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Energy Metrics for State Government Buildings

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ABSTRACT

Measuring true progress towards energy conservation goals requires the accurate reporting and accounting of energy consumption. An accurate energy metrics framework is also a critical element for verifiable Greenhouse Gas Inventories. Energy conservation in government can reduce expenditures on energy costs leaving more funds available for public services. In addition to monetary savings, conserving energy can help to promote energy security, air quality, and a reduction of carbon footprint. With energy consumption/GHG inventories recently produced at the Federal level, state and local governments are beginning to also produce their own energy metrics systems.

In recent years, many states have passed laws and executive orders which require their agencies to reduce energy consumption. In June 2008, SC state government established a law to achieve a 20% energy usage reduction in state buildings by 2020. This study examines case studies from other states who have established similar goals to uncover the methods used to establish an energy metrics system. Direct energy consumption in state government primarily comes from buildings and mobile sources. This study will focus exclusively on measuring energy consumption in state buildings. The case studies reveal that many states including SC are having issues gathering the data needed to accurately measure energy consumption across all state buildings. Common problems found include a lack of enforcement and incentives that encourage state agencies to participate in any reporting system. The case studies are aimed at finding the leverage used to gather the

needed data. The various approaches at coercing participation will hopefully reveal methods that SC can use to establish the accurate metrics system needed to measure progress towards its 20% by 2020 energy reduction goal**.** Among the strongest incentives found in the case studies is the potential for monetary savings through energy efficiency. Framing energy conservation as budget enhancement is found to be a particularly useful approach in political environments that are not always receptive to climate change oriented efforts. For example, the NC Utility Savings Initiative claims to have saved over $400 million in avoided tax costs. The case studies reveal a wide range of individual successes as a result of energy conservation efforts. Despite the successes found, results indicate that most states have not obtained or completely measured progress towards their energy reduction goals.

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CHAPTER 1

INTRODUCTION

States, Agencies and Local governments have found the need to track energy consumption for reasons related to budget, energy security, air quality and carbon footprint. The gathering of detailed information from energy usage can assist policy makers in identifying potential savings. Energy information can also expose areas of wasteful spending and empower users to make better choices for investments in building infrastructure related to energy and monetary savings. Accurate energy metrics can then be used as the primary input for Greenhouse Gas (GHG) inventories. These inventories are essential to gauging the size of the U.S. government carbon footprint.

The passage of the Energy Independence and Security Act (EISA) in December 2007 contained provisions with GHG emissions reduction potential through Corporate Average Fuel Economy (CAFÉ), Title V Energy Savings in Government, and Public Institutions. EISA also included a reauthorization of State energy programs. About the same time as the passage of the EISA, several state governments passed laws and executive orders requiring energy usage reductions in their own buildings. President Obama's EO 13514 requires all federal government agencies to measure GHG emissions and has resulted in the first comprehensive inventory of GHG emissions by federal organizations (Executive Office of the President, 2011). EO 13514 establishes goals to reduce scope 1 and scope 2 emissions by 28% by the year 2020.

Standard GHG inventory protocol refers to scope 1 emissions as being direct emissions from an organizations buildings and mobile sources. Direct emissions can result from things such as an on-site natural gas boiler exhaust stack or tailpipe emissions from an organization's motor fleet. Scope 2 emissions generally refer to off-site emissions created as a result of the energy an organization consumes. The most common example of scope 2 emissions would be the electricity generated off site by a power plant and then transferred to a building through the electrical grid. Although the consumption of electricity within a building does not result in on-site emissions, the creation of that electricity likely resulted in large part from coal fired emissions at a power plant. Scope 1, 2 and other forms of indirect emissions known as Scope 3 are used to create the broader "carbon footprint" concept. A carbon footprint encompasses all emissions resulting from an organization or and individuals activities. Examples of the broader activities contributing to a carbon footprint include raw materials consumed by an organization. Emissions as a result of raw materials consumption, such as office paper, would normally be classified as Scope 3 emissions. Scope 3 emissions can also include GHG emissions resulting from daily commutes of employees.

Some state and local governments are also developing their own energy metrics and GHG tracking systems. Non-profit organizations such as the American Council for an Energy Efficient Economy (ACEEE), and the Climate Registry are often found to be closely involved with state and local energy tracking efforts. The Climate Registry (CR) has initiated an effort to establish GHG Inventory standards for sub-federal government entities in North America. To date, the database of carbon inventories available to the public through the CR's Climate Registry Information System (C.R.I.S.) only includes

entities at the state and local levels. However, no single state has been able to present a cumulative GHG inventory for its entire state government. A quick review of information available in the C.R.I.S. database reveals that these inventories are scattered and incomplete. Among the state governments that have contributed GHG information to the C.R.I.S.database, Massachusetts has made the most progress. Massachusetts's contributions to the Climate Registry, which includes several agencies and universities, are featured in a separate database on the Climate Registry website. Although Massachusetts represents the most complete source of GHG information for the CR's database, not all agencies and public universities are included. From a national perspective, the participation of state and local governments in the CR is patchy and incomplete. Gauging the size of the US sub-federal carbon footprint cannot be done with this resource alone.

Estimating the complete energy consumption/carbon footprint of all government agencies from the private sector is virtually impossible. Although a GHG inventory now exists for the federal government, accurately measuring energy consumption for the countless state agencies, universities, county and municipal departments at state and local levels is difficult and few reliable resources exist. The Energy Information Administration (EIA) as well the EPA US GHG Inventory Report group government energy consumption and GHG estimates into the transportation and commercial sectors[1]. Extracting the government contributions from these reports is impossible since the energy and economic statistics that contribute to the EPA's US GHG report are not designed to treat the government sector as a separate economic entity. Government buildings, for

[1] See the EPA's report at http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html and the EIA's Annual Energy Review at http://www.eia.gov/consumption/data.cfm#consumption

example, are included with private sector buildings in the commercial sector of the economy. The EPA's inventory presents the carbon footprint of buildings for the commercial sector as a whole. Estimates of building energy consumption for the government sector are available through the EIA Commercial Building Consumption Survey (CBECS) but this information has not been updated since 2003[2]. Likewise GHG emissions from government vehicles are grouped into the transportation sector which also includes all mobile sources from the private sector.

Energy related information can be used to guide policy makers and the public. Policy makers can learn more about their expenditures with the budget enhancement that information related to energy consumption can offer. The amount and types of energy consumed can allow policy makers to analyze which types of energy, such as electricity or natural gas, would be more cost effective for buildings. Instead of energy costs being a single budget item, energy can be divided into costs for computer hardware, building heating cooling, transportation etc. These areas can then be targeted to identify savings potential. Cost/benefit analysis can be performed for tradeoffs between fuel types such as such as ethanol vs. unleaded gasoline. Where and how much energy is being consumed can provide details for identifying where consumption is most and least cost effective in buildings. Buildings which consume more energy per person or per square foot can be identified. Decisions can then be made as to whether or not an organization should continue to use a particular building or if retrofits can improve the building in a cost efficient way. Energy consumption information can be combined with a life cycle

[2] See http://www.eia.gov/consumption/data.cfm#cec. The CBECS includes estimates for all three levels of US government. This survey was also conducted in 2007 but the data was not considered serviceable enough to be published.

analysis of building heating and cooling equipment for further effective use of retrofitting expenditures. The exposure of energy information to the public can also create incentive for governments to become more efficient.

The concept of information providing incentives for organizations to reduce their energy and material consumption has proven successful in other areas of environmental policy. Khana et al. 1997 and Caplan et al. 2003 describe how the public disclosure of information from the U.S. Toxic Release Inventory (TRI) provided incentives for private firms to reduce their pollution. The TRI was the first legislatively mandated database in the history of the U.S. government and represented the first time a U.S. law included a requirement that information be made publicly available in a computer database (Jobe, 1999). In order to make this data available, the EPA had to design a system that could store and distribute large amounts of data electronically in a manner that promoted easy access and use. The simple exposure of toxic release information from companies to the public is believed to be a direct cause of reduction in toxic releases from companies (Jobe, 1999; Caplan 2003). The release of information to the public or possibly high ranking government officials could have an effect on how people working in state agencies behave. State agencies who don't want to appear wasteful could begin changing behavior to conserve energy. This concept of exposed wastefulness through the public release of information appeared as a result of the TRI. Khanna et al. 1997 described how investors perceived companies generating more waste as being inefficient. The TRI has also been used by researchers to rank the environmental management policies of states. (Jobe, 1999) Excess GHG emissions from an organization could also be seen as wasteful because of its direct link to energy consumption. The vast majority of energy consumed

in any organization will have to result in Carbon Dioxide (CO_2) emissions, an inevitable by-product of combustion. CO_2 is by far the most common GHG created during the burning of fossil fuels. Other GHGs such as Nitrogen Dioxide (NO_2) also result from the burning of fossil fuels. These gases are more potent than CO_2 but the quantity of new CO_2 released into the atmosphere since before the industrial revolution is the most significant. Atmospheric concentrations of CO_2 since the beginning of the industrial revolution have increased from approximately 280 parts per million (ppm) to 400 ppm.[3] The cost of an organization's energy budget could be seen as a factor in its overall operational efficiency. Like the TRI, scope 3 emissions from an organization's GHG inventory could be used to analyze operational efficiency of material consumption from computer equipment purchases to consumption rates of office paper. A GHG inventory can offer budget enhancement in terms of detailed consumption rates for energy and materials while also providing details of an organizations environmental impact.

Energy expenditures are often reviewed on a monthly or quarterly basis with a "snapshot" analysis that does not show continuous trends in cost and consumption. Studies of consumer decision making when buying automobiles have revealed that buyers are often unable to calculate the long term cost savings of cars with higher fuel efficiency. This lack of knowledge can lead to irrational decisions. This irrational decision making process is further complicated when considering the other numerous variables involved in the car buying process. It has also been implied that the limited fuel use instrumentation available on most automobiles leads to less attention to fuel economy. (Kurani, 2004) Information such as converting miles per gallon into cost per

[3] CO2now.org is one of the most accessible references for tracking the rise of CO_2 concetrations in the atmosphere.

mile should lead to better awareness of operating costs for automobiles. (Goldberg, 1998) Other studies have also pointed to the consumer misperception of energy efficiency benefits because of a lack of information. This lack of information can even lead to over-expectations of the savings associated with a more fuel efficient automobile. (Parry, 2010) As with automobiles, detailed knowledge of energy consumption and expenditures provides the basic building blocks necessary to make calculated decisions for budget and GHG savings. Continuously providing information such as cost per gallon could help the consumer to understand the trends of monetary expenditures for fuel and lead to more rational decision making.

An energy management and benchmarking tool created by the EPA known as Energy Star Portfolio Manager (ESPM) may have the potential to function as a database of information similar to the TRI. This web based tool already contains energy consumption information for many government buildings. The case studies found in this paper will show that several states, such as New York, have utilized ESPM as their primary energy tracking and benchmarking tool. High ranking government officials and the public may find a complete energy usage database useful for assessing the operational efficiency of agencies and public universities. Requiring users to report information consistently empowers them to make better choices. The Climate Registry represents one way in which a tracking and reporting standard has been established for metrics related to energy use through verifiable GHG inventories. Energy benchmarking, such as the scores available through ESPM, can present indicators of financial as well as environmental performance in government. Energy consumption and expenditures can be used as a public information tool through government transparency. The repeated

provision from year to year of the TRI has allowed investors to track changes in the environmental performance of firms. (Khanna, 1997). Likewise an energy metrics system in government can allow policy makers to track the changes and improvements in money saving energy efficiency efforts.

Stolaroff et al. 2009 suggests that GHG inventories for private sector industries should include a system for identifying corporate ownership of reporting facilities. Identifying the corporate ownership or "brand" from which these emissions originate would likely have an influence on consumers. This effect on consumers is based on the assumption that consumers would begin to associate a brand with higher or lower GHG emissions. Just as the TRI influenced the decision making process of investors, consumers may begin to choose brands that they perceive as more "environmentally" because that product has a lower carbon footprint. This concept could have a similar effect on the mind of voters if the carbon footprint of government entities is known. Stolaroff also comments on the value of "Scope 2" (indirect emissions from purchased electricity) vs the more direct "Scope 1" emissions that may be generated on site through equipment such as a natural gas boiler. Scope 2 emissions for government buildings is likely to be the largest contributor to the overall carbon footprint. Tracking the cost of energy consumption in buildings would make the information necessary for calculating Scope 2 emissions readily available. Once this information is available, simple algorithms can be used to calculate GHG emissions.

The examples listed in this introduction introduce concepts of transparency and budget/ trend analysis that can be applied to energy databases. If all government agencies were to enter and track their data into established systems such as ESPM and the

Carbon Registry, a consistent source of information could develop. Policy makers and the public could use this information to assess the operational efficiency of their government agencies. The benchmarking information available from such databases could assist policy makers in managing the energy consumption that is measured. Better management of energy consumption will lead to budget and emissions savings.

This study examines case studies from state governments that have established energy conservation/efficiency goals or measurement systems to identify the methods used to establish useful sources for energy metrics systems. Energy consumption in state government involves two primary types: buildings and mobile sources. Table 1 lists states which have issued laws or executive orders outlining energy conservation goals for public buildings and the deadlines for meeting them[4].

Table 1.1 **Energy Efficiency/Conservation Laws and Executive Orders for State Governments**

State	Percent Reduction	Date(s) Goal is to be Met	Total Percent Reduction	Baseline
Alabama	10%, 20%	FY 2008, 2010	20%	**FY 2005**
Colorado	20%	FY 2011-2012	20%	**FY 2005-2006**
Delaware	10%, 20%, 30%	FY 2011,FY 2013, FY 2015	30%	**FY 2008**

[4] Minnesota has not established a goal date but has been included in the following list because of its relevance to this study.

Florida	GHG reductions of 10%, 25%, 40%	2012, 2017, 2025	40%	**2007**
Georgia	15%	2020	15%	**2007**
Illinois	10%	2018	10%	**2007**
Iowa	15%	2015	15%	**2008**
Kentucky	10%	Annual Energy Cost		
Maryland	5%, 10%	2009, 2010	10%	**2000**
Massachusetts	20%, 35%	2012, 2020	35%	**2004**
Michigan	25%	2015	25%	**FY 2001-2002**
Minnesota	20%	none set		
Missouri	2%	Annually for the next 10 years starting in 2009	20%	
Nevada	20%	2015	20%	
New York	35%	2010	35%	**1990**
North Carolina	20%, 30%	2010, 2015	30%	**FY 2003-2004**
Ohio	5%, 15%	2008, 2011	15%	**FY 2007**
South Carolina	20%	2020	20%	**2000**

Texas	5%	Each year for 6 years beginning in 2010	30%	
Washington	10%	September 2009	10%	**FY 2003**
Wisconsin	10%, 20%	2008, 2010	20%	**FY 2005**

This table was compiled using a combination of the DSIRE and ACEEE databases. All states found in these two databases with either an Executive Order or Law for energy reductions are listed. Similar energy policies with energy reduction goals originating from areas other than the executive and legislative branches may exist in other states.

All of the laws and executive orders passed in Table 1.1 include energy conservation/efficiency goals in public buildings expressed as a percentage reduction. The study will focus on the common trend of measuring energy consumption and energy efficiency goals in state buildings. The reader should be aware that language within the various legislative actions and executive orders for meeting the goals in table 1 can vary from state to state. For example, Alabama (AL) state government set a goal of 10% energy reduction in all "conditioned", state owned facilities by Fiscal Year (FY) 2008 and a 20% reduction in the same manner by FY 2010.[5] Other states such as Ohio (OH) specify their goals for buildings owned or *leased*.[6] Such language can have a heavy influence on where and how energy usage must be tracked across state government systems. Many states which pass their laws as part of an executive order choose to impose their energy conservation efforts only on agencies which are part of the "executive branch" or those agencies in which the governor has direct authority[7]. Other

[5] AL Executive Order 33
[6] OH House Bill 251 and Executive Order 2007-02S
[7] See NY Executive Order No. 111 which states "for state agencies and departments under the Governor"

differences include the incorporation of water conservation efforts[8]. Also, some states such as Massachusetts and North Carolina designate total energy reduction goals from all fuel and electricity usage as BTU's per square foot. Others states such as Michigan and Nevada specify only *purchased, grid-based electricity.* The following case studies will reveal different approaches among the various states studied. The overall attitude in a state government towards energy efficiency can influence whether the deadline requirements are truly treated as goals or if they are merely aspirations.

The following case studies will feature energy conservation, emissions and budget savings. Throughout the studies a relationship between energy consumption at buildings and emissions reductions at the energy generating source is apparent. One of the goals is to explore the cost saving oriented motivations of energy efficiency measures and their relationship to the often separate but co-dependent goal of of GHG mitigation. In the U.S., 1 kilowatt hour of electricity equals approximately 1.3 pounds of CO2 emissions. (DOE, 2000) A reduction in carbon footprint for building(s) will almost always lead to less power consumed leading to lower costs for energy for the building(s). Verifiable GHG inventories usually require various types of energy consumption such as natural gas and electricity to be accounted for separately, since the ultimate emissions from these different energy sources are create varying amounts of GHG emissions. Energy budgets can also separate different sources of energy to analyze cost effectiveness. Some studies such as Massachusetts show that climate and energy goals can be integrated. Other cases such as North Carolina will have a more budget oriented focus. The Texas example will show the air quality benefits of energy efficiency/conservation. The research conducted

[8] See North Carolina Senate bills 668 and 1946

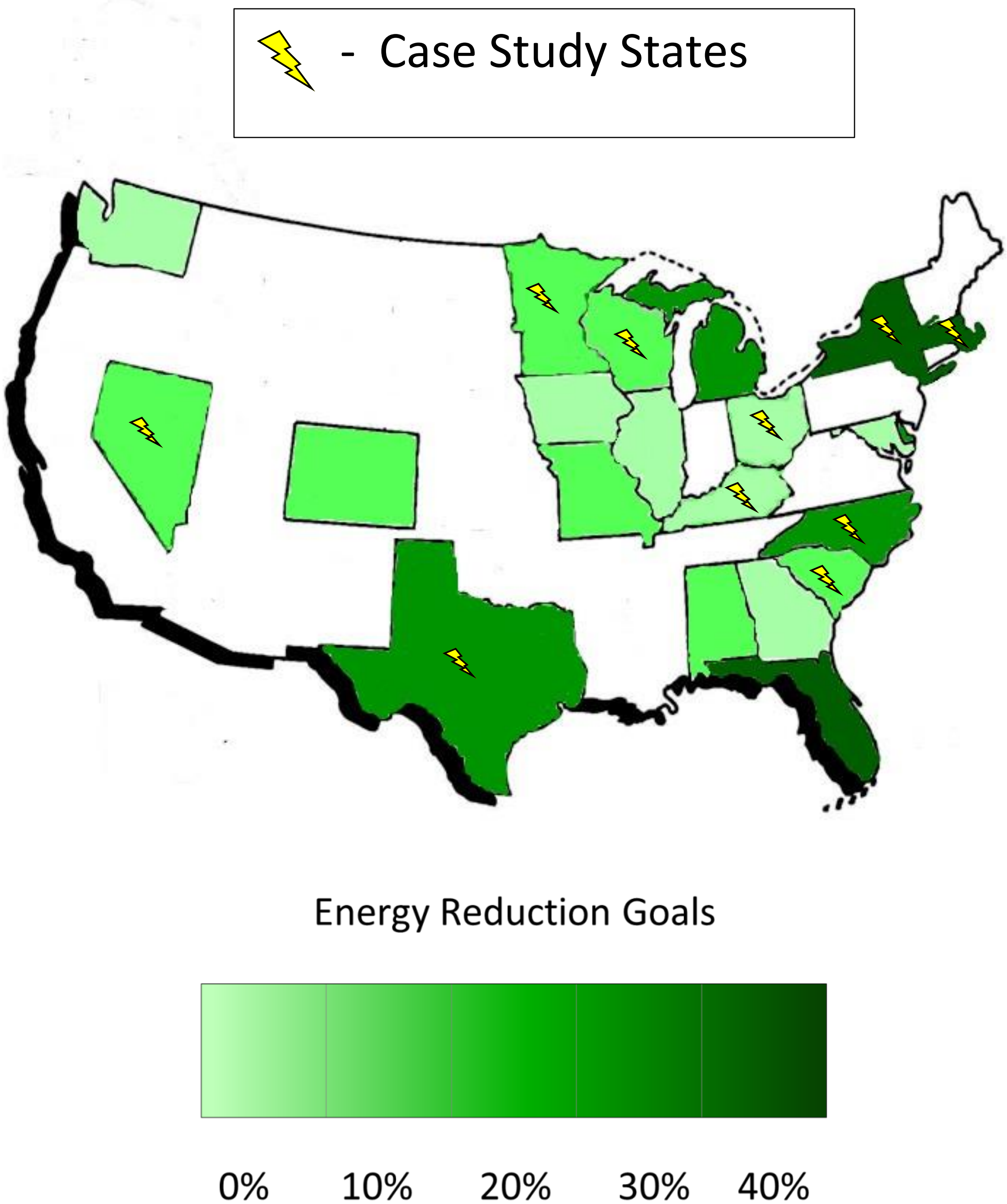
in this study will reveal that reducing cost can be a major motivator for the implementation of energy efficiency/conservation measures in the public sector**.** In addition to budget savings energy metrics is also a critical element for verifiable Greenhouse Gas Inventories (GHG). These same inventories are almost always accompanied by goals for reduction of carbon footprint. GHG reduction efforts can often directly translate into reductions in energy related costs.

This study will reveal that regional trends in energy tracking and consumption reductions are similar to regional trends in environmental policy engagement. With states managing over 90 percent of environmental programs, the federal government also has interest in how transfer dollars are spent. (Rabe, 2010) Funding from EISA and the more recent American Reinvestment and Recovery Act (ARRA) has had a direct impact on state energy agencies. ARRA funds have particularly left a direct mark on many of the programs found in this study. Organizations such as the National Association of State Energy Officials (NASEO) and the Climate Registry offer sizeable networks of professionals interested in policy innovation related to energy and emissions management. The creation of task forces and committees is a common theme throughout the case studies. This creates new opportunities for policy innovation in state government. Many of the innovations found in this study are shown in the form of incentives that state energy offices use to collect the data needed for energy usage analysis. While some states have taken a leadership role in energy management, others have sought an economic advantage by imposing as few environmental policies as possible. Almost none of the southeastern states featured in this study have any form of public outreach for their energy management efforts. Only the state of Kentucky displays

any type of leadership role in innovation with its technological approach to managing its energy consumption. Other regional issues that emerge are related to the quality of data. "Many efforts to rank states according to their environmental regulatory rigor, institutional capacity, or general innovativeness find the same subset of states at the top of the list year after year". (Rabe, 2010) This study will show that states such as Massachusetts and New York, who often find themselves near the top of environmental policy rankings, are also showing leadership in their self-imposed energy management programs. Innovation is also found in states such as Texas who is consistently be ranked in the middle in terms of environmental policy engagement. This study will show that some states have focused on the GHG reduction potential of self-imposed public building policies. GHG and related emissions management can force programs to focus on conserving energy rather than becoming more energy efficient. Fewer emissions from an organization can only result from a reduction in overall energy consumption. In contrast, a focus on energy efficiency in per square foot or per person terms may not result in less overall energy and emissions if on organization grows in size. A focus on emissions is generally more oriented towards actual reductions in total emissions rather than on a per square foot or per person basis.

The states chosen for case studies were the ones that generally had the most information readily available for research. Many states not chosen had no mention of their internal energy conservation programs on their websites. A visual representation using this research approach can be seen in the map that follows. All states listed in Table 1 are outlined. States represented in the case studies are shaded according to the amount of percent-energy reduction goal.

State Government Energy Reductions



Some of the policies found specify state agencies while others will specify state-owned buildings. Policies that specify state agencies could imply that property not owned by state government would be included in the energy reduction goals and thus the state's energy metrics system. Issues regarding tracking energy in leased property will be discussed throughout the following sections of this study. Many state agencies operate in buildings shared with local government and private sector entities. These buildings can be owned by the state, local government or a private entity. Such buildings will often have one meter for the entire building for which the owner of the building pays the utilities. Separating the energy consumption of the various tenants within these buildings is difficult without the added cost of sub-metering. Many of the laws and executive orders found in table 1 use the term "Energy Conservation" although the actual base metric for measuring progress in in some form of Energy Usage Index (EUI). EUI is often represented as energy usage per square foot. Energy from electricity and natural gas are converted to BTU's and then commonly expressed as kBTU/s.f. State laws and executive orders entitled as "Energy Conservation" often do not represent conservation in its truest sense. Policies will often state that energy per square foot is to be reduced rather than a total energy reduction. The number of buildings in a state government could increase to the point that more energy is consumed despite the fact that energy on a per-building basis has decreased. Thus a government system could become more efficient in its use of energy without conserving energy by reducing its overall energy consumption.

Whether or not a policy originated as an executive order can have implications to the direct involvement of a state's governor which in turn can have implications for the execution of the policy. This theme will also be found in some of the case studies that

follow. Some of the states in Table 2 have created multiple policies of different origins for their energy goals. The third column of table 2 is designed to focus on the original policy that was passed. Table 2 is designed to display some of the common themes and differences in the way the policies were originally written.

Energy efficiency in government can help to reduce the tax dollars spent on energy bills leaving more resources available for services to the public. (ACEEE, 2010) The KY and NC examples found later in this study will show how strongly some states have correlated their efforts with monetary savings. In addition to monetary savings, conserving energy can help to promote energy security, air quality, and reducing carbon footprint. Energy efficiency/conservation in state governments is primarily focused on two areas, mobile fleet management and commercial buildings. This study will feature energy metrics across state-owned and leased commercial buildings although many of the incentive and leverage concepts presented in this study could also be applied to the tracking of mobile fleet fuel consumption.

A state government-wide energy metrics system across a large, diverse group of commercial buildings can provide the data necessary to compare and contrast energy usage from multiple buildings together at one time. This effort can help to identify “energy hogs”, allowing retrofitting resources to be targeted for maximization of their value. The main elements of any effective energy tracking system are benchmarking, analyzing and management of energy expenditures both in terms of utility billing and efficiency investments. (Guess G., 2009) Utility billing can be audited to determine if utilities have applied inappropriate rates to government buildings. If buildings have been overcharged for their power consumption, money can be reclaimed from the utilities.

This represents another way that energy metrics can be used to save money. Utility billing audits can be integrated with energy efficiency since both efforts use the same information. The Kentucky and Nevada examples found in this study will show how this integration can be done. Once the reporting and metrics system is established, buildings can be benchmarked for optimal performance. Once the benchmark is established for a particular building, that baseline can be set against the actual operating parameters to measure energy and money saving potential.

Creating a consistent and accurate reporting system in which all subject state agencies, public schools districts, public universities, etc. are willing to actively participate is the first step to establishing a useful energy metrics system. None of the energy offices found in these case studies feature the use of direct enforcement to encourage reporting cooperation. The case studies will show that states use a variety of incentives for reporting purposes. A major goal of this study is to identify these incentives in the absence of direct enforcement mechanisms.

CHAPTER 2

The Case Studies

Massachusetts

The state of Massachusetts (MA) has been designated as the first case study because its GHG inventories are featured prominently on the CR website. Much of MA state government energy policy creates a model example from which other states can learn. In 2007 the Governor of MA issued Executive Order 484 creating the *Leading by Example* program. This program integrates GHG reductions and renewable energy targets with energy conservation goals. State-wide GHG reduction targets were set in line with the IPCC goal of 80% GHG reductions worldwide by 2050. (IPCC 2010)

The integration of different sustainability goals for MA is displayed below:

Renewable Sources	Energy Reductions	GHG Reductions	Goal Date (FY)
15%	20%	25%	2012
30%	35%	40%	2020
		80%	2050

GHG inventories for numerous institutions in MA government have been compiled and uploaded to the CR C.R.I.S. database. The MA portion of the C.R.I.S. database only includes the organizations which the MA executive office feels it has good data and does not include all of MA state government.[9] Much of the energy usage data readily available for MA state government is represented as a GHG inventory. An FY 2007 GHG inventory for MA state government, totaling 1.2 MMT of carbon dioxide equivalents (CO2e), revealed that buildings were responsible for 90% of GHG emissions in MA state government. The remaining 10% resulted largely from transportation related activities. [10] The fact that 90% of GHG emissions came from buildings in the MA example highlights the strong link between commercial building energy conservation and GHG reductions.

To date, MA has not completely quantified its overall 2005 baseline or its current total energy use. The Executive Office has experimented with using cost to estimate past power usages by calculating average cost per kWh year in order to establish the 2005 energy usage baseline at each facility. With regards to current energy consumption, MA is attempting to account for all leased buildings as well as those that are state-owned. It is however unlikely that every building, in particular smaller ones, will be accounted for. Most information that the MA Executive Office has available is coming from owned buildings rather than leased. Leased buildings in MA state government are often shared with other public and private entities creating issues with responsibility for paying power bills. Shared building situations make it can be difficult to separate power consumption between the different entities if only one power meter exists for an entire building.

[9] MA data is represented separately from other states and territories data in the C.R.I.S. database. See https://www.crisreport.org for more details

[10] Pg 7 of the Report on Sustainable Programs and Practices at Massachusetts State Agencies 2003-2008

The program director of the MA Leading by Example feels that overall accounting will be close to 90% of the 60 million square feet of commercial building space that houses the 161 agencies comprising MA state government. Currently, the hope is that totals will be quantified by the end of FY 2012 coinciding with the first energy reduction goal date. The director does not feel that the 20% energy reduction by FY 2012 goal will be met[11].

In terms of implementing a measurable reporting standards program across MA state government, the *Leading by Example* website includes outreach information such as brochures, a reporting form, and workshops for state agencies. Instructions on how agencies can submit grant applications for energy efficiency projects and other various outreach such as “Office Green Easy-Tips” is also included.

Roughly 2/3’s of MA’s agencies are reporting in a handful of different ways, depending on what is practicable. Some agencies fill the form available on the MA executive office website while others are sending utility bills directly to the Executive Office. Although the MA Executive Office has no enforcement mechanisms to encourage agencies to report their energy usage accurately, it has found that “peer support” (or what may be better described as “peer pressure”) has been the main angle they can use to get agencies to comply with reporting obligations.[12] This peer support approach mostly consists of notifying non-reporting agencies of all the ones that have complied. Similar to what was found in the KY example, the MA Executive Office hopes to be able to take advantage of obtaining energy usage data directly from utilities.

[11] Interview with Eric Friedman, Director of the MA Leading by Example Program 3/30/12
[12] Interview with Eric Friedman, Director of the MA Leading by Example Program 3/30/12

MA has also taken advantage of their public university systems to help achieve energy conservation goals. The MA approach includes acknowledgement of the American College and University President's Climate Commitment (ACUPCC) which also recognizes the 80% GHG reduction by 2050 goal set forth by the IPCC. Signatories to this commitment are required to establish a GHG inventory and establish and submit an action plan for becoming climate neutral "as soon as possible"[13]. Current results of this commitment include over 1500 GHG Inventories submitted over multiple years and 450 action plans. The ACUPCC reporting system provides a useful resource that contains more readily useable information in a more efficient manner than the CR's C.R.I.S. database. In all case studies represented in this paper, public universities seem to be the most consistently reliable state government entity for tracking and reporting energy usage. As can be seen in the WI example, public universities can also represent a huge portion of the overall energy consumption for state government.

Kentucky

Kentucky (KY) has been chosen as one of the first featured case studies because of its innovative approaches to energy management. KY Executive Order 2005-122 established a 10% energy cost reduction goal in state facilities. As part of KY's effort to attain this goal, a $3.65 million ARRA grant was used to create the Commonwealth Energy Management and Control System (CEMCS). The pilot phase of this centralized

[13] Available at http://presidentsclimatecommitment.org/

system currently tracks energy usage in 23 public campuses for a total of 43 buildings across the state of Kentucky. The CEMCS “dashboard” website provides live information on energy and monetary savings to the public. The dashboard website claims to have saved approximately $1.2 million in energy expenditures compared to 2009 baseline usage and to have saved a total of 12.5% in energy usage. Like many of the examples found later in this study, the energy reduction total includes only a select group of buildings and is not representative of all buildings in KY state government. According to grants written for the CEMCS, some buildings in its system are saving as much as 50% in energy costs. (Guess, 2010)

The four components of the CEMCS system are utility monitoring and analysis, building automation integration and diagnostics, centralized automated utility bill payment, and work order generation and tracking. Essential metrics to accomplish CEMCS tasks are utility account numbers, meter number, vital building stats, occupancy numbers, schedules, equipment lists and any unique energy usage types. (Guess, 2010) The KY CEMCS is a ground breaking technological approach that could potentially provide other state and local governments with a model example of how energy can be managed and tracked. As the CEMCS leaves its pilot phase, the goal will be to integrate 400 more buildings in the next 2 years and ultimately integrate all 1759 state owned buildings across KY state government. All buildings in the system are state owned but some have local government entities sharing space with government agencies.

Like several of the other case studies, the KY CEMCS system has found some success in tracking energy data directly from utilities. The CEMCS then takes this advantage a step further by automating this process through the use of software. Power

bills can be paid automatically to utility companies through a data exchange between utility records and the CEMCS system. The synchronization of the CEMCS system between state buildings and power companies can help agencies to avoid late fees and unfavorable billing rates. One of the major hurdles in compiling billing invoices from various agencies into a single source is accommodating the many different types of operational software that various state agencies are using. The CEMCS uses a program known as "Energy Witness" to transfer data from the different operational software types that various agencies in KY are using. (Guess, 2009) Software known as EDI allows data exchange between the CEMCS and utilities for billing purposes. Another software entity known as eMARS is used to pay utility bills. The automatic usage and billing data exchange between KY state agencies and power companies has consisted of only the larger utility companies to date. No electric cooperatives have participated in the automated exchange. As found in several of the following case studies issues can arise when state government systems are dealing with a variety of utility types such as electric cooperatives and municipal sources. Also, some of the fuel usage data that the KY CEMCS system collects such as natural gas cannot be exchanged automatically. The non-automated data can be gathered from energy bills if necessary but this creates some lag in the continuous monitoring process. A property management database known as Archibus is also housed by the CEMCS. Archibus provides building info such as location, use and square footage. Included in total square footage calculations are parking garages; parking lots are not counted.

One of the key elements of any energy tracking system that the CEMCS provides an excellent example for is benchmarking. Using the information provided by Archibus,

benchmarks for energy usage norms normalized for weather and efficiency goals are customized for each building. CEMCS allows the monitoring of building energy usage compared to its benchmarks to be observed continuously in real time. If a building is operating outside of its normal operating parameters the CEMCS will automatically generate e-mail and text alerts to on-site and CEMCS personnel. Building maintenance and repairs as a result of these alerts are tracked through software known as FMWorks.

Where feasible, the CEMCS system has the capability to control energy consuming equipment such as boilers, lights and chillers remotely from its central location. Although the CEMCS has no formal enforcement in terms of penalties for non-compliant agencies, it does possess properties similar to enforcement in the form of remote capabilities. The CEMCS is also capable of tracking energy usage of individual equipment through the use of sub meters and "smart meters". In some cases, utilities in KY have installed a single power meter for a campus or group of buildings. As a result, total building usage is sometimes tracked as a group rather than energy usage at each individual building. This is the reason for the discrepancy between the number of "campuses" monitored (23) vs. the number of buildings monitored (43) mentioned in the first paragraph of this case study.

The essential output metric of cost savings is also displayed by the CEMCS continuously in real time. The CEMCS dashboard website features these cost savings prominently. Displaying cost savings through the dashboard website is a huge selling point to the public and state agencies outside of the CEMCS system. Budget strained agencies will naturally be attracted to this system because of the money savings results that it is able to show. The cost-savings metric provides a "proof of concept" in selling

this system inside and outside the state of Kentucky. (Guess, 2009) Each agency within the KY state government system typically pays its own utility bills creating a natural incentive for saving on energy costs. KY differs from many states in this aspect. Other examples found in this study will show that state agencies often used leased space and do not pay utility bill directly. These leasing situations can create incentive issues among the occupant agencies to implement energy related, cost-saving measures.

Despite only having 43 buildings in its system to date (approximately 2 million square ft and 7000 occupants), the $1.3 million in energy savings from this system are significant and show promise for justifying the 3.65 million in ARRA grant expenditures[14]. The software in the KY example shows us that cost saving can be generated not only through energy conservation but also through monitoring of billing rates to assure that the most favorable rates is secured for each facility. The benefits of auditing bills can be integrated into energy tracking and reporting efforts to generate instant revenue. For example, the KY CEMCS dedicated two staff members to audit power bills in state buildings for one week. This effort produced over $200k in recovered energy bill expenditures[15].

Minnesota

Minnesota's (MN) Executive Order 11-12 established a goal of energy reduction in state facilities by 20%. The goal established for MN does not set a date for the 20% goal to be

[14] Continuous statistics are available on the Commonwealth Energy Management and Control System dashboard website at http://kyenergydashboard.ky.gov/

[15] Interview with Dick Mink of the KY DEDI 10/11/12

met nor does it establish a baseline year as found in the other case studies. MN's energy conservation effort with public buildings is actually a series of laws and executive orders dating back to 2001. Through legislative acts in 2001 and 2002, MN laid the groundwork for the creation of its Benchmarking and Beyond or "B3" database. In 2004, this database began collecting data for MN public buildings. As of January 4, 2008, the B3 database was tracking over 4,000 state and local government buildings. (ACEEE, 2008)

The MN Department of Administration and the Department of Commerce were required to maintain information on all public buildings, local as well as state, leading to the creation of the B3 database. The B3 database was specifically designed to guide resource allocation for building retrofits and other conservation measures. The B3 system includes parametric models based on the MN energy code. This means that baseline or ideal operating parameters for each building in the system are designed with the assumption that the buildings are built to current MN state code specifications. The B3 models were also developed with DOE2 models to match public energy stock in MN. (ACEEE, 2008) This allows the B3 database to base its benchmarks off of utility energy services specific to MN. It also allows the models to be based on climate information specific to the different regions in MN.

During the early phases of designing and implementing the B3 system, designers set out to compile a list of public buildings and identify "stakeholders". These stakeholders were defined as a person for each building who can supply building consumption data such as a building manager, an owner or possibly even someone who works for the utilities. An important lesson learned from the implementation stages of the B3 system is that there was a "tradeoff between the amount of information that could

be acquired and the willingness of participants to invest the time to supply the data". (ACEEE, 2008) This is an issue for any reporting system that lacks enforcement, as can be found in all case studies. The initial information gathered for the B3 system was very basic and short to help encourage cooperation. The system gathered this "Tier 1" information in the form of space usage types, building area and hours of operation. Buildings that were identified as candidates for having the most potential for energy savings were then investigated further for more specific information such as special uses and history of retrofits. (ACEEE, 2008) Another related feature of the B3 system is that it will query the user for this same Tier 2 information. The Tier 2 information gathered can then be used in a fashion similar to the Life-Cycle Analysis concept found in the KY example.

Pilot tests for the design of the B3 system were performed using three different reporting options, paper, e-mail and web based. These tests revealed that a web-based reporting approach was ideal for providing immediate feedback. Users could get this instant feedback in graph form on energy usage trends and expenditure trends as they are entering information into the system. This provided an instant gratification appeal that appealed to users and attracted them to continue using the B3 system.

Because the B3 database was created and in use before the onset of ARRA funds, the MN example provides us with the opportunity to observe the benefits of a benchmarking and tracking system when a stimulus of funds dedicated to energy conservation measures is received. The Public Buildings Energy Efficiency Enhancement Program (PBEEEP) was funded primarily with ARRA funds totaling $4 out of a $5 million total budget. The PBEEEP initiative was managed largely by the MN

Center for Energy and the Environment (CEE) which also provides the MN case study with an opportunity to observe the relationship between non-profit organizations and government in energy conservation efforts. This non-profit relationship is a unique aspect of the MN example that is not found in the other case studies.

The PBEEEP program used B3 data to identify building commissioning potential. PBEEEP funds were separated into two parts, one for local government buildings and one for state buildings, the latter being the main focus of this thesis. PBEEEP commissioning was able to use the B3 database to identify 2,986 state buildings comprising 74.9 million S.F. prior to the screening phase. These buildings had a mean EUI (kBtu/s.f.) of 67. (ACEEE, 2012) The B3 system excludes any building that is less the 5,000 S.F. An important observation made by PBEEEP was the focus on a holistic commissioning approach vs. the widely used auditing approach that is more snap-shot oriented. (ACEEE, 2012) A long-standing energy metrics system with many years of data can provide the information necessary to observe energy consumption trends rather than snapshots of buildings over a short period of time. The benefit of being able to identify these trends was displayed during the four phases of the PBEEEP building commissioning process.

Steps identified for the PBEEEP commissioning approach were Screening, Investigation, Implementation, Measurement and Verification. The B3 system includes filters that can help decision makers identify the buildings with useable information for screening purposes. For example, these filters can be set to only include buildings with at least 12 months of data to analyze energy usage in the past year.

Not only could B3 data be used in the screening phase to identify building size, age, condition, ect. but the PBEEEB initiative also shows us the potential of how a metrics system can be used during the verification phase of a commissioning project. Energy conservation funds, such as provided by ARRA, are often earmarked to be used within a certain period of time with specific payback period expectations. In the case of the PBEEEP, a payback period restriction of 3 years was in place due to ARRA funding. Because the B3 system has been tracking the buildings commissioned before and after the implementation of energy efficiency measures, those pay back periods can be monitored for verification.

Results of the PBEEEP retrofits to date have shown that there was no correlation between actual savings in participating buildings and the various benchmark ratios calculated for buildings in the program[16]. All participating buildings regardless of benchmark score have shown to be good candidates for retrofits. Administrators of the PBEEP program believe that a combination of factors which comprise the single benchmark number could be causing this lack of correlation. Administrators also believe that using various inputs to create a single benchmark number does not help to reveal much about the potential savings for a building and that the necessarily low cost and easy-to-use nature of the B3 system causes its model to be somewhat rigid. Therefore the benchmark number driven by this model "should be considered a +/- 10% estimate, rather than something more precise"[17]. The MN PBEEEP example displays the tradeoff between an easy to use reporting system that encourages participation and the usefulness of benchmarks created from such a system.

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[16] Direct communication with Chris Plum of the PBEEP staff 10/15/12
[17] Email communication with Chris Plum, MN PBEEP staff 10/19/12

The commissioning approach found in the MN example can provide guidelines for retrofitting efforts in other state governments. The metrics system will have to be able to calculate payback periods for any retrofits. Payback periods should also be adjustable to accommodate the pressures placed on any funding received for the implementation of energy efficiency measures. An example of such an adjustment can be found in MN where projects using ARRA funds had to be designed with a payback period of no more than three years. The original aim of the B3 system was to design projects with a payback period of as much as 15 years. (ACEEE, 2008)

Nevada

In 2005 Nevada (NV) Revised Statute 701.215 was issued requiring state agencies to reduce their grid-based electricity consumption 20% by 2015 from the 2005 total consumption amount. The 2011-12 State of Nevada Status of Energy Report states that NV reduced energy consumption in state buildings by 6.3% from 2005 to 2011. This number is set against the 2005 baseline and is based on per square foot consumption. The EUI was reduced from 16.24 kWh/s.f. in 2005 to 15.22 kWh/s.f. in 2011. These numbers come from grid-based, electricity usage only and do not include other forms of site energy consumption such as natural gas. The NV State Energy Office and the NV State Public Works Division believe that another 1% reduction can be accomplished from remaining ARRA retrofit funds. (NV State Energy Office, 2012) According to NV State Energy Office Personnel, approximately 2800 state buildings are being tracked. Since 2005 the state has added 2,383,801 square feet of building space for a total of 23,526,624.

The 6.3% energy reduction is believed to have been accomplished largely from lighting projects in which incandescent bulbs have been changed in favor of more energy efficient types such as CFL's. Public schools are not currently included in this tracking program.

NV has one unique advantage not shared by most other states in that 95% of its buildings are supplied electricity by one power company, NV Energy. This has allowed the NV State Energy Office to easily gather its electricity consumption from this single utility. Each month NV Energy sends the State Energy Office a spreadsheet showing the electricity consumption from each meter that monitors state buildings. There are situations where multiple buildings will feed into one meter so the consumption data is not always specific to a single building. Similar to the KY example, efforts to recover money due to energy billing errors have been made. To date $8,744 has been recovered from this effort for NV state government.

The NV State Public Works Division (SPWD) manages building maintenance for state properties. The NV SPWD and NV SEO have successfully shown an ability to create a partnership for the benchmarking and implementation of retrofits in NV public buildings. As explained in the NV State Buildings Benchmarking Report, the SPWD was responsible for identifying retrofit projects with simple payback calculations designed with a goal of 10 MBTUs per $1000 spent. Verifying savings from ARRA funds is a key focus of the NV State Buildings Benchmarking Report as the buildings monitored in this study are the same buildings which received ARRA funded retrofitting projects. Such a system can first be used for identifying buildings which could benefit the most from energy efficiency investments. After those investments are made and executed, the system can then be used for the purpose of verifying projected pay back periods. As

pointed out in the KY example, a significant portion of ARRA funds have been allocated for state building energy efficiency efforts. $7 million of ARRA grant funds were allocated for energy efficiency efforts in NV state buildings. NV chose to allocate their funds largely for lighting replacement and lighting controls projects. Funds were also allocated towards window, HVAC and solar projects.

The NV State Buildings report includes Energy Star Portfolio Manager (ESPM) for benchmarking NV buildings. ESPM is a free tool designed by the EPA for use in commercial buildings. This tool allows a building owner to evaluate the energy efficiency of his/her building on a scale of 1-100 as compared to average performance of commercial buildings across the U.S. The use of ESPM is a theme that will be found later in other case studies. If states are struggling to find the necessary resources to establish its own reporting and benchmarking system, ESPM offers a low cost and serviceable alternative. The NV State Buildings report also benchmarks NV state government facilities against other buildings with similar climate characteristics using a database compiled by the outside consulting firm. Comparing buildings in the same region allows for consideration of how buildings perform within a particular climate.

The NV report also includes GHG calculations for the buildings studied. The calculations used in this report acknowledge the guidelines of the Climate Registry, showing once again the potential that the CR organization has for compiling a complete GHG inventory for U.S. sub-federal government. GHG emissions are not presented as prominently as the main energy consumption and monetary figures. However, using simple algorithms to calculate GHG emissions adds value to the report and the energy

tracking effort. The NV benchmarking report highlights the simple additional step taken to include carbon footprint once building energy is accurately tracked.

New York

New York (NY) Executive Order No. 111 established a goal for energy reduction in state government buildings of 35% relative to 1990 baseline levels. The 1990 baseline and 35% reduction by 2010 goal is considerably more aggressive compared to the other states found in table 1. The 1990 baseline is also the same year that the Kyoto Protocol emissions standards are based on although it is unknown if this was done intentionally by policy makers in NY. EO 111 was issued to all state facilities "under which the governor has executive authority". This approach utilizes the strength of the governor's position over certain state agencies in NY.

The New York State Energy Research and Development Authority (NYSERDA) publishes the results of its energy tracking efforts in annual reports which are available online to the public. For fiscal year 2009-2010, NYSERDA stated that of reporting agencies, a total of 2,624 gWh of electricity were consumed. Energy usage from electricity and all other fuel types is converted to MMBTU's to provide a singular unit for all energy types. These totals are the sum of approximately 16,000 state owned buildings consisting of 224 million square feet. Statewide energy usage reductions were measures at approximately 12.7% for FY 09-10. The largest 10 agencies, which account for approximately 97% of the reported energy consumption total, measured a reduction of 24.3% against the 1990 baseline.

NYSERDA has a standardized reporting form that facilities are required to fill out for energy tracking purposes on a yearly basis. This form is a Microsoft Excel spreadsheet that automatically calculates conversions and energy totals as various fields are filled out.[18] The use of a spreadsheet form with built in algorithms for conversions such as BTUs to MMBTUs is a helpful and convenient feature that makes the tracking reporting process more efficient and user friendly. Simplifying and automating reporting forms is critical for cooperation in a program that lacks traditional enforcement mechanisms. Convenient features such as using a spreadsheet form will hopefully encourage agencies to comply with reporting obligations as well as streamline the calculating process for the entity responsible for reporting.

A look at Table 1 of the FY 2009/10 report reveals that square footage has fluctuated significantly from one year to the next, particularly from FY 2001/02 (the first year of EO 111) to FY 2002/03. NYSERDA explains this fluctuation by stating: "Historically, reporting Affected State Entities have changed from year to year. Some Affected State Entities have merged, others have changed their organizational structure, some have moved into new facilities. In addition, employee attrition has occasionally led to subject matter experts being replaced with newer employees, which sometimes results in the loss of historical data."[19] . NYSERDA requires agencies to report the sum of square footage across all buildings within an agency rather than reporting for each building individually which could have implications for the accuracy of the reported SF totals.

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[18] Pgs. 67-72 of the NYSERDA annual report sfy 2009/10
[19] Refer to Pg 1 of the NYSERDA "Clean and Green" Annual Report

NYSERDA's FY 2009/10 Annual "Clean and Green" Report largely focuses on the ten agencies with the largest amount of energy consumption accounting for 96% of total reported energy usage. Of these agencies, the State University of New York accounts for 39% of total usage. The large share of energy consumed by public universities in NY is a consistent theme among many states in these case studies. As pointed out in the WI and MA examples, public universities are also among the most consistent types of public facilities in terms of reporting and tracking among many states.

For the purpose of internal guidance, the NYSERDA published a set of guidelines for compliance with Executive Order No. 111. These guidelines help agencies to determine applicability to Executive Order 111 for their various building ownership and leasing arrangements as well as building size and type. According to the guidelines, exemptions include "… buildings of less than 5,000 square feet and those loads defined as process loads by each State Entity. Leased space that is not billed for any utilities based upon direct use is also exempt. The guidance specifies that "the provider Entity (building owner) owns the meter and therefore is responsible for the Annual Energy Report for that space[20]. The guidance goes on to distinguish leasing agreements for agencies in which the tenant pays the power bill by saying "the tenant State Entity paying the utility bill is responsible for reporting the facility space. If a State Entity is leasing space that is not individually metered, the State Entity shall not estimate energy usage nor shall they include the square feet of the space in its Annual Energy Report". The guidance also states that "If a State Entity chooses to exempt process buildings or process loads within a building, they must identify each exemption and explain the reasoning for

[20] Pg 30 of the guidelines

its exemption in a footnote to the Annual Energy Report. Each State Entity shall determine its own process-oriented exemptions." These exemption options allow NY to immediately eliminate smaller buildings which generally have the least potential for energy savings or would be too difficult to measure energy consumption on a consistent basis. Exempting certain leasing arrangements eliminates incentive issues inherent to lease occupants whose rates do not change whether energy consumption is reduced or not.

The guidelines also lay out other specifics for "exterior" energy consumption as follows:

> "street lighting, highway lighting, exterior lighting, parking garage lighting, and other ancillary electrical loads shall be included in the determination of a State Entity's BTU/SF metric. The electric usage of these end-uses should be distributed over the square footage of the buildings owned by the State Entity". [21]

The guidelines recognize and specify provisions for the consumption of renewable energy as follows:

> "Renewable electricity (kWh) that is generated on-site should not be recorded in the Annual Energy Report as energy consumed, but should be reported in the Renewable Energy Section. Procurement of renewable energy from the open-market should also be noted." [22]

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[21] Pg. 40 of the guidelines
[22] Pg. 40 of the guidelines

NYSERDA reporting requirements do not include weather adjustments for harsh winters etc. as the guidance states that “harsh weather conditions average out over the long-term”.[23] The thorough specifics laid out by these guidelines help to promote consistency in reporting across subject NY state agencies.

The EO 111 Guidelines also advise entities to use ESPM. NYSERDA suggests that agencies include their ESPM score in the Annual Energy Report. In addition to directing agencies to the ESPM benchmarking programs, NYSERDA also offers its own free benchmarking service. Agencies who wish to take advantage of this benchmarking service fill out a building data request which asks for the year the building was built, number of occupants and the size of the building in square feet. The form also asks for info related to appliances, HVAC systems, and number of hours of occupancy. Information from this form is run through models to evaluate overall performance. Comparisons are then made to other buildings within the same agency and to other NY state buildings. Comparing energy consumption to other state buildings allows agencies to see how their financial resources are allocated to energy vs. other agencies within the same state government and within a similar climate.

A unique aspect of the NY approach is the use of source conversion factors based on ESPM for measuring energy usage[24]. Source conversion factors account for aspects such as grid loss during the transfer of power from the Electrical Generating Unit (EGU) (ex. coal fired power plant). Using source conversion allows for accounting of total energy savings which provides a better reflection of the effects of energy conservation

[23] Pg. 40 of the guidelines
[24] Refer to Pg 1 of the 2009-2010 Annual Report

measures in terms of fuel usage by the EGU. Showing energy usage and savings in terms of source conversion brings energy lost during transfer into consciousness. Source conversion can also better represent the environmental effects of pollution from EGU's. Presenting the results of energy conservation efforts in terms of fuel saved at EGUs shows the true value of energy conservation and will help with the perceived success of a program making it more attractive to participants, policy makers and the public. Accounting for source conversion is also a way to educate interested parties in the true cost of energy consumption at the site in terms of total energy and emissions.

North Carolina

North Carolina (NC) Senate Bill 668 of 2007 established energy efficiency goals of 20% and 30% reduction per square foot by 2010 and 2015, respectively. FY 2003-04 is set as the baseline for these reduction goals. Through its *Utility Savings Initiative* (USI), the NC Department of Energy boasts a cumulative "avoided utilities cost" of $417 million since the 2002/03 state fiscal year. During that time, state expenditures towards the USI program have totaled $11.5 million in addition to money spent from Federal grants. As of June 2011, utility usage had been reduced by 21%[25] against the established goals. The USI includes water and sewer savings in addition to the base energy costs (ex. electricity and natural gas). Water and sewer costs accounted for approximately 17% of total utility costs in FY 2011. In cases where NC was unable to obtain all of the historical data needed for its energy cost baseline, estimates were made based on information obtained

[25] Information gathered from Len Hoey, NC Department of Energy

from the Comptroller's office. Taking advantage of information from the comptroller's office shows good resourcefulness by the NC USI staff and similar research may prove to be beneficial for states lacking the necessary data to establish a baseline.

The USI report shows that GHG emissions have been reduced by 30%. Featuring GHG emissions can add incentive to energy tracking efforts for individuals interested in climate change. Once energy is accurately measured, converting the data to CO2 equivalents can be done with relative simplicity adding value and diversity in output metrics with minimal effort.

Fifteen NC state agencies and twenty one UNC institutions are required to submit an annual update to their strategic energy plan along with their annual consumption and cost report. The USI 2011 report takes note that one agency failed to produce the required reporting. By exposing non-compliant agencies through publications reviewed by state agencies, the NC Department of Energy is able to encourage reporting completeness.

One key difference of the USI program is that it does not include the 115 public, K-12 school districts. This reduces the overall energy tracking work load substantially compared to many of the other case study states. Similar programs in other states include the K-12 school districts as "state buildings". The NC Energy Office did distribute grants to 55 public schools. As part of the requirement for applying for these grants, NC public schools were required to submit energy plans and consumption reports. Requiring grant applicants to effectively comply with reporting for an energy metrics system before

receiving funds is another incentive which could be utilized by energy programs in other states.

Ohio

Ohio (OH) Executive Order 2007-02s established an energy reduction goal of 5% by FY2008 and 15% by FY2011 using an FY2007 baseline for buildings owned or leased by state agencies. Public institutions of higher education are addressed separately under House Bill 251. HB 251 states that these public universities must reduce energy usage in buildings by 20% from 2004 levels by 2014. Ohio Administrative Code 123:4 designates ESPM for energy benchmarking and tracking purposes.

At the peak of the OH energy tracking program, approximately 90% of all buildings were reporting energy consumption into ESPM. This effort accounted for 30 state agencies and approximately 5,000 buildings[26]. Around this time, an energy reduction of about 15% was accomplished over four years[27]. Much of this reduction was attributed to downsizing of several OH state agencies and consolidation of buildings. The main EUI OH has used to track all energy usage is kBTU per square foot and the 15% reduction is expressed in those terms. In the last couple of years, OH participation in ESPM has declined largely due to the downsizing of state government.

An important aspect of OH established goals is that leased buildings are specifically stated as having the same energy reduction goals as those buildings which are

[26] Ohio is a featured case study on the EPA Energy Star website. These statistics were obtained at http://www.energystar.gov/index.cfm?fuseaction=labeled_buildings.showResults&p_federal_bldg_yn=Y&building_type_id=ALL%20Buildings

[27] Direct Communication with Oscar Zanganeh of OH State Architect's Office

owned by the state. Recognizing the issues that can arise from implementing energy tracking and reduction measures in leasing arrangements, OH has established the "Green Lease Program". Several other states found in this case study have recognized the leased space issue but OH is the only example found that has designed a specific program for addressing it.

One method for providing reporting incentive found in the OH example was initiated through the Governor's office. As part of EO 2007-02, the governor of OH specifically placed a high ranking individual from each state agency in charge of managing and reporting for that agency's energy program. Placing the responsibility on an individual, rather than the agency as a whole, prevents that responsibility from being lost in a bureaucracy.

South Carolina

South Carolina (SC) House Bill 4766 established a 20% energy usage reduction goal in state buildings by 2020 using the year 2000 as a baseline. The SC State Energy Office has collected energy usage and square footage for buildings occupied by state agencies, public universities and K-12 public school districts. Public school districts alone account for approximately 2/3's of the reported square footage[28]. The FY 2000 reported EUI has been calculated by the SC SEO to be 75 kBTU per square foot. The FY 2012 reported EUI is 57 kBTU per square foot. In addition to energy per square foot, the SC SEO also

[28] Direct communication with Andrew Berger-Gross of the SC State Energy Office

calculates and reports cost per square foot. To date the cost per square foot has gone down about 4% since 2000[29].

The SC SEO accommodates state facilities by gathering energy information in a variety of ways rather than imposing a single reporting format. The only case study using a similar information gathering approach was found in the MA example. Attempts have previously been made to get all entities reporting under a single generic reporting format but these attempts have failed. Many of the SC agencies use a program known as “Utility Direct”. Data from Utility Direct can be accessed directly by the SC SEO. The SC SEO also has a “Consumption Reporting Tool” that can be downloaded from its website. Some entities have found ESPM to be their preferable energy tracking format and the SC SEO has assisted a handful of entities with setting up ESPM accounts. The SC SEO sends out an Annual Progress Report form for agencies to fill out which provides the various reporting options. Key metrics for the Annual Progress Report include energy cost, energy consumption and gross square footage. The Annual Progress report also asks for entities to list energy conservation measures taken, estimated savings from such measures, energy team members and purchases of any energy conservation products. The SC SEO has explored possibilities with gathering data directly from utilities but this effort is complicated by the variety of electric cooperatives and power companies in which reporting partnerships would have to be created. HB 4766 does not provide specifics for state owned vs leased space and entities often report this information in different manners. HB 4766 does specify exemptions for buildings of different sizes but

[29] Direct Communication with Andrew Berger-Gross of the SC State Energy Office

reporting irregularities including square footage make it difficult for the SC SEO to identify and enforce those exemptions.

Texas

The energy conservation efforts of Texas (TX) state government are primarily outlined in Senate Bills 5, 12 and Executive Order RP49. SB5 and 12 require entities to "establish a plan to" reduce consumption by 5% yearly. Executive Order RP49 was issued on 10/27/05 directing state agencies in Texas to submit quarterly reports detailing their energy conservation and efficiency efforts.

The state of TX has unique motivations for initiating its energy conservation efforts. TX currently has 41 counties of mostly urban areas which are considered to be in non-attainment for ground level ozone pollutants under the National Ambient Air Quality Standards (NAAQS) of the Clean Air Act (CAA). As part of the TX State Implementation Plan (SIP), all public entities in non-attainment areas are required to reduce energy consumption by 5% yearly[30]. The SIP approach gives energy conservation efforts in TX state government federal authority and funding through the CAA. The TX effort emphasizes emissions of NOx and SO2 reductions from EGU's with a "Clean Air through Energy Efficiency" slogan. In recent years, the EPA has encouraged other states to use energy efficiency policy as a means of reducing emissions from EGU's through guidance documents such as the Roadmap for Incorporating Energy Efficiency/Renewable Energy in State Implementation Plans. (EPA, 2012)

[30] Senate Bill 5 includes some exceptions for public schools.

The SIP approach has prompted TX state government to work extensively on energy metrics in local government as well as state. The 2007 SB5 Report from the Texas State Energy Conservation Office (SECO) contains hundreds of these public entities along with their energy conservation progress in percent reductions or gains. Results of these efforts include a claimed 2,132,663 kWh of energy saved among 271 jurisdictions. The energy reduction totals stated in the 2007 SB5 report were not measured against the 5% energy reduction goal and the report does not express the overall reduction in terms of a percentage. (TX SECO, 2008)

SB5 establishes FY 2007 as the baseline for measuring energy increases and decreases. Political subdivisions (including state government) are required to submit their 2007 energy consumption baseline followed by gross square footage and annual consumption in kWh. TX SECO uses a form that local governments, such as counties and municipalities, fill out for reporting purposes. Optional information on this form includes kWh for water pumps, wastewater, and traffic lighting. The form also asks if a 5% goal has been established and a summary of any retro-fitting activities. The results are compiled in the annual SECO report which is given to the TX state legislature. Because the energy measuring efforts of complying and non-complying entities are exposed to the state legislature on an annual basis, some incentive for compliance is created. A political subdivision, institute of higher education, or state agency that does not attain their goal established is required to provide justification to SECO that the entity has already implemented all cost-effective measures.

Reporting efforts specific to state agencies, public institutions of higher learning and public school districts are compiled by the TX State Facilities Management Division

(SFDM). These state government institutions also have a form for reporting energy usage which can be submitted online. The data from these forms is then entered into a database at Texas A&M University for statistical analysis. Agencies are required to establish a Resource Efficiency Plan to address required energy reductions. The plan must be re-certified every two years. State agencies must also submit a semi-annual status report form. The TX State Facilities Management Division provides some internally developed guidance documents including a suggested outline for an Energy Management Plan and EMP general guide. The TX SFMD has also established a State Agency Energy Advisory Group. This volunteer-interest oriented group meets on a bi-monthly basis and includes approximately 31 member entities in which institutions of higher learning are heavily represented. The regular meeting of this committee helps to reinforce energy conservation efforts including reporting and tracking of energy usage.[31]

Wisconsin

Wisconsin (WI) Senate Bill 459 established a 10% energy reduction goal by Fiscal Year (FY) 2008 and a 20% reduction by FY 2010. Both goals are set against an FY 2005 baseline. In January 2011, shortly after the 20% reduction deadline had passed, the WI Department of Administration, Division of State Facilities produced the FY 2010 Conserve Wisconsin Report. The Conserve Wisconsin report provides a comprehensive description of WI state government energy conservation efforts over the previous six years. The report claims that energy use has been reduced by 9.8% per square foot,

[31] E-mail communication with Eddie Trevino, TX SECO 7/16/13

adjusted for weather. Only select “larger” buildings owned by WI state government in departments such as Administration, Corrections, and public universities are included in the energy reduction totals. The energy reduction figures are not comprehensive of all WI state owned facilities.

Despite falling short of established goals, WI was able to attain significant, measurable energy usage reductions in a matter of 5 years (from FY 2005 to FY 2010). A key aspect of the WI example was the decision to only use a select group of ideal, larger buildings out of the hundreds or even thousands that state government systems can consist of. Using a small percentage of ideal, larger buildings may be the best approach for states struggling to establish an all-inclusive energy metrics program. Targeting larger buildings can help reduce the overall work load while possibly accounting for the bulk of state government wide energy usage. WI is similar to the KY example in that both states have focused on energy savings in a small, select group of buildings.

The WI report may have missed out on an opportunity by not prominently featuring estimates of monetary savings from its energy efficiency efforts. Part of the reason for not featuring monetary savings could be that overall cost for electricity across all WI state owned facilities actually increased by almost $20 million in FY 2010 from the FY 2005 baseline year. Natural gas costs increased by approximately $5 million during this same time period.[32] More than 50% of this reported cost and approximately ¾'s of total energy consumption originated with the WI public universities system.[33] The executive summary of the Conserve Wisconsin report briefly mentions that colder

[32] Refer to pg 55 of the WI FY 2010 Conserve Wisconsin report. Total cost of electricity was 85 mil and total cost of N.G. was 45 mil in FY 2010. This total includes all state of Wisconsin buildings and not just the buildings featured in the report as sated in the executive summary on pg. 4.
[33] Refer to pg 54 of the WI FY 2010 Conserve Wisconsin report.

weather could explain part of the increase in energy expenditures. The report also notes a 25% cost increase in electricity rates. The statewide total for gross square footage (GSF) increased by approximately 4 million which can also explain the increase in energy costs despite a decrease in energy usage per GSF for the reported buildings. Finding a way to present the energy savings monetarily could have been beneficial for the WI energy tracking program. Such a total could have been presented in "avoided costs" since actual costs for energy increased. Also, the energy costs presented in the FY 2010 conserve Wisconsin report are cumulative for all state government in WI. Energy costs for only the reported buildings are not represented. Had cost for only the reported buildings also been shown, it is possible that monetary savings, adjusted for inflation, could have been presented. Displaying "avoided costs", as seen in the NC example, in turn could make the program more attractive to policy makers. The rise in energy cost could also be used as a case for promoting energy conservation in the form of fiscal security.

In order to accurately measure energy usage in the reported buildings, WI coordinated monthly energy bills with fuel consumption reports. WI also specifies that the energy usage for these select facilities is based on "end–use" consumption rather than "resource" energy consumption. Using the end-use approach basically means that electricity from grid loss during power transfer and energy used to transfer fuels such as natural gas and fuel oil to facilities is not accounted for. Although the end-use approach is a better representation of the true energy consumption at a site (ex. office building), it hides the additional value of energy conservation through energy saved at the source.

Energy Usage Index (EUI) in the WI example is measured in a standard fashion of BTU's per gross square foot (GSF). Converting all types of energy use, whether it be

Natural Gas, Electricity etc. into BTU's effectively treats all energy sources as equal. One disadvantage of focusing on EUI as the primary output is that it can hide the various GHG and pollutant emission rates that different fuel types possess. Calculating all types of energy into a single EUI also hides the varying cost of different fuel types which can make targeting cost more difficult. These issues can still be addressed with the base fuel and electricity data that comprises EUI. Problems cited by the Conserve Wisconsin report for the collection of data include differing accounting systems in the various agencies making it difficult to compile a complete data set across all buildings. The issues of differing accounting systems and billing software is common and can also be found in other states represented in this study.

WI and several other states have chosen to calculate energy usage as it relates to weather. The Conserve Wisconsin report uses a common approach that adjusts energy usage by setting average temperature at 65 degrees Fahrenheit. A "degree day" represents one degree of declination from 65. The average temperature for every day (the mean of the high and low for a particular day) of the year is set against 65. If mean temperature for a given day is 60 degrees, for example, the day is given 5 "heating degree days" because energy was needed to heat buildings.

Not surprisingly, the results of the weather adjustment analysis revealed a direct correlation between cold weather and heating energy use for WI state buildings. WI found a correlation factor of greater than .9 related to thermal (ex. Nat. gas) energy use for winter heating. The correlation factor for electricity use was around .75. The weather adjustment caused Wisconsin's total energy reduction results to increase from 9.1% without weather adjustments to 9.8%. Relating energy consumption to weather shows

one of the many ways that a few inputs gathered from a reporting system can be analyzed. The weather relationship could be taken a step further to show correlations between cost and variability of climate. Such a relationship could help to relate energy cost to issues with climate change. Showing participants how a relatively few inputs can be used for a variety of analysis can help them to understand the value of their reporting efforts.

CHAPTER 3

ELEMENTS OF STATE GOVERNMENT ENERGY METRICS SYSTEMS

Essential Elements

Awareness – In the introduction to this study we saw an example of how limited fuel consumption instrumentation in automobiles can limit knowledge of MPG in the mind of the consumer. The act of creating consumption reports and energy plans helps to create awareness within an agency of energy usage. Compiling data to show energy usage and cost trends can help to create awareness for policy makers

Many of the low cost measures that can be taken to reduce energy usage are driven by changes in human behavior. Changing human behavior and habits related to lifestyle is one of the most difficult aspects of environmental policy. Awareness is a key element to driving these behavioral changes. Active participation through reporting can create awareness. Programs that provide instant feedback on trends and progress, such as the MN B3 system help to increase that awareness. If data is gathered direct from the utilities, building occupants will not be aware of energy usage because they will not be reporting that usage. In the KY example, behavioral changes were dictated because the CEMCS system has remote capabilities to control lights, boiler and chillers. With remote capabilities, awareness in general may not be as important. Bypassing the reporting process does not impede needed behavioral changes because those changes are automatic.

Cost is one of the most successful ways to create awareness. All of the case studies feature the relationship between energy and cost.

***Incentives* –** An energy metrics system must provide incentives in order to encourage agencies to report their usage. In many cases, incentives will be related to financial metrics showing budget savings. In the case of energy efficiency in government, incentives are almost always related to monetary savings. Framing energy conservation as budget savings can be a particularly useful approach in political environments that are not always receptive to environmental oriented efforts such as climate change.

A major factor that can affect financial incentives is whether or not an entity is paying the power bills within the building(s) it operates. Agencies will often pay a lease that doesn't change regardless of any energy efficiency/conservation measures taken. In leasing situations, financial partnerships must be established between the agency tenant and the landlord in order for incentive to be established for the building occupant(s). In the OH case study we found an example of the "Green Leasing" program which was specifically designed for this purpose. Leases can be renegotiated at the time of renewal to specifically account for energy efficiency measures or even require usage to be reported into a benchmarking system. Tenant agencies can be offered a chance to be paid for the cost savings that their energy efficiency/conservation efforts generate. These same tenants could be required to pay a surcharge to the landlord if their power consumption increases.

The NC USI report recommended allowing colleges in the UNC system to retain the savings they generated if there was a credit balance in their utility account.[34] Being able to accurately measure not only energy but Return on Investment(ROI) is critical for any energy efficiency program that plans to appropriate money saved as incentive for participation. The NC example also shows an innovative way of creating incentive by requiring public schools who apply for energy efficiency grants to establish an energy tracking system and report usage.

In the MN example we found that there is a trade-off between asking too much detailed information and the willingness of stakeholders to participate. Requiring only basic information or "Tier 1" info at first and then querying stakeholders for more detailed information as they get used to participating is a good way to maintain momentum. The commissioning program found in the MN example was administered in part by offering free screening and investigation to building managers. This free offer was made in exchange for a commitment from building managers to implement all recommended measures; provided the measures had a payback of 3 years or less as required by the ARRA funding. (ACEEE, 2010)

Another common theme to drive incentives found in some case studies is to use the leverage of the governor's position. In the OH example, we found that the governor specifically named an individual, typically high ranking, to be responsible for reporting energy usage. Placing specific accountability on a high ranking official can prevent responsibilities from being lost in the depths of a bureaucracy. A similar concept can be found in MN where "stakeholders" were identified early in the process. Placing a

[34] Pg 12 of the USI sfy 2011 report

specific individual or stakeholder as being responsible for each building is another way of implementing accountability in the energy metrics system.

The MN and NV examples both had established ARRA funding stipulations. These stipulations could lead us to another way of leveraging an energy metrics system writing reporting requirements into funds for energy efficiency measures. If energy efficiency funding were designed to require verification of payback periods and ROI, some form of an energy metrics system would have to be created. A reporting system could possibly be created around the needs for verification of funds. The NC case study displayed an example of verification by attaching reporting requirements to grant funding for energy efficiency retrofits.

Table 3.1 summarizes the different incentives found in the case studies and shows their commonalities between the different states.

Table 3.1 **Incentives Utilized**

KY	MA	MN	NV	NC	OH	TX
Automated Data Collection/Exchange	GHG/Climate Implications	Funding Verification	Bill Auditing	Cost Savings	Special Program for Leased Space	Energy Advisory Committee
Bill Auditing	Peer Support	Instant Feedback	Cost Savings	Exposure of Non-Reporting Entities	Specific Stakeholder Responsibility	Progress Report to Legislature
Cost Savings		Stakeholder Identification	Data Exchange with Utilities	GHG/Climate Implications		SIP Emissions Reductions
Remote Control		User Friendly Reporting Database	Funding Verification			

Source Specific – Metrics must be source specific in order for energy efficiency expenditures to be accurately targeted and value to be maximized. Many of the case studies showed us examples where a campus of buildings will all be serviced by one meter. These situations can make it difficult to distinguish good buildings from the "energy hogs" or bad buildings.

Less essential but still crucial to maximizing effectiveness is the idea that source specificity can also go beyond individual buildings as seen in the KY example. Sub-meters can be placed on power consuming units such as boilers, chillers, etc. for more precise targeting of energy hogs. Life-cycle awareness for power-consuming equipment can augment the benefits of these sub-meters.

Adaptability – Adaptability is crucial to being able to measure all or close to all of the public buildings within a state. Without this element, the system will be limited to a handful of ideal agencies and buildings. Energy metrics systems must be adaptable to accommodate a variety of building sizes, types and leasing/tenant arrangements. Systems must also be able to adjust to varying data from different operational records and accounting software that agencies may use. The KY example shows us a system that can normalize the different types of accounting software and systems. In some situations it may be practicable to eliminate smaller buildings as seen in the Wisconsin and NY examples due to the low potential for savings vs. workload.

Output metrics from a system in the form of return on investment and/or payback periods must be able to adjust to the changing demands attached to funding dedicated to energy efficiency measures. For example, the B3 system from the MN example shows us

a system that was able to provide the output metrics necessary to accommodate stipulations attached to ARRA funding.

***Benchmarking* –** The creation of good quality benchmarks requires good quality data plus the use of normalization factors to separate operational issues from efficiency issues. (Bannister and Hinge, 2006) Operational norms for buildings and the power consuming equipment within buildings must be established. As shown in the KY example, defining norms can help to identify when a building/equipment is consuming more power than is usually necessary for normal output. Defining normal operating parameters can also help establish the efficiency of buildings/equipment relative to each other. This is necessary for the purposes of flagging and identifying "energy hogs" among buildings and equipment within those buildings. "Ideal" operating benchmarks must also be set for tracking progress towards conservation goals established by state laws and executive orders. ESPM and the CBECS are two sources readily available where operational norms for a variety of buildings can be found. Using regional data can help to compare a building's performance to those in a similar climate.

Boundaries – Clear definitions and boundaries help make energy metrics and reduction goals more executable. Throughout the examples found in this study, policies appear to lack the boundary specifics necessary for execution. Many state agencies operate within buildings that also contain and are owned by local governments complicating the types of situations the metrics system must adapt to. Leasing can be particularly difficult to designate responsibility for reporting energy consumption.

Wherever possible, boundaries should be established to encourage inherent incentives. Boundaries can be designed to encourage inherent incentives by placing responsibility for reporting and implementing energy reduction measures with whoever is responsible for paying the power bill. NY EO 111 provides us with an example of well-established boundaries. The NYSERDA guidelines specifically designate who is responsible in leasing situations by placing reporting responsibility on the “owner” of the power meter. Another important boundary established by the NYSERDA guidelines is designating only *state-owned* buildings as part of its metrics system. Guidelines such as these prevent tenants in commercial buildings, who often do not pay utility bills, from being responsible for reporting energy usage and implementing energy efficiency measures.

NY and OH provide boundaries by exempting buildings that are less than 5000 square feet in size, coinciding with ESPM requirements. Using specific boundaries to exempt smaller buildings which have little potential for energy savings vs. the work required for tracking can help to make the work load more manageable. In order for a sound energy metrics program to gain momentum, initial focus should be placed on the largest buildings with the most potential for energy savings. Larger buildings generally consume the most power and will receive the most benefit from efficiency measures. Reporting exemptions should be made for smaller buildings less than 5,000 square feet. Exempting buildings of less than 5,000 square feet, at least in the early phases of tracking system implementation, coincides with the ESPM benchmarking system which ranks offices and warehouses of 5,000 square feet or greater. Other boundaries that can be established to make the work load more manageable include the option of exempting

school districts as seen in the NC example. Another good example of how specific boundaries must be established is found in the KY example where parking garages are counted towards total square footage but parking lots are excluded. Both parking garages and parking lots often include lighting that contributes towards and agencies total energy consumption. Boundary decisions such as these are somewhat arbitrary but still must be consistent from agency to agency for the establishment of consistent data.

A focus on state-owned buildings will help to establish the boundaries needed for maximizing incentive. Initially it would be much easier to focus on buildings that are self- owned by state agencies. These self-owned buildings have the most direct incentive for the occupants because they avoid the aforementioned issues of leasing arrangements. The most sensible thing to do for metrics purposes is to follow the NY example and place reporting liability on the owner of the power meter, since that entity will also likely be responsible for paying the power bills.

***Baseline* –** In order for energy conservation/efficiency progress to be measured, a baseline must be designated. In the case studies presented, the baseline is usually established according to the EUI for a particular state fiscal year. NY had one of the most aggressive baselines of FY 1990. The NC, MA and NY examples all point to difficulties gathering the historical data needed to establish this baseline. In the case of NC and MA estimates were made by using historical budget expenditures dedicated to energy. Although usage can be estimated based on expenditures, none of the case studies provided a method for estimating historical square footage for the baseline year.

Return on Investment – The cost effectiveness of an energy efficiency or retro-fitting investment can be measured in terms of a period of time that the savings of that measure take to pay for the initial investment. Knowing how long it should take for a retrofitting expenditure to pay for itself can also be referred to as a *pay-back period.* Setting a standard for cost effectiveness will help an energy metrics scheme to conceptualize the benefits of the system and its targeted efficiency investments. The TX example set a standard for measuring the success of an energy efficiency investment in terms of 20 years or less. In the examples where ARRA funds were used, we saw requirements for pay back periods and goals to be measured in order to justify the expenditure of the funds.

Marginal Elements

Enforcement – If the executive orders and legislative actions examined in these case studies included penalties for non-compliance with reporting obligations, gathering data would obviously be easier. The enforcement element has been placed in the *marginal* category because none of the case studies established any true enforcement mechanisms. The closest thing to enforcement is found in the TX and NC examples where non-reporting agencies are exposed to lawmakers through periodic reports which identify the agencies that are not participating. Because enforcement is virtually non-existent in any of the examples studied, *incentives* become even more crucial. For these reasons it was decided to categorize *incentive* as an essential element.

Real-time Tracking – Energy measurements that are taken continuously allow for operation outside of normal parameters to be flagged and addressed quickly. Quickly identifying and addressing problems will maximize the effect of energy efficiency monitoring investments. Relying on utility bills vs. continuous meters and sub-meters can cause a lag of more than 1 month. Although using utility bills is not ideal due to lag, it can be the only means of tracking possible when funds for sophisticated systems such as the KY CEMCS are not available.

Adjusting for Weather – Adjusting energy consumption for climate as seen in the WI example has advantages that can augment the core benefits of an energy metrics system. Historical energy usage related to climate data can help project necessary energy and energy security for a region based on predicted climate change and efficiency measures. The WI example showed that energy consumption can be largely dependent upon the intensity and duration of extreme climate temperatures. Some states may find some value in weather adjustment depending on geographical location.

If system administrators are aware of the number of heating degree and cooling degree days for the various regions their buildings are located in, this information can be used to benchmark a buildings performance against buildings within a similar climate. This concept is displayed in the NV benchmarking report where buildings with similar amounts of heating and cooling degree days were compared. Programs such as ESPM can automatically adjust energy usage for weather and can provide regional based comparisons for buildings.

Automation and Remote Control – Although this element is non-essential, controlling energy consumption in the form of lights, boilers etc. from many buildings at a single site is a major advantage. Without being able to control indoor climate and lights remotely, execution of tasks such as turning off lights on a daily basis becomes dependent upon behavioral changes from building occupants who often lack incentive. Many behavioral tasks are the least expensive cost/energy saving measures to implement.

The KY CEMCS is the only example found with remote control capabilities. However, some level of automation can still be found on site in many cases. Automation can exist in the form of timers on lights or set points on boilers. A detailed energy metrics system can include information for automation such as boiler temperature set points to help identify when adjustments are needed.

Equipment Life Cycle Data – The understanding of life cycle expenses for energy consuming equipment provides benefits to the retrofitting decision making process. Balancing the cost of old equipment that must be replaced in the near future against the benefits for retrofitting can help agencies to work within established budgets while improving energy efficiency. In general, retrofitting should be focused on equipment that will provide the most monetary benefit and is close to the end of its life cycle at the same time. Life cycle data can be combined with climate data to determine the resiliency of seasonal energy infrastructure such as boilers and chillers. The combination of these two forms of data can help to predict the resiliency of an infrastructure in times of more extreme climatic episodes. For example, an older boiler may provide needed heating comfort during a "normal" winter but could fail if stressed too much during a more harsh winter. As pointed out in the NY example, the ESPM program uses life cycle analysis as

part of their rating system. In order to take advantage of these free programs, some building specific Life Cycle details will have to be gathered for boilers, chillers etc.

Accessibility by the Public – In the example of the KY CEMCS system, the cost of the program's inception ($3.65 million ARRA grant) is clearly stated on the dashboard website. At the same time savings of $1.2 million are also clearly stated. Public access of information can help to bring transparency to a government system or program. Outreach efforts that display the benefits of energy tracking systems provides government with the opportunity to lead by example and possibly motivate private sector entities to establish energy monitoring systems. The public could also begin to expect their state governments to operate as efficiently as possible in terms of energy expenditures.

Renewable Energy – Although renewable energy does directly correlate to less energy consumption at the site, the benefits of accounting for renewables has many advantages for sustainable development. A state government energy metrics system could include exemptions for energy purchased from renewable sources when counting towards a designated energy reduction goal. This would help the state achieve its renewable standards. Many types of renewable energy result in zero or minimal pollutant emissions. Exemptions should be made for energy coming from zero and low emission renewable sources since the use of this energy does not contribute to climate change in the same way as energy derived from fossil fuels.

Source Conversion – The models used in ESPM provide a national average source to site ratio of 3.34 meaning that it takes over 3 times as much energy consumed at the EGU to

produce the electrical energy consumed in buildings (EPA, 2011). As seen in the NY example, accounting for energy reductions in terms of Source Conversion can help to display the true savings of energy conservation by accounting for energy saved during consumption and transfer. Using Source Conversion can also provide outreach benefits by displaying how energy is lost during grid transfer and during production.

GHG Inventories – The true carbon footprint of a system such as state government cannot be calculated without an accurate energy metrics system. GHG inventories are needed for state government for inclusion in the Climate Registry. Public universities within a state may also have GHG reporting obligations for the ACUPCC. In recent years states have shown a leadership role in climate policy through such organizations as the Regional Greenhouse Gas Initiative. The success of these initiatives depends largely on the accurate quantification of energy data.

Using simple algorithms available from eGRID factors, energy usage can be calculated to account for source conversion and GHG inventories. Once good quality data is available, converting that data into GHG emissions will add value to the metrics system with minimal effort. GHG inventories can also be used to account for the benefits of renewable, low emissions and zero emissions sources of energy.

Standardized GHG reporting as found in the Climate Registry reporting requirements includes provisions that account for direct and indirect energy consumption elements by dividing usage into scope 1, scope 2 and scope 3 emissions. It also include provisions for accounting the emissions at EGU's including NOx emissions which can be used for purposes found in State Implementation Plans from the TX example.

The NC and NV examples do not feature their GHG savings prominently but do mention them adding value for those who are climate change conscious. Using potential GHG savings can provide incentive for “green teams” who may wish to reduce energy consumption for purposes of climate change mitigation. Reporting the GHG reductions resulting from behavioral changes among building tenants can help bring about awareness through displaying measurable benefits. This provides a positive feedback mechanism for the efforts of building tenants who wish to take part in climate change mitigation. A GHG inventory can also help to display the benefits of renewable energy since most forms of renewable energy represent zero or low GHG emissions compared to their fossil fuel; counterparts.

***Stakeholder Identification* -** Following the MN and OH examples, placing a specific, high ranking official in charge of managing an agency’s energy data, rather than placing the responsibility on the agency as a whole, could help to ensure that participation is consistent and reporting is successfully executed. Such an approach could depend a great deal on the interest of the governor on implementing an energy policy and whether or not that interest transfers from one governor to the next. Reporting the results of the program on a periodic basis to the governor and legislature, including who has reported and who hasn’t could also provide leverage.

***Leasing Partnerships* -** As mentioned in the NYSERDA EO 111 guidelines, lease agreements between state agencies and building owners should be negotiated at the time of renewal in order to create partnerships between the tenant and the owner for energy incentive based agreements. The lease agreements could also include energy reporting requirements. Lease agreements could be reviewed by a state government’s energy

authority prior to approval. For example, the NYSERDA guidelines require that energy improvements should pay for themselves through energy savings prior to the end date of the lease.

Billing Invoices - One way in which funding may be generated is through a concerted effort for analyzing energy billing invoices for inappropriate rates and negotiating refunds from power companies. This study revealed that KY and NV have both made organized efforts to audit billing invoices. If billing invoices are routinely reviewed, much of the information needed for energy tracking would be readily available. It is possible that agencies could be required to report for bill auditing purposes and then an energy tracking system could be built around the information gathered from billing audits.

Standardized Reporting - The consistency that a standardized reporting criteria offers can help to improve the accuracy of energy data. Many of the case studies presented use a form that agencies fill out to provide information that is needed. Others use ESPM or their own software for internet based reporting. A form such as a spreadsheet with fields that automatically populate, similar to the NY example, can also be helpful. A web based system such as ESPM or the MN B3 system is also helpful because data can be instantly analyzed for trend spotting and benchmarking. Such a system can also reward participants with instant feedback on their progress. Required reporting parameters in the early phases should be minimal in order to encourage participation. A program that compares the progress of participating buildings can also encourage competition.

Another reporting option found in some of the case studies is gathering info directly from utilities. Gathering all needed info from utilities across a state can be difficult because of the different utilities and co-ops in which arrangements would have to be made. This option also limits the active participation potential of participation from the stake holder agencies. Gathering data direct from utilities however may be worth exploring in certain situations where an agency or public school simply lacks the resources needed for participation. Power companies may have an interest in improving the energy efficiency of the infrastructure they are servicing. Creating a data exchange scheme could help to create partnerships between state governments and power companies that will improve the ability of state governments to achieve their energy goals. Table 3.2 provides a summary of tracking and reporting methods used by different states in the case studies and shows which states share commonalities.

Table 3.2 **Executed Tracking Methods**

	Published Internal Guidance	Data Direct from Utilities	Focus on Specific Group of Ideal Buildings	Funding Verification	Stakeholder Identification	Web Based Reporting	Bill Auditing Integration	External Leased Space Accounting
KY		x	x	x			x	
MA	x	x						x
MN	x		x	x	x	x		
NV		x		x			x	
NY	x					x		
NC								
OH					x	x		x
SC		x						
TX	x		x					
WI			x					

The “Published Internal Guidance” column refers to states that had some form of guidance on how to report energy usage readily available on their state energy authority websites. The “Data Direct from Utilities” column refers to states that were found to have gathered at least some of their energy usage data direct from power companies servicing state government buildings. The “Focus on Ideal Group of Buildings” column identifies states that reported on a select group of buildings and related that group to their energy goals rather than attempting to gather data and report on all buildings in their system. The “Funding Verification” column is intended for states who to some extent integrated the verification of energy improvement funds with the attainment of their energy goals. The “Web Based Reporting” column refers to states that either created their own web based system or had their stakeholders report through ESPM. The “Bill Auditing Integration” column refers to states that had some form of energy bill auditing closely linked to the tracking of building energy usage. The “External Leased Space Accounting” column refers to states that attempted to account for leased space in buildings not owned by their state government.

CHAPTER 4

CONCLUSIONS

Success in attaining accurate and consistent data over a significant period of time is found to be spotty throughout the case studies. Fundamental deficiencies that appear to plague many state government energy reporting and tracking efforts include:

- different agencies managing bills in different ways, each with their own accounting/auditing system and software

- various leasing and ownership arrangements within buildings that confuse where responsibility for energy consumption within a building should be placed

- lack of enforceability and/or incentive for various agencies to participate particularly through reporting

-multiple buildings monitored by one utility meter making benchmarking of individual buildings more difficult.

Quality data for energy metrics in state government systems requires budgetary incentives related to energy costs. The case studies reveal that many states are having issues gathering the data needed to accurately measure energy consumption across all state buildings. A quality assurance scheme to ensure the accuracy of data reported is one element that is largely absent from all of the case studies. The closest thing to a

quality assurance scheme found is the verification process outlined by the CR for its GHG inventories.

The case studies presented in this paper have revealed some common and uncommon forms of incentive that states have used for reporting in the absence of enforcement. The best examples for creating incentive found are requiring reporting when grant money is offered for energy efficiency retrofits, incorporating reporting into lease arrangements at renewal and placing high ranking individuals within agencies accountable for reporting.

This study has also attempted to display the benefits of an energy metrics system by showing how other states have benefitted from it. Table 3.3 displays some of the common results or outputs found in the series of case studies.

Table 4.1

Outputs

	Public Outreach	Progress Reports	Monetary Representation	Stated Energy Reduction	Stated GHG Reductions	Source Energy Displayed	Adjustments for Weather
KY	X		x	X			
MA	X						
MN	X						
NV	X	x	x	X	x		x
NY	X	x	x	X		x	
NC		x	x	X	x		
OH				X			
SC		x		X			
TX		x		X		x	x
WI		x		X			x

The columns in table 3.3 should be mostly self-explanatory. The "Public Outreach" column is designated for states who clearly displayed their state building energy programs in a manner intended for public outreach. The "Progress Reports" column is for states that published a comprehensive report on their energy goal progress. The "Monetary Representation" is designated for states that prominently displayed some form of monetary savings in their progress reports. The "Stated GHG Reduction" column is for states that mentioned GHG emissions reductions as part of their reporting on energy goal progress. The "Source Energy Displayed" column refers to states that used energy consumed at the EGU to represent either total energy consumption or emissions reductions other than those represented as GHG reductions. The "Adjustments for Weather" column is for states that mentioned some form of weather adjustment to their data in their progress reports.

Although it is evident that states are struggling to meet established energy reduction goals, states who have sound energy metrics systems are displaying the most success in achieving those goals. Quality benchmarking requires quality data plus the use of benchmarks to separate operational issues from efficiency issues. (Bannister and Hinge, 2006) Benchmarking, trend spotting, screening and verification are all important steps in the building commissioning process that require the use of an energy metrics system. Such a system requires consistent reporting that is participant driven in order to successfully provide the information needed for the commissioning process ultimately leading to the attainment of established goals. Consistent reporting is also essential for accurate accounting of the government's contribution to the U.S. carbon footprint.

The spotty success of measuring for and obtaining the goals set forth by state agencies in these case studies highlights the overall lack of execution of the initial policies. The general lack of execution renders the policies largely ineffective regardless of how well or poorly the policies were designed. The case studies reveal a wide range of incentives and leverages used to encourage and in some cases force state government entities to report their energy usage. Other methods used for energy tracking include working around the issue of reporting such as gathering data direct from power companies. Despite the methods, incentives and leverages found, this sample of case studies indicates that most states have not obtained or completely measured progress towards their energy reduction goals.

REFERENCES

ACEEE State Energy Efficiency Policy Database.

http://www.aceee.org/sector/state-policy

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- SC House Bill 4766
- Texas Senate Bills 5, 12 and Executive Order RP49

Much of the research for this thesis came from direct communication with individual working in the States represented in the case studies. The following list represents the individuals contacted directly:

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