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Attributes of the Federal Energy Management Program's Federal Site Building Characteristics Database

SA Loper
WF Sandusky

December 2010



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Pacific Northwest National Laboratory
Richland, Washington 99352

Executive Summary

Typically, the Federal building stock is referred to as a group of about one-half million buildings throughout the United States. Additional information beyond this level is generally limited to distribution of that total by agency and maybe distribution of the total by state. However, additional characterization of the Federal building stock is required as the Federal sector seeks ways to implement efficiency projects to reduce energy and water use intensity as mandated by legislation and Executive Order. By using a Federal facility database that was assembled for use in a geographic information system tool, additional characterization of the Federal building stock is provided including information regarding the geographical distribution of sites, building counts and percentage of total by agency, distribution of sites and building totals by agency, distribution of building count and floor space by Federal building type classification by agency, and rank ordering of sites, buildings, and floor space by state. A case study is provided regarding how the building stock has changed for the Department of Energy from 2000 through 2008.

Results from this study are valuable as agencies implement tactical aspects of their strategic sustainability plans as it relates to achieving and hopefully exceeding energy and water reduction goals. For example, within the Department of Defense (DOD), the Army has nearly twice as many sites as the Air Force or Navy and has the largest number of buildings and total floor space. The Army, therefore, may be able to achieve a larger percentage of the goal depending on building types and geographic location. In terms of building type and total floor space within the DOD, the majority is associated with housing, so a specific group of energy efficiency and water conservation measures should be considered.

For the civilian agencies, the US Postal Service has the largest number of sites, but the Department of Interior has the largest number of buildings, while the General Services Administration has the most floor space. For the civilian agencies, the largest percentage of building type is also housing, but in terms of floor space, the office building type is the largest. Thus a unique set of efficiency measures would be implemented. In terms of distribution of sites, buildings, and floor space geographically, the state with the most in all these categories is California. This is important in terms of available state incentives that could be captured to reduce the overall cost of implementation. When considering the total database, the state with the second most number of sites, buildings, and total floor space is Texas, which is an open access state with little or no incentives available. States with the second largest number of civilian sites, buildings, and floor space are New York, Wyoming, and New York, respectively. Each of these states has unique conditions regarding electric rates and available incentives. Washington DC has the third largest amount of civilian Federal floor space.

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1.0 Introduction

The Federal sector continues to seek ways to reduce both energy and potable water intensity in the Federal building stock, as required by legislation (EISA 2007) and Executive Orders (72 FR 3919-3923 and 74 FR 52117-52127). Specific goals, on both an annual and cumulative basis, were established in both the legislation and Executive Orders. Additionally, agencies must report progress in meeting these goals on an annual basis. Both the annual and cumulative goals were established in terms of intensity reduction values (resource reduction per square foot) so knowledge of how an agency's floor space varies by building type and geographic region is useful in the development of effective and sound project implementation programs. These programs can then be adjusted over time to ensure a maximum level of impact for each agency.

Reducing the intensity value over time requires that actions must be taken to directly reduce or more efficiently use the available energy and potable water resource. The latter method is the preferred approach because it does not affect the ability of an agency to complete its assigned mission. This requires that efficiency opportunities be evaluated in terms of activities that can be implemented in association with the existing Federal building stock.

The Federal government manages a diverse real property inventory that is broken down into three asset categories: buildings, structures, and land. The structure category consists of such items as utility systems, road and bridges, parking structures, storage buildings, navigation and traffic aids, reclamation and irrigation, communication systems, airfield pavements, harbors and ports, museums, railroads, monuments and memorials. The vast majority of the efficiency opportunities will be associated with the buildings asset category. The most recent data (FY 2008) indicates there are 895,923 Federal buildings and structures, of which 407,062 are labeled as building assets with a combined total area of 3.29 billion square feet (FRPC 2009). Overall, these numbers can be considered stable given a reduction of less than 1% in the total number of assets and a 2% decrease in total areas, as compared to FY 2007 data. In terms of the building assets category, the change is larger with the total numbers of buildings being decreased by 8.8%, as compared to the number reported in FY 2007 (FRPC 2009).

To better understand the potential efficiency opportunities, the U.S. Department of Energy's Federal Energy Management Program (FEMP) developed a database to provide information regarding building characteristics that can aid in locating energy and water efficiency opportunities. The database allows Federal agencies to identify potential projects that, once implemented, will increase the energy and water conservation of the sites, thus achieving mandated goals and saving taxpayer dollars. Information in the database includes the administrative agency, site names and addresses, building types, building counts, floor space in total square feet (ft²) associated with each building type, energy data and source

of data, if available. With this data, a better understanding of the Federal building stock can be determined to evaluate potential efficiency project opportunities.

Looking at a few components of the database is not enough to understand the characteristics of the Federal building stock. Annual real property reports are published by the Federal Real Property Council on other important aspects of the building stock such as disposition of real property, operating cost and various performance measures such as utilization and condition at the total Federal level or key agency level. When identifying efficiency potential, all aspects of the Federal building stock must be considered. For example, the United States Postal Service (USPS) has the most sites, a Marine Corp Base has the most buildings and an Army Base has the most total floor space. Therefore, to isolate one aspect does not provide a full, realistic picture of the Federal building stock.

This document provides information on the Federal building stock beyond generalizations, such as total floor space and number of buildings. It can assist agencies in making informed decisions in implementing actions related to their Strategic Sustainability plans and how those plans will evolve over time as projects are implemented and the nature of the Federal building stock changes over time.

2.0 History of Database

The database is an integral part of a geographic information system (GIS) tool that was developed by the Pacific Northwest National Laboratory (PNNL) in 2000 as part of the on-going activities for FEMP as part of the Utility Service Program. Specific building characteristics data for Federal sites was provided by the General Services Administration (GSA), supplemented with agency specific data provided directly from agencies. Initially, the data was only accessible in ArcView 3.0, and the user had to purchase the software program to use the database. In 2002, the GIS tool was updated to ArcView 8.0, the latest version of the software available. In 2003, an Excel workbook was developed with predefined query tools, called Quicksort, so users did not have to purchase ArcView to use the data. Also, a web-based GIS tool was created soon after so users could have access the data on-line, as well as access to other spatial data, such as utility service area information, without having to purchase and install the software or acquire specific database information (<http://fempgis.pnl.gov/>).

In 2009, an effort was undertaken to determine how to improve the GIS tool. The first part of this effort was to reconcile and update the two different databases that existed for the Quicksort tool, an Excel file, and the GIS Web-based tool. Quicksort had data for 6,864 sites, while the web tool had 4,121 sites. It is uncertain why the two databases did not contain the same set of data. The database for both tools contained some data not found in the other, but the majority of the data was common between the two. The two datasets were combined into one called the Federal Site Building Characteristic Database (FSBCD). The data was reviewed to improve overall data quality (fixing missing address data, truncated text), and sites under 15,000 ft², not previously included in the database, were added. Site data was updated as agencies provided new information. A request went out to every major agency asking for updated information. Agencies responding included GSA with data for 2007, United States Department of Agriculture- Agricultural Research Service (USDA-ARS) with data for 2009, and the Department of Interior (DOI) with data for 2008 and included sub-agency data for Bureau of Indian Affairs (DOI-BIA) and National Parks Service (DOI-NPS). Department of Energy (DOE) data was obtained directly from GSA's Federal Real Property Profile website for 2008.

Since the creation of the initial databases in 2000, the Department of Homeland Security (DHS) was created. However, for the FSBCD, the U.S. Coast Guard was retained as part of its original agency as of the year 2000.

3.0 Limitations

Although some agencies have provided updated building information over the years, most of the data is from FY 2000. Also, not every site has complete building characteristics information associated with it and only domestic sites with a few sites in Puerto Rico, Virgin Islands, Guam and American Samoa are included. A decision was made during the development of the FSBCD not to include smaller agencies (Smithsonian, Washington Headquarters Services, Broadcasting Board of Governors) and sites with unmanned buildings, such as substations and communication buildings because they offer minimal energy saving opportunities.

For some GSA, DOI, and DOI-BIA sites, only data for overall total building counts and total floor space were provided but were not broken down into building types (see Section 5.0 for definitions of building types). Therefore, this causes a discrepancy between total build counts and total floor space when compared to building type totals for building counts and floor space. This discrepancy caused total building count to be 525 greater than when looking at total building counts by building types (a variance of only 0.035) and total floor space is 14,246,968 ft² greater than when looking at total floor space by building types (a variance of only 0.005).

4.0 Federal Real Property Overview

Currently, within the FSBCD, there are 14,861 Federal sites (Figure 1). A site does not necessarily mean one building; it can mean multiple buildings with multiple building types. These sites consist of a total of 409,494 buildings with almost 3 billion total ft² of floor space (Table 1). The number of buildings per site range from 1 building to 5,410 buildings.

The Federal Real Property Council's FY 2008 Federal Real Property Report (FRPC 2009) states that the total Federal building asset is 407,062 and the total area of building assets is 3.29 billion ft². These numbers include buildings located in the U.S., the District of Columbia, and U.S. Territories (America Samoa, Baker Island, Federated States of Micronesia, Guam, Howland Island, Jarvis Island, Midway Islands, Northern Mariana Islands, Republic of Palau, Puerto Rico, the U.S. Virgin Islands, Wake Island, and various Atolls).

The general overall characteristics of Department of Defense (DOD) and civilian sites are analyzed separately in Table 1. Even though DOD has fewer sites, they have a disproportionately greater number of buildings and total floor space, representing 67% of the total Federal floor space. DOD is made up of four departments (Services): Air Force, Army and Department of the Navy (which includes Marines). Information for the Army Corps of Engineers (ARCE) is broken out separately because they have different building characteristics than the Army. Civilian sites are made up of all other agencies excluding DOD and include 22 agencies. For the DOI, Department of Justice (DOJ), Department of Transportation (DOT), and USDA, data have been categorized into sub-agencies.

4.1 DOD

Of the 14,861 Federal sites, 2,588 are within DOD (Figure 2). These sites make up 17% of the total number of all Federal sites, but 78% of the total number of buildings and 67% of the total floor space (Table 1). DOD sites range from 1 to 5,410 buildings and from a few hundred square feet of floor space to over 26,000,000 ft².

Table 2 provides a breakdown of the DOD sites by Service. The Army has the largest number of sites (41%), buildings (41%) and total floor space (38%). The Air Force is next with 20% of the sites, 29% of the buildings and 30% of the total floor space. The Navy has 21% of the sites, 27% of the buildings and 31% of the total floor space. The ARCE has 18% of the sites, 3% of the buildings and 1% of the total floor space.

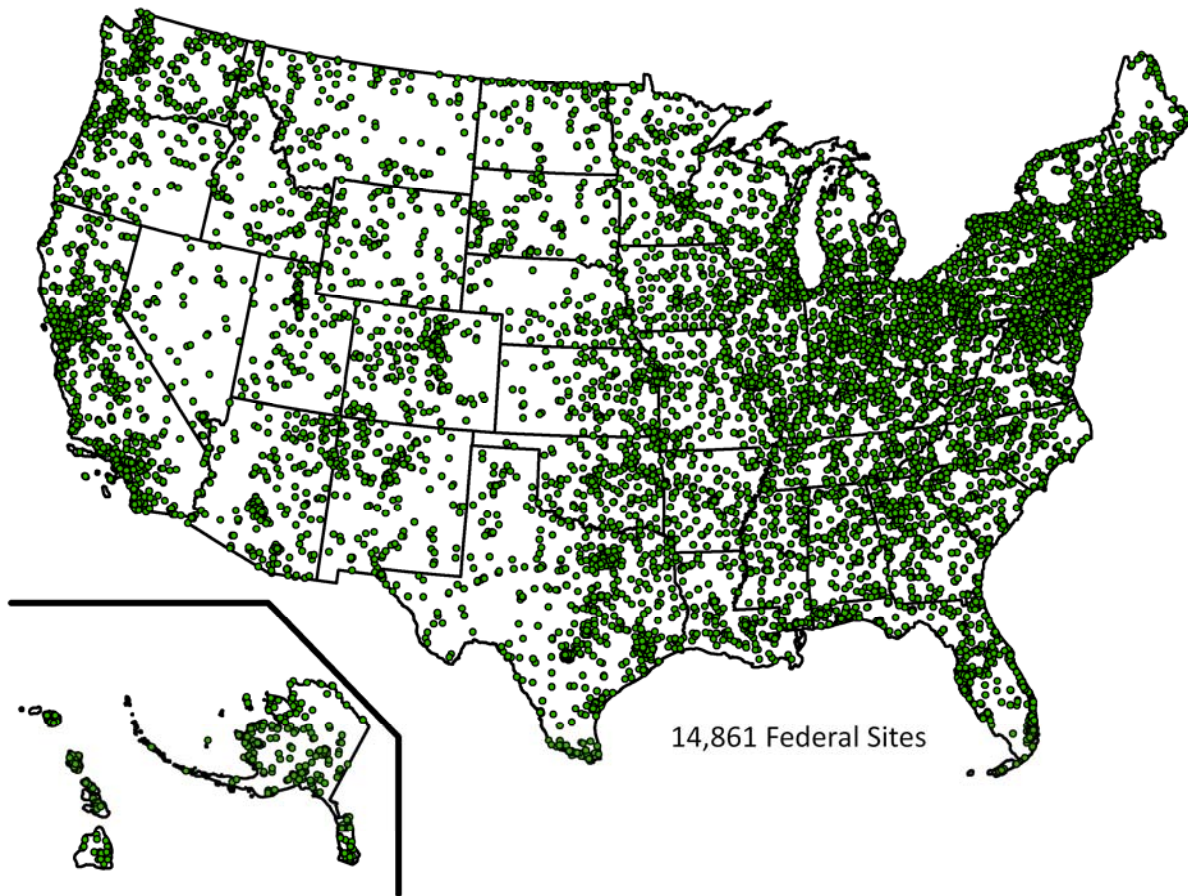


Figure 1. Locations of Federal Sites 2010

Table 1. Summary of Total Federal Building Stock

	DOD	Civilian	Total
Number of Sites/ (%)	2,588 (17)	12,273 (83)	14,861
Number of Buildings/ (%)	318,090 (78)	91,404 (22)	409,494
Total Floor Space (ft ²)/ (%)	1,993,480,978 (67)	987,594,647 (33)	2,981,075,625

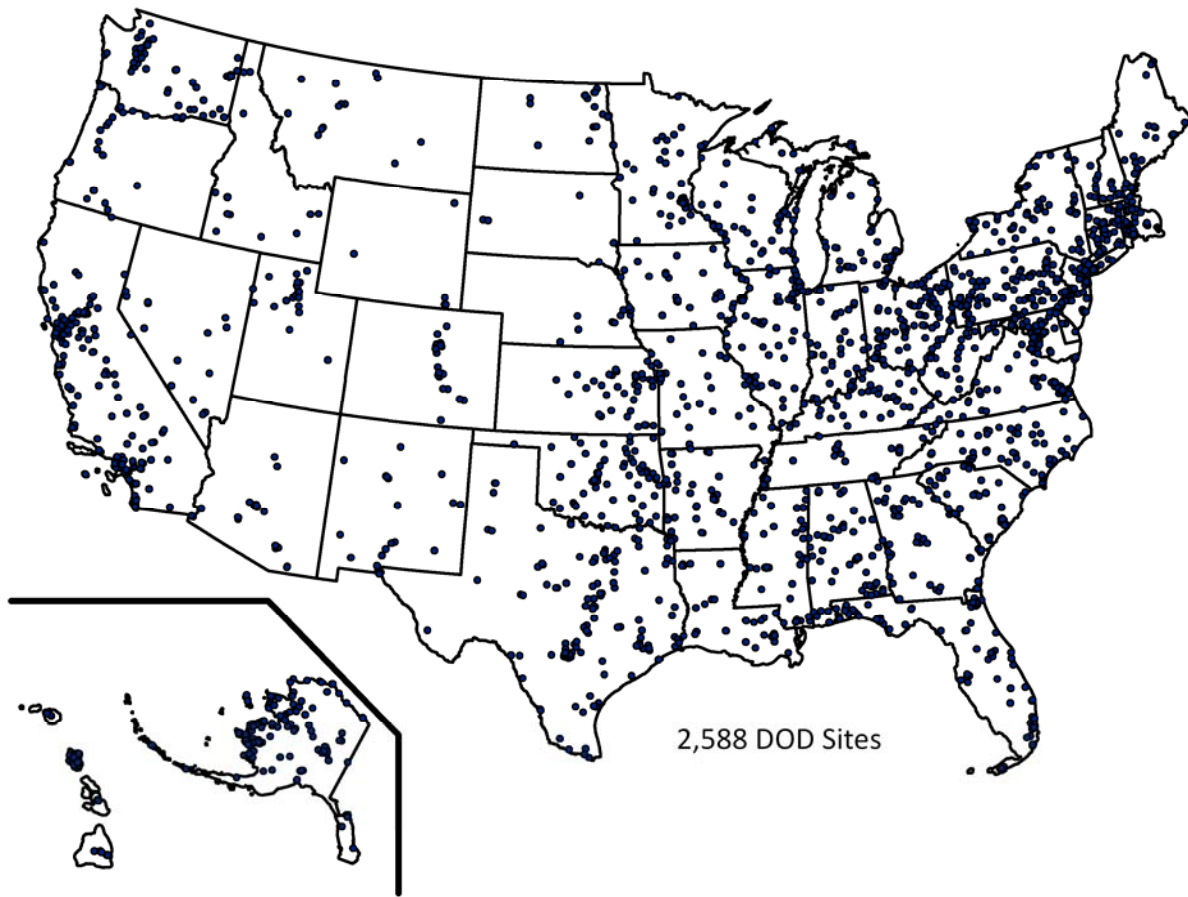


Figure 2. Locations of DOD Sites 2010

Table 2. Summary of DOD Building Stock by Service

DOD Agency	Number of Sites/ (%)	Number of Buildings/ (%)	Total Floor Space (ft ²)/ (%)
Air Force	507 (20)	93,090 (29)	602,128,614 (30)
Army	1,075 (41)	130,885 (41)	767,998,297 (38)
Army Corps of Engineers	466 (18)	9,217 (3)	11,260,293 (1)
Navy/Marines	540 (21)	84,898 (27)	612,093,774 (31)
TOTAL	2,588	318,090	1,993,480,978

4.2 Civilian Agencies

There are 12,273 sites that make up the civilian agency building stock (Table 1), which are geographically plotted in Figure 3. These sites make up 83% of the total number of Federal sites but only 22% of the total number of buildings and 33% of the total floor space (Table 1). Civilian sites range from 1 to 3,863 buildings per site and from a few hundred square feet in floor space to over 12,000,000 ft².

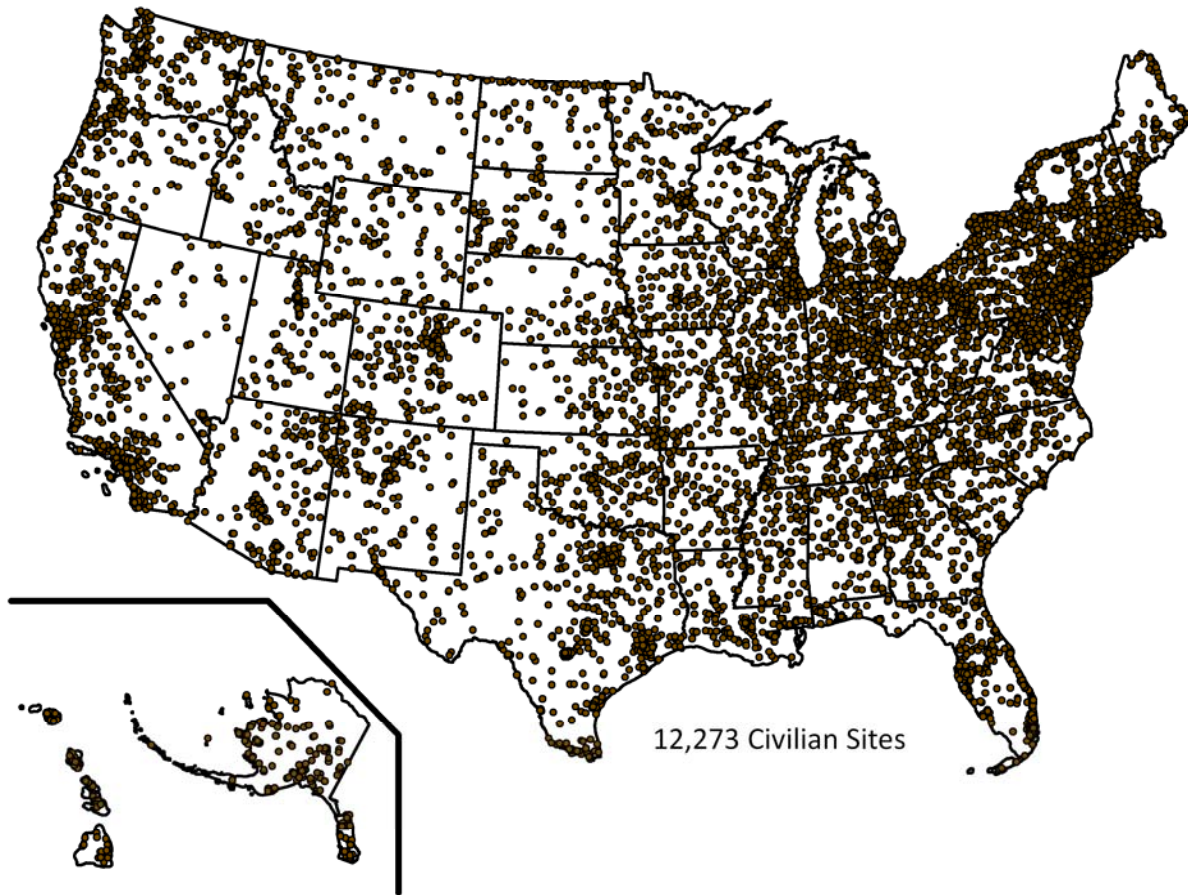


Figure 3. Locations of Civilian Sites 2010

In the database, there are 22 civilian agencies and 6 sub-agencies. Agencies vary from having 1 site in the database (Government Printing Office) up to 5,704 sites for the USPS. In terms of number of buildings, the National Archives and Records Administration has only four buildings, while DOI has 23,830 buildings. In terms of total floor space, the Federal Communications Commission has just over 100,000 ft², while the GSA has 296,212,609 ft² of floor space (Table 3).

Figure 4 compares the top 15 Civilian agencies for total number of buildings and total floor space. DOI has the most buildings with 23,830, but is 6th in total floor space with 36,412,016 ft². GSA has the greatest total floor space at 296,212,609 ft², but ranks 12th in total number of buildings with 2,554. USDA-Forest Service (USDA-FS) is second in total building count with 16,593, but 10th in total floor space with 21,941,117 ft². DOI and USDA-FS by the nature of their mission activities tend to have lots of smaller buildings when compared to an agency like GSA, which has fewer total buildings, but with a larger amount of floor space due to the presence of larger office buildings. This is critical information as agencies develop their respective efficiency programs.

Table 3. Summary of Civilian Building Stock by Agency

Civilian Agency	Number of Sites	Number of Buildings	Total Floor Space (ft²)
Defense – Education	41	124	5,142,912
Dept. Homeland Security	56	520	4,369,451
Dept. of Commerce	165	513	5,625,966
Dept. of Energy	134	9,184	116,794,299
Dept. of Interior	580	23,830	36,412,016
Dept. of Interior –Bureau of Indian Affairs	378	7,969	24,489,690
Dept. of Interior – Fish & Wildlife Service	97	558	4,240,124
Dept. of Justice	139	616	7,891,447
Dept. of Justice-Bureau of Prisons	76	2,367	35,476,518
Dept. of Labor	54	1,167	9,894,828
Dept. of Transportation	460	2,759	14,021,874
Dept. of Transportation –Federal Aviation Administration	1,307	2,605	9,948,041
Environmental Protection Agency	17	125	2,644,475
Federal Communications Commission	13	65	103,219
Government Printing Office	1	5	1,852,724
General Services Administration	1,490	2,554	296,212,609
Health and Human Services	177	2,702	22,674,609
National Archives and Records Administration	4	4	3,328,000
National Aeronautics and Space Administration	33	3,085	44,333,568
National Science Foundation	16	204	970,874
Dept. of State	9	122	377,859
Dept. of Treasury	7	9	2,730,463
Tennessee Valley Authority	51	440	3,050,503
US Dept. of Agriculture	42	324	1,571,883
US Dept. of Agriculture –Agriculture Research Service	130	2,674	12,778,304
US Dept. of Agriculture –Forest Service	799	16,593	21,941,117
US Postal Service	5,704	5,704	162,347,342
Veterans Affairs (VA)	293	4,582	136,369,932
TOTAL	12,273	91,404	987,594,647

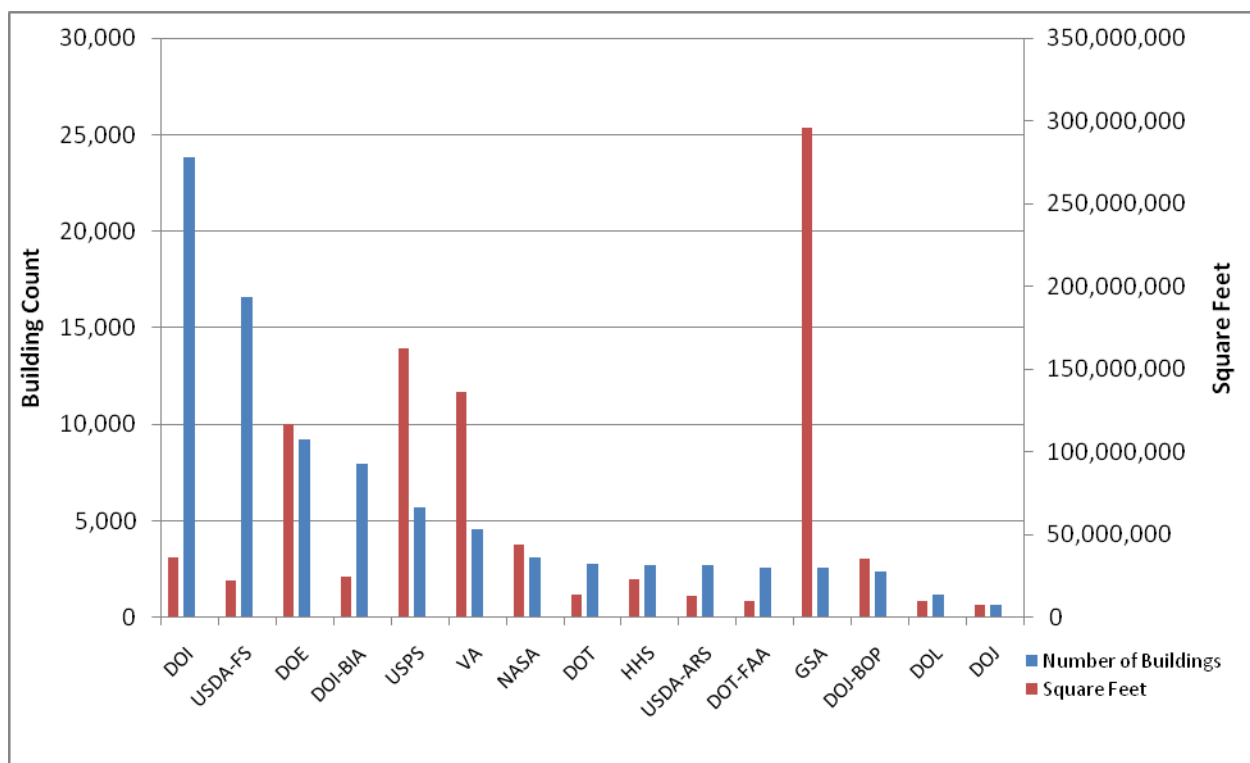


Figure 4. Top 15 Civilian Agencies by Total Building Count and Total Floor Space (ft²)

5.0 Building Types

There are 10 different building types within the database (Table 4). These building types follow GSA's real property database definitions of building categories (FRPC 2009). Comparing total building counts between agencies does not give enough information to thoroughly understand the characteristics of the building stock. Different agencies have different building needs. One agency may have only offices, where others agencies may have all building types. Only five DOD sites and no civilian sites have all types of buildings. But, when looking at Department of Justice-Bureau of Prisons (DOJ-BOP), prisons make up 82% of the building type and 97% of their total floor space. Only one other civilian agency, DOI-BIA, and 22 DOD sites have prisons.

By understanding the type of buildings in an agency's inventory, it can provide insight on energy and water savings potential because different building categories have distinct usage patterns. For example, prisons tend to have high potential for water efficiency improvements, while storage facilities typically have little potential for large efficiency enhancements. Prisons are extremely water intensive facilities because they operate 24 hours per day, seven days per week.

There are 6,954 DOD and civilian sites that only have office buildings types. USPS has 5,514 sites and GSA has 1,279 sites that only have office buildings. The remaining agencies each have less than 38 sites, with only office buildings. DOJ-BOP has no office building types.

For DOD, the housing building type makes up 45% of the total, followed by storage at 18%, and service at 16% (Figure 5). For total floor space, housing building type makes up 31% of the total, followed by 22% for service and 18% for storage (Figure 6). When each DOD branch of service is compared in terms of building counts, housing is the top building type for Air Force, Army and Navy (Table 5). ARCE's top building type is other (see Table 4 for description of components within this category). In terms of total floor space, housing is the top building type for Army and Navy, but service is top for Air Force (Table 6). The Air Force and Army have all building types. The ARCE does not have any hospitals or prisons and very few schools and R&D building types. The Navy does not have any prison building types listed in the database.

Table 4. Types of Buildings in Database

Building Type	Explanation
Hospital	In-patient healthcare facilities
Housing	Houses, dormitories, barracks
Industrial	Production or manufacturing
Office	Office space
Prison	Buildings for incarceration
Other	Not fitting into another category (Out-patient healthcare facilities, libraries, chapels)
Research & Development	Laboratories
School	Formal training
Service	Service activities (Maintenance and repair)
Storage	Warehouse used for storing goods

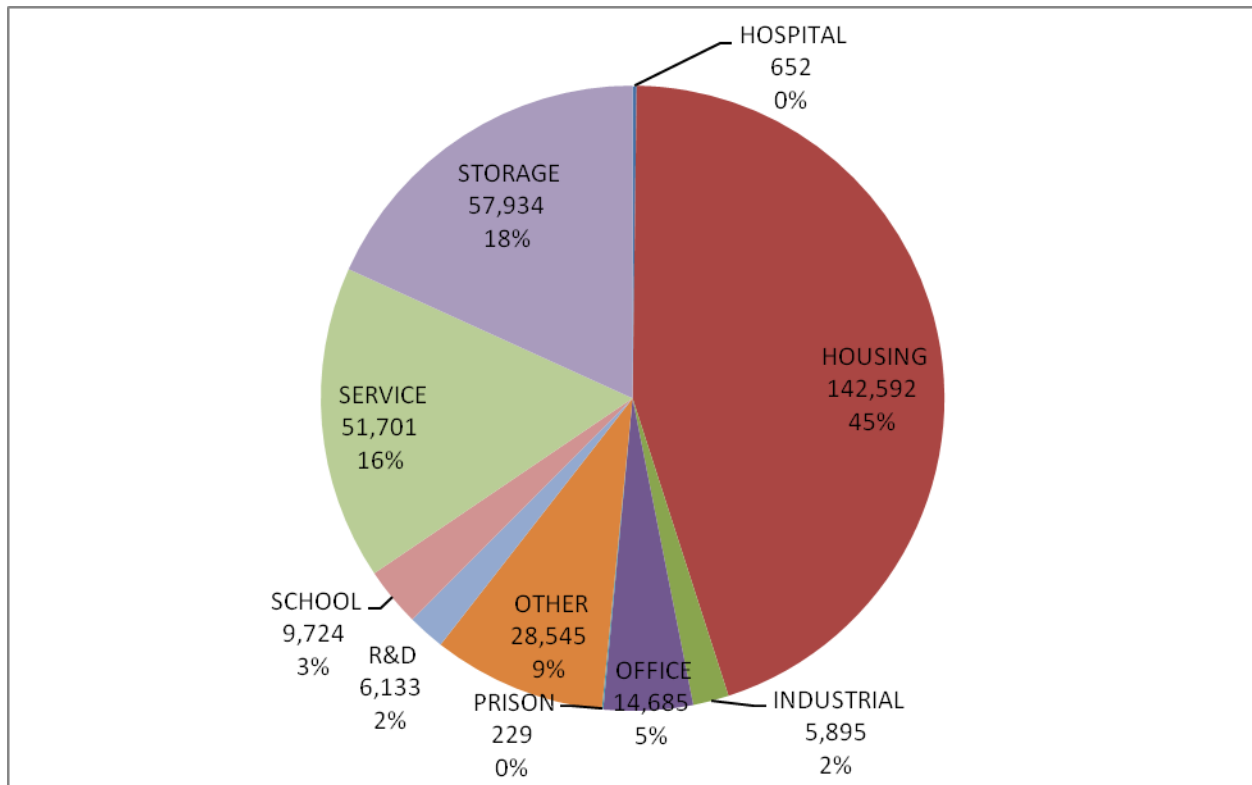


Figure 5. DOD Building Counts by Building Types

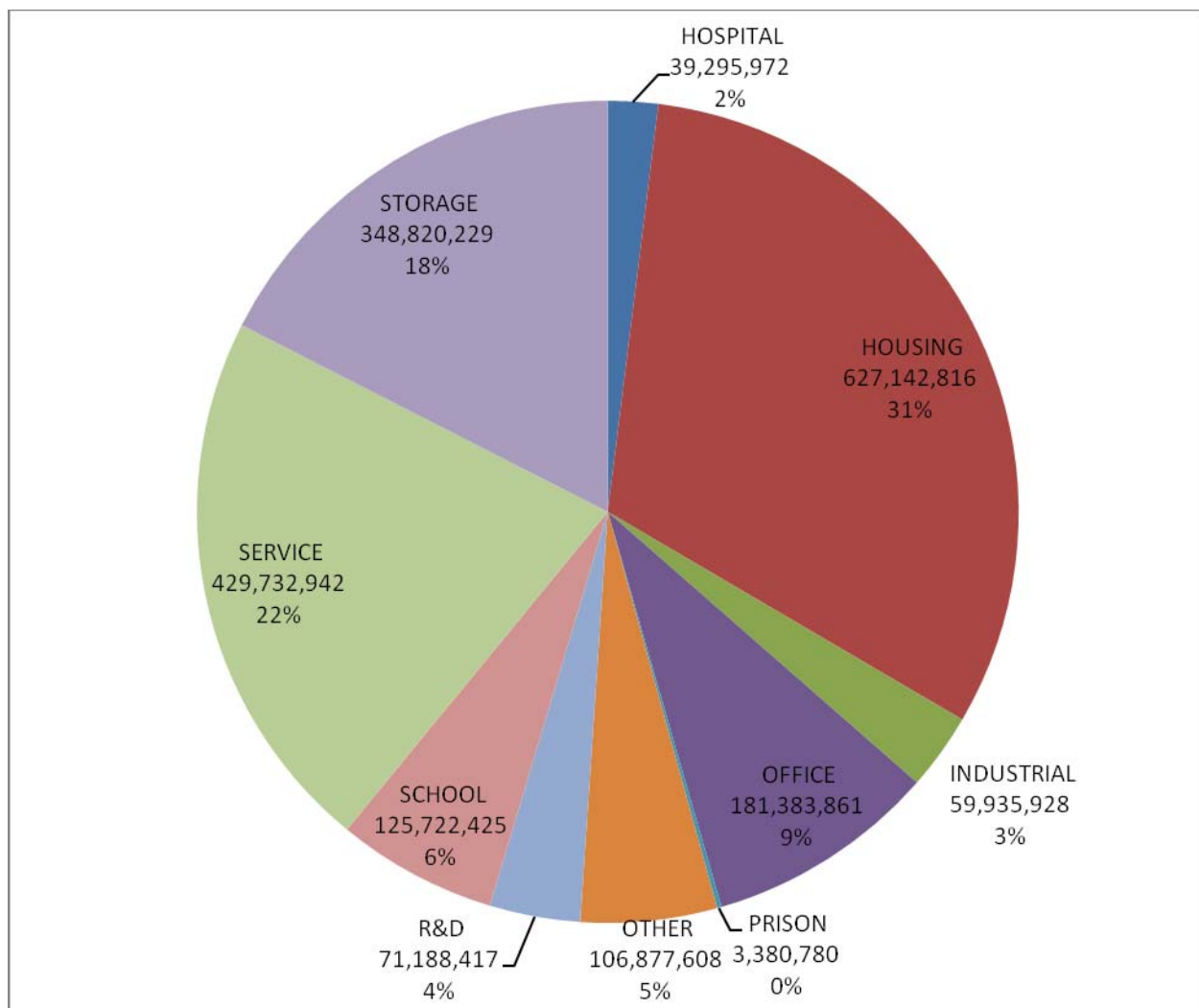


Figure 6. DOD Total Floor Space (ft²) by Building Type

Table 5. DOD Building Type by Total Building Count

Building Type	Air Force	Army	ARCE	Navy
HOSPITAL	338	180	0	134
HOUSING	50,034	44,002	328	48,228
INDUSTRIAL	197	4,944	40	714
OFFICE	2,484	8,737	485	2,979
PRISON	63	166	0	0
OTHER	5,077	10,976	5,652	6,840
R&D	1,551	1,769	9	2,804
SCHOOL	2,286	5,363	1	2,074
SERVICE	16,669	17,488	1,054	16,490
STORAGE	14,391	37,260	1,648	4,635
TOTAL	93,090	130,885	9,217	84,898

Table 6. DOD Building Type by Total Floor Space (ft²)

Building Type	Air Force	Army	ARCE	Navy
HOSPITAL	14,126,181	16,206,413	0	8,963,378
HOUSING	190,226,443	234,620,413	501,889	201,794,071
INDUSTRIAL	14,949,830	32,484,738	98,617	12,402,743
OFFICE	45,660,254	83,977,997	2,098,252	49,647,358
PRISON	407,993	2,972,787	0	0
OTHER	12,917,933	66,764,465	4,326,860	22,868,350
R&D	26,248,257	15,514,206	47,636	29,378,318
SCHOOL	35,359,794	51,406,154	748	38,955,729
SERVICE	190,933,294	83,848,624	1,929,509	153,021,515
STORAGE	71,298,635	180,202,500	2,256,782	95,062,312
TOTAL	602,128,614	767,998,297	11,260,293	612,093,774

For civilian agencies building counts, the housing building type makes up 22% of the total, followed by other at 21%, storage at 19%, and office at 15% (Figure 7). For total floor space, office building type makes up 47% of the total, followed by the hospital building type with 10%, and 8% for both the storage and research and development building types (Figure 8).

The predominant civilian agencies by building type for building count and floor space is detailed in Table 7. Tables 8 and 9 show all civilian agencies by total building count and total floor space for each building type, respectively.

Table 7. Predominate Civilian Agencies for Building Count and Floor Space by Building Type

Building Type	Predominant Agency by Building Count	Predominant Agency by Building Square Feet
HOSPITAL	VA	VA
HOUSING	DOI	DOI-BIA
INDUSTRIAL	DOE	DOE
OFFICE	USPS	GSA
PRISON	DOJ-BOP	DOJ-BOP
OTHER	DOI	VA
R&D	DOI	DOE
SCHOOL	DOI-BIA	DOI-BIA
SERVICE	DOI	DOE
STORAGE	USDA-FS	GSA

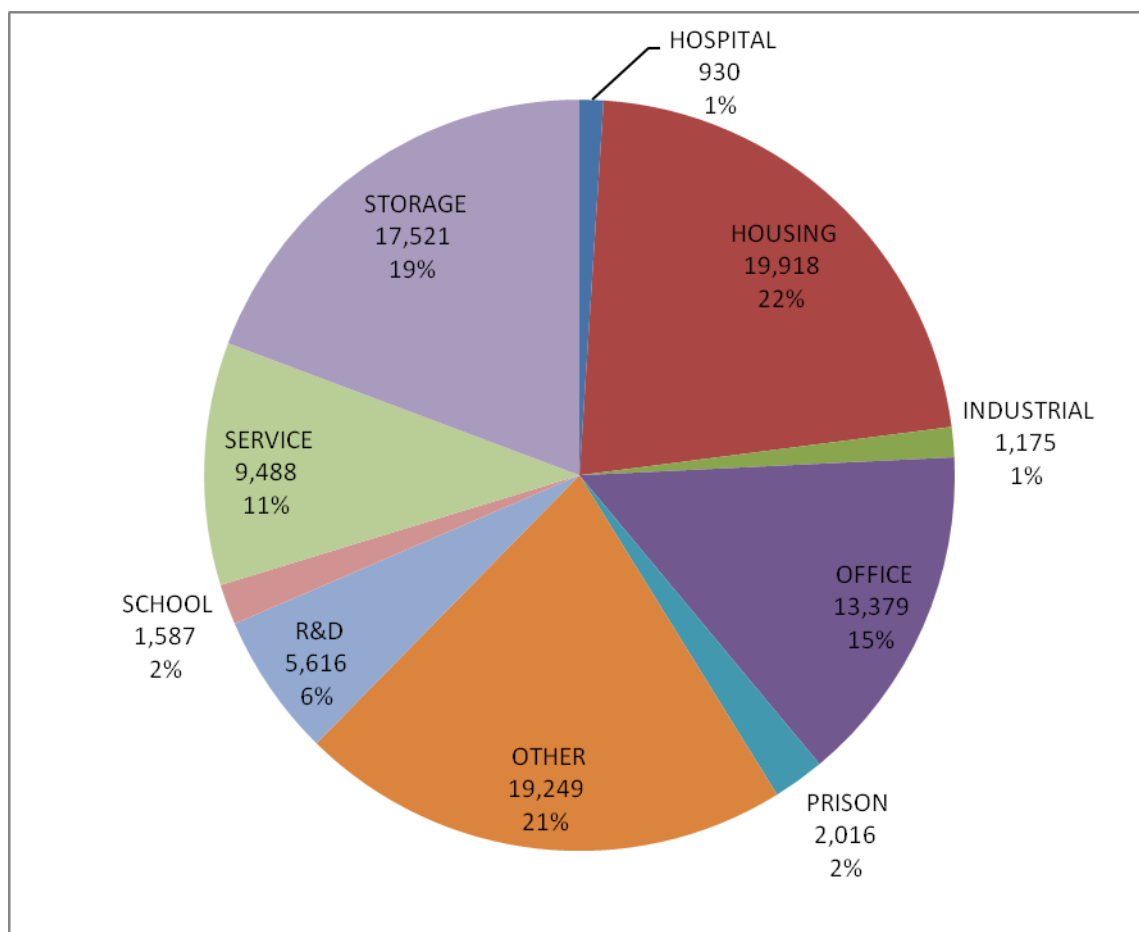


Figure 7. Civilian Building Counts by Building Types

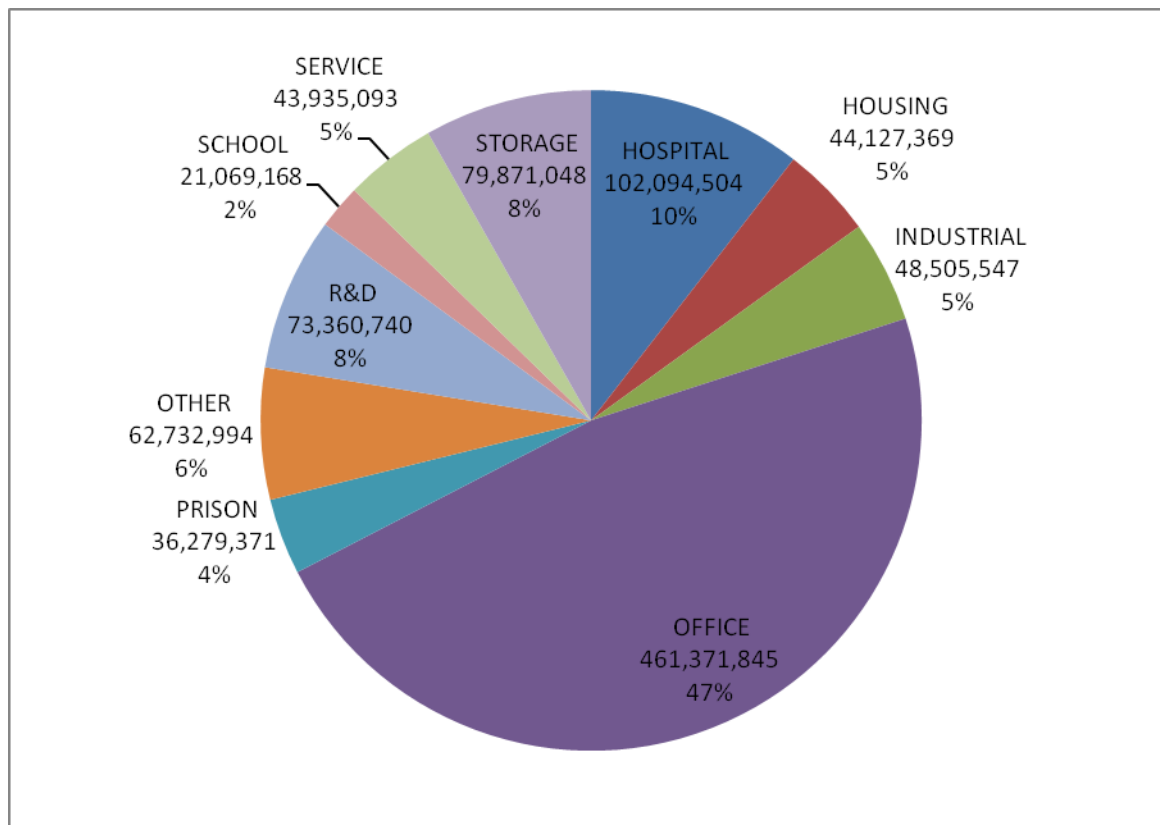


Figure 8. Civilian Total Floor Space (ft²) by Building Type

There are 27 agencies/sub-agencies that have buildings classified as offices, 26 with building types classified as storage, 24 that have other and service, 22 that have housing, 19 that have R&D, 16 that have industrial and schools, 9 that have hospitals and 3 that have prisons. In terms of building counts, the values can range from one building to over 8,340 for any specific building type. Total floor space for an agency building type can be less than 200 ft² (DOI-BIA R&D) to 242,309,575 ft² (GSA buildings).

Table 8. Civilian Agencies Building Type by Total Building Count

Agency	Building Count									
	HOSPITAL	HOUSING	INDUSTRIAL	OFFICE	PRISON	OTHER	R&D	SCHOOL	SERVICE	STORAGE
Defense - Education	0	0	0	1	0	0	0	121	1	1
Dept. Homeland Security	0	80	0	58	0	22	7	13	30	58
Dept. of Commerce	0	71	0	76	0	25	336	0	0	5
Dept. of Energy	24	181	731	1,745	0	374	1,407	126	2,319	2,277
Dept. of Interior	3	6,026	92	740	0	8,340	1,857	44	3,032	3,539
Dept. of Interior –Bureau of Indian Affairs	11	4,098	10	255	1	530	1	744	473	1,598
Dept. of Interior – Fish & Wildlife Service	0	119	55	49	0	114	18	13	94	96
Dept. of Justice	0	100	106	116	79	60	0	0	34	121
Dept. of Justice- Bureau of Prisons	0	431	0	0	1,936	0	0	0	0	0
Dept. of Labor	17	212	0	103	0	235	0	287	71	242
Dept. of Transportation	1	1,311	3	214	0	215	13	94	360	548
Dept. of Transportation –Federal Aviation Administration	0	124	0	60	0	1,952	42	18	73	336
Environmental Protection Agency	0	0	2	5	0	25	63	0	3	27
Federal Communications Commission	0	0	0	2	0	46	2	0	3	12
Government Printing Office	0	0	1	3	0	0	0	0	0	1
General Service Administration	0	19	2	1,618	0	93	1	4	95	602
Health and Human Services	56	1,385	0	241	0	286	200	1	282	251
National Archives and Records Administration	0	0	0	1	0	3	0	0	0	0
National Aeronautics and Space Administration	17	49	150	841	0	140	722	10	602	554
National Science Foundation	0	72	4	8	0	7	50	0	36	27
Dept. of State	0	36	2	9	0	39	0	0	22	14
Dept. of Treasury	0	49	5	33	0	57	0	81	9	27
Tennessee Valley Authority	0	8	0	5	0	112	10	0	77	228
US Dept. of Agriculture	0	4	4	36	0	28	139	0	23	90
US Dept. of Agriculture –Agriculture Research Service	0	85	0	114	0	1,131	406	0	237	701
US Dept. of Agriculture –Forest Service	1	4,642	3	994	0	4,573	184	1	838	5,357
US Postal Service	0	0	0	5,514	0	0	0	9	163	18
Veterans Affairs	800	816	5	538	0	842	158	21	611	791
TOTAL	930	19,918	1,175	13,379	2,016	19,249	5,616	1,587	9,488	17,521

Table 9. Civilian Agencies Building Type by Total Floor Space

Agency	Total Square Feet									
	HOSPITAL	HOUSING	INDUSTRIAL	OFFICE	PRISON	OTHER	R&D	SCHOOL	SERVICE	STORAGE
Defense - Education	0	0	0	1,521	0	0	0	4,807,687	333,288	416
Dept. Homeland Security	0	307,916	0	136,381	0	184,230	278,757	143,648	114,064	332,630
Dept. of Commerce	0	152,128	0	3,468,510	0	81,211	1,895,169	0	0	28,948
Dept. of Energy	224,713	790,205	36,304,115	23,890,176	0	3,913,750	29,950,564	1,085,426	9,477,561	11,157,789
Dept. of Interior	22,592	8,045,327	494,906	3,747,320	0	12,068,858	1,969,935	437,919	4,680,648	4,944,511
Dept. of Interior –Bureau of Indian Affairs	32,062	11,054,721	23,177	1,018,052	12,296	2,459,384	196	6,477,378	1,411,182	2,001,242
Dept. of Interior – Fish & Wildlife Service	0	346,667	703,199	639,450	0	1,127,146	226,352	168,072	538,241	490,997
Dept. of Justice	0	173,419	3,058,743	475,611	1,898,655	1,246,872	0	0	102,904	935,243
Dept. of Justice-Bureau of Prisons	0	1,108,098	0	0	34,368,420	0	0	0	0	0
Dept. of Labor	167,754	2,588,181	0	778,122	0	2,052,798	0	3,371,954	149,771	786,248
Dept. of Transportation	49,281	4,217,198	150,716	2,697,203	0	1,328,630	726,400	1,299,888	2,372,948	1,179,610
Dept. of Transportation –Federal Aviation Administration	0	210,463	0	746,983	0	6,534,492	946,371	97,629	958,775	453,328
Environmental Protection Agency	0	0	16,800	16,875	0	170,282	1,172,647	0	3,870	1,264,001
Federal Communications Commission	0	0	0	5,420	0	48,379	23,250	0	2,404	23,766
Government Printing Office	0	0	159,253	1,306,748	0	0	0	0	0	386,723
General Service Administration	0	97,483	54,990	242,309,575	0	4,454,866	38,735	74,600	3,009,777	31,925,615
Health and Human Services	6,082,924	2,983,042	0	2,597,447	0	2,324,091	6,186,111	14,931	1,855,665	630,398
National Archives and Records Administration	0	0	0	1,375,000	0	1,953,000	0	0	0	0
National Aeronautics and Space Administration	77,731	395,208	5,537,746	9,509,249	0	201,906	17,645,818	222,312	5,966,554	4,777,044
National Science Foundation	0	148,887	7,976	134,738	0	9,645	543,192	0	87,687	38,749
Dept. of State	0	59,195	9,111	22,278	0	214,300	0	0	36,551	36,424
Dept. of Treasury	0	569,695	1,802,215	1,110,365	0	1,203,919	0	705,509	45,179	165,406
Tennessee Valley Authority	0	10,207	0	310,598	0	166,279	20,166	0	278,192	2,265,061
US Dept. of Agriculture	0	9,848	76,405	76,361	0	412,741	737,582	0	95,352	163,594
US Dept. of Agriculture –Agriculture Research Service	0	167,614	0	651,962	0	3,702,017	6,027,877	0	873,514	1,355,320
US Dept. of Agriculture –Forest Service	2,200	6,064,932	10,428	3,047,816	0	2,513,804	1,345,251	1,160	1,780,407	7,175,119
US Postal Service	0	0	0	153,829,512	0	0	0	1,422,092	5,234,834	1,860,904
Veterans Affairs	95,435,247	4,626,935	95,767	7,468,572	0	14,360,394	3,626,367	738,963	4,525,725	5,491,962
TOTAL	102,094,504	44,127,369	48,505,547	461,371,845	36,279,371	62,732,994	73,360,740	21,069,168	43,935,093	79,871,048

6.0 Distribution of Building Stock

Using average floor space size for a specific building type is not effective in the ultimate design of energy and water efficiency programs since the size of the individual buildings vary markedly across the Federal building stock. For example, there are 552 sites with greater than 1 million ft² of floor space with five over 20 million ft² (Figure 9). There are 1,728 sites between 100,000 and 999,999 ft² of floor space, 2,594 sites between 25,000 and 99,999 ft², and 9,987 buildings less than 25,000 ft² (Figure 9).

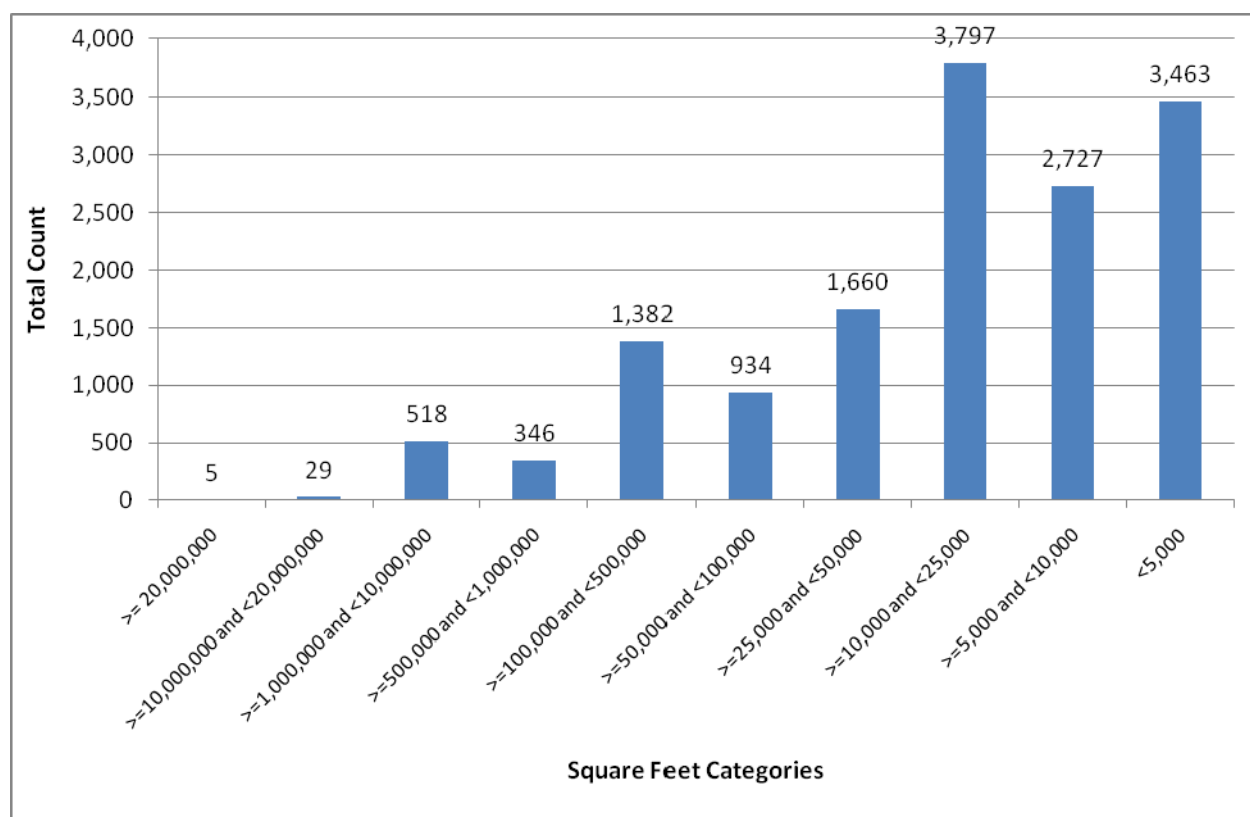


Figure 9. Total Sites Floor Space (ft²)– All Sites

In terms of geographic location, California is the predominant state of Federal sites (8%), number of buildings (15%), and total floor space (14%) (Table 10). Texas is second in all three categories; sites (6%), buildings (7%), floor space (7%). Washington DC is ranked 45th in number of sites and number of buildings, but 12th in total floor space indicating a predominate number of larger Federal buildings. The states of Rhode Island, Delaware, New Hampshire, and Vermont have the lowest number of sites, buildings and total floor space.

Table 10. Top Five States for Number of Sites, Buildings and Total Floor Space

	Rank	All	DOD	Civilian
Sites	1	California	California	California
	2	Texas	Texas	New York
	3	New York	Pennsylvania	Texas
	4	Pennsylvania	Alaska	Pennsylvania
	5	Illinois	Florida	Illinois
Buildings	1	California	California	California
	2	Texas	Texas	Wyoming
	3	Virginia	North Carolina	Arizona
	4	North Carolina	Virginia	New Mexico
	5	Hawaii	Hawaii	Texas
Floor Space	1	California	California	California
	2	Texas	Texas	New York
	3	Virginia	Virginia	Washington DC
	4	Maryland	Georgia	Texas
	5	Georgia	Florida	Maryland

For each state, land area by square miles was obtained (Drexel University 2009) so that density per square mile for number of Federal sites, number of buildings, and total floor space could be determined. Per square mile, Washington DC has the most sites (2.23), the greatest number of buildings (32.5) and greatest total floor space (1,317,297 ft²). Rhode Island, New Jersey, Massachusetts and Maryland are in the top five for the most sites per square mile. Hawaii, Rhode Island, New Jersey, and Maryland are in the top five for the greatest number of buildings and greatest total floor space per square mile.

For DOD sites only, California has the most sites (8%), number of buildings (16%) and total floor space (16%) (Table 10). Texas is second with 6% of the sites, 7% of the total buildings, and 8% total floor space. Vermont, New Hampshire, and Wyoming have the lowest number of DOD sites.

In terms of the branches of services with DOD, California has the most sites (10%), number of buildings (16%) and total floor space (13%) for Air Force sites (Table 11). California also has the most sites (18%), number of buildings (32%) and total floor space (32%) for the Navy. Alaska has the most Army sites (7%), but Texas has the most Army buildings (10%) and total floor space (9%).

For the civilian agencies, California has the largest number of sites (7%), number of buildings (11%) and total floor space (10%) (Table 10). The state of Wyoming has the second largest number of buildings (6%), but ranks 36th for number of sites and 39th for total floor space. This is because of DOI's Yellowstone and Grand Teton National Parks sites in Wyoming have a large number of smaller buildings. Delaware, Rhode Island, Vermont, and New Hampshire have the lowest number of civilian agency sites, buildings, and total floor space.

Table 11. DOD Service Top Five States for Number of Sites, Buildings and Total Floor Space

	Rank	Air Force	Army	ARCE	Navy
Sites	1	California	Alaska	Ohio	California
	2	Alaska	Pennsylvania	Texas	Virginia
	3	Texas	Texas	Pennsylvania	Florida
	4	New York	California	Oklahoma	Hawaii
	5	Florida	New York	Kentucky	Washington
Buildings	1	California	Texas	Oklahoma	California
	2	Texas	California	Texas	Hawaii
	3	Florida	Georgia	Georgia	North Carolina
	4	New Mexico	Alabama	Kansas	Virginia
	5	Arizona	Virginia	Arkansas	Florida
Floor Space	1	California	Texas	Oregon	California
	2	Texas	Georgia	Texas	Virginia
	3	Florida	California	Florida	Florida
	4	Georgia	Virginia	Georgia	North Carolina
	5	Ohio	Alabama	Louisiana	Hawaii

Location of Federal sites is important in terms of available incentives from either the state, or state run organizations, or utilities in terms of available incentives that can be used to offset the cost of implementing efficiency programs. Geographic location is also important in terms of baseline energy and water cost, which is important in determining the cost-effectiveness of potent specific energy and water efficiency measures. For example, in California large opportunities exist for obtaining incentive payments to offset the overall cost of programs compared to other states.

Five of the civilian agencies were selected to investigate the distribution of sites, number of buildings, and total floor space. These agencies included DOE, GSA, Health and Human Services (HHS), National Aeronautics and Space Administration (NASA), and VA. The results can be seen in Table 12. For DOE, California has the most sites (12%), New Mexico has the most number of buildings (25%) and Tennessee has the greatest total floor space (15%). For GSA, New York has the most sites (11%), Maryland has the most buildings (12%) and Washington DC has the greatest total floor space (17%). For HHS, Arizona has the most sites (20%) and number of buildings (29%), but Maryland has the greatest total floor space (41%). NASA only has sites in 12 states. California has the most sites (42%), number of buildings (26%) and greatest total floor space (24%). For the VA, New York has the most sites (7%) and the greatest total floor space (9%); and California has the most number of buildings (7%).

Table 12. Civilian Agencies Top Five States for Number of Sites, Buildings and Total Floor Space

	Rank	DOE	GSA	HHS	NASA	VA
Sites	1	California	New York	Arizona	California	New York
	2	Colorado	Texas	New Mexico	Florida	California
	3	New Mexico	Illinois	South Dakota	*	Virginia
	4	Tennessee	Washington DC	Alaska		Pennsylvania**
	5	Ohio	Maryland	Montana		Texas**
Buildings	1	New Mexico	Maryland	Arizona	California	California
	2	California	New Jersey	South Dakota	Florida	New York
	3	Tennessee	New York	New Mexico	Virginia	Maryland
	4	Texas	Texas	Maryland	Ohio	Pennsylvania
	5	South Carolina	California	Montana	Maryland	Texas
Floor Space	1	Tennessee	Washington DC	Maryland	California	New York
	2	New Mexico	California	Arizona	Florida	California
	3	Ohio	Maryland	Georgia	Maryland	Texas
	4	California	New York	New Mexico	Alabama	Illinois
	5	Kentucky	Texas	Alaska	Louisiana	Pennsylvania

*Louisiana, Virginia, Ohio, Mississippi, and New Mexico all tied for 3rd place

**Pennsylvania and Texas have same number of sites for VA

6.1 Specific Agency Examples

Federal agencies can have sub-agencies but the FSCDB only has sub-agencies broken out for four agencies - DOI, DOJ, DOT, and USDA. The sub-agency data is not included in the total agency data set. With this data, it is possible look at sub-agency data to see how it compares to the agency data. For DOI, California has the most sites (9%) and floor space (15%), but Wyoming has the most number of buildings (20%) (Table 13). For DOI-BIA, Arizona has the most sites (20%), number of buildings (33%) and floor space (30%). For DOI-Fish and Wildlife Service (DOI-FW), Washington has the most sites (11%), Alaska has the most number of buildings (12%) and Illinois has the greatest total floor space (19%).

For DOJ, Texas has the most sites (22%) and number of buildings (27%), but Georgia has the greatest total floor space (23%) (Table 13). For DOJ-BOP, Texas has the most sites (13%), number of buildings (15%) and floor space (14%).

For DOT, California has the most sites (11%), Massachusetts has the most number of buildings (15%) and New York has the greatest total floor space (17%) (Table 13). For the DOT-FAA, California has the most sites (10%), Alaska has the most number of buildings (13%), and Virginia has the greatest total floor space (15%).

Table 13. Civilian Agencies and Sub-Agencies Top Five States for Number of Sites, Buildings and Total Floor Space

	Rank	DOI	DOI-BIA	DOI-FW	DOJ	DOJ-BOP	DOT	DOT-FAA	USDA	USDA-ARS	USDA-FS
Sites	1	California	Arizona	Washington	Texas	Texas	California	California	Florida	Texas	California
	2	Washington	New Mexico	Alaska	California	California	Massachusetts	Texas	California	Florida	Colorado
	3	Arizona	South Dakota	California	Montana	Florida	Michigan	Alaska	Maryland	California	Oregon
	4	Alaska	Alaska	Idaho	Arizona	*	Florida	New York	New York	Georgia	Idaho
	5	Idaho	Washington	Oregon	Minnesota		New York	Pennsylvania	Texas	**	Utah
Buildings	1	Wyoming	Arizona	Alaska	Texas	Texas	Massachusetts	Alaska	Texas	Maryland	California
	2	California	New Mexico	Illinois	California	California	Florida	California	Florida	Texas	Oregon
	3	Washington	South Dakota	Washington	Georgia	Pennsylvania	California	Texas	New York	Mississippi	Idaho
	4	Pennsylvania	North Dakota	Arizona	Montana	Florida	New York	New Jersey	Iowa	Georgia	Montana
	5	Virginia	Montana	Texas	Arizona	Minnesota	Washington	Virginia	Mississippi	Florida	Colorado
Floor Space	1	California	Arizona	Illinois	Georgia	Texas	New York	Virginia	Maryland	Maryland	California
	2	Wyoming	New Mexico	Washington	Virginia	California	Massachusetts	New Jersey	Texas	Texas	Oregon
	3	Pennsylvania	South Dakota	West Virginia	Texas	Florida	California	California	North Carolina	Georgia	Idaho
	4	Washington	North Dakota	Virginia	Pennsylvania	Kentucky	Alaska	Texas	Iowa	Nebraska	Montana
	5	New York	Oklahoma	Maryland	California	Pennsylvania	Florida	Alaska	New York	California	Washington

*Illinois, Minnesota, New York, and Pennsylvania all tied for 4th place.

** Colorado, Iowa, Idaho, and Oregon all tied for 5th place.

For USDA, Florida has the most sites (10%), Texas has the most number of buildings (15%), and Maryland has the most floor space (25%) (Table 13). For USDA-ARS, Texas has the most sites (9%), and Maryland has the most number of buildings (16%) and floor space (18%). For USDA-FS, California has the most sites (13%), number of buildings (16%) and floor space (15%).

7.0 Top 10 Sites

The largest DOD and civilian agencies sites, in terms of buildings and floor space, may be drivers of energy and water consumption for that agency. By breaking out the largest installations, agencies can use this information to assist prioritize sites for the extent of efficiency improvements. The following provides information on the top ten sites for both DOD and civilian agencies.

7.1 DOD

When looking at the DOD data for the top ten sites for all services, the Navy has the site with the largest number of buildings (site in North Carolina), but the Army has the site with greatest total floor space (site in Texas). The Army and Navy both have four sites and the Air Force has two sites in the top 10 for total number of buildings. The Army has 6, the Navy has 3, and the Air Force has 1 site in the top 10 for total floor space.

7.2 Civilian

When looking at the civilian data for the top 10 sites, DOI has the site with the largest number of buildings (site in Wyoming). However, this site only ranks 26th for total floor space. DOE and DOI each have 4 sites and DOI-BIA has 2 sites in the top 10 for total number of buildings. DOE has 7 sites and DOI-BIA, HHS, and NASA each have 1 site in the top 10 for total floor space. DOE has the largest site for total floor space (site in Ohio), however, this site ranks 116th for total number of buildings indicating the occurrence of very large individual buildings on the site.

8.0 Changes over Time – DOE

Data is available for DOE building inventory for 2000 and for 2008, and this lends itself to looking at changes in an agency's real property over time. When comparing data between these 2 years, there are major changes in some of the DOE building types; however, when looking at overall changes to building counts and total floor space, the building stock has not changed considerably.

Overall, total number of buildings have decreased 8.0% and total floor space has decreased 5.1% from 2000 to 2008 (Figures 10, 11 and Tables 14, 15). When looking at specific building types by building counts, the number of buildings classified as offices has increased 62.4%, while the number of buildings classified as other has increase 50%. Storage building types and hospitals have decreased 28% and 25.8%, respectively. Other building types have increased in total floor space 79.1% and office building types have increase in total floor space 46.2%. Whereas, service (26%) and industrial (25.2%) building types total floor space has gone down since 2000 to 2008.

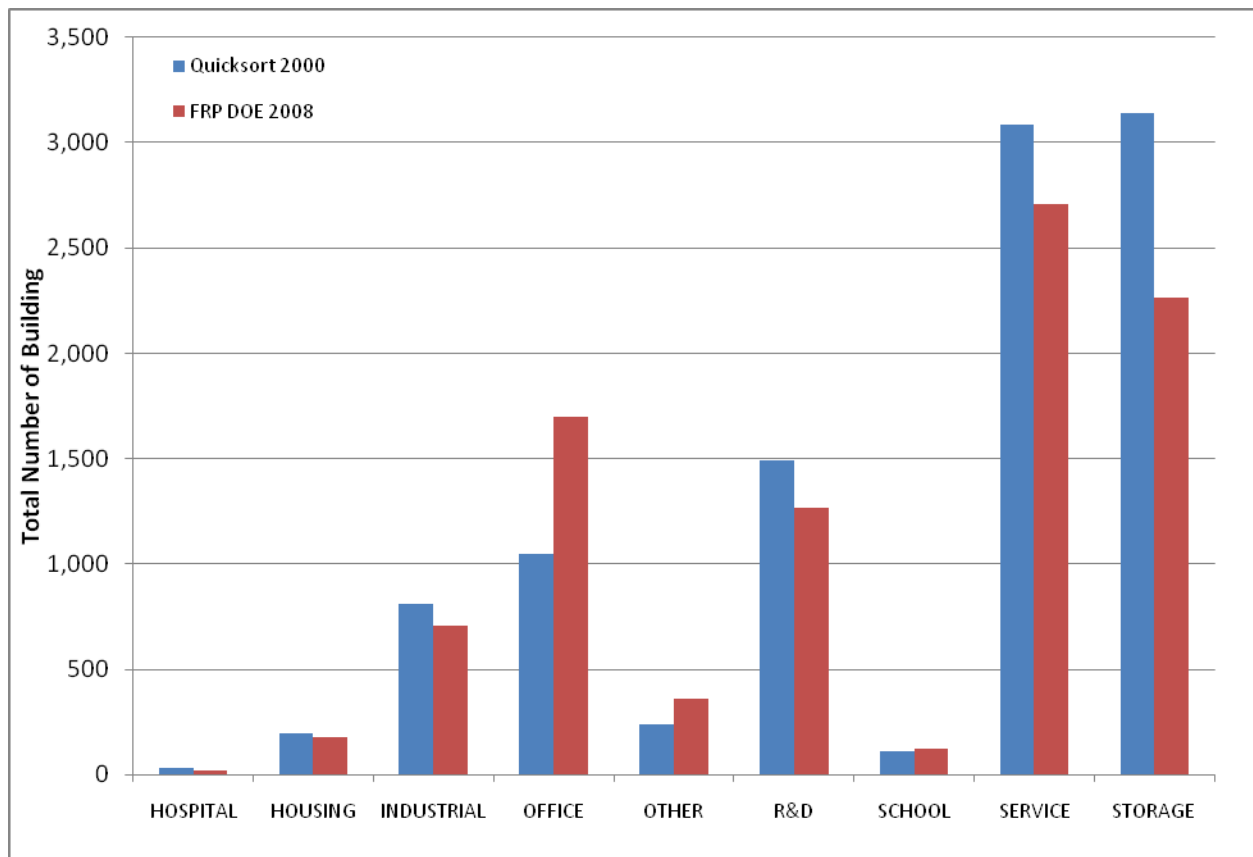


Figure 10. Changes in Total Building Counts by Building Types for DOE

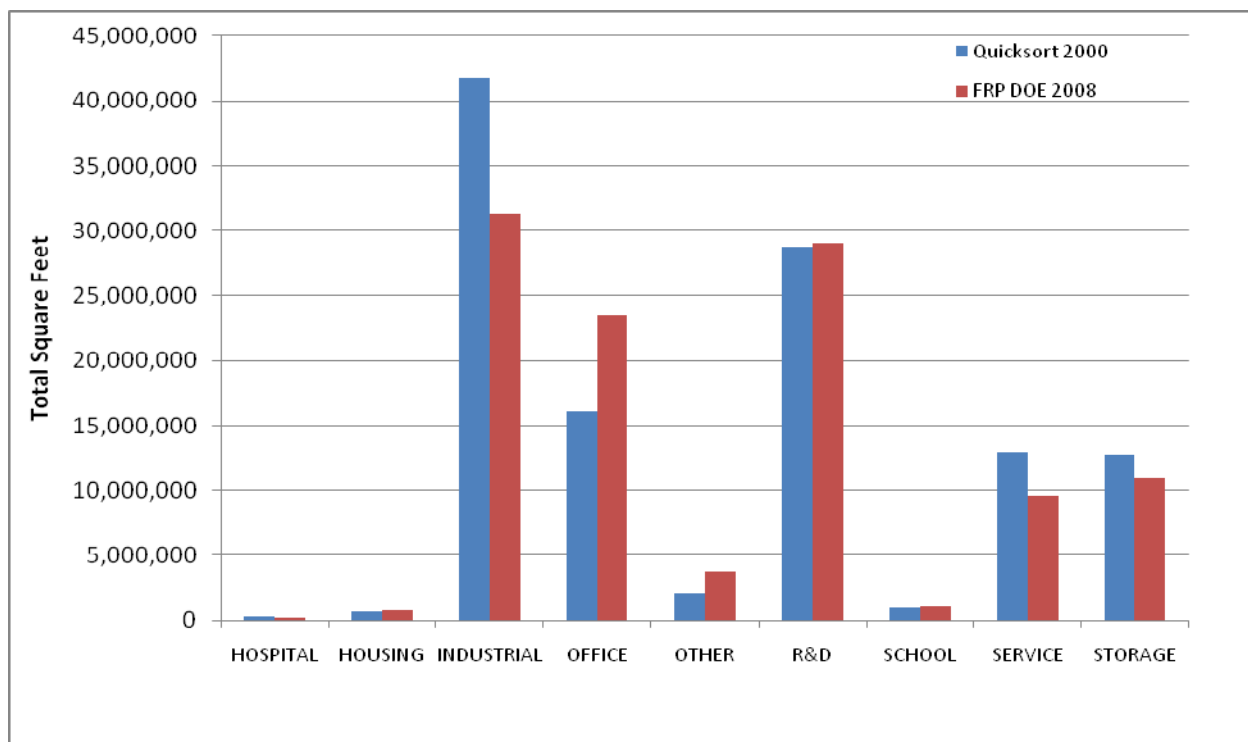


Figure 11. Changes in Total Floor Space (ft²) by Building Types for DOE

Table 14. Changes to DOE Building Stock by Building Type and Building Count

	Total Building Counts									
	HOSPITAL	HOUSING	INDUSTRIAL	OFFICE	OTHER	R and D	SCHOOL	SERVICE	STORAGE	TOTAL
Quicksort 2000	31	199	811	1,046	242	1,491	110	3,082	3,139	10,151
FRP DOE 2008	23	181	710	1,699	363	1,264	124	2,710	2,261	9,335
Percent Change	-25.8%	-9.0%	-12.5%	62.4%	50.0%	-15.2%	12.7%	-12.1%	-28.0%	-8.0%

Table 15. Changes to DOE Building Stock by Building Type and Total Floor Space

	Total Floor Space (ft ²)									
	HOSPITAL	HOUSING	INDUSTRIAL	OFFICE	OTHER	R&D	SCHOOL	SERVICE	STORAGE	TOTAL
Quicksort 2000	258,306	694,843	41,769,500	16,094,741	2,121,897	28,720,333	943,436	12,966,260	12,733,133	116,302,449
FRP DOE 2008	223,033	790,205	31,263,936	23,533,437	3,800,863	29,057,566	1,082,066	9,593,910	10,997,724	110,342,740
Percent Change	-13.7%	13.7%	-25.2%	46.2%	79.1%	1.2%	14.7%	-26.0%	-13.6%	-5.1%

The building categories of office, other, and school have not only increased in total number of buildings but in total floor space as well. Hospitals, industrial, service and storage building types have decreased in both number of buildings and total floor space. Housing and R & D have decreased in building count, but total floor space has increased. The exact reason for these changes is unknown, but a few factors may be involved. Buildings may have been recategorized to a different building type. Older buildings are not being used and/or newer buildings with different building types are being built.

Changes in inventory can be useful to an agency to assist in understanding the influences on energy and water intensity. As building stock changes, so does the agency's water and energy consumption. In the case of DOE, there has been a large upswing in office space and a reduction in industrial buildings. Industrial buildings tend to be much more energy and water intensive than office buildings. So as DOE's building stock trends to less resource intensive buildings, the agency may experience an overall energy and water intensity reduction.

9.0 Conclusion

Federal laws and Executive Orders require Federal agencies to reduce energy use, pollution, and water and fuel consumption, and report progress in meeting these goals on an annual basis. Energy and water saving opportunities can be identified using the building characteristics information provided by the FEMP database. The database allows Federal agencies to identify the location and type of potential projects, once implemented, will increase the energy efficiencies and/or water conservation of the sites thus achieving mandated goals for the agency and saving taxpayer dollars. All aspects of the Federal building stock, such as the geographic location of Federal sites, along with building types, building counts, total floor space and changes over time should be considered when identifying efficiency potentials. To isolate one aspect of the Federal building stock does not provide a full, realistic picture.

10.0 References

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