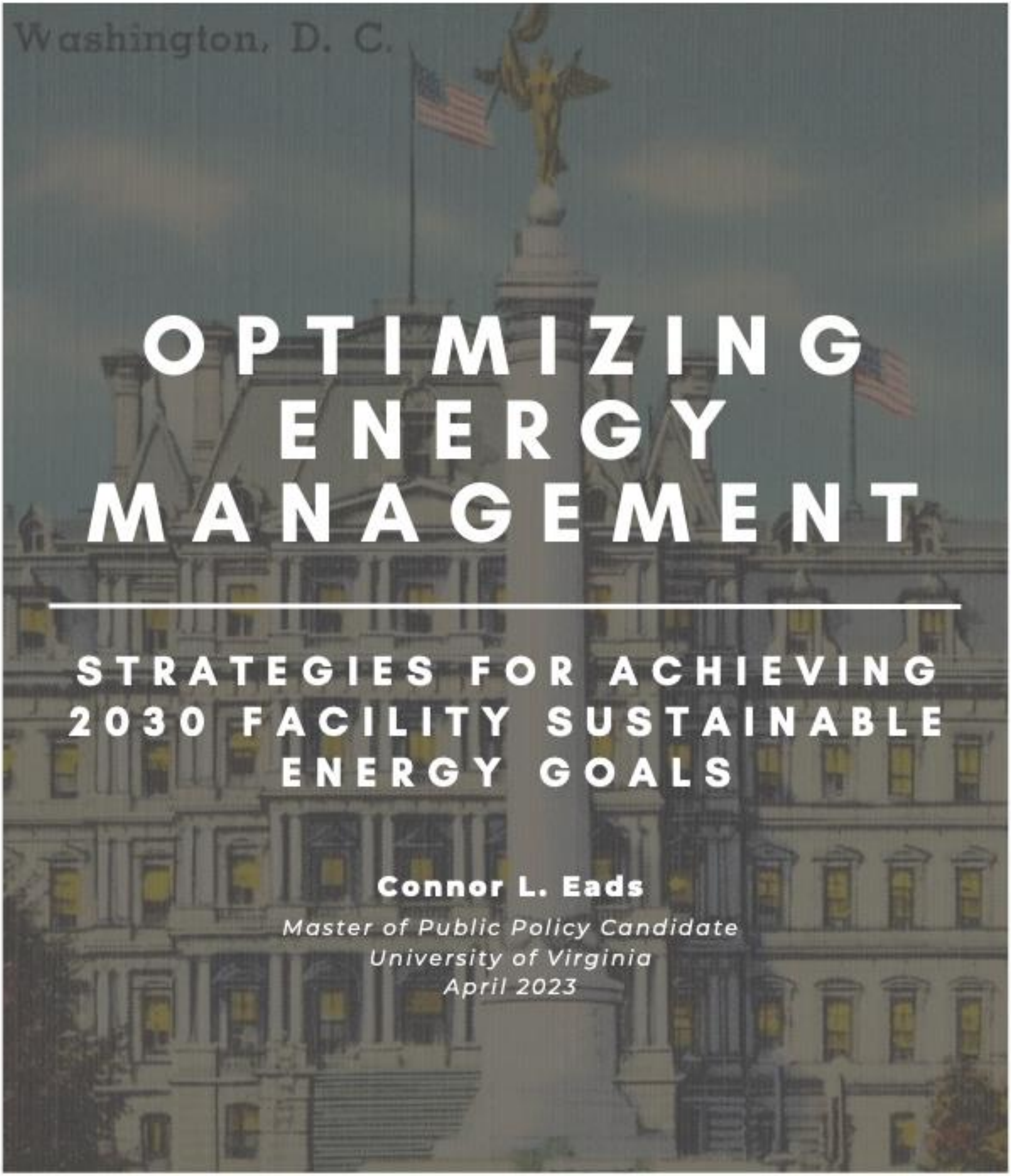

OPTIMIZING ENERGY MANAGEMENT

STRATEGIES FOR ACHIEVING 2030 FACILITY SUSTAINABLE ENERGY GOALS

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UNIVERSITY *of* VIRGINIA
FRANK BATTEN SCHOOL *of* LEADERSHIP *and* PUBLIC POLICY

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DISCLAIMER

The author conducted this study as part of the program of professional education at the Frank Batten School of Leadership and Public Policy, University of Virginia. This paper is submitted in partial fulfillment of the course requirements for the Master of Public Policy degree. The judgments and conclusions are solely those of the author, and are not necessarily endorsed by the Batten School, by the University of Virginia, or by any other agency.

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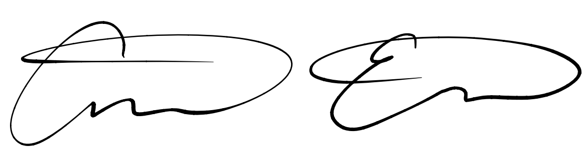
HONOR PLEDGE

On my Honor as a student, I have neither given nor received any unauthorized aid on this assignment nor am I aware of any breach of the Honor Code that I shall not immediately report.



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GLOSSARY

CAP – Consulting and Advanced Projects
CFE – Carbon Free Energy
DOE – U.S. Department of Energy
DOS – U.S. Department of State
ECM – Energy Conservation Measure
EMIS – Energy Management Information System
ESA – Energy Savings Agreement
ESPC – Energy Savings Performance Contract
FEMP – U.S. Department of Energy Federal Energy Management Program
GDI – Greening Diplomacy Initiative
GHG – Greenhouse Gas Emissions
GSA – General Services Administration
GSF – Gross Square Footage
M|SS – Office of Management Strategy and Solutions
MTCO2e – Metric Tonnes of Carbon Dioxide Equivalent
PPA – Power Purchase Agreement
UESC – Utility Energy Savings Contract
Btu – British Thermal Units
kBtu – Thousand British Thermal Units
MBtu – Million British Thermal Units
BBtu – Billion British Thermal Units

EXECUTIVE SUMMARY

Across the board, countries are seeking cleaner energy alternatives and efficient energy management strategies to combat their impacts on climate change. The reality of climate change worsening is becoming more apparent as natural disasters—droughts, wildfires, extreme rainfall, accelerated sea level rise, and intense heat waves—are occurring faster than initially expected (NASA, n.d.). The Intergovernmental Panel on Climate Change (IPCC) acknowledged that "many of the changes observed in the climate are unprecedented in thousands, if not hundreds of thousands of years, and some of the changes already set in motion—such as continued sea level rise—are irreversible over hundreds to thousands of years" (IPCC, 2021).

This report assesses how the U.S. Department of State (DOS) can further aid the fight against anthropogenic climate change by accomplishing its 2030 goal to reduce energy intensity by 30%. Energy intensity represents a foundation of how effective energy is consumed per square footage of goal-subject facilities, so DOS' performance is essential when demonstrating its commitment to these sustainable initiatives. However, this policy problem is urgent because the Department has a long-standing history of not meeting its energy intensity targets. The Department failed to meet its previous 30% reduction goal back in 2015—meeting only a 6% reduction and missing the mark by 24% points (FEMP Energy Total Cost/Use Data, 2022). DOS has to focus on this goal because it is not on track to meet the 2030 goal either.

The Department of State needs to transition from improvements on a case-by-case basis to improvements at scale if it is to meet its 30% reduction goal. DOS ought to prioritize achieving this energy intensity target through public-private partnerships to curb energy consumption while also modernizing its domestic facilities. This report answers to what extent the private sector should bear the burden of modernizing the public sector and then provides a recommendation from the alternatives below of how the Department should move forward.

- Alternative 1: Status Quo
- Alternative 2: Energy Savings Performance Retrofit Goals
- Alternative 3: Utility Contract Goals

EXORDIUM

Problem Statement

The U.S. Department of State (DOS) faces pressure to achieve the most ambitious federal sustainability goals in history—Executive Order 14057 and its respective sustainability plan. These sustainability goals are critical for the department because "[they] demonstrate[e] how the United States will leverage its scale and procurement power to lead by example in tackling the climate crisis" (The White House, 2021). The main goal that DOS faces the most pressure in achieving by 2030 is its statutory requirement to:

(1) Reduce goal-subject facility energy intensity by 30% of its 2003 intensity metric.

DOS' specific policy problem is that it will not meet its energy intensity reduction mandate by 2030 at its current rate of reduction. If the Department does not achieve this performance target, it will introduce three negative externalities affecting the public—specifically, (1) the worsening of climate change through poor energy management, (2) forgone taxpayer dollars, and (3) compromising the United States' credibility abroad regarding the international sustainability push to combat the climate crisis.

Client Overview

The client for this applied policy analysis is the DOS' Office of Management Strategy & Solutions (M|SS)--namely, its Consulting and Advanced Projects (CAP) directorate. M|SS, housed under the Undersecretary for Management, is responsible for the Department's enterprise policy and data analytics capabilities through three directorates: Policy and Global Presence, Center for Analytics, and my client. Through these directorates, the office champions management work that creates policies that strengthen its alignment of resources, leverages data as a strategic asset, and resolves enterprise-wide challenges–while striving to serve as a leading example of continuous improvement (U.S. Department of State, n.d., A)

Tasked with resolving the enterprise-wide challenges, CAP "is made up of four work streams that provide in-house consulting to the Department that meet the needs of solving complex 21st century challenges: [Advanced Projects, Greening Diplomacy Initiative (GDI), Management Optimization & Applied Analytics, and Teamwork@State]". CAP is invested in this policy problem because these energy intensity implications directly align with the GDI's role as the Department's carbon footprint and sustainability lead. The initiative began in 2009 as a result of the White House and Congress' expansion of sustainability and performance requirements. Its creation furthered the concept of eco-diplomacy, where the department "leverages its facilities and operations as a strategic platform to advance the conservation of natural resources and highlight U.S. environmental technological and policy successes [around the globe]" (U.S. Department of State, n.d., A).

The office has a standing track record when it comes to advancing the Department's environmental innovation. For example, M|SS deployed energy meters in 2012 to 100+ embassies and consulates to harness energy efficiency at scale and then developed an air quality app, ZephAir, in 2020 to provide actionable health information to the public (U.S. Department of State, n.d., B). M|SS consistently demonstrates its commitment to improving the Department's sustainability performance; therefore, M|SS, and more specifically CAP, has a vested interest in ensuring that DOS' goal-subject buildings successfully reduce energy intensity to meet the 2030 goal.

PROBLEM BACKGROUND

Energy Intensity

Consuming over 1,230,000 BBtu in primary source energy to operate 3.2 billion square feet of facilities and 600,000 vehicles, the Federal Government stands as the United States' largest energy consumer (U.S. Department of Energy, 2020). This scale is considerably large, given that the operations in 2020 generated an energy bill of roughly $16.1 billion. When compared to the overall Federal Government's energy profile, DOS' role is relatively minimal: 0.20% of total Federal Goal-Subject Facility Space, 0.18% of total Federal Goal-Subject Facility energy consumption, 0.36% of total Federal goal-subject facility energy costs, 0.14% of gross Federal energy consumption, and 0.22% of gross Federal energy costs (FEMP Energy Total Cost/Use Data, 2022). Despite the minimal proportional size, the problem statement's full impact of the externalities stemming from the failure to reduce energy intensity is discussed later in the consequences to society section.

Since the Federal Government plays such a significant role in energy consumption and size, DOS' role is overshadowed. Energy intensity adds transparency to this issue because it measures the quantity of energy required per square foot of facility space (Btu/GSF). The figure below represents how each of these factors has changed over the past two decades–following the theme where consumption rises as facility space rises. It is also important to note that energy intensity only factors in space and consumption from facilities that are subject to sustainability goals, where facilities from standard operations are counted while facilities pertaining to mission security or are fully-serviced leases are excluded (U.S. Department of Energy, 2005). Applying this understanding of energy intensity to DOS then means that its foreign consulates and embassies in over 190 countries do not get factored into the reported footprint.

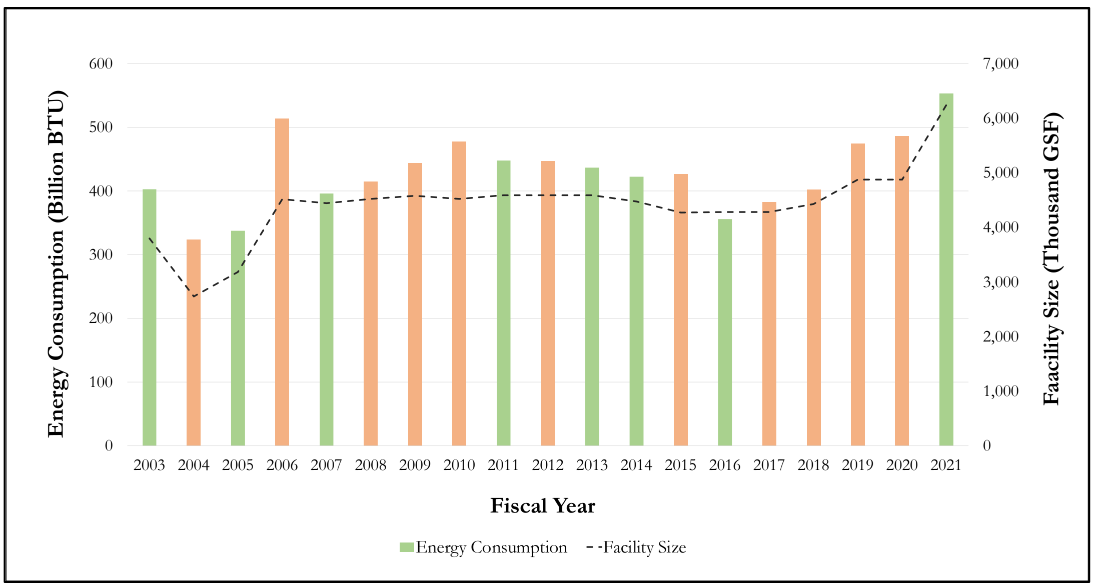

Figure 1: U.S. Department of State Energy Consumption & Facility GSF Trends

Source: Connor Eads, Using FEMP Energy Total Cost/Use Data (2022) & FEMP GSF Data (2022)

This measurement is essential in the sustainability movement because it further indicates how energy efficient a department is by tracking how its energy intensity changes over time. Figure 1 depicts how the energy intensity factors –facility space and energy consumption—have changed, where green bars indicate a year where DOS' intensity reduced year-on-year, while orange bars indicate a year where DOS' intensity grew year-on-year. In 2021, DOS and the Federal Government's energy intensity was 88,568 and 91,668 (Btu/GSF), respectively (FEMP Energy Total Cost/Use Data, 2022). However, given the Federal Government operates at such a large scale, the Social Security Administration (SSA), Tennessee Valley Authority (TVA), and U.S. Army Corps of Engineers (USACE) serve as better benchmarks since they more closely align with the relative size of DOS. The figure below illustrates the importance of how much progress DOS has made over the past two decades after seeing how other Departments have performed. Despite the similarity in facility size, each Department already met the 2030 mandate to reduce 30% of their respective 2003 energy intensity metrics except for DOS in 2021–where DOS reduced by -16.6%, while SSA by -38.7%, TVA by -74.8%, and USACE by -36.5%.

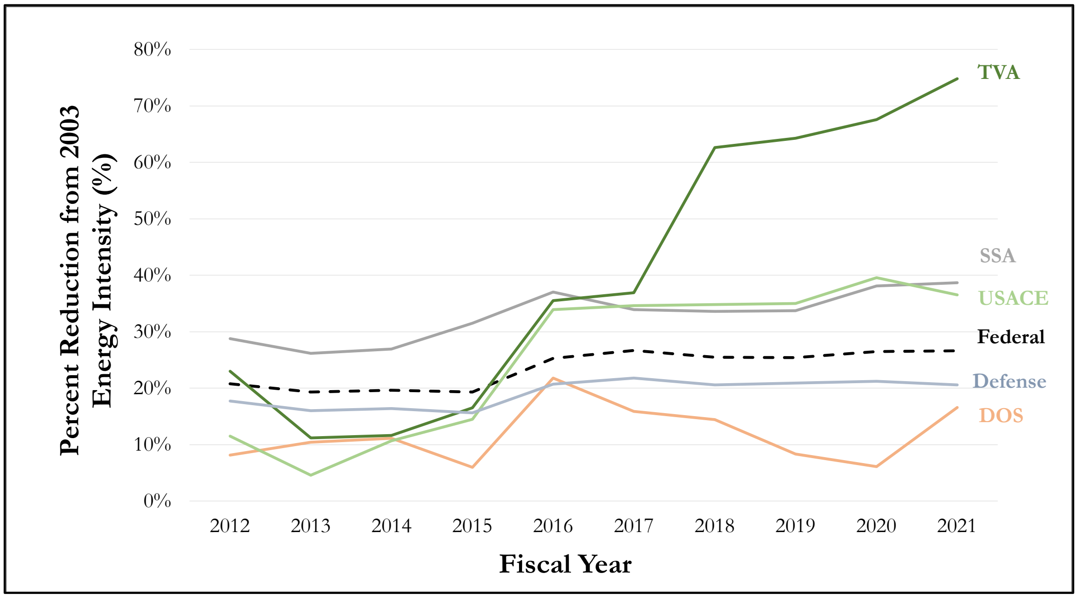

Figure 2: U.S. Department of State Energy Intensity Benchmark Across the Federal Government

Source: Connor Eads, Using FEMP Energy Total Cost/Use Data (2022)

If DOS has been required to meet energy intensity requirements since it was first required in 1999, why has it not met the goal yet? The answer to this question will be captured in the existing evidence and research gaps; however, the synopsis is that it's a combination of both an information externality as well as operational constraints. On the one hand, the information externality…

> may be due to inadequate or poor information about new clean energy or energy-efficient consumer technologies. In the context of energy efficiency, these information market failures may even interact with behavioral failures, such as consumer myopia (i.e., consumers only focusing on the very short- run at the expense of the long-run for a particular good or service in a way that is different than other choices consumers make) leading to an overweighting of the upfront costs for energy-using durable goods relative to other decisions consumers make. There is some evidence that these issues could lead to underinvestment in consumer energy efficiency decisions (Office of the President, 2016).

While on the other hand, DOS operates closely with the Intelligence Community as well as works across the globe. "Successful deployment of more efficient building equipment and business practices is not always apparent when using energy intensity as a metric. Reducing GSF while increasing both the hours a space is in use and related occupancy rate may have operational benefits, but they skew an energy intensity score. A more capable metric or means of evaluating progress in energy efficiency should be considered." (U.S. Department of State, 2013).

The previous deadline for federal departments to reduce 30% of their 2003 energy intensity was in 2015; however, the Department recognized its capacity to meet the goal in its 2010 sustainability goal, saying that it "strives to achieve the mandated 30% reduction in energy intensity by FY 2015, [but its] glide path will not necessarily align with the projected linear year-to-year targets but will track with proposed and planned energy conservation projects and initiatives" (U.S. Department of State, 2010). DOS was correct about the glide path because the Department had only reduced energy intensity by 6% in 2015 (FEMP Energy Total Cost/Use Data, 2022). Forecasting DOS' trajectory with a sensitivity analysis from its historical energy intensity rates reveals that the Department would likely meet the reduction goal in 2039–acting in non-compliance for nine years at a minimum. DOS needs to strategically address this problem at scale because, at its current rate of reduction, it is not projected to achieve this goal by 2030 seen in the figure below.

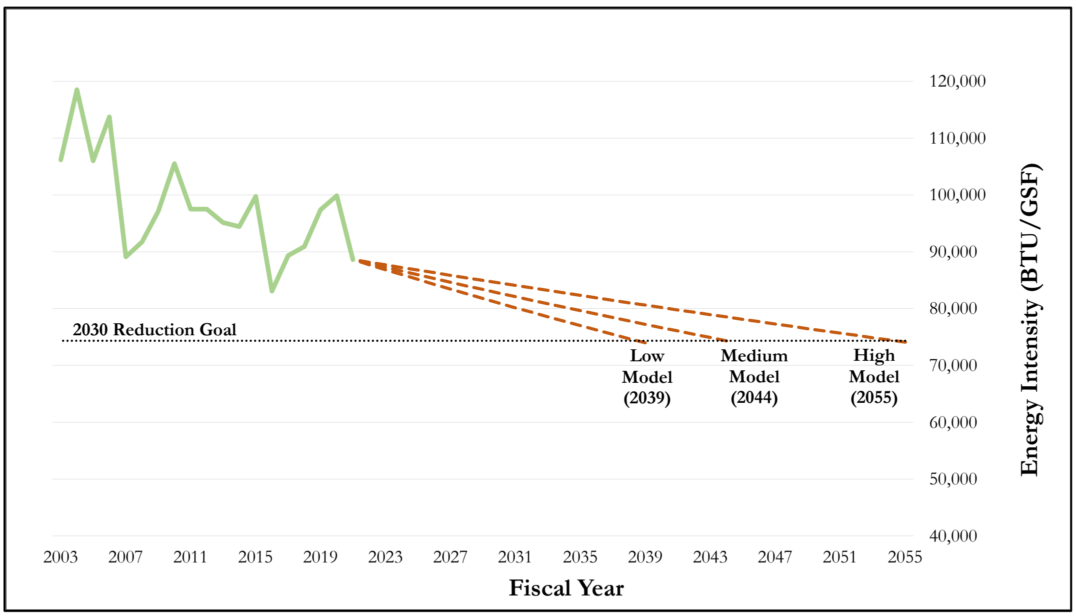

Figure 3: U.S. Department of State Status Quo Forecast

Source: Forecasted by Connor Eads, FEMP Energy Total Cost/Use Data (2022)

Consequences to Society

Negative Externalities, in the context of sustainable energy or developments, often revolve around the depreciation of natural resources or pollution's implication on health. Pigou argued that these externalities were "divergences between private and social [welfare] of the kinds we have so far been considering cannot, like divergences due to tenancy laws, be mitigated by a modification of the contractual relation between any two contracting parties, because the divergence arises out of a service or disservice rendered to persons other than the contracting parties"(Pigou, 1920). In other words, these negative externalities arise when an actor only considers the direct costs or benefits but neglects to incorporate the indirect costs posed to society–where the social costs then exceed the direct costs (e.g. energy plant polluting local air quality).

The three negative externalities that are most relevant to energy intensity at DOS are forgone cost-savings, compromising international credibility, and climate change. Internalizing each of these is important to consider because it touches on how DOS has set a consequential standard by considering how to consume more renewable sources to wane off traditional ones while also remaining committed to efficiently decreasing energy consumption; in 2021 alone, 39.5% of all site-source electricity was produced from renewable sources (U.S. Department of State, 2021).

> The first category of market failure that afflicts markets for clean energy and energy efficiency consists of environmental externalities from the burning of fossil fuels…If these environmental externalities are internalized into the market price for energy services, the price of fossil fuel-based energy would increase and the relative financial attractiveness of clean energy would improve, resulting in more clean energy investment. Thus, without some intervention to internalize these negative externalities or otherwise address this market failure, the market will under-provide clean energy (Office of the President, 2016).

The first externality stems from renewable energy's capacity to generate cost-savings that directly impact the use of taxpayer dollars. For example, the use of renewable portfolio standards "led to $1.3 billion to $4.9 billion in consumer savings from reduced electricity and natural gas prices [in 2013]," where the counterfactual would have resulted in higher costs. (Mai et al., 2016). Although the costs directly fall on the Department of State, the externality is found in the costs posed to United States' taxpayers—where the costs do not factor in the counterfactual savings the Department could have taken utilized. In other words, the externality is the divergence that arises out of the now-wasted taxpayer dollars.

The second externality of compromising international credibility stems from the implications of DOS' eco-diplomacy on a global platform–demonstrating the U.S.' sustainable practices and innovations to over 190 countries. In the case that the Federal Government does not deliver on its international treaties (e.g. Paris Agreement Accord or Kyoto Protocol), credibility has spillover effects on how other countries address their similar goals.

> When credibility is high, then cooperation to address the problem of climate change is a bit like a rolling snowball. A growing number of countries make credible commitments, and investors follow by putting money into new technologies. Those technologies get better and cheaper, which makes further commitment easier to achieve politically. Efforts in the highly credible countries and markets then spill over into broader cooperation (Victor, et al. 2022).

The final negative externality with climate change has slowly come into focus since "U.S. Federal regulations have traditionally focused on the benefits and costs that accrue to individuals that reside within the country's national boundaries…[but] the global nature of [greenhouse gasses] means that U.S. interests, and therefore the benefits to the U.S. population of [greenhouse gasses] mitigation, cannot be defined solely by the climate impacts that occur within U.S. borders " (Interagency Working Group, 2021). The externality of climate change is a much more complex one since some of the social costs from global warming make it a global externality and not a local one; although the second and third are exclusive, they closely support the significance of the other. The same interagency working group substantiated the direct and indirect impacts through the impacts on the assets of 9 million citizens abroad or the U.S. position in the international economy. Adverse spillover effects in economic destabilization and national security have also been forecasted as a result of extreme events like rising sea levels (Center for Climate and Security, 2018).

GOVERNANCE

Policy Analysis

Federal sustainability performance targets have existed for roughly 50 years, spanning nine presidential administrations. Dating back to the comprehensive structure of energy efficiency and production of the 1970s, the National Energy Policy and Conservation Act (NEPCA) first directed the Secretary of Energy to begin establishing performance metrics of their respective facilities. Through the late 1980s into the 1990s, Congress passed legislation such as the Federal Energy Management Improvement Act in 1988 that made departments begin auditing its energy consumption and efficiency—whereas the 1992 Energy Policy Act specifically “authorized several alternative-financing mechanisms that promote ESCO projects” (Hopper et al., 2004, p. 3). H.W. Bush and Clinton administrations also followed suit with Executive Orders 12759, 12902, and 13123 to further specify the Federal Government's sustainability targets and establish the first energy intensity targets: reducing consumption at least 10% of 1985 by 1995; reducing the energy intensity of Federal buildings by 20% of 1985 energy before 2000; raising energy intensity reduction to 30% of 1985 before 2005; require Departments to develop/implement an industrial facilities plan to increase energy efficiency by at least 20 percent by the year 2005 as compared to the 1990 benchmark; reduce energy intensity by 30% and 35% of 1985 metrics before 2005 and 2010 respectively; and begin excluding facilities from sustainability goals based off of operational criteria. (Executive Order No. 12759, 1991)(Executive Order No. 12902, 1994)(Executive Order No. 13123, 1999).

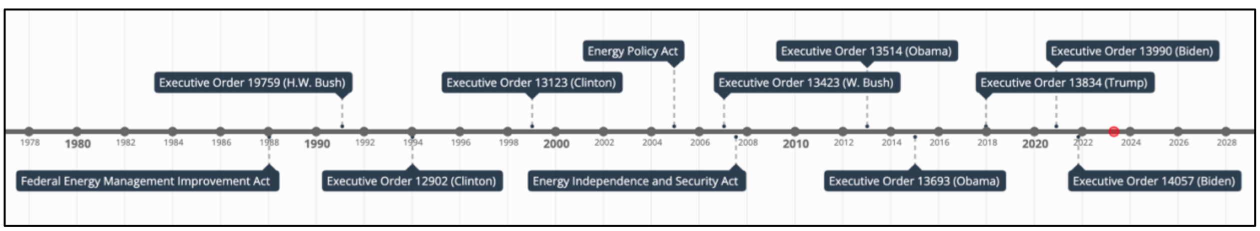

Figure 4: Energy Intensity Policy History

Source: Connor Eads, Legislative History from Past Executive Orders & Legislative Acts

At the turn of the century, the picture became clearer as policy started to establish annual metrics that Federal departments needed to achieve rather than leaving the goal to the discretion of the departments. The Energy Policy Act of 2005 and Energy Independence and Security Act of 2007 under the Bush administration then expanded on the available initiatives to help incentivize the use of technologies and alternative fuels to combat greenhouse gasses and energy efficiency--where the EISA furthered facility energy intensity goals to meet 27% and 30% of 2003 by 2014 and 2015 respectively (Energy Policy Act, 2005)(Energy Independence and Security Act, 2007). In Bush’s Executive Order No.13423, he added an ambitious caveat to the energy intensity targets by mandating a 3% annual reduction from 2007 to 2015 or until the Department met 30% of 2003’s baseline (Executive Order No. 13423, 2007).

The Obama administration furthered the previously established goals with Executive Order 13514 and then continued to refine targets with Executive Order No. 13693, dedicating them to long-term strategies after coining the order "Planning for Federal Sustainability in the Next Decade." Here, President Obama, reduced the energy intensity annual reduction from 3% to 2.5% through the end of 2025 and furthering the requirement that renewable electricity comprise no less than 30% of total facility electricity usage by 2025 as well (Executive Order 13693, 2015). President Trump did not pass any strict goals other than leaving the discretion and coordination of his Executive Order No. 13834 to Chairman of the Council on Environmental Quality (CEQ) and the Director of the Office of Management and Budget (OMB). The most ambitious sustainable targets established over these five decades, however, was under President Biden's administration with Executive Order No. 13990 and 14057–committing the Federal Government to leverage its scale with long-term objectives to 100% carbon pollution-free electricity by 2030, 100% zero-building emissions by 2045, and net-zero procurement emissions by 2050 to name a few (Executive Order No. 13990, 2021)(Executive Order No. 14057, 2021).

The legislation mandated all federal agencies to direct resources to prioritize efficient energy management and reduce the impacts of climate change; therefore, the jurisdiction stemmed from the executive orders and acts, but the responsibility fell on the agencies to meet their own goals. The operations that devolve to the state and local level do not affect the client's stake in the problem. This concern would fall under the Department of Energy since it already provides energy efficiency policies and programmatic resources for the other levels of government. The Department's stakeholders who have a role in this problem—focusing on the STATE' domestic facilities—are the U.S. Department of Energy (DOE), the U.S. General Services Agency (GSA), the U.S. Environmental Protection Agency (EPA), and the U.S. Environmental Protection Agency (EPA). President Biden has since then created task forces to inform strategies on tackling carbon emissions as well as the Climate Smart Buildings Initiative to establish funding to modernize facilities via performance contracting (The White House, 2022, A.)(The White House. (2022, B.).

EXISTING EVIDENCE

As long as the policy history stretches documenting the problem with energy intensity, methods for reducing it has been not far behind. For example, the Department of Energy's (DOE) list of awarded performance contracts reaches as far back as 1998 (FEMP Federal Awarded ESPC Data, 2023). The three methods that demonstrate the efficacy of achieving this 30 % reduction at the federal scope are Energy Savings Performance Contracts (ESPCs) and Utility Energy Savings Contracts (UESCs). The Department has also deployed other noteworthy methods such as energy demand management, machine learning integration, and building consolidation. There is plenty of research surrounding the history of these three methods impacting energy consumption; however, there are also gaps on the impacts under certain operational constraints that are unique to some federal departments.

Energy Savings Performance Contracts (ESPCs)

The ESPC method is one of the most effective when it comes to reducing energy intensity over the past two decades. Since 1998, DOE has recorded roughly $8 billion in project investments through these partnerships with over $18 billion in guaranteed cost savings and 33,263 BBtu in reduced annual energy consumption (FEMP Federal Awarded ESPC Data, 2023). Essentially, an ESPC is a partnership that allows an energy service company (ESCO) to conduct a full-scope energy audit for a federal department and deliver a project that improves the identified energy conservation measures. What makes these contracts ideal is that the ESCO finances the project and bears the burden of implementation risk to secure the agreed upon energy conservation measures; however, it is paid back through the energy cost savings throughout the life or "periods of performance" of the agreed upon contract—with the strict life cutoff being 25 years, excluding the years during construction.

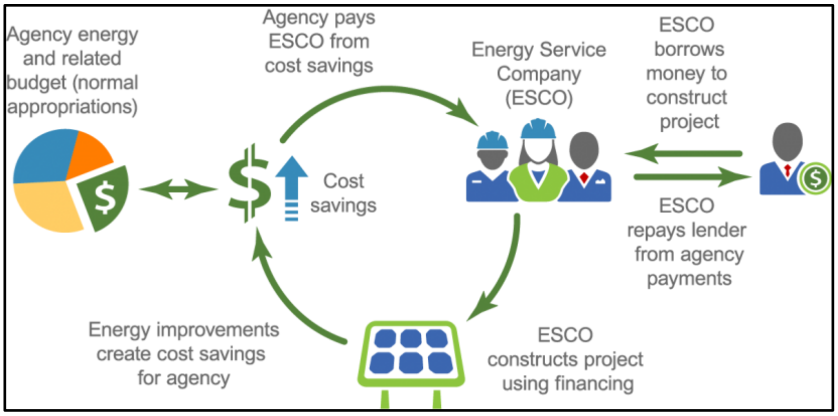

Figure 5: Energy Savings Performance Contract (ESPC) Cycle

Source: Department of Energy, Federal Energy Management Program

The main concerns around ESPCs, besides the trend of increasing costs, stem from the private sector challenges with project complexity and innovation. Specifically, the former includes "increasing project development times…difficulty finding qualified subcontractors…and difficulty accessing project documents and quickly fulfilling customer requests" (Stuart et al., 2021). The latter concern of ESPCs is that:

> "ESCOs and other third-party financers have an incentive to minimize risk on individual projects. This leads these entities to use older, proven technology, rather than the kinds of innovative technologies coming out of the DOD and GSA test bed programs… This disincentive to adopt innovative technologies is a recognized issue with ESPCs and the ESCOs that perform them. The clearest evidence comes from the experience with ESCOs that are part of larger companies that are themselves developing technologies to improve building energy efficiency. Rather than use the new technology that its parent company has developed, the ESCO will typically use an off-the-shelf solution to minimize financial risk" (Deutch, 2016, p. 104).

This method of public-private partnerships has been effective at enabling the federal government to make great strides in mitigating its footprint while the private fronts the financing. "In FY 2020 alone, federal agencies invested $842 Million in energy efficiency and renewable energy improvements using DOE's ESPC contract vehicle, which will result in approximately $1.7 billion in energy and water cost savings and will reduce annual greenhouse gas emissions by more than 106,100 metric tonnes carbon dioxide equivalent" (Nicholls, 2021). Even in Virginia from 2000 to 2018, public-private partnership contracts led to the creation of 3,420 jobs and over $57 Million in annual energy cost savings (U.S. Department of Energy Federal Energy Management Program, 2018). The Department is aware of these benefits and has taken advantage of ESPCs in the past, spending roughly $12 Million on them over the past 13 years (FEMP Sustainable Investment Data, 2022).[1]

The research surrounding ESPCs and their impacts on energy management has varied over the past two decades. In its fiscal year 2021 report, acknowledging the change in operations due to the COVID pandemic, Oak Ridge found that "ESPC contractors guaranteed 92.6% of the estimated cost savings [and the] projects reported achieving 101.8% of the estimated cost savings…[and] 110% of the guaranteed cost savings" (Walker, 2022, p. 5). The report aggregated impacts by fuel type as seen below, showing that electricity, coal, and steam accounted for 87.7% of the reported energy savings. These figures limit the application to this analysis because of access restrictions to previous facility specific energy consumption; therefore, these energy conservation measures need to be represented as a measurement per square footage—adding further value because it accounts for differences in project size.

Table 3. Aggregate Net Annual Reported and Estimated Energy Savings by Fuel Type for 193 DOE ESPC IDIQ Projects

	Reported		Estimated		Ratio of Reported to Estimated
	Savings (MMBtu)	Percentage of total	Savings (MMBtu)	Percentage of total	
Electricity	5,795,030	35.9%	5,817,707	36.6%	0.996
Coal	4,632,542	28.7%	4,632,542	29.2%	1.000
Steam	3,727,382	23.1%	3,843,726	24.2%	0.970
Natural Gas	826,909	5.1%	588,586	3.7%	1.405
Fuel Oil	562,154	3.5%	514,835	3.2%	1.092
Chilled Water	310,923	1.9%	311,360	2.0%	0.999
Other	286,432	1.8%	166,613	1.0%	1.719
Total	**16,141,372**		**15,875,368**		**1.017**

Figure 6: Aggregated Energy Savings by Fuel Type

Source: Oak Ridge National Laboratory, DOE ESPC IDIQ FY 2021 Report

In 2013, a sensitivity study of ESPCs from 2003 to 2012, normalized by facility space, found that federal ESPCs saved 0.015 – 0.038 MBtu/sq. ft. in energy savings while totaling $2.72 - $7.06/sq. ft. in implementation costs (Stuart et al., 2013). While another Oaxaca-Blinder decomposition study in 2019 estimated that federal ESPCs from 2008 to 2017, normalized by facility space, saved $0.70/sq. ft. in annual cost savings and totaled $6.8/sq. ft. in implementation costs (Carvallo et al., 2019). This latter study was novel because it attempted to explain how other metrics not traditionally reported (e.g. material costs) impacted ESPC installation cost increases, finding that the number of conservation measures and project composition helped explain why these costs are outpacing annual savings over the past three decades (Carvallo et al., 2019). This result then verified a trend of decreasing ESPC benefit-cost ratios found in a past 2012 study (Larsen et al., 2012). However, a gap in the 2019 study failed to explain the remaining 50% of increased installation costs, where the author suggests further study of the ESPC labor market and cost framework.

[1] Adjusted 2021 Dollars from FEMP to 2023 Dollars using January 2021 CPI (261.582) and January 2023 CPI (299.17).

Utility Energy Savings Contracts (UESCs)

The UESC method follows the same concept of using private partners for energy management projects, except a utility service is delivering the energy conservation measures instead of an energy service company (ESCO). Looking at the UESC's progress since its inception, the Federal Government invested over $4 billion into 2000+ contracts, generating an impact of "32,000 job years, 16.5 Million MBtu saved, 17 Million metric tonnes of [greenhouse gases] avoided" (Sotos, 2022, p. 21). Essentially, a UESC mirrors the same financing structure as ESPCs where a private third party fronts the project construction and recoups the cost from the Department through the cost savings over at most 25 years; however, the distinctions between the two are seen in the authority of obtaining the energy conservation measures—where an ESPC is directly overseen by DOE, while a UESC falls under the specific department pursuing the contract and the General Services Administration (GSA).

One concern, though, in this contracting style is that "the authority for UESCs does not require utilities to guarantee savings; the repayment is based on estimated cost savings…[still], efficiency improvements can provide benefits such as reduction in demand, which can lead to cost savings for the utility" (Congressional Research Service, 2018, p. 2). Therefore, this concern is diluted because the private third party has a vested interest to deliver on the improvements. Another concern also arises in the state level policy for energy markets. For example, "some states and utility service territories do not allow an entity other than the serving utility to sell electricity to retail customers…[where] the third party/private developer would be subject to public utility commission regulations, which are a barrier to PPA-type arrangements such as ESPC ESAs"—DOS' Kentucky, Florida, and South Carolina facilities would be either disallowed or restricted by legal barriers" (DSIRE, 2021)(U.S. Department of Energy, n.d.). This regulatory impact is critical to the utility-based contracts because some "power purchase agreements [have been] selected due to highly concentrated energy demand within areas that do not allow for extensive energy production infrastructure to be built on-site, particularly in the National Capital Area Region" (U.S. Department of State, 2018, p. 4).

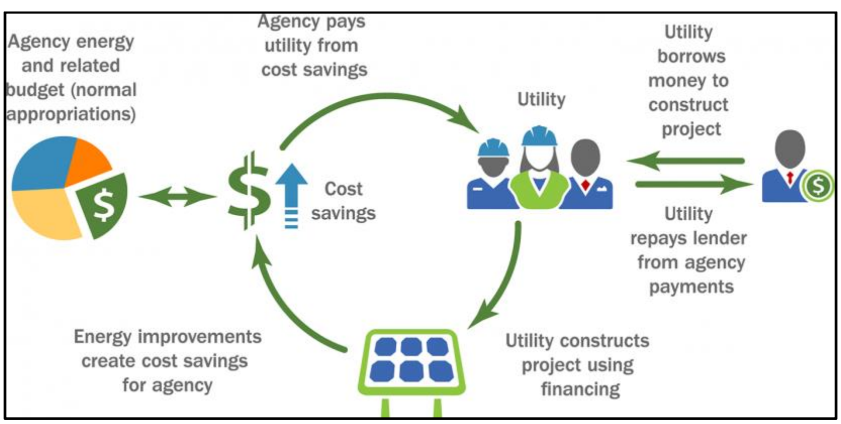

Figure 7: Utility Energy Service Contract (UESC) Cycle

Source: Department of Energy, Federal Energy Management Program

The benefits of this type of contract are that it serves as a "one stop shop [for] audit study opportunit[ies], feasibility assessment[s], detail design and engineering, project implementation, project commissioning, measurement and verifications (optional), [and] operations and maintenance (optional)" (Thomas, 2009, p.7). DOS is familiar with this form of contracting because it spent nearly $49.6 Fillion on UESC projects, comprising 58.92% of the Departments sustainability expenditures from 2005 to 2021 (FEMP Sustainable Investment Data, 2022).[2] One of the Department's greatest successes with these contracts involved delivering solar PV energy to its Charleston, South Carolina facility (Building 84), making it the Department's first net-zero domestic facility (U.S. Department of State, 2022). Going even further into its 2019 sustainability plan, the Department demonstrated contract success from a power purchase agreements (PPAs) that generated over 1 gigawatt of energy for facility use through just 3 facilities (U.S. Department of State, 2019). Especially in times with vulnerable supply chains and market insecurity, DOS recognizes that these renewable energy contracts add additional value through operational resilience (U.S. Department of State, 2019).

A FEMP study from 2005 dives into UESC data from 2000 to 2004, finding that UESCs had an average annual energy savings of 26,194 (MBtu), an annual cost savings of $327,764, and an average capital investment of $1.64 Million (Tonn et al., 2005, p. 19). In this case, UESCs share the same issue of not reporting the impacts per facility space, where it is possible to overstate the impact due to larger contracts. This is a concern because the issue lies in the access to information regarding their impacts per facility space; "[FEMP] states that it has collected data on more than 2,100 UESC projects dating back to 1992…but it has kept individual details of the information agencies provided confidential" (Congressional Research Service, 2018, p. 6). However, a 2017 study helps address this concern by analyzing UESCs from 2009 to 2013 (Hoffman et al., 2017) with a quadratic function. Their initial regression produced an average of $0.028/kWh, but, after weighting the electricity savings to account for larger portfolios, "a somewhat different picture emerges…where the savings-weighted average[d]…$0.022/kWh for the five-year period" (Hoffman et al., 2017, p. 6-7). The researchers acknowledged the restraint with voluntary reporting could have led to missing UESC data and suggested that the reporting has to improve, in which "future work will also take a more expansive look at factors that potentially influence the cost of achieving electricity savings" (Hoffman et al., 2017, p. 14).

Other Methods

DOS has historically used three other methods to reduce energy intensity: building consolidation, energy demand management, and integrated machine learning. The Department indicated in 2016 that it "will continue to work to consolidate facilities and locate buildings in public transit-accessible locations to optimize sustainable space utilization…[consolidating its] non-back office functions within the Foggy Bottom and Rosslyn, Virginia areas" (U.S. Department of State, 2016). The Environmental Protection Agency (EPA) also replicated these consolidation measures, finding that "[consolidation] will significantly reduce EPA's energy intensity and Scope 1 and 2 greenhouse gas emissions…[and] also reduce the [EPA's] operating costs, including rent and annual energy costs" (Environmental Protection Agency, 2014). However, DOS has experienced negative results from this method in 2013, claiming "the additional hours Department Buildings are in use also have a negative effect on the Department's energy intensity profile." (U.S. Department of State, 2013). A caveat to the building consolidation was that the Department was also following its Sustainable Buildings Implementation plan (SBIP), which "ensure[d] all new construction of Federal buildings greater than 5,000 GSF that enters the planning process be designed to achieve energy net-zero and, where feasible, water or waste net-zero by FY 2030" (U.S. Department of State, 2016).

[2] Adjusted 2021 Dollars from FEMP to 2023 Dollars using January 2021 CPI (261.582) and January 2023 CPI (299.17).

Executive Order No. 13834 established energy demand management as a target because it was a relatively low-cost method to reduce greenhouse gas emissions and energy consumption. In 2015, in efforts to reduce intensity, the Department also participated in demand management programs. However, "participation in demand management programs conflicts with the Department's GHG reduction goals as many of our buildings receive electricity under a renewable Energy Savings Agreement" (U.S. Department of State, 2015). The Government Accountability Office identified "[OMB's] demand management as an action agencies should take, but it says little about how agencies should define requirements before making decisions to award a contract. Demand management involves, among other things, the practice of eliminating inefficient purchasing and consumption behaviors" (Government Accountability Office, 2020). However, this second method also had negative effects on the Department of State in 2013; "[where] successful deployment of more efficient building equipment and business practices is not always apparent when using energy intensity as a metric. Reducing GSF while increasing both the hours a space is in use and related occupancy rate may have operational benefits, but they skew an energy intensity score." (U.S. Department of State, 2013).

The final method DOS has successfully implemented in the past was its integration of a machine learning-based for energy use metering within its MeterNet platform. . "MeterNet is [DOS'] smart metering program that collects and analyzes real-time data to identify opportunities to reduce cost, increase resilience, and plan for future investments" (U.S. Department of State, 2018). This type of integration performs comprehensive energy use data and attempts to find trends that help reduce anomalies and improve facility performance in the process. Specifically, this application has "already identified no-cost energy efficiency improvements worth Millions of dollars in its pilot tranche of 30 U.S. diplomatic posts…[and will eventually help] automatically identify savings and efficiencies, predict blackouts, and optimize maintenance and replacement schedules for equipment" (U.S. Department of State, n.d., B). Machine learning was a successful initiative because it is able to help account for occupancy or time of space being used in the energy intensity calculation—where the Department felt as though it was already maximizing its efficiency of office space (U.S. Department of State, 2016). For an example, GSA recognized that in one case "supervisory control [of the machine learning-based EMIS] was informed by occupancy data from thermal occupancy counters installed at the building entrances and exits, as well as weather data, which were processed/analyzed via machine learning for optimal operation" (Pachuta et al., 2022). The efficacy for further machine learning at DOS continues to add value because the Department's information technology equipment accounted for nearly half of the Department's energy consumption (U.S. Department of State, 2010).

Takeaways

DOS has long recognized the positive impacts that public-private partnerships or modernization initiatives have had on the Department's progress towards achieving its sustainability requirements. The main takeaway from this literature is that, despite the decreasing of energy savings performance contracts (ESPCs) cost-benefit ratios, the ESPC's impact on energy management still overshadows the respective impacts from utility energy savings contracts (UESCs). Although these contracts have demonstrated their ability to move agencies closer to the 30% energy intensity reduction target, DOS has not consistently applied these contracts at an enterprise scale for its other facilities.

POLICY ALTERNATIVES

In order for DOS to reduce its goal-subject facility energy intensity by 30% of 2003 metrics, the Department needs strategies that are applied at an enterprise scale. Based on the existing literature, the Department needs to evaluate its capacity to engage the private sector to help distribute the burden of meeting these goals. Therefore, DOS ought to consider implementing these three policy alternatives:

Alternative #1: Status Quo

The first alternative offers DOS what its current trajectory means for its progress towards achieving the 2030 energy intensity goal. This alternative analyzes the Department's historical energy consumption and cost data to offer a linear sensitivity analysis of when it will meet the 30% reduction through three models: an average of year-on-year energy intensity change, a historical growth rate of energy intensity, and an average of these two methods. Through this alternatives findings, the Department will be able to not only use it as a benchmark to evaluate the other alternatives, but also emphasize the importance of prioritizing its next steps to achieve the energy intensity target.

Alternative #2: Energy Savings Performance Retrofit Goal

The second alternative advises DOS to engage private energy service companies (ESCOs) through Energy Savings Performance Contracts (ESPCs) for deep energy retrofits of all its 15 domestic facilities—a method to address wide comprehensive, aggressive energy conservation measures. Similar to the first alternative, the second focuses on the building infrastructure installations rather than utilities. In other words, these contracts would allow ESCOs to install full-scope energy management that incorporate dominant technology categories like boiler plant improvements, building automation, energy distribution systems, HVAC, or lighting. These ESPCs, as seen in the evidence, relate directly to meeting the 30% reduction target because the contracts effectively mitigate energy consumption.

Alternative #3: Utility Contracting Goal

The third alternative advises DOS to enter public-private partnerships with utility companies or energy service companies (ESCOs) to improve energy efficiency while also reducing energy demand at all 15 of its domestic facilities. These contracts primarily flow through either technical (e.g. power quality improvements) or financial services (e.g. utility rebates) (Thomas, 2009). Although Utility Energy Service Contracts (UESCs) would be the primary contract vehicle, Energy Sale Agreements (ESAs) and Power Purchase Agreements (PPAs) will also be encouraged due to their revolving around clean energy generation, distribution, or procurement (e.g. installation of solar panels). These utility or energy distribution contracts relate directly to meeting the 30% reduction because it not only mitigates energy consumption, but it also has the capacity to shift consumption towards alternative energy sources.

EVALUATIVE CRITERIA

Four criteria based on the value to the Department will be applied to assess how effective each alternative is at making DOS compliant with the 30% energy intensity reduction goal: projected costs, cost-savings, climate impact, and cost-effectiveness. Administrative feasibility was not considered as a valuable criteria for this analysis due to some proposed alternatives partially relying on private energy service company (ESCOs) or utility authority. Their role in implementation are not straightforward nor easily forecasted without explicit facility data around consumption or past projects—neither of which I have. Therefore, administrative feasibility would only produce variable and ambiguous results. An equity criteria was also not considered because there was no clear, operational application to federal facilities or the alternatives' processes.

Projected Costs

The projected costs criterion evaluates the direct costs associated with implementing each alternative's timeline. These direct costs would include additional hires' salaries and benefits, expected contract financing expenditures, other upfront energy audit fees, and additional costs associated with the contracting phase that fall on DOS' budget. These costs will then be adjusted for a long-term average inflation rate of 3.8% and then discounted at OMB's guidance of 3% and 7% (Council of Economic Advisors, 2017). Therefore, the projected cost measurement will be an output of FY 2023 dollars ($). This cost criterion directly supports M|SS' goal to achieve its 30% reduction because it will advise alternative selection based on the budget it has available.

Cost-Savings

The cost-savings criterion evaluates the indirect savings delivered from the facilities after all facility projects have been implemented and completed. These indirect savings are calculated from previous studies' average savings such as Oak Ridge National Laboratory (Walker, 2020)(Tonn et al. 2020). These savings will be adjusted for a long-term average inflation rate of 3.8% and then discounted at OMB's guidance of 3% and 7% (Council of Economic Advisors, 2017). Therefore, the projected cost measurement will be an output of FY 2023 dollars ($). This cost criterion directly supports M|SS' goal to achieve its 30% reduction because it will advise alternative selection based on how much DOS would save in the long-run.

Climate Impact

The climate impact criterion will measure the projected annual reduction in energy consumption from all of DOS' 15 facilities after the implementation is completed. These impacts will be calculated from previous studies' average energy savings such as Lawrence Berkeley National Laboratory and Oak Ridge National Laboratory (Walker, 2020)(Hopper et al., 2004). The measurement for climate impact will be an output of annual energy savings (MBtu). This criterion directly supports M|SS' goal to achieve its 30% reduction goal because it will enable DOS to decide whether or not the alternative generates a large enough impact on energy reduction to pursue.

Cost-Effectiveness

The cost-effectiveness criterion will measure how effective each alternative's climate impact and cost-savings are given the projected costs to implement the project. In other words, this criterion will calculate how much the alternative costs to reduce 1 MBtu as well as the costs to repay the initial capital investment. These two outputs will be measured in ($ Spent/MBtu reduced) and ($ Spent/Annual Cost-Savings). These measurements directly support M|SS' goal to achieve its 30% reduction goal because they will communicate how effective each alternative is at getting DOS closer to achieving it, allowing the Department to maximize the impact on energy intensity given its budget constraints.

ALTERNATIVE FINDINGS

Fundamental Assumptions

The two universal assumptions are applied to each alternative: that DOS (1) does not increase its domestic goal-subject GSF and (2) its past projects will not impact the proposed alternatives. The former assumption is significant because this allows the findings to forecast energy savings and energy intensity. The assumption is also further supported from the Department's 2016 Sustainability Report, where it claimed that "[DOS] does not currently have new buildings entering the construction planning process in FY 2020 and beyond" (FY 2016 Report).

The latter assumption, however, stems from the barrier to access past, current, or future DOS project-specific data. The Department reports cumulative data of past projects, but the data does not include facility-level findings of the private energy service company's guaranteed savings or energy impacts. For example, in FEMP's Sustainable Investment Data, the data indicates that DOS spent nearly $12 Million on ESPC financed expenditures and $49 Million on UESC financed expenditures since 2005, but the project logistics such as how many buildings were improved, what type of improvement (e.g. HVAC/Steam/LED lighting/etc.), or gross square footage the contract impacted are not accessible (FEMP Sustainable Investment Data, 2022).

This access is critical because certain performance contracts offer different cost or energy savings guarantees, as the Oak Ridge National Laboratory demonstrated with the distinctions of the type of energy the contract targeted—reporting that electricity type projects removed 4.8 Million MBtu in energy consumption while natural gas only removed around 680,000 MBtu (Walker, 2022). GSA alludes to these contract differences where eight case studies averaged nearly 2-3 times energy cost savings than the federal government average (Bronski, 2015). Although past sustainable reports and project summaries indicate that projects were performed, I will not be able to offer more concise forecasts due to the variability of outcomes from the lack of data. However, despite not offering a more sensitive analysis, the impacts seen in the evidence still provide valuable findings even if the Department of State increases its domestic facility space.

Alternative #1: Status Quo

The most effective way to compare the success of the proposed alternatives is to benchmark them to how DOS will likely perform in meeting the 2030 goal under its current rates of reduction energy intensity. This status-quo forecast is built on a sensitivity analysis of the Department's historical rate of reduction—low, medium, and high models. Each of these models use a linear trend from its rate of reduction to forecast until DOS meets the 2030 goal, where the low, medium, and high models estimate 16 years, 21 years, and 32 years from 2023 respectively.

Using DOS' historical energy intensity data year (FEMP Energy Total Cost/Use Data, 2022), the models are calculated:

- Low Model (-0.524%): Average of the Department's Year-on-Year Energy Intensity change from 2005 to 2023
- Medium Model (-0.762%): Average of the High and Low Models rate of change
- High Model (-0.992%): Growth Rate of the Department's Energy Intensity from 2005 to 2023

These models are a good sign because it showed that the Department is making progress towards achieving the 30% energy intensity reduction goal rather than working against it. The fundamental takeaway though is that, after applying these rate of reduction to accomplish the remaining 14.5% of the 2030 goal, the findings reveal that DOS will not meet the goal by the 2030 deadline.

Alternative 1: Status Quo		
Low Model (16yr)	Medium Model (21yr)	High Model (32yr)
Projected Costs (NPV)		
$ 35,023,187.88	$ 45,209,051.60	$ 67,027,429.30
Cost-Savings (NPV)		
$ 2,496,437.88	$ 2,433,498.26	$ 2,485,659.01
Climate Impact (MBtu)		
80,422.45	80,797.13	84,783.03
Cost-Effectiveness ($/Years to Pay Off)		
14.05	18.56	26.90
Cost-Effectiveness ($/MBtu)		
$ 435.49	$ 559.54	$ 790.58

Table 1: Alternative 1 Status Quo

Source: Connor Eads, Using FEMP Energy Total Cost/Use Data (2022) & Trimmed Average[3]

Projected Costs:
This criterion uses DOS' historical sustainable investment data for its goal-subject facilities from 1985 to 2021. The problem with this data is that it includes several years that are nearly 10 times larger than the average. In order to account for these abnormal years, an upper and lower 25 percentile trimmed mean analysis of the expenditures is used to exclude them—producing an average of $2.3 Million dollars annually instead of the raw average of $4.1 Million (Cost-Savings: FEMP Sustainable Investment Data, 2022). After applying this trimmed average to the three models as well as adjusting for both inflation and discounting , there were high (3%) and low (7%) NPV estimates (Technical Appendix C). The table above depicts the average of those high and low NPV estimates: Low = $35 Million, Medium = $45 Million, and High = $67 Million.

Cost-Savings:
This criterion uses the current energy cost of $33.06/MBtu for DOS' domestic goal-subject buildings (FEMP Energy Total Cost/Use Data, 2022). In order to calculate the cost-savings, the analysis uses the model forecasts of energy intensity and then converts it to energy consumed. It then subtracts the current year's energy consumption from the previous year's energy consumption to find the energy-savings. Once the energy savings are estimated, the analysis multiplies them by the $33.06/MBtu cost rate. Assuming the Department continues to pay that energy cost rate as well as adjusting for inflation and discounting, there were high (3%) and low (7%) NPV estimates (Technical Appendix C). The table above depicts the average of those high and low NPV estimates, where the cost-savings was roughly $2.5 Million for each model. Each of the model's cost-savings

[3] Findings Chart in Report uses averages of the NPV High & Low Statistics in Projected Costs, Cost-Savings, and Cost-Effectiveness sections (For Statistics & Calculations, Reference Technical Appendix p.48 - 49).

would be relatively similar because they forecast until DOS meets the 30% reduction—having to reduce the exact same amount of energy consumption.

Climate Impact:
This criterion uses the past cost-savings findings to identify each model's energy savings (FEMP Energy Total Cost/Use Data, 2022). In order to calculate the energy savings, the analysis uses the model forecasts of energy intensity and then converts it into energy consumed. The analysis then subtracts the current year's energy consumption from the previous year's energy consumption to find the energy-savings. These findings are depicted in the table above: Low = 80,000 MBtu, Medium = 80,000 MBtu, and High = 84,000 MBtu.

Cost-Effectiveness:
This criterion considers two lenses that the client needs to consider: (1) how effective the alternative is at repaying off the initial capital investment and (2) how effective the alternative is at reducing its energy consumption. As with the past criterions, there were high (3%) and low (7%) NPV estimates (Technical Appendix C). The table above depicts the average of those high and low NPV estimates: Low = 14 years to pay off and $400/MBtu, Medium = 18 years to pay off and $550/MBtu, and High = 26 years to pay off and $790/MBtu.

Alternative #2: Energy Savings Performance Retrofit Goal

The second alternative for DOS focuses on addressing comprehensive and aggressive energy conservation measures comprehensive targeting of smaller operations of the facility such as HVAC, lighting, plumbing, and heating through energy savings performance contracts (ESPCs). Unlike the next alternative, this one deals more with energy service companies rather than utility companies. The plan contains two steps: (1) hire two project facilitators to provide structure in the contracting phases and (2) formulate a strategy that engages public-private partnerships via ESPCs.

These two facilitators would prepare and implement the 15 facility contracting goal over the next average contract time of 17.1 years (FEMP Federal ESPC Inventory Data, 2023). In order to implement this alternative, the two new positions would first help plan the contract phases by grouping its 15 facilities into three groups to rollout separately. The main stakeholder with DOS in this alternative would be the private energy service companies that would be conducting the projects. However, in the request for proposal and implementation process, the other stakeholders would be the FEMP ESPC staff who will help advise the process.

Projected Costs:
This criterion includes two major items: (1) the two project facilitators salaries and benefits over 17 years and (2) the implementation cost of 15 energy savings performance contracts (ESPCs). The criterion first uses Office of Personnel Management Pay data for a GS-10: Step 10 ($71,000) and GS-7: Step 1 ($41,000) after adjusting for CPI indexes for January of each year (2022 with 281.148 to 2023 with 299.17). The benefits are then added from CATO's analysis, where it was estimated to be $50,000 after adjusting for the same CPI Indexes (Edwards, 2022). Both of these measures are then combined to produce an annual staff salary that is adjusted for inflation and discounted over the next 17 years—forecasting a cost of $3.3 Million for staff. The criterion then uses the Lawrence Berkeley National Laboratory findings of implementation cost per square foot and applies them to the FEMP facility data to calculate contract costs. Averaging the high and low estimates after discounting and adjusting for inflation, the study multiplies the square feet of each facility by

$6.45/sq. ft (Stuart et. al., 2013). After multiplying the $6.45 ratio to the square footage of each facility group, each group is then adjusted for inflation and discounted according to the year that the Department pays the full amount of the contract group up front—estimating $41 Million over the 15 facilities. The total projected net present cost of the second alternative would then be roughly $45 Million.

Cost-Savings:
This criterion also uses a different Lawrence Berkeley National Laboratory findings of implementation cost-savings per square foot and applies them to the FEMP facility data to calculate the estimated savings. After adjusting the 0.70/sq. ft with CPI indexes, the study multiplies the square feet of each facility by $0.88/sq. ft (Carvallo et. al., 2019). After multiplying each group's facility square footage by this ratio, those numbers are then adjusted for inflation and discounted to when the full impact of benefits begin at project completion. The official estimates of the cost savings were estimated to roughly $5 Million annually after alternative completion.

Climate Impact:
This criterion uses the past 2013 Lawrence Berkeley National Laboratory study for its climate impact of 0.034 MBtu/sq. ft. (Stuart et. al., 2013). The square footage of each group is then multiplied by this ratio and combined, reducing roughly 220,000 MBtu annually from the pre-project benchmark. In other words, this reduction would accomplish the 2030 goal by 2.5 times the required reduction needed to meet it.

Cost-Effectiveness:
This criterion was applied through two lenses: (1) time needed to pay off the initial capital investment and (2) how much it costs to reduce an MBtu from current energy consumption. The effectiveness of the time to payoff was roughly 9 years after the contracts would begin, while the effectiveness at reducing energy consumption was around $200 for every MBtu reduced.

Alternative 2: Energy Savings Performance Retrofit Goal		
Projected Costs (NPV)		
Annual Staff (17 Years)	$	3,344,214.37
15 ESPC Contracts	$	41,268,211.82
Total	$	44,612,426.19
Cost-Savings (NPV)		
$		4,991,053.33
Climate Impact (MBtu)		
222,736.73		
Cost-Effectiveness ($/Years to Pay Off)		
8.94		
Cost-Effectiveness ($/MBtu)		
200.29		

Table 2: Alternative 2 Energy Savings Performance Retrofit Goal

Source: Connor Eads

Alternative #3: Utility Contract Goal

The third alternative for DOS focuses specifically on its facilities' utility procurement and green energy generation. These contracts would primarily flow through either technical (e.g. power quality improvements) or financial services (e.g. utility rebates) (Thomas, 2009). However, one specific assumption with this alternative, is that it pays back the contract price until the last contract year. This is important because other measures might impact the price reduction over the contract period, like behaviors, services, and operations that might be reduced as a result of the UESC and reduce the price—I assume that this does not happen, and the payback is solely on the estimated impacts of the contract and not the possible compounding effects. The plan contains two steps: (1) hire two project facilitators for providing structure in the contracting phases and (2) formulate a strategy that engages public-private partnerships via Utility Energy Service Contracts (UESCs), Energy Service Agreements (ESAs), or Power Purchase Agreements (PPAs).

These two facilitators would prepare and implement the 15 facility contracting goal over the next average contract time of 14 years (ASE, 2015).The main stakeholder with DOS in this alternative would be the private utility service providers; however, in the request for proposal and implementation process, the other stakeholders would be the Department of Energy's Federal Energy Management Program (FEMP) UESC project staff who specialize in projects for renewable energy management and generation. This alternative, however, adds another sensitivity analysis by weighting the average impacts found from the research because none account for effect per square foot—it is just the average contract effect (Tonn et al., 2005).

Share of GSF	Weight
Under 2%	0.3
3% to 5 %	0.8
6% to 7 %	1
8 % to 15 %	1.5
Over 15%	4

Figure 8: Alternative 3 Weighting Scale

Source: Connor Eads

Projected Costs:
This criterion uses the same project staff assumption and methods as the past alternative, except this one will be for 21 years instead of 17 years. This would then estimate roughly $3.6 Million over that 21 year period. In other words, the average projected cost of $1.3 Million from the study (converted to $2.12 Million through CPI indexes) would then be multiplied a weight dependent on how much of the total share of Department of State gross square foot each facility constituted (Tonn et. al., 2005). After adjusting each of the projected costs by the facilities share of total gross square feet, each group totals are then adjusted for inflation and discounted. This analysis produces a high and low discounted methods that are then averaged to the total UESC cost of $32 Million—producing a total projected cost of the alternative as $36 Million over the 21 years.

Cost-Savings:
This criterion also uses the same weighted scale method as the previous criterion. Here though, the analysis multiplies the CPI adjusted, average cost-savings from the report ($270,000) by the weighted scale dependent on the respective facilities' gross square foot (Tonn et. al., 2005). These weighted savings are then adjusted for inflation and discounted by the year that the full effects begin after the

group of projects is completed. Averaging each groups' two high and low discounted estimates, the sum of the three averages then depict the total cost-savings from the projects, roughly $3.5 Million annually.

Climate Impact:
This criterion mirrors the same methodology as the past criterion. The average climate impact of 19,000 for each facility would then be multiplied by the same weighted average scale dependent on the respective share of total DOS gross square footage (Tonn et. al., 2005). After summarizing each groups weighted impacts, the analysis estimates a total annual reduction of 297,000 MBtu annually compared to pre-project benchmark. In other words, alternative 3's climate impact was 3.3 times larger than what was needed to achieve the energy intensity reduction goal.

Cost-Effectiveness:
This criterion was applied through two lenses: (1) time needed to pay off the initial capital investment and (2) how much it costs to reduce an MBtu from current energy consumption. The effectiveness of the time to payoff was roughly 10 years after the contracts were completed, while the effectiveness at reducing energy consumption was around $120 for every MBtu reduced.

Alternative 3: Utility Contract Goal		
Projected Costs (NPV)		
Annual Staff (21 Years)	$	3,682,226.16
15 UESC Contracts	$	32,409,980.72
Total	$	36,092,206.88
Cost-Savings (NPV)		
$		3,591,686.95
Climate Impact (MBtu)		
297,350.00		
Cost-Effectiveness ($/Years to Pay Off)		
10.05		
Cost-Effectiveness ($/MBtu)		
121.38		

Table 3: Alternative 3 Utility Contract Goal

Source: Connor Eads

RECOMMENDATION

DOS ought to implement the second alternative—establishing a deep energy retrofit goal through energy saving performance contracts(ESPCs). From the data collected, the second alternative provides the optimal value to DOS through its cost-savings performance and impact on daily management of facilities—where the savings from all 15 projects could pay off the initial capital investment in roughly under 9 years. These cost savings will then compound past the 17 year completion timeline of its contracts, allowing the department to invest further money into the clean energy transition all while saving a minimum of 297,000 MBtu compared to the pre-project benchmark each year. The Department has considered and partially implemented this recommendation over the past two decades, but it has been only on a case-by-case basis where priority was given to the facilities who were the largest emitters. This recommendation would instead apply the contracts at the larger scale, where each facility would receive improvements via performance contracts. Pulling additional value from the research, the impacts with "ESPCs' higher savings realization is important, given the likely reliance on paid-from savings models…to address existing buildings in the pursuit of mitigating climate change"(Erani & Coleman, 2022, p. 72)

As stated in the previous fundamental assumption, there is a margin of error associated with estimating the true impact on energy consumption. The third alternative opens concerns for accuracy of weighting; however, some scale needed to be used to account for square footage—an ESPC for a 70,000 GSF facility would not cost the same as on for a 2.5 Million GSF facility. However, the research and studies on contract performance consistently demonstrate positive results with reducing energy intensity across the federal government—as the Oak Ridge Lab, Pacific Northwest National Laboratory, National Renewable Energy Laboratory, and Lawrence Berkeley Lab all found after studying the unique application of these partnerships in the public sector.

The main trade off from the second alternative is that, although it makes the largest impact on energy cost savings, it does not the largest climate impact nor is it the cheapest. The third alternative is cheaper by nearly $8 Million in total costs as well as by nearly $80/MBtu in cost-effective reduction. The third alternative's caveat is that it has a 2 year longer wait time to pay off the initial capital investment and makes nearly $2 Million less in cost-savings annually than alternative two. This criterion is critical because, once its cost-savings repay the projected costs over those 10 years, it would enable the Department to direct the cost-savings to other initiatives faster than the other alternatives

OUTCOMES MATRIX		
Alternative 1	Alternative 2	Alternative 3
Projected Costs (NPV)		
$35 Million to $67 Million	$44.5 Million	$36.5 Million
Cost-Savings (NPV)		
$2.5 Million	$5 Million	$3.5 Million
Climate Impact (MBtu)		
80,000 to 85,000	220,000	300,000
Cost-Effectiveness ($/Years to Pay Off)		
14 to 27	8.94	10.05
Cost-Effectiveness ($/MBtu)		
430 to 790	200	121.38

Table 4: Outcomes Matrix

Source: Connor Eads

IMPLEMENTATION

Stakeholders

The legislation mandated all federal agencies to direct resources to prioritize efficient energy management and reduce the impacts of climate change; therefore, the jurisdiction stemmed from the executive orders and acts, but the responsibility fell on the agencies to meet their own goals. The operations that devolve to the state and local level do not affect the client's stake in the problem. This concern would fall under the Department of Energy since it already provides energy efficiency policies and programmatic resources for the other levels of government. The other federal stakeholders who have a role in this problem—focusing on DOS' domestic facilities—are the U.S. Department of Energy (DOE), the U.S. General Services Agency (GSA), and the U.S. Environmental Protection Agency (EPA).

Although these recommendations allow DOS to gain more ground than the status quo projection in accomplishing the energy intensity goal, "designing policies that work in practice, not just in theory, is the acid test of policy analysis." (Weaver & Patashnik, 2021). Under the current political climate, especially with the turbulence of executive transitions, the implementation of the second alternative needs to withstand the pressures of policy, regardless of which party is in office. Building on Weaver and Patashnik, I argue that this recommendation would be in good standing to receive support from both sides of the isle, engaging interests improving both the Department's cost-effectiveness and carbon footprint simultaneously. The recommendation's political resources would also self-reinforce itself from criticism because to attack the other party would sink the values of its own party—demonstrated in this specific goal's bipartisan support from President Bush's Executive Order 13423 in 2007 to President Biden's Executive Order 14057. In order to accomplish this though, DOS must (1) protect its supportive coalition, (2) clarify its high fiscal demands, and (3) address the cooperation needed with multiple agencies, like the Department of Energy (DOE), the Office of Management and Budget (OMB), and the General Services Administration (GSA).

(1) Protecting the Supportive Coalition: The primary enhancing factor about the second alternative is that it engages a coalition of consolidated stakeholders, namely the private sector energy service companies (ESCOs). These companies are the ones offering the improvements and cost-savings for that contract period; therefore, DOS must protect the private stakeholders' interests with transparency and aggressive long-term targets when considering the project planning phases, as suggested by GSA (Bronski, 2015). Additionally, the federal government's momentum from President Biden's Executive Order 14057 further insulates the alternative from opponents solely from the funding made available to agencies and private companies to access in modernizing infrastructure. However, to be proactive against opponents, the Department of State needs to front-load the benefits of the environmental and cost-savings benefits rather than deferring them to decades down the line. By doing so, this would allow both sides of the aisle to find value in the alternative, whether it is monetary with financing falling on the private sector or environmental with combatting anthropogenic climate change.

(2) Clarify High Fiscal Demands: The largest undermining factor of the second alternative is the high visibility regarding the steep budget projections. This factor is critical because opponents will criticize the efficacy of implementing these projects at DOS as well as increasing its budget to afford the projects—specifically, because the Department constitutes a small fraction of the larger federal energy consumption picture. The staff proposed in this process will be able to account for my

limited access to data to tailor the proposed climate impact, cost-savings, and projected costs with the ESCO that is selected in the request for proposal. These project facilitators would have access to the facilities past projects as well as a familiarity with these contracts, so they would be able to build a more sensitive, tailored analysis—closing the gap on the ambiguity around the true actionable costs and benefits of the alternative. Therefore, DOS needs to delay the concentration on specific project costs and benefits by focusing on the partnership with FEMP staff and two project facilitators; this focus would reemphasize the professionalism and experience with ensuring the guaranteed savings of the energy savings performance contracts.

(3) Address Cooperation w/ Multiple Agencies: One concern with the implementation of this alternative is that it demands the cooperation between (1) agencies as well as between (2) the agencies and the private ESCOs. For example, if the cooperation between DOS and the ESCO is not transparent and smooth throughout the contracting phases, the contract could easily risk extending the timeline, where either the ESCO could not be fully considering the Department's priorities or DOS could be rushing the ESCO to deliver guaranteed savings. This concept of communication needs to be factored into the project planning because it only gets more complicated when the contract also through a GSA leased facility—balancing the cooperation between both other agencies and the private sector simultaneously. Therefore, in the early stages, DOS must completely translate its needs and energy conservation measures (ECMs) from the beginning of the contracting process.

CONCLUSION

The Department of State's (DOS) mission is to promote and protect the United States' values within the international community. With the Department of State's long-standing struggle for accomplishing past energy intensity initiatives, ta concern for how the Office of Management Strategy & Solutions will advise the Department to best meet the mandated 30% energy intensity reduction is ever present. President Biden's Executive Order 14057 established the most ambitious sustainability targets to-date; therefore, the Department needs a comprehensive strategy that not only meets its energy intensity target, but also supports its other targets. This strategy is critical for the Department because it is not forecasted to meet its 30% reduction of 2003 metrics by 2030—instead, it is projected to meet the target in 2039 at the earliest and 2055 at the latest.[4] Should the Department fail by this margin, it will directly impact externalities with energy management and indirectly impact the global initiative to combat climate change. The Department of State ought to prioritize achieving this energy intensity target by engaging public-private partnerships to curb energy consumption while also modernizing its domestic facilities. In order to maximize the effect of these partnerships, the Department of State needs to bring the Department of Energy's (DOE) into the picture so that DOS can leverage the Federal Energy Management Program's (FEMP) expertise as well as its research and development in rolling out these contract strategies.

[4] Connor Eads (2023). Forecasted from 2022 FEMP Energy Total Cost/Use Data.

ADDENDUM

Greenhouse Gas (GHG) Limitations

The Congressional Research Service acknowledged in 2018 that the Department of Energy's FEMP did not have enough data to deduce ESPC's and UESC's effect on greenhouse gas emissions. However, viewing the overall federal decrease in scope 1 emissions is much like the error in viewing just energy consumption and not the energy consumption per square footage that was discussed in the background section. Specifically, "[FEMP says that] scope 1 and 2 GHG emissions—which include emissions from federal facilities—have declined by nearly 26% between FY2008 and FY2017 across the federal government" (Congressional Research Service, 2018, p. 8).

But after using the Department of State's 2021 data emissions data, the department's domestic facility scope I emissions changed from 1,646.7 in 2008 to 6,325.6 in 2021 (MTCO2e), while its gross square footage changed from 4,521.2 in 2008 to 6,238.4 in 2021 (Thou. GSF). Although this is a 284% increase in scope I emissions, it is important to view these metrics from a scope I per thousand gross square footage since it aligns with the goals intent to capture emissions per square footage—in which it changed from 0.364 in 2008 to 1.014 in 2021 (MTCO2e/Thou. GSF). Therefore, STATE increased its scope I emissions per thousand gross square footage by 178% (FEMP Greenhouse Gas Emissions, 2022). Although not a lot of data was found around the impact of these contracting alternatives, they still would prove useful in helping the Department achieve its other 2030 goal to meet zero scope I greenhouse gas emissions in 30% of its owned facility space.

Energy Intensity Measurement Limitations

The main constraint that DOS has recognized in working towards its energy intensity goal is the nature of the Department's work. "Energy intensity, as calculated by OMB, continues to be an issue with buildings operating 24/7 to power a global presence. The Department has raised with DOE and OMB the need to account for the amount of time office space is used within the energy intensity calculation. Office space continues to be at a premium and the Department feels we are maximizing the use of office space." (U.S. Department of State, 2016). Even in other studies, researchers acknowledge the potential for occupancy to influence impacts during COVID-19; "Note that the period of performance…include[s] the period from March 2020 onward, when the operation of most federal facilities changed due to the COVID-19 pandemic. These changes, which varied from department to department and facility to facility, included reductions in occupancy and operating hours, as well as increases in outdoor air ventilation. These changes may account for the identified increase in potential impacts to savings" (Walker, 2021, p. 5). A unique study from the Pacific Northwest National Laboratory looked further to "examines whether a refined energy use intensity (EUI) metric that accounts for occupant density might provide a more nuanced understanding of the true energy footprint of a building" (Selvacanabady & Judd, 2017). The current energy intensity formula:

$$Energy\ Intensity = \frac{(Total\ Energy\ Consumed\ by\ Facility)}{(Total\ Gross\ Square\ Footage)}$$

The problem with this calculation is that it does not account for the occupancy within the buildings as DOS indicates is a concern. The literature around this aspect suggests that it could have an impact on buildings energy use because teleworking and 24/7 operating facilities can impact the site use energy consumed. The Selvacanabady & Judd study recognized this aspect of reporting intensity, so it considered adding a new control that took the amount of time occupied in the building and divided it by the full-time occupancy (Selvacanabady & Judd, 2017)

$$Full\,Time\,Equivalent\,Occupancy = \frac{(Total\,Annual\,Occupied\,Person\,Hours)}{\left(\left(35\,\frac{Hours}{Week}\right)\times\left(52\,\frac{Weeks}{Year}\right) - 5\,Weeks\,Regulatory\,Vacation\right)}$$

$$Full\,Time\,Equivalent\,Occupancy = \frac{(Total\,Annual\,Occupied\,Person\,Hours)}{(1{,}654\,Hours)}$$

The study found the influence of occupancy to be small and statistically significant; however, the analysis was limited due to the application of only two buildings on daily-scale data as well as impacts from weather-related loads as well as no accounting for weather-related loads. In terms of being generalizable, the study explains that the two metrics are not comparable due to the buildings' unique parameters of building area and occupancy; but it also indicates that "building owners considering consolidation could use the energy use per occupant estimate from this study to come up with ballpark estimates of the influence of adding occupants on EUI" (Selvacanabady & Judd, 2017).

Table 7. Summary of the influence of occupancy on building energy use

Analysis	Occupancy Influence
GSA HQ building data	2.28 kWh/day-FTEO
Byron Rogers building data	2.41 kWh/day-FTEO
DOE Building Performance Database	1.93 kWh/day-FTEO
Bottom-up analysis (plug loads only)	0.43 to 0.94 kWh/day-occupant

Figure 9: Summary Findings from Regression of Energy Use and Occupancy

Source: Selvacanabady & Judd Study (2017): Pacific Northwest National Laboratory (PNNL)

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TECHNICAL APPENDIX

A. Data Collection & Consolidation

TITLE: General Information About 2030 Energy Intensity Goal

Source: FEMP Energy Total Cost/Use Data (2022)

U.S. Department of State Energy 2030 Intensity Goal	
2030 Reduction Goal of 2003 Benchmark	30%
2003 Energy Intensity Benchmark (BTU/GSF)	106,169.26
2021 Energy Intensity (BTU/GSF)	88,612.46
Intensity Goal Met at (BTU/GSF)[1]	74,318.48
Intensity Reduction Needed (BTU/GSF)[2]	14,293.98
Assume Fixed 2021 (Thou. GSF)	6,238.40
BTU Needed to Meet 30% Reduction (Billion BTU)[3]	463.6284144
2021 Energy Consumption (Billion BTU)	552.8
BTU Reduction Needed (Million BTU)[4]	89,171.58555

[1] Calculation:

$$106{,}169.26 \times 0.70 = 74{,}318.48$$

[2] Calculation:

$$106{,}169.26 - 88{,}612.46 = 74{,}318.48$$

[3] Calculation:

$$(74{,}318.48 \times (6{,}238.4 \times 1{,}000)) / 1{,}000{,}000{,}000 = 463.6284144$$

[4] Calculation:

$$(552.8 - 463.62) \times 1{,}000 = 89{,}171.58555$$

TITLE: CPI Adjusting Data

Source: CPI Data (2023)

Year	CPI January
1998	161.6
1999	164.3
2000	168.8
2001	175.1
2002	177.1
2003	181.7
2004	185.2
2005	190.7
2006	198.3
2007	202.416
2008	211.080
2009	211.143
2010	216.687

2011	220.223
2012	226.665
2013	230.280
2014	233.916
2015	233.707
2016	236.916
2017	242.839
2018	247.867
2019	251.712
2020	257.971
2021	261.582
2022	281.148
2023	299.170

TITLE: U.S. Department of State Energy Consumption Data
Source: FEMP Energy Total Cost/Use Data (2022)

Fiscal Year	Total Energy Consumed (BBTU)	Gross Square Footage (Thousand)	Energy Intensity (BTU/GSF)	Progress to Meeting 30% Reduction[5]	Y-o-Y Energy Intensity Change (BTU/GSF)[6]	Y-o-Y Energy Consumption Change[7]
2021	552.80	6,238.40	88,612.46	-16.5%	-11.3%	14%
2020	486.50	4,872.20	99,852.22	-5.9%	2.5%	3%
2019	474.50	4,872.20	97,389.27	-8.3%	7.1%	18%
2018	402.20	4,423.30	90,927.59	-14.4%	1.8%	5%
2017	382.50	4,281.90	89,329.50	-15.9%	7.5%	8%
2016	355.70	4,281.90	83,070.60	-21.8%	-16.7%	-17%
2015	426.10	4,271.00	99,765.86	-6.0%	5.7%	1%
2014	422.40	4,473.30	94,426.93	-11.1%	-0.8%	-3%
2013	436.60	4,588.40	95,152.99	-10.4%	-2.4%	-2%
2012	447.40	4,588.40	97,506.76	-8.2%	0.0%	0%
2011	447.50	4,588.40	97,528.55	-8.1%	-7.6%	-6%
2010	477.00	4,521.20	105,502.96	-0.6%	8.6%	7%
2009	444.20	4,574.30	97,107.75	-8.5%	5.9%	7%
2008	414.70	4,521.20	91,723.44	-13.6%	2.9%	5%
2007	396.00	4,443.10	89,126.96	-16.1%	-21.6%	-23%

2006	513.70	4,516.20	113,746.07	7.1%	7.3%	52%
2005	337.50	3,183.20	106,025.38	-0.1%	-10.6%	4%
2004	323.80	2,731.40	118,547.27	11.7%	11.7%	-20%
2003	402.70	3,793.00	106,169.26	0.0%	0.0%	0%

[5] Calculation:

(Year$_A$ Energy Intensity – 2003 Energy Intensity) / 2003 Energy Intensity = X%

[6] Calculation:

(Year$_A$ Energy Intensity – Previous Year$_B$ Energy Intensity) / Previous Year$_B$ Energy Intensity = X%

[7] Calculation:

(Year$_A$ Energy Consumed– Previous Year$_B$ Energy Consumed) / Previous Year$_B$ Energy Consumed = X%

TITLE: U.S. Department of State Sustainable Investment Data by Financing Type
Source: FEMP Sustainable Investment Data (2022)

Fiscal Year	Direct Expenditures (Adj. Constant FY2021 Dollars)	ESPC Financed Expenditures (Adj. Constant FY 2021 Dollars)	UESC Financed Expenditures (Adj. Constant FY2021 Dollars)	Year Total (Adj. Constant FY2021 Dollars)[8]	Year Total (CPI Adj. 2023 Dollars)[9]
2021	-	-	-	-	-
2020	7,526,000	4,000	-	7,530,000	8,612,022.62
2019	-	-	1,791,400	1,791,400	2,048,815.05
2018	-	-	8,452,000	8,452,000	9,666,509.32
2017		-	15,058,300	15,058,300	17,222,100.95
2016	294,300	-	-	294,300	336,589.41
2015	4,224,000	-	4,224,000	8,448,000	9,661,934.54
2014	31,700	-	13,852,700	13,884,400	15,879,517.51
2013	875,800	-	-	875,800	1,001,648
2012	-	4,536,100	-	4,536,100	5,187,914.45
2011	2,806,000	6,627,100	-	9,433,100	10,788,588.39
2010	1,216,700	-	-	1,216,700	1,391,533.59
2009	821,300	-	-	821,300	939,316.62
2008	1,238,100	-	-	1,238,100	1,416,008.66
2007	-	-	-	-	-
2006	47,200	-	-	47,200	53,982.40
2005	-	-	-	-	-

2004	97,500	NA	NA	97,500	111,510.25
2003	1,213,500	NA	NA	1,213,500	1,387,873.76
2002	5,300	NA	NA	5,300	6,061.58
2001	385,400	NA	NA	385,400	440,780.02
2000	-	NA	NA	-	-
1999	1,919,400	NA	NA	1,919,400	2,195,208
1998	80,200	NA	NA	80,200	91,724.33
1997	3,023,800	NA	NA	3,023,800	3,458,304.65
1996	-	NA	NA	-	-
1995	-	NA	NA	-	-
1994	112,800	NA	NA	112,800	129,008.79
1993	-	NA	NA	-	-
1992	-	NA	NA	-	-
1991	-	NA	NA	-	-
1990	-	NA	NA	-	-
1989	-	NA	NA	-	-
1988	-	NA	NA	-	-
1987	-	NA	NA	-	-
1986	-	NA	NA	-	-
1985	-	NA	NA	-	-

[8] Calculation:

$$Year_A\ ESPC + Year_A\ UESC + Year_A\ Direct = \$X$$

[9] Calculation:

$$(CPI_{2023} / CPI_{2021}) \times Year\ Total_A = \$X$$

TITLE: U.S. Department of State Sustainable Expenditures Breakdown
Source: FEMP Sustainable Investment Data (2022)

	ESPC Financed Expenditures (Adjusted Constant FY 2021 Dollars)	UESC Financed Expenditures (Adjusted Constant FY 2021 Dollars)	Direct Investment (Adjusted Constant FY 2021 Dollars)	Total Expenditures Spent
Total	11,167,200	43,378,400	25,919,000	92,026,952.86
CPI Adjusted (2023)[10]	12,771,869.72	49,611,654.96	29,643,428.18	
Share of Total[11]	13.88%	53.91%	32.21%	

[11] Calculation:

$$\Sigma\ Financing\ Type_A\ Spending_{Years 1985\ to\ 2021} = Type\ Total\ Spending$$

[12] Calculation:

$$Financing\ Type_A\ /\ Type\ Total\ Spending_A = Type_A\ share\ of\ Total\ Expenditures\ Spent$$

TITLE: U.S. Department of State Domestic Facilities Data
Source: FEMP Facilities Data (2022)

Facility Name	Energy Manager Designated	Gov. Owned	State	Covered Facility (Thou. GSF)	GSF	Number of Buildings Metered	Annual Facility Energy Use (Milion BTU)	Annual Facility Energy Intensity (BTU/GSF)
[redacted]	Yes	Yes	DC	2429.7	2,429,700	1	240,930.20	99,160.47
	Yes	Yes	VA	581.5	581,500	11	73,916.90	127,114.19
	Yes	Yes	DC	573.1	573,100	1	30,421.70	53,082.71
	Yes	No	D.C.	459	459,000	1	43,199.50	94,116.56
	Yes	Yes	SC	435.8	435,800	6	39,659.60	91,004.13
	Yes	No	MD	400	400,000	1	7,778.20	19,445.50
	Yes	Yes	VA	346.8	346,800	1	40,208.50	115,941.46
	Yes	Yes	D.C.	253.4	253,400	8	11,507.90	45,413.97
	Yes	Yes	NH	222	222,000	3	20,352.40	91,677.48
	Yes	Yes	DC	74.3	74,300	1	7,989.30	107,527.59
	Yes	Yes	VA	70	70,000	1	4,875.10	69,644.29
	Yes	Yes	FL	69.9	69,900	1	2,168.50	31,022.89
	Yes	Yes	DC	61.1	61,100	1	8,122.00	132,929.62
	Yes	Yes	KY	58.9	58,900	1	5,615.70	95,342.95
	Yes	-	-	434.20		-	-	-

B. Major Assumptions

Assumptions	Unit	Cost/Figure	Source
U.S. Department of State Space	GSF	6,238,400	FEMP GSF Data
U.S. Department of State Facilities	Quantity	15	FEMP Facilities Data
Inflation	%	3.8%	World Data.info (1960 to 2021 average inflation rate)
Discount Low	%	3%	Council of Economic Advisors (2017)
Discount High	&	7%	Council of Economic Advisors (2017)

C. Alternative 1 Status Quo: Data & Calculations

TITLE: Sensitivity Analysis of U.S. Department Meeting 2030 Energy Intensity Goal
Source: Connor Eads—Using FEMP Energy Total Cost/Use Data (2022)

Title	Method	Statistic
Low Model[13]	Average Year-on-Year Energy Intensity (2003 - 2021)	-0.5249%
Medium Model[14]	Assumption: Average of Low & High Model	-0.7621%
High Model[15]	Historical Energy Intensity Growth Rate (2003 - 2021)	-0.9992%

[13] Calculation:

$$\Sigma \text{ Energy Intensity Y-o-Y Change}_{\text{Years 2003 to 2021}} \; / \; 19 = -0.5249\%$$

[14] Calculation:

$$(-0.5249\% + -0.9992\%) \; / \; 2 = -0.7621\%$$

[15] Calculation:

$$(\text{Energy Intensity}_{2003} \; / \; \text{Energy Intensity}_{2021})^{(1/18)} - 1 = 0.9992\%$$

TITLE: Trimmed Mean Analysis to Forecast Sustainability Expenditures
Source: Connor Eads—Using FEMP Energy Total Cost/Use Data (2022)

Fiscal Year	Annual Expenditures (2023 CPI Adjusted)	Above Top or Below Bottom 25th Quartiles
FY 2021	-	Yes
FY 2020	8,612,022.62	No
FY 2019	2,048,815.05	No
FY 2018	9,666,509.32	Yes
FY 2017	17,222,100.95	Yes
FY 2016	336,589.41	No
FY 2015	9,661,934.54	Yes
FY 2014	15,879,517.51	Yes

FY 2013	1,001,648.00	No
FY 2012	5,187,914.45	No
FY 2011	10,788,588.39	Yes
FY 2010	1,391,533.59	No
FY 2009	939,316.62	No
FY 2008	1,416,008.66	No
FY 2007	-	Yes
FY 2006	53,982.40	Yes
FY 2005	-	Yes
FY 2004	111,510.25	Yes
FY 2003	1,387,873.76	No
FY 2002	6,061.58	Yes
FY 2001	440,780.02	No
FY 2000	-	Yes
FY 1999	2,195,208	No
FY 1998	91,724.33	Yes
FY 1997	3,458,304.65	No
FY 1996	-	Yes
FY 1995	-	Yes
FY 1994	129,008.79	Yes
FY 1993	-	Yes
FY 1992	-	Yes
FY 1991	-	Yes
FY 1990	-	Yes
FY 1989	-	Yes
FY 1988	-	Yes
FY 1987	-	Yes
FY 1986	-	Yes
FY 1985	-	Yes

3rd Quartile[16]	8,874,500.60
1st Quartile[17]	284,694.25
Trimmed Average[18]	2,368,001.23

[16] Calculation:

$$L + ((N/4) - F_L) \times ((U - L)/Q_L) = 3^{rd}\ Quartile,\ where:$$
$$L = Lower\ Limit$$
$$U = Upper\ Limit$$
$$N = Number\ of\ Fiscal\ Years\ (=37)$$
$$F_L = Number\ of\ Observations\ in\ Lower\ Limit$$

$$Q_L = \textit{Frequency of Observation in Lower Limit}$$

[17] Calculation:

$$L + ((N/4) - F_U) \times ((U - L)/Q_U) = 1^{st} \textit{ Quartile, where:}$$
$$L = \textit{Lower Limit}$$
$$U = \textit{Upper Limit}$$
$$N = \textit{Number of Fiscal Years } (=37)$$
$$F_U = \textit{Number of Observations in Upper Limit}$$
$$Q_U = \textit{Frequency of Observation in Upper Limit}$$

[18] Calculation:

$$(\Sigma \textit{ Energy Intensity}_{\,2003 \text{ to } 2021} - \Sigma \textit{ Energy Intensity}_{\,\text{Exceeds Limit Range}}) \,/\, N_{\text{Years Remain After Trim}} = \textit{Trimmed Average}$$

TITLE: U.S. Department of State Energy Intensity Model Forecast

Source: Connor Eads—Using FEMP Energy Total Cost/Use Data (2022)

Fiscal Year	Forecast Year (N)	Project Year	Energy Intensity (BTU/GSF)	High Model (BTU/GSF)[19]	Medium Model (BTU/GSF)[20]	Low Model (BTU/GSF)[21]
2003	-	-	106,169.26			
2004	-	-	118,547.27			
2005	-	-	106,025.38			
2006	-	-	113,746.07			
2007	-	-	89,126.96			
2008	-	-	91,723.44			
2009	-	-	97,107.75			
2010	-	-	105,502.96			
2011	-	-	97,528.55			
2012	-	-	97,506.76			
2013	-	-	95,152.99			
2014	-	-	94,426.93			
2015	-	-	99,765.86			
2016	-	-	83,070.60			
2017	-	-	89,329.50			
2018	-	-	90,927.59			
2019	-	-	97,389.27			
2020	-	-	99,852.22			
2021	-	-	88,612.46	88,612.46	88,612.46	88,612.46
2022	1	-	-	87,727.04	87,937.15	88,147.34
2023	2	0		86,850.46	87,266.98	87,684.65
2024	3	1		85,982.64	86,601.92	87,224.40
2025	4	2		85,123.50	85,941.93	86,766.55
2026	5	3		84,272.93	85,286.96	86,311.12
2027	6	4		83,430.87	84,636.99	85,858.07
2028	7	5		82,597.22	83,991.97	85,407.40
2029	8	6		81,771.90	83,351.87	84,959.10

2030	9	7		80,954.83	82,716.64	84,513.15
2031	10	8		80,145.92	82,086.26	84,069.54
2032	11	9		79,345.09	81,460.68	83,628.26
2033	12	10		78,552.27	80,839.87	83,189.29
2034	13	11		77,767.37	80,223.79	82,752.63
2035	14	12		76,990.31	79,612.40	82,318.26
2036	15	13		76,221.01	79,005.68	81,886.17
2037	16	14		75,459.41	78,403.57	81,456.35
2038	17	15		74,705.41	77,806.06	81,028.79
2039	18	16		73,958.94	77,213.10	80,603.47
2040	19	17			76,624.66	80,180.38
2041	20	18			76,040.70	79,759.52
2042	21	19			75,461.20	79,340.86
2043	22	20			74,886.11	78,924.40
2044	23	21			74,315.40	78,510.12
2045	24	22				78,098.02
2046	25	23				77,688.09
2047	26	24				77,280.30
2048	27	25				76,874.66
2049	28	26				76,471.14
2050	29	27				76,069.75
2051	30	28				75,670.46
2052	31	29				75,273.26
2053	32	30				74,878.15
2054	33	31				74,485.12
2055	34	32				74,094.14

[19] Calculation:

$$\textit{High Projected Energy Intensity}_{\textit{Previous Year}} \times (1 + -0.99\%)^{\textit{Project Year A}} = \textit{High Projected Year Energy Intensity}_{A}$$

[20] Calculation:

$$\textit{Medium Projected Energy Intensity}_{\textit{Previous Year}} \times (1 + -0.76\%)^{\textit{Project Year A}} = \textit{Medium Projected Year Energy Intensity}_{A}$$

[21] Calculation:

$$\textit{Low Projected Energy Intensity}_{\textit{Previous Year}} \times (1 + -0.52\%)^{\textit{Project Year A}} = \textit{Low Projected Year Energy Intensity}_{A}$$

TITLE: U.S. Department of State Expenditure Discounting & Inflation Forecast
Source: Connor Eads—Using FEMP Sustainable Investment Data (2022)

Year	Project Timeline (N)	Trimmed Average (2023 $)	Nominal Cost (Inflation)[22]	NPV Discounted Low[23]	NPV Discount High[24]
2023	0	-	-	-	-
2024	1	2,368,001.23	2,457,985.28	2,386,393.48	2,297,182.51
2025	2	2,368,001.23	2,551,388.72	2,404,928.57	2,228,481.72
2026	3	2,368,001.23	2,648,341.49	2,423,607.63	2,161,835.54
2027	4	2,368,001.23	2,748,978.47	2,442,431.77	2,097,182.51
2028	5	2,368,001.23	2,853,439.65	2,461,402.11	2,034,463.04
2029	6	2,368,001.23	2,961,870.36	2,480,519.80	1,973,619.28
2030	7	2,368,001.23	3,074,421.43	2,499,785.97	1,914,595.15
2031	8	2,368,001.23	3,191,249.45	2,519,201.78	1,857,336.23
2032	9	2,368,001.23	3,312,516.93	2,538,768.40	1,801,789.73
2033	10	2,368,001.23	3,438,392.57	2,558,486.99	1,747,904.43
2034	11	2,368,001.23	3,569,051.49	2,578,358.73	1,695,630.65
2035	12	2,368,001.23	3,704,675.44	2,598,384.82	1,644,920.20
2036	13	2,368,001.23	3,845,453.11	2,618,566.45	1,595,726.33
2037	14	2,368,001.23	3,991,580.33	2,638,904.83	1,548,003.67
2038	15	2,368,001.23	4,143,260.38	2,659,401.18	1,501,708.23
2039	16	2,368,001.23	4,300,704.27	2,680,056.72	1,456,797.33
2040	17	2,368,001.23	4,464,131.04	2,700,872.69	1,413,229.56
2041	18	2,368,001.23	4,633,768.02	2,721,850.35	1,370,964.75
2042	19	2,368,001.23	4,809,851.20	2,742,990.93	1,329,963.94
2043	20	2,368,001.23	4,992,625.55	2,764,295.72	1,290,189.32
2044	21	2,368,001.23	5,182,345.32	2,785,765.97	1,251,604.21
2045	22	2,368,001.23	5,379,274.44	2,807,402.99	1,214,173.06
2046	23	2,368,001.23	5,583,686.87	2,829,208.06	1,177,861.34
2047	24	2,368,001.23	5,795,866.97	2,851,182.49	1,142,635.58
2048	25	2,368,001.23	6,016,109.91	2,873,327.60	1,108,463.30
2049	26	2,368,001.23	6,244,722.09	2,895,644.71	1,075,313.00
2050	27	2,368,001.23	6,482,021.53	2,918,135.15	1,043,154.11
2051	28	2,368,001.23	6,728,338.35	2,940,800.28	1,011,956.97
2052	29	2,368,001.23	6,984,015.21	2,963,641.45	981,692.84
2053	30	2,368,001.23	7,249,407.78	2,986,660.02	952,333.80
2054	31	2,368,001.23	7,524,885.28	3,009,857.38	923,852.79
2055	32	2,368,001.23	7,810,830.92	3,033,234.91	896,223.55

***Yellow Indicates Year Model Forecasts 2030 Goal Met: 2039 = High Model, 2044 = Medium Model, 2055 = Low Model*

Metric	Unit	Source
2021 Cost per MBTU (FY2021$)	33.06	FEMP Energy Total Cost/Use Data (2022)

[22] Calculation:

$$Year_A\ Trimmed\ Average \times (1 + 3.8\%)^{Project\ Year\ A} = Year_A\ Nominal\ Cost$$

[23] Calculation:

$$Year_A\ Nominal\ Cost\ /\ (1 + 3\%)^{Project\ Year\ A} = Year_A\ Net\ Present\ Discounted\ Low$$

[24] Calculation:

$$Year_A\ Nominal\ Cost\ /\ (1 + 7\%)^{Project\ Year\ A} = Year_A\ Net\ Present\ Discounted\ High$$

TITLE: U.S. Department of State Cost-Savings Projection: High Model

Source: Connor Eads –Using FEMP Energy Total Cost/Use Data (2022) & Trimmed Average

Fiscal Year	Project Timeline (N)	Energy Intensity (Btu/GSF)	Energy Consumed (Bbtu)[25]	Energy Saved That Year (MMBtu)[26]	Cost Savings (2021 Rate)[27]	Nominal Cost (Inflation)[28]	NPV Discounted Low[29]	NPV Discount High[30]
2023	0	86,850.46	541.81	-	-	-	-	-
2024	1	85,982.64	536.39	5,413.80	178,980.19	185,781.44	180,370.33	173,627.52
2025	2	85,123.50	531.03	5,359.70	177,191.81	190,914.25	179,954.99	166,751.90
2026	3	84,272.93	525.73	5,306.15	175,421.29	196,188.87	179,540.60	160,148.55
2027	4	83,430.87	520.48	5,253.13	173,668.46	201,609.21	179,127.17	153,806.70
2028	5	82,597.22	515.27	5,200.64	171,933.15	207,179.31	178,714.69	147,715.99
2029	6	81,771.90	510.13	5,148.67	170,215.18	212,903.30	178,303.16	141,866.46
2030	7	80,954.83	505.03	5,097.23	168,514.37	218,785.44	177,892.58	136,248.57
2031	8	80,145.92	499.98	5,046.30	166,830.56	224,830.09	177,482.95	130,853.16
2032	9	79,345.09	494.99	4,995.87	165,163.57	231,041.74	177,074.25	125,671.40
2033	10	78,552.27	490.04	4,945.95	163,513.24	237,425.00	176,666.50	120,694.83
2034	11	77,767.37	485.14	4,896.53	161,879.40	243,984.63	176,259.69	115,915.34
2035	12	76,990.31	480.30	4,847.61	160,261.88	250,725.48	175,853.81	111,325.11
2036	13	76,221.01	475.50	4,799.17	158,660.53	257,652.58	175,448.87	106,916.66
2037	14	75,459.41	470.75	4,751.22	157,075.18	264,771.06	175,044.86	102,682.78
2038	15	74,705.41	466.04	4,703.74	155,505.67	272,086.20	174,641.78	98,616.56
2039	16	73,958.94	461.39	4,656.74	153,951.84	279,603.46	174,239.63	94,711.36
						Total	2,836,615.87	2,087,552.89

[25] Calculation:

$$(Year_A\ Energy\ Intensity * (6{,}238.4^{*} \times 1{,}000))\ /\ 1{,}000{,}000{,}000{,}000 = Year_A\ Energy\ Consumed$$

[26] Calculation:

$$((Year_B\ Energy\ Consumed - Pervious\ Year_A\ Energy\ Consumed) \times 1{,}000) \times -1 = Year_B\ Energy\ Saved$$

[27] Calculation:

$$Year_A\ Energy\ Saved \times \$33.06^{**} = Year_A\ Cost\ Savings$$

[28] Calculation:

$$Year_A\ Trimmed\ Average \times (1 + 3.8\%)^{Project\ Year\ A} = Year_A\ Nominal\ Cost$$

[29] Calculation:

$$Year_A\ Nominal\ Cost\ /\ (1 + 3\%)^{Project\ Year\ A} = Year_A\ Net\ Present\ Discounted\ Low$$

[30] Calculation:

$$Year_A \text{ Nominal Cost } / \ (1 + 7\%)^{\text{Project Year } A} = Year_A \text{ Net Present Discounted High}$$

** 6,238.4 = 2021 GSF Assumption*
*** $33.06 = 2021 Cost per MBtu Assumption*

TITLE: U.S. Department of State Cost-Savings Projection: Medium Model
Source: Connor Eads –Using FEMP Energy Total Cost/Use Data (2022) & Trimmed Average

Fiscal Year	Project Timeline	Energy Intensity	Energy Consumed (BBtu)[31]	Energy Saved That Year (MBtu)[32]	Cost Savings (2021 Rate)[33]	Nominal Cost (Inflation)[34]	NPV Discounted Low[35]	NPV Discount High[36]
2023	0	87,266.98	544.41	-	-	-	-	-
2024	1	86,601.92	540.26	4,148.92	137,163.32	142,375.52	138,228.66	133,061.24
2025	2	85,941.93	536.14	4,117.30	136,117.99	146,659.52	138,240.66	128,098.10
2026	3	85,286.96	532.05	4,085.92	135,080.64	151,072.41	138,252.66	123,320.09
2027	4	84,636.99	528.00	4,054.78	134,051.19	155,618.09	138,264.66	118,720.30
2028	5	83,991.97	523.98	4,023.88	133,029.59	160,300.55	138,276.66	114,292.07
2029	6	83,351.87	519.98	3,993.22	132,015.77	165,123.90	138,288.66	110,029.02
2030	7	82,716.64	516.02	3,962.79	131,009.67	170,092.37	138,300.67	105,924.98
2031	8	82,086.26	512.09	3,932.58	130,011.25	175,210.35	138,312.67	101,974.02
2032	9	81,460.68	508.18	3,902.61	129,020.43	180,482.33	138,324.68	98,170.43
2033	10	80,839.87	504.31	3,872.87	128,037.17	185,912.93	138,336.68	94,508.71
2034	11	80,223.79	500.47	3,843.36	127,061.40	191,506.94	138,348.69	90,983.57
2035	12	79,612.40	496.65	3,814.07	126,093.06	197,269.27	138,360.70	87,589.92
2036	13	79,005.68	492.87	3,785.00	125,132.11	203,204.98	138,372.71	84,322.84
2037	14	78,403.57	489.11	3,756.15	124,178.48	209,319.30	138,384.72	81,177.63
2038	15	77,806.06	485.39	3,727.53	123,232.11	215,617.59	138,396.73	78,149.74
2039	16	77,213.10	481.69	3,699.12	122,292.96	222,105.40	138,408.74	75,234.78
2040	17	76,624.66	478.02	3,670.93	121,360.97	228,788.42	138,420.75	72,428.55
2041	18	76,040.70	474.37	3,642.95	120,436.07	235,672.52	138,432.77	69,727.00
2042	19	75,461.20	470.76	3,615.19	119,518.23	242,763.77	138,444.79	67,126.21
2043	20	74,886.11	467.17	3,587.64	118,607.38	250,068.39	138,456.80	64,622.42
2044	21	74,315.40	463.61	3,560.30	117,703.48	257,592.79	138,468.82	62,212.03
						Total	2,905,322.87	1,961,673.65

[31] Calculation:

$$(Year_A \text{ Energy Intensity} * (6{,}238.4^{*} \times 1{,}000)) \ / \ 1{,}000{,}000{,}000{,}000 = Year_A \text{ Energy Consumed}$$

[32] Calculation:

$$((Year_B \text{ Energy Consumed} - \text{Pervious } Year_A \text{ Energy Consumed}) \times 1{,}000) \times -1 = Year_B \text{ Energy Saved}$$

[33] Calculation:

$$Year_A \text{ Energy Saved} \times \$33.06^{**} = Year_A \text{ Cost Savings}$$

[34] Calculation:

$$Year_A \, Trimmed\ Average \times (1 + 3.8\%)^{Project\ Year\ A} = Year_A \, Nominal\ Cost$$

[35] Calculation:

$$Year_A \, Nominal\ Cost \ / \ (1 + 3\%)^{Project\ Year\ A} = Year_A \, Net\ Present\ Discounted\ Low$$

[36] Calculation:

$$Year_A \, Nominal\ Cost \ / \ (1 + 7\%)^{Project\ Year\ A} = Year_A \, Net\ Present\ Discounted\ High$$

** 6,238.4 = 2021 GSF Assumption*
*** $33.06 = 2021 Cost per MBtu Assumption*

TITLE: U.S. Department of State Cost-Savings Projection: Low Model
Source: Connor Eads –Using FEMP Energy Total Cost/Use Data (2022) & Trimmed Average

Fiscal Year	Project Timeline	Energy Intensity	Energy Consumed (Bbtu)[37]	Energy Saved That Year (MMBtu)[38]	Cost Savings (2021 Rate)[39]	Nominal Cost (Inflation)[40]	NPV Discounted Low[41]	NPV Discount High[42]
2023	0	87,684.65	547.01	-	-	-	-	-
2024	1	87,224.40	544.14	2,871.27	94,924.04	98,531.16	95,661.32	92,085.19
2025	2	86,766.55	541.28	2,856.19	94,425.79	101,738.50	95,898.29	88,862.34
2026	3	86,311.12	538.44	2,841.20	93,930.15	105,050.24	96,135.85	85,752.29
2027	4	85,858.07	535.62	2,826.29	93,437.11	108,469.79	96,374.00	82,751.08
2028	5	85,407.40	532.81	2,811.45	92,946.65	112,000.65	96,612.74	79,854.91
2029	6	84,959.10	530.01	2,796.70	92,458.78	115,646.44	96,852.07	77,060.11
2030	7	84,513.15	527.23	2,782.02	91,973.46	119,410.91	97,092.00	74,363.11
2031	8	84,069.54	524.46	2,767.41	91,490.69	123,297.92	97,332.52	71,760.51
2032	9	83,628.26	521.71	2,752.89	91,010.46	127,311.46	97,573.63	69,249.00
2033	10	83,189.29	518.97	2,738.44	90,532.74	131,455.64	97,815.34	66,825.38
2034	11	82,752.63	516.24	2,724.06	90,057.54	135,734.72	98,057.65	64,486.59
2035	12	82,318.26	513.53	2,709.76	89,584.83	140,153.10	98,300.56	62,229.65
2036	13	81,886.17	510.84	2,695.54	89,114.60	144,715.29	98,544.07	60,051.70
2037	14	81,456.35	508.16	2,681.39	88,646.83	149,426.00	98,788.19	57,949.98
2038	15	81,028.79	505.49	2,667.32	88,181.53	154,290.05	99,032.91	55,921.81
2039	16	80,603.47	502.84	2,653.32	87,718.66	159,312.42	99,278.24	53,964.63
2040	17	80,180.38	500.20	2,639.39	87,258.23	164,498.29	99,524.17	52,075.95
2041	18	79,759.52	497.57	2,625.54	86,800.21	169,852.96	99,770.71	50,253.36
2042	19	79,340.86	494.96	2,611.75	86,344.59	175,381.94	100,017.87	48,494.57
2043	20	78,924.40	492.36	2,598.05	85,891.37	181,090.89	100,265.63	46,797.33
2044	21	78,510.12	489.78	2,584.41	85,440.53	186,985.68	100,514.01	45,159.49
2045	22	78,098.02	487.21	2,570.84	84,992.05	193,072.35	100,763.01	43,578.97
2046	23	77,688.09	484.65	2,557.35	84,545.93	199,357.15	101,012.62	42,053.77
2047	24	77,280.30	482.11	2,543.92	84,102.14	205,846.53	101,262.85	40,581.95
2048	25	76,874.66	479.57	2,530.57	83,660.69	212,547.15	101,513.70	39,161.64
2049	26	76,471.14	477.06	2,517.29	83,221.56	219,465.89	101,765.18	37,791.04

2050	27	76,069.75	474.55	2,504.08	82,784.73	226,609.84	102,017.27	36,468.40
2051	28	75,670.46	472.06	2,490.93	82,350.19	233,986.34	102,269.99	35,192.06
2052	29	75,273.26	469.58	2,477.86	81,917.93	241,602.95	102,523.33	33,960.39
2053	30	74,878.15	467.12	2,464.85	81,487.95	249,467.50	102,777.31	32,771.83
2054	31	74,485.12	464.67	2,451.91	81,060.22	257,588.05	103,031.91	31,624.86
2055	32	74,094.14	462.23	2,439.04	80,634.73	265,972.94	103,287.14	30,518.04
						Total	3,181,666.10	1,789,651.92

[37] Calculation:

$$(Year_A\ Energy\ Intensity * (6{,}238.4* \times 1{,}000)) \ /\ 1{,}000{,}000{,}000{,}000 = Year_A\ Energy\ Consumed$$

[38] Calculation:

$$((Year_B\ Energy\ Consumed - Pervious\ Year_A\ Energy\ Consumed) \times 1{,}000) \times -1 = Year_B\ Energy\ Saved$$

[39] Calculation:

$$Year_A\ Energy\ Saved \times \$33.06** = Year_A\ Cost\ Savings$$

[40] Calculation:

$$Year_A\ Trimmed\ Average \times (1 + 3.8\%)^{Project\ Year\ A} = Year_A\ Nominal\ Cost$$

[41] Calculation:

$$Year_A\ Nominal\ Cost \ /\ (1 + 3\%)^{Project\ Year\ A} = Year_A\ Net\ Present\ Discounted\ Low$$

[42] Calculation:

$$Year_A\ Nominal\ Cost \ /\ (1 + 7\%)^{Project\ Year\ A} = Year_A\ Net\ Present\ Discounted\ High$$

** 6,238.4 = 2021 GSF Assumption*
*** $33.06 = 2021 Cost per MBtu Assumption*

TITLE: Status Quo Alternative Analysis
Source: Connor Eads—Using FEMP Energy Total Cost/Use Data (2022) & Trimmed Average

Model	Low (16yr)	Medium (21yr)	High (32yr)
Projected Costs			
Net Present High[43]	$ 29,557,176.55	$ 36,213,128.33	$ 47,740,788.68
Net Present Low[44]	$ 40,489,199.20	$ 54,204,974.86	$ 86,314,069.91
Cost-Savings			
Net Present High[45]	$ 2,087,552.89	$ 1,961,673.65	$ 1,789,651.92
Net Present Low[46]	$ 2,905,322.87	$ 2,905,322.87	$ 3,181,666.10
Climate Impact			
Total MBtu Saved[47]	80,422.45	80,797.13	84,783.03
Cost-Effectiveness			
Years to Pay Off (NPV High)[48]	14.16	18.46	26.68
Years to Pay Off (NPV Low)[49]	13.94	18.66	27.13
Climate Impact (NPV High)[50]	$ 367.52	$ 448.20	$ 563.09
Climate Impact (NPV Low)[51]	$ 503.46	$ 670.88	$ 1,018.06

[43] Calculation:

$$\Sigma \, Model_Y \; NPV \; Discount \; High_{\; Years \; 2023 \; to \; 2039} = Model_Y \; Projected \; Costs \; NPV \; High$$

[44] Calculation:

$$\Sigma \, Model_Y \; NPV \; Discount \; Low_{\; Years \; 2023 \; to \; 2039} = Model_Y \; Projected \; Costs \; NPV \; Low$$

[45] Calculation:

$$\Sigma \, Model_Y \; NPV \; Discount \; High_{\; Years \; 2023 \; to \; 2039} = Model_Y \; Cost\text{-}Savings \; NPV \; High$$

[46] Calculation:

$$\Sigma \, Model_Y \; NPV \; Discount \; Low_{\; Years \; 2023 \; to \; 2039} = Model_Y \; Cost\text{-}Savings \; NPV \; Low$$

[47] Calculation:

$$\Sigma \, Model_Y \; Energy \; Saved_{Years \; 2023 \; to \; 2039} = Model_Y \; Total \; MBtu \; Saved$$

[48] Calculation:

$$Model_Y \; NPV \; High \; Projected \; Costs \; / \; Model_Y \; NPV \; High \; Cost\text{-}Savings = Model_Y \; Years \; to \; Pay \; Off \; (NPV \; High)$$

[49] Calculation:

$$Model_Y \; NPV \; Low \; Projected \; Costs \; / \; Model_Y \; NPV \; Low \; Cost\text{-}Savings = Model_Y \; Years \; to \; Pay \; Off \; (NPV \; Low)$$

[50] Calculation:

$$Model_Y \; NPV \; High \; Projected \; Costs \; / \; Model_Y \; Total \; MBtu \; Saved = Model_Y \; Climate \; Impact \; (NPV \; High)$$

[51] Calculation:

$$Model_Y \; NPV \; Low \; Projected \; Costs \; / \; Model_Y \; Total \; MBtu \; Saved = Model_Y \; Climate \; Impact \; (NPV \; Low)$$

****Findings Chart in Report uses averages of the NPV High & Low Statistics in Projected Costs, Cost-Savings, and Cost-Effectiveness sections

C. Alternative #2 Energy Savings Performance Retrofit Goal: Data & Calculations

TITLE: General Information & Assumptions for Alternative 2

Quantitative Assumptions	Unit	Amount	CPI Adjusted[52]
U.S. State Department Facility Space	GSF	6,238,400	-
U.S. Dept. of State Domestic Facilities	Count	15	-
GS-10 (Step 10)	2023 $	67,425.00	71,747.04
GS-7(Step 1)	2023 $	38,649.00	41,126.46
Benefits	2021 $	44,021.00	50,346.59
Federal ESPC Annual Cost Savings	2016 $/sq. ft.	0.70	0.88
Federal ESPC Low Implementation Cost	2012 $/sq. ft.	2.72	3.59
Federal ESPC High Implementation Cost	2012 $/sq. ft.	7.06	9.32
Average Federal ESPC Implementation Cost[53]	2012 $/sq. ft.	-	6.45
Federal ESPC Low Energy Savings	2013 $/sq. ft.	0.015	0.019
Federal ESPC High Energy Savings	2013 $/sq. ft.	0.038	0.049
Average Federal ESPC Energy Savings[54]	Mbtu/sq. ft.	-	0.034

[52] Calculation:

$$(CPI_{Year \; 2023} \; / \; CPI_{Year \; A}) \times Amount_{Year \; A} = CPI \; Adjusted \; \$X \; in \; 2023 \; Dollars$$

[53] Calculation:

$$(\textit{ESPC Low Implementation Cost}_{\textit{CPI Adjusted}} + \textit{ESPC High Implementation Cost}_{\textit{CPI Adjusted}}) \ / \ 2 = \textit{Average}$$

[54] Calculation:

$$(\textit{ESPC Low Energy Savings}_{\textit{CPI Adjusted}} + \textit{ESPC High Energy Savings}_{\textit{CPI Adjusted}}) \ / \ 2 = \textit{Average}$$

TITLE: Discounting & Inflation Forecast for Alternative 2 Salaries
Source: Connor Eads

Year	Project Timeline	Salary + Benefits	Nominal Cost (Inflation)[55]	NPV Discounted Low[56]	NPV Discount High[57]
2023	0	0.00	0.00	0.00	0.00
2024	1	213,566.69	221,682.22	215,225.46	207,179.64
2025	2	213,566.69	230,106.14	216,897.11	200,983.62
2026	3	213,566.69	238,850.18	218,581.75	194,972.89
2027	4	213,566.69	247,926.48	220,279.47	189,141.93
2028	5	213,566.69	257,347.69	221,990.38	183,485.35
2029	6	213,566.69	267,126.90	223,714.58	177,997.93
2030	7	213,566.69	277,277.73	225,452.16	172,674.63
2031	8	213,566.69	287,814.28	227,203.25	167,510.53
2032	9	213,566.69	298,751.22	228,967.94	162,500.87
2033	10	213,566.69	310,103.77	230,746.33	157,641.03
2034	11	213,566.69	321,887.71	232,538.53	152,926.53
2035	12	213,566.69	334,119.44	234,344.66	148,353.03
2036	13	213,566.69	346,815.98	236,164.81	143,916.30
2037	14	213,566.69	359,994.99	237,999.10	139,612.26
2038	15	213,566.69	373,674.80	239,847.64	135,436.94
2039	16	213,566.69	387,874.44	241,710.53	131,386.49
2040	17	213,566.69	402,613.67	243,587.89	127,457.18
			Total	3,895,251.57	2,793,177.17
				Average Both[58]	3,344,214.37

55 Calculation:

$$\textit{Year}_A \textit{ Salary and Benefits} \times (1 + 3.8\%)^{\textit{Project Year A}} = \textit{Year}_A \textit{ Nominal Cost}$$

56 Calculation:

$$\textit{Year}_A \textit{ Nominal Cost} \times (1 + 3\%)^{\textit{Project Year A}} = \textit{Year}_A \textit{ Net Present Discounted Low}$$

57 Calculation:

$$\textit{Year}_A \textit{ Nominal Cost} \times (1 + 7\%)^{\textit{Project Year A}} = \textit{Year}_A \textit{ Net Present Discounted High}$$

58 Calculation:

$$(\textit{NPV Discounted Low Total} + \textit{NPV Discounted High Total}) / 2 = \$3{,}444{,}214.37$$

TITLE: Projected Costs & Cost-Savings by Group Implementation
Source: Connor Eads

Project Costs	2023 Dollars	Paid	Inflation Adj.[60]	Discount High[61]	Discount Low[62]	Average of Both[63]
Pay Group 1	3,589,826.18	2024	3,726,239.57	3,482,466.89	3,617,708.32	3,550,087.61
Pay Group 2	12,230,709.48	2026	13,678,664.91	11,165,865.13	11,799,336.51	11,482,600.82
Pay Group 3	25,936,203.71	2028	31,253,105.37	25,511,843.56	26,959,203.23	26,235,523.39
					Total	41,268,211.82

Cost Savings	2023 Dollars	Begins	Inflation Adj.[64]	Discount High[65]	Discount Low[66]	Average of Both[67]
Pay Group 1	491,646.19	2035	769,167.48	341,519.56	539,478.60	440,499.08
Pay Group 2	1,675,062.07	2037	2,823,539.41	1,095,017.26	1,866,692.18	1,480,854.72
Pay Group 3	3,552,103.92	2041	6,950,851.75	2,056,506.22	4,082,892.84	3,069,699.53
					Total	4,991,053.33

60 Calculation:

$$\textit{Group}_A \textit{ Projected Costs} \times (1 + 3.8\%)^{\textit{Project Year A Paid In}} = \textit{Group}_A \textit{ Nominal Cost}$$

61 Calculation:

$$\textit{Group}_A \textit{ Nominal Cost} / (1 + 3\%)^{\textit{Project Year A Paid In}} = \textit{Group}_A \textit{ Net Present Discounted Low}$$

62 Calculation:

$$\textit{Group}_A \textit{ Nominal Cost} / (1 + 7\%)^{\textit{Project Year A paid In}} = \textit{Group}_A \textit{ Net Present Discounted High}$$

63 Calculation:

$$(\textit{Group}_A \textit{ NPV Discounted Low Total} + \textit{Group}_A \textit{ NPV Discounted High Total}) / 2 = \textit{Group}_A \textit{ Average}$$

64 Calculation:

$$\textit{Group}_A \textit{ Cost-Savings} \times (1 + 3.8\%)^{\textit{Project Year A Begins}} = \textit{Group}_A \textit{ Nominal Cost}$$

65 Calculation:

$$\textit{Group}_A \textit{ Nominal Cost} / (1 + 3\%)^{\textit{Project Year A Begins}} = \textit{Group}_A \textit{ Net Present Discounted Low}$$

66 Calculation:

$$\textit{Group}_A \textit{ Nominal Cost} / (1 + 7\%)^{\textit{Project Year A Begins}} = \textit{Group}_A \textit{ Net Present Discounted High}$$

67 Calculation:

$$(\textit{Group}_A \textit{ NPV Discounted Low Total} + \textit{Group}_A \textit{ NPV Discounted High Total}) / 2 = \textit{Group}_A \textit{ Average}$$

D. Alternative #3 Utility Contract Goal: Data & Calculations

TITLE: General Information & Assumptions for Alternative 3
Source: Connor Eads

Quantitative Assumptions	Unit	Amount	CPI Adjusted Amount[68]
U.S. State Department Facility Space	GSF	6,238,400	-
U.S. Dept. of State Domestic Facilities	Count	15	-
GS-10 (Step 10)	2023 $	67,425.00	71,747.04
GS-7(Step 1)	2023 $	38,649.00	41,126.46
Benefits	2021 $	44,021.00	50,346.59
Average UESC Capital Investment per project (2005 $)	2005 $	1,366,000.00	2,142,979.65
Average UESC Cost-Savings (2005 $)	2005 $	269,000.00	422,006.97
Average UESC Energy Consumption (MBtu) Impact	MBtu	19,000	-
Facility Share of Total GSF Under 2%	Weighted Average[69]	0.3	-
Facility Share of Total GSF 3% to 5 %	Weighted Average	0.8	-
Facility Share of Total GSF 6% to 7 %	Weighted Average	1	-
Facility Share of Total GSF 8 % to 15 %	Weighted Average	1.5	-
Facility Share of Total GSF Over 15%	Weighted Average	4	-

[68] Calculation:

$$(CPI_{Year\ 2023} \ / \ CPI_{Year\ A}) \times Amount_{Year\ A} = CPI\ Adjusted\ \$X\ in\ 2023\ Dollars$$

[69] Calculation:

Weighted averages were applied to account for differences in cost & savings from GSF ranges because the one average from 2005 does not include this in their findings. The values mirrored the proportional impact of the $/sq. ft. or cost-savings/sq. ft. from Alternative 2.

TITLE: Discounting & Inflation Forecast for Alternative 3 Salaries
Source: Connor Eads

Year	Project Timeline	Salary + Benefits	Nominal Cost (Inflation)[70]	NPV Discounted Low[71]	NPV Discount High[72]
2023	0	-	-	-	-
2024	1	213,566.69	221,682.22	215,225.46	201,145.29
2025	2	213,566.69	230,106.14	216,897.11	189,446.34
2026	3	213,566.69	238,850.18	218,581.75	178,427.82
2027	4	213,566.69	247,926.48	220,279.47	168,050.15
2028	5	213,566.69	257,347.69	221,990.38	158,276.07
2029	6	213,566.69	267,126.90	223,714.58	149,070.47
2030	7	213,566.69	277,277.73	225,452.16	140,400.28

2031	8	213,566.69	287,814.28	227,203.25	132,234.36
2032	9	213,566.69	298,751.22	228,967.94	124,543.39
2033	10	213,566.69	310,103.77	230,746.33	117,299.73
2034	11	213,566.69	321,887.71	232,538.53	110,477.38
2035	12	213,566.69	334,119.44	234,344.66	104,051.83
2036	13	213,566.69	346,815.98	236,164.81	98,000.00
2037	14	213,566.69	359,994.99	237,999.10	92,300.15
2038	15	213,566.69	373,674.80	239,847.64	86,931.82
2039	16	213,566.69	387,874.44	241,710.53	81,875.72
2040	17	213,566.69	402,613.67	243,587.89	77,113.69
2041	18	213,566.69	417,912.99	245,479.84	72,628.63
2042	19	213,566.69	433,793.68	247,386.48	68,404.42
2043	20	213,566.69	450,277.84	249,307.93	64,425.91
2044	21	213,566.69	467,388.40	251,244.30	60,678.79
			Total	4,888,670.10	2,475,782.22
				Average Both[73]	3,682,226.16

[70] Calculation:

$$\textit{Year}_A \textit{ Salary and Benefits} \times (1 + 3.8\%)^{\textit{Project Year A}} = \textit{Year}_A \textit{ Nominal Cost}$$

[71] Calculation:

$$\textit{Year}_A \textit{ Nominal Cost} \,/\, (1 + 3\%)^{\textit{Project Year A}} = \textit{Year}_A \textit{ Net Present Discounted Low}$$

[72] Calculation:

$$\textit{Year}_A \textit{ Nominal Cost} \,/\, (1 + 7\%)^{\textit{Project Year A}} = \textit{Year}_A \textit{ Net Present Discounted High}$$

[73] Calculation:

$$\textit{(NPV Discounted Low Total + NPV Discounted High Total) / 2 = \$3,682,266.16}$$

TITLE: Weighted Average Calculations for Alternative 3

Source: Connor Eads

Group 1	Weighted Costs[74]	Weighted Savings[75]	Weighted Impact[76]
[redacted]	642,893.90	67,250	4750
	642,893.90	67,250	4750
	642,893.90	67,250	4750
	642,893.90	67,250	4750
	642,893.90	67,250	4750
	1,714,383.72	215,200	15200

Group 2	Weighted Costs	Weighted Savings	Weighted Impact
[redacted]	2,142,979.65	269,000	19000
	2,142,979.65	269,000	19000

[redacted]	1,714,383.72	215,200	15200
	1,714,383.72	215,200	15200
	2,142,979.65	269,000	19000

Group 3	Weighted Costs	Weighted Savings	Weighted Impact
[redacted]	10,714,898.27	1,345,000	95000
	3,214,469.48	403,500	28500
	3,214,469.48	403,500	28500
	2,142,979.65	269,000	19000

[74] Calculation:

$$\textit{Projected Costs Average} \times \textit{Weighted Scale}_{\textit{If Facility GSF = X of Total GSF}} = \textit{Weighted Costs}_{\textit{Group A}}$$

[75] Calculation:

$$\textit{Cost-Savings Average} \times \textit{Weighted Scale}_{\textit{If Facility GSF = X of Total GSF}} = \textit{Weighted Cost-Savings}_{\textit{Group A}}$$

[76] Calculation:

$$\textit{Climate Impact Average} \times \textit{Weighted Scale}_{\textit{If Facility GSF = X of Total GSF}} = \textit{Weighted Climate Impact}_{\textit{Group A}}$$

TITLE: Projected Costs by Implementation Group
Source: Connor Eads

Project Costs	2023 Dollars	Paid in	Inflation Adj.[77]	Discount High[78]	Discount Low[79]	Average of Both[80]
Pay Group 1	4,928,853.20	2025	5,310,563.31	4,638,451.67	5,005,715.25	4,822,083.46
Pay Group 2	9,857,706.41	2027	11,443,669.15	8,730,320.41	10,167,551.82	9,448,936.11
Pay Group 3	19,286,816.89	2029	24,123,742.17	16,074,668.01	20,203,254.28	18,138,961.15
					Total	32,409,980.72

Cost Savings	2023 Dollars	Full Begins	Inflation Adj.[81]	Discount High[82]	Discount Low[83]	Average of Both[84]
Pay Group 1	551,450.00	2041	1,079,092.08	319,264.41	633,852.87	476,558.64
Pay Group 2	1,237,400.00	2043	2,608,898.49	674,188.95	1,444,483.84	1,059,336.39
Pay Group 3	2,421,000.00	2045	5,499,669.19	1,241,347.74	2,870,236.11	2,055,791.92
					Total	3,591,686.95

[77] Calculation:

$$\textit{Group}_A \textit{ Projected Costs} \times (1 + 3.8\%)^{\textit{Project Year A Paid In}} = \textit{Group}_A \textit{ Nominal Cost}$$

[78] Calculation:

$$\textit{Group}_A \textit{ Nominal Cost} \ / \ (1 + 3\%)^{\textit{Project Year A Paid In}} = \textit{Group}_A \textit{ Net Present Discounted Low}$$

[79] Calculation:

$$\textit{Group}_A \textit{ Nominal Cost} \ / \ (1 + 7\%)^{\textit{Project Year A paid In}} = \textit{Group}_A \textit{ Net Present Discounted High}$$

[80] Calculation:

$$(Group_A\ NPV\ Discounted\ Low\ Total + Group_A\ NPV\ Discounted\ High\ Total) / 2 = Group_A\ Average$$

[81] Calculation:

$$Group_A\ Cost\text{-}Savings \times (1 + 3.8\%)^{Project\ Year\ A\ Begins} = Group_A\ Nominal\ Cost$$

[82] Calculation:

$$Group_A\ Nominal\ Cost / (1 + 3\%)^{Project\ Year\ A\ Begins} = Group_A\ Net\ Present\ Discounted\ Low$$

[83] Calculation:

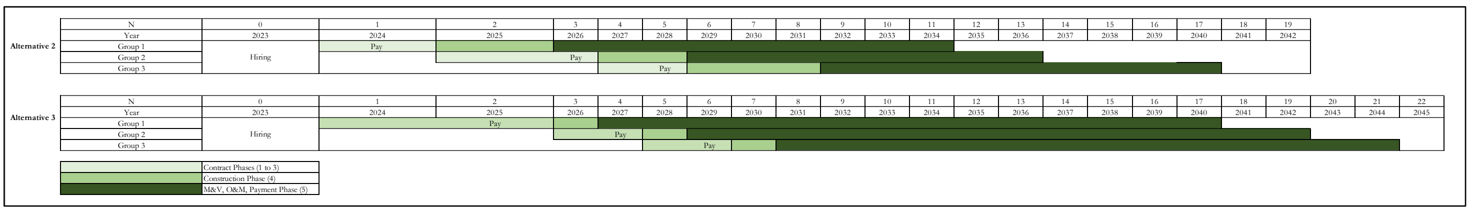
$$Group_A\ Nominal\ Cost / (1 + 7\%)^{Project\ Year\ A\ Begins} = Group_A\ Net\ Present\ Discounted\ High$$

[84] Calculation:

$$(Group_A\ NPV\ Discounted\ Low\ Total + Group_A\ NPV\ Discounted\ High\ Total) / 2 = Group_A\ Average$$

TITLE: Project Implementation Timelines for Alternatives 1 & 2

Source: Connor Eads



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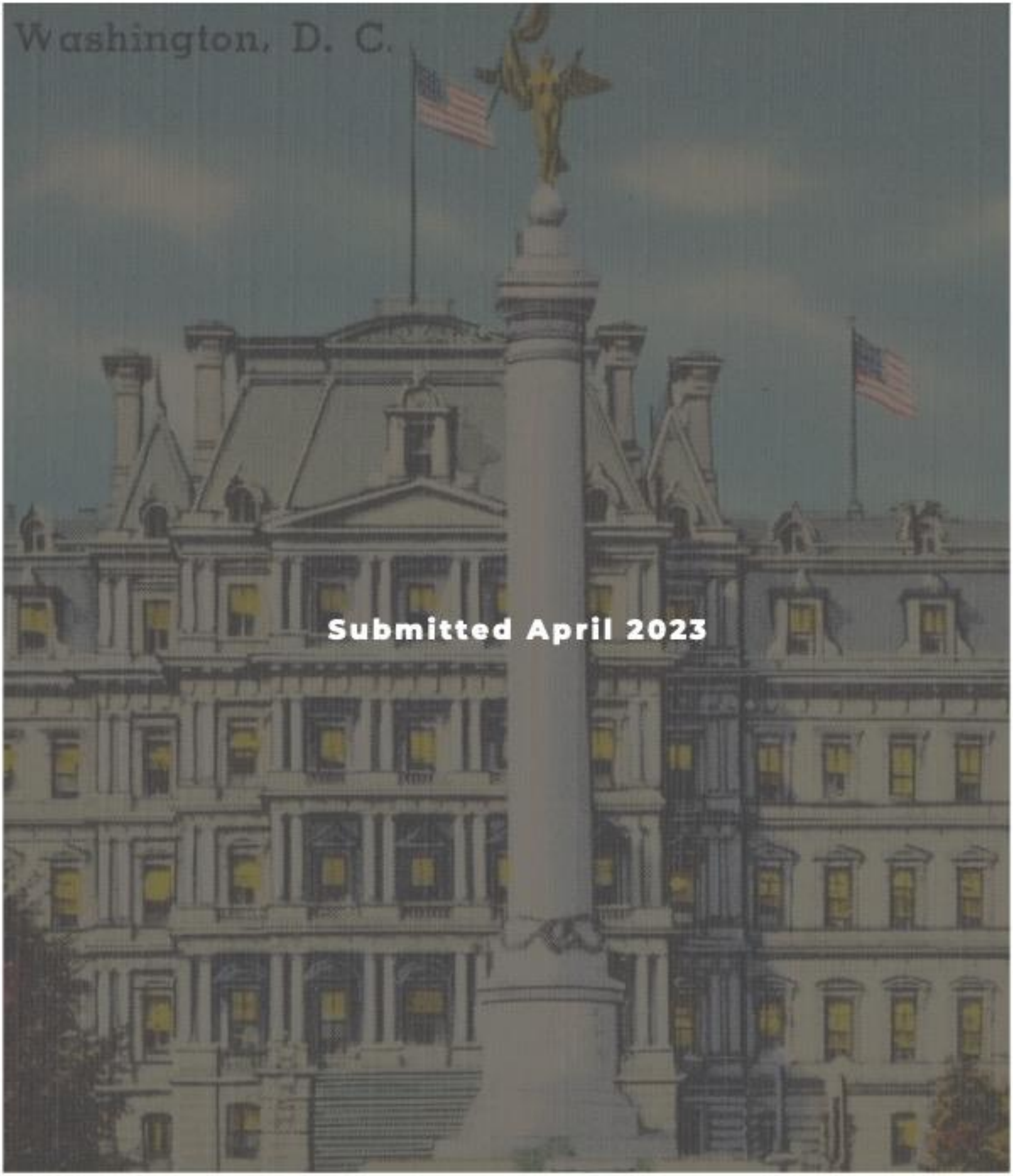

OPTIMIZING ENERGY MANAGEMENT

Strategies for Achieving 2030 Facility Sustainable Energy Goals

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