DFCM High Performance Building Standard Review and Analysis

State of Utah

Department of Facilities and Construction Management

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ETC GROUP #11-216

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Executive Summary

1.1 Abstract

The Utah Department of Facilities and Construction Management commissioned this study to inform decisions regarding the future of its High Performance Building Rating System (HPBRS), particularly with regard to the use of the United States Green Building Council's LEED accreditation system and the management of energy for the life cycle of State buildings.

This report documents the efforts made to evaluate the State's current practices of construction and facility management with regard to energy efficiency. It highlights good practices that should be retained, and recommends various changes to optimize the whole building life cycle processes.

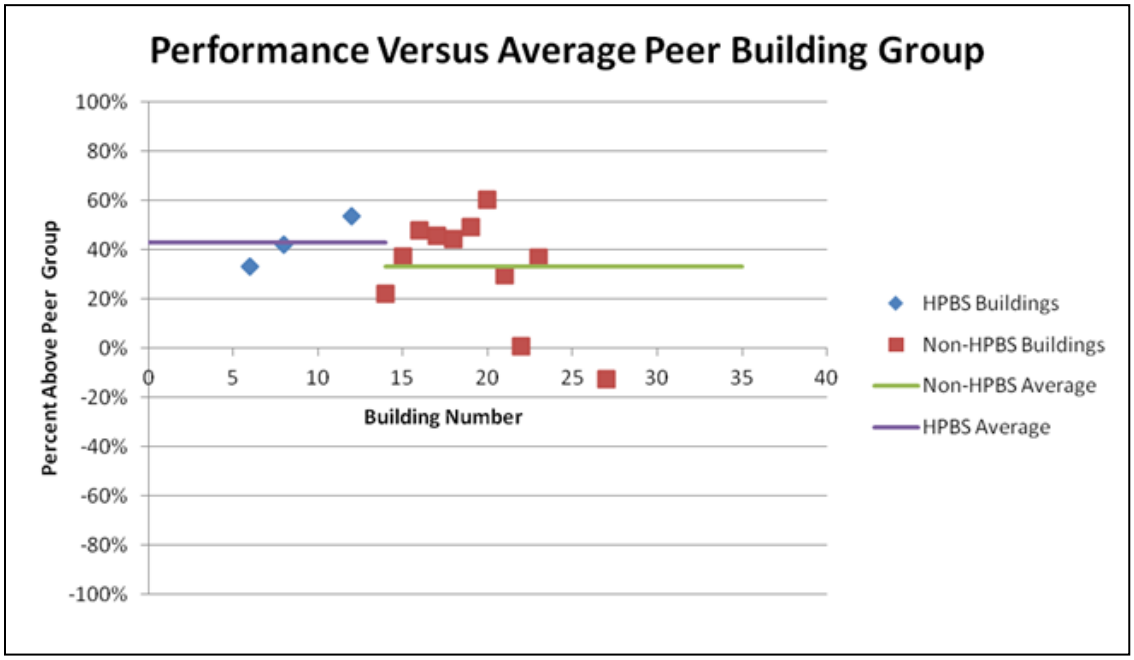
1.2 Phase I Summary

In Phase I of the study, ETC Group and DFCM collected data for the following subset of buildings:

- Constructed within approximately the last ten years
- Located on Wasatch front, This reduces the climate-driven differences between buildings, which is independent of system selection
- Similar building occupancy, not including occupancies of known extreme energy usage (laboratories, e.g.)
- Stand alone, new construction
- Building documentation is available
- Reliable energy metered data is available

With the available utility data, we compared the gas, electric, and combined energy utilization indexes (EUI) of each building and the entire group vs. peer buildings as defined by the 2003 Commercial Buildings Energy Consumption Survey (CBECS) as contained in the Energy Star database. The following chart summarizes the results of this work:

Figure 1 – Performance Comparison



The goal of gathering complete data for 8-10 buildings built under the High Performance Building Rating System (HPBRS) and/or LEED was defeated by a lack of available information, particularly reliable energy consumption data. In the end, only two LEED and/or HPBRS buildings fully qualified for the study. As a result, we consider the dataset inconclusive. We offer the following observations, all borne of the effort to collect data:

1) All State of Utah buildings built in the study period perform significantly above peer averages, where the peer group is defined by CBECS.
2) The *average* building built under LEED and/or the HPBRS performed above the *average* for non-LEED and non-HPBRS building the study group. However, some buildings built without either standard performed better than the LEED/HPBRS group.
3) The State does not use a central repository for State building energy usage. Furthermore, many buildings served by district (aka campus) energy have little or no reliable energy consumption record. This lack of collected data makes analysis cumbersome and in some cases impossible.

From the available dataset we conclude that the use of standards such as LEED and/or the HPBRS do promote energy efficiency as a goal. However, we must also conclude that they are neither sufficient nor necessary to improve building energy efficiency.

In order to have the most valid comparison set possible, we did not survey older buildings. We recommend revisiting this effort in roughly three years, presumably when more data is available, including data for older buildings.

1.3 Phase II Summary

For the Phase II portion of study, we selected six facilities from the Phase I data set for detailed investigation. For each Phase II building we reviewed the design, construction and operation of each facility. As part of this work we surveyed key stakeholders and performed ASHRAE Level 1 energy assessments with the intent of informing the DFCM's high performance building standard.

Phase II work focused on identifying what conditions are necessary in order to improve building energy efficiency in new buildings. Based on that work, we recommend the following practices for DFCM's construction standards.

1.3.1 Continuous Improvement Process Adoption

All recommendations point to a unified continuous improvement process to improve performance. Continuous improvement (CI) processes are conceptually well-known. In this report, we discuss elements of such a process that are unique to construction and the DFCM's needs.

Our proposed DFCM version of the CI process involves

1) **Capturing data, analyzing it, and creating "lessons learned" documents for each new building**:
    a. Accurate and uniform energy metering across all existing and new buildings, with a unified approach to storing and retrieving this information.
    b. Surveying stakeholders one ***and*** two years after construction.
    c. Working with the designers, commissioning agents, occupants, and other stakeholders to produce a concise "lessons learned" list for each building.
    d. Keep documentation. Drawings, Comcheck reports, commissioning reports, LEED

submittals, and other documentation proved difficult and time consuming to obtain in the existing DFCM system. In some cases, documents had to be requested from consultants.

e. Keep a database of building characteristics. With such data, it may be possible to analyze the effect of major decisions such as the use of IDEC, glazing percentage, building size and so forth. The DFCM maintains one of the largest building inventories in Utah and should be able to provide itself an excellent analysis basis but cannot do so at this time.

2) Regularly improving the DFCM construction and maintenance **standards** using the "lessons learned" documents from the previous step.

3) Using or improving design and construction **processes** to ensure adherence to DFCM standards.

1.3.2 Use of USGBC LEED

Based on the small data available, we cannot confidently quantify the effect of the LEED process on the DFCM's buildings. We can say that LEED offers the following:

- A process for tracking owner goals through design and construction
- An industry-recognized concept of the state of the art in building efficiency and sustainability.
- Continuous updates reflecting the state of the art. While the State of Utah can self-perform this work, doing so requires considerable expertise and manpower that the USGBC is already employing at a cost that is defrayed amongst all stakeholders.
- Third party review of critical components of the design and construction process.
- Documentation of decisions, for future critique

All of this is similar to the process we propose (see Section 1.3.1) for the DFCM. LEED, if used, should therefore be seen as a tool and companion to the DFCM's own processes that will develop over time.

1.3.3 Specific Improvements to Construction Standards

We recommend areas of improvement for the HPBRS, outside of the above-described continuous improvement process. See Section 4 for details.

2 Methodology

For the phase II study we selected a set of six buildings to represent typical State buildings. The six buildings were primarily selected based on availability of data (plans, specifications, commissioning reports, COMCheck reports, and the like). Two buildings were large offices with central plants, two were small buildings with packaged mechanical equipment, and two were educational and/or laboratory buildings.

Building Name	Location	Year Built	Size (SF)	Type	Mechanical System
Multi Agency Building	Salt Lake City	2009	140,000	Office	Indirect-Direct Evap Cooled; VAV
West Jordan Courts	West Jordan	2006	123,000	Office/ Assembly	Ground Source Heat Pump
Draper DMV	Draper	2009	23,400	Office/ Assembly	Gas/Electric Packaged RTU Single Zone
SLCC Gunderson Campus Services	Taylorsville	2008	16,800	Office	Gas/Electric Packaged RTU VAV
Unified Laboratory	Taylorsville	2008	72,000	Office/ Laboratory	Indirect-Direct Evap Cooled; VAV
U of U Health Sciences Building	Salt Lake City	2005	185,900	Office/ Education/ Laboratory	Central Station VAV; Campus Hydronic

For each building, we:

1) Reviewed design documents to learn about the character of each building and its systems.
2) Reviewed the design, construction, commissioning, and management processes employed.
3) Gathered results of those processes through specific surveys given to the architect, DFCM project manager, commissioning agent, and facility maintenance staff (see Appendix for these survey responses.
4) Looked for patterns and anomalies among the key players' opinions and actual building performance.
5) Provided guidance for getting each building to achieve the next level of energy efficiency through specific investigation and/or measures. In this effort we followed the general methods of an ASHRAE Level 1 Audit (see appendix for reports).

From this process, we compiled a list of considerations and recommendation for improvements to the DFCM construction standards.

3 Process Recommendations

Recommendations in this section are based on a combination of comments from DFCM personnel, design consultants, collected energy use metrics, and ETC Group's collective experience.

3.1 Data Capture

3.1.1 Energy Monitoring (LEED EAc5)

Require electrical distribution design that separates lighting, receptacle, and HVAC energy end-uses to allow end use monitoring to be easily installed in buildings at a later date. We highly recommend mandating that energy end uses be metered and recorded over time.

Require fuel gas piping design to separately monitor domestic water heating, process, and building heat end-uses.

Require energy metering that captures whole building electric and natural gas energy consumption. The data should be trended at appropriate intervals (15 minute data is preferred, hour data is acceptable) and archived.

3.1.2 Energy Meters

As noted above, the lack of utility quality meters was a major impediment to this study's scope. For buildings that are not metered by a utility, use a utility-quality meter. Commission each meter's operation until reliable data storage is established. Include calibration and testing in annual preventative maintenance plans. This recommendation is largely based on our experience with the University of Utah's non-utility metering (chilled water and high temperature water). Non-utility metering was, by the account of the University's facility maintenance staff, generally unreliable. Reasons included lack of calibration and lack of communication with a server to store data.

Include efficiency metering at central plant(s) as part of non-utility metering. This necessarily includes accurate water flow, pressure, temperature, and gas flow continuous (non-pulse) metering. Use this information in conjunction with satellite building metering to obtain the true cost of the campus type systems.

3.1.3 Energy Management

Regardless of whether utility or Client metering is used, create and maintain a single database of energy and demand usage data for all DFCM buildings, existing and new. There are various ways to achieve this, ranging from in-house databases and spreadsheets to services like the Energy Star Portfolio Manager. In any case, the Study revealed that the State is not using a unified approach for its buildings. This lack of unified approach made gathering simple data difficult or impossible, which made comparisons and analysis inconclusive.

3.1.4 Surveys.

We found the surveys gathered to be a very useful tool, one worth repeating for every building. We recommend that the surveys be continuously improved, and used as a tool for capturing lessons learned. LEED's credit for interviewing occupants has an important lesson in this regard – occupants and

maintenance staff hold critical key information about how design and construction assumptions do or do not yield optimal building performance.

3.2 Construction Standards Improvement

3.2.1 Design and Construction Feedback

The DFCM already publishes and uses construction standards, in addition to some of its client agency's standards. These should be improved continuously, using experience gained on every project no matter how small, and at various points in the building's life.

We recommend that all key players be brought back together to evaluate building performance, at one and two years after substantial completion. We suggest this be done under separate contract. We also recommend giving all players building metered data and key performance indicators in hand before any meetings. The key players include:

- Client representative present through design and construction
- DFCM project manager
- DFCM facilities:
    - Maintenance staff (on-site)
    - Controls staff (remote)
    - Technicians
- Architect of record
- Electrical and mechanical engineers of record
- Commissioning agent
- Energy consultant
- Key contractors
    - General
    - Mechanical
    - Electrical

The goal of these walkthroughs and meetings is to identify what is working well, what is less than ideal, and what is critical not to repeat. This will require candid discussion with all parties on equal grounds. Current industry practice does not require bringing key players back to a building to evaluate its successes and failures. Rather, facilities maintenance staff deal with the results, and have little feedback to the design community. This gap must be bridged if real improvements are to be made; it will require contracts to be written differently, and attitudes to change. No blame needs to be assigned in the process (even if it is obvious); rather, the approach should be forward-looking to keep dialogue open.

The need for this activity was partially identified through an anomaly in the surveys. The highest performing building in the study was the *only one* not listed as "high performance" by its architect. This underscores the utility of making the design teams aware of building performance after 1-2 years of operation.

3.2.2 Construction Standard Updates

Once surveys, energy usage history, and other data gathering efforts are complete for a given building, recommendations for changes to the DFCM's construction standards should be produced, reviewed by DFCM management, and incorporated where appropriate. This should occur at regular intervals, perhaps every 3-6 months to keep the effort manageable and the feedback fresh.

3.2.3 Construction Standard Consolidation

We find no compelling reason why a building performance standard should stand alone from the rest of the construction standards. We recommend that all key aspects of the HPBRS, including references to and requirements for LEED, be integrated into the construction standards. Responsibility for enforcing this subset of the construction standards should be assigned to a person or persons dedicated to this aspect of the building's life cycle cost.

3.3 Construction Standards Enforcement

According to our surveys, DFCM Project Managers and commissioning agents alike noted the difficulties of achieving compliance with Owner's Project Requirement (OPR) and Basis of Design (BOD) documents under design-build contracts. Construction standards must be enforced and DFCM project requirments must be met, with reasonable leeway for justifiable exceptions. The following players should play a part in enforcement of standards (see Table 1for a summary of these recommendations):

3.3.1 DFCM Project Manager

The project manager's responsibility is already to manage all other parties to make sure all critical tasks are completed. The key to this proposed process is to expand the PM's involvement further into the building's life, at least two years.

DFCM policies already provide cross-talk between its construction and management sides much more than most large organizations, but this can still be improved. These managers provide a critical link between real performance and future work as they coordinate new programming documents. We propose specific task, consultant and personnel management practices as outline in the following sections.

3.3.2 Client Representative

Depending on the client agency, the client representative's responsibility is to enforce their own standards and make sure that stakeholders are involved as needed. They also speak for the interests of their agency where they believe exceptions to the DFCM construction standards are needed.

3.3.3 DFCM Facilities Management

Currently, facility management (FM) personnel attend design and construction meetings, and have input to varying degrees. Based on our surveys, the consultants and DFCM project managers have a more optimistic view of the impact FM staff have on the design and construction that the FM staff do. In any case, the FM staff has operations experience exceeding that of most designers, and should have a significant say in design decisions where maintenance is affected.

The FM structure involves at least four sub-groups – maintenance, controls, technicians, and management. All of these should have a role to play in the design and construction pertaining to their function. For example, the controls staff set up VAV boxes in a specific way, frequently different from the design intent. We recommend saving both design and FM time and confusion by creating standard sequences and guidelines for set points.

3.3.4 Programming Consultants

We recommend the use of programming consultants, especially for complex and costly buildings. In addition to the normal programming duties, they should integrate the DFCM construction standards into an Owner's Project Requirements (OPR) document as well as a Basis of Design (BOD) document, the latter of which will contain the direction of architectural/mechanical/electrical systems determined by energy modeling.

3.3.5 Energy Consultant

Energy modeling should begin in the programming stage, before design or construction contracts are let. Typical industry practice allows designers and/or design-build contractors to bid for contract work without a definition of the systems to be used. Energy models are then constructed by the same people, to match systems they think desirable. Such choices may or may not be ideal for the building's life cycle cost, but by that point they are not bound to decide on such a basis.

Programming-level models need not be fully detailed in order to direct what envelope, lighting, and mechanical systems are chosen. They will, however, require cost opinions to be of use. This will be best performed by engineers or contractors skilled in cost opinions that may be separate from the energy consultant.

Once this model is set as the baseline, a design model should be created, more detailed than the programming model and used to evaluate major decisions in the context of the programmed systems. During the bid phase, any deviations from equipment efficiencies proposed in the contractor's bids should be evaluated with the model; these will be relatively minor changes to the model.

In this way, the energy consultant enforces the broad intent of the construction standards, which is to deliver the lowest life-cycle cost for each very different building.

3.3.6 Commissioning Agent

Commissioning agent(s) are a key component of enforcement. As is already the case with DFCM practice, they should be retained under direct contract, separate from design and construction. We recommend the following scope for commissioning (under one agent per project):

Programming: Advise the selection of systems in cooperation with other programming consultants and in light of energy modeling. Develop an outline of the commissioning plan based on the selected systems. Help write the OPR and BOD.

Design: Review design documents and advise where design documents do not comply with the OPR and/or BOD, whether for better or worse.

Bidding: Validate the contractor's proposed scope, especially conflicts and exclusions between sub-contractors.

Construction: As customary, attend construction meetings and maintain control over compliance with the design documents, which should be in harmony with the OPR and BOD.

Optimization: Optionally, identify improvements throughout design and construction for DFCM consideration.

Continuous Commissioning: Separately from the design & construction scope for the CxA. Every building's performance decays to an extent, as normal operation and human decisions wear out components and defeat sequences. "Continuous commissioning" is a concept; it may not need to be continuous (as in occurring at all times), and may not need a commissioning agent as much as automatic checks and reminders in a well-rounded control system.

3.3.7 Design Consultants

Since the programming phase will generally set the system type under the above arrangement, the design consultant's primary role is to create buildable documents that are true to the OPR and BOD. They merge the design intent with current best practices and applicable code. They work with the stakeholders to resolve differences of opinion on what is best for the building in the context of the BOD and OPR.

During bidding, they identify differences between the design and proposed alternates. One change in this process is that, unlike the current practice, all alternates must be declared by the contractor at bid phase, with rationale (deductive alternate, e.g.). This will lengthen the time between bid opening and acceptance, but will allow much better control over the end result and reduce

During construction, the design consultants perform all the traditional administration tasks.

3.3.8 Contractor

Contractors work with the DFCM and its consultants to construct according to the design documents, which conform to the BOD and OPR. They identify improvements and propose them at bid or during construction.

3.3.9 Bidding

As discussed above, we recommend that contractors, be required to submit equipment performance and cut-sheets for all items that deviate from the basis-of-design equipment in any regard at the time of bid. We further recommend that any such deviations be justified in some way, or rejected.

Table 1 - Recommended Workflow for Improving Building Performance

	Building Life Stage										Involved Parties							
Task	Pre-Programming	Programming	Schematic Design	Design Development	Construction Documents	Bidding	Construction	1-year Post-Construction Review	2-year Post-Construction Review	Life Span to Demolition	Client	DFCM Project Manager	DFCM Facilities	Programming Consultants	Design Consultants	Commissioning Agent	Energy Consultant	Contractor
Production of Owner's Project Requirements	X										X	X	X	X				
Modeling & Selection of Mechanical System Alternatives		X		X[6]		X[6]		X[8]			X	X	X	X		X	X	
Modeling & Selection of Architectural Alternatives		X		X[6]		X[6]					X	X	X	X		X	X	
Production of Basis of Design[7]		X									X	X	X	X		X	X	
Commissioning Plan Creation (or Modification)		X			X[2]	X[2]						X			X	X		
Monitoring and Metering Plan (creation or update)		X	X		X		X	X			X	X	X	X	X	X		
Power Factor Analysis		X			X	X		X			X	X		X	X			
Design Submittal Review (vs. BOD and OPR, with reference to DFCM Standards)			X	X	X						X	X	X[4]		X	X	X	
Construction Submittal Review (vs. design)						X[1]	X						X		X	X	X	X
Create systems manuals and training for FM							X					X	X		X[3]	X		X
Meter Validation & Utility Data Tracking								X	X	X	X	X	X			X	X	
Lessons Incorporated into Construction Standards / HPBS								X	X	X	X	X	X			X		
Feedback to Designers								X	X		X	X	X	X	X	X	X	X
Continuous Commissioning										X[5]	X	X	X			X		

3.3.10 Table 1 Notes

1) This is a review of energy-related items (chillers, windows, etc) submitted as alternates to the designed products. Items designated as of lower performance in any regard must become deductive alternates and be

considered as part of the value-based selection process. Changes to the Cx Plan must be paid for through the deduction if applicable.

2) Changes to the Cx plan can be simply an update based on different equipment, or expansion of detail level appropriate to the stage of work and complexity of systems. In any case, the Cx plan should be created by the CxA and included in the project specifications at programming and through bid documents.
3) Design engineers' lack of involvement in the training and production of training materials was a common thread between the FM staff and Commissioning Agents.
4) DFCM Facilities is composed of more than one group (maintenance, technician, controls) and each group will have a different influence on design and construction; all should be involved.
5) The use of sub-metering and diagnostics in control sequences (neither of which is common now) will lower the cost of continuous commissioning.
6) Changes to the model can be relatively minor updates based on the timing and substance of changes.
7) BOD will by definition refer to the DFCM construction standards including HPBS (if separate).
8) Modeling as required for model calibration and comparison to actual performance.

4 Current Practice Recommendations and Observations

4.1 Recommendations

Based on the results of the surveys and building site visits, we recommend that the following items be addressed in the DFCM Construction Standards.

Design Recommendations

1. Lighting controls appear to be reliable energy efficiency measures. However, FM personnel commented frequently about proprietary systems, lack of local control, and lack of visibility. Consider creating a DFCM lighting control standard that specifies non-proprietary lighting controls, possibly integrated into a common platform with mechanical controls.
2. Air infiltration was a significant issue for three of the six buildings surveyed. Window sill leaks, parapet leakage, and vestibule design were the major sources. Envelope commissioning use was sporadic. Consider making envelope commissioning a normal part of the process, using a recognized standard written with enforceable language.
3. Economizer and smoke management damper actuator failures are common, both in controls and components. Consider a requirement for end-switches and automatic self-checking, or adding a point to point check as part of normal maintenance.
4. VAV box operation was generally unknown to the maintenance staff. We understand that the DFCM strives to keep a consistent approach to VAV box operation after warranty period is up. Consider creating a DFCM standard sequence of operation and VAV controller specification to match, to avoid having to change this each time.
5. Heat pumps drew much criticism for lack of access. Create specific requirements for access wherever this system type is to be used.
6. Snowmelt systems are consistently run in hand. Consider requiring automatic controls ***along with*** annual operational checks.
7. Review hood face velocity requirements for laboratory buildings. Most of the hoods we visited operated in center of the conservative safe range, 80-120 FPM; efforts to reduce airflow to the bottom of this safe range may yield significant savings.
8. Identify standard details for common usage, in order to promote uniformity where desirable. This may include standard architectural details such as parapet wall caps, and mechanical details such as coil piping. Alternates should be allowed when justified.
9. Create requirements specific to system types –IDEC and heat pumps, for instance. This runs counter to the more general approach of the current construction standards. However, it may help the more complicated and energy efficient system types avoid the “black eyes” they get from design and installation deficiencies.

Training and Other Recommendations

1. Design consultants, commissioning agents, and contractors should all be under contract to provide part of the training of FM staff. Consider creating minimum uniform requirements in the construction standards.
2. Facility maintenance staffs are generally not trained on the use of trends or in the sequences of operation for the buildings they deal with. Consider increasing training for them.
3. Building maintenance staffs are aware that energy anomalies are tracked and they may be called upon to help deal with them. However, they are generally unaware of the performance of their

buildings and do not see the data. Consider including them in monthly reports and enlisting them in continuous energy reduction efforts.

4. Significant issues are left outstanding in some of the commissioning reports, even though the commissioning process ended. Consider who should be responsible for terminating commissioning efforts, and when. Commissioning may simply run out of funds; if so, consider the use of retention for non-compliant contractors.

4.2 Observations

Here we offer final observations from the surveys, which do not necessarily suggest changes to the current program:

1. Indirect Direct Evaporative Cooling's success is demonstrated with few chiller starts and hours. Maintenance do not report comfort complaints.
2. We only found one VFD or starter in hand during 6 site visits; this is commendable. Continue efforts to train maintenance personnel to specifically avoid this condition and address it quickly.

5 Appendices

5.1 Phase I Report

10 pages

5.2 Surveys

19 Pages

5.3 Level I Audits

88 Pages

Phase I Report:

Performance of LEED Buildings

For

State of Utah

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Disclaimer

The intent of this Report is to establish what, if any, verifiable impact that pursuit of USGBC LEED certification has had on State-owned buildings. This report is believed to be reasonably accurate, but the findings are preliminary estimates, and application of available past data does not necessarily imply future performance. As a result, ETC Group is not liable for any use of this report with respect to existing or future projects.

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Executive Summary

This study documents an effort to establish what impact the State's High Performance Building Standard (HPBS) had on DFCM buildings' energy performance. Provided that the available conclusions are compelling enough, the DFCM may use them to keep or modify the HPBS. We reached several fundamental conclusions from the data, and from the effort to gather it:

1) Measurement and verification is needed across all buildings to improve performance.
2) Buildings built under the HPBS have 12% lower average energy use intensity (EUI) than otherwise.
3) DFCM buildings are consistently performing better than their peers among all buildings of any owner.
4) Further study to determine the factors of high performance are needed, beyond this effort.

Measurement and Verification (M&V)

The first result of this phase's work is that the available data is insufficient to allow full conclusions. This is a result of two basic conditions:

1) **Unreliable or non-existent measurements.** A significant number of relevant buildings are located on campuses, where the State relies on its own metering rather than utility metering. Operators for such buildings reported widespread known failures of meters, data gathering systems, or both.
2) **Unsuitable buildings.** Several buildings were of occupancies not suitable for comparison. The most common type are laboratory buildings, where the energy use is often extremely high relative to office type occupancies, and where there is little or no correlation between laboratory space percentage and performance.

Only three HPBS-era buildings qualify for the study at this time. Little if anything can be done about unsuitable occupancies, but we recommend the following actions:

1) Implement a comprehensive M&V effort on all buildings.
    a. Short term - identify and correct all known inadequacies of instruments and data gathering until reliable data is being gathered consistently for all buildings.
2) Long term - employ people and/or automated systems to store data in a retrievable way for every building whether on or off outside utilities.
3) Re-evaluate the data under this study after the M&V effort is complete.

Relative Performance Among DFCM Buildings

The second result of this phase's work is that HPBS buildings are performing better on average than non-HPBS buildings. Specifically, the mean energy use (EUI, in kBtu/SF/year) is 12% lower in the HPBS buildings.

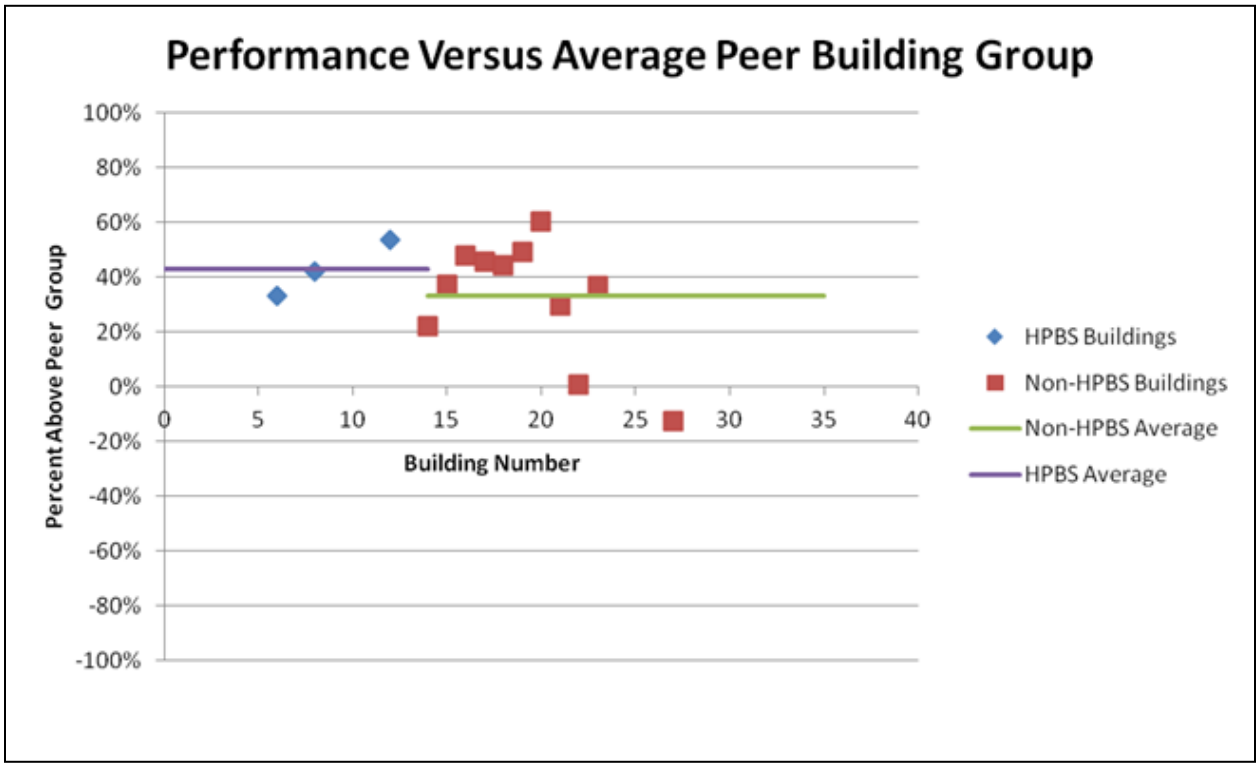
Counter-arguments for this conclusion include:

1) The dataset for the HPBS buildings was too small to be statistically significant.
2) The minimum EUI for the non-HPBS buildings was actually lower than the minimum HPBS building, indicating that HPBS is not necessarily required to achieve a low EUI.

3) The diversity of behavior of buildings represented defies across-the-board use of EUI due to the inherent impact of building size and occupancy.

In order to reduce the uncertainty in the second and third items above, we compare each building to its peers (as defined by the EPA's Target Finder). With each building's performance normalized against its thus defined "peers," rather than against the buildings in the dataset, we believe the results are clearer as shown in the following figure:

Figure 1 – Building Performance Comparison



The conclusion remains constant, that HPBS buildings have performed, on average, better than other buildings in the dataset. However, it's also clear that non-HPBS buildings in the dataset are better than any HPBS buildings, and a large number of them are similar to the HBPS set. This leads to the second conclusion: while the use of the HPBS may help building performance, it is neither sufficient nor necessary as a condition of high performance.

Relative Performance Among Peer Buildings

Another point to consider is that the entire population, independent of HPBS, is performing above the respective building peer group, with only one exception (neglecting the buildings with significant laboratory and other high-intensity space). This is notable in and of itself, but more notable against the backdrop of what CBECS data says about building ownership. CBECS data shows that government-owned buildings have a generally higher intensity than the national average of all buildings. We intentionally removed some of the high-intensity labs characteristic of State-owned higher education, which of course skews the dataset favorably. However, the fact remains that the DFCM's recent buildings are significantly and consistently better performing than all peers as judged by Target Finder.

Figure 2 - Energy Use Intensity vs. Building Ownership[1]

Ownership and Occupancy	
Nongovernment Owned.....	kBtu/SF
Owner Occupied	87.3
Nonowner Occupied	88.4
Government Owned	105.3
Federal	155.0
State	134.8
Local	83.4

Further Study

We believe that the available data alone does not fully determine the impact of the HPBS. In any case, the true need for the DFCM as with any owner is to understand the factors of high building performance and to apply them consistently. For this understanding to mature we recommend detailed study of a series of high and low performance buildings to determine the factors and document them in a way that can be used on existing and future buildings. See Phase II Recommendations for further discussion.

[1] See Energy Information Administration, Table E2. Major Fuel Consumption (Btu) Intensities by End Use for Non-Mall Buildings, 2003

Methodology

Study Population

A population of 29 buildings was identified by the DFCM for study. We took this population and reduced it to only those buildings for which the following were true:

- Constructed within approximately the last ten years.
- Located on Wasatch front. This reduces the climate-driven differences between buildings, which is independent of system selection.
- Similar building occupancy.
- Stand alone, new construction.
- Building documentation is available, especially ***reliable*** utility data.

The ideal data set would have included at least 8-10 buildings from both pre- and post-HPBS periods. In reality, the data set reduced to three HPBS buildings and 11 non-HPBS buildings at this point.

Data Sources

All square foot data is from the DFCM databases. All utility data is from the respective fuel gas or electrical utility, where available, with the following exceptions:

- COURTS MATHESON_1553; There is no kwh data for 12/11/2012. We used an interpolation of November and January data.
- TAX DRAPER DMV_1459; There is no kwh data for 12/11/2012. We used an interpolation of November and January data.
- USU NEW MERRILL LIBRARY; we have steam (in lbs) for heating. We assumed a steam output of 970 btu/lb and a boiler plant efficiency of 80%. Missing data for one steam meter during November, we used an interpolation of October and December data.

We initially pursued steam, chilled water, and/or high temperature heating water data for buildings such as those located on the University of Utah campus. However, campus Facilities Management personnel expressed a clear lack of confidence in nearly all of the meters available. Were this not the case, we would also need to estimate the efficiency of the boiler and chiller plants serving these buildings. This is not trivial; efficiencies vary greatly not only in plants, but in the losses between plant and a client building through ground conduction. In any case, buildings using district energy use slightly more than twice the energy of standalone buildings[2]; this casts some uncertainty onto efforts to use campus buildings for comparison.

[2] See Energy Information Administration, Table E2. Major Fuel Consumption (Btu) Intensities by End Use for Non-Mall Buildings, 2003

Calculations

EUI is calculated by converting the available site energy data into 1,000 Btu (kBtu), and dividing that quantity by the building's reported gross area in square feet. Peer-group Energy Star scores are found by entering the building's characteristics (location, size, occupancy, etc) into the Energy Star Target Finder and seeking for the target score of 50 (the statistical average score for buildings of a similar character). We then re-rate each building by its percentage above or below the peer group average performance, in the form:

EUI is calculated as above, and CBECS is the result of the Energy Star Target Finder.

We would prefer to use the median EUI value to establish and compare performance for the HPBS and non-HPBS groups. This is because median values tend to de-weight statistical outliers. However, with the HPBS buildings only numbering 3, the median value is simply the middle building's performance. Thus we resorted to the mean as a comparative tool until more data points are available.

Further Analysis

Other arrangements of data are helpful in understanding what factors are important.

Building Area

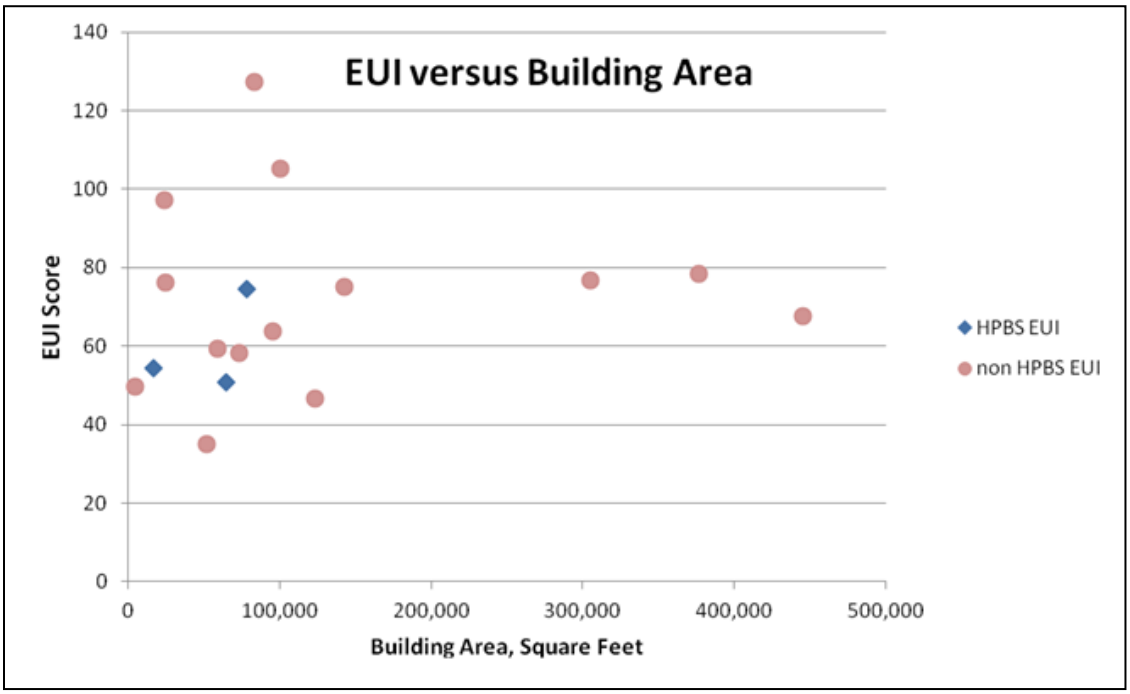
Data publicly available through the U.S. Energy Information Administration clearly shows that, according to best available data, there is a relationship between building size and building energy use intensity. For example, the 2003 CBECS Data[3] shows the following:

Table 1 - Major Fuel Consumption (Btu) Intensities by End Use for Non-Mall Buildings

Building Floorspace (Square Feet)	kBtu/SF
1,001 to 5,000	98.9
5,001 to 10,000	78.3
10,001 to 25,000	67.3
25,001 to 50,000	77.6
50,001 to 100,000	83.8
100,001 to 200,000	103.0
200,001 to 500,000	101.0
Over 500,000	129.7

For the DFCM building dataset, the relationship was effectively non-existent, with an R^2 value of 0.025. Because this appears to be a non-factor, other factors must be evaluated for relevance.

Figure 3 – Building Performance as a Function of Area



[3] http://www.eia.gov/emeu/cbecs/cbecs2003/detailed_tables_2003/detailed_tables_2003.html, Table E2

Phase II Recommendations

Correlation studies such as Phase I of this report can offer a reasonable representation of *what* happened. For systems as complex as buildings including the design, installation, commissioning, occupancy, operation, and so forth, they offer little insight into *why*. In order to develop an understanding of why building performance has been as various as it is even within HPBS, size, and other categories, we recommend investigation.

A systematic approach to investigation should involve the following:

- Interviews with those closest to the processes that created the building:
  - Design engineers and architects including energy modelers
  - Commissioning agents
  - DFCM project managers
  - Control contractors
- Interviews with those that are closest to the current operation of the building:
  - DCFM facilities operators
- Further segregation and correlation of buildings by characteristics
  - Overall envelope composition
  - Building tightness
  - HVAC system types and complexities
- Examination of records for insights
  - LEED submittals, specifically for what was anticipated
  - Commissioning reports, specifically for the type of issues addressed.

With this data in hand, we expect that an approach to improving building performance overall will become obvious. Such an approach will certainly include all of the above people having the same basic understanding of both *what* has happened, and *why*.

We suggest the following or a similar set of buildings for examination:

1. UTNG Readiness Center. An average size HPBS Building with the highest performance above its peer group, this may be an ideal candidate to learn what works.

2. SLCC RRC NEW CAMPUS SERVICES BLDG/GUNDERSEN SERVICES BUILDING. Also a HPBS building, but small (16,800 SF) and a good representation of small-building decisions and dynamics. Has been energy modeled.

3. Draper DMV. A non-HPBS with the lowest performance against its peer group, a good example of small building dynamics to learn what does not work.

4. West Jordan Courts. A non-HPBS using heat pumps, a unique larger building with higher performance than any HPBS building.

5. Multi-Agency Building. A large non-HPBS using evaporative cooling (IDEC) common to many DFCM buildings in the last 10 years.

	Kevin Miller West Jordan Courts	Salt Lake Multi Agency Building	Libby Haslam SLCC Gunderson	Danny Fuchs Draper DMV	Unified Lab	Joe Milillow UofU Health Sciences	ETC Observations
Design and Construction							
Describe how the following building parameters were evaluated, in relation to energy efficiency:							
Building orientation	Not considered. Building was, by contract, an adaptation of a prototype that in its final form, including planned expansion, is roughly square.		Orientation and massing were considered during Schematic Design.	Building orientation was governed primarily by site constraints.		Due to alignment with a major north-south road, the building orientation is not ideal for solar gain.	Site constraints generally impact orientation more than energy considerations
Massing (geometry, window: wall ratio, window location)	Not considered.		Orientation and massing were considered during Schematic Design.	Window locations, size and orientation were primarily designed to maximize daylight and views.		Window:wall ratio = 31%. Many design features (clerestories, skylights, interior transoms) were used to bring natural daylight deep into the center of the building.	windows were used for daylighting and views
Programming (space location)	Not considered, Judicial Functionality and Security were the determining factors.		None	Building space location and adjacencies were governed primarily by building function.		The plan was based on a module of 11 feet which works well for laboratory spaces. Individual offices and classrooms were located at the perimeter of the building and labs were located in the center with a full ambulatory corridor looping the entire floor.	Program determined space locations without high regard of energy efficiency
Building envelope choices	Not considered. West Jordan City and Judicial Council design input drove material choices.		Building envelope and other parameters were considered during design development and construction documents.	Building envelope type (load bearing masonry) was primarily selected for durability and longevity.		Highly insulated stud walls were used. Batt insulation in the stud cavity, rigid insulation outboard of the wall sheathing and fully sealed and taped air infiltration barrier. Roof = R25 rigid, Walls = R-19 batt with R6.5 continuous exterior rigid, foundation perimeter = R10	Envelope was typically chosen for reasons other than thermal performance; decisions regarding energy were made in design not programming
Other parameters not listed above				Enhanced glazing was provided on west facing windows to decrease solar heat gain.			

	Kevin Miller **West Jordan Courts**	**Salt Lake Multi Agency Building**	Libby Haslam **SLCC Gunderson**	Danny Fuchs **Draper DMV**	**Unified Lab**	Joe Mililllow **UofU Health Sciences**	**ETC Observations**
Was the energy efficiency impact of design decisions addressed during Programming (or was is addressed in the programming documents) Schematic Design, Design Development, or Construction Documents, Bidding/VE, and construction? Help us understand at what stage energy efficiency was discussed and to what level.	I don't recall. There was legislative directive to use ground sourced heat pumps in the project. Our preliminary studies indicated that a two stage system would have provided equal or greater energy savings. As with all GSBS projects, energy efficiency was a high priority throughout the design process, within the context of the other project determinants.		This was a Design/ Build project awarded after schematic design. Program was defined prior to the RFP. This was not a LEED project. It was designed to be 10% better than code. Orientation and massing were considered during Schematic Design. Building envelope and other parameters were considered during design development and construction documents.	Programming was performed under a separate contract with a different design firm. Energy efficiency impact relating to HVAC systems was discussed during the SD, DD, CD phases. Coordination of HVAC systems and building envelope choices occurred during SD, DD and CD phases.		This was a design-build project so the contractor was the lead. The contractor was aware of the energy goals from schematic design forward and tailored their contraction budget to them. We have LEED accredited professional on our staff and at the beginning of this process, the contractor assigned a LEED accredited professional on their staff to interface with the design team, track all design decisions and their cost implications.	Energy efficiency was discussed for all projects. The extent the design team prioritized it most likely determined the acutal performance of the building.
Looking back at the design and construction phases of the project what were some of the successes, failures and lessons to be learned about the project as it relates to energy efficiency?	We have had no feedback on the effectiveness of the heat pumps. Our concern was that they would be a maintenance issue over time with no measurable performance advantage over a high performance centralized system. There is also a cooling tower designed to supplement the heat pumps when the well field began to deliver higher temperature water – I don't know if that has ever been required, or if there is institutional memory sufficient to		Energy Efficient standards should be more stringent.	Increased ventilation in large customer services areas enhanced comfort for building occupants. Air movement via ceiling fans in large customer service areas increased perceived comfort of building occupants.		The design team is always limited by the owner's budget and how they choose to spend it. We can recommend highly efficient buildings and design everything to LEED Platinum standards, however energy efficiency is not always the priority of the client compared to providing a larger building with more aesthetic features.	Designers receive little feedback of "high performance systems" once the construction is complete. Designers perceive but are not always clear on the DFCM's intent for a building's balance of interests between energy efficiency and other considerations
Energy Engineering & Modeling							
Was an energy engineer contracted on this project?	No		No	No. Mechanical design was provided by the General Contractor (design/build)		Nexant was contracted by DFCM directly to do all energy modeling	Energy modleing has not been used as a design tool for DFCM projects.

	Kevin Miller **West Jordan Courts**	**Salt Lake Multi Agency Building**	Libby Haslam **SLCC Gunderson**	Danny Fuchs **Draper DMV**	**Unified Lab**	Joe Milillow **UofU Health Sciences**	**ETC Observations**
If Yes, please describe how they integrated into the project and the role they played.			N/A			Because of the difficulty position they were in to be both a watchdog and a critical team member, we did not receive the feedback we expected at the critical times we needed it. DFCM defined their parameters of involvement which restricted our access to their data and our ability to use them effectively.	The DFCM may benefit from changes to the contract structure of modeling
If No, would energy engineering services have been helpful during the design process? (please expand on your answer)	I don't think so. Building system decisions were mandated, not informed by analysis.		Yes	The Mechanical engineer is capable of providing energy engineering input.			Mixed comments suggest some discussion about the topic is in order.
How do you think the energy engineer's contract should be held, and why? (by owner, by principal consultant, by mechanical engineer)	Principal Consultant. Needs to be part of an integrated team to be truly effective.		Owner	The Mechanical engineering firm should provide energy engineer input and building modeling.		We would like them under our contract directly. We understand why the owner would keep the energy modeling outside the mechanical engineer's scope, however we could not control how many meetings were held during the process and therefore received limited input regarding the critical energy calculation data. If they were under our contract, we could have met with them more often at critcal stages in the design process.	Energy Engineeers have been limited in their influence by contract structure; changing the chronology of modeling may help give modeling offer positive influence without undue strain on the consultant workflow
If an energy model was used was it part of the design dialogue during the design process (programming, SD, DD, CD)? If so please describe at what level?	No		Not used	Coordination of building envelope and HVAC systems.		We had one kickoff meeting with Nextant to discuss energy goals and only one final meeting to receive their recommendations. At this late stage of the project we had already implemented their suggestions via the mechanical engineers input or were limited by the schedule to implement any of Nextant's major suggestions.	Modeling up front may raise its value.

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If the energy model was used but more as a way of showing compliance to the LEED requirements or the HPBS requirements please indicate and describe the barriers that occurred that prevented if from being used as a design tool.	In 2001 most of us were only using energy models to validate FinAnser projects.		Not used			The energy model was used for LEED certification, however given the contractual arrangement the design team was unable to request changes to the energy model and/or LEED documentation. Serious issues arose during the LEED review process due to the poorly executed LEED documentation provided by Nexant resulting in complete denial of LEED energy points and therefore putting in jeopardy not only LEED Silver, but any LEED certification at all. Only through two appeals of the energy model involving heavy influence of the design team and mechanical engineer outside their	
Commissioning							
Was a CxA involved during the design process?	Yes		N/A	Yes.		Yes, they were contracted directly by DFCM.	Most DFCM projects were commissioned.
If yes, when did they become involved?	Early design, I think		N/A	DD I believe.		They became involved in the design development phase.	Cx is involved early in the design process
Did their involvement improve the performance of the building?	Not that I am aware of		N/A	Yes		Their involvement was sporadic and unpredictable. As a result their input provide little influence to the design. Their contributions were felt mostly during the startup phase.	Mixed comments suggest some discussion about the topic is in order.
Was envelope commissioning included in their scope of work?	I do not believe so		N/A	No		No	**Envelope commissioning has generally not been included; where it was (according to the CxA) the architects do not believe it to have been so**
Did they review construction details?			N/A	Yes		No	

	Kevin Miller West Jordan Courts	Salt Lake Multi Agency Building	Libby Haslam SLCC Gunderson	Danny Fuchs Draper DMV	Unified Lab	Joe Milillow UofU Health Sciences	ETC Observations
Do you feel that they enhanced the design's performance or constructability? (expand as needed)			N/A	A few suggestions such as the use of high performance glazing enhanced the building's performance. Constructability was not enhanced as a result of the CxA.			Inconclusive
If no, why not?						This specific agent was not responsive to our invitation to review project design and systems submittals. Commissioning agents in general are mechanical-systems oriented and might not have the skills to understand a comprehensive view of the entire building design.	Qualifications of a CxA may mean more than one CxA is needed to execute the work.
Facility Manager							
Was the facility manager or an operations representative involved in the design process?	Yes		Yes	Yes		Since this was the first building on this specific campus, there was no facility manager hired until the very end of the construction process. We did consult with the owner's representative during design to get general input on maintenance and building management issues.	FM has been involved
If yes, did it improve the building design?	To a degree. They did not concur with the heat pump directive but had no choice in the matter either.		Yes	Yes			FM involvement is positive overall
If no, should there have been more involvement from operations? (expand as needed)							Inconclusive
High Performance Building Standard (LEED as appropriate)							

	Kevin Miller		Libby Haslam	Danny Fuchs		Joe Mililllow	
	West Jordan Courts	**Salt Lake Multi Agency Building**	**SLCC Gunderson**	**Draper DMV**	**Unified Lab**	**UofU Health Sciences**	**ETC Observations**
Do you perceive this to be a high performing building?	Not to my knowledge		10% above code	Yes		Yes	The highest performing building was the only one not percieved as "high performance;" Design Team feedback loop may be helpful here.
How did HPBS Influence the building during design, if at all? (discuss specific EEMs if possible)			10% above code is not difficult to achieve.	HPBS was a catalyst for coordination among all discilplines.		LEED was the major driver of the design, however the design team was very aware of the HPBRS and kept them in mind during the entire process. This heavily influenced the day-lighting approach and the lab systems requirements.	HPBS has had impact on the design teams' mindset with regard to energy performance
How did HPBS Influence the building during construction, if at all?			See above			see above	
What if anything would you change about the HPBS to have greater effect on energy?			Standards should be a lot higher.	The HPBS required for this building is no longer in effect.		The HPBRS and LEED do not specifically address thermal efficiencies of envelope systems, air barriers or window and door sealant systems.	

	Sid Killian	Mike Butler	Scott Whitney	Scott Whitney	Rory Scott	Richard Beck	
	West Jordan Courts	**Salt Lake Multi Agency Building**	**SLCC Gunderson**	**Draper DMV**	**Unified Lab**	**UofU Health Sciences**	**ETC Observations**
How were you, or other FM people, involved in the design?	Not involved	No	D-B, specs, Meetings. Total review SD/DD/Cd	Not Involved	Don't know	Was not present	Facility Management personnel are involved, although not the current personnel (due to changes). Those involved questioned how much they effected decisions.
How were you, or other FM people, involved in the construction?	Invited to attend construction meetings and from talking with staff, little input was taken.	Yes- Maintenance Convenience (floor drains) minimize light styles	Yes, weekly consulting. DFCM Managers	Invited to attend construction	Yes, Meetings	Was not present	FM personnel were generally present during construction. Influence level was questioned.
How have HPBS decisions influenced operations & maintenance?	Potential increased O&M costs. Heat pumps may be less installation but cost heavily in operation and O&M costs -Wear out issues conflict caused, access issues	IDEC works well. Didn't know about resets and other controls decisions.	AC units (York) are built poorly and fail despite efficiency. Condensing boilers have had issues with condensate-born humidity in a small unventilated room. Waterless urinals are a mistake.	None	Not negative	No impact	In some cases where "high performance" decisions were made, increased maintenance costs resulted from design or execution.
Have any efficiency measures (such as lighting controls, VFDs etc) been problematic, and/or disabled?	Not that I am aware of - tough programming, DST issues	No	No- OCC/lights work, VAV zoning	No (lighting)	No		Lighting Controls and VFDs seem to be reliable efficiency measures. However, FM personnel regularly complain about proprietary systems and lack of local control.
What is your background? (i.e. engineer, diesel mechanic, etc…)	HVAC, business -FM other places	DFCM OJT Apprentice	HVAC Tech, Similar (IH) 34 years	Building maintenance	Sales, 5yrs in HVAC	Building management career	Background vary; even those with long building maintenance background require technician help frequently.
Did you receive training on how to maintain and operate the building?	secondary BCS yes- Super, staff no ojt The Facility Coordinator at The time The building was built may have, I have not.	Yes, DFCM. Lighting Lutron, No IDEC, Lighting tech	Very minor- Yamas 2hr familiarization, Tech-boiler	General overview	Through construction phase, classroom time	No	Most Building Managers have not had extensive training on all equipment but have techs trained for specific tasks.
If no, do you think training would be beneficial to the facility energy performance?	Any additional training, if retained, would be beneficial -staff yes	Yes, tech, especially sequences	Yes	Maybe	No	No - cannot make changes here at any rate (ask the controls shop)	Mixed messages. The responsibility split between maintenance, technicians, and controls sections seems to have pros and cons.
If yes, do you feel that you received adequate training?	Somewhat	Not on sequences of operation equipment	No	For what they do, yes. They are not techs.	N/A	Not on sequences of operation	Building Managers generally feel trained to do maintenance work, but some would like to be trained in other aspects like controls sequences.

	Sid Killian	Mike Butler	Scott Whitney	Scott Whitney	Rory Scott	Richard Beck	
	West Jordan Courts	**Salt Lake Multi Agency Building**	**SLCC Gunderson**	**Draper DMV**	**Unified Lab**	**UofU Health Sciences**	**ETC Observations**
Were specific O&M schedules provided in the manuals? Training on how to perform the O&M?	Built into system, I believe The manufactures provided maintenance schedules in The O&M submittals. Training is typically an overview of systems and not system specific. You have to rely on staff to read and understand The maintenance schedules	Yes, PM schedule- developed by ? (didn't know)	Constra Pm- System	Don’t know but all tasks come from the DFCM system	main system for DFCM, Yes	Don't know; all orders on PM tasks come from the FM system	Building Managers rely on a central system that sends the weekly/monthly schedule of to-dos. Further scrutiny of that system would help inform the designers who are probably not aware of this, and continue to require O&Ms that do not seem to be used.
Did you receive any control system front end training?	OJT- 5 min- WHP needs laptop, It may have been available to the original building manager. This control system is archaic and proprietary. Expensive to operate.	Minimal, Adjust	Normally Johnson-Yamas	No	Yes, by DFCM and Atkinson	No	Typically minimal or no training is provided for FM staff on front end controls.
Did you receive any control sequence training?	No, but previous manager may have.	No	Yes- has changed some items	No	No	No	Minimal or no training has been provided to FM staff for control sequence editing.
Can you adjust the building temperature and other HVAC schedules?	Yes but it causes issues as one HP affects the other so they don't make changes	Yes	Yes	Yes	Temp yes, Schedules - heavy	No	Mixed message - most Building Managers are capable of adjusting building temperature and other HVAC schedules but some don't or can't.
Can you set-up trends, and download trends?	No	No	Yes	No	No	No - viewing only	Trending data for DFCM buildings is done by campus or state Energy Managers, not Building Managers. The exception is SLCC personnel who appear to have a different level of ownership.
Did you receive any training on how to use trends to monitor bldg performance?	Not for this particular project but I do have experience.	NO	Analyze Problem	Basic	No	No	Energy Performance is not trended or made known to most Building Managers.
Power- sub-metering on one lines (DMM @MCC)	No, but possible - many panels but fairly separated	lighting 4th -not used-	No	None, and very difficult - RTUs on panels with lighting	Yes- they are working on it; there is a multi meter present but it is not reporting to the BAS.	Did not know about the existing meters	Only one building was in process of getting sub-metering, most were not using any that existed. Sub-metering should be considered and electrical/gas piping internal architecture arranged for it where feasible.
Mechanical- Sub-metering on gas, steam, etc		No	No	None	No	Works, AO Chilled water valve on the central plant side	Few buildings are sub-metered leaving little room for optimization of systems. Some have sub-metering on electrical but aren't aware of it and don’t use it.
Can you adjust lighting schedules?	Yes, very complicated	No-Auto (6:30-6pm) 2 people's want would dominate	Yes	Only with manufacturer assistance	No, Manufacturer (dislike)	No	Most lighting controls systems are not easily adjusted. This prevents energy saving corrections and understanding of what is happening.

	Sid Killian	Mike Butler	Scott Whitney	Scott Whitney	Rory Scott	Richard Beck	
	West Jordan Courts	**Salt Lake Multi Agency Building**	**SLCC Gunderson**	**Draper DMV**	**Unified Lab**	**UofU Health Sciences**	**ETC Observations**
Can you adjust lighting controls (occ sensors, daylighting as applicable)?	avoided if possible, Not me personally, but staff may the ability	Yes	No	Same	No, Manufacturer	No	Most lighting controls systems are not easily adjusted. This prevents energy saving corrections and understanding of what is happening.
Lighting- Controls- Extensive sensor- How effective?	FM cannot make changes without negative impact - generally not an issue. Controls not integrated with heat pumps.	Lighting controls work and FM believes they are integrated with VAVs as proposed (unocc forces min CFM=0)	Yes	Yes - Proprietary and requires vendor to make changes. Timers and sensors both seem to work.	Yes, Works, no VAV connection	Scheduling - can't adjust but works well Motion - Rare failures, but works well	Lighting controls have proven reliable in DFCM buildings.
Lighting- User training, efforts to cut down on use	Some explanations and corrections needed for events like daylight savings time. FM makes efforts but the most effort is by the agencies.	They train users to deal with automatic controls.	Not noticed. overhead lights not used	Nothing significant	No	None - too difficult to achieve with so many users and occupant groups	User lighting control training is minimal and infrequent.
Lighting- Potential improvements	Design for better, simpler control	Needs training - @install	main hall extra circuits	Non-proprietary vendor if possible	No	None	Highly controllable, simple lighting systems are preferential.
Lighting- controls- Integrated with BMS and trended?	No	The 4th floor lights appear to be; this is not used by the FM			Analog panel with dial. Rory does not like. Has to call manufacture to change.	Totally separate systems	
Do you know how efficient your facility is?	No, just for issues, Compared to what and based on what?	No	No	No	No	No	Building Managers are tasked to operate and maintain buildings, not to optimize or improve performance.
If yes how?	NA	NA	NA	NA	NA	NA	Building Managers are tasked to operate and maintain buildings, not to optimize or improve performance.
If no, how do you think your facility is performing?	WSHP is better -radiant floor doesn't work	Ok	Don't know relative to others, only month-month	Suspect is has problems given the wind-blown cold issues	Pretty well considering its use	Pretty well compared to similar buildings	FM personnel mostly think their buildings are good performers energy-wise.
Do you track your utility data?	Data is tracked by the Energy Manager and reports distributed	NO	Yes	No	No	No	Maintenance staff in the building are aware the it is tracked but they only react to issues pointed out through others.
If not, do you know who does?	Chris Atkins provides this data	Mike Butler		Yes, on state energy man- Chris Atkins	DFCM- Scott Coordinates around (reactive) problems	Yes	Maintenance staff in the building are aware the it is tracked but they only react to issues pointed out through others.
Are you responsible for a utility budget?	I am responsible for monitoring costs, but determining the budget, No.	No	Monitor to previous year/month, Comnet, usual bills, degree day, Kathy	No	No	No	DFCM Building Maintenance are not responsible for energy usage, nor incentivized to reduce consumption.
If not, do you know who is?	DFCM accounting and management	No	Kathy- 2x/yr email allowable temps (ignored) Energy star	Yes	Yes, DFCM energy manager	No	Mixed message - some believe they know and others do not.

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Known envelope leakage areas	Parapet leakage - can see daylight above the 3rd floor ceiling. Dock area leakage - cannot keep the area heated	Windows leak extensively; dust could be seen coming in in certain locations. FM has caulked and sealed where it was most problematic. The "Street" skylights also leak a lot.	No	Entryway is a big issue particularly in the winter when the wind blows; both doors open and the vestibule isn't large enough to accommodate.	No	None	Air infiltration in many DFCM buildings is a significant detriment to performance. Best practices should be determined and required.
Known areas where return air is difficult to achieve	No	South half of the building, many walls were built to deck. FM has sawed holes wherever people cannot get return through the plenum.	No	None	No	None	Best practices should be addressed to avoid the few issues here.
Tall building- significant draft areas	NA	Maybe, related to leaks	NA	NA	No	None	Generally not many were aware of issues.
VAV sequence of operation	No actual VAVs found - may be constant volume DOAS, dumped in during occupied times, fed either into the room near a HP or into a HP return. No DCV.	FM believes it's working per spec - not in his control; Kevin Healy has control of all programming. Sensors- Exterior only Complaints- morning unocc sp 10 min Reset to 0- don't see on graphics	No issues	NA	Don't know	No comments about VAVs; AHU shuts down every night	DFCM has a fairly unified theory on VAVs, and all are controlled centrally. Maintenance staff are generally only peripherally aware of the operation until complaints come in.
VAV set points ReCx after opening	NA	Extensive - set point changes. Open area ceiling-mounted sensors necessitated an offset in all cases. Master Sp@71:5 deg F, No DB, Di Adj 73.5, lo 70.5 Plenum- mounted Tstats	Few	NA	No	Went to 72F with no dead band on all VAVs, January 2012	Other than changes in the build out of Multi-Agency, the DFCM central control keeps this out of maintenance's hands. UofU changes are worth tracking for their effect with no dead band.
Exhaust fan scheduling, speed	FM did not know.	Yes (except 1) Scheduled to stop with the building. Operation is 6AM-6PM including OSS	maybe, don't know	FM assumes that the exhaust fans turn off on unoccupied, but is not sure.	Only DP set point. Phoenix Hood in room controls. No BAS connection.	Believes they shut off general exhausts in unocc; lab hoods are on manual; **does not know about lab room exhausts (12,800 CFM)**	Maintenance knowledge is mixed; discussion with DFCM controls personnel is a logical next step.
Economizer operation	No economizer	Works according to FM	assumed	FM believes they work but is not certain	OK	None; unlikely given distances	Economizer failures are common in controls and physical breakdown. Further investigation is generally worthwhile.

	Sid Killian	Mike Butler	Scott Whitney	Scott Whitney	Rory Scott	Richard Beck	
	West Jordan Courts	**Salt Lake Multi Agency Building**	**SLCC Gunderson**	**Draper DMV**	**Unified Lab**	**UofU Health Sciences**	**ETC Observations**
IDEC operation & Chiller starts	NA	Works - 1 start last year according to FM	NA	NA	Works- average runtime in 2 years is ~250 hours	NA	IDEC's success is demonstrated with few chiller starts and hours. Maintenance do not report comfort complaints.
Any original sequence defeated?	No.	No	No	Yes - replaced packaged controller	Don't know	No	Generally maintenance doesn't know as this is out of responsibility. Discussions with DFCM controls is advisable.
Any VFDs in hand?	No.	No	No	NA	No	Yes - HP-1 pump in hand (was not known)	Specific training and procedures are advisable to avoid this.
General comments about mechanical systems	Heat pumps in this configuration and level of access are a serious and increasing problem for maintenance. FM figures these will require at least part of an FTE to manage in 5-10 years.	FM believes they work very well in general, after the initial efforts to correct the thermostat issues on the south side. Wants local control- , Tenants give the managers grief	RTUS are not well built and have maintenance costs despite being "high-efficiency"	Seem to work very well	Built to overkill. Cooling plant can run 2 other buildings.	Does very well in terms of ease of use, vs. other buildings	More complex systems tend to draw more comments.
Snowmelt operation, failsafe	NA	NA	NA	NA	NA	Hand operated - runs most of winter.	Resolve this issue.
Kitchen Exhaust hours & control	NA	NA	NA	NA	NA	Daytime, user operated	Minimal issue.
Lab Ventilation reductions, criteria	NA	NA	NA	NA	Set point turn down. 3530-1200 cfm. Most 90-100	Phoenix valves, fans ride the curve	General exhaust may be a source for reductions
Face Velocity	NA	NA	NA	NA	80-105, measured @ 100-105 set point. Need training.	77 FPM; was not on - manually operated occasionally, 1 lab hood	Hoods are generally operating in the acceptable range but may be reduced.
Heat Recovery	NA	NA	NA	NA	Yes- general exhaust only	NA	
RTU Sequence of operation	NA	NA	set-Paul. Controllers M-F 801-898-6243	Base system (York Millennium) was replaced by Richards-Zeta; FM does not know what the sequences are.	NA	NA	
Smoke management dampers fixed closed?	Yes, but these have had repeated problems sticking open. Need end switches.	NA	NA	NA	NA	NA	
OA AHU Sequences, schedule	Did not know - HPs are internally controlled, only report and have basic R/W points.	NA	NA	NA	NA	NA	

	West Jordan Courts	Salt Lake Multi Agency Building (Todd Rindlisbaker)	SLCC Gunderson	Draper DMV	Unified Lab	UofU Health Sciences (Brian Welsh)	ETC Observations
Cx design questions							
When, during the design or construction process, was your contract put into place?		Before the Design build team was hired				Contract in place after design phase was complete. August 2, 2004.	Cx was involved at various points
Was your scope of work different because of the HPBS?		Yes				Not sure of intent of this question. The project was LEED from the beginning so by definition it included elements of the HPBS. If the project had not been LEED, we would follow a similar process and protocol with the exception would likely not produce a Systems Manual nor to perform a near-warranty-end review.	
When, during the design or construction process, did you start to get involved?		We held an OPR workshop before the design-build team was hired				Initial involvement was in the form of a design document and submittal review in August, 2004 (report delivered 8/24/04). Design was complete so design document review portion was for clarification on significant items.	
If during design, how often did you attend design team meetings?		Four Times				N/A	
Was an OPR created and maintained?		Yes, it was created before the design began. The problem was that it was not given to the contractor/design team by the owner.				No. A Design Intent Document was provided post-facto for us to include in our commissioning work and report.	Early creation of OPR (and BOD) needs to be followed by its enforcement in design
Did you perform design reviews?		Yes, we had good design reviews and the design-build team was responsive. The engineers and subcontractors responded well to comments and to the requirements of the OPR when we showed it to them.				Limited, post-design.	Cx involvement should extend to compliance checking of the designs vs. OPR/BOD, as Owner's agent

	West Jordan Courts	Salt Lake Multi Agency Building	SLCC Gunderson	Draper DMV	Unified Lab	UofU Health Sciences	ETC Observations
If yes, when and how many? (ie 100% DD, 90% CD, etc)		The big problems arose during the beginning of construction when the General Contractor went to the subcontractors and told them to take everything out of their bid that was not explicitly called for in the program. The ended up throwing out a bunch of requirements from the OPR. Because it was a design build project, the contractor had control of the engineers and they didn't dare speak up and say anything. In the end, there was equipment installed without adequate service access, the owner ended up paying change orders to put things back into the project that they shouldn't have.				A post-bid design review was conducted and report provided. The review was conducted along with submittal review. Only significant and clarification items were identified in the design document review. The submittal review was comprehensive.	
If yes, were control sequences reviewed in detail?		Three, SD, 60% CD, 90% CD				In the construction document review, no. In the submittal review, yes.	
If yes, were control sequences reviewed in detail?		Yes, we even had an additional review for the controls sequences.					
How did HPBS influence the building during design?		They used High-efficient equipment and added building envelope commissioning to the scope.There is a very poor understanding of the OPR and how to use it. On this project, if the owner had given the OPR to the contractor with the building program and made it a contract requirement then the contractor would have been bound by it as well. Ultimately there were conflicts in the program and the OPR which would have had to be reconciled but it would have solved a lot of problems on our project.				The building was designed with LEED as the standard. We do not know how that impacted the overall building design concepts except that energy efficiency was important.	

	West Jordan Courts	Salt Lake Multi Agency Building	SLCC Gunderson	Draper DMV	Unified Lab	UofU Health Sciences	ETC Observations
What, if anything, would you change about the HPBS to have greater effect on the building's energy performance?		There is a very poor understanding of the OPR and how to use it. On this project, if the owner had given the OPR to the contractor with the building program and made it a contract requirement then the contractor would have been bound by it as well. Ultimately there were conflicts in the program and the OPR which would have had to be reconciled but it would have solved a lot of problems on our project.				Would include an element to prove performance and hold designers/installers accountable for results. Use M&V strategies to verify performance. Challenge here is that new construction performance is based on an energy model and getting a fair and accurate baseline is problematic.	Integrate the OPR into the design and construction contracts whether they are under design-build, plan-spec, CMGC, or otherwise.
Cx construction questions							
Did you review equipment submittals under your contract?		Yes				Yes. In particular control submittals.	CxA already reviews submittals under their scope
How often were you on-site for:							
Construction Meetings?		Weekly, We ended up with over 80 commissioning meeting / site visits				20 times, conducted a site observation at same time.	
Walk-throughs?		See Above				20 times. A site observation report was completed for each visit.	
What systems were commissioned?							
HVAC		Yes				High temperature hot water systems, pumps, heat exchangers, air handlers, VAV terminal units, exhaust fans.	
Lighting/Lighting Controls		Yes				Yes	
DHW		Yes				Yes	
Envelope		Yes				No	
Other		Fire Alarm, Security, CCTV				Plumbing, Security, Elevators, Emergency Power, Life Safety Systems, Paging	
(please expand on eachsystem as needed)							
Were systems manuals compiled adequately? (whether by you or the contractor)		We provided a systems manual. It could have been improved with more input from the owner, designer, and the contractor. The SM could be greatly improved by input from the designers, but it needs to be put in their contracts.				This was in our scope. Cannot find a copy of it in the files. Assume it was provided. Usefulness of these manuals is often questionable. We compile them, however, we know in most cases they are never looked at.	**Add systems manuals (training docs) to contract for all parties**

	West Jordan Courts	Salt Lake Multi Agency Building	SLCC Gunderson	Draper DMV	Unified Lab	UofU Health Sciences	ETC Observations
Were the building operators trained, under the contract?		Yes. Again training would be improved with more improvement from the design team. They are the best people to explain how the systems work.				Yes.	
If so by whom?		The Contractors				Installing contractors. Verified by CxA.	
Were any records of the training given to the owner?		Yes.				Yes. Included in commissioning report also.	
How did HPBS Influence the building construction if at all?		Yes.				Did not appear to influence construction. Typical practices were followed.	Mixed reviews from the CxA suggest discussion is needed
Performance Monitoring (continuous commissioning)							
Did you perform a 10 month check in?		Yes				Yes.	
Were any trends set up and monitored during the 1 year warrantee period?		Yes				Not for the entire period. Just for the time around the 10 month review.	
If yes, please describe what was trended and how that information was used.		Almost all set points and corresponding controlling devices (example; temperature set point, CHW Valve, HW Valve, evap cooler, OA damper position) These were reviewed for proper sequence and stability. There were times when set points were adjusted to optimize control and in some cases, the sequence altered because the trends showed something different than the designer expected.				VAV air flows, zone temperatures and discharge temperatures. Used to find leaking boxes, simultaneous heating and cooling, verified zone control.	
Were RMP Cx requirements part of the commissioning?		Yes				No.	
Was this part of your original scope or was it added later?		Original				N/A	
Did the DFCM change your scope and fee for the additional work?		Part of the original fee				N/A	

	West Jordan Courts	Salt Lake Multi Agency Building	SLCC Gunderson	Draper DMV	Unified Lab	UofU Health Sciences	ETC Observations
Do you perceive this to be a high performing building?		Yes				General perception would be no, however do not have data to indicate one way or another. At the time, meter data was not available for high temperature hot water and chilled water to evaluate performance. The Cx process was critical to getting improved performance over if it had not been done because of simultaneous heating and cooling on a major scale that would not have been noticed otherwise.	Metering as a consistent issue in some facilities needs to be addressed more rigorously
Commissioning Documentation							
Commissioning Plan						Is contained in report.	
Commissioning Report						Forwaded	
If you have other comments about how this building's process could have been improved, please feel free to comment.		I think there are fundamental problems with the design/build contracting process that will never let the owner fully achieve their goals. I think the Integrated Design Process (IDP) would allow the owner achieve better results. Also, a better understanding of the commissioning process – including strengths and limitations – by the DFCM and User project managers would go a long way to effectively utilizing the commissioning authority.				Get CxA involved earlier so design review can be completed.	

	Lynn Hinrichs	Matthias Mueller	Brian Bales	Dave McKay				
	West Jordan Courts	**Salt Lake Multi Agency Building**	**SLCC Gunderson**	**Draper DMV**	**Unified Lab**	**UofU Health Sciences**	**Bingham EER**	**ETC Observations**
When was the Commissioning agent (CxA) retained in the course of the project?	11/18/03 During Schematic Design	I don't remember but you can find out by accessing the project archives	I was not involved during the programming of the building and the building was a design build project. **There was no commissioning agent** so most of the questions do not apply. This was only a 2.5 million dollar building built on a very tight budget funded at least partially by the SL Community College.. The design was created by the contractor and their A/E team not the State of Utah. As far as I know The DFCM plan review process required the building to meet the DFCM energy	As the construction got underway (this is a fast developing design/build project)			Prior to construction	
Was this the right time?	Yes	See above		It could have been instituted earlier			Yes, it was as early as possible for a design build project.	
During what phases was a CxA *effectively* involved?	Schematic design	See above		Shop drawing Review			Late in the design and throughout Construction	
What systems were commissioned? Please provide a digital copy of the report.	See Attatched Report	Electrical, mechanical, plumbing and envelope		HVAC, not in digital form			See report	
Building envelope	no			no				
Lighting	yes			no				
HVAC Air-Side	yes			yes- rooftops (high efficiency)				
HVAC CHW	n/a			NA				
HVAC HW	yes			NA				
Other?	security, HVAC controls, GSHP			No				
Did the commissioning agent engage the contractor through the warranty period?	Yes	Yes		yes- rooftops (high efficiency)			Yes	
Were all the commissioning-identified issues resolved?	Yes	I believe they were		yes- rooftops (high efficiency)			Yes	
How is commissioning most effectively used?	As a tool to check the building systems design concept and as an owner's representative to insure that systems actually function as designed and are optimized for efficiency of the overall system.	Throughout the duration of the project. Of course the greatest impact is when it's used during the design of the project.		Validated air balance and operability			To confirm you get what the engineer designed	Various responses but the general sense is earlier is better
Energy Engineering								

When was an energy consultant retained in the course of the project?	6/6/03 Pre-design, to evaluate the site for geothermal suitability.	I don't remember but you can find out by accessing the project archives		Just design team and Cx's agent so not much time in development of option			Early construction	
Is this the right time?	Yes, for this type of energy consultation.	See above		design/build therefore…			Not sure, they contracted with the energy group	
During what phases was an energy consultant effectively involved?	Pre-design/programming.	See above						
How is energy modeling most effectively used?	There wasn't a formal energy model as we are accustomed to requiring now on our development projects, this was more of a site analysis and boring to determine geothermal suitability.	During the design of the project		wasn't used				
Facility Managers								
Were facility management personnel consulted during design?	Yes	Yes	Yes	yes, but there could have been more			Yes	**FM personnel take a dimmer view of their influence than the PMs do.**
How/When did this happen?	They were invited to all design meetings and invited to review all plan reviews.	Throughout the duration of the project's design and construction	During Programming- Not design	At review of selected design and submittals			Throughout design and construction	
Were facility management personnel consulted during construction?	They were in attendance to all construction meetings.	Yes	Yes	yes				
How/When did this happen?	Bi-Weekly	Throughout the duration of the project's design and construction	During Construction					
HPBS								
Do you perceive this to be a high performing building?	It was constructed prior to our High Performance Building Standard, so it doesn't compare to our buildings constructed in the last two years, but it was required to exceed ASHRAE 90.1 by a healthy percentage, so it should be a higher performing building than the average building of that era.	Yes		moderately high (early years)			Yes	
How did HPBS Influence the building during design? (discuss specific EEMs)	HPBS had not formally been adopted as of the date of the design of this building.	It was required as a part of DFCM's design Criteria	No	More efficient HVAC units selection of plumbing fixtures, landscape design			It was planned to be LEED so no impact	
How did HPBS Influence the building during construction?	N/A	The HPBS requirements were a part of the contract documents	Once again I was not involved with the programming and design.	not much			It was planned to be LEED so no impact	

What if anything would you change about the HPBS to have greater effect on energy?	We would need to require some prerequisites in the LEED analysis to ensure that energy conservation points were mandated to a certain degree, as opposed to some of the other areas like sustainability, that may be easier to achieve within project budget constraints. Our experience indicates that a building envelope system is effective at saving energy and **power factor analysis** is also very effective. These may not be point worthy in LEED, but should be part of the state's HPBS requirements.	Include an updated version of the DFCM building envelope standards. Also include electrical harmonic dampening when it's cost effective.		Need more experience applying to design/build delivery system				**Design/Build challenges similar to the CxA comments; creation and enforcement of the OPR/BOD may help ameliorate these issues; Power Factor Analysis is also suggested**

BENCHMARKING & DISCLOSURE REPORT

SUBJECT PROPERTY:

Property Name: Draper DMV

Property Address: 14555 S. Minuteman Drive
Draper , UT
84020

Property Type: Office - Medium (10,000-50,000 SF)

Gross Square Footage (SF): 23,396 SF

PROJECT NAME:

Utah DFCM Review

PROJECT PROPERTY:

Draper DMV

REPORT DATE:

May 09, 2012

PREPARED FOR:

John Burningham
State of Utah DFCM - 450 North State Street - Salt Lake City, Ut 84114

PREPARED BY:

ETC Group, LLC - 1997 South 1100 East - Suite 201 - Salt Lake City, UT 84106

ETC Group
ENERGY ENGINEERING FOR A SUSTAINABLE FUTURE ™

EXECUTIVE SUMMARY

Introduction

ETC Group, under contract with the State of Utah DFCM, after a high level review of 29 DFCM owned buildings, has selected 6 facilities of various sizes and uses to inform possible changes to the State High Performance Building Standard. The Draper DMV was selected and analyzed as part of this study. This report documents the building's energy consumption and its relative performance to similar buildings in the region. Also identified are building-specific energy efficiency measures.

On overview, this building performs adequately with an energy utilization index 15% higher than average; further improvement efforts should focus on:

1. Building leakage minimization
2. Ventilation reductions, via re-commissioning and HVAC balancing
3. Demand-Controlled Ventilation
4. Review of the status of deficiencies noted in the commissioning report

Peer Building Benchmarking

Peer Building Benchmarking - Utility Cost

Property Type: Office - Medium (10,000-50,000 SF)
Peer Group: Same 3-Digit ZIP Code (6 peer buildings)

Utility Type	Subject Property 12 Months Spend Jan 2011 to Dec 2011	Subject Property Cost per SF ($/SF/yr)	Peer Group Benchmark Median Cost per SF ($/SF/yr)	Subject Property % Better / (Worse) Than Peer Group Median	Subject Property Potential Annual Cost Savings vs Peer Group Median ($/yr)
Electricity		$12,785	$0.55 / SF	$1.39 / SF	**60.7%**
Fuels		$5,881	$0.25 / SF	$0.30 / SF	**16.2%**

SRS Peer Building Benchmarking data is current through May 2011.

Peer Building Benchmarking - Energy Use Intensity

Property Type: Office - Medium (10,000-50,000 SF)
Peer Group: Same 3-Digit ZIP Code (6 peer buildings)

Key Performance Metric	Subject Property 12 Months Total Use per SF Jan 2011 to Dec 2011	Peer Group Benchmark Median Use per SF	Subject Property % Better / (Worse) Than Peer Group Median	Subject Property Potential Annual Cost Savings vs Peer Group Median ($/yr)
Electricity Use Intensity	15.91 kWh / SF	16.46 kWh / SF	**3.3%**	N/A
Fuels Use Intensity	42.91 kBTU / SF	33.77 kBTU / SF	**(27.1%)**	$1,253
Energy Use Intensity (EUI)	97.20 kBTU / SF	89.34 kBTU / SF	**(8.8%)**	$1,509

SRS Peer Building Benchmarking data is current through May 2011.

As compared to its peer buildings median annual fuels use per square foot, the fuels use at the subject property is 9.14 kWh / SF more than its peer group. If the performance of the subject property was improved to meet the median fuels performance of its peer group, the subject property has the potential to reduce its annual fuels cost by $1,253.

As compared to its peer buildings median annual energy use per square foot, the energy use at the subject property is 7.86 kWh / SF more than its peer group. If the performance of the subject property was improved to meet the median energy performance of its peer group, the subject property has the potential to reduce its annual energy cost by $1,509.

SUBJECT PROPERTY PROFILE

Property Name:	Draper DMV
Property Address:	14555 S. Minuteman Drive Draper, UT 84020
Property Type:	Office - Medium (10,000-50,000 SF)
Gross Square Footage (SF):	23,396 SF
Reporting Period:	Jan 2011 to Dec 2011

Property Location

The maps below display the subject property location.

Street Map

Aerial Map

Utility Account Summary

Subject Property Utilities		
Utility Account	**Utility Type**	**Specified Reporting Period**
Questar Gas GS rate	Gas	01/2011 - 12/2011
Rocky Mountain Power Rate 6	Electrical	01/2011 - 12/2011

Subject Property Profile Discussion

The Tax Draper DMV building is a single story, 23,396 square foot building. Construction was completed in august of 2009. The HVAC system consists of gas-furnace, DX roof top packaged units. It includes two large rooms with smaller offices in between. Skylights and windows allow natural daylight into the building core.

ENERGY STAR RATING

The ENERGY STAR national energy efficiency performance rating is a benchmark that helps building stakeholders assess how efficiently their buildings consume energy, relative to similar buildings nationwide. The rating system's 1-100 scale allows a relatively quick determination to understand how a building is performing. A rating of 50 indicates average building energy performance while a rating of 75 or better indicates top 25th percentile performance and building's achieving this level are eligible to earn an ENERGY STAR label.

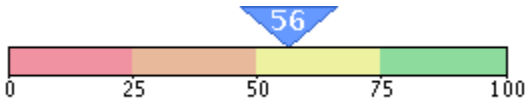
ENERGY STAR's benchmarking scale is based upon comparison with the U.S. Energy Information Administration's (EIA) Commercial Building Energy Consumption Survey (CBECS) data (current through December 2003) for existing commercial building stock, including approximately 5,200 buildings nationwide across 15 property types.

The below chart displays the ENERGY STAR rating for the subject property.

ENERGY STAR Rating

Property Type: Office (>5,000 SF)

Peer Group: Nationwide (498 peer buildings)

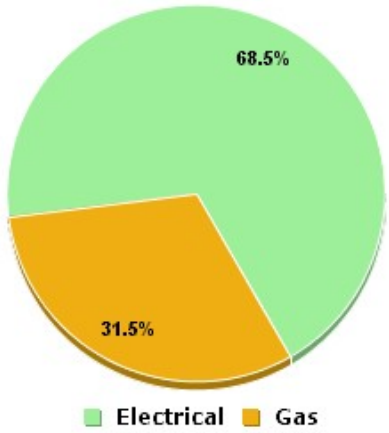


Commercial Building Energy Consumption Survey (CBECS) data is current through December 2003.

The subject property's most recent Energy Star rating of 56, received in December 2011, is 6 points above the national average and 19 points below the threshold rating of 75 needed to earn an Energy Star label.

UTILITY COST

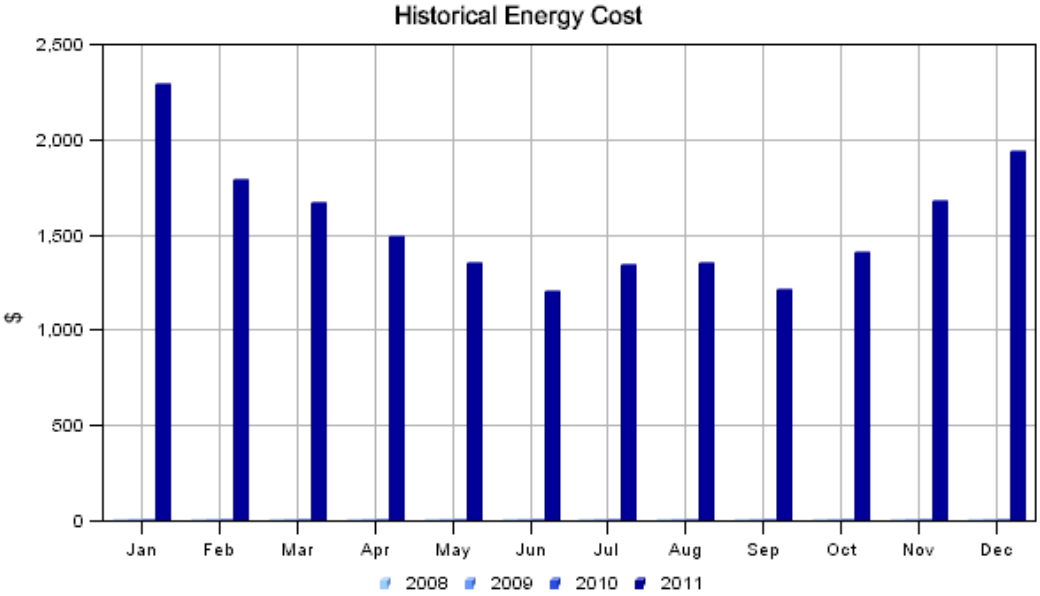
Overall Utility Cost



The above chart displays the percentage allocation of utility costs over the last twelve months of the specified reporting period from Jan 2011 to Dec 2011.

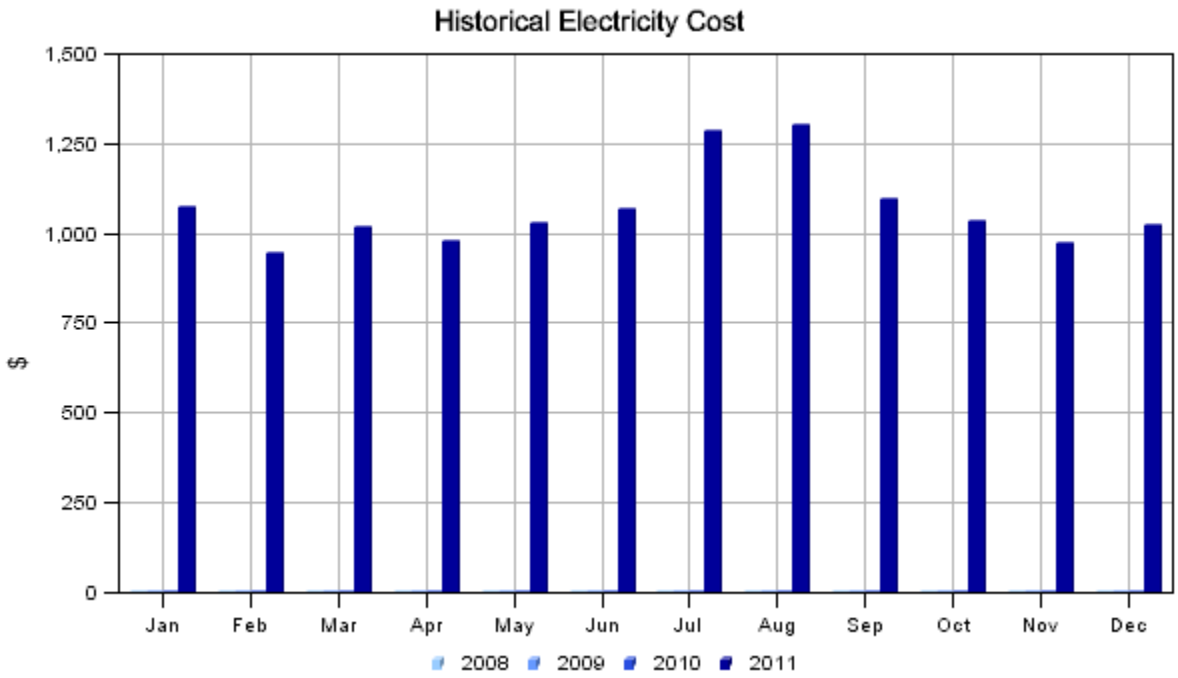
The subject property's total utility costs are allocated between Electrical (68.5%) and Gas (31.5%).

Historical Energy Cost



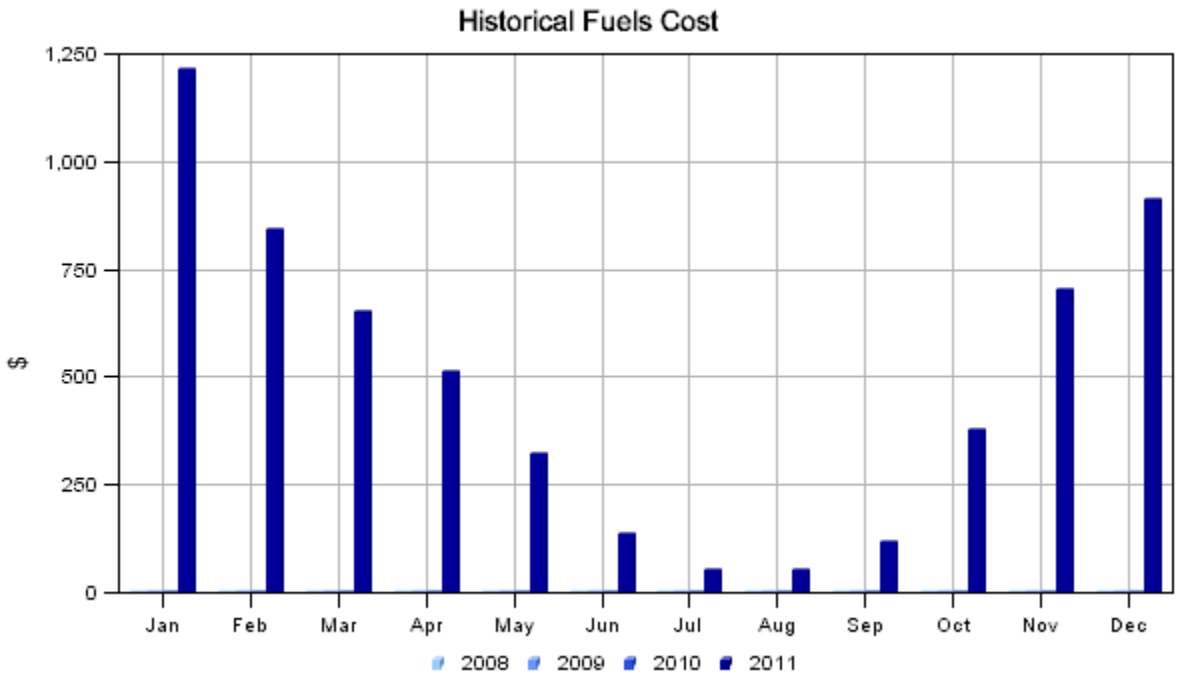
The above chart displays a comparison of total energy (electric and fuels) cost, on a monthly basis, over the specified reporting period from Jan 2011 to Dec 2011.

Historical Electricity Cost



The chart above displays a comparison of electricity cost, on a monthly basis, over the specified reporting period from Jan 2011 to Dec 2011.

Historical Fuels Cost



The chart above displays a comparison of all fuels cost, on a monthly basis, over the specified reporting period from Jan 2011 to Dec 2011.

PEER BUILDING BENCHMARKING - UTILITY COST

To facilitate an industry best practice for benchmarking building energy and sustainability performance, Sustainable Real Estate Solutions, Inc, (SRS) maintains the SRS Peer Building Benchmarking™ database, containing over 120,000 buildings. These buildings, encompassing 15 primary property types and 3.3 billion square feet, consume more than $7.8 billion in annual energy costs and $635 million in annual water/sewer costs. The database is aggregated from multiple private sources, including energy services and property due diligence providers and is current through May 2011.

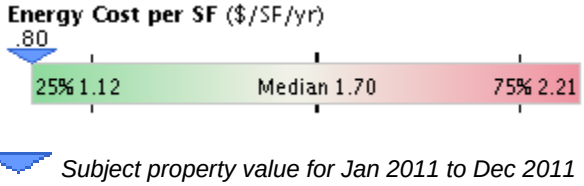
To facilitate benchmarking, the subject property's energy and sustainability performance is compared to its peer group's performance distribution (25th percentile, median, 75th percentile) across multiple geographic areas, i.e., ZIP Code, Core Based Statistical Area (CBSA), State, Climate Region and Nationwide.

For each subject property under review, the Database is queried with reference to the property type and location. The results are summarized in the following charts and descriptions which include a detailed statistical analysis of energy and sustainability key performance indicators.

Energy Cost per SF

Peer Group Comparison Property Type: Office - Medium (10,000-50,000 SF)

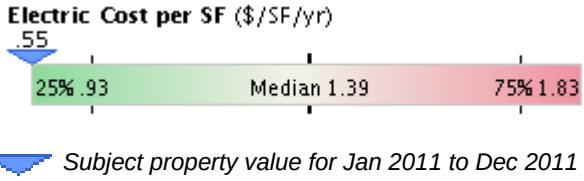
Same Climate Region
(100 peer buildings)



Electric Cost per SF

Peer Group Comparison Property Type: Office - Medium (10,000-50,000 SF)

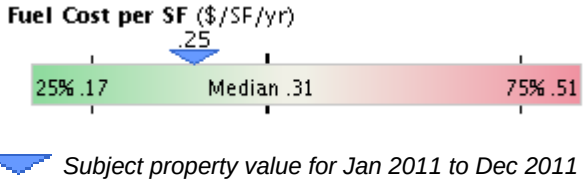
Same Climate Region
(98 peer buildings)



Fuels Cost per SF

Peer Group Comparison Property Type: Office - Medium (10,000-50,000 SF)

Same Climate Region
(82 peer buildings)

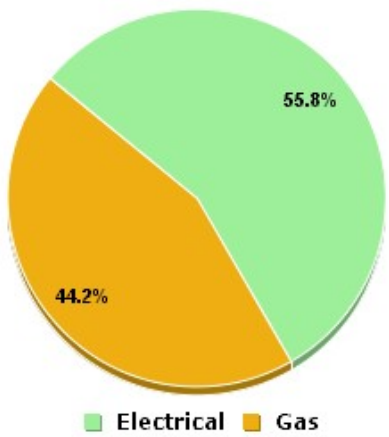


Peer Building Benchmarking - Utility Cost Discussion

Compared to its peer buildings, annual energy cost is low for the Draper DMV, with an Energy Cost Index (ECI) of $0.80/sf compared to $1.70/sf for climate region peer buildings. Electric costs were also low, at $0.55/sf compared to an average of $1.39/sf for peers. Gas costs at $0.25/sf are slightly lower than the peer-average of $0.31/sf.

ENERGY USE

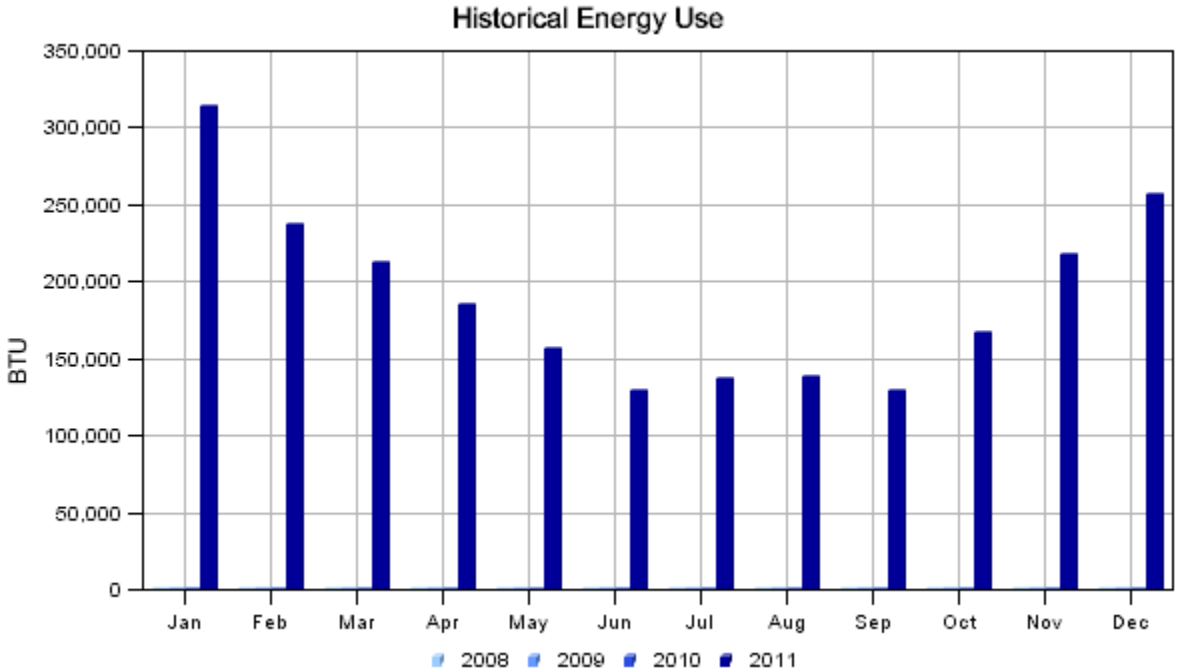
Overall Energy Use



The above chart displays the percentage allocation of energy use by type over the last twelve months of the specified reporting period from Jan 2011 to Dec 2011.

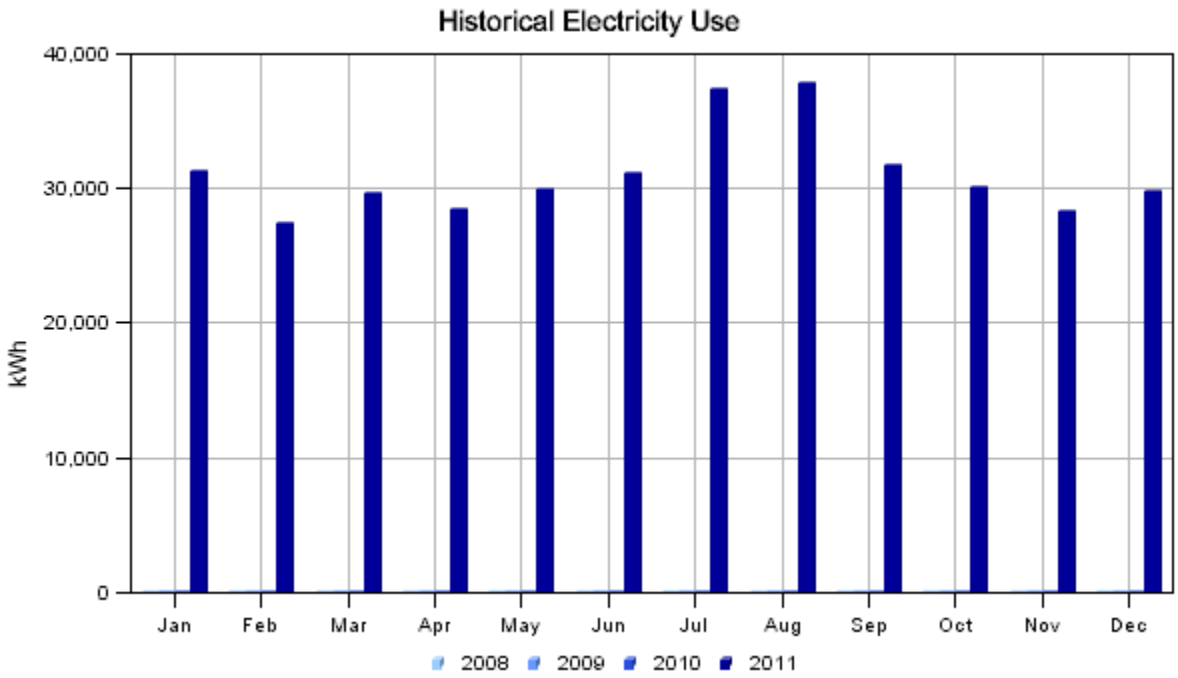
The subject property's energy use is allocated between Electrical (55.8%) and Gas (44.2%).

Historical Energy Use



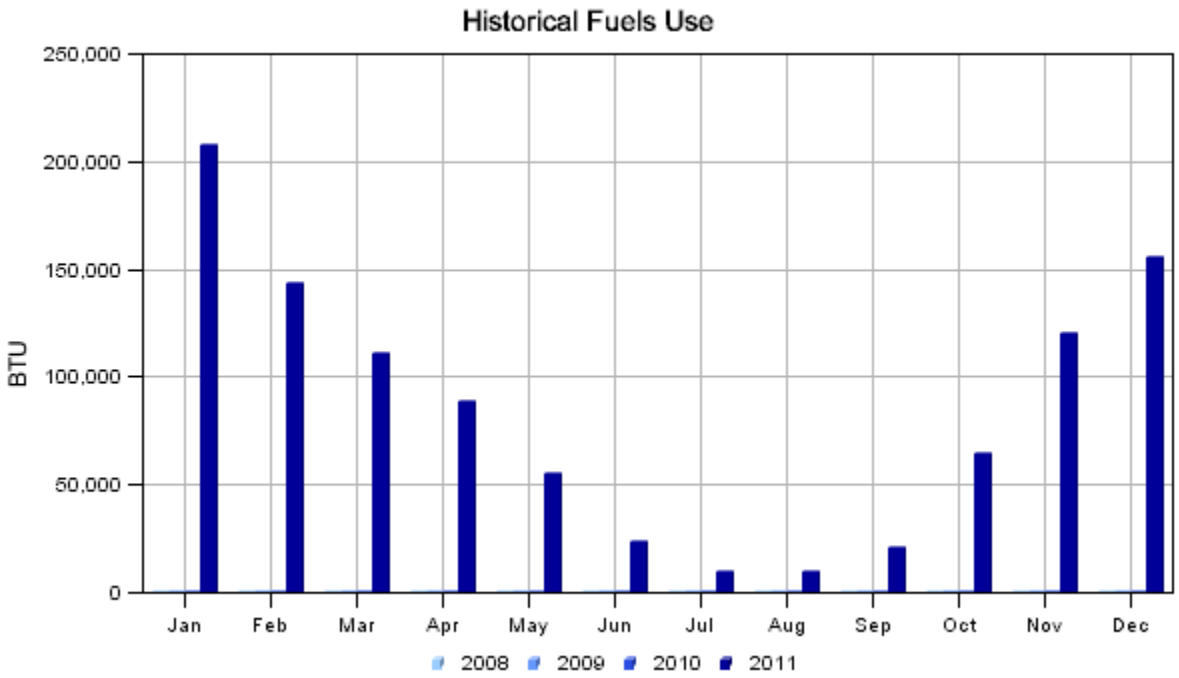
The above chart displays a comparison of total energy (electric and fuels) usage, on a monthly basis, over the specified reporting period from Jan 2011 to Dec 2011.

Historical Electricity Use



The chart above displays a comparison of electricity usage, on a monthly basis, over the specified reporting period from Jan 2011 to Dec 2011.

Historical Fuels Use



The chart above displays a comparison of all fuels usage, on a monthly basis, over the specified reporting period from Jan 2011 to Dec 2011.

PEER BUILDING BENCHMARKING - ENERGY USE INTENSITY

To facilitate an industry best practice for benchmarking building energy and sustainability performance, Sustainable Real Estate Solutions, Inc, (SRS) maintains the SRS Peer Building Benchmarking™ database, containing over 120,000 buildings. These buildings, encompassing 15 primary property types and 3.3 billion square feet, consume more than $7.8 billion in annual energy costs and $635 million in annual water/sewer costs. The database is aggregated from multiple private sources, including energy services and property due diligence providers and is current through May 2011.

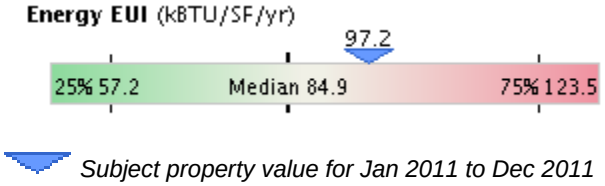
To facilitate benchmarking, the subject property's energy and sustainability performance is compared to its peer group's performance distribution (25th percentile, median, 75th percentile) across multiple geographic areas, i.e., ZIP Code, Core Based Statistical Area (CBSA), State, Climate Region and Nationwide.

For each subject property under review, the Database is queried with reference to the property type and location. The results are summarized in the following charts and descriptions which include a detailed statistical analysis of energy and sustainability key performance indicators.

Energy Use per SF (EUI)

Peer Building Comparison Property Type: Office - Medium (10,000-50,000 SF)

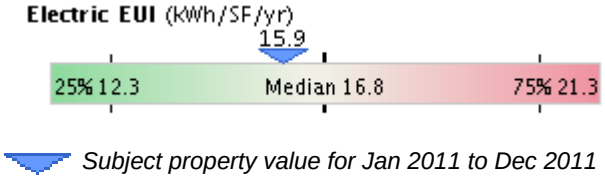
Same Climate Region
(100 peer buildings)



Electricity Use per SF

Peer Group Comparison Property Type: Office - Medium (10,000-50,000 SF)

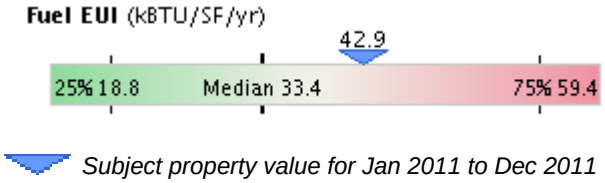
Same Climate Region
(98 peer buildings)



Fuels Use per SF

Peer Group Comparison Property Type: Office - Medium (10,000-50,000 SF)

Same Climate Region
(82 peer buildings)



Peer Building Benchmarking - Energy Use Intensity Discussion

Draper DMV's total Energy Utilization Index (EUI) of 97.2 kBtu/sf/yr is slightly above the climate region peer- average of 84.9 kBtu/sf/yr. Its electric-only EUI of 15.9 kwh/sf/yr is slightly lower than the peer-average of kwh/sf/yr, while its gas-only EUI of 42.9 kBtu/sf/yr is higher than the peer-average of 33.4 kBtu/sf/yr.

PEER BUILDING BENCHMARKING SUMMARY

Peer Building Benchmarking - Utility Cost

Property Type: Office - Medium (10,000-50,000 SF)
Peer Group: Same 3-Digit ZIP Code (6 peer buildings)

Utility Type	Subject Property 12 Months Spend Jan 2011 to Dec 2011	Subject Property Cost per SF ($/SF/yr)	Peer Group Benchmark Median Cost per SF ($/SF/yr)	Subject Property % Better / (Worse) Than Peer Group Median	Subject Property Potential Annual Cost Savings vs Peer Group Median ($/yr)
Electricity	$12,785	$0.55 / SF	$1.39 / SF	**60.7%**	N/A
Fuels	$5,881	$0.25 / SF	$0.30 / SF	**16.2%**	N/A

SRS Peer Building Benchmarking data is current through May 2011.

Peer Building Benchmarking - Energy Use Intensity

Property Type: Office - Medium (10,000-50,000 SF)
Peer Group: Same 3-Digit ZIP Code (6 peer buildings)

Key Performance Metric	Subject Property 12 Months Total Use per SF Jan 2011 to Dec 2011	Peer Group Benchmark Median Use per SF	Subject Property % Better / (Worse) Than Peer Group Median	Subject Property Potential Annual Cost Savings vs Peer Group Median ($/yr)
Electricity Use Intensity	15.91 kWh / SF	16.46 kWh / SF	**3.3%**	N/A
Fuels Use Intensity	42.91 kBTU / SF	33.77 kBTU / SF	**(27.1%)**	$1,253
Energy Use Intensity (EUI)	97.20 kBTU / SF	89.34 kBTU / SF	**(8.8%)**	$1,509

SRS Peer Building Benchmarking data is current through May 2011.

As compared to its peer buildings median annual fuels use per square foot, the fuels use at the subject property is 9.14 kWh / SF more than its peer group. If the performance of the subject property was improved to meet the median fuels performance of its peer group, the subject property has the potential to reduce its annual fuels cost by $1,253.

As compared to its peer buildings median annual energy use per square foot, the energy use at the subject property is 7.86 kWh / SF more than its peer group. If the performance of the subject property was improved to meet the median energy performance of its peer group, the subject property has the potential to reduce its annual energy cost by $1,509.

CONCLUSIONS & RECOMMENDATIONS

Electrical usage appears to be in order for this building. Lighting controls are operational. Plug loads may be a source of savings, with occupant training and plug strip use as applicable. HVAC use may be reduced with set points adjustments. HVAC use (particularly compressor use) will largely be covered by investigation of the economizer operation, as discussed under the following gas usage recommendations.

Gas usage in buildings of this nature are dominated by envelope u-value (conductive/radiation loss) and by outside air introduction, whether via infiltration, exfiltration, or ventilation. Little can be done about the envelope resistance at this point, and the building appears to conform to standard practices and applicable code in that regard. We therefore recommend investigation into the sources of outside air in the following way:

1. For ventilation (outside air forced by RTUs and/or exhaust fans):
    a. Validate that the appropriate airflows exist at exhaust fans and at outside air minimum positions. These are subject to test and balance error and/or drift or defeat.
    b. Validate the sequences of operation.
        i. This is particularly important for the RTUs, where OEM controls were stripped and replaced, and presumably re-programmed. Visually check positions of the economizer dampers against DDC system graphics and control point outputs. Once this is done, log positions against time of day, outside air temperature, and heating/cooling operation.
        ii. For exhaust fans, visually check operation against DDC system graphics and control point outputs. Log time of day to validate the scheduling.
2. For infiltration (outside air forced by wind and temperature):
    a. Perform envelope leakage tests. Depending on the results, smoke testing and/or envelope sealing may be in order.
    b. According to FM staff, the high and relatively constant prevailing winds combine with the short main vestibule to result in heavy winter heating needs. While re-arranging the entrance is likely an expensive proposition, the potential energy savings and comfort benefits may be worthwhile.

The commissioning report has a long list of outstanding issues relative to the size and complexity of this building. However, it appears that the original York controls were stripped and replaced with custom controls. Still, determination of the status of all the listed issues is advisable. One of the major issues in the report is that the report omits sensor calibration; we recommend checking instrument calibration with handheld calibrated instruments.

We also noted that while the DMV main spaces can hold hundreds of people, they are sparsely populated for many technically occupied hours of the year. CO_2 based demand controlled ventilation for the main area should be considered. Before considering any of the above, note that the energy cost benefit of reducing gas use to the peer-average is approximately $1,500/year, based on a gas cost of $6.80/DTH.

BENCHMARKING & DISCLOSURE REPORT

SUBJECT PROPERTY:

Property Name: SLCC Gunderson Campus Services

Property Address: 4365 S. 2200 W.
Taylorsville, UT
84123

Property Type: Office - Medium (10,000-50,000 SF)

Gross Square Footage (SF): 16,800 SF

PROJECT NAME:

Utah DFCM Review

PROJECT PROPERTY:

SLCC Gunderson Building

REPORT DATE:

May 09, 2012

PREPARED FOR:

John Burningham
State of Utah DFCM - 450 North State Street - Salt Lake City, Ut 84114

PREPARED BY:

ETC Group, LLC - 1997 South 1100 East - Suite 201 - Salt Lake City, UT 84106

ETC Group
ENERGY ENGINEERING FOR A SUSTAINABLE FUTURE™

EXECUTIVE SUMMARY

Introduction

ETC Group, under contract with the State of Utah DFCM, after a high level review of 29 DFCM owned buildings, has selected 6 facilities of various sizes and uses to inform possible changes to the State High Performance Building Standard. The Gunderson building was selected and analyzed as part of this study. This report documents the building's energy consumption and its relative performance to similar buildings in the region. Also identified are building-specific energy efficiency measures.

On overview, this building already performs well with an energy utilization index 35 % lower than average; further improvement efforts should focus on:

1. Air side economizer maintenance
2. Building leakage minimization
3. Demand-Controlled Ventilation
4. User training to reduce plug loads

Peer Building Benchmarking

Peer Building Benchmarking - Utility Cost

Property Type: Office - Medium (10,000-50,000 SF)
Peer Group: Same 3-Digit ZIP Code (8 peer buildings)

Utility Type	Subject Property 12 Months Spend Mar 2011 to Feb 2012	Subject Property Cost per SF ($/SF/yr)	Peer Group Benchmark Median Cost per SF ($/SF/yr)	Subject Property % Better / (Worse) Than Peer Group Median	Subject Property Potential Annual Cost Savings vs Peer Group Median ($/yr)
Electricity	$16,811	$1.00 / SF	$1.47 / SF	**31.9%**	N/A
Fuels	$2,407	$0.14 / SF	$0.26 / SF	**44.9%**	N/A

SRS Peer Building Benchmarking data is current through May 2011.

Peer Building Benchmarking - Energy Use Intensity

Property Type: Office - Medium (10,000-50,000 SF)

Peer Group: Same 3-Digit ZIP Code (8 peer buildings)

Key Performance Metric	Subject Property 12 Months Total Use per SF Mar 2011 to Feb 2012	Peer Group Benchmark Median Use per SF	Subject Property % Better / (Worse) Than Peer Group Median	Subject Property Potential Annual Cost Savings vs Peer Group Median ($/yr)
Electricity Use Intensity	11.05 kWh / SF	18.44 kWh / SF	**40.1%**	N/A
Fuels Use Intensity	17.79 kBTU / SF	29.87 kBTU / SF	**40.5%**	N/A
Energy Use Intensity (EUI)	55.50 kBTU / SF	100.69 kBTU / SF	**44.9%**	N/A

SRS Peer Building Benchmarking data is current through May 2011.

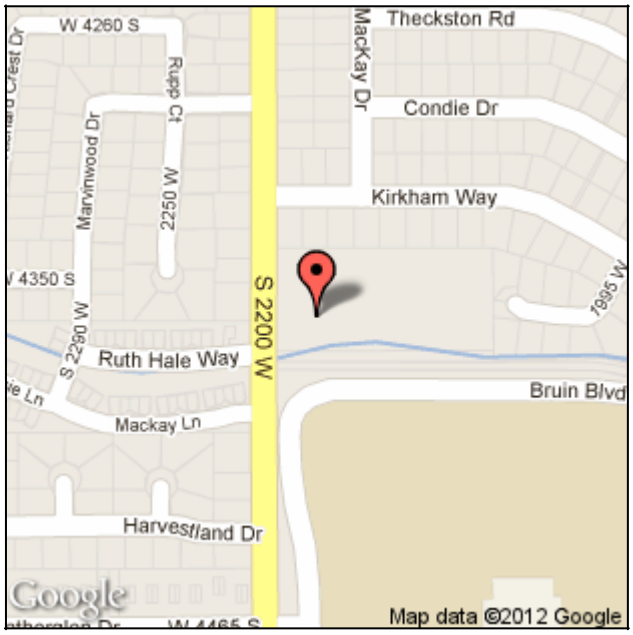
SUBJECT PROPERTY PROFILE

Property Name:	SLCC Gunderson Campus Services
Property Address:	4365 S. 2200 W. Taylorsville, UT 84123
Property Type:	Office - Medium (10,000-50,000 SF)
Gross Square Footage (SF):	16,800 SF
Reporting Period:	Aug 2010 to Feb 2012

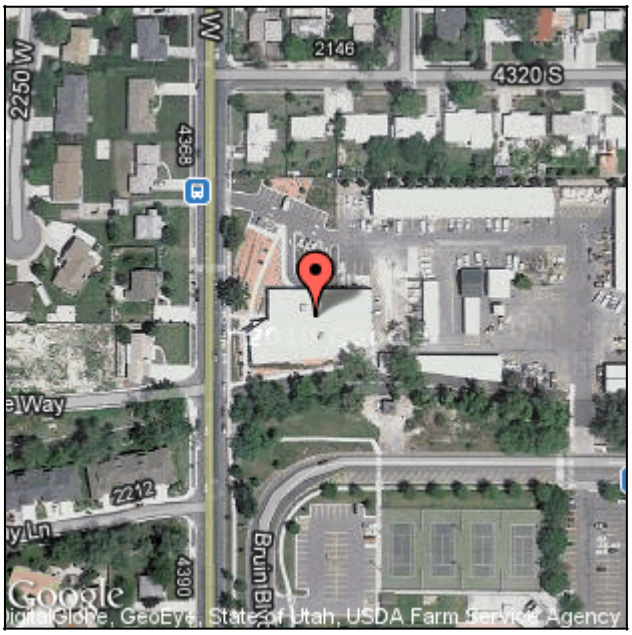
Property Location

The maps below display the subject property location.

Street Map



Aerial Map



Utility Account Summary

Subject Property Utilities		
Utility Account	**Utility Type**	**Specified Reporting Period**
Questar Gas GS Rate	Gas	08/2010 - 02/2012
Rocky Mountain Power Rate 6	Electrical	08/2010 - 02/2012

Subject Property Profile Discussion

The Gunderson Campus Services building is a small single story office building located on the Salt Lake Community College Redwood campus. It was completed in October of 2008 and is 16,800 square feet. The building houses Facility Maintenance personnel as well as the Campus Police. The building is spit into halves by a clear story that is located above a central hallway. The building uses a basic VAV system conditioned by a condensing boiler and a roof top packaged cooling unit.

ENERGY STAR RATING

The ENERGY STAR national energy efficiency performance rating is a benchmark that helps building stakeholders assess how efficiently their buildings consume energy, relative to similar buildings nationwide. The rating system's 1-100 scale allows a relatively quick determination to understand how a building is performing. A rating of 50 indicates average building energy performance while a rating of 75 or better indicates top 25th percentile performance and building's achieving this level are eligible to earn an ENERGY STAR label.

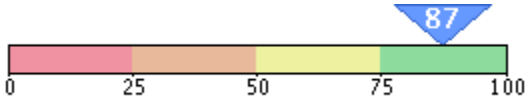
ENERGY STAR's benchmarking scale is based upon comparison with the U.S. Energy Information Administration's (EIA) Commercial Building Energy Consumption Survey (CBECS) data (current through December 2003) for existing commercial building stock, including approximately 5,200 buildings nationwide across 15 property types.

The below charts display the ENERGY STAR rating for the subject property.

ENERGY STAR Rating

Property Type: Office (>5,000 SF)

Peer Group: Nationwide (498 peer buildings)

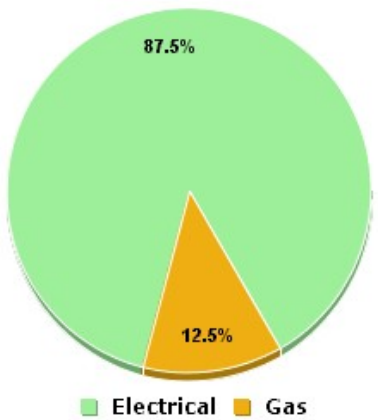


Commercial Building Energy Consumption Survey (CBECS) data is current through December 2003.

The subject property's most recent Energy Star rating of 87, received in February 2012, is 37 points above the national average and 12 points above the threshold rating of 75 needed to earn an Energy Star label.

UTILITY COST

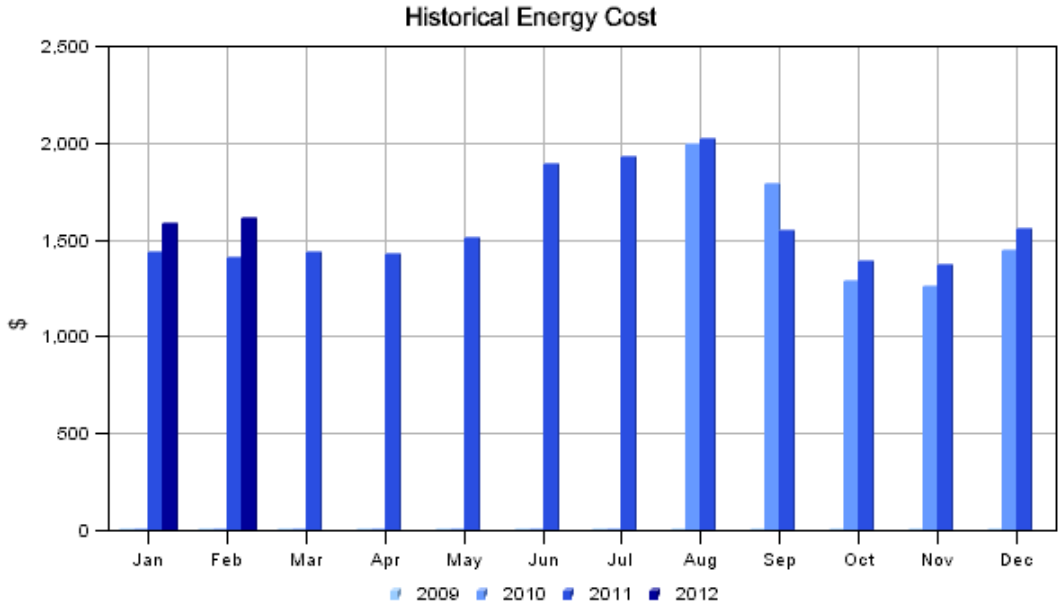
Overall Utility Cost



The above chart displays the percentage allocation of utility costs over the last twelve months of the specified reporting period from Mar 2011 to Feb 2012.

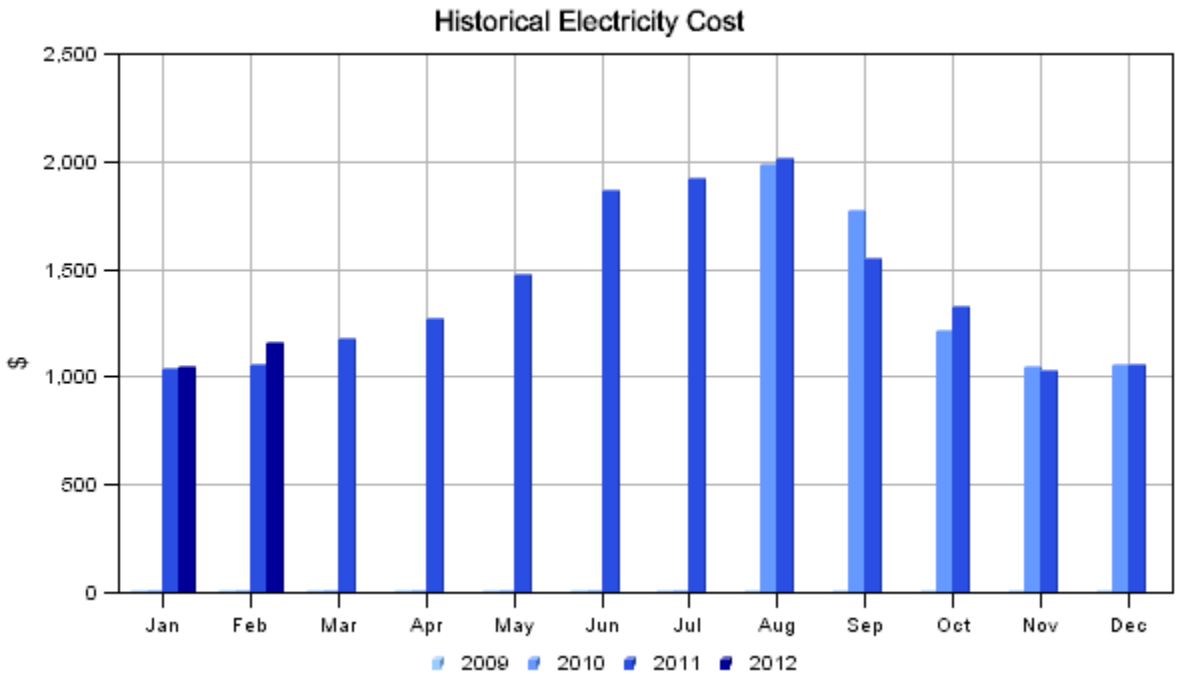
The subject property's total utility costs are allocated between Electrical (87.5%) and Gas (12.5%).

Historical Energy Cost



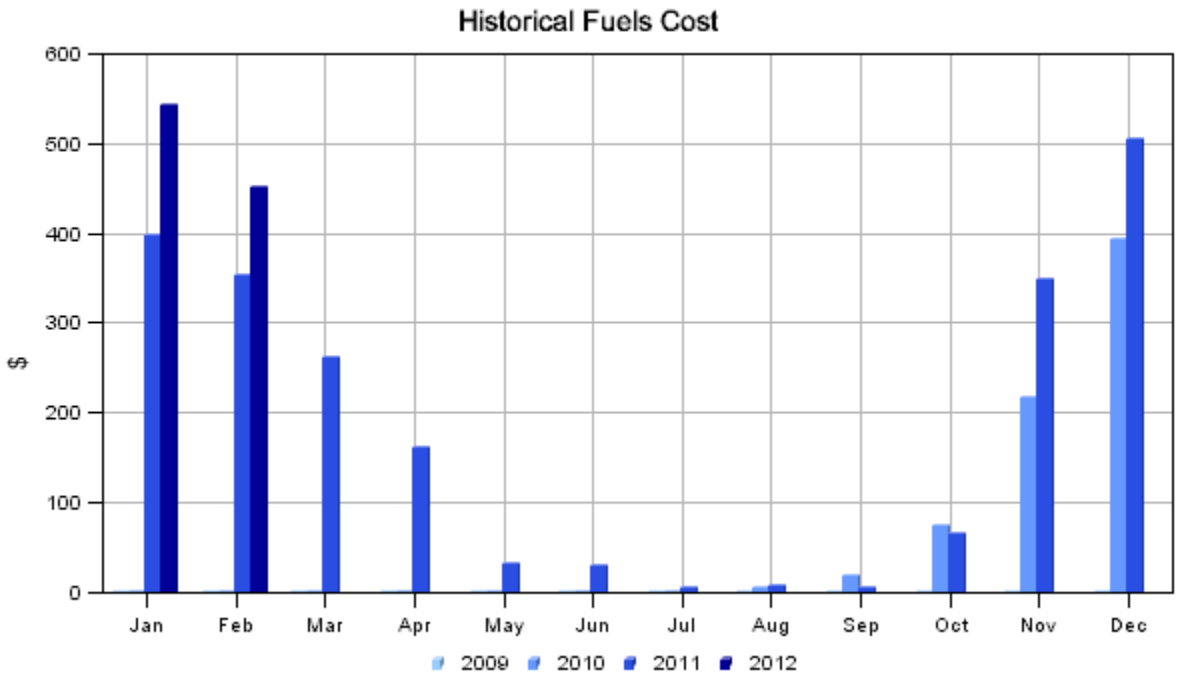
The above chart displays a comparison of total energy (electric and fuels) cost, on a monthly basis, over the specified reporting period from Aug 2010 to Feb 2012.

Historical Electricity Cost



The chart above displays a comparison of electricity cost, on a monthly basis, over the specified reporting period from Aug 2010 to Feb 2012.

Historical Fuels Cost



The chart above displays a comparison of all fuels cost, on a monthly basis, over the specified reporting period from Aug 2010 to Feb 2012.

PEER BUILDING BENCHMARKING - UTILITY COST

To facilitate an industry best practice for benchmarking building energy and sustainability performance, Sustainable Real Estate Solutions, Inc, (SRS) maintains the SRS Peer Building Benchmarking™ database, containing over 120,000 buildings. These buildings, encompassing 15 primary property types and 3.3 billion square feet, consume more than $7.8 billion in annual energy costs and $635 million in annual water/sewer costs. The database is aggregated from multiple private sources, including energy services and property due diligence providers and is current through May 2011.

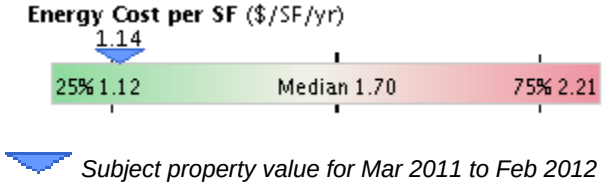
To facilitate benchmarking, the subject property's energy and sustainability performance is compared to its peer group's performance distribution (25th percentile, median, 75th percentile) across multiple geographic areas, i.e., ZIP Code, Core Based Statistical Area (CBSA), State, Climate Region and Nationwide.

For each subject property under review, the Database is queried with reference to the property type and location. The results are summarized in the following charts and descriptions which include a detailed statistical analysis of energy and sustainability key performance indicators.

Energy Cost per SF

Peer Group Comparison Property Type: Office - Medium (10,000-50,000 SF)

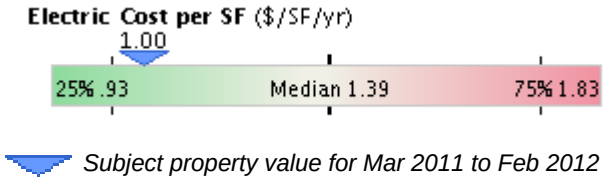
Same Climate Region
(100 peer buildings)



Electric Cost per SF

Peer Group Comparison Property Type: Office - Medium (10,000-50,000 SF)

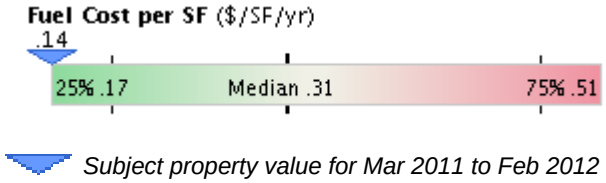
Same Climate Region
(98 peer buildings)



Fuels Cost per SF

Peer Group Comparison Property Type: Office - Medium (10,000-50,000 SF)

Same Climate Region
(82 peer buildings)

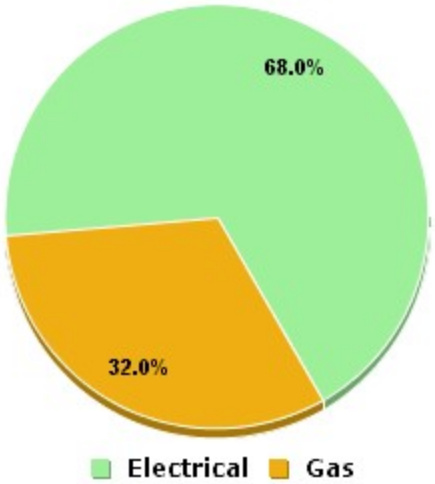


Peer Building Benchmarking - Utility Cost Discussion

The SLCC Gunderson Campus Services Building's total Energy Cost Index (ECI) of $1.14/sf is below the climate region peer-average of $1.70/sf. Its electric-only ECI of $1.00/sf is also lower than the peer-average of $1.39and its gas-only ECI at $0.14/sf is lower than the peer-average of $0.25/sf

ENERGY USE

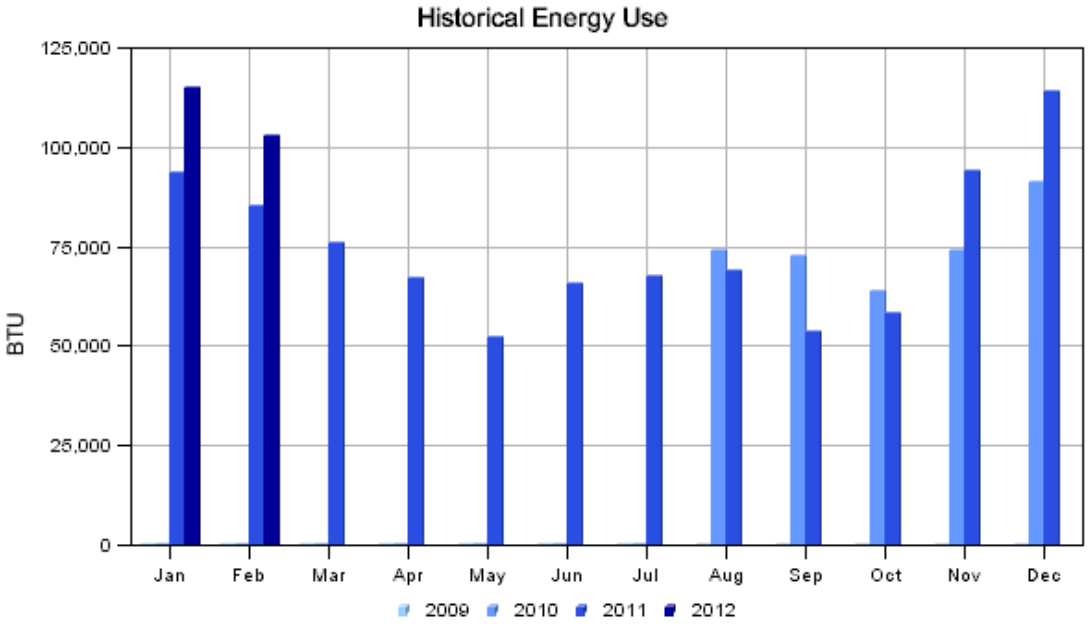
Overall Energy Use



The above chart displays the percentage allocation of energy use by type over the last twelve months of the specified reporting period from Mar 2011 to Feb 2012.

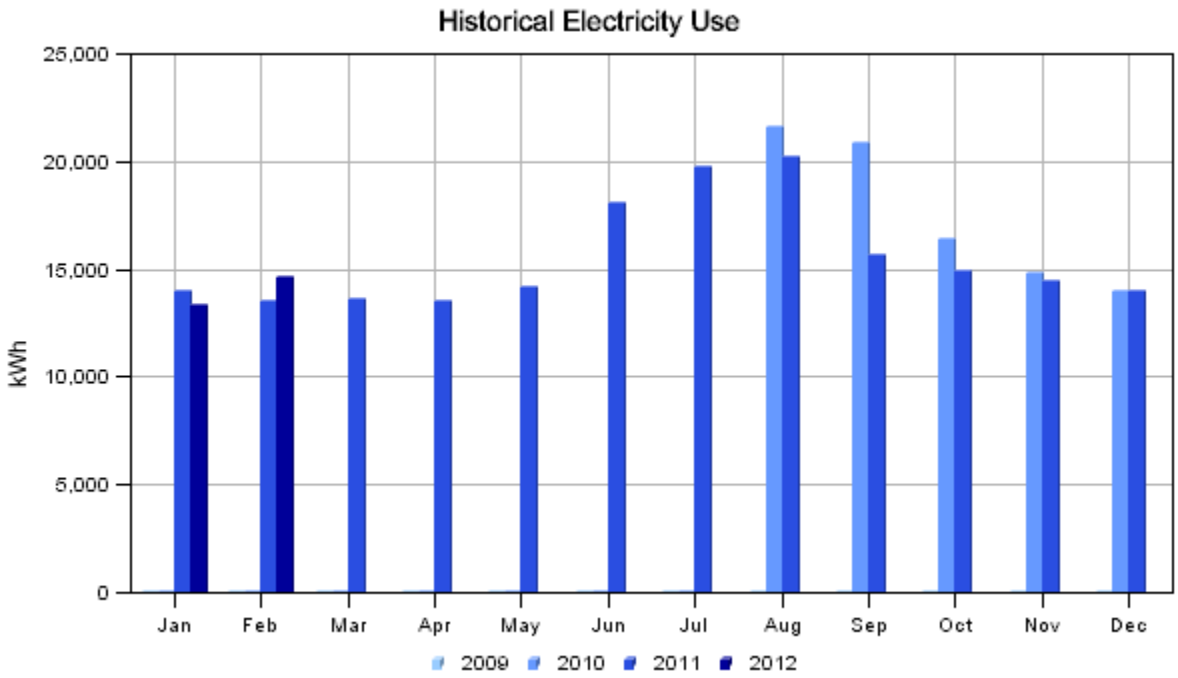
The subject property's energy use is allocated between Electrical (68.0%) and Gas (32.0%).

Historical Energy Use



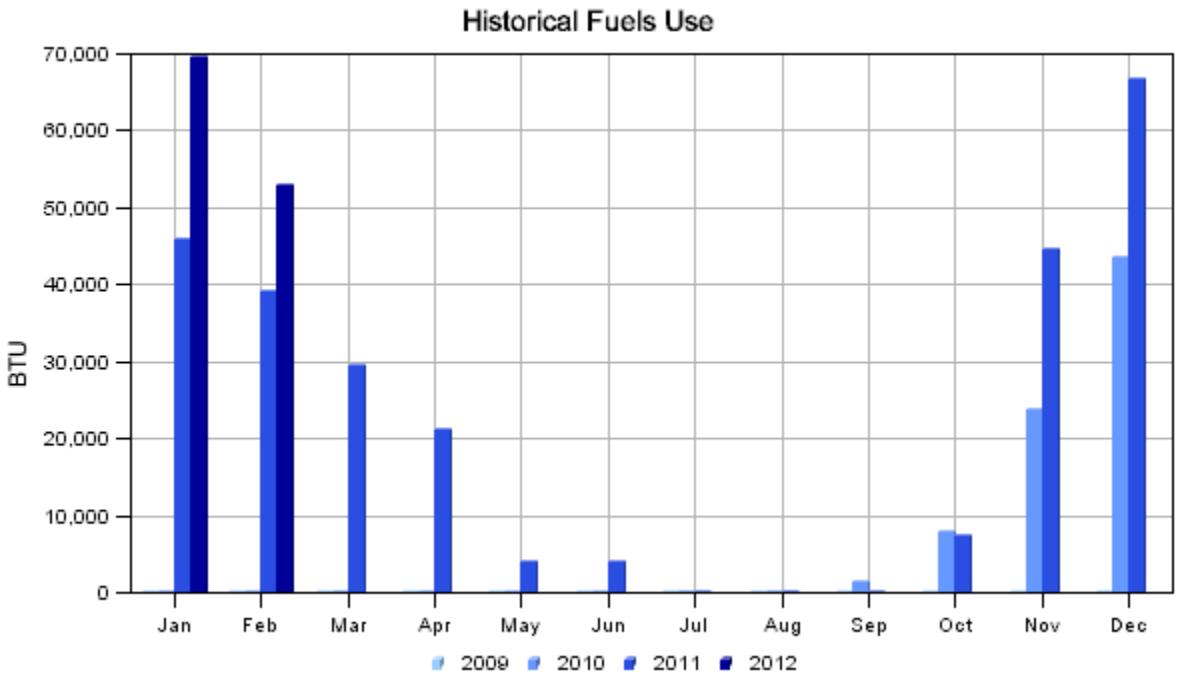
The above chart displays a comparison of total energy (electric and fuels) usage, on a monthly basis, over the specified reporting period from Aug 2010 to Feb 2012.

Historical Electricity Use



The chart above displays a comparison of electricity usage, on a monthly basis, over the specified reporting period from Aug 2010 to Feb 2012.

Historical Fuels Use



The chart above displays a comparison of all fuels usage, on a monthly basis, over the specified reporting period from Aug 2010 to Feb 2012.

PEER BUILDING BENCHMARKING - ENERGY USE INTENSITY

To facilitate an industry best practice for benchmarking building energy and sustainability performance, Sustainable Real Estate Solutions, Inc, (SRS) maintains the SRS Peer Building Benchmarking™ database, containing over 120,000 buildings. These buildings, encompassing 15 primary property types and 3.3 billion square feet, consume more than $7.8 billion in annual energy costs and $635 million in annual water/sewer costs. The database is aggregated from multiple private sources, including energy services and property due diligence providers and is current through May 2011.

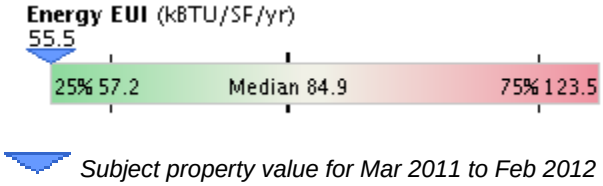
To facilitate benchmarking, the subject property's energy and sustainability performance is compared to its peer group's performance distribution (25th percentile, median, 75th percentile) across multiple geographic areas, i.e., ZIP Code, Core Based Statistical Area (CBSA), State, Climate Region and Nationwide.

For each subject property under review, the Database is queried with reference to the property type and location. The results are summarized in the following charts and descriptions which include a detailed statistical analysis of energy and sustainability key performance indicators.

Energy Use per SF (EUI)

Peer Building Comparison Property Type: Office - Medium (10,000-50,000 SF)

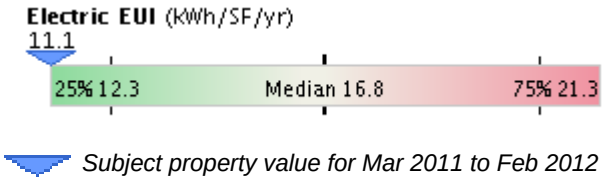
Same Climate Region
(100 peer buildings)



Electricity Use per SF

Peer Group Comparison Property Type: Office - Medium (10,000-50,000 SF)

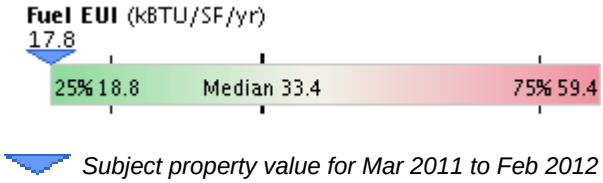
Same Climate Region
(98 peer buildings)



Fuels Use per SF

Peer Group Comparison Property Type: Office - Medium (10,000-50,000 SF)

Same Climate Region
(82 peer buildings)



Peer Building Benchmarking - Energy Use Intensity Discussion

The SLCC Gunderson Campus Services Building's total Energy Utilization Index (EUI) of 55.5 kBtu/sf/yr is well below the peer-average of 84.9 kBtu/sf/yr. Its electric-only EUI at 11.1wh/sf/yr is lower than the peer-ave of 16.8kwh/sf/yr, and its gas-only EUI at 17.8 kBtu/sf/yr is lower than the peer-average of 33.4 kBtu/sf/yr.

PEER BUILDING BENCHMARKING SUMMARY

Peer Building Benchmarking - Utility Cost

Property Type: Office - Medium (10,000-50,000 SF)
Peer Group: Same 3-Digit ZIP Code (8 peer buildings)

Utility Type	Subject Property 12 Months Spend Mar 2011 to Feb 2012	Subject Property Cost per SF ($/SF/yr)	Peer Group Benchmark Median Cost per SF ($/SF/yr)	Subject Property % Better / (Worse) Than Peer Group Median	Subject Property Potential Annual Cost Savings vs Peer Group Median ($/yr)
Electricity	$16,811	$1.00 / SF	$1.47 / SF	**31.9%**	N/A
Fuels	$2,407	$0.14 / SF	$0.26 / SF	**44.9%**	N/A

SRS Peer Building Benchmarking data is current through May 2011.

Peer Building Benchmarking - Energy Use Intensity

Property Type: Office - Medium (10,000-50,000 SF)
Peer Group: Same 3-Digit ZIP Code (8 peer buildings)

Key Performance Metric	Subject Property 12 Months Total Use per SF Mar 2011 to Feb 2012	Peer Group Benchmark Median Use per SF	Subject Property % Better / (Worse) Than Peer Group Median	Subject Property Potential Annual Cost Savings vs Peer Group Median ($/yr)
Electricity Use Intensity	11.05 kWh / SF	18.44 kWh / SF	**40.1%**	N/A
Fuels Use Intensity	17.79 kBTU / SF	29.87 kBTU / SF	**40.5%**	N/A
Energy Use Intensity (EUI)	55.50 kBTU / SF	100.69 kBTU / SF	**44.9%**	N/A

CONCLUSIONS & RECOMMENDATIONS

Electrical usage appears to be in order for this building. Lighting controls are operational. Plug loads may be a source of savings, with occupant training and plug strip use as applicable. HVAC use may be reduced with set points adjustments.

At the time of the visit, the economizers were manually wedged open to overcome a compressor issue on one RTU, and to provide minimum outside air on the other RTU. We recommend evaluating the dampers for potential damage and verifying that these manual methods are replaced with automatic methods if possible. This building's occupancy appeared low relative to its size, given the conference rooms. CO2 based demand controlled ventilation for the two RTUs should therefore be considered.

Gas usage in buildings of this nature are dominated by envelope u-value conductive/radiation loss and by outside air introduction, whether via infiltration, exfiltration, or ventilation. Little can be done about the envelope resistance at this point, and the building appears to conform to standard practices and applicable code in that regard. Given the relatively low gas usage cost, envelope leakage tests are the only suggestion. Depending on the results, smoke testing and/or envelope sealing may be in order.

BENCHMARKING & DISCLOSURE REPORT

SUBJECT PROPERTY:

Property Name: Salt Lake Multi Agency

Property Address: 195 N 1950 West
Salt Lake City, UT
84116

Property Type: Office - Large (>50,000 SF)

Gross Square Footage (SF): 142,314 SF

PROJECT NAME:
Utah DFCM Review

PROJECT PROPERTY:
Salt Lake Multi Agency

REPORT DATE:
May 09, 2012

PREPARED FOR:
John Burningham
State of Utah DFCM - 450 North State Street - Salt Lake City, Ut 84114

PREPARED BY:
ETC Group, LLC - 1997 South 1100 East - Suite 201 - Salt Lake City, UT 84106

ETC Group
ENERGY ENGINEERING FOR A SUSTAINABLE FUTURE ™

EXECUTIVE SUMMARY

Introduction

ETC Group, under contract with the State of Utah DFCM, after a high level review of 29 DFCM owned buildings, has selected 6 facilities of various sizes and uses to inform possible changes to the State High Performance Building Standard. The Multi-Agency building was selected and analyzed as part of this study. This repo documents the building's energy consumption and its relative performance to similar buildings in the region. Also identified are building-specific energy efficiency measures.

On overview, this building already performs well with an energy utilization index 20% lower than average; further improvement efforts should be focused on:

1. Building leakage minimization
2. Re-commissioning focusing on:
    1. Boiler temperature reset control sequence
    2. Review of and improvements to supply fan pressure reset
    3. VAV Box minimum airflow review, with possible reductions
    4. Reheat savings
3. User training to reduce plug loads

Peer Building Benchmarking

Peer Building Benchmarking - Utility Cost

Property Type: Office - Large (>50,000 SF)
Peer Group: Same 3-Digit ZIP Code (6 peer buildings)

Utility Type	Subject Property 12 Months Spend Jan 2011 to Dec 2011	Subject Property Cost per SF ($/SF/yr)	Peer Group Benchmark Median Cost per SF ($/SF/yr)	Subject Property % Better / (Worse) Than Peer Group Median	Subject Property Potential Annual Cost Savings vs Peer Group Median ($/yr)
Electricity	$69,872	$0.49 / SF	$1.90 / SF	**74.2%**	N/A
Fuels	$22,670	$0.16 / SF	$0.32 / SF	**50.2%**	N/A

SRS Peer Building Benchmarking data is current through May 2011.

Peer Building Benchmarking - Energy Use Intensity

Property Type: Office - Large (>50,000 SF)

Peer Group: Same 3-Digit ZIP Code (6 peer buildings)

Key Performance Metric	Subject Property 12 Months Total Use per SF Jan 2011 to Dec 2011	Peer Group Benchmark Median Use per SF	Subject Property % Better / (Worse) Than Peer Group Median	Subject Property Potential Annual Cost Savings vs Peer Group Median ($/yr)
Electricity Use Intensity	14.29 kWh / SF	26.62 kWh / SF	**46.3%**	N/A
Fuels Use Intensity	26.39 kBTU / SF	33.24 kBTU / SF	**20.6%**	N/A
Energy Use Intensity (EUI)	75.16 kBTU / SF	118.75 kBTU / SF	**36.7%**	N/A

SRS Peer Building Benchmarking data is current through May 2011.

SUBJECT PROPERTY PROFILE

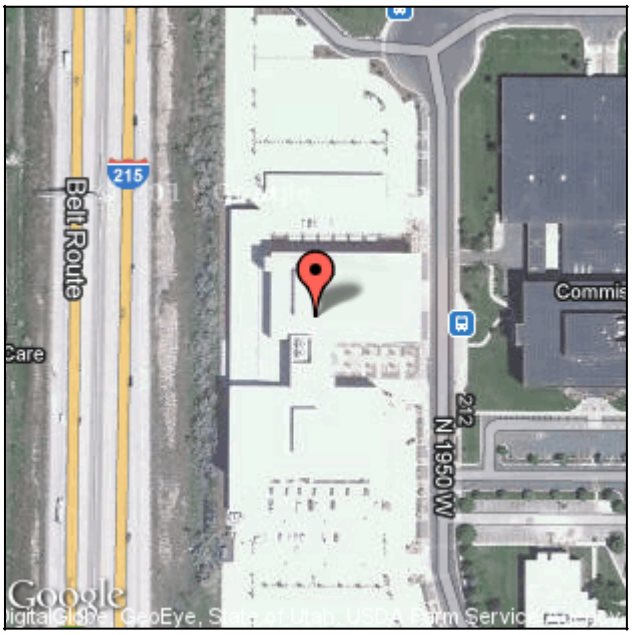
Property Name:	Salt Lake Multi Agency
Property Address:	195 N 1950 West Salt Lake City, UT 84116
Property Type:	Office - Large (>50,000 SF)
Gross Square Footage (SF):	142,314 SF
Reporting Period:	Jan 2011 to Dec 2011

Property Location

The maps below display the subject property location.

Street Map

Aerial Map



Utility Account Summary

Subject Property Utilities		
Utility Account	**Utility Type**	**Specified Reporting Period**
Questar Gas GS	Gas	01/2011 - 12/2011
Rocky Mountain Power Rate 6	Electrical	01/2011 - 12/2011

Subject Property Profile Discussion

The Multi-Agency State Office Building is a 265,000 square foot office building at 195 North 1950 West in Salt Lake City. It houses the Utah Department of Human Services and the Environmental Quality. Each Department occupies a four story wing, with a shared entrance and a common gathering space between them. Its mechanical systems include an IDEC system with direct and indirect cooling, boilers and chillers etc. There is a Building Information System but it is not utilized effectively.

ENERGY STAR RATING

The ENERGY STAR national energy efficiency performance rating is a benchmark that helps building stakeholders assess how efficiently their buildings consume energy, relative to similar buildings nationwide. The rating system's 1-100 scale allows a relatively quick determination to understand how a building is performing. A rating of 50 indicates average building energy performance while a rating of 75 or better indicates top 25th percentile performance and building's achieving this level are eligible to earn an ENERGY STAR label.

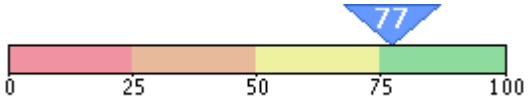
ENERGY STAR's benchmarking scale is based upon comparison with the U.S. Energy Information Administration's (EIA) Commercial Building Energy Consumption Survey (CBECS) data (current through December 2003) for existing commercial building stock, including approximately 5,200 buildings nationwide across 15 property types.

The below charts display the ENERGY STAR rating for the subject property.

ENERGY STAR Rating

Property Type: Office (>5,000 SF)

Peer Group: Nationwide (498 peer buildings)

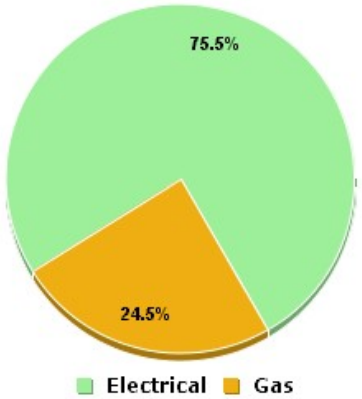


Commercial Building Energy Consumption Survey (CBECS) data is current through December 2003.

The subject property's most recent Energy Star rating of 77, received in December 2011, is 27 points above the national average and 2 points above the threshold rating of 75 needed to earn an Energy Star label.

UTILITY COST

Overall Utility Cost



The above chart displays the percentage allocation of utility costs over the last twelve months of the specified reporting period from Jan 2011 to Dec 2011.

The subject property's total utility costs are allocated between Electrical (75.5%) and Gas (24.5%).

PEER BUILDING BENCHMARKING - UTILITY COST

To facilitate an industry best practice for benchmarking building energy and sustainability performance, Sustainable Real Estate Solutions, Inc, (SRS) maintains the SRS Peer Building Benchmarking™ database, containing over 120,000 buildings. These buildings, encompassing 15 primary property types and 3.3 billion square feet, consume more than $7.8 billion in annual energy costs and $635 million in annual water/sewer costs. The database is aggregated from multiple private sources, including energy services and property due diligence providers and is current through May 2011.

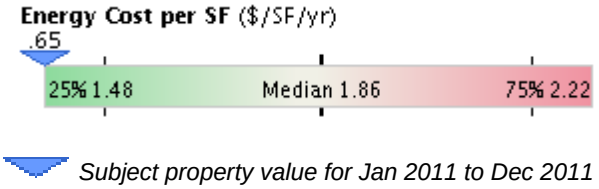
To facilitate benchmarking, the subject property's energy and sustainability performance is compared to its peer group's performance distribution (25th percentile, median, 75th percentile) across multiple geographic areas, i.e., ZIP Code, Core Based Statistical Area (CBSA), State, Climate Region and Nationwide.

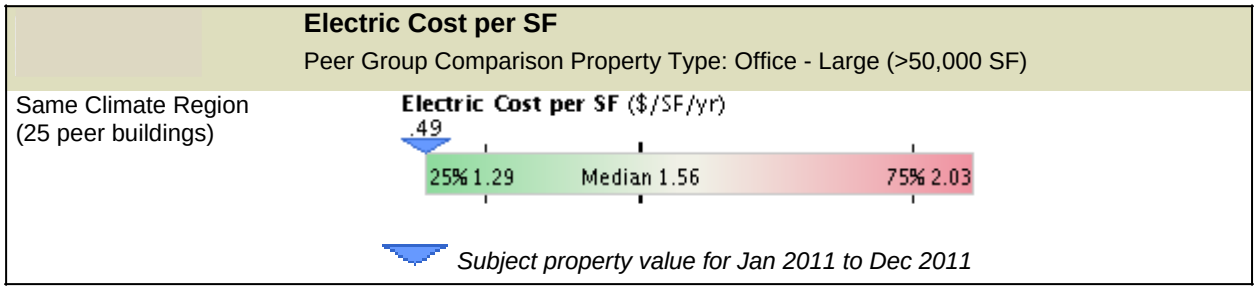
For each subject property under review, the Database is queried with reference to the property type and location. The results are summarized in the following charts and descriptions which include a detailed statistical analysis of energy and sustainability key performance indicators.

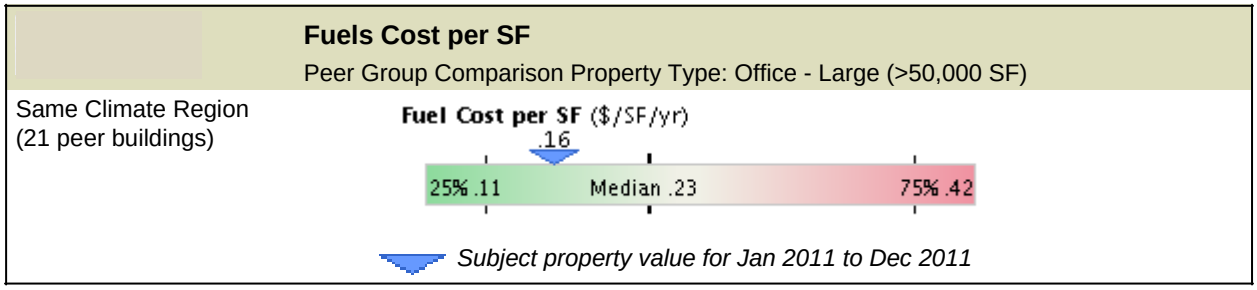
Energy Cost per SF

Peer Group Comparison Property Type: Office - Large (>50,000 SF)

Same Climate Region
(25 peer buildings)





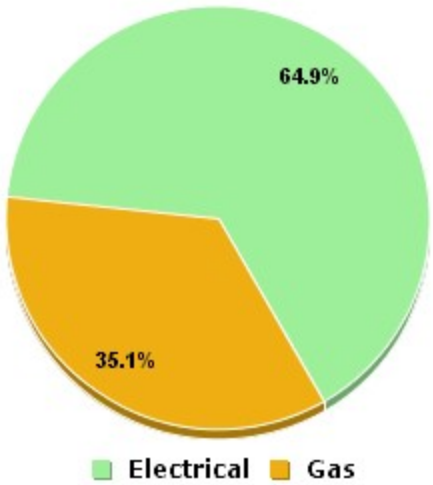


Peer Building Benchmarking - Utility Cost Discussion

The Salt Lake Multi-Agency Building's total Energy Cost Index (ECI) of $0.65/sf is well below the climate regio peer-average of $1.86/sf. Its electric-only ECI of $0.49/sf is also lower than the peer-average of $1.56, a gas-only ECI at $0.16/sf is lower than the peer-average of $0.23/sf.

ENERGY USE

Overall Energy Use

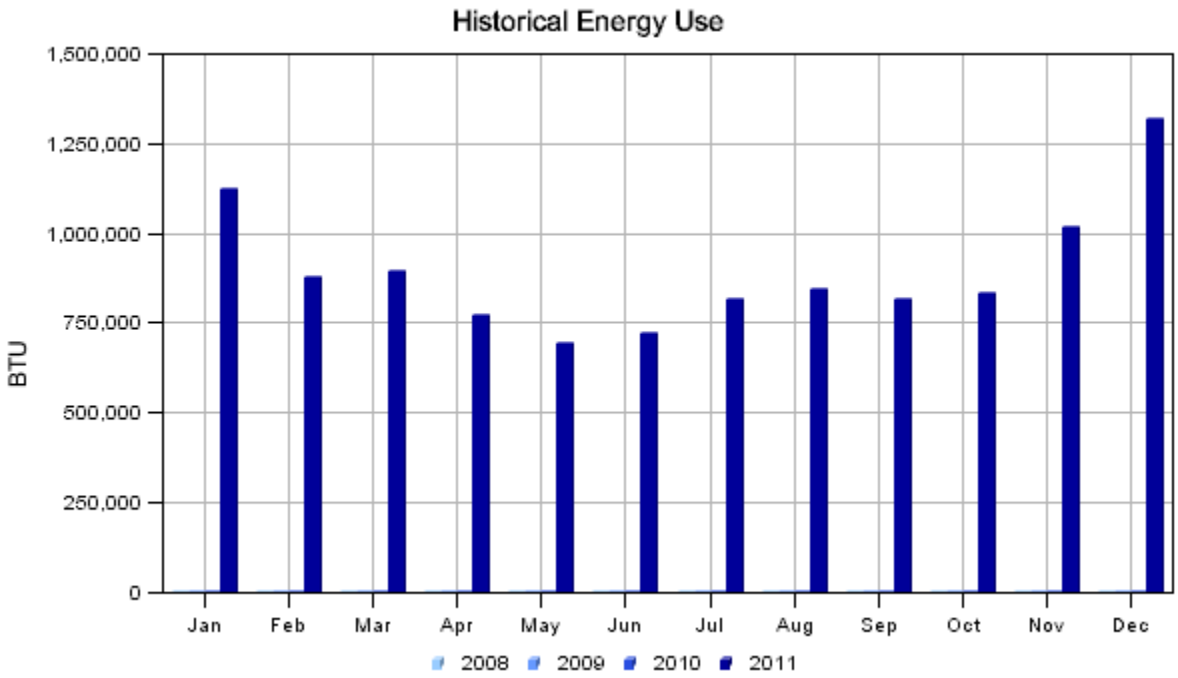


The above chart displays the percentage allocation of energy use by type over the last

twelve months of the specified reporting period from Jan 2011 to Dec 2011.

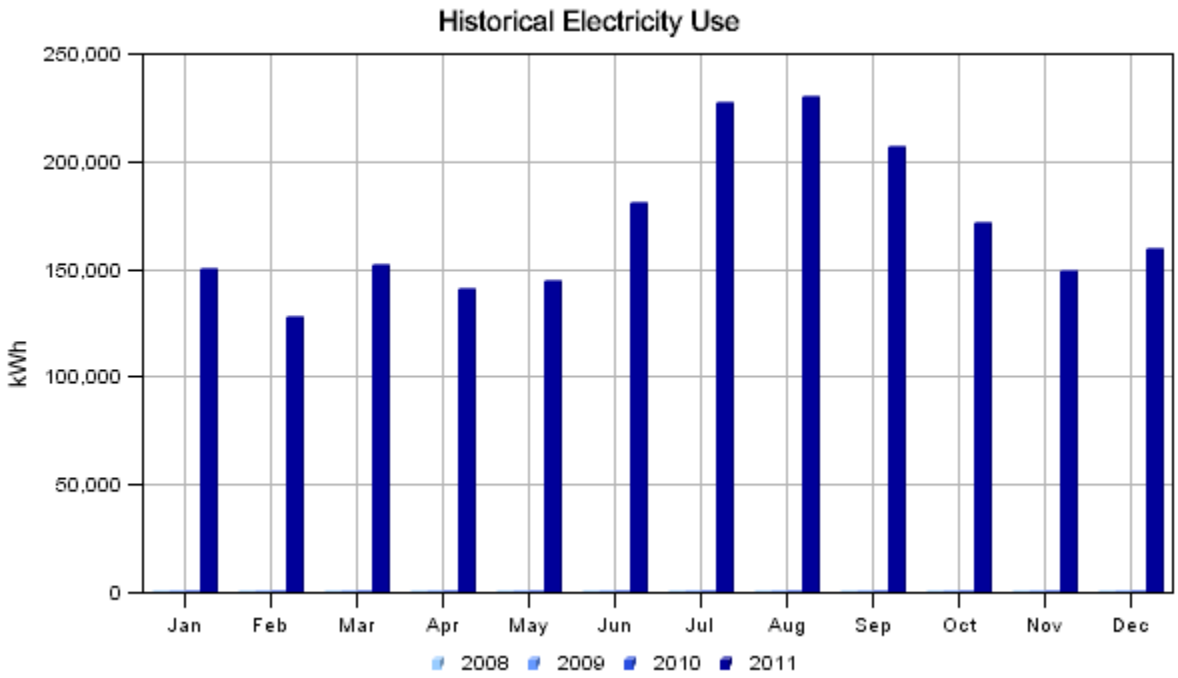
The subject property's energy use is allocated between Electrical (64.9%) and Gas (35.1%).

Historical Energy Use



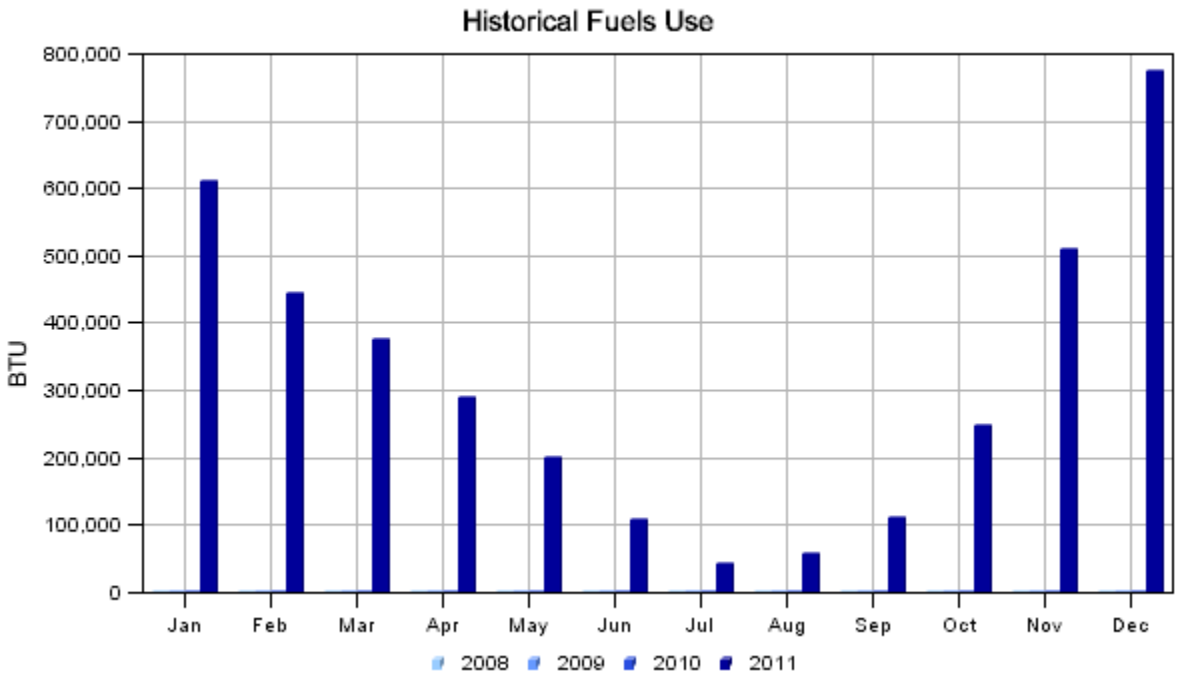
The above chart displays a comparison of total energy (electric and fuels) usage, on a monthly basis, over the specified reporting period from Jan 2011 to Dec 2011.

Historical Electricity Use



The chart above displays a comparison of electricity usage, on a monthly basis, over the specified reporting period from Jan 2011 to Dec 2011.

Historical Fuels Use



The chart above displays a comparison of all fuels usage, on a monthly basis, over the specified reporting period from Jan 2011 to Dec 2011.

PEER BUILDING BENCHMARKING - ENERGY USE INTENSITY

To facilitate an industry best practice for benchmarking building energy and sustainability performance, Sustainable Real Estate Solutions, Inc, (SRS) maintains the SRS Peer Building Benchmarking™ database, containing over 120,000 buildings. These buildings, encompassing 15 primary property types and 3.3 billion square feet, consume more than $7.8 billion in annual energy costs and $635 million in annual water/sewer costs. The database is aggregated from multiple private sources, including energy services and property due diligence providers and is current through May 2011.

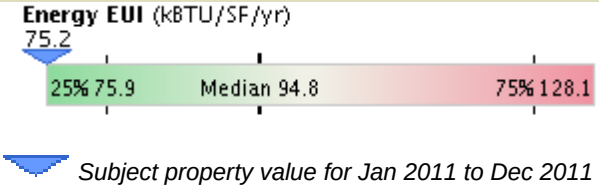
To facilitate benchmarking, the subject property's energy and sustainability performance is compared to its peer group's performance distribution (25th percentile, median, 75th percentile) across multiple geographic areas, i.e., ZIP Code, Core Based Statistical Area (CBSA), State, Climate Region and Nationwide.

For each subject property under review, the Database is queried with reference to the property type and location. The results are summarized in the following charts and descriptions which include a detailed statistical analysis of energy and sustainability key performance indicators.

Energy Use per SF (EUI)

Peer Building Comparison Property Type: Office - Large (>50,000 SF)

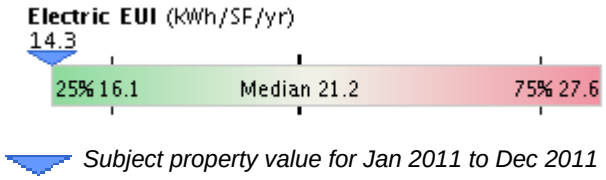
Same Climate Region
(25 peer buildings)



Electricity Use per SF

Peer Group Comparison Property Type: Office - Large (>50,000 SF)

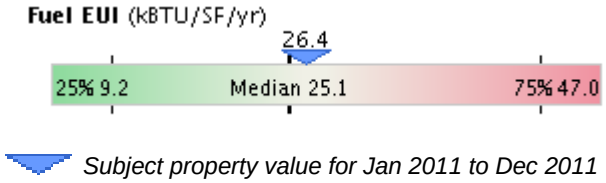
Same Climate Region
(25 peer buildings)



Fuels Use per SF

Peer Group Comparison Property Type: Office - Large (>50,000 SF)

Same Climate Region
(21 peer buildings)



Peer Building Benchmarking - Energy Use Intensity Discussion

The Salt Lake Multi-Agency Building's total Energy Utilization Index (EUI) of 75.2 kBtu/sf/yr is below the peer- average of 94.8 kBtu/sf/yr. Its electric-only EUI at 14.3 kwh/sf/yr is lower than the peer-average of 21.2 k yr, and its gas-only EUI at 26.4 kBtu/sf/yr is above the peer-average of 25.1 kBtu/sf/yr.

PEER BUILDING BENCHMARKING SUMMARY

Peer Building Benchmarking - Utility Cost

Property Type: Office - Large (>50,000 SF)
Peer Group: Same 3-Digit ZIP Code (6 peer buildings)

Utility Type	Subject Property 12 Months Spend Jan 2011 to Dec 2011	Subject Property Cost per SF ($/SF/yr)	Peer Group Benchmark Median Cost per SF ($/SF/yr)	Subject Property % Better / (Worse) Than Peer Group Median	Subject Property Potential Annual Cost Savings vs Peer Group Median ($/yr)
Electricity	$69,872	$0.49 / SF	$1.90 / SF	**74.2%**	N/A
Fuels	$22,670	$0.16 / SF	$0.32 / SF	**50.2%**	N/A
Water/Sewer	$0	$0.00 / SF	$0.18 / SF	**100.0%**	N/A

SRS Peer Building Benchmarking data is current through May 2011.

Peer Building Benchmarking - Energy Use Intensity

Property Type: Office - Large (>50,000 SF)
Peer Group: Same 3-Digit ZIP Code (6 peer buildings)

Key Performance Metric	Subject Property 12 Months Total Use per SF Jan 2011 to Dec 2011	Peer Group Benchmark Median Use per SF	Subject Property % Better / (Worse) Than Peer Group Median	Subject Property Potential Annual Cost Savings vs Peer Group Median ($/yr)
Electricity Use Intensity	14.29 kWh / SF	26.62 kWh / SF	**46.3%**	N/A
Fuels Use Intensity	26.39 kBTU / SF	33.24 kBTU / SF	**20.6%**	N/A
Energy Use Intensity (EUI)	75.16 kBTU / SF	118.75 kBTU / SF	**36.7%**	N/A
Water/Sewer Use Intensity	.00 gal / SF	50.00 gal / SF	**100.0%**	N/A

SRS Peer Building Benchmarking data is current through May 2011.

CONCLUSIONS & RECOMMENDATIONS

Energy usage is lower than the peer average, but there is room for improvement – more for gas usage then electric usage based on the peer comparison. Lighting controls are operational; further review of scheduling may still yield savings. Lighting controls appear to be operational. Plug loads may be a source of savings, with occupant training and plug strip use as applicable.

HVAC loads in buildings of this nature are heavily influenced by interior loads, the reduction of which is discussed above. Beyond interior loads, envelope u-value (conductive/radiation loss) and outside air introduction are the biggest loads. Little can be done about the envelope

resistance at this point, and the building appears to conform to standard practices and applicable code in that regard. We therefore recommend investigation into the sources of outside air in the following way:

1. For ventilation (outside air forced by the dedicated ventilation unit and/or exhaust fans):
    1. Validate the appropriate airflows exist at exhaust fans and at the ventilation units. These are subject to test and balance error and/or drift or defeat.
    2. Validate the sequences of operation. For all fans, visually check operation against DDC system graphics and control point outputs. Log time of day to validate scheduling. We suggest turning off outside air after normal hours and outside of useful economizer hours. While there may be occupants, the drastically fewer occupants are unlikely to raise CO2 levels above acceptable limits.
2. For infiltration (outside air forced by wind and temperature):
    1. Perform envelope leakage tests. Depending on the results, smoke testing and/or envelope sealing may be in order.
    2. According to FM staff, many windows leak extensively, and some efforts to caulk them have been made. This lends some urgency to envelope seal testing.
    3. According to FM staff, the “street” interior common space’s skylights are a maintenance issue for leakage. We recommend a review of both the product and its sealing methods.
3. The Commissioning report graphs show boiler supply set point being maintained at roughly 130°F for extended periods of time through periods where outside air temperature is well below 20 °F. However, on the site visit the same boiler supply set point was at 150 °F. Due to the nature of condensing boilers, the lower temperature should yield roughly 4% savings as long as the spaces are satisfied. We therefore recommend both reducing the boiler temperature set point and considering an open loop reset schedule or a closed loop feedback reset to achieve maximum savings; both measures are low-cost programming and verification exercises.
4. Fan energy is a very large component of the energy use of a building with IDEC and efforts to reduce it should be primary. The commissioning report showed a relatively constant maximum damper position (poll of all VAV boxes) for AHU-1, and yet a nearly constant static pressure set point. We recommend determining which VAV box(es) dominate this system, and if their pressure needs can be reduced. AHU-2’s maximum damper position was not available; however, the trends show a lack of overnight shut-down and limited reset. We recommend programming changes to achieve overnight shut-down and more aggressive pressure set-point reset.
5. The design intent was for occupancy controls to shut down both lighting and VAV boxes where possible. We recommend verifying (or adding as needed) this occupancy-based VAV box control all over the building including the build-out side.
6. VAV Box operation is a key driver of energy in reducing simultaneous heating and cooling as well as reducing fan energy. For a building of this size, periodic sample-based re-commissioning is advisable. The commissioning report graphs we saw did not include box airflow or damper position; this should be a part of future efforts as CFM drives essentially every other demand for each box

BENCHMARKING & DISCLOSURE REPORT

SUBJECT PROPERTY:

Property Name: Unified Lab

Property Address: 4501 South 2700 West
Salt Lake City, UT
84123

Property Type: Hospital (General Medical and Surgical)

Gross Square Footage (SF): 72,055 SF

PROJECT NAME:
Utah DFCM Review

PROJECT PROPERTY:
Unified Lab

REPORT DATE:
May 09, 2012

PREPARED FOR:
John Burningham
State of Utah DFCM - 450 North State Street - Salt Lake City, Ut 84114

PREPARED BY:
ETC Group, LLC - 1997 South 1100 East - Suite 201 - Salt Lake City, UT 84106

ETC Group
ENERGY ENGINEERING FOR A SUSTAINABLE FUTURE ™

EXECUTIVE SUMMARY

Introduction

ETC Group, under contract with the State of Utah DFCM, after a high level review of 29 DFCM owned buildings, has selected 6 facilities of various sizes and uses to inform possible changes to the State High Performance Building Standard. The Unified Lab was selected and analyzed as part of this study. This report document building's energy consumption and its relative performance to similar buildings in the region. It also identifies building-specific energy efficiency measures.

On overview, this building has room for improvement based on observed improvement potential (not on peer comparison as with other buildings). Further improvement efforts should be focused on:

1. User training to reduce plug loads, and improvements to plug load power supplies and controls
2. Reduce airflows where safe and appropriate, automatically if possible
3. Review of and improvements to supply fan pressure reset
4. Investigate the applicability of combined heat and power

Peer Building Benchmarking

Peer Building Benchmarking - Utility Cost

Property Type: Hospital (General Medical and Surgical)
Peer Group: Same Climate Region (20 peer buildings)

Utility Type	Subject Property 12 Months Spend Jan 2011 to Dec 2011	Subject Property Cost per SF ($/SF/yr)	Peer Group Benchmark Median Cost per SF ($/SF/yr)	Subject Property % Better / (Worse) Than Peer Group Median	Subject Property Potential Annual Cost Savings vs Peer Group Median ($/yr)
Electricity	$144,750	$2.01 / SF	$1.00 / SF	**(100.9%)**	$72,695
Fuels	$67,707	$0.94 / SF	$0.46 / SF	**(104.3%)**	$34,561

SRS Peer Building Benchmarking data is current through May 2011.

As compared to its peer buildings median annual electricity cost per square foot, the electricity cost at the subject property is $1.01 / SF more than its peer group. If the performance of the subject property was improved to meet the median electricity performance of its peer group, the subject property has the potential to reduce its annual electricity cost by $72,695.

As compared to its peer buildings median annual fuels cost per square foot, the fuels cost at the subject property is $0.48 / SF more than its peer group. If the performance of the subject property was improved to meet the median fuels performance of its peer group, the subject property has the potential to reduce its annual fuels cost by $34,561.

Peer Building Benchmarking - Energy Use Intensity

Property Type: Hospital (General Medical and Surgical)
Peer Group: Same Climate Region (20 peer buildings)

Key Performance Metric	Subject Property 12 Months Total Use per SF Jan 2011 to Dec 2011	Peer Group Benchmark Median Use per SF	Subject Property % Better / (Worse) Than Peer Group Median	Subject Property Potential Annual Cost Savings vs Peer Group Median ($/yr)
Electricity Use Intensity	58.48 kWh / SF	10.55 kWh / SF	**(454.3%)**	$118,638
Fuels Use Intensity	178.64 kBTU / SF	44.89 kBTU / SF	**(298.0%)**	$50,693
Energy Use Intensity (EUI)	378.18 kBTU / SF	77.03 kBTU / SF	**(391.0%)**	$169,182

SRS Peer Building Benchmarking data is current through May 2011.

As compared to its peer buildings median annual electricity use per square foot, the electricity use at the subject property is 47.93 kWh / SF more than its peer group. If the performance of the subject property was improved to meet the median electricity performance of its peer group, the subject property has the potential to reduce its annual electricity cost by $118,638.

As compared to its peer buildings median annual fuels use per square foot, the fuels use at the subject property is 133.75 kWh / SF more than its peer group. If the performance of the subject property was improved to meet the median fuels performance of its peer group, the subject property has the potential to reduce its annual fuels cost by $50,693.

As compared to its peer buildings median annual energy use per square foot, the energy use at the subject property is 301.15 kWh / SF more than its peer group. If the performance of the subject property was improved to meet the median energy performance of its peer group, the subject property has the potential to reduce its annual energy cost by $169,182.

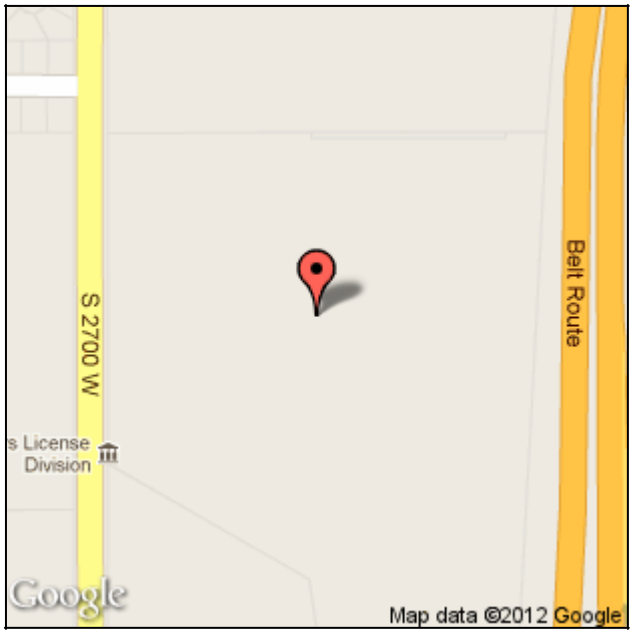
SUBJECT PROPERTY PROFILE

Property Name:	Unified Lab
Property Address:	4501 South 2700 West Salt Lake City, UT 84123
Property Type:	Hospital (General Medical and Surgical)
Gross Square Footage (SF):	72,055 SF
Reporting Period:	Jan 2010 to Dec 2011

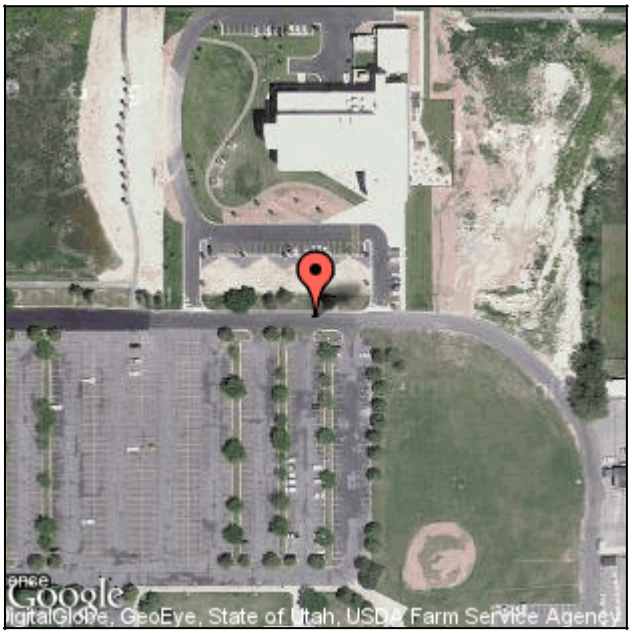
Property Location

The maps below display the subject property location.

Street Map



Aerial Map



Utility Account Summary

Subject Property Utilities		
Utility Account	**Utility Type**	**Specified Reporting Period**
Questar GS rate FS	Gas	01/2010 - 12/2011
Rocky Mountain Power Elec Rate 6	Electrical	01/2010 - 12/2011

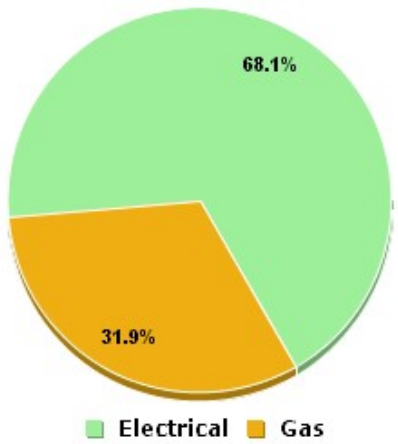
Subject Property Profile Discussion

The Unified Lab Building is a three story, 78000 square foot building. The building was designed to be a High performance building. The HVAC system includes AHUs, Boilers,

Chillers, and VAV boxes etc. There are labs and office space. The labs consist of a variety of Utah Department of Health labs. The hoods in the labs were working properly when checked during the visit but they were all left open. There are solar arrays around the building.

UTILITY COST

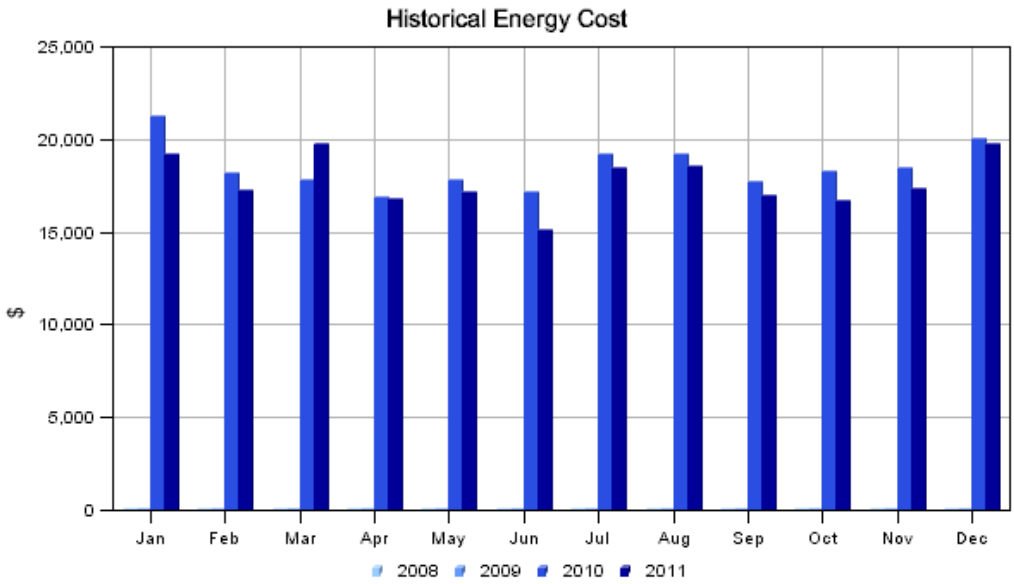
Overall Utility Cost



The above chart displays the percentage allocation of utility costs over the last twelve months of the specified reporting period from Jan 2011 to Dec 2011.

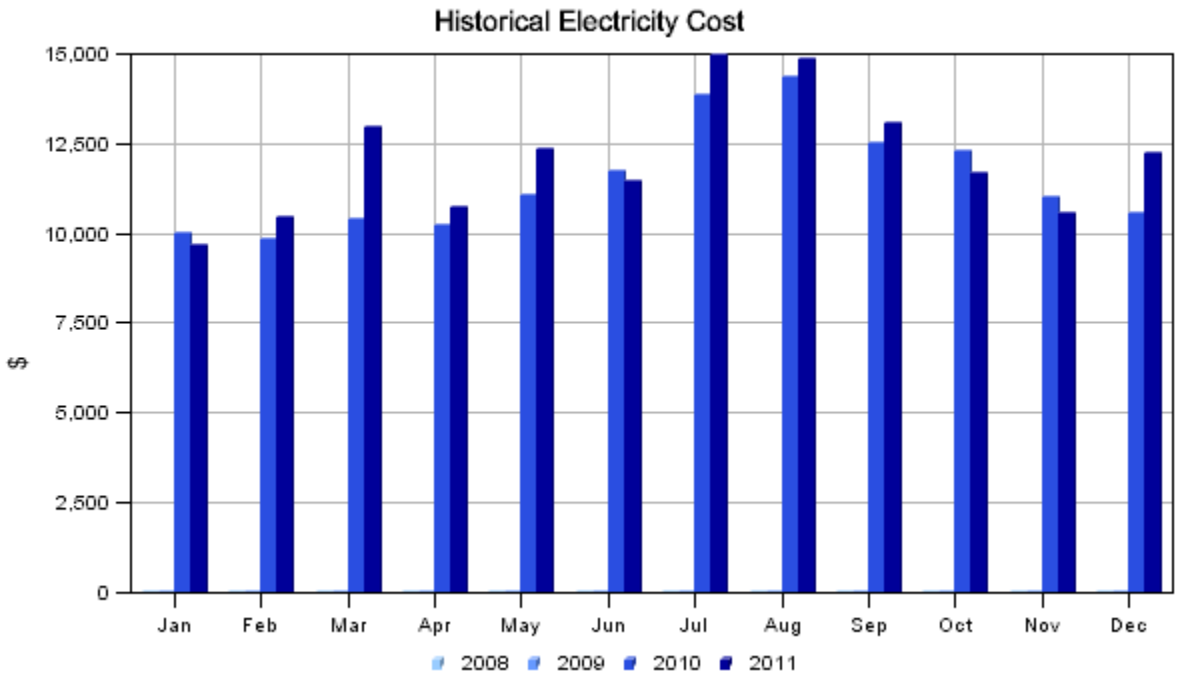
The subject property's total utility costs are allocated between Electrical (68.1%) and Gas (31.9%).

Historical Energy Cost



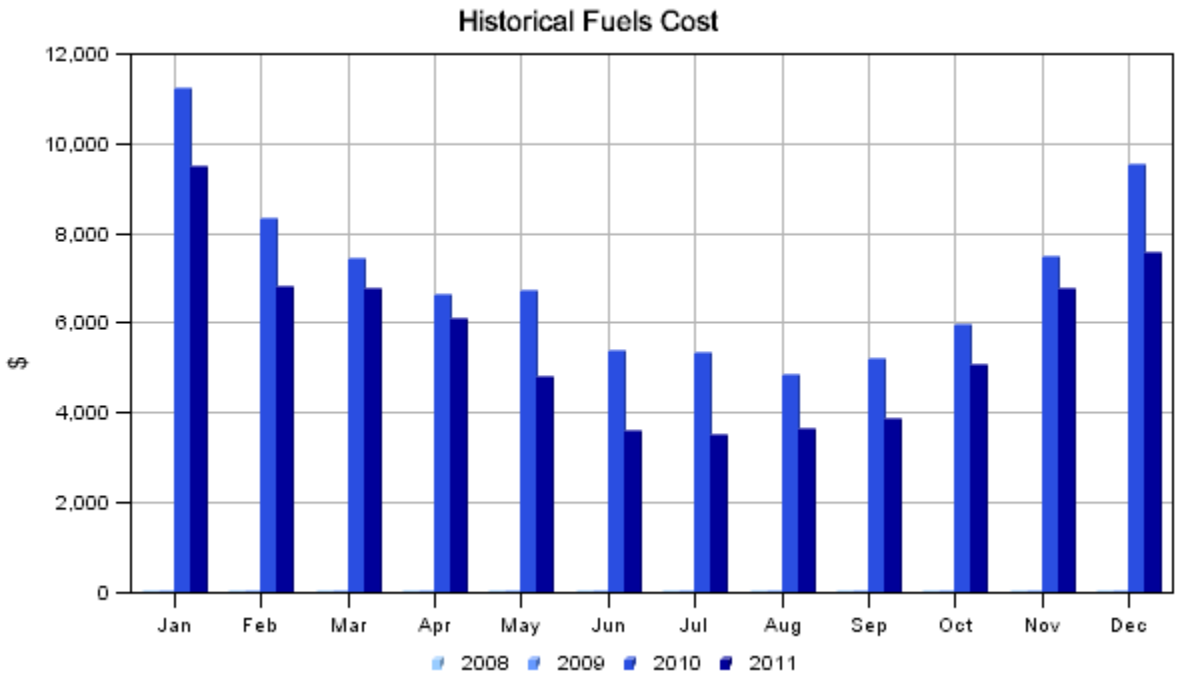
The above chart displays a comparison of total energy (electric and fuels) cost, on a monthly basis, over the specified reporting period from Jan 2010 to Dec 2011.

Historical Electricity Cost



The chart above displays a comparison of electricity cost, on a monthly basis, over the specified reporting period from Jan 2010 to Dec 2011.

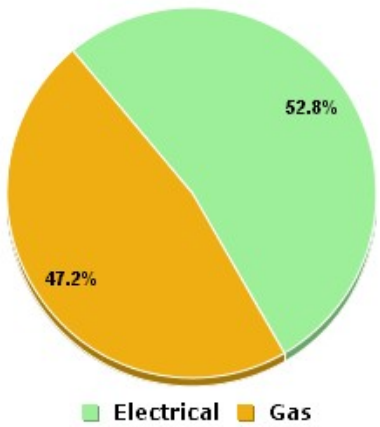
Historical Fuels Cost



The chart above displays a comparison of all fuels cost, on a monthly basis, over the specified reporting period from Jan 2010 to Dec 2011.

ENERGY USE

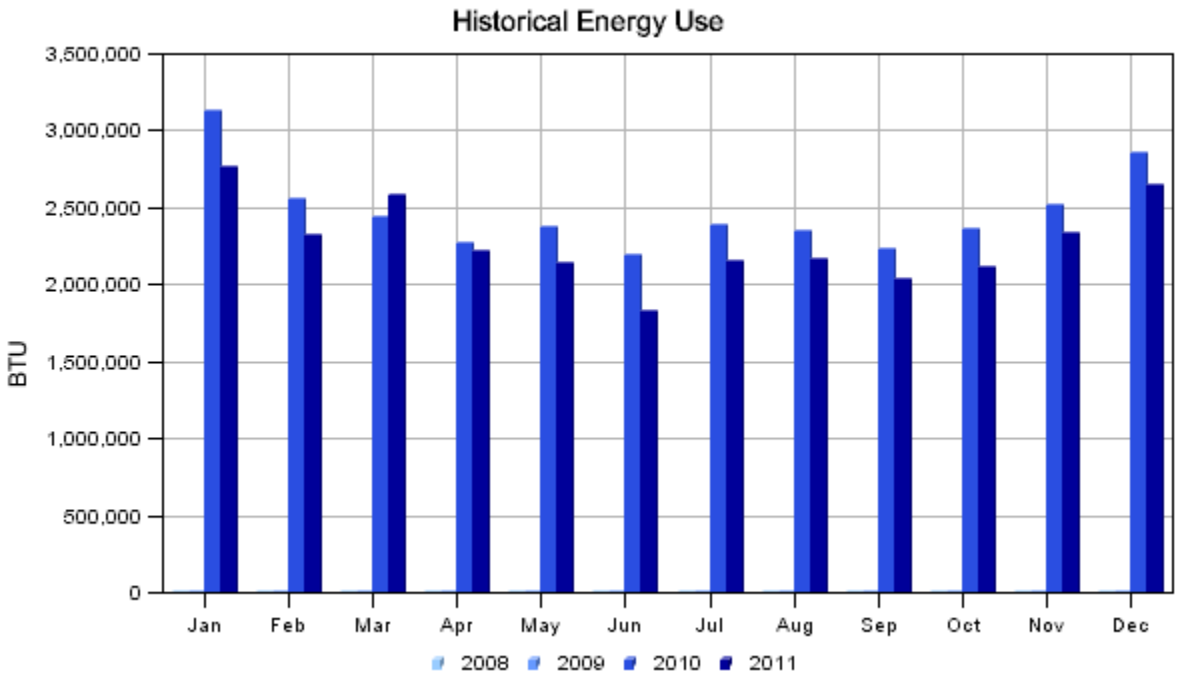
Overall Energy Use



The above chart displays the percentage allocation of energy use by type over the last twelve months of the specified reporting period from Jan 2011 to Dec 2011.

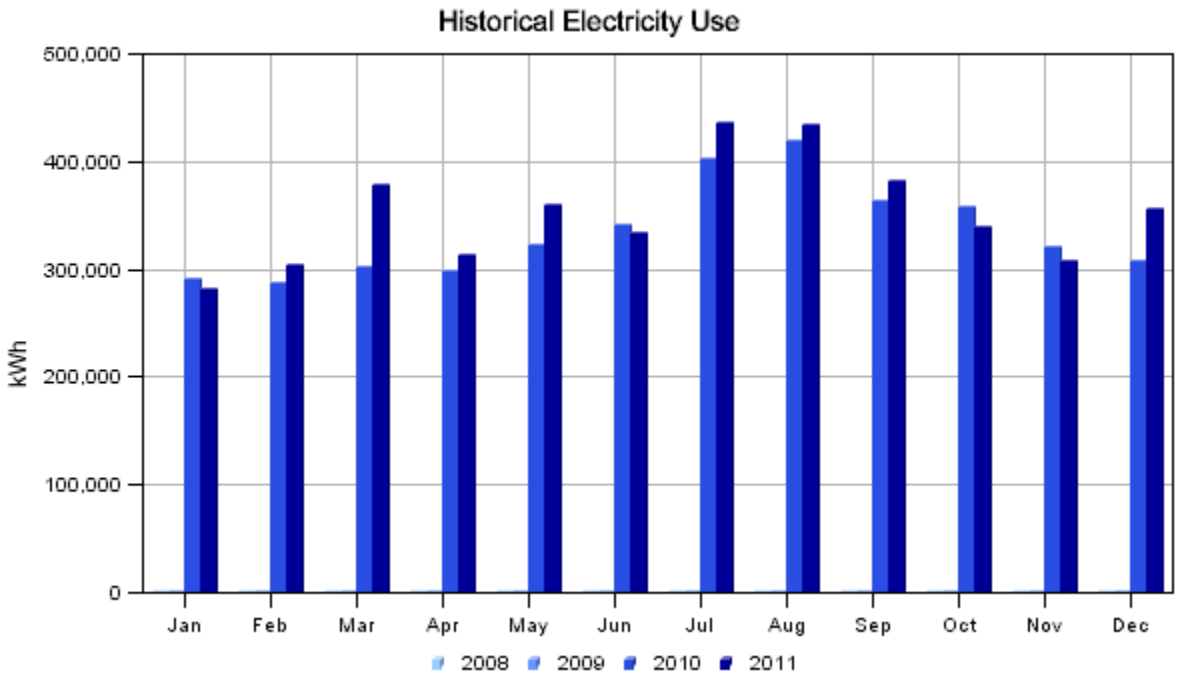
The subject property's energy use is allocated between Electrical (52.8%) and Gas (47.2%).

Historical Energy Use



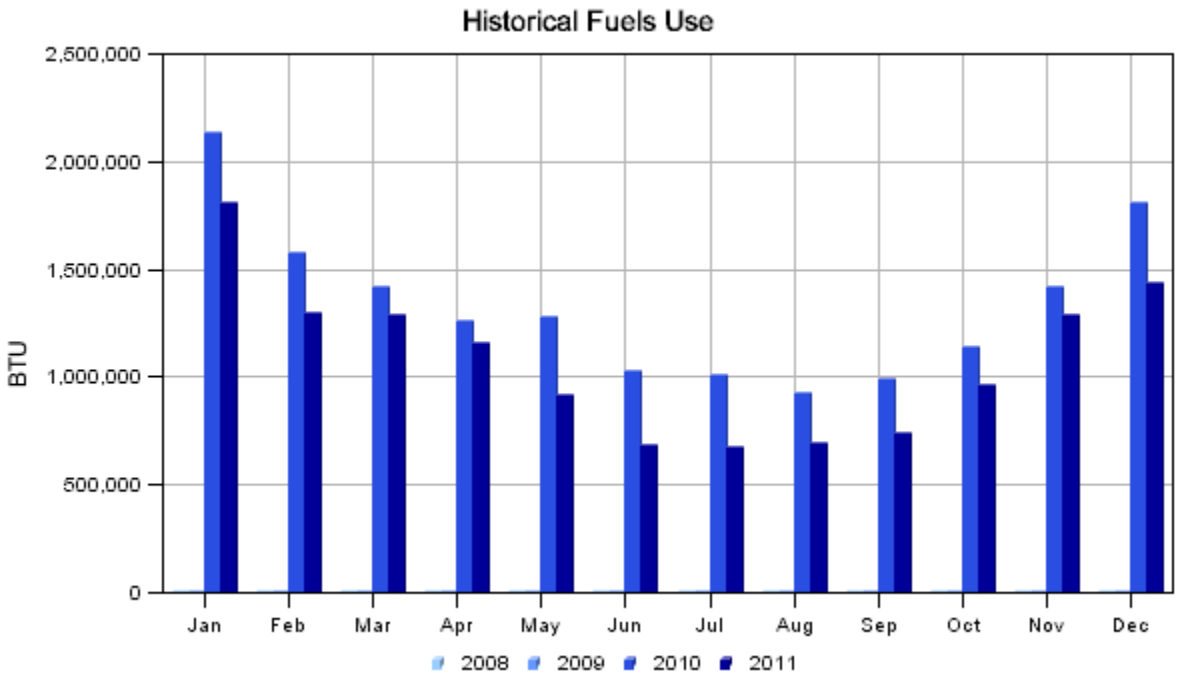
The above chart displays a comparison of total energy (electric and fuels) usage, on a monthly basis, over the specified reporting period from Jan 2010 to Dec 2011.

Historical Electricity Use



The chart above displays a comparison of electricity usage, on a monthly basis, over the specified reporting period from Jan 2010 to Dec 2011.

Historical Fuels Use



The chart above displays a comparison of all fuels usage, on a monthly basis, over the specified reporting period from Jan 2010 to Dec 2011.

CONCLUSIONS & RECOMMENDATIONS

Energy usage is higher than the peer average, with room for improvement. Unfortunately, peer benchmarking of laboratory spaces is mostly inconclusive based on poor or nearly non-existent correlations between energy use and operating hours, area, lab fraction, and other seemingly correlated variables.

Lighting controls are operational; further review of scheduling may still yield savings. Review of illumination needs versus actual levels my show that de-lamping and other elimination strategies have merit. We recommend investigation into VAV box tie-in to lighting controls (depends on existing occupancy sensor outputs as well as VAV/AHU controller inputs and programmability).

As with most laboratory occupancies, plug loads are likely a significant source of savings, with occupant training and plug strip use as applicable. Many laboratory equipment power supplies are poor efficiency and replaceable; replacements can yield >10% savings per device and many devices pull wasted power all year long. We recommend logging a sampling of typical plug loads to establish the off- and on-use loads. It is not unusual for lab plug loads to draw the majority of

their power when not in use.

HVAC loads in buildings of this nature are heavily influenced by interior loads, the reduction of which is discussed above. Little can be done about the envelope resistance at this point, and the building appears to conform to standard practices and applicable code in that regard. We therefore recommend investigation into ventilation outside air in the following way:

1. For ventilation (outside air forced by the dedicated ventilation unit and/or exhaust fans):
    a. Validate the appropriate airflows exist at hoods in relation to safety requirements. ANSI/AIHA Standard Z9.5 suggests velocities of 60 FPM – 80 FPM may be acceptable for given applications and for hoods with excellent capture characteristics. If this relatively new building has such hoods and can safely reduce flow from the current standard of ~100 FPM, corresponding energy savings will be significant. The hood controllers are stand-alone and this work will have to be performed at each hood independently.
    b. Train all lab personnel to close hoods when they are not in use. Automatic closers are available but training is effective and inexpensive in this regard.
    c. Review the general exhaust rates of laboratories. Much debate over general exhaust rates is on record in the laboratory design field, but reductions during occupied and especially during unoccupied periods are often safe and possible.
    d. Validate the sequences of operation. For all fans, visually check operation against DDC system graphics and control point outputs. Log time of day to validate scheduling.
    e. If dynamic resets of AHU static pressure and/or discharge air temperature sequences are not operation, these should be added. Fan and VAV reheat energy are large causes of unnecessary laboratory HVAC energy use.

Facility staff pointed out that the central systems in this building were designed for a large build-out, and are therefore oversized for the current building size. Generally, laboratory HVAC systems and electrical transformers are oversized for all the potential building uses already; over-sizing for expansion would exacerbate this typical problem. Further investigation of the operating modes and choices (multiple parallel fans or pumps for instance) is advisable. Plotting actual flows on pump and fan curves for instance may suggest that running a different number of units may save significant energy and reduce wear at the same time.

Fan energy is a very large component of the energy use of a building with IDEC and efforts to reduce it should be primary.

The commissioning report was not available at the time of this report but a review of the commissioning report will likely suggest that re-commissioning is advisable.

For this building, we advise 15- minute or faster logs of both total building and mechanical-only electrical use, and a review of that data through all seasons. Depending on results of efforts to reduce energy use, this building may be a good candidate for combined heat and power (CHP) in the form of a heat recovery turbine, which have become smaller and generally more applicable to this size of building in recent years. This building's base load, probable simultaneous need for heating and cooling, ground-level proximity of boiler and electrical service utilities all point to a potential for CHP.

BENCHMARKING & DISCLOSURE REPORT

SUBJECT PROPERTY:

Property Name:	U of U Health Sciences
Property Address:	25 South 2000 East Salt Lake City, UT 84112
Property Type:	Medical Classroom
Gross Square Footage (SF):	185,869 SF

PROJECT NAME:
Utah DFCM Review

PROJECT PROPERTY:
University of Utah Health Sciences

REPORT DATE:
May 09, 2012

PREPARED FOR:
John Burningham
State of Utah DFCM - 450 North State Street - Salt Lake City, Ut 84114

PREPARED BY:
ETC Group, LLC - 1997 South 1100 East - Suite 201 - Salt Lake City, UT 84106

ETC Group
ENERGY ENGINEERING FOR A SUSTAINABLE FUTURE ™

EXECUTIVE SUMMARY

Introduction

ETC Group, under contract with the State of Utah DFCM, after a high level review of 29 DFCM owned buildings, has selected 6 facilities of various sizes and uses to inform possible changes to the State High Performance Building Standard. The University of Utah Heath Sciences Facility was selected and analyzed as part of the study. This report documents the building's energy consumption and its relative performance to similar buildings in the region. It also identifies building-specific energy efficiency measures.

1. Re-commissioning
2. Evaluate laboratory ventilation rates and ventilation reduction strategies
3. Snow melt controls
4. Occupancy based VAV controls

Peer Building Benchmarking

Peer Building Benchmarking - Utility Cost

Property Type: Medical Office
Peer Group: Same CBSA Market (5 peer buildings)

Utility Type	Subject Property 12 Months Spend Dec 2010 to Nov 2011	Subject Property Cost per SF ($/SF/yr)	Peer Group Benchmark Median Cost per SF ($/SF/yr)	Subject Property % Better / (Worse) Than Peer Group Median	Subject Property Potential Annual Cost Savings vs Peer Group Median ($/yr)
Electricity	$82,760	$0.45 / SF	$1.30 / SF	**65.7%**	N/A
Fuels	$257	$0.00 / SF	$0.71 / SF	**99.8%**	N/A

SRS Peer Building Benchmarking data is current through May 2011.

SUBJECT PROPERTY PROFILE

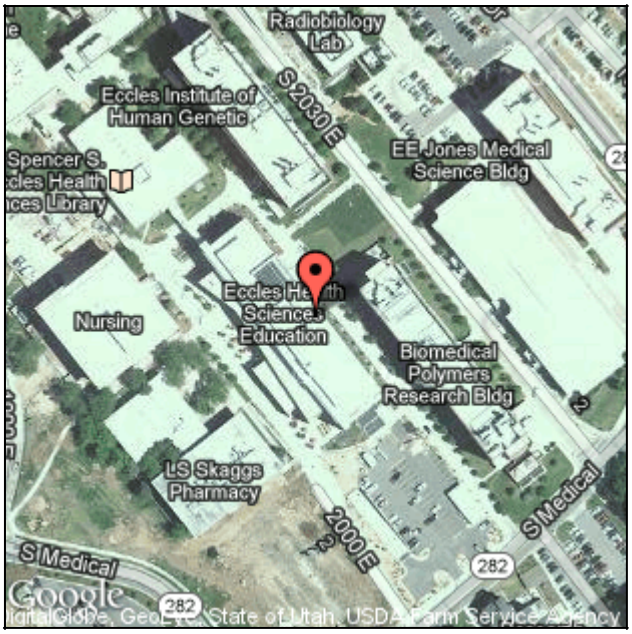
Property Name:	U of U Health Sciences
Property Address:	25 South 2000 East Salt Lake City, UT 84112
Property Type:	Medical Classroom
Gross Square Footage (SF):	185,869 SF
Reporting Period:	Apr 2009 to Nov 2011

Property Location

The maps below display the subject property location.

Street Map

Aerial Map



Utility Account Summary

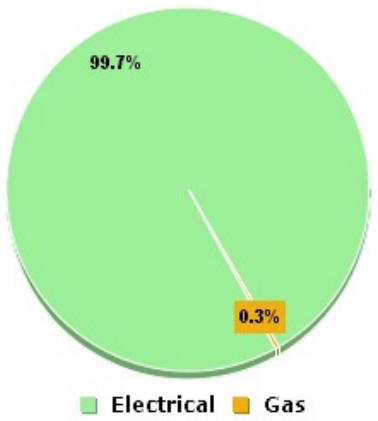
Subject Property Utilities		
Utility Account	**Utility Type**	**Specified Reporting Period**
District CHW	Gas	04/2009 - 11/2011
Rocky Mountain Power	Electrical	04/2009 - 11/2011

Subject Property Profile Discussion

The Health Sciences Education Building (HSEB) is a five-story facility with 185,000 sf. The building was completed in 2005, and utilizes examination and seminar rooms, in addition to laboratories, classrooms, offices, a bookstore, a bistro, and common areas.

UTILITY COST

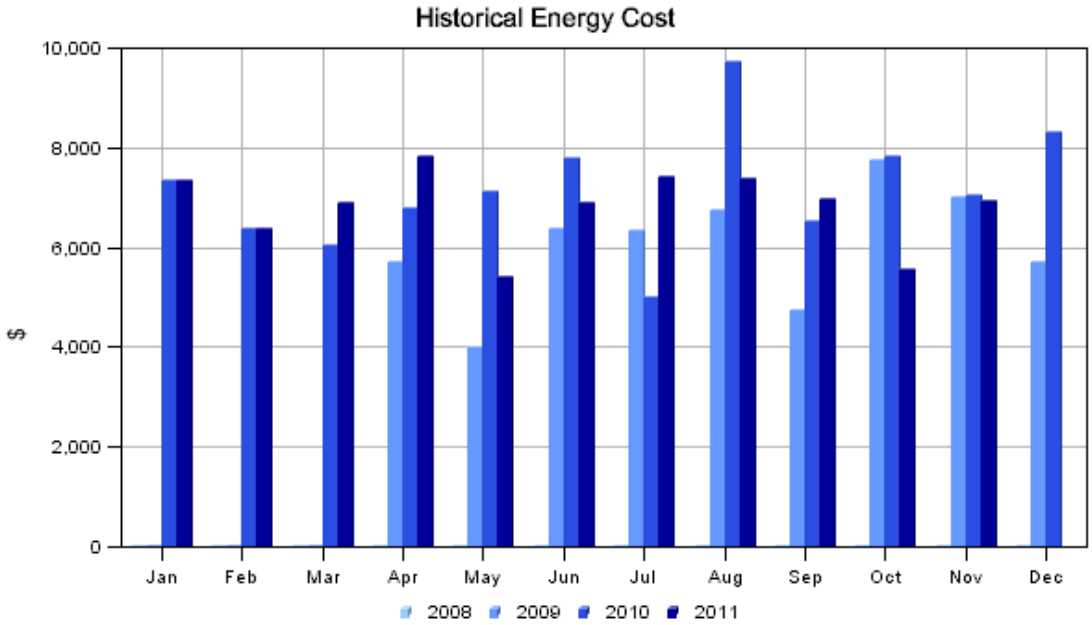
Overall Utility Cost



The above chart displays the percentage allocation of utility costs over the last twelve months of the specified reporting period from Dec 2010 to Nov 2011.

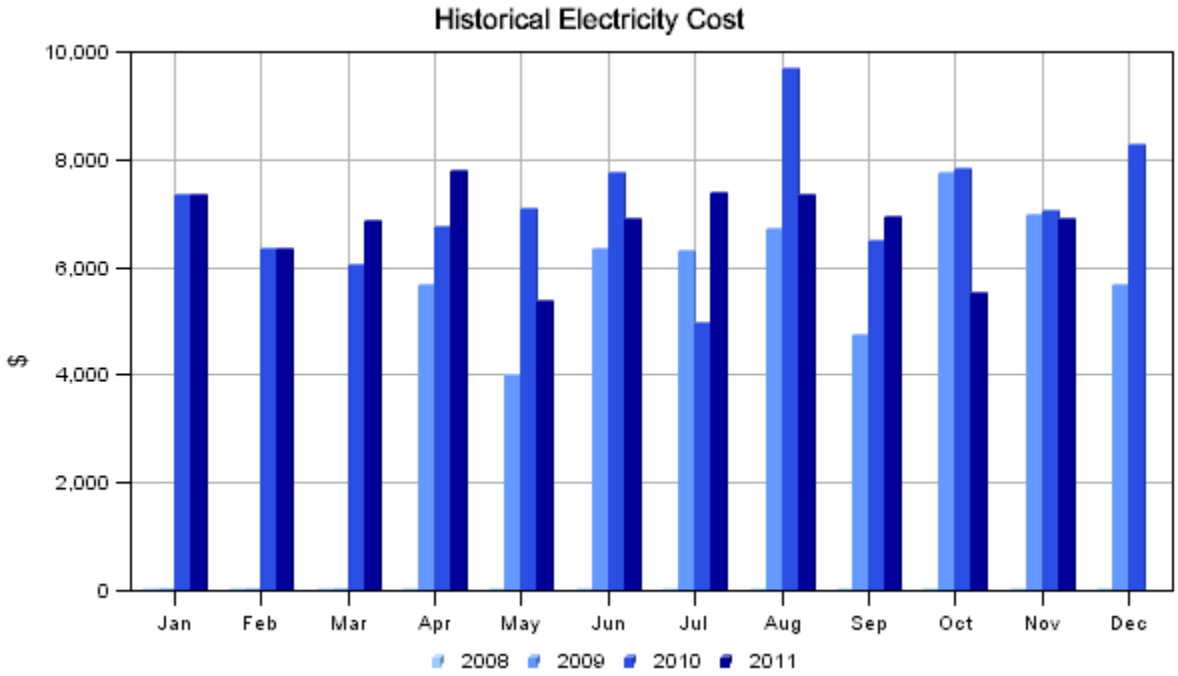
The subject property's total utility costs are allocated between Electrical (99.7%) and Gas (0.3%).

Historical Energy Cost



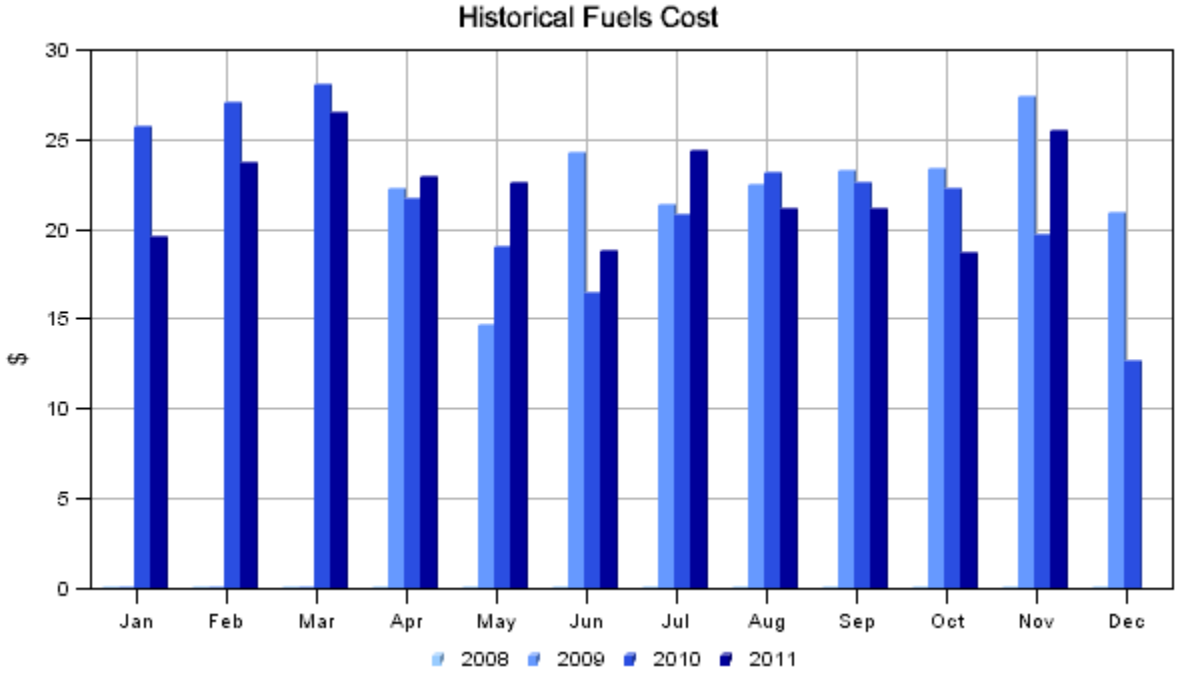
The above chart displays a comparison of total energy (electric and fuels) cost, on a monthly basis, over the specified reporting period from Apr 2009 to Nov 2011.

Historical Electricity Cost



The chart above displays a comparison of electricity cost, on a monthly basis, over the specified reporting period from Apr 2009 to Nov 2011.

Historical Fuels Cost



The chart above displays a comparison of all fuels cost, on a monthly basis, over the specified reporting period from Apr 2009 to Nov 2011.

PEER BUILDING BENCHMARKING - UTILITY COST

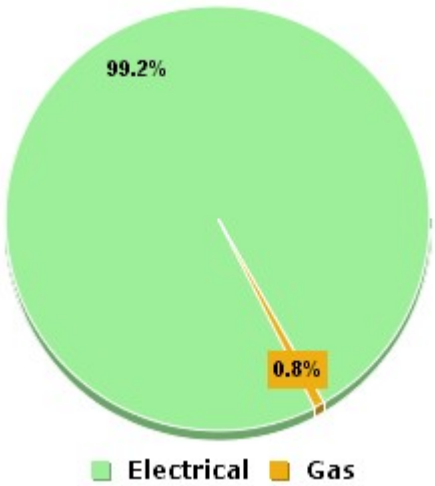
To facilitate an industry best practice for benchmarking building energy and sustainability performance, Sustainable Real Estate Solutions, Inc, (SRS) maintains the SRS Peer Building Benchmarking™ database, containing over 120,000 buildings. These buildings, encompassing 15 primary property types and 3.3 billion square feet, consume more than $7.8 billion in annual energy costs and $635 million in annual water/sewer costs. The database is aggregated from multiple private sources, including energy services and property due diligence providers and is current through May 2011.

To facilitate benchmarking, the subject property's energy and sustainability performance is compared to its peer group's performance distribution (25th percentile, median, 75th percentile) across multiple geographic areas, i.e., ZIP Code, Core Based Statistical Area (CBSA), State, Climate Region and Nationwide.

For each subject property under review, the Database is queried with reference to the property type and location. The results are summarized in the following charts and descriptions which include a detailed statistical analysis of energy and sustainability key performance indicators.

ENERGY USE

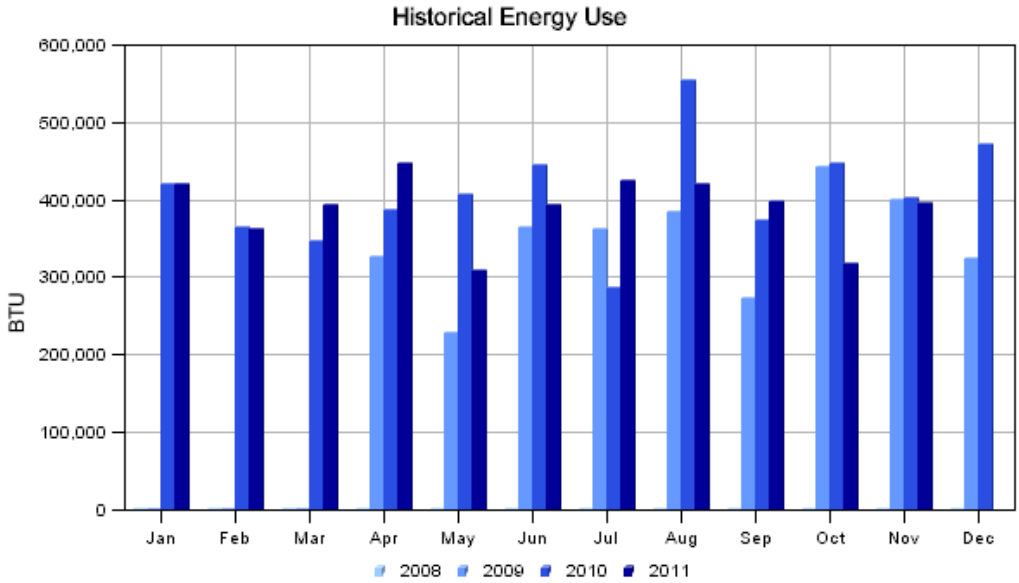
Overall Energy Use



The above chart displays the percentage allocation of energy use by type over the last twelve months of the specified reporting period from Dec 2010 to Nov 2011.

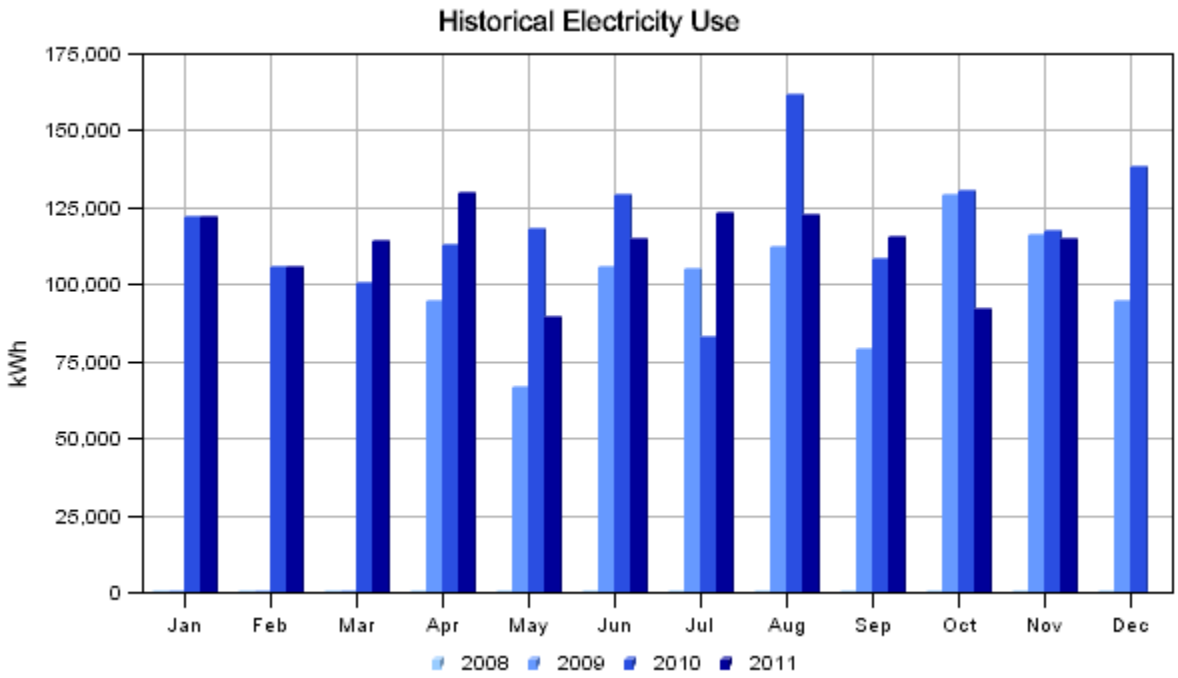
The subject property's energy use is allocated between Electrical (99.2%) and Gas (0.8%).

Historical Energy Use



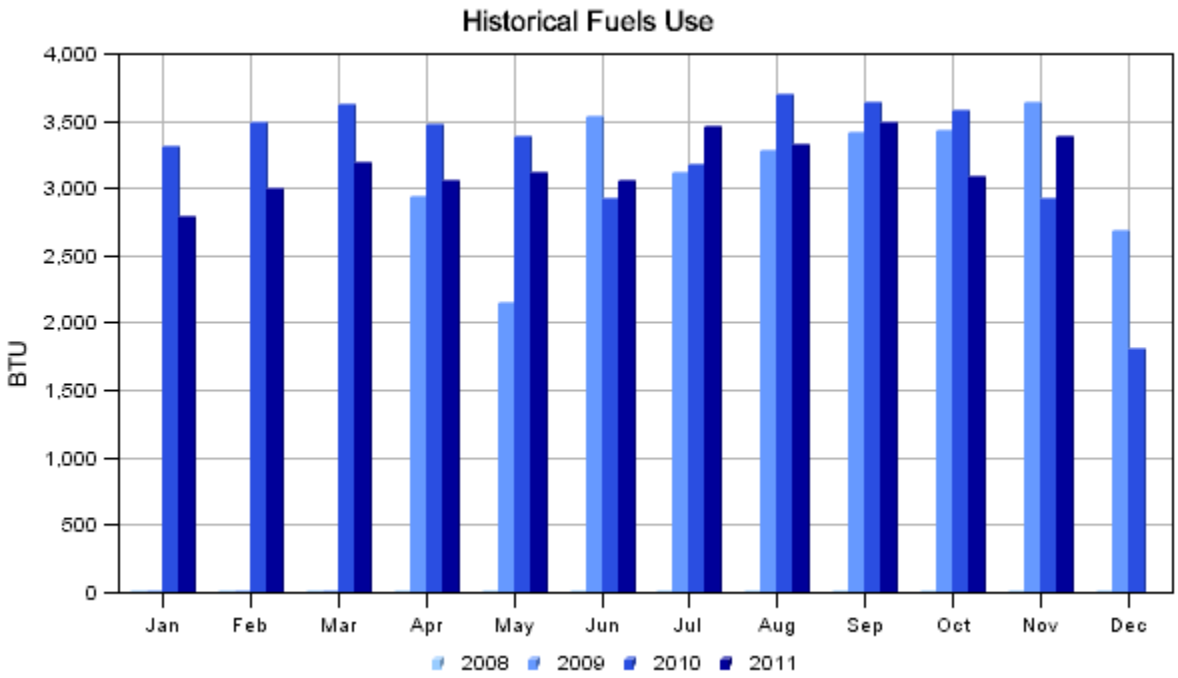
The above chart displays a comparison of total energy (electric and fuels) usage, on a monthly basis, over the specified reporting period from Apr 2009 to Nov 2011.

Historical Electricity Use



The chart above displays a comparison of electricity usage, on a monthly basis, over the specified reporting period from Apr 2009 to Nov 2011.

Historical Fuels Use



The chart above displays a comparison of all fuels usage, on a monthly basis, over the specified reporting period from Apr 2009 to Nov 2011.

Peer Building Benchmarking - Energy Use Intensity Discussion

As discussed under “Utility Cost Benchmarking,” energy meters are not adequate for analysis at this time.

PEER BUILDING BENCHMARKING SUMMARY

Peer Building Benchmarking - Utility Cost

Property Type: Medical Office

Peer Group: Same CBSA Market (5 peer buildings)

Utility Type	Subject Property 12 Months Spend Dec 2010 to Nov 2011	Subject Property Cost per SF ($/SF/yr)	Peer Group Benchmark Median Cost per SF ($/SF/yr)	Subject Property % Better / (Worse) Than Peer Group Median	Subject Property Potential Annual Cost Savings vs Peer Group Median ($/yr)
Electricity	$82,760	$0.45 / SF	$1.30 / SF	**65.7%**	N/A
Fuels	$257	$0.00 / SF	$0.71 / SF	**99.8%**	N/A

SRS Peer Building Benchmarking data is current through May 2011.

CONCLUSIONS & RECOMMENDATIONS

Energy usage is not totally reliable, due to the lack of data on the efficiency of high-temperature heating water and chilled water plants that serve with building. Facility staff also expressed concerns that the meters installed may not be reliable.

Lighting controls are operational; further review of scheduling may still yield savings. Review of illumination needs versus actual levels my show that de-lamping and other elimination strategies have merit. We recommend using the existing occupancy controls to shut down VAV boxes

Plug loads in teaching labs can be much lower than in production or research labs. Still they may be significant without some management. Many laboratory equipment power supplies are poor efficiency and replaceable; replacements can yield >10% savings per device and many devices pull wasted power all year long. We recommend logging a sampling of typical plug loads to establish the off- and on-use loads. It is not unusual for lab plug loads to draw the majority of their power when not in use.

HVAC loads in buildings of this nature are heavily influenced by interior loads, the reduction of which is discussed above. Little can be done about the envelope resistance at this point, and the building appears to conform to standard practices and applicable code in that regard. We therefore recommend investigation into ventilation outside air in the following way:

1. For ventilation (outside air forced by the dedicated ventilation unit and/or exhaust fans):
    1. Review the general exhaust rates of laboratories. Much debate over general exhaust rates is on record in the laboratory design field, but reductions during occupied and especially during unoccupied periods are often deemed safe. This building's lab general exhaust fan at ~12,500 CFM appears to provide 8 air changes per hour for the 4th floor labs, which may be 2-4 times as much as is required for safety.
    2. The Staff believes the lab exhaust fan rides its curve based on flow changes from lab valves in the spaces. We recommend the use of a VFD for this fan with static pressure reset.
    3. We saw only one, manual operation hood in the building. It appears hood airflow is a minor consideration for this facility.
    4. Validate the sequences of operation. For all fans, visually check operation against DDC system graphics and control point outputs. Log time of day to validate scheduling.
    5. If dynamic resets of AHU static pressure and/or discharge air temperature sequences are not operation, these should be added. Fan and VAV reheat energy are large causes of unnecessary laboratory HVAC energy use.

Staff reported that the building's controls were recently re-programmed for 72F set point and no dead band, for all rooms. While a 72F set point is a very typical value, dead band use is a code requirement and advisable from and energy standpoint.

The snowmelt system is manually enabled for winter operation. ASHRAE data (Applications, 2011, Table 51.3) suggests that actual melting time in Salt Lake City is 142 hours or 1.6% of the typical year. We recommend the use of a high-quality snowmelt sensor for this system.

The commissioning report indicated that significant simultaneous heating and cooling was documented and subsequently addressed in the commissioning process. Re-commissioning is advisable given the demonstrated potential for this issue, and the known re-programming that has occurred in the intervening 8 year.

BENCHMARKING & DISCLOSURE REPORT

SUBJECT PROPERTY:

Property Name:	West Jordan Courts
Property Address:	8040 S. Redwood Rd. West Jordan, UT 84084
Property Type:	Courthouse
Gross Square Footage (SF):	123,094 SF

PROJECT NAME:
Utah DFCM Review

PROJECT PROPERTY:
West Jordan Courts

REPORT DATE:
May 09, 2012

PREPARED FOR:
John Burningham
State of Utah DFCM - 450 North State Street - Salt Lake City, Ut 84114

PREPARED BY:
ETC Group, LLC - 1997 South 1100 East - Suite 201 - Salt Lake City, UT 84106

ETC Group
ENERGY ENGINEERING FOR A SUSTAINABLE FUTURE ™

EXECUTIVE SUMMARY

Introduction

ETC Group, under contract with the State of Utah DFCM, after a high level review of 29 DFCM owned buildings, has selected 6 facilities of various sizes and uses to inform possible changes to the State High Performance Building Standard. West Jordan Court was selected and analyzed as part of this study. This report documents the building's energy consumption and its relative performance to similar buildings in the region. Also identified are building-specific energy efficiency measures.

On overview, this building performs very well with an energy utilization index 57% lower than average; further improvement efforts should focus on:

1. Ventilation reductions, via re-commissioning and HVAC balancing
2. Building leakage minimization
3. Demand-Controlled Ventilation

Peer Building Benchmarking

Peer Building Benchmarking - Utility Cost

Property Type: Courthouse
Peer Group: Same 3-Digit ZIP Code (10 peer buildings)

Utility Type	Subject Property 12 Months Spend Jan 2011 to Dec 2011	Subject Property Cost per SF ($/SF/yr)	Peer Group Benchmark Median Cost per SF ($/SF/yr)	Subject Property % Better / (Worse) Than Peer Group Median	Subject Property Potential Annual Cost Savings vs Peer Group Median ($/yr)
Electricity	$57,900	$0.47 / SF	$1.63 / SF	**71.1%**	N/A
Fuels	$0	$0.00 / SF	$0.34 / SF	**100.0%**	N/A

SRS Peer Building Benchmarking data is current through May 2011.

Peer Building Benchmarking - Energy Use Intensity

Property Type: Courthouse

Peer Group: Same 3-Digit ZIP Code (10 peer buildings)

Key Performance Metric	Subject Property 12 Months Total Use per SF Jan 2011 to Dec 2011	Peer Group Benchmark Median Use per SF	Subject Property % Better / (Worse) Than Peer Group Median	Subject Property Potential Annual Cost Savings vs Peer Group Median ($/yr)
Electricity Use Intensity	13.69 kWh / SF	20.73 kWh / SF	**33.9%**	N/A
Fuels Use Intensity	.00 kBTU / SF	42.45 kBTU / SF	**100.0%**	N/A
Energy Use Intensity (EUI)	46.72 kBTU / SF	112.11 kBTU / SF	**58.3%**	N/A

SRS Peer Building Benchmarking data is current through May 2011.

SUBJECT PROPERTY PROFILE

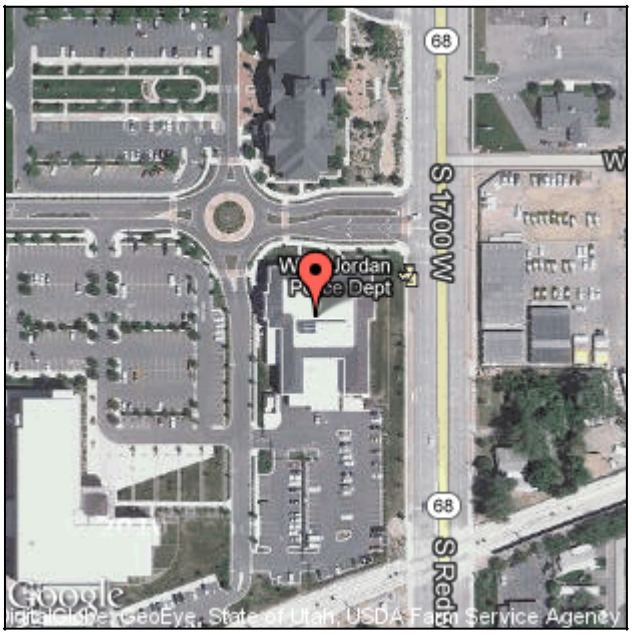
Property Name:	West Jordan Courts
Property Address:	8040 S. Redwood Rd. West Jordan, UT 84084
Property Type:	Courthouse
Gross Square Footage (SF):	123,094 SF
Reporting Period:	Jan 2011 to Dec 2011

Property Location

The maps below display the subject property location.

Street Map

Aerial Map



Utility Account Summary

Subject Property Utilities		
Utility Account	**Utility Type**	**Specified Reporting Period**
RMP Electric	Electrical	01/2011 - 12/2011

Subject Property Profile Discussion

The West Jordon Courts Building is a three story building that has a total of 123,094 square

feet. There are offices, court rooms, holding cells, judge's chambers and jury rooms. The HVAC system consists of 167 heat pumps throughout the building to both heat and cool the spaces. The heat pumps are electrically operated and the facility uses no natural gas. As a result, this building has the lowest Energy Utilization Index (EUI) of the buildings we studied but the system is strongly disliked by Facility Maintenance staff because of limited mechanical equipment access and a tendency to break down.

ENERGY STAR RATING

The ENERGY STAR national energy efficiency performance rating is a benchmark that helps building stakeholders assess how efficiently their buildings consume energy, relative to similar buildings nationwide. The rating system's 1-100 scale allows a relatively quick determination to understand how a building is performing. A rating of 50 indicates average building energy performance while a rating of 75 or better indicates top 25th percentile performance and building's achieving this level are eligible to earn an ENERGY STAR label.

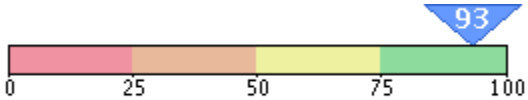
ENERGY STAR's benchmarking scale is based upon comparison with the U.S. Energy Information Administration's (EIA) Commercial Building Energy Consumption Survey (CBECS) data (current through December 2003) for existing commercial building stock, including approximately 5,200 buildings nationwide across 15 property types.

The below charts display the ENERGY STAR rating for the subject property.

ENERGY STAR Rating

Property Type: Courthouse

Peer Group: Nationwide (498 peer buildings)

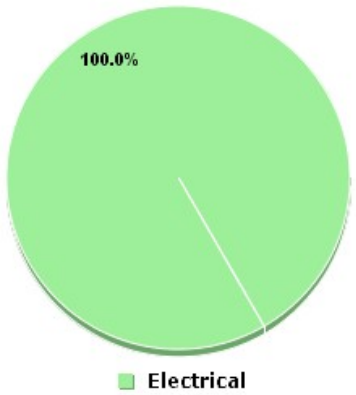


Commercial Building Energy Consumption Survey (CBECS) data is current through December 2003.

The subject property's most recent Energy Star rating of 93, received in December 2011, is 43 points above the national average and 18 points above the threshold rating of 75 needed to earn an Energy Star label.

UTILITY COST

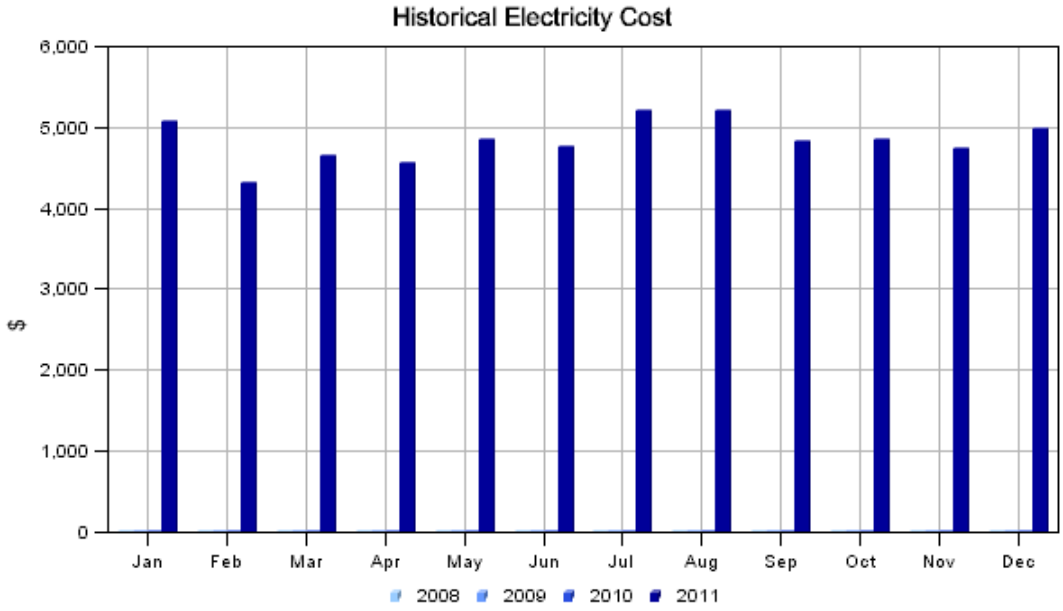
Overall Utility Cost



The above chart displays the percentage allocation of utility costs over the last twelve months of the specified reporting period from Jan 2011 to Dec 2011.

The subject property's total utility costs are allocated between Electrical (100.0%).

Historical Electricity Cost



The chart above displays a comparison of electricity cost, on a monthly basis, over the specified reporting period from Jan 2011 to Dec 2011.

PEER BUILDING BENCHMARKING - UTILITY COST

To facilitate an industry best practice for benchmarking building energy and sustainability performance, Sustainable Real Estate Solutions, Inc, (SRS) maintains the SRS Peer Building Benchmarking™ database, containing over 120,000 buildings. These buildings, encompassing 15 primary property types and 3.3 billion square feet, consume more than $7.8 billion in annual energy costs and $635 million in annual water/sewer costs. The database is aggregated from multiple private sources, including energy services and property due diligence providers and is current through May 2011.

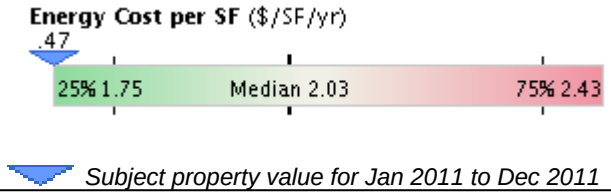
To facilitate benchmarking, the subject property's energy and sustainability performance is compared to its peer group's performance distribution (25th percentile, median, 75th percentile) across multiple geographic areas, i.e., ZIP Code, Core Based Statistical Area (CBSA), State, Climate Region and Nationwide.

For each subject property under review, the Database is queried with reference to the property type and location. The results are summarized in the following charts and descriptions which include a detailed statistical analysis of energy and sustainability key performance indicators.

Energy Cost per SF

Peer Group Comparison Property Type: Courthouse

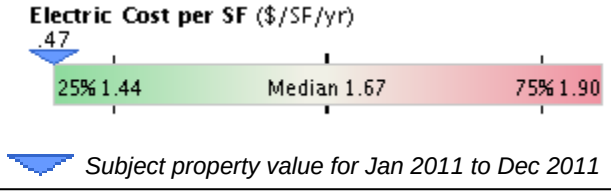
Same Climate Region
(70 peer buildings)



Electric Cost per SF

Peer Group Comparison Property Type: Courthouse

Same Climate Region
(68 peer buildings)

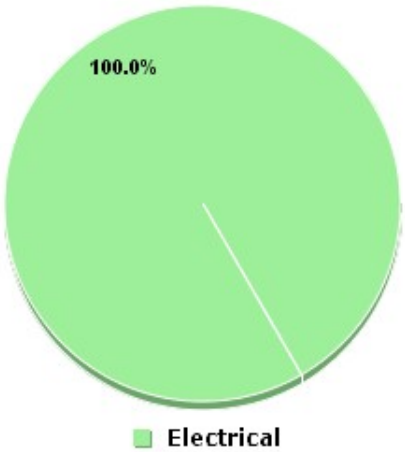


Peer Building Benchmarking - Utility Cost Discussion

The West Jordan Court Building's total Energy Cost Index (ECI) of $0.47/sf is well below the climate region peer average of $2.03/sf. Its electric-only ECI of $0.47/sf is also lower than the peer-average of $1.67/sf. Electricity is the only source of energy for this building.

ENERGY USE

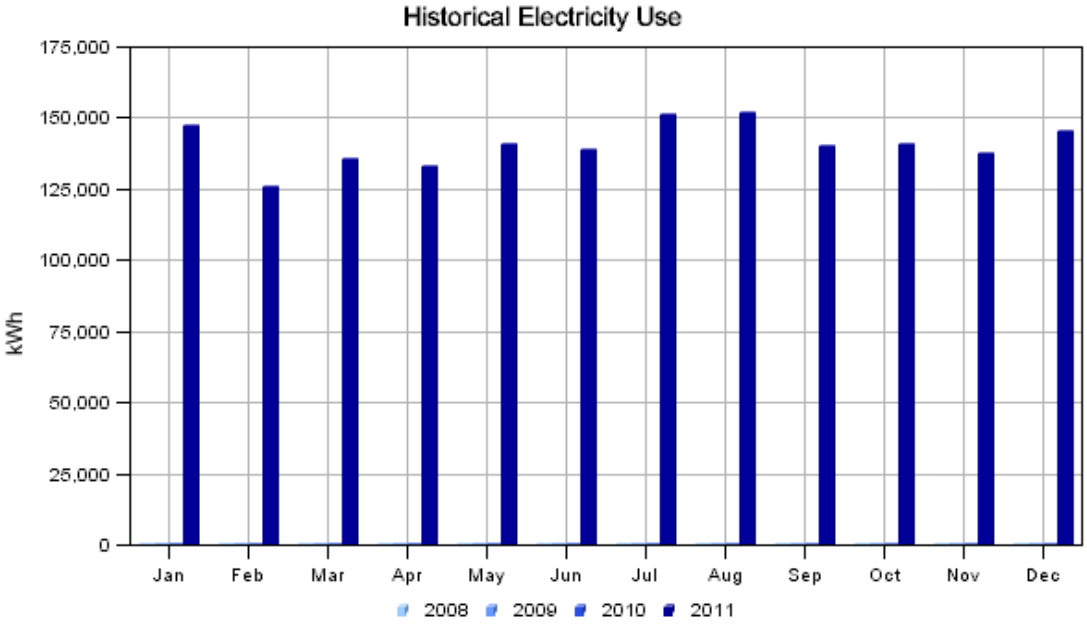
Overall Energy Use



The above chart displays the percentage allocation of energy use by type over the last twelve months of the specified reporting period from Jan 2011 to Dec 2011.

The subject property's energy use is allocated between Electrical (100.0%).

Historical Electricity Use



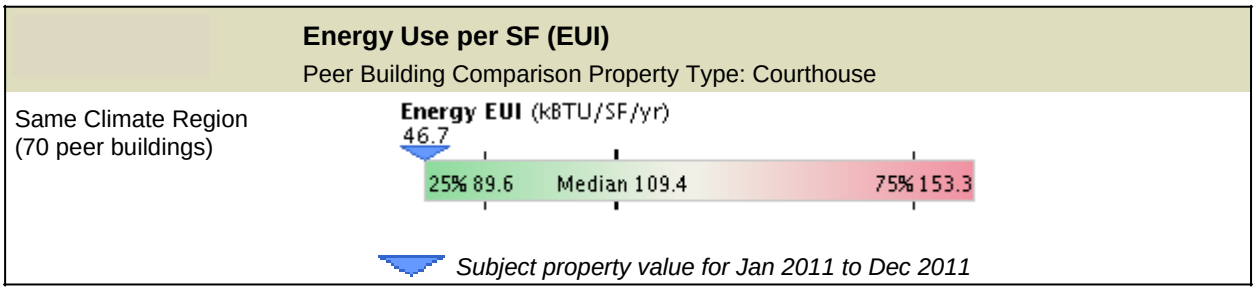
The chart above displays a comparison of electricity usage, on a monthly basis, over the specified reporting period from Jan 2011 to Dec 2011.

PEER BUILDING BENCHMARKING - ENERGY USE INTENSITY

To facilitate an industry best practice for benchmarking building energy and sustainability performance, Sustainable Real Estate Solutions, Inc, (SRS) maintains the SRS Peer Building Benchmarking™ database, containing over 120,000 buildings. These buildings, encompassing 15 primary property types and 3.3 billion square feet, consume more than $7.8 billion in annual energy costs and $635 million in annual water/sewer costs. The database is aggregated from multiple private sources, including energy services and property due diligence providers and is current through May 2011.

To facilitate benchmarking, the subject property's energy and sustainability performance is compared to its peer group's performance distribution (25th percentile, median, 75th percentile) across multiple geographic areas, i.e., ZIP Code, Core Based Statistical Area (CBSA), State, Climate Region and Nationwide.

For each subject property under review, the Database is queried with reference to the property type and location. The results are summarized in the following charts and descriptions which include a detailed statistical analysis of energy and sustainability key performance indicators.



Peer Building Benchmarking - Energy Use Intensity Discussion

The West Jordan Court Building's total Energy Utilization Index (EUI) of 46.7 kBtu/sf/yr is well below the peer- average of 109.4 kBtu/sf/yr. Its electric-only EUI at 13.7 kwh/sf/yr is lower than the peer-average of 19.9 yr.

PEER BUILDING BENCHMARKING SUMMARY

Peer Building Benchmarking - Utility Cost

Property Type: Courthouse
Peer Group: Same 3-Digit ZIP Code (10 peer buildings)

Utility Type	Subject Property 12 Months Spend Jan 2011 to Dec 2011	Subject Property Cost per SF ($/SF/yr)	Peer Group Benchmark Median Cost per SF ($/SF/yr)	Subject Property % Better / (Worse) Than Peer Group Median	Subject Property Potential Annual Cost Savings vs Peer Group Median ($/yr)
Electricity	$57,900	$0.47 / SF	$1.63 / SF	**71.1%**	N/A
Fuels	$0	$0.00 / SF	$0.34 / SF	**100.0%**	N/A

SRS Peer Building Benchmarking data is current through May 2011.

Peer Building Benchmarking - Energy Use Intensity

Property Type: Courthouse
Peer Group: Same 3-Digit ZIP Code (10 peer buildings)

Key Performance Metric	Subject Property 12 Months Total Use per SF Jan 2011 to Dec 2011	Peer Group Benchmark Median Use per SF	Subject Property % Better / (Worse) Than Peer Group Median	Subject Property Potential Annual Cost Savings vs Peer Group Median ($/yr)
Electricity Use Intensity	13.69 kWh / SF	20.73 kWh / SF	**33.9%**	N/A
Fuels Use Intensity	.00 kBTU / SF	42.45 kBTU / SF	**100.0%**	N/A
Energy Use Intensity (EUI)	46.72 kBTU / SF	112.11 kBTU / SF	**58.3%**	N/A

SRS Peer Building Benchmarking data is current through May 2011.

CONCLUSIONS & RECOMMENDATIONS

Energy (in this case, electrical only) usage is already low for this building. Lighting controls are operational; further review of scheduling may still yield savings. Plug loads may be a source of savings, with occupant training and plug strip use as applicable.

HVAC use may be reduced with set point adjustments, particularly broader dead bands for unoccupied periods. HVAC loads in buildings of this nature are heavily influenced by interior loads, the reduction of which is discussed above. Beyond interior loads, envelope u-value (conductive/radiation loss) and outside air introduction are the biggest loads. Little can be

done about the envelope resistance at this point, and the building appears to conform to standard practices and applicable code in that regard. We therefore recommend investigation into the sources of outside air in the following way:

1. For ventilation (outside air forced by the dedicated ventilation unit and/or exhaust fans):
    1. Validate the appropriate airflows exist at exhaust fans and at the ventilation units. These are subject to test and balance error and/or drift or defeat. Outside air ducts were designed to physically connect to the small return air plenum for each heat pump. Many outside air ducts were disconnected, probably to increase service access which is very limited. For many units it is therefore not possible to validate outside air flows.
    2. Since the heat pumps are pulling from a common plenum, providing CO2 based demand-controlled ventilation at each plenum may provide inexpensive outside air reductions, while allowing removal of maintenance-hindering ducts.
    3. Validate the sequences of operation. For DOAS and exhaust fans, visually check operation against DDC system graphics and control point outputs. Log time of day to validate scheduling. We suggest turning off outside air after normal hours; while there may be occupants, the drastically fewer occupants are unlikely to raise CO2 levels above acceptable limits.
    4. For infiltration (outside air forced by wind and temperature):
        1. Perform envelope leakage tests. Depending on the results, smoke testing and/or envelope sealing may be in order.
        2. According to FM staff, daylight is visible within the plenum of the top floor. We recommend inspection of parapets and other elements to identify leakage issues.
        3. According to FM staff, smoke management dampers have had repeated issues with sticking. This can be a significant source of infiltration. We recommend automatic testing of damper operation via end switches, both energy as well as safety (automatic testing and reporting is required by most codes).

FM staff also expressed concern about increasing heat pump re-built requirements as the units get older. Consider replacement of older units with upgrades.