EXECUTIVE SUMMARY

Houston has a promising start to supporting a sustainable commercial energy efficiency program with a multi-year agenda to upgrade its municipal buildings, and its engagement of over 180 privately-owned commercial buildings in the Green Office Challenge. Our recommendations aim to support Houston's leadership and enable its energy efficiency activities to persist after Recovery Act funding is spent. Overall, our plan creates awareness, provides affordable financing, and stimulates more confidence in energy efficiency as a proven concept. We propose four main strategies:

1) **Pilot and Scale Monitoring-Based Commissioning (MBCx).** MBCx is gaining traction and builds on in-state expertise in Texas A&M University. Houston can pilot these technologies in several municipal projects before attracting volunteers from the commercial sector. Proving that MBCx is able to sustain savings of up to 25% and accurately identify opportunities for energy reduction will spur more private investment in building upgrade activities.

2) **Provide Access to Affordable Capital.** To date, Houston has a $23M allocation of Qualified Energy Conservation Bonds (QECBs) that have not yet been issued. QECBS are amongst the lowest cost public financing tools, providing a net interest cost of 2-3% for the issuer. Houston can issue QECBs as a 20-year bullet and use the proceeds to provide financing at low rates to borrowers, which will take Houston beyond the $3M in EECBG grant money currently used to rebate energy expenditures in the city's program. The City can establish a revolving loan fund or work with lenders to fund credit enhancements such as a loan loss reserve or debt service reserve. Affordable financing available can encourage more MBCx and retrofit activities in the private space and make energy upgrades more cost-effective. Houston can also leverage the money for retrofits in their own municipal buildings, since the financing will likely be cheaper than what ESCOs provide.

3**) Pass a Building Disclosure Ordinance.** Houston can adopt an ordinance which requires an annual benchmark report that includes an Energy Star Performance Score, an energy audit every 5 years, and the filing of an audit report with the city showing all retrofit and retrocommissioning (RCx) opportunities with a simple payback of less than 3 years. The City can lead the way for this transparency by disclosing the benchmarking of its municipal buildings and making the results public. The City can showcase best practices for its office buildings, so that the commercial buildings industry can learn from past experiences. Any successes from piloting new MBCx technologies or approaches would be revealed.

4) **Coordinate Resources and Reporting.** Houston can enhance its current outreach and marketing efforts by providing a long-term web platform that can facilitate connections between building energy managers, utility staff, and contractors. The City could collaborate with its utilities to smooth benchmark reporting, enable compatibility with EPA Portfolio Manager software; provide information on incentives, qualified contractors, and best practices; facilitate reporting on Recovery Act and Davis Bacon requirements; and do bulk purchasing on windows on a one-stop shop website.

INTRODUCTION

Energy efficiency in the commercial building sector faces numerous barriers to implementation. Several dominant barriers include agency issues, elevated hurdle rate, capital constraints, and the lack of awareness or information (McKinsey & Co., 2009).

Houston has already started to address many of these through its current programs. To solve the agency problem, the Green Office Challenge (GOC) engages tenants to reduce their energy consumption, and awards buildings managers for recruiting tenants to participate. To tackle the problem of elevated hurdles rates, Houston's Energy Efficiency Incentive Program (EEIP) offers a rebate of up to a 20% of project cost, which reduces the elevated hurdle rate and makes projects more affordable. Lastly, the City has a number of activities and resources that it shares with GOC participants in order to inform best practices and has already recruited 188 building properties in the challenge.

The City has an opportunity to build upon these successes and can consider several options to modify current program approaches to optimize success in the GOC or pursue new avenues that would pave the way for energy efficiency activities to last beyond the scope of the Recovery Act grant.

We propose four strategies that will supplement current efforts to tackle the challenges in the commercial energy efficiency space. 1) Monitoring-based commissioning can lead to greater uptake of energy efficiency through more accurate, real-time analysis that can boost confidence for the prospects of achieving real energy savings. 2) Issuing Qualified Energy Conservation Bonds (QECBs) can provide a source of funding to enable access to affordable financing. This enables building managers to get over the initial hurdle of securing enough capital. 3) Passing a building disclosure ordinance will create more awareness and enable energy efficiency to be incorporated in property leasing arrangements. 4) Creating a one-stop shop for resources disseminates resources efficiently, minimizes transaction costs in finding resources, and increases the retention rates of building managers who want to undertake energy improvements.

Together, these solutions tackle the greatest barriers to commercial energy efficiency in Houston. The city has a great platform with its GOC and has overcome one of the major barriers in gaining interest. To maximize this opportunity, Houston must act promptly to engage the sector, support its constituency with best practices and resources, prime local lending, and lead by example.

APPROACH

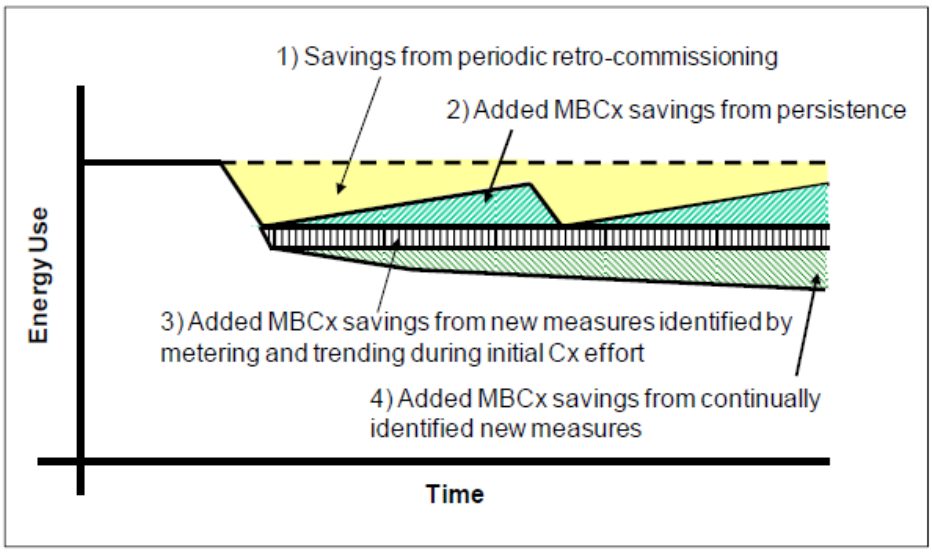
1. Monitoring-based Commissioning (MBCx) provides long term savings

Traditional RCx provides cost-effective savings and efficiencies to a building's operations that controls air flow, cooling and heating. Because of factors such as weather, space use, number of occupants, buildings are rarely optimized for performance (Brambley, 2009).

RCx identifies low-cost operational and maintenance improvements in existing buildings and updates the building's operations to reflect its current usage. The process typically includes an audit of the entire building as well as analysis of past utility bills and interviews with facility personnel. It is followed by diagnostic monitoring and tests of building systems in order to optimize the use of current mechanical equipment and lighting controls. Between 5% and 30% of potential energy savings can be realized (Brambley, 2009).

However, implementing RCx by itself is not a panacea. Over longer periods of time, when much of the testing and monitoring equipment removed after RCx, building performance will degrade over time because of operational changes which may lead to creeping increases in energy use (Mills, 2009). Adjustments and changes in the building over time may require deviations from the previously set optimized controls. Without measurements for this data, these changes leave a building operating inefficiently. Often, operational "bugs" in the system are difficult to solve under a constrained time during the RCx process. Since long term based data is not recorded and instead estimated, building owners can overlook long term savings for RCx. Thus with RCx, there is still a great deal of opportunity to improve building efficiencies (Mills, 2009).

Figure 1. MBCx provides three streams of additional energy savings relative to RCx.



Research shows that MBCx would create the certainty and the confidence needed for private investment in RCx and retrofit activities and facilitate building disclosure policies. Progress, after all, must be measured. Through MBCx, building managers base their analyses on real-time measurements as opposed to estimations and assumptions during the RCx process. The accumulated measurements would help document general metrics for comparisons with other similar buildings. It could also provide benchmarks that would also provide for longer term data in the Houston area and documented measurements for cost savings for equipment and operational efficiencies for use in Houston's private sector. Energy savings in MBCx activities are more robust and persistent than for conventionally commissioned activities (Mills, 2009).

MBCx would ensure efficient building operations. In addition, continuous measurements engages staff who assist with the diagnosis, testing, and trending of measurements. MBCx stimulates a more knowledgeable energy team to gain valuable experience performing these measurement duties on an ongoing basis (California Commissioning Collaborative, 2006). The City and its utilities could establish training partnerships to train staff to optimize settings using monitoring tools in a continuous commissioning program. This process brings building staff deeper into the investigative and diagnostic experience and provides them training for energy

savings techniques, baselines, equipment, and tools to affect improvements in buildings in the area.

MBCx is not only technologically advanced but also extremely cost-effective. MBCx includes the installation of permanent energy information systems and tools to monitor the building and sub-systems. This would include hardware meters at the subsystem level, software to analyze and display the data, and telemetry trending software. As sub meters become widespread, the costs for meters are projected to decrease to an estimated $500/meter per 5,000 sq. ft., for an average cost of $0.10/sq. ft. (Padmanabhan, 2012). By using software to analyze the data, building managers would also be able to centrally monitor the system to determine the overall effects throughout the building such as measurements for airflow and temperature settings and adjust accordingly when deviations and variations in the systems change.

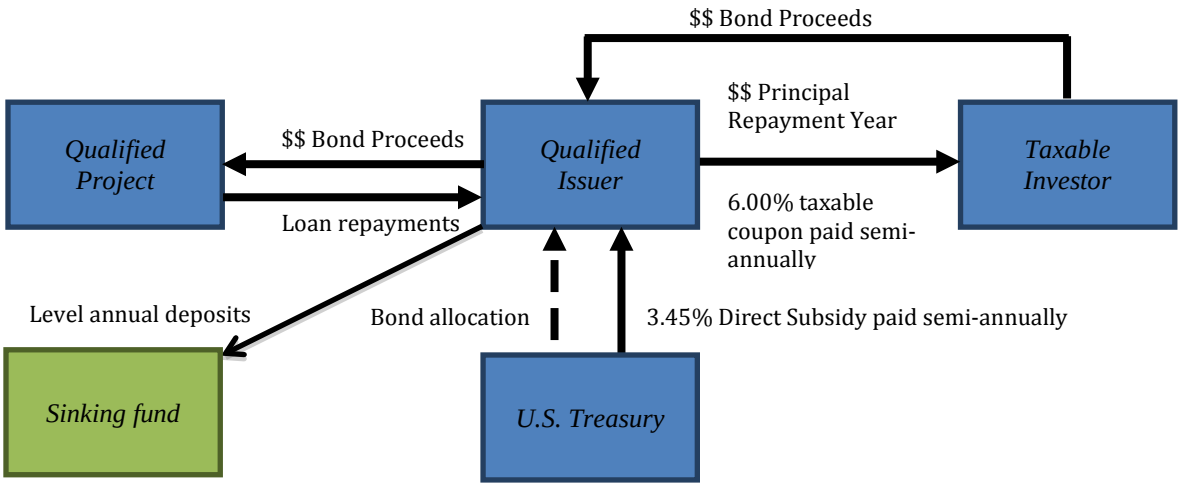
There is huge potential for MBCx to dramatically improve the persistence of RCx efforts and maximize gains from current efforts. However, MBCx needs to be coupled with affordable financing in order to enable RCx and energy upgrades to take place. Without access to capital, building owners cannot act on the information provided from the measurements within MBCx.

2. Issuing Qualified Energy Conservation Bonds provides affordable financing

The current rebate program through Houston's EEIP mitigates only addresses back-end costs, once financing has been secured. However, the hurdle for many projects is getting capital at the outset. Houston has an opportunity to leverage Qualified Energy Conservation Bonds (QECB) in order to address this problem. A QECB is a debt instrument that enables qualified issuers to borrow money to fund energy conservation projects (DOE, 2011). A big advantage to QECBs as a source of capital funding is their low cost to the issuer since the U.S. Department of Treasury subsidizes the issuer's borrowing costs.

Houston has a QECB allocation of more than $23M (Texas Bond Review Board) that could be put towards financing projects in the municipal and commercial buildings sectors. If Houston wanted to obtain more QECB allocation, it could potentially use allocations from any cities in Texas who have waived their allotment (DOE TAP Presentation, 2010). The State of Texas altogether has more than $250M in QECB allocations, none of which have been issued as of February 2012 (Texas Bond Review Board). Altogether, this amount of money available presents a huge opportunity to jump start a sustainable retrofit industry that will last past its allocation of Recovery Act dollars and to drive deeper energy savings in the City's current efforts to upgrade its municipal buildings and drive demand in the privately owned commercial building sector.

To illustrate how Houston's QECB issuance might work, we provide the following example:



The issuer (City of Houston) pays the $23 million of principal to the investor at the end of 20 years. To fund this lump sum payment at bond maturity, the issuer makes level annual deposits into a sinking fund. The level annual deposits consist of principal deposits the issuer funds plus annual interest earnings of 3.55% on these deposits for a total of $1,150,000 ($23 million/ 20 years) The annual principal deposit required to reach $1,150,000 annually decreases as cumulative interest earnings increase. While the maximum permitted sinking fund yield is 3.55%, actual market re-investment rates may be lower. The sum of all sinking fund deposits (principal + interest) cannot exceed the principal amount of the bonds.

Principle Amount	$23,000,000
Years to Maturity	20
Level Sinking Fund Payments	$1,150,000
Max Sinking Fund Investment Rate	3.55%
Taxable Rate	6.00%
Tax Credit Rate*	4.93%
Direct Subsidy (70% of TCR)	3.45%
Net Coupon Payment	2.55%

As of February 17, 2012

*Tax credit rate is published daily on https://www.treasurydirect.gov/GA-SL/SLGS/selectQTCDate.htm

Figure 2. Issuing QECB bonds provides an affordable source of public money for energy efficiency projects.

Adapted from DOE's QECB/CREB Primer (DOE, 2011)

Funds from Houston's EECBG grant could be used to support QECB issuance via a debt service reserve fund, capitalized interest fund, or principle sinking fund payments (DOE, 2011). A debt service reserve fund is established by a qualified issuer of QECBs for payment of debt service on QECBs in the event pledged receipts are insufficient. A capitalized interest fund is established as a separate account by a qualified issuer of QECBs that pays interest on the QECBs for a specific period of time. Lastly, a qualified issuer of QECBs can deposit level payments on an annual basis in a principal sinking fund to be used for retiring bonds at maturity (DOE, 2011).

QECBs can be used for a variety of purposes, including energy efficiency capital expenditures in public buildings; renewable energy production, energy efficiency education campaigns, as well as green communities programs. Congressional intent indicates that establishing programs to finance retrofits of existing private buildings through loans and grants is

permissible (DOE Clean Energy Finance Guide, 2010). The law also requires a 20% reduction in energy consumption (NASEO).

Figure 3. Hypothetical payments to sinking fund and to boldholder based on terms outlined in Figure 2.

Year	Principle	Interest Earnings	Level Annual Deposit	Net coupon payment	Total effective debt service
0					
1	$ 1,150,000		$ 1,150,000	586,270	$ 1,736,270
2	$ 1,109,175	$ 40,825	$ 1,150,000	586,270	$ 1,695,445
3	$ 1,068,350	$ 81,650	$ 1,150,000	586,270	$ 1,654,620
4	$ 1,027,525	$ 122,475	$ 1,150,000	586,270	$ 1,613,795
5	$ 986,700	$ 163,300	$ 1,150,000	586,270	$ 1,572,970
6	$ 945,875	$ 204,125	$ 1,150,000	586,270	$ 1,532,145
7	$ 905,050	$ 244,950	$ 1,150,000	586,270	$ 1,491,320
8	$ 864,225	$ 285,775	$ 1,150,000	586,270	$ 1,450,495
9	$ 823,400	$ 326,600	$ 1,150,000	586,270	$ 1,409,670
10	$ 782,575	$ 367,425	$ 1,150,000	586,270	$ 1,368,845
11	$ 741,750	$ 408,250	$ 1,150,000	586,270	$ 1,328,020
12	$ 700,925	$ 449,075	$ 1,150,000	586,270	$ 1,287,195
13	$ 660,100	$ 489,900	$ 1,150,000	586,270	$ 1,246,370
14	$ 619,275	$ 530,725	$ 1,150,000	586,270	$ 1,205,545
15	$ 578,450	$ 571,550	$ 1,150,000	586,270	$ 1,164,720
16	$ 537,625	$ 612,375	$ 1,150,000	586,270	$ 1,123,895
17	$ 496,800	$ 653,200	$ 1,150,000	586,270	$ 1,083,070
18	$ 455,975	$ 694,025	$ 1,150,000	586,270	$ 1,042,245
19	$ 415,150	$ 734,850	$ 1,150,000	586,270	$ 1,001,420
20	$ 374,325	$ 775,675	$ 1,150,000	586,270	$ 960,595
Total	**$ 15,243,250**	**$ 7,756,750**	**$ 23,000,000**	**$ 11,725,400**	**$ 26,968,650**

There are some conditions on their use. For example, a maximum of 30% of QECB allocations may be used for private activity purposes. In addition, all bond proceeds must be spent within 3 years or used to redeem bonds at the end of that 3 year period. Issuers must have a binding commitment with a third party to spend at least 10% of the bond proceeds within 6 months of the issuance date, and only 2% of the bond proceeds can be used towards cost of issuance (DOE, 2011). Aggregating QECB allocations from other cities who have waived their allocation can lower the issuance cost. The City can also cover any additional costs with an unsubsidized taxable bond (DOE Clean Energy Finance Guide, 2010).

We recommend that the City of Houston can use its allocation of Qualified Energy Conservation Bonds (QECBs) to pursue several options:

1) Drive deeper energy improvements in its municipal buildings within ESPC arrangements
2) Establish a revolving loan fund or do credit enhancements to finance commercial retrofit projects beyond the lifetime of the Houston Green Office Challenge
3) Pilot projects utilizing MBCx approaches in a select few of the Green Houston Office Challenge partners

Revolving Loan Funds (RLF)

Revolving loan funds can sometimes suffer from fund depletion over time. When capitalizing a revolving loan fund with traditional bond financing and adding administrative costs, each round of financing could deplete up to 30 percent of program funding (DOE TAP Presentation, 2010). However, by capitalizing a revolving loan fund with 20-year bullet QECBs, cities have a low net interest cost of less than 3 percent, which mitigates fund depletion, permits multiple rounds of funding, and allows the lower interest rate to be passed onto program participants, making energy efficiency improvements more affordable. While there are provisions to prevent interest rate arbitrage, the returns on the projects that QECBs can fund are high enough that the interest that the City would pay to borrow with the securities is more than offset by the energy savings that Houston would obtain from these projects (DOE TAP Presentation, 2010).

The City can structure interest rates in a RLF to be lower than ESPC financing rates and/or market rates, which makes its municipal projects more affordable and drives deeper energy savings since additional energy conservation measures can fit within the allowable term. An RLF can be used to fund a portion of an ESPC project such as the audit or an energy manager. Because many of these projects have a payback period less than the maximum allowable years of the QECB's maturity time, the revolving loan fund could undergo multiple rounds of financing. An additional benefit in having the City administer a RLF is that it could issue smaller loans to commercial buildings since small loan sizes required for certain energy efficiency retrofit projects can be challenging to arrange financing for in the marketplace. (DOE Clean Energy Finance Guide, 2010).

Other Credit Enhancements

If Houston chose to not establish a RLF, it could alternatively work with local lenders to create a loan product that is supported by any number of credit enhancements that are particularly suited to the commercial building sector. This could have the added advantage of engaging the private sector and disbursing money more quickly. The 20 percent energy savings requirement would still have to apply to any loans that the financial institution issued, and the city would need to coordinate a quality assurance protocol with the bank to ensure compliance with government regulations.

Figure 4. Houston can use QECB bond proceeds towards credit enhancements in order to jump-start lending.

Credit enhancements	Applicable sector
Loan loss reserves cover potential defaults within a loan portfolio. It is potentially useful in the small commercial sector where the target market consists of a larger number of small projects an financial institutions will be making a large number of small loans (DOE Clean Energy Finance Guide, 2010)	Small commercial
Debt service reserve funds cover the borrower's failure to pay its regular principal and interest debt service payments. They allow the loan to stay current while the borrower works out arrangements with the lender. This credit enhancement can be useful for large transactions (DOE Clean Energy Finance Guide, 2010).	Large commercial and/or big retrofit projects
Subordinated Co-financing describes two separate loans (senior and subordinated) that covers a project's financing. The subordinated lender takes on	ESCO project

greater risk, allowing the senior lender to put in more capital and charge a lower interest rate. (DOE Clean Energy Finance Guide, 2010).	finance programs

While QECB issuance can offer many great benefits to Houston, it takes several months to structure, market, price and close (DOE TAP Presentation, 2010). The City would need to evaluate how to stagger projects so that it could pay the coupon to the bondholder while making its annual deposits. Qualified issuers would need to first select eligible projects and consult their bond counsel for more information on the QECB opportunity.

3. Passing a city ordinance to disclose benchmarking creates greater awareness

The City of Houston is already making great strides to benchmark their own public buildings to track the performance of public buildings over time. Greater awareness on building performance is the first step towards drive better decision-making by identifying maintenance and control problems, prioritizing efforts, identifying savings and potential, and validating designs (Mills, 2009). The City has a great opportunity to encourage this practice in the private sector as well, by creating policies that will help transition privately owned buildings to benchmark as well.

The City has the opportunity to lead by example and to showcase the benefits of energy RCx and retrofits. It can improve upon what Arlington County, VA did in showcasing its commitment to reduce emissions from its own operations by 10% by 2012 (County of Arlington, 2012). Arlington County issues Energy Report Cards for each municipal building, and shows the site energy intensity by building for the past several years. Voters are able to observe how their city dollars are being spent wisely, while building managers can see real improvements in building energy loads. The Arlington County website also includes a number of case studies that reveal lessons learned for each building type (County of Arlington, 2012). In combination with MBCx practices, Houston could reveal more granular data that enables better decision-making.

Several cities provide ready examples of how Houston can structure an audit and disclosure ordinance. Features include phasing in small buildings gradually over time (SEE Action, 2011). The City of Austin has already started to implement an audit and disclosure ordinance.

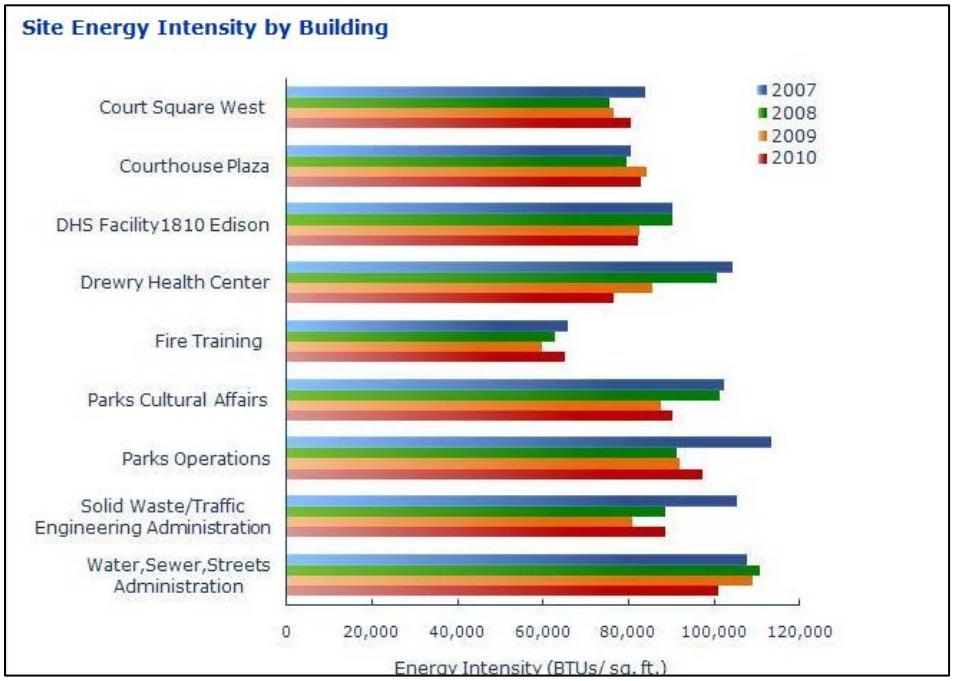
Benchmarking, however, is one of several complementary measures that comprise an effective commercial energy efficiency program. The City of San Francisco provides an example of leveraging building disclosure opportunities into energy audit opportunities (SEE Action, 2011). The energy audit requirement ensures that building owners are not only aware of their building's current energy performance but also of opportunities to improve. The ordinance also requires the city to disclose annual benchmarking results and audit compliance confirmation to the public after the second annual report. Owners are required to make annual benchmarking summaries available to tenants.

4. Coordinate resources to streamline reporting and disseminate resources

Houston can build online infrastructure that enables easy compliance and facilitates effective retrofit measures and enabled the GOC to integrate social media aspects that might enhance the outreach. Competitions could be set up between schools, or among similarly sized buildings within the GOC districts.

In the long term, a general reporting website can be built to facilitate ARRA and Davis Bacon reporting requirements, energy audit disclosure requirements and provide information on utility incentives, such as CenterPoint's free energy audit, and bulk purchasing options. Expediting the reporting process and enabling subcontractors to report their hours and wages directly to the grantee facilitates uptake of financing opportunities. If possible, Houston could start to centralize its resources for Office Challenge Participants on a central hub, paving the way for future energy efficiency projects to come.

Figure 5. The City of Houston can adapt the "report card" approach from Arlington, VA to showcase the results of retrofits on the city's buildings.



Utility support

Utilities have the unique ability to provide whole-building energy consumption data to building owners and are essential in overcoming the transaction costs related to benchmarking policy implementation (Institute for Market Transformation, 2011). Centerpoint and Reliant Energy could use proceeds from the systems benefit charge to service benchmarking, by reporting information to building owners in a form compatible with EPA Portfolio Manager. Allowing utilities to earn some credit toward mandated energy efficiency goals could align the incentives of both the City and the utilities (Institute for Market Transformation, 2011).

CONCLUSION

Houston must act promptly to pilot new technologies, prime local lending, lead by example, and support the sector with best practices and resources to build infrastructure that will last beyond the lifetime of federal Recovery Act dollars. Together, these actions maximize the opportunity for Houston to engage the private sector in making deep and sustained energy improvements and become a leader in commercial energy efficiency.

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