdictions, demystify green building practices, and/or make a statement to the public. The Florida Green Building Coalition (FGBC), a non-profit group, launched voluntary standards in 2001 with the intention of creating a state-wide green building standard. Since then the FGBC has become the main certifier of green projects in the state. The state of Washington's Evergreen Sustainable Development Standard is informed by LEED and Enterprise Green Communities Criteria but is a separate, distinguishable standard. CALGreen, the farthest reaching state standard, is profiled below. While very extensive, CALGreen has been criticized by some as setting too low a bar. These critics fear that developers will opt for compliance with state standards rather than (not in addition to) compliance with 'greener' national standards.

California Green Building Standards Code (CALGreen)

CALGreen is the first state-wide, mandatory, code-enforceable green building standard in the country. Initially launched in 2009 as a voluntary program, it became mandatory state-wide beginning on January 1, 2011. It applies to all new residential, commercial, and institutional buildings constructed after that date. CALGreen was a collaborative effort among state agencies, county and local governments, and special districts. Property owners can build to a certifiable green standard with no cost for certification. Code compliance is monitored by local and state building departments. CALGreen also offers voluntary provisions to encourage municipalities to increase building energy efficiency and conserve resources.

State and local governments are becoming more proactive in this arena. Many are searching for locally-administrable, code-based measures that provide greater control over building. Some are collecting utility usage data for their own purposes. Since utilities are regulated by the states, this may provide a nexus for cooperation with utility providers and represent an avenue for improving access to multifamily data.

5. C. Relationship of Standards to Utility Usage Data

Generally, green building standards present a menu of available options, minimums, or requirements that must be met in order to achieve a particular level of certification. The certifications are not intended to be a proxy for a particular level of energy efficiency in a building or to predict utility consumption or expenses. In fact, the connection between buildings standards and utility usage data is very limited and indirect, both with respect to the development of the standards and their ongoing administration. The green standards community recognizes the dearth of hard usage data for multifamily buildings and there is considerable interest in capturing better information to improve the standards and better evaluate building performance over time. Fortunately, nearly all of standard-setting organizations cooperate with each other and work regularly with entities that gather utility data or offer analytic tools.

5. C. 1. *Developing the Standards*

Most of the green building standards surveyed did not use utility consumption data directly during their creation or formulation. An exception is the EPA's Multi-Family High Rise pilot, which is gathering utility data from projects in the pilot nationwide to assist in the development of its new standard. More typical is a once-removed relationship. For example, the USGBC did not examine utility usage data when it created the LEED standards. However, LEED does reference ENERGY STAR for Homes and is informed by the relative efficiency metrics of the latter.

5. C. 2. *Attention to Utility Usage Within the Standards*

All standards have core criteria that focus on utility usage, but the relative importance when compared with other factors varies from standard to standard. For instance, the Green Globes standard weighs utility usage criteria as 35-36% of the total points possible. These criteria manifest variously as broad energy or water efficiency assumptions or, as in the case of ENERGY STAR, are broken down into heating/cooling, lighting etc. However, in all cases, these are projected or hypothetical savings derived from simulation models and should not be confused with data derived from property operations.

A very few standards, such as Enterprise Green Communities Criteria, offer points for collecting and monitoring of a projects' utility data. Data collected by Enterprise will be used in conjunction with ENERGY STAR. Green Globes recommends monitoring a building for a further five years, with a recertification at the three year mark. It hopes to make this recertification mandatory in the future. Data collected would be input into the Portfolio Manager database. LEED for Homes does not now, and will not in the immediate future, require utility data reporting as a condition of certification. However, other LEED rating systems (LEED for New Construction for example) have begun to require at least five years energy and water usage reporting back to USGBC.

5. C. 3. *Pathways -- Prescriptive vs. Performance*

Most of the green building standards that we surveyed follow a 'prescriptive' path – sometimes referred to as a checklist -- to achieving greater building efficiency. This is considered the simplest way to reach the efficiency levels required by a standard. It involves employing a single set of measures, both components and practices, to construct a building. For example, ENERGY STAR for Homes offers a builder option package. This dictates a set of specifications (building envelope, heating and cooling systems, etc.) which can be adopted in order to qualify for the ENERGY STAR label. In other cases, a green standard will simply reference another existing building standard. For instance, Criterion 5.1a of the Enterprise Green Communities Criteria 2011 requires that builders "certify the project under ENERGY STAR New Homes Version 2, 2.5, or 3 depending on when the project is permitted."[10] Prescriptive paths have only an indirect relationship to actual utility usage data.

As an alternative to the prescriptive route, some green building standards require or recommend a 'performance path' or 'simulated performance alternative'. This approach calls for utility usage analysis and modeling to estimate the energy efficiency of a building compared to that of a standard reference design. Here, the relationship of the data and the standards is much more direct.

[10] http://www.practitionerresources.org/cache/documents/674/67453.pdf

Most of the data for performance testing within these models originates from the CBECS or RECS databases. ENERGY STAR Qualified Homes recommends Home Energy Rating software programs accredited by the Residential Energy Services Network (RESNET) for these purposes. The LEED ratings system requires only the submission of modeling forms which follow ASHRAE 90.1 modeling (this is true for both LEED for Homes & LEED New Construction). Green Globes has an initiative for commercial buildings (Continuous Improvement of Existing Buildings or CIEB) that utilizes Portfolio Manager.

Notwithstanding that the performance path is used to greater effect with existing buildings, the national green building standards tend to be prescriptive with regard to multifamily retrofits. There is considerable tension in the industry over this, including concerns (particularly among affordable housing owners) that the standards do not adequately consider the costs of bringing an existing building into compliance. These costs may render compliance financially infeasible, put pressure on affordable rents, or both. Advocates of the performance path also point out that a property may be retrofit to great effect, reducing energy use dramatically, and still be unable to meet the (prescriptive) criteria for certification. To these owners, a property's utility usage data before and after retrofit should play a more significant role in qualifying properties for certifications under green standards.

6. Cooperation and Convergence

Within the multifamily housing sector, the green industry is growing, dynamic, and fluid. As the industry matures, it is evolving from a set of disparate pioneer actors with specialized programs to a more complex set of durable relationships and cross-functional activities. Eventually these informal and gravitational relationships will solidify and become more formal and rigid. Although the links between multifamily utility usage databases, simulation models, and green building standards are not as direct as one might expect, we can observe a general movement toward cooperation between entities and a convergence of product offering types.

6. A. Cooperation Among Actors

There are numerous examples of cooperation between entities, particularly around issues relating to the collection and access to data. The real and perceived value of shared utility usage information is inspiring collaboration, as illustrated by the examples below.

6. A. 1. *The Residential Energy and Water Data Collaborative*

Beginning in early summer 2010, a group of affordable housing intermediaries joined together to explore the standardization of data collection for multifamily. Members of the collaborative agreed that the lack of uniform data was a hindrance to policy advocacy and more importantly, securing new financing for energy improvements. Dubbed the Residential Energy and Water Data Collaborative (REWDC), the original participants included Enterprise Community Partners, the Local Initiatives Support Corporation (LISC), NeighborWorks, and SAHF. The Housing Partnership Network (HPN), an advocacy group whose members include nearly 100 housing organizations, subsequently joined the effort.

The REWDC set out with the intention of creating a threshold set of data points, based on agreed definitions, which could then be collected from any property and analyzed using a variety of database/analytic tools. Collecting this data could help members better understand the performance of their existing portfolios, identify poor performers, and prioritize among their properties for retrofit investment. Data collected could also be loaded

into EPA's Portfolio Manager and potentially increase the utility of that tool for multifamily analysis.

After extensive discussion and debate, the REWDC achieved consensus on a set of data points that will be collected by its members for the multifamily properties in their portfolios. REWDC is not advocating for the use of any single database/analytic tool or product, and throughout the process worked closely with a number of providers (EnergyScoreCards, WegoWise, and Peregrine Focus) to establish the common data points. The REWDC has published its conclusions and a summary paper in hopes of encouraging other owners to collect this same information for their properties and thereby standardization of utility usage data and performance tracking across the industry.

Even if only the existing members of the REWDC are committed to gathering this data, this could represent a very significant data sample given the size of the REWDC members' multifamily portfolios. However, it remains to be seen whether the cost and time investment associated with gathering this data will prove to be a major barrier to the success of the effort.

6. A. 2. ***The New York City Collaborative***

Independent of the REWDC effort, the Deutsche Bank Americas Foundation and Living Cities reached a similar conclusion: the paucity of hard data on the effectiveness of multifamily retrofits is a critical barrier to obtaining new financing for such improvements. Their objective, to be realized through the EER initiative, is to aggregate utility usage data on recently retrofit properties and compare this actual performance with the pre-retrofit projections. Using this performance data, the effort seeks to provide financiers with good data that will inform underwriting and improve investment confidence. The effort may also trigger renewed exploration of mechanisms to support both first mortgage and subordinated debt associated with energy efficiency improvements.

The effort is focused within New York City at the moment, but may well influence the finance ecosystem more broadly. Current participants include:

- New York City agencies including the Department of Housing Preservation and Development (HPD), the Housing Development Corporation (HDC), the Economic Development Corporation (EDC), and the Mayor's Office of Long Term Planning and Sustainability.
- New York State agencies including the Energy Research and Development Authority (NYSERDA) and the Division of Housing and Community Renewal (HCR);
- Utilities such as Con Edison and National Grid;
- Funding intermediaries including Enterprise Community Partners, the Community Preservation Corporation (CPC), the Low Income Investment Fund (LIIF), LISC, and Seedco; and
- Advocacy organizations such as the Partnership for NYC and the National Resources Defense Council (NRDC).

Technical support to the EER efforts is being provided by Steven Winter Associates and HR&A Advisors. The effort has identified as many as 85 projects (18,000 units) for inclusion in the data pool. To date, they have gathered data on over 8,000 units and have begun analyzing the results on over half of those.

6. A. 3. ***Multiple Layers of Cooperation and Convergence***

Further demonstrating the spirit of cooperation, both the REWDC and New York City groups have coordinated with one another, attempting to align to the greatest degree possible the data points that they will gather and analyze. These organizations are also in active discussions with Fannie Mae, who has partnered with EPA's ENERGY STAR Commercial Buildings Program[11] in an effort to improve the energy and water efficiency of the nation's multifamily housing stock. Fannie Mae will help EPA explore the development of an ENERGY STAR 1-100 energy performance rating, a rating system widely adopted by the commercial building market and centered around the ENERGY STAR brand. Through the partnership EPA will be able to leverage Fannie Mae's existing property database and develop a framework for the collection of additional energy consumption and operational data needed to analytically assess energy performance in existing multifamily housing buildings. Once the data collection is complete, EPA can begin an analysis to determine the viability of developing a 1-to-100 score for these property types.

In this way, collegial cooperation among actors with significant gravitational pull due to their size, financial resources, and influence could result in an industry-wide standardization of data points to be collected for multifamily housing. To the extent that these organizations are collaborating with one or more of the private database/analytic tool providers (with their broader customer bases and datasets), there is even further potential for standardization. Most of the firms providing data analytics have already designed their tools to export data into Portfolio Manager.

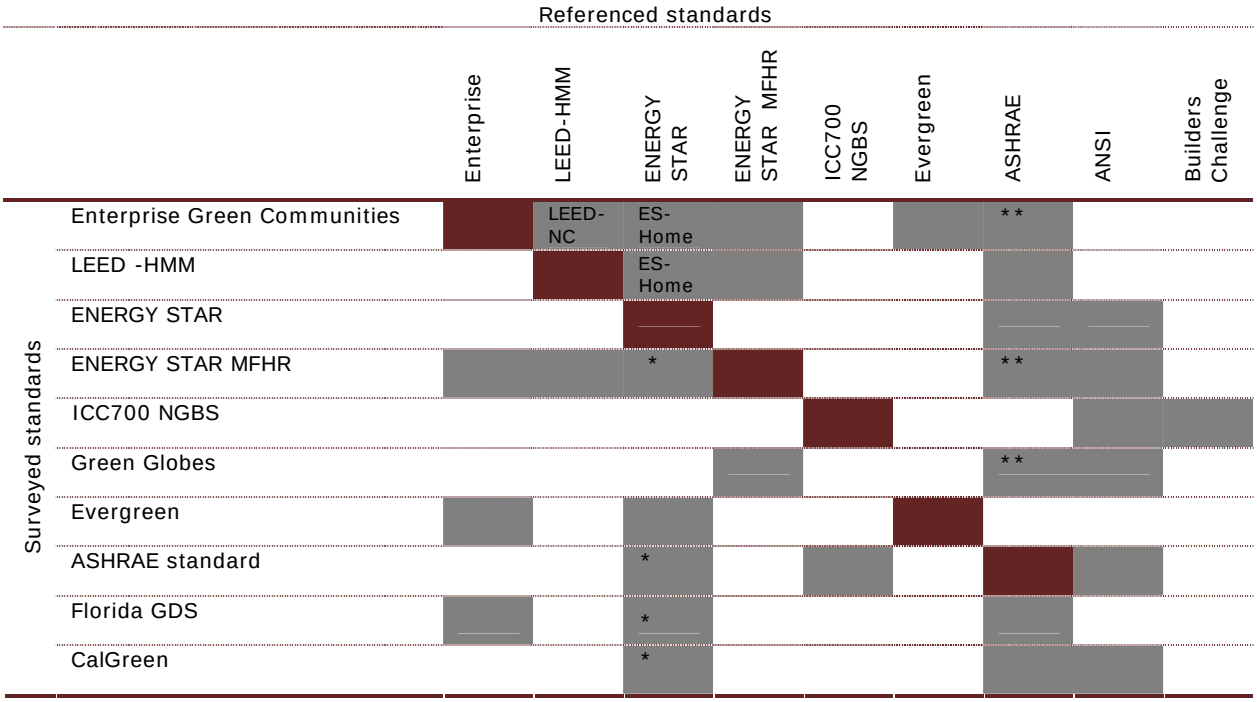
It should also be noted that nearly all the green building standards that we surveyed cooperate or interact with other standards or with entities that gather data or offer analytic tools. Many standards use CBECS as the underlying source to inform their models and for benchmarking of commercial properties. DOE and EPA tools are used widely for tracking, evaluating, and/or forecasting utility consumption within standards. For instance, Green Globes uses the EPA's Target Finder for new construction and Portfolio Manager for monitoring existing buildings. Enterprise recommends using energy simulation tools such as DOE-2 and EQuest for new construction and Home Energy Rating System (HERS) for rehab.

The underlying reliance upon federal agency sources for data and basic analysis in standards and the cross-referencing that occurs among standards and rating systems also illustrates the interconnectedness of programs and actors in this universe. This might not be readily apparent at first glance, particularly as these organizations attempt to distinguish themselves in their promotions and marketing. In particular, we note that CBECS is frequently cited even though it does not contain any multifamily data. CBECS data informs, even if indirectly, a great many multifamily green initiatives.

The table on the following page indicates some of the cross-referencing between the standards we surveyed and other green building standards.

[11] http://www.energystar.gov/buildings

Cross-Referencing Among Standards



* Appliances only
** ASHRAE 90.1 2007

6. B. Convergence of Programs and Products

While defining programs and products according to our typology is helpful in understanding the current environment, the lines between our categories are blurry. Increasingly, organizations that gather data, and companies who create products to serve this market, are looking to increase the functionality and convenience of their tools. Likewise, companies that have previously focused on tools for monitoring and analysis of historical utility usage are now looking to add forecasting capacity as well.

We can observe this in the current state, but it becomes even clearer in examining the pilot projects that are underway and in the aspirations that various actors have for their own product development. For instance, green building standards have to date had little or no direct connection to the collection or analysis of property utility usage data. However, some of the entities who sponsor standards and rating systems are now proactively aligning this data with their programs, and elective participation in data collection is now rewarded in a few standards or ratings. This movement toward integration of data into standards systems and the expanded functionality of analytic tools has caused most actors in the space to reassess their ability to integrate utility usage data into their existing activities.

This is not to suggest that in a 'mature state' there will be a complete convergence where building standards, data pools, analytic tools, and simulation models will be completely and seamlessly integrated. For some, there is little to gain from this type of integration – continuing to offer a freestanding service, product, or program will remain appropriate.

7. Issues and Obstacles

Considerable progress is being made in gathering and analyzing utility usage data for multifamily housing. However, as outlined below, significant obstacles remain with respect to aggregating quality data and leveraging that data to more broadly achieve energy efficiency for multifamily housing.

7. A. Access to Data

Privacy concerns at the household and property level are paramount to discussions of how multifamily data can be accessed, used, shared, and published. There are no national or universally-adopted privacy guidelines in place today, and to some extent the current regulatory framework is subject to interpretation.

Technological capacity is also a factor, as personal data (for example Social Security Numbers, payment account information, age, etc.) may be intermingled with utility usage data when it is stored by utility companies. According to our respondents, some utility companies have developed systems to effectively remove sensitive personal data, but others have not. This inability to separate useful utility usage information from sensitive personal information means that utilities are often unable to share any information at all.

The same issue arises for databases around 'identifying information'. All databases expressed a need to protect their users from publishing information, in a direct or comparative context, at a level of disaggregation that could potentially identify the household, building, or property. However, there is no agreed standard for determining when this threshold is met.

Few of the entities we interviewed seemed to have firm policies regarding receipt of permission to hold consumption information in their databases. Several organizations noted that they have a 'philosophy' of protecting their users' data. 'Terms of use' was the privacy paradigm most commonly mentioned among the newer and more exclusively web-based platforms. Under this construct, any information entered onto a form on the website is subject to the terms of use and therefore protected. It is not necessarily clear how the terms of use concept extends to occasions when consent is given to 'scrape' data from an online user account, when data is submitted in hard copy or transferred from another database, or when apartment tenancy turns over. It may also be ambiguous whether the granting of permission can ever be revoked once given.

Other providers have built their databases, at least initially, on the basis of actual signed permissions to access and use consumption data. This was required by local utilities in some cases. For master metered properties, these permissions can be obtained from the building owner or manager. Where the utilities are tenant-paid, it may require going door-to-door and attempting to get signatures from all tenants. This is an often futile exercise which almost always results in a portion of units of a building being excluded from data tracking. An alternative for such properties may be to acquire a master meter, which is becoming increasingly common in the commercial sector, although for some residential properties the cost of this may be prohibitive.

While some have advocated for a national standard for permissions, it seems more likely that these policies will be set at the state level, as part of regulation of utility providers.

7. B. Data Collection

Beyond data access, there are significant issues relating to data collection, data integrity, and the costs and resources associated developing large scale multifamily databases. The most important of these are highlighted below.

7. B. 1. *What is Worth Collecting?*

Setting the variables to be included in a database and used for subsequent analysis depends on two fundamental considerations: what is possible, and what appears to be potentially significant. This is clearly reflected in the decisions that have been made for those properties for which usage data is currently being collected and monitored. There is a significant level of complexity in utility consumption data alone, independent of the many other variables that may be meaningful for a multifamily property. Databases have to choose the degree of granularity needed in order to provide a vehicle for useful analysis.

Setting the threshold of variables collected implies that the variables have been prioritized by their correlation with utility use – their predictive power. To rate the importance of different variables though, they must be tested in a model using the data. Up until now, each entity developing a database has undertaken this prioritization process using their own database and key variables without access to other data that may be held by others. Presumably access to a broader dataset would help refine the analytic tools and improve their value and utility. However, the lack of standards for variables throughout the data collection process is a fundamental weakness underlying the quality of the databases and the effectiveness of analytic tools.

The analytic tools in use today have generally been designed with property owners and managers in mind, to help understand property performance and identify candidates for further evaluation. While this is clearly valuable, there is also a sense among interviewees that these efforts may be somewhat disconnected from other important potential end users, including but not limited to lenders and equity investors.

For example, it seems likely that high quality multifamily utility usage databases could play a part in the underwriting of proposed retrofits going forward. While some lenders (including Fannie Mae, Deutsche Bank, Boston Community Capital, and Enterprise Community Partners) have taken a strong interest in data collection, it is too soon to know how much data, and what kind of data, would be sufficient to trigger new investment. Conversely, some lenders and investors have already taken the position that no amount of data will be sufficient in the absence of guarantees by the borrower or others around the projected energy savings. While this may be a perfectly reasonable position to take in some instances, it potentially calls into question the value of large scale data collection efforts, at least in terms of developing financing vehicles to address energy inefficient properties.

Property owners and managers may also question the value of these efforts. While acknowledging that data can be important, there is a certain amount of fatigue with the collection process and debates about what needs to be collected and how it should be done. These groups welcome standardization so that their collection efforts can be made as efficient and cost-effective as possible. Owners and managers also have concerns about savings projections models given the small amount of data that has been collected for multifamily and the effect of uncontrollable variables (such as climate or resident behavior) on post-retrofit performance. Short of government mandates, multifamily retrofits can only occur if building owners and managers have sufficient motivation and incentive. They are the ones who will most often initiate energy audits and financing plans, and bear the transaction and certification costs. Even for the most forward thinking and optimistic

property owners, there are significant upfront investments required in advance of long-term efficiency payoffs.

7. B. 2. ***Data Quality Concerns***

Data quality is another overriding issue raised frequently among the interviewees. The more steps required to transfer basic consumption data from utility companies to the database, the more room there is for 'human error', such as misreading or miscoding values. Also, in some cases the quality of the data itself, especially when reported through others, cannot be confirmed. This presents a quandary to those using utility data in their analysis or to inform simulation models. Is it better to use a larger dataset of indeterminate quality or a smaller dataset in which one has full confidence? Most working in this space now choose to utilize only data that they themselves have sourced or that they have great confidence in. Greater data transparency would enable the building of larger datasets without sacrificing integrity. Automation through scraping or smart meters holds significant promise, but these technologies are not without their critics.

The lack of standard methodology also hampers the normalization of data. Some databases, for example, 'scale up' unit data to the building level using random sampling; others try to get representative units. Other databases – RECS most prominently – have developed protocols to go in the opposite direction, 'scaling down' building-level consumption use to the unit scale. There are multiple examples of these types of normalization techniques but there is no standard approach. The lack of standardization impedes not only the ability to compare between databases (and even within a single database as protocols evolve over a period of years), it limits the effectiveness of the database tools and analytics that rely on this information to evaluate and forecast property utility usage.

7. B. 3. ***Cost and Effort***

Interviewees frequently noted that the multifamily industry lags far behind the single family and commercial sectors with respect to data and analytic tools. Most cited as the key barrier the high initial cost to build a viable database and relevant analytical models that encompass the nuances of multifamily utility consumption and related variables. "Multifamily is just more complicated" was a frequent refrain.

Simply collecting the relevant data requires a considerable investment in staff time on the part of utilities, property and asset managers, and building owners. One interviewee indicated that the "hidden cost of participation on the part of property owners will be in the millions". Those with a business interest in building databases and tools will invest their resources in the hopes of recouping that investment through the sale of their product. Some are doing just that. However, those who don't benefit immediately and directly from data collection and aggregation might need stronger incentives – or need to see a much stronger connection between the database efforts and improved property performance, reduced energy expenditures, or access to financing - to continue their efforts over time.

Finally, while we have described a certain level of cooperation and interconnection between the various standards databases and tools, one cannot underestimate the power of self-interest in hindering data sharing and the transparency of data. Recent collaborative efforts aimed at creating common datasets - much less shared databases - have encountered some resistance from those who have already developed their own proprietary information stores and tools. Though most entities expressed an interest in having access to a broader array of data, there is a long list of caveats.

This self-interest is not reserved to private business concerns. Understandably, any entity that has invested significant time, resources, and reputation in developing their green standard, database or simulation model will be reluctant to compromise their own program or diminish their unique value proposition. Given their investment to date, these parties will need to see greater value in collaboration and interconnectivity in order to contribute data, ideas, and energy to a broader industry-wide effort.

8. Conclusion

Although the majority of the nation's multifamily rental housing stock was built before 1980, there is very little data available on utility usage for these developments. Increasingly, the industry is recognizing the great potential of retrofit strategies to reduce energy and water consumption for these buildings, but the effectiveness and scale of these opportunities are hindered by the lack of good data on current usage. Perhaps in part due to the lack of sufficient data, simulation models and green building standards used in the context of retrofits do not tie very directly to property operating histories or peer comparison analysis.

Over the past five years, a greater emphasis on data collection and analysis has emerged, and there are significant initiatives underway at the federal and state government level, among nonprofit housing organizations and philanthropic organizations, and in the private sector. As of yet, there is no industry consensus as to the data variables that should be collected and there are no recognized best practices regarding data access, aggregation, and sharing. Nevertheless there is an increasing degree of collaboration and growing potential for building large datasets which may have great value in formulating and executing strategies to improve energy efficiency in multifamily rental housing.

The key to achieving this impact likely begins with creating standards around the collection and use of utility usage data, to foster the development of larger databases and enable coordinated industry efforts to overcome known obstacles. The standards should be firm enough to promote strong data integrity and efficient collection efforts, but flexible enough to recognize that different constituents will inevitably use the data for different purposes.

Exhibit 1: List of Interviewees

Entity	***Name***	***Title***
Boston Community Capital	**DeWitt Jones**	Executive Vice President
Bright Power	**Jeffrey Perlman**	President
California Energy Consumption Database	**Steven Mac**	Database Manager
Center for Neighborhood Technology	**Ann McKibbin**	Policy Director
Center for State Innovation	**Joseph Cullen**	Senior Advisor
Deutsche Bank Americas Foundation	**Sam Marks**	Vice President
DOE - Residential Energy Consumption Survey	**Chip Berry**	Survey Manager
EPA - Energy Star Commercial and Industrial Branch	**Michael Zatz**	Chief, Market Sectors Group
EPA - Energy Star Residential Branch	**Ted Leopkey**	National Program Manager for the ENERGY STAR Multifamily High Rise program
Enterprise Community Partners	**Dana Bourland**	Vice President, Green Initiatives
Enterprise Community Partners	**Emily Mitchell**	Program Director,Enterprise Green Communities
Enterprise Community Partners	**Yianice Hernandez**	Senior Program Director, Green Communities
Executive Office of the President/Office of Science and Technology Policy	**Nick Sinai**	Senior Advisor to the CTO, Innovation & Entrepreneurship
Fannie Mae	**Chrissa Pagitsas**	Multifamily Green Initiative Program Manager
Green Building Initiative	**Ward Hubbell**	President
Housing Trust Fund, WA	**Dena Harris**	Evergreen Program Manager
HUD	**Theodore Toon**	Deputy Assistant Secretary of HUD, Office of Affordable Housing Preservation
Local Initiatives Support Corporation	**Madeline Fraser Cook**	Program Director, Green Development Ctr.
Massachusetts Housing Partnership	**Mark Curtiss**	Managing Director
NAHB Research Center	**Michelle Desiderio**	Director, Green Building Programs
National Multi Housing Council / NAA	**Paula Cino**	Director, Energy and Environmental Policy
National Multi Housing Council	**Eileen Lee**	Vice President, Energy and Environmental Policy
Neighborworks America	**Thomas Deyo**	Director, Real Estate, Community Stabilization, and Green Strategies
New Ecology	**Edward Connelly**	President
New York State Division of Homes & Community Renewal	**Daniel Buyer**	Assistant Commissioner for Regional Affairs
Office of Housing, Seattle	**Joanne Quinn**	Sustainability Specialist
PSD Consulting	**Chris Balbach**	Vice President for Research and Development
PSD Consulting	**Jerone Gagliano**	Director, Energy Engineering Services
Pennsylvania Housing Finance Agency	**David Evans**	Asst. Execuive Director of Multifamily
Related Management	**Jeffrey Brodsky**	President
Stewards of Affordable Housing for the Future	**Bill Kelly**	President
Stewards of Affordable Housing for the Future	**Richard Samson**	President, SAHF Energy
Steven Winter Associates	**Marc Zuluaga**	Senior Engineer
Sustainable Real Estate Solutions	**Brian Burstiner**	Director of Sales
Sustainable Real Estate Solutions	**Brian McCarter**	CEO and Founder
Sustainable Real Estate Solutions	**Rich Barrett**	Director of Account Management
TCF Bank/MPHA	**Mark Manbeck**	Vice President CRE
USGBC	**Asa Foss**	LEED Homes manager of technical development
USGBC / Consultant	**Casius Pealer**	former Director of Affordable Housing Initiative
US Bank Commercial Real Estate	**Scott Wisdom**	Associate Relationship Manager

Exhibit 2: Glossary of Terms

The green "industry" is innovative, dynamic, and rapidly evolving, and the vocabulary used to accurately describe and market products and services is co-evolving at an equally rapid pace. As a guide for readers, the terms we use throughout our report are defined below. We recognize that others may have slightly different definitions or interpretations of what is meant by these terms.

Analytic Tools - computer programs that use data from a single property or a pool of properties in order to 1) understand historic performance or 2) project future performance.

Benchmarking – comparison of a building's utility usage vs. usage at "similar" buildings.

Benchmarking Pool – a group of properties used as a basis for benchmarking comparison purposes.

Building Code - a set of regulations adopted by a government legislative authority, such as a city, county or state, that specifies minimum requirements in construction so as to assure that buildings are "practical and adequate for protecting life, safety, and welfare of the public" (International Codes Council).

Building Standards – a set of criteria used to rate or compare the physical components and construction methods used in the development (and sometimes rehabilitation) of a building. These standards may include threshold criteria that *MUST* be satisfied in order to trigger funding, approval by a government entity or to achieve a rating or certification. Other standards provide more flexibility, allowing the applicant to choose from a wide set of options in order to achieve a qualifying score. Some have various levels may be attained (Bronze, Silver, Gold), while others have certifications that are either earned or not.

Certification – documentary confirmation that a building or construction project has achieved the intended level of compliance with a specific standard.

Database - a large collection of utility usage data gathered and aggregated to promote an efficient analysis of properties and portfolios.

Energy Audit – an evaluation of utility usage, property improvements, and building characteristics to identify opportunities to improve energy efficiency and lower utility usage and costs in the future. Audits typically include a review of historical utility usage at the subject property but not others.

The American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) has developed standards for three tiers of energy audits:

- **Level I – Walk-Through Analysis/ Preliminary Audit** provides a simple energy use report identifying major problem areas, suggesting low-cost/no-cost corrective measures with associated implementation costs, savings and payback, as well as potential capital improvements. They are used to assess the need for a more detailed audit.

- **Level II – Energy Survey and Analysis** includes ASHRAE Level I analysis as well as more detailed building survey, energy analysis, and financial projections. Utility bill-based energy use profiles for up to 3 years are evaluated to identify all appropriate energy conservation measures. A life cycle cost analysis/financial analysis evaluates the costs and benefits of potential capital-intensive measures, and helps justify project implementation.

- **Level III – Detailed Analysis of Capital-Intensive Modifications**, also called a comprehensive audit, detailed audit, or technical analysis audit, focuses on the potential capital-intensive projects identified in the Level II analysis and involves more detailed field data gathering as well as a more rigorous engineering analysis. It uses existing utility data to compute cost and savings for all energy conservation measures proposed with the high level of detail required for major capital investment decisions.

HERS – Home Energy Rating System developed by the Residential Energy Services Network (RESNET) measures a building's energy performance with respect to the current International Energy Conservation Code (IECC). Following energy modeling, a building is assigned an index as an indicator of its own energy efficiency. The score does not include a peer comparison, a score of 100 is equivalent to minimum IECC recommendations; a score of 0 equals zero net energy use.

Peer Comparison Analysis. See 'Benchmarking.'

Peer Benchmarking. See 'Benchmarking'

Performance Path/ Performance-Based Compliance – a method whereby energy modeling tools are used to identify the most effective design and building systems that would enable a building to achieve a target level of energy performance. This usually requires a specialist such as a Home Energy Rating System (HERS) rater to carry out the energy simulation and to perform inspections and audits at prescribed construction stages.

Prescriptive Path/Prescriptive-based Compliance – a method whereby a building can be constructed or extensively remodeled to meet a given green building standard's criteria using a prescribed set of specifications for products and practices. A certified professional must verify that the requirements have been met.

Protocol - a set of rules or guidelines establishing a methodology for collecting or analyzing data as well as addressing outlier attributes or situations.

Retrofit – a substantial or partial upgrade of a property's materials or systems. Energy retrofits specifically target interventions that are intended to reduce future energy consumption.

Rating System - a scale-based system of assessment or classification which, in the green building context, frequently employs a point system to grade efficiency in design, practices, use of energy, water, materials, and more. A given number of aggregated points from these areas correspond to levels of "greenness," or project efficiency. A ratings system can help builders and owners set green building goals and achieve certification.

Simulation Model – a computer program used to create a detailed model of a building and simulate future energy usage, typically used by an energy auditor or other qualified professional. Within our report, this term only refers to whole-building simulation tools that facilitate modeling of retrofits in multifamily properties.

Variable – categories of attributes, e.g. 'size', or 'energy consumption per hour' or 'multifamily status'. Problems with interoperability exist when variables are defined differently.

Verification - the process of determining whether or not a building or construction project has achieved the intended level of compliance with a specific standard. Verification can be a review of building design alone, or be combined with an on-site building inspection.

Exhibit 3: Abbreviations and Acronyms

The following is an alphabetically ordered list of abbreviations and acronyms that are used consistently within the report. While most of these are universally recognized, a few have been specifically created when a common shortened form was not available.

ANSI – American National Standards Institute

ASHRAE – The American Society of Heating, Refrigerating, and Air Conditioning Engineers

BPCo – Building Performance Compass

CBECS – Commercial Building Energy Consumption Survey

CIEB – Continuous Improvement of Existing Buildings

CBSC – California Building Standards Commission

CNT – Center for Neighborhood Technology

CPC – Community Preservation Corporation

DOE – United States Department of Energy

EDC – New York City Economic Development Corporation

EER – Energy Efficiency Report

EPA – United States Environmental Protection Agency

FGBC – Florida Green Building Coalition

GBI – Green Building Initiative

HCR – New York State Division of Housing and Community Renewal

HDC – New York City Housing Development Corporation

HERS – Home Energy Rating System

HPD – New York City Department of Housing Preservation and Development

HPN – Housing Partnership Network

HUD – United States Department of Housing and Urban Development

ICC – International Code Council

IES – Illuminating Engineering Society of North America

IGCC– International Green Construction Code

LEED – Leadership in Energy and Environmental Design

LIIF – Low Income Investment Fund

LISC – Local Initiatives Support Corporation

MF – Multifamily

NAHB – National Association of Home Builders

NAHBRC – National Association of Home Builders Research Center

NGBS – National Green Building Standard

NMHC – National Multi Housing Council

NRDC – Natural Resources Defense Councul

NYSERDA - New York State Energy Research and Development Authority

PM C– eMF – Portfolio Manager – Commercial and Existing Multifamily

PM H – nMF – Portfolio Manager – Homes and New or Substantially Retrofitted Multifamily

RECS – Residential Energy Consumption Survey

RESNET – Residential Energy Services Network

SAHF – Stewards of Affordable Housing for the Future

SRM – Sustainable Real Estate Manager

USGBC – US Green Building Council

WSU – Washington State University

Exhibit 4: Comparison of Multifamily Utility Usage Databases

	Factsheet	Name of program	Abbv. used in paper	Managing entity	Year launched	Variables included for majority of database				Automation of data collection process			Score or rating offered	Geography	Portfolio	
						EW	CC	BDR	OB	Low	Med.	High			Total properties	% MF
Federal		Commercial Building Energy Consumption Survey	CBECS	Department of Energy	1979	√		BD	O			Most		National +	~5,000*	0%
		Fannie Mae/ EPA Energy Data Initiative	Fannie Mae	Fannie Mae	2012	√	U	B	O		TBD		MF rating planned	National	5,000-40,000 (planned)	100%
	√	Mark to Market/Retrofit Initiative	HUD	Department of Housing and Urban Development	2007	√	√	BDR	O			All		National	<500	100%
	√	Portfolio Manager – Commercial and existing MF	PM C– eMF	Environmental Protection Agency	1999	√	√	BD(R)		Some	Most	Some	Planned as joint effort w/ Fannie Mae	National	202,000 total 1,500 MF	<1%
	√	Energy Star – Homes and the MFHR pilot for new or substantially rehabilitated multifamily buildings	PM H - nMF	Environmental Protection Agency	1995, 2007 MFHR pilot	√		BD R in MFHR pilot	O		All		Yes for SF, no for MFHR pilot	National	~1,000,000 total <500 MF	<1%, 100% in MFHR pilot
		Residential Energy Consumption Survey	RECS	Department of Energy	1978	√	√	BDR	OB		Some	Most		National +	12,083*	~18% +
Private	√	Building Performance Compass	BPCo	PSD Consulting	2006	√	√	BDR			Most	Some	Comm. only	National, NEast, CA	~1,000	~5%
	√	EnergyScorecards	Energy ScoreCards	Bright Power	2006	√	√	BD(R)	O		All		√	Clusters in NY,PA, CA	~1,500	99%
	√	Sustainable Real Estate Manager	SRM	Sustainable Real Estate Solutions	2007	√	√	BD(R)	O	Most		Some		50 Countries	~120,000	~3-5%
	√	WegoWise	WegoWise	New Ecology (founder)	2010	√	√	BD(R)	O		All		planned	Clusters in MA, NY, CA	~3,500	99%
Mission		Green Retrofit Program and DoE Energy Weatherization Innovation Pilot Program	SAHF	Stewards of Affordable Housing for the Future	2010	√	√	BDR	O	Some	Some		√	National	~700, additional 2,500 coming in next year	100%
	√	Energy Efficiency Report	EER	Deutsche Bank Americas Foundation	2010	√		BDR	O	All				New York City	<200	100%
	√	Enterprise Communities Data	Enterprise	Enterprise Community Partners	2008	√	√	BDR	O	All		Some	planned	National	~250	80%

Variable type:
EW= Energy and water usage
CC= Charges and Costs
BDR =Basic Property data **B**, Property Details **D** or Retrofit data
R. (R) Indicates capacity exists but not majority participation
OB = Occupant, Behavior data

Data Automation:
Low = manually entered, or submitted by user with high degree of standardization needed.
Medium = scraped or submitted by user with some degree of standardization needed.
High = submitted through standardized protocol, automatic importing, directly submitted from utilities

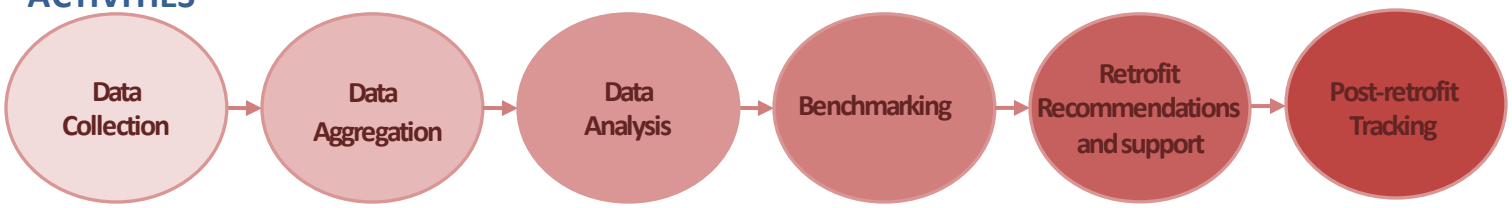
Geography and portfolio:
+ Nationally representative sample
***** Number of properties surveyed in 2009; survey performed every 4 years.

Building Performance Compass

Building Performance Compass is a web-interface where users can track and monitor energy usage for commercial and multifamily properties. The system provides peer comparisons as well as an EPA Portfolio Manager score for commercial properties.

BUILDING PERFORMANCE COMPASS

ACTIVITIES



OVERVIEW

Initiated	2006
Geographic Coverage	National (NE, CA focus)
Database Format	MSSQL
Database Analysis Software	Proprietary
Portfolio	~1,000 bldgs
Primary Clients	Energy consultants, prop. owners & managers, state & local governments
Data Range	12 month min benchmarking
Multifamily focus	~5% (50 bldgs)

PRIMARY DATA SOURCES

Property Owner/ Management Company	✓
Utility Company	✓
Online User Accounts (Scraping)	✓
Third Party	✓

CORE CONTENT

(All collected monthly)
Detailed (D)/ Basic (B)

Utility	Usage	Cost
Electricity	D	B
Gas	D	B
Oil	D	B
Water	D	B

BASIC PROPERTY VARIABLES

Square Footage	✓
Age of Structure	✓
Stories	✓
Occupant Type	X

IN-DEPTH PROPERTY VARIABLES

Energy Retrofits	✓
Geography/ Weather	✓
Other in-depth	✓

DATA ANALYSIS

Historical Tracking	✓
Peer Comparisons	✓
Retrofit Energy Modeling	✓
Before & After Retrofit	✓

DATA OUTPUTS

Score	X Not for MF
General Recommendations	X
Retrofit Recommendations	X

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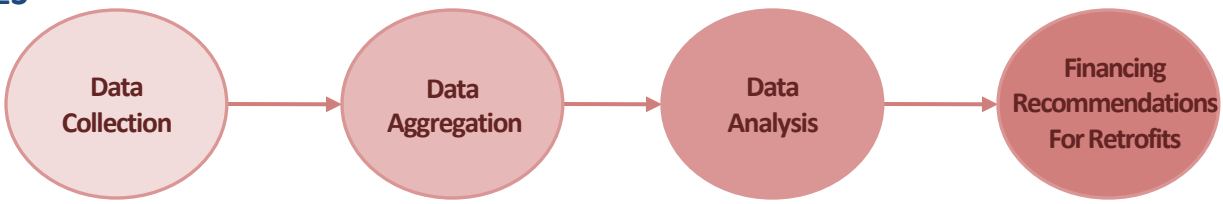
Energy Efficiency Report

Deutsche Bank Americas Foundation and Living Cities are undertaking a study of the before-and-after utility usage of a few hundred multi-family buildings in New York City. The data will be presented in a format that intends to help leverage financing for MF retrofits. Analysis is being performed by Steven Winter Associates and Michael Blasnik.

Deutsche Bank

Steven Winter Associates, Inc.
Building Systems Consultants

ACTIVITIES



OVERVIEW

Initiated	2010
Geographic Coverage	NYC
Database Format	Excel
Database Analysis Software	STATA
Portfolio	200 props.
Primary Clients	Deutsche Bank, Living Cities
Data Range	2 years +
Multi –Family focus	100%

CORE CONTENT

(All collected monthly)
Detailed (D)/ Basic (B)

Utility	Usage	Cost
Electricity	D	X
Gas	D	X
Oil	D	X
Water	D	B

DATA ANALYSIS

Historical Tracking	X
Peer Comparisons	X
Retrofit Energy Modeling	✓
Before & After Retrofit	✓

BASIC PROPERTY VARIABLES

Square Footage	✓
Age of Structure	✓
Stories	✓
Occupant Type	✓

DATA OUTPUTS

Score	X
General Recommendations	✓
Retrofit Recommendations	X

PRIMARY DATA SOURCES

Property Owner/ Management Company	X
Utility Company	X
Online Accounts (Scraping)	X
Third Party	✓

IN-DEPTH PROPERTY VARIABLES

Energy Retrofits	✓
Geography/ Weather	✓
Other in-depth	✓

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EnergyScoreCards

EnergyScoreCards is a third party database and online software service which aggregates, analyzes, and presents utility usage data paired with basic property data. Its primary business is benchmarking multifamily properties. It offers recommendations in the form of an online 'scorecard'.

ACTIVITIES

OVERVIEW

Initiated	2006
Geographic Coverage	National (esp. CA, NY, PA)
Database Format	MYSQL
Database Analysis Software	Proprietary & Excel
Portfolio	1,500 Props.
Primary Clients	Property owners and managers, gov't agencies & housing intermediaries
Data Range	12 mos. up to 4 yrs.
Multifamily focus	99%

PRIMARY DATA SOURCES

Property Owner/ Management Company	✓
Utility Company	✓
Online User Accounts (Scraping)	✓
Third Party	✓

CORE CONTENT

(All collected monthly)
Detailed (D)/ Basic (B)

Utility	Usage	Cost
Electricity	D	D
Gas	D	D
Oil	D	D
Water	D	D

BASIC PROPERTY VARIABLES

Square Footage	✓
Age of Structure	✓
Stories	✓
Occupant Type	✓

IN-DEPTH PROPERTY VARIABLES

Energy Retrofits	✓
Geography/ Weather	✓
Other in-depth	✓

DATA ANALYSIS

Historical Tracking	✓
Peer Comparisons	✓
Retrofit Energy Modeling	X
Before & After Retrofit	✓

DATA OUTPUTS

Score	✓
General Recommendations	✓
Retrofit Recommendations	✓

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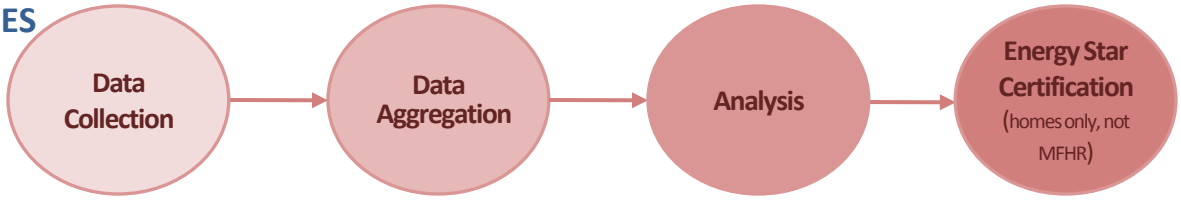
Energy Star Homes and MFHR pilot for new & rehabbed multifamily

Data is one component of the one-time Energy Star certification process for homes. Energy Star also has a recently launched ambitious pilot on new, or substantively retrofitted multifamily properties - MFHR - which includes a more thorough data collection initiative but has a limited number of properties.

ACTIVITIES



OVERVIEW

Initiated	1995 SF 2007 MF pilot
Geographic Coverage	National
Database Format	Excel
Database Analysis Software	Unknown
Portfolio	~1,000,000
Primary Clients	Property Owners
Data Range	12 mo minimum
Multifamily focus	SF. Few MF under special circumstances In MFHR pilot, MF is 100%

PRIMARY DATA SOURCES

Property Owner/ Management Company	✓
Utility Company	X
Online User Accounts (Scraping)	X
Third Party	X

CORE CONTENT

(All collected monthly)
Detailed (D)/ Basic (B)

Utility	Usage	Cost
Electricity	D	X
Gas	D	X
Oil	D	X
Water	D	X

BASIC PROPERTY VARIABLES

Square Footage	✓
Age of Structure	✓
Stories	✓
Occupant Type	X

IN-DEPTH PROPERTY VARIABLES

	MF HR
Energy Retrofits	✓
Geography/ Weather	✓
Other in-depth	✓

DATA ANALYSIS

Historical Tracking	✓
Peer Comparisons	✓ Homes
Retrofit Energy Modeling	X
Before & After Retrofit	✓ MFHR

DATA OUTPUTS

Score	✓ Homes
General Recommendations	✓
Retrofit Recommendations	✓ MFHR

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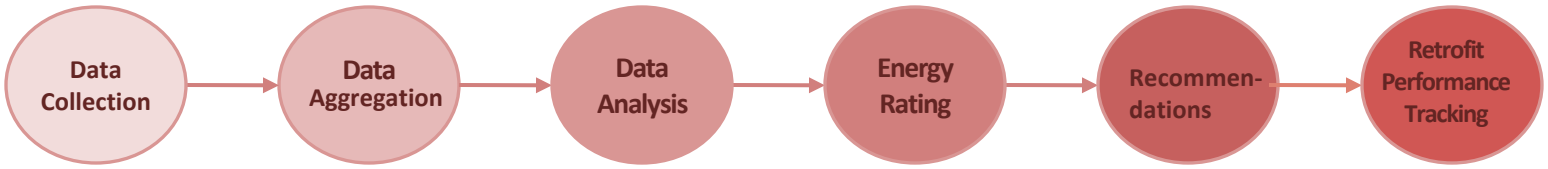
Enterprise Community Partners

Enterprise Community Partners tracks the energy and water usage of affordable SF and MF properties. Enterprise is using the health, economic and environmental benefits it documents to definitively prove that all affordable housing **must be** green by 2020. Enterprise is increasingly incorporating detailed performance tracking in green developments.

Enterprise®

ACTIVITIES



OVERVIEW

Initiated	2008
Geographic Coverage	National
Database Format	Excel
Database Analysis Software	DBS, also use TREAT
Portfolio	~250
Primary Clients	Owners & managers; affordable housing developers
Data Range	12 mos.
Multi –Family focus	~80%

CORE CONTENT

(All collected monthly)
Detailed (D)/ Basic (B)

Utility	Usage	Cost
Electricity	D	D
Gas	D	D
Oil	N/A	N/A
Water	D	D

DATA ANALYSIS

Historical Tracking	✓
Peer Comparisons	✓
Retrofit Energy Modeling	✓
Before & After Retrofit	✓

BASIC PROPERTY VARIABLES

Square Footage	✓
Age of Structure	✓
Stories	✓
Occupant Type	✓

DATA OUTPUTS

Score – In Development	✓
General Recommendations	✓
Retrofit Recommendations	✓

PRIMARY DATA SOURCES

Property Owner/ Management Company	✓
Utility Company	✓
Online User Accounts (Scraping)	X
Third Party	✓

IN-DEPTH PROPERTY VARIABLES

Energy Retrofits	✓
Geography/ Weather	✓
Other in-depth	✓

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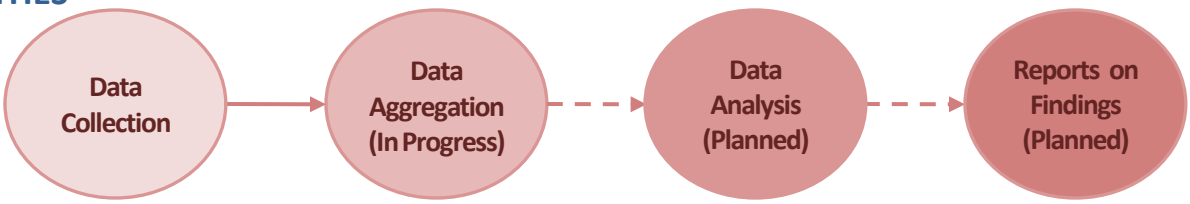
Mark to Market & Green Retrofit Program

HUD has two multi-family 'green' initiatives which feature data from utility usage as well as retrofits. One is nested in the ongoing Mark 2 Market program and the other, the 'Green Retrofit Program', is a one-time pilot. All properties must submit one year of utility usage data in order to qualify, and under the M2M program the properties will be continuously

ACTIVITIES



OVERVIEW

Initiated	2007
Geographic Coverage	National
Database Format	Excel
Database Analysis Software	Excel
Portfolio	M2M -221 prop GRP-45 prop
Primary Clients	HUD –assisted Properties
Data Range	Unknown
Multifamily focus	100%

CORE CONTENT

(All collected monthly)
Detailed (D)/ Basic (B)

Utility	Usage	Cost
Electricity	D	U
Gas	D	U
Oil	D	U
Water	D	U

DATA ANALYSIS

Historical Tracking	✓
Peer Comparisons	X
Retrofit Energy Modeling	X
Before & After Retrofit In Development	✓

BASIC PROPERTY VARIABLES

Square Footage	X
Age of Structure	✓
Stories	✓
Occupant Type	✓

DATA OUTPUTS

Score	X
General Recommendations *In Development*	✓
Retrofit Recommendations *In Development*	✓

PRIMARY DATA SOURCES

Property Owner/ Management Company	✓
Utility Company	✓
Online User Accounts (Scraping)	X
Third Party	✓

IN-DEPTH PROPERTY VARIABLES

Energy Retrofits	✓
Geography/ Weather	✓
Other in-depth	✓

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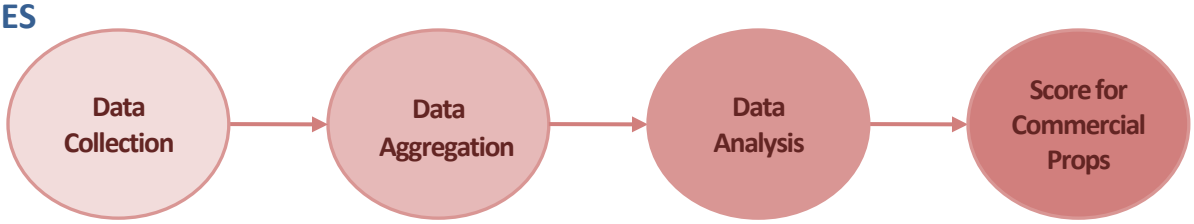
Portfolio Manager - Commercial & Existing Multifamily

Portfolio Manager tracks energy usage of buildings as part of Energy Star. Commercial properties are scored based on comparison with a national pool, mostly drawn from the CBECS survey. Multifamily properties can participate and track their historical energy consumption data.

ACTIVITIES



OVERVIEW

Initiated	1999
Geographic Coverage	National
Database Format	Oracle
Database Analysis Software	
Portfolio	~202,000 bldgs
Primary Clients	Owners & Managers. Third party bill managers
Data Range	12 months + Required for commercial rating
Multifamily focus	~0.74% MF (1,500 bldgs)

PRIMARY DATA SOURCES

Property Owner/ Management Company	✓
Utility Company	✓
Online User Accounts (Scraping)	X
Third Party	✓

CORE CONTENT

(All collected monthly)
Detailed (D)/ Basic (B)

Utility	Usage	Cost
Electricity	D	B
Gas	D	B
Oil	D	B
Water	D	X

BASIC PROPERTY VARIABLES

Square Footage	✓
Age of Structure	✓
Stories	✓
Occupant Type	X

IN-DEPTH PROPERTY VARIABLES

Energy Retrofits	✓
Geography/ Weather	✓
Other in-depth	✓

Historical Tracking	✓
Peer Comparisons	Not for MF
Retrofit Energy Modeling	X
Before & After Retrofit	✓

DATA OUTPUTS

Score	Not for MF
General Recommendations	✓
Retrofit Recommendations	X

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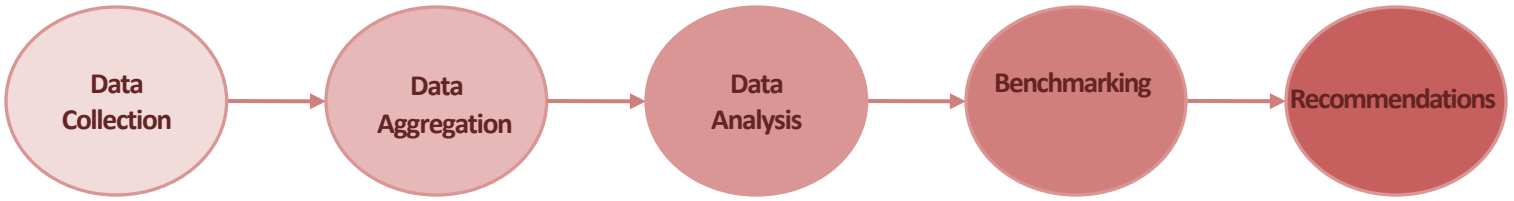
Sustainable Real Estate Manager

Sustainable Real Estate Manager (SRM) is an internet based management tool that allows clients to track energy usage, provides benchmarking of performance and recommendations.

SUSTAINABLE REAL ESTATE MANAGER®

ACTIVITIES



OVERVIEW

Initiated	2007
Geographic Coverage	50 Countries
Database Format	SQL
Database Analysis Software	Proprietary
Portfolio	120,000 bldgs,
Primary Clients	Owners, managers & energy consultants.
Data Range	12 mos.
Multifamily focus	3-5% MF

CORE CONTENT

(All collected monthly)
Detailed (D)/ Basic (B)

Utility	Usage	Cost
Electricity	D	D
Gas	D	D
Oil	D	D
Water	D	D

DATA ANALYSIS

Historical Tracking	✓
Peer Comparisons	✓
Retrofit Energy Modeling	X
Before & After Retrofit	✓

BASIC PROPERTY VARIABLES

Square Footage	✓
Age of Structure	✓
Stories	✓
Occupant Type	✓

DATA OUTPUTS

Score	X
General Recommendations	X
Retrofit Recommendations	X

PRIMARY DATA SOURCES

Property Owner/ Management Company	✓
Utility Company	X
Online User Accounts (Scraping)	X
Third Party	X

IN-DEPTH PROPERTY VARIABLES

Energy Retrofits	X
Geography/ Weather	✓
Other in-depth	✓

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WegoWise

WegoWise marries utility and property data with a focus on affordable and multi-family housing. It offers users the ability to track , analyze, and benchmark utility usage data.

ACTIVITIES

OVERVIEW

Initiated	2010
Geographic Coverage	National (MA, NY, CA focus)
Database Format	MYSQL
Database Analysis Software	Ruby on Rails
Portfolio	~3,500 Bldgs.
Primary Clients	Property owners & Affordable housing managers
Data Range	12 months +
Multifamily focus	99%

PRIMARY DATA SOURCES

Property Owner/ Management Company	✓
Utility Company	✓
Online User Accounts (Scraping)	✓
Third Party	✓

CORE CONTENT

(All collected monthly)
Detailed (D)/ Basic (B)

Utility	Usage	Cost
Electricity	D	D
Gas	D	D
Oil	D	D
Water	D	D

BASIC PROPERTY VARIABLES

Square Footage	✓
Age of Structure	✓
Stories	✓
Occupant Type	✓

IN-DEPTH PROPERTY VARIABLES

Energy Retrofits	✓
Geography/ Weather	✓
Other in-depth	✓

DATA ANALYSIS

Historical Tracking	✓
Peer Comparisons	✓
Retrofit Energy Modeling	X
Before & After Retrofit	✓

DATA OUTPUTS

Score (In development)	X
General Recommendations (available via custom reports)	✓
Retrofit Recommendations (available via custom reports)	✓

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Exhibit 6: In-depth discussion of variables; utility consumption and other

1. Consumption data

a. Types of utilities tracked

The majority of the databases surveyed track consumption of the four major utilities: electricity, gas, water and oil. Water and oil are the most common exceptions due to a focus on 'energy' consumption for the former or on regions where oil is not commonly used for the latter.

A few databases rigorously collect, track and analyze the less-common energy sources, such as propane, wood or coal. Self-generated power sources, or 'self-gen', were only mentioned by the California Energy Consumption Database, which has developed a tracking protocol for inclusion and adjustments for their database. Monitoring consumption of water not provided by a utility was not discussed by any database.

b. Level of data collected

Most of the databases we reviewed collect consumption data by building or by property. These include private databases/analytic tools (BPCo, EnergyScoreCards, Sustainable Real Estate Manager, and WegoWise) as well as the data efforts associated with federal or mission-driven entities (HUD, Fannie Mae, EPA's Portfolio Manager - Commercial, SAHF, the Deutsche Bank effort, and Enterprise Communities). RECS and Portfolio Manager – Homes collect unit-level consumption data.

c. Complications to consumption tracking

For the four major utilities, the usage data itself is relatively straight-forward: consumption is typically reported on a monthly basis by meter, for a standard unit of measurement (Btu, KwH, gallons). The primary challenge is accessing quality and standardized reports on the scale desired (building, unit). Multifamily properties present particular challenges, and metering and data access and acquisition remain significant barriers to tracking consumption data.

Some additional utility-specific complications emerged for multifamily properties. Some entities track all natural gas usage, and others focus on common area heating and hot water energy usage only. Oil is often delivered to an entire building in large tanks on an irregular schedule, and monthly or unit-level usage is not captured. Some databases address this by normalizing the oil deliveries up, to the year, and others normalize back to the month, to try to better approximate inter-winter variation. The process of normalization is further complicated by the fact that deliveries do not always correspond with the date of payment or receipt.

d. Disaggregation according to use of single utility

Disaggregation by type of use is included by a few of the databases, to different degrees. The most common analysis separates seasonal energy use from year-round energy use. Seasonal variations from the baseline are assumed to be for heating or air conditioning. A few databases go further and cross-reference component appliances and usages to disaggregate to the usage level.

2. Additional variables

Certain other variables are used along with the utility usage data when conducting analysis. This additional information can be used to help to choose benchmarking pools or to craft predictions.

a. Cost structure and billing

Utility usage should hypothetically have a correlation to utility cost. However, the degree to which billing (tenant/owner) and cost structure (i.e. demand charges) impacts overall consumption in multifamily buildings is still not well understood.

Complications arise because utilities are not all billed by a universal rate and schedule. In multifamily buildings, some bills are paid directly by the building owner or manager, and others directly by the residents in the unit. There are multiple permutations of how costs and charges can occur in a building.

Approaches to addressing inclusion of cost structure and billing data are still in development. About half of the databases surveyed track charges currently, and a few disaggregate in detail (recording for example demand charges or payment plans).

b. Property data

The physical characteristics of a building are some of the most commonly collected and used in conjunction with utility data. The majority of databases include a few basic variables in their analysis, such as square footage, age, and number of floors. Many other relevant factors (such as the primary building material type, the percentage of the building dedicated to common areas or other uses, or the window-to-wall ratio) are most commonly excluded because of difficulties in collection or measurement, or perceived lack of substantial impact on overall consumption.

This is different, however, for the databases that collect retrofit data, which typically pair consumption data with detailed variables on building materials and components. This data is often entered by a building owner or property manager. Sometimes this is supplemented and confirmed by an on-site energy audit, although this is generally seen as a separate service from the ‘database’ and monitoring service.

c. Location data

Micro-location data, such as orientation of a building, exposure or protection from surrounding buildings, or proximity to body of water, were not collected by anyone. Several interviewees mentioned that while they think there is a small impact of these variables, they are not feasible to collect without a standardized protocol and on-site energy audit. Currently, they are sometimes included in the narrative report, if an energy audit was conducted.

d. Occupant data

The type of tenants residing in a building can significantly impact utility consumption. Buildings with a majority of 'supportive'- elderly or special needs – units will have a different profile of energy and water usage than a building housing families or individuals. Only about half of databases surveyed currently collect information on the primary tenant type. More specific profile data on the type of tenants is only gathered by one database – RECS – and was considered to be beyond the scope and capacity of the rest of the entities.

e. Behavioral data

Two similar households in identical units will very rarely have the same energy and water consumption due to differences in lifestyle. The only database which currently tracks behavior is RECS. The data is collected through 45-minute interviews with occupants of a representative sample of residential units across the country. RECS then can produce summary reports that show average energy consumption by various characteristics of the households interviewed. None of the other databases interviewed mentioned drawing on RECS behavior data, likely in part because of RECS' focus on the individual dwelling units.

f. Retrofit data

A few databases, all relatively new pilots, are delving deeper into the physical characteristics of a building to include and cross-reference this information with utility usage data. HUD's M2M effort, and the multifamily pilots stewarded by the Deutsche Bank Foundation, Enterprise, and ENERGY STAR Homes are all capturing a comparatively high level of granularity on the materials and components of a building.

Some of this information is standardized, and can be entered by the building owner or manager, and some is more subjective, and is typically entered by a third-party professional after an on-site energy audit or consultation. The analysis of this level of data is typically performed using sophisticated retrofit simulation models such as TREAT or EnergyPlus.

3. Designations used in our analysis

Below, we provide further information regarding distinctions we made in summarizing different facets of the data collection efforts we surveyed. These designations were made to facilitate broader comparison among the databases, are not necessarily more broadly used in the industry, and are in no way definitive.

a. Utility usage

When we have used the term “Detailed” utility usage date, we refer to utility usage that is collected on at least a monthly basis for at least three of the major utilities (water, electricity, natural gas, oil) with some differentiation between major usage (such as landscaping water vs. household water) or separation of yearlong changes for energy (hot water and cooking) from those associated with heating. Highly detailed utility usage data may also include information by appliance, season, or specific purpose. All of the entities surveyed were considered to collect utility data at some level of detail beyond the basic level.

b. Cost and charge data

For cost and charge data, “Basic” means the data differentiates the party paying the bills and/pr collecting the actual charges paid. “Detailed” means that the variables being collected capture some additional complexity, such as fixed cost components, seasonal usage/pricing, or other separation charges.

c. Property and location data

“Basic” property and location data includes variables such as zip code and/or address, square footage or buildings, number of floors, and some collection of a few basic descriptors of building materials and type. “Detailed” property and location data refers to the systematic collection of the overall physical attributes of building and/or its location, such as primary building materials, past retrofits, major component types, and ‘micro-locational’ factors such as elevation, shading, exposure, etc.

d. Retrofit data

For retrofit data, “Basic” means that the primary facts of the retrofit were captured, for example date of retrofit and basic description. “Detailed” means that extensive detail was recorded regarding the retrofit and the equipment installed, consistent with the level of detail that would typically be provided in an energy audit.

e. Occupant data

“Basic” occupant data refers to the number of residents and the general occupancy characteristics of the property (elderly, family, student housing, etc.). “Detailed” occupant data means the systematic inclusion of more specific details about household configurations including but not limited to socioeconomic status, ethnicity, tenure in building, etc.

f. Behavior data

“Basic” behavioral data means primary actions and patterns that contribute to utility consumption, for example average thermostat setting. “Detailed” behavioral data refers to an extensive set of variables describing patterns and practices such as frequency of specific appliance and electronics use, climate preferences, time in unit per week, etc. on a per unit/household basis.

Exhibit 7: Comparison of Simulation Programs for Multifamily Retrofits

Name	Entity	Version	Latest release date	Simulation Engine	DOE approved for multifamily WAP*	Utility usage variable included in model		Cost of service	Graphical user interface (GUI)
						Energy	Water		
DOE-2	James J. Hirsch and Associates and Lawrence Berkeley National Laboratory (DOE)	2.2 47d	6/2009	Proprietary	No	√	No	Free, front-end software typically with between $300-2,000	No - 3rd-party available
EA-QUIP	Association for Energy Affordability, Inc.	N/A	Continuous rolling updates	Proprietary	Yes	√	No	$200/model for WAP, $300/model otherwise	√ - web-based
EnergyPlus (e+)	Lawrence Berkeley National Laboratory (DOE)	6.0	10/2010	New code, but based on DOE-2 and BLAST	No	√	√	Free	No - 3rd-party available
eQUEST	James J. Hirsch and Associates	3.64	8/2010	DOE-2.2	No	√	No	Free	√ -functionality with all
NEAT	Oak Ridge National Laboratory	8.6.0.4	11/2009	Proprietary	<25 units	√	No	Free	√- via Microsoft Access
TREAT	Performance Systems Development Inc.	3.2.5	9/2010	Proprietary	Yes	√	No	$1,495/license + $400 annual**	√
Visual DOE	Architectural Energy Corporation	4.1	9/2006	DOE-2.1E	No	√	No	$1,250/license**	√ - functionality with all

* Weatherization Assistance Plan. The following Simulation Models have been previously reviewed and accepted for use in the Weatherization Assistance Plan for multifamily properties of less than 25 units, where the units are individually heated or cooled: AKWarm, EA-4, EASY 2.1, HomeCheck, REM/Rate. However, a separate audit tool is necessary to evaluate mechanical measures.

**Subject to discounts. Annual fee may be required for upgrades and support.

DOE-2

Most information from the DoE Building Energy Software Tools directory

DOE-2is an hourly, whole-building analysis program of energy performance and life-cycle cost of operation, used to analyze energy efficiency of designs.

OVERVIEW

Initiated: 1978

Latest Release Date: 6/2009

Version: 2.2 47d

DOE approved for Multifamily WAP? : No

Managed By:
James J. Hirsch and Associates & Lawrence Berkeley National Laboratory

Users to Date: 800 user organizations in the US

Geographic Coverage: International

Construction Type: New build, designs

USERS

Architects, engineers in private A-E firms, energy consultants, building technology researchers, utility companies, state and federal agencies, university schools of architecture and engineering.

INPUT AND OUTPUT

Input
Hourly weather file plus Building Description Language input describing geographic location and building orientation, building materials and envelope components (walls, windows, shading surfaces, etc.), operating schedules, HVAC equipment and controls, utility rate schedule, building component costs. Available with a range of user interfaces, from text-based to interactive/graphical windows-based environments.

Output
20 user-selectable input verification reports; 50 user-selectable monthly/annual summary reports; user-configurable hourly reports of 700 different building energy variables.

TECHNICAL PLATFORM

Computer Platform
PC-compatible; Sun; DEC-VAX; DECstation; IBM RS 6000; NeXT; 4 megabytes of RAM; math coprocessor; compatible with Windows, UNIX, DOS, VMS.

Programming Language
FORTRAN 77

FIND ONLINE

http://www.doe2.com/

http://simulationresearch.lbl.gov/

http://apps1.eere.energy.gov/buildings/tools_directory/

STRENGTHS AND MINUSES
(from the DoE)

Strengths
Detailed, hourly, whole-building energy analysis of multiple zones in buildings of complex design; widely recognized as the industry standard.

Weaknesses
High level of user knowledge.

AVAILABILITY

Free but typically purchased with front-end software costing between $300 to $2000, depending upon hardware platform and software vendor.

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The Quick Energy Simulation Tool (eQUEST)

Most information from the DoE Building Energy Software Tools directory

eQuest is a front-end whole building energy performance design tool with a user interface and dynamic defaults , run on the DOE 2.2 simulation engine.

OVERVIEW

Latest Release Date: 8/2010

Version: 3.64

DOE approved for Multifamily WAP? : No

Managed By:
James J. Hirsch and Associates

Users to Date: Over 10,000 downloads of the full program annually

Geographic Coverage: National

Construction Type: Multiple

USERS

Building designers, operators, owners, and energy/LEED consultants. eQUEST is also widely used by regulatory professionals, universities, and researchers.

FIND ONLINE

http://apps1.eere.energy.gov/buildings/tools_directory/

www.EnergyDesignResources.com

INPUT AND OUTPUT

Input
Inputs can be provided at three levels: schematic design wizard, design development wizard, and detailed (DOE-2) interface. In the wizards, all inputs have defaults (based on the California Title 24 building energy code).

Output
Graphical summary reports provide a single-run results summary, a comparative results summary (compares results from multiple separate building simulation runs), and parametric tabular reports (compare annual results by end use, incremental or cumulative results). Additional output includes input/output summary reports (rule-of-thumb and other indices), non-hourly simulation results (tabular/text DOE-2 SIM file reports), hourly simulation results (text and comma-separated variable hourly listings for thousands of simulation variables), and California Title 24 compliance analysis reports.

TECHNICAL PLATFORM

Computer Platform
Microsoft Windows 98/NT/2000/XP/Vista

Programming Language
Interface: C++, DOE-2.2 engine: FORTRAN

STRENGTHS AND MINUSES
(from the DoE)

Strengths
Detailed interface (a full-featured Windows front-end for DOE-2.2) supports detailed analysis throughout the construction documents, commissioning, and post occupancy phases. Its execution speed makes it feasible to perform many evaluations of large models, capturing critical interactions between building systems at the whole-building level.

Weaknesses
Defaults and automated compliance analysis has not yet been extended from California Title 24 to ASHRAE 90.1. It does not yet support SI units (I-P units only). Ground-coupling and infiltration/natural ventilation models are simplified and limited. Daylighting can be applied only to convex spaces.

AVAILABILITY

eQuestis available at no cost from www.EnergyDesignResources.com and www.doe2.com. Long-term average weather data (TMY, TMY2, TMY3, etc.) for 1000+ locations in North America are available via automatic download from within eQUEST (requires Internet connection).

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Energy Audit using the Queens Information Package (EA-QUIP)

Most information from the DoE Building Energy Software Tools directory

Analyzes energy use and energy conservation measure opportunities in single- and multifamily dwellings and determines economically optimal mix.

OVERVIEW

Initiated: Adapted from early 1980s version from the Lawrence Berkeley Laboratory.

Latest Release Date: Continuous rolling updates

Version: N/A

DOE approved for Multifamily WAP? : Yes

Managed By: Association for Energy Affordability, Inc.

Users to Date: Over 300

Geographic Coverage: ~9 states

Construction Type: Single and multifamily retrofits

USERS

Energy professionals interested in energy-efficient retrofitting of single- and multifamily buildings, including (but not limited to) low-income weatherization program professionals.

FIND ONLINE

http://apps1.eere.energy.gov/buildings/tools_directory/

http://www.ea-quip.com/

INPUT AND OUTPUT

Input
Client information, geographic location, general site details, at least one year's worth of complete heating fuel bills, lighting, walls, windows, infiltration, heating system, appliances, doors, roof, basement, and control and distribution. A number of adjustable parameters which data to be entered can be measured, through the on-site inspection of the dwelling.

Output
Monthly and yearly heating and cooling energy consumption, evaluates current electricity use, seasonal infiltration, seasonal solar gain, heating load, and, on request, recommends combinations of energy-saving measures suitable for a range of budgets. Users can also alter the savings calculations by changing the cost, lifetime, and new efficiency or energy rating of retrofits such as boiler, domestic hot water, and window replacements to tailor the software to specific scopes of work.

TECHNICAL PLATFORM

Computer Platform
Internet connection strictly required. Either Internet Explorer or Mozilla Firefox (other browsers may be acceptable but are not actively tested by EA-QUIP technical support). PDF viewers and Microsoft Excel and Word are also strongly suggested.

Programming Language
Basic (nontechnical)

STRENGTHS AND MINUSES
(from the DoE)

Strengths
There is no need to learn a language or remember any commands to use EA-QUIP. EA-QUIP leads the user automatically through each component. EA-QUIP has extensive retrofit and cost libraries, all of which are grouped by components, easy user modifications.

Weaknesses
Adding new retrofits is not possible without software administrator intervention; external analysis may be necessary. Many aspects of the software and user's model are unavailable without Internet access. Does not allow a building model to use multiple fuel types.

AVAILABILITY

A reduced fee per building model is offered to weatherization agencies nationwide. Fee-based technical assistance is available to all. Training is offered by the Association for Energy Affordability. For all other nongovernmental entities, fully functional software and technical training packages are available.

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EnergyPlus (e+)

All information from the DoE Building Energy Software Tools directory

EnergyPlus is an energy simulation tool that models energy and water use to optimize building design for minimum utility consumption.

OVERVIEW

Initiated: 2001

Latest Release Date: 2005

Version: 6.0

DOE approved for Multifamily WAP? : No

Managed By:
U.S. DOE & Lawrence Berkeley National Laboratory

Users to Date: 85,000

Geographic Coverage: Nationwide

Construction Type: New build, full & Partial rehab

USERS

Mechanical, energy, and architectural engineers working for architect/engineer firms, consulting firms, utilities, federal agencies, research universities, and research laboratories.

INPUT AND OUTPUT

Input
EnergyPlus uses a simple ASCII input file. Private interface developers are already developing more targeted / domain specific user-friendly interfaces. See the EnergyPlus web site for up-to-date information on interfaces and other tools for EnergyPlus.

Output
EnergyPlus has a number of ASCII output files - readily adapted into spreadsheet form for further analysis.

TECHNICAL PLATFORM

Computer Platform
Available for Windows XP/Vista, Mac OS, and Linux.

Programming Language
Fortran 2003

STRENGTHS AND MINUSES
(from the DoE)

Strengths
Accurate, detailed simulation capabilities through complex modeling capabilities. Input is geared to the 'object' model way of thinking. Successful interfacing using IFC standard architectural model available for obtaining geometry from CAD programs. Extensive testing (comparing to available test suites) is completed for each version and results are available on the web site. Weather data for more than 1250 locations worldwide available on the web site.

Weaknesses
Text input may make it more difficult to use than graphical interfaces.

AVAILABILITY

EnergyPlus and weather data for more than 2000 locations worldwide can be downloaded at no cost from the EnergyPlus Web site.

FIND ONLINE

http://apps1.eere.energy.gov/buildings/energyplus/energyplus_about.cfm

http://simulationresearch.lbl.gov/

http://apps1.eere.energy.gov/buildings/tools_directory/

National Energy Audit (NEAT)

Most information from the DoE Building Energy Software Tools directory

NEAT was designed for state agencies and utilities to determine the most cost-effective retrofit measures for single-family and small multi-family site-built homes to increase the energy efficiency and comfort levels.

OVERVIEW

Initiated: 1985, launched 1993

Latest Release Date: 11/2009

Version: 8.6.0.4

DOE approved for Multifamily WAP? : Yes ,for less than 25 units

Managed By:
Oak Ridge National Laboratory

Users to Date: Over 700

Geographic Coverage: 30 states

Construction Type: Single-family and small multi-family site-built homes

USERS

State and local Weatherization Assistance Program subgrantees, utility companies, home energy auditors.

FIND ONLINE

http://apps1.eere.energy.gov/buildings/tools_directory/

http://weatherization.ornl.gov/assistant.shtml

INPUT AND OUTPUT

Input
Microsoft Access (not required for use) data input screens for basic housing components (walls, windows, attics, etc.) and equipment. Local fuel and retrofit costs for measures considered.

Output
NEAT offers a list of retrofit measures ranked by SIR with associated heating and cooling energy and cost savings, installed cost, and SIR. Cumulative savings and SIR are also included as well as a listing of major materials required to install the recommended measures. Pre- and post-retrofit heating and cooling energy consumption estimates and equipment loads are listed. Individual component contributions and total peak load estimates are available for equipment sizing. If requested a comparison of program predictions against actual billing data is available with the option to adjust measure predictions to reflect the billing data.

TECHNICAL PLATFORM

Computer Platform
Version 6.x - DOS/Win3.1/Win95/98/2000/NT with 9Mb RAM, 10Mb disk. Version 7.x - Win 95,98,NT,2000, 32 Mb RAM, min 800x600 Graphics, CD ROM drive.

Programming Language
C / MS Access

STRENGTHS AND MINUSES
(from the DoE)

Strengths
Specifically designed to be a home energy auditing tool for non-technical users, producing list of energy efficiency improvements specific to each home audited. Both input and output data stored in database format for retrieval and processing using other software if desired.

Weaknesses
Not intended to be a building simulation tool. Though program (7.x) evaluates many baseload measures, energy consumption estimates reflect only HVAC equipment operation.

AVAILABILITY

Available from the Energy Science and Technology Software Center at the Oak Ridge National Laboratory. Only requires basic familiarity with home energy auditing; minimal computer experience (keyboard).

Targeted Retrofit Energy Analysis Tool (TREAT)

Most information from the DoE Building Energy Software Tools directory

TREAT performs hourly simulations for single family, multifamily, and mobile homes and includes analysis tools for materials and component retrofits.

OVERVIEW

Initiated: Before 2004

Latest Release Date: 9/2010

Version: 3.2.5

DOE approved for Multifamily WAP? : Yes

Managed By: Performance Systems Development Inc.

Users to Date: Over 1,000

Geographic Coverage: National

Construction Type: Existing multifamily, single-family, mobile homes, some new construction but primarily retrofits.

USERS

Weatherization, Home Energy Raters, Home Performance with Energy Star Contractors, Insulation and Mechanical contractors, Mechanical or Energy Engineers performing multifamily building energy analysis.

INPUT AND OUTPUT

Input
Building components libraries are used to input building geometry and thermal characteristics, heating and cooling equipment and system characteristics, lighting, appliances, ventilation, and hot water. Imports utility bills and daily weather data.

Output
20 user-selected, formatted reports printed directly by TREAT; generates custom program-designed reports for weatherization, home performance programs or HERS providers. Exports project data in XML format which may be uploaded to online database and tracking system.

TECHNICAL PLATFORM

Computer Platform
CPU: Pentium 300 or higher (600 MHz recommended); RAM: 256 MB (512 MB recommended); operating system: Windows XP and Windows Vista. Internet access required for software registration.

Programming Language
Delphi and FORTRAN

FIND ONLINE

http://www.psdconsulting.com/software/treat

http://apps1.eere.energy.gov/buildings/tools_directory/

STRENGTHS AND MINUSES
(from the DoE)

Strengths
Comprehensive and highly flexible whole building retrofit tool, easy to use graphic user interface which includes libraries of building components (walls / surfaces, windows, doors, appliances, lighting, heating and cooling, and hot water). Performs utility billing analysis including weather normalization. Calculations consider solar heat gain and waste heat generated by baseload and fully interacted savings from energy retrofit measures.

Weaknesses
Not recommended for commercial buildings with complex HVAC systems.

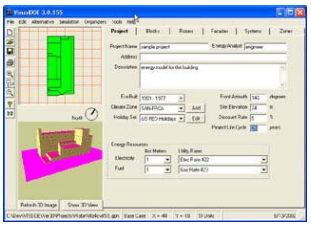
AVAILABILITY

For purchase through PSD consulting website, one-time license and yearly fee for upgrades and support. Demo version available for free download.

Visual DOE

Most information from the DoE Building Energy Software Tools directory

VisualDOE is a front-end tool run on the DOE 2.1E simulation engine, with a Windows interface. Especially useful for studies of envelope and HVAC design alternatives. Up to 99 alternatives can be defined for a single project.



OVERVIEW

Latest Release Date: 12/2006

Version: 4.1

DOE approved for Multifamily WAP? : No

Managed By:
Architectural Energy Corporation

Users to Date: Over 1,000

Geographic Coverage: International

Construction Type: Residential and commercial, HVAC systems specialized

USERS

Mechanical/electrical/energy engineers and architects working for architecture/engineering firms, consulting firms, utilities, federal agencies, research universities, research laboratories, and equipment manufacturers.

FIND ONLINE

http://apps1.eere.energy.gov/buildings/tools_directory/

http://www.archenergy.com/products/visualdoe/

INPUT AND OUTPUT

Input
Required inputs include floor plan, occupancy type, and location. These are all that is required to run a simulation. Typically, however, inputs include wall, roof and floor constructions; window area and type; HVAC system type and parameters; and lighting and office equipment power. Smart defaults are available for HVAC systems based on the building vintage and size. A library and templates are provided to greatly ease user input.

Output
Summary reports that may be viewed on-screen, stored as PDF files, or printed. A number of graphs may be viewed and printed that compare selected alternatives and/or selected hourly variables. Standard DOE-2.1E reports and hourly reports are available.

TECHNICAL PLATFORM

Computer Platform
Windows 95/98/NT/ME/2000/XP. 486 or better, 16MB+ RAM, 50MB hard drive space.

Programming Language
Visual Basic and Visual C++

STRENGTHS AND MINUSES
(from the DoE)

Strengths
Allows rapid development of energy simulations, dramatically reducing the time required to build a DOE-2 model. Specifying the building geometry is faster than other comparable software; useful for schematic design studies of the building envelope or HVAC systems. Implements DOE-2's daylighting calculations; allows input in SI or IP units; imports CADD data to define thermal zones.

Weaknesses
Implements about 95% of DOE-2.1E functionalities. Advanced users familiar with DOE-2.1E can implement the remaining 5% features by modifying the DOE-2 input files generated by VisualDOE.

AVAILABILITY

Available for download from Architectural Energy Corporation with license fee and annual support fee. Requires basic experience with Windows programs. Familiarity with building systems and one to two days of training is also desirable but not necessary.

Exhibit 9: Comparison of Green Building Standards for Multifamily

	Factsheet	Name		Managing entity	Year launched	Multifamily designation	Construction type			Pathway		Database/ tools referenced	Data collection encouraged	Data collection in	Properties
							N	S	M	PR	PE				
National	√	ASHRAE 189.1		ASHRAE	2009	Over 4 floors	√	√		√	√	ASHRAE 140 tested & jurisdiction compliant tools.	√	Portfolio Manager	U
	√	Energy Star	Energy Star New Homes for Single Family & low-rise Multi-family	U.S. EPA and U.S. DOE	1995	To 3 floors	√			√	√	RESNET approved HERS tools			>1,000,000 total
			Energy Star For Multi Family High Rise (MFHR)		pilot 2005	Over 4 floors	√	√		√	√	ASHRAE 90.1 compliant tools	√	Portfolio Manager	U
	√	Enterprise Green Communities Criteria		Enterprise Foundation – Green Communities	2005	To 3 floors	√	√	√	√		Energy Star New homes	√	Portfolio Manager or Enterprise	U (>17,000 units total)
						Over 4 floors						Energy Star MFHR/ TREAT			
	√	Green Globes	Green Globes New Construction	GBI	2005	All	√	√		√		CBECS/Target Finder	√		>150 some MF
			Green Globes CIEB			All					√	CBECS/	√	Portfolio Manager	
	√	ICC 700 National Green Building Standard		NAHBRC	2007	All	√			√	√	U/IECC compliant: DOE-2 etc.			2400 little MF
	√	LEED	LEED for Homes	USGBC	1998	To 3 floors	√			√		Energy Star for Homes			>9,400 70% MF
			LEED for New Construction		2000	Over 4 floors	√			√		Energy Star	√	USGBC	Some MF
			LEED for Multifamily Midrise		2011	4-6 floors	√			√		Energy Star MFHR			72 registered 22 certified
Regional		CALGreen		CBSC, CA	2009	All	√			√		U/CA code compliant HERS tools	√		20 in pilot
		Evergreen Sustainable Development Standard		Department of Commerce, WA	2008	All	√	√		√	√	WSU		WSU	>100 mainly MF
		Green Designation Standard	Green Home Standard	FGBC, FL	2001	To 3 floors	√	√		√		U/EnergyGauge			>3,000 Some MF
			Green Hi-Rise Residential Standard			Over 4 floors	√			√		U/EnergyGauge			

Construction type: N = New Construction, S = Substantial Rehab, M = Moderate Rehab

Pathway to compliance: PR = prescriptive, PE = Performance

Data/tools referenced: Database/ tools for construction & remodel, Collection

Data collection in: Data to be collected & entered into tool by owners/managers post construction

U: unavailable as of printing

ASHRAE 189.1

ASHRAE 189.1 is a voluntary standard, written in mandatory, enforceable, language intended for adoption into building codes, that sets minimum requirements for the design, construction, and operation of high performance green buildings, except low-rise residential.

OVERVIEW

Standards Initiated in: 2006

Latest Version: 2009

Managed By:
American Society of Heating, Refrigerating and Air Conditioning Engineers

Portfolio: # Properties
Unavailable as of printing

Geographic coverage:
Nationwide

Property Type: All residential over 3 floors, commercial

Construction type: New build, substantial renovations

Specialty: None

PRESENTATION

Charge to customer: Fee for purchase of documents, member discount

Primary customers: Currently, the US Army has adopted many portions of 189.1

Ratings score: None

Website:
www.ashrae.org/greenstandard

STANDARD CRITERIA

- Energy efficiency
- Water use efficiency
- Indoor environmental quality
- Building's impact on atmosphere, materials, and resources
- Construction and operation - maintenance plan and training

USE OF CRITERIA

- All criteria have mandatory minimum requirements
- Prescriptive & Performance pathway options for compliance
- Written in codified language for adoption into building codes by states and local jurisdictions
- Adopted as an jurisdictional optional path of compliance for the International Green Construction Code

CERTIFICATION

- None - compliance determined by adopting jurisdiction
- Third party verification of requirements throughout process, and regular inspections

UTILITY DATA & ANALYSIS

Data used in formation:
CBECS

Data collection Encouraged:
Required: metering and sub-metering for large systems; data into Portfolio Manager

Database(s) used:
Unavailable as of printing

Software package(s) used:
Testing according to ASHRAE 140
Software must be acceptable to jurisdiction in authority

COLLABORATIONS

During formation: IES, ANSI, USGBC

Data sold /shared: DOE, National Renewable Energy Laboratory

Linkage with other business lines: Training Program

With other standards:
•ASHRAE 90.1 and others
• Designed to work with ENERGY STAR, LEED, and many others

ENERGY STAR MFHR

ENERGY STAR Multifamily High Rise (MFHR) program is a variant of the successful ENERGY STAR Qualified Homes program that applies to buildings of four floors and over and is currently in pilot phase.

OVERVIEW

Standards Initiated in: 2006

Latest Version: due 2011

Managed By: Energy Star, US Environmental Protection Agency

Portfolio: # Properties
20 In pilot program

Geographic coverage: Nationwide

Property Type: Multifamily above 4 floors, mixed use, commercial with over 50% separately metered residential space

Construction type: New build, substantial renovations

Specialty: High rise, mostly residential buildings

PRESENTATION

Charge to customer: n/a

Primary customers: all, including affordable housing developers

Ratings score: Label or none for building

Website:
http://www.energystar.gov/

STANDARD CRITERIA

- Heating/Cooling
- Water
- Lighting
- Operations

USE OF CRITERIA

- Currently under development
- Prescriptive & Performance pathway options for compliance
- Minimum performance standards - Performance Target
- Mandatory testing and verification protocols
- Benchmarking in Portfolio Manger for at least 2 years

CERTIFICATION

- ENERGY STAR label by meeting performance target about ASHRAE 90.1-2001 baseline
- Third party verification and field testing throughout construction

UTILITY DATA & ANALYSIS

Data used in formation:
Yes

Data collection Encouraged:
Required: whole building metering; data into Portfolio Manager

Database(s) used: Unavailable as of printing

Software package(s) used:
ASHRAE 90.1 compliant software

COLLABORATIONS

During formation: States, cities, non-profit organizations etc.

Data sold /shared: Unavailable as of printing

Linkage with other business lines: Training programs, qualified appliance programs

With other standards:
- ASHRAE 90.1 and others
- LEED HMM, Enterprise Green Communities Criteria

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Green Communities Criteria

Enterprise Green Communities Criteria is a voluntary, cost-effective green framework and certification system for all affordable housing types.

OVERVIEW

Standards Initiated in: 2005

Latest Version: 2011

Managed By:
Enterprise Green Communities

Portfolio: # Properties
Not available as of printing. Over 17,000 units, includes both single and Multifamily properties

Geographic coverage:
Nationwide- Green Communities

Property Type: All housing types

Construction type: New build, substantial & moderate rehab

Specialty: Affordable housing

PRESENTATION

Charge to customer: Free to developers

Primary customers: Affordable housing developers, both non-profit & for-profit organizations.

Ratings score: Binary Certification (Certified or not)

Website:
http://www.greencommunitiesonline.org/

STANDARD CRITERIA

- Integrative Design
- Location & Neighborhood Fabric
- Site Improvements
- Water conservation
- Energy efficiency
- Materials Beneficial to the Environment
- Healthy living environment
- Operations & maintenance
  - ◇Manual & training

USE OF CRITERIA

- 40 mandatory criteria , 23 optional criteria (2008 version)
- Projects must meet applicable mandatory measures & achieve requisite number of optional points
- Prescriptive & Performance pathways
  - ◇Linked to ENERGY STAR programs

CERTIFICATION

- Online process available
- Not mandatory
- Third party verification by sampling, onsite inspection
- Certification valid 1 year
- LEED dual certification possible
- No recertification

UTILITY DATA & ANALYSIS

Data used in formation:
No (criteria grew from analysis of GC properties)

Data collection Encouraged:
Optional

Database(s) used:
- Has own in Excel
- RECS, CBECS (indirect)

Software package(s) used:
- Bright Power E-Scorecard
- EPA tools (DOE2, etc,)
- TREAT
- HERS for rehab

COLLABORATIONS

During formation: NRDC, USGBC

Data sold /shared: Analysis published & methodology shared with HUD, DOE, EPA

Linkage with other business lines: Technical Assistance Program

With other standards:
- EPA's ENERGY STAR Homes or Multifamily High-Rise (MFHR)
- ASHRAE 90.1
- LEED for Homes

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Green Globes

Green Globes is a voluntary web-based Canadian/British environmental assessment and ratings system that was adapted to U.S. conditions and introduced in 2005 as an alternative to LEED.

OVERVIEW

Standards Initiated in: 2005

Latest Version: in pilot phase

Managed By: The Green Building Initiative

Portfolio: # Properties >150, 10 multi-unit residential

Geographic coverage: Nationwide and international

Property Type: Residential, mixed use, commercial buildings ≥6 units or ≥4 floors

Construction type: New Construction (NC), Continuing Improvement of Existing Buildings (CIEB)

Specialty: Institutional

STANDARD CRITERIA

- Energy
- Indoor environment
- Site
- Resources
- Water
- Emissions
- Project management

USE OF CRITERIA

- Not mandatory, not intended for adoption into building codes
- Prescriptive & Performance pathway options
- Incorporates life cycle assessment
- Linked to ENERGY STAR programs

UTILITY DATA & ANALYSIS

Data used in formation:
No

Data collection Encouraged:
CIEB: data into Portfolio Manager

Database(s) used:
CBECS

Software package(s) used:
EPA Target Finder, Portfolio Manager, working on own tool, Athena Software for Life Cycle Analysis

COLLABORATIONS

During formation: Multiple industry stakeholders, ANSI

Data sold /shared: Unavailable as of printing

Linkage with other business lines: Professional Training Programs

With other standards:
- ENERGY STAR MFHR
- ASHRAE 90.1, ANSI

PRESENTATION

Charge to customer: Fees for software use and certification.

Primary customers: Federal, Veterans Administration

Ratings score: 1 to 4 (best) Green Globes

Website:
http://www.thegbi.org/green-globes/

CERTIFICATION

- Online questionnaire and reporting process
- Minimum points out of 1000 possible required for certification
- Third party certification and building inspection
- Recommended re-certification on 2-3 year cycle. Will require it in updates

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ICC 700 NGBS

The ICC National Green Building Standard was launched in 2007 as the first voluntary code-based residential green building rating system approved by the American National Standards Institute (ANSI).

OVERVIEW

Standards Initiated in: 2007

Latest Version: 2008

Managed By:
NAHB Research Center

Portfolio: # Properties
2400, MF fastest growing segment currently (>1200 units)

Geographic coverage:
Nationwide

Property Type: Single and MF, mixed use, land development

Construction type: Residential new build and renovation.

Specialty: Regional modifications

PRESENTATION

Charge to customer: Certification discount to members (MF is $200/building + $20/ unit for members, $500/building +$20/ unit for non-members. Verification costs vary.

Primary customers: All

Ratings score:

Bronze, Silver, Gold, Emerald

Website:

http://www.nahbgreen.org/Certification/default.aspx

STANDARD CRITERIA

- Indoor environmental quality
- Energy efficiency
- Water efficiency
- Lot design
- Resource efficiency
- Operations & education

USE OF CRITERIA

- Mainly design & construction oriented
- Total 1100 possible points: mandatory and optional points
- Mandatory measures for compliance with municipal codes, and voluntary use for municipal and private sector incentive programs
- Point–based optional measures to allow regional variations etc
- Prescriptive (for energy efficiency) or Performance Pathway for new build. Green remodel pathway for pre-1980 buildings

CERTIFICATION

- Online process available
- Third party verification
- No recertification

UTILITY DATA & ANALYSIS

Data used in formation:
Indirect through DOE who helped with research analysis for baseline

Data collection Encouraged:
No (may in future)

Database(s) used:
Unavailable as of printing

Software package(s) used:
IECC compliant: DOE2 etc. , Incorporates Builders Challenge into online tool, RESCheck

COLLABORATIONS

During formation: ANSI, DOE, EPA, ICC, multiple membership organizations

Data sold /shared: Share with partners, builders, and verifiers. Sell to interested manufacturers

Linkage with other business lines: Training program

With other standards: 22 other standard-setting organizations, plus government programs

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LEED Multifamily Midrise

Leadership in Energy and Environmental Design for Homes Ratings System for Midrise Multifamily Buildings (LEED-Midrise), launched in 2010, is voluntary for multi-unit residential buildings with four and six floors.

OVERVIEW

Standards Initiated in: 2008

Latest Version: 2010

Managed By:
US Green Building Council

Portfolio: # Properties
72 Registered; 22 Certified

Geographic coverage:
Nationwide

Property Type: Multifamily buildings between four and six floors. Commercial with >50% residential.

Construction type: New build , Substantial rehab

Specialty: Multifamily and MF mixed use buildings (affordable housing, Condominiums and apartments)

PRESENTATION

Charge to customer: Yes. Verification and certification fees at multiple points during processing

Primary customers: All, including commercial and residential

Ratings score:
Certified, Silver, Gold, Platinum

Website:
http://www.usgbc.org/

STANDARD CRITERIA

- Indoor environmental quality
- Energy & atmosphere
- Water efficiency
- Location & Linkages
- Sustainable Sites
- Materials and Resources

USE OF CRITERIA

- Prerequisite and elective criteria based on LEED for Homes 2008 Version
- 110 points possible
- Prescriptive Pathway
- Linked to ENERGY STAR programs

CERTIFICATION

- Certification is currently available, but LEED Online process is not currently available for LEED for Homes Multifamily Midrise
- Not mandatory
- Third party verification by onsite inspection (sampling protocol available, depending on project)
- No time limit on certification
- No requirement for recertification

UTILITY DATA & ANALYSIS

Data used in formation:
No

Data collection Encouraged:
Not in current version, but encouraged in 2012 version

Database(s) used:
Indirect through ENERGY STAR (RECS, CBECS)

Software package(s) used:
ENERGY STAR MFHR

COLLABORATIONS

During formation: Multiple membership organizations

Data sold /shared: No

Linkage with other business lines:

With other standards:
- EPA's ENERGY STAR Homes MFHR
- ASHRAE 90.1
- ASHRAE 62.2

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