NEW YORK STATE GREEN FLEETS

A study of Green Revolving Funds and Electric Vehicles

Columbia University, Sustainability Management Capstone, Spring 2016

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FOREWORD

This report is the culmination of the work done by a group of graduate students at Columbia University as part of the Integrative Capstone Workshop for the M.S. in Sustainability Management program.

The Integrative Capstone Workshop serves as the final educational experience for students in the Sustainability Management program, which equips students with analytical knowledge and practical skills to address real-world environmental challenges. New York State's Department of Environmental Conversation engaged with this group in order to determine whether a green revolving fund would be a feasible solution to financing the procurement of electric vehicles in New York State fleets.

Please note that although the research problem addressed in this report was recommended by staff members of the New York State Department of Environmental Conservation (NYSDEC), the views and opinions expressed in this report are those of the authors and do not necessarily reflect the official policy or position of NYSDEC. Assumptions made within the analysis do not reflect NYSDEC's positions.

EXECUTIVE SUMMARY

Executive Summary

In 2013, Governor Andrew Cuomo set New York State on an aggressive path to reducing Greenhouse Gas (GHG) emissions associated with the state's public fleet vehicles. As a result, state agencies are mandated to convert 25% of light-duty non-emergency fleet purchases to Zero Emissions Vehicles (ZEVs) by 2025. New York State's Department of Environmental Conservation (DEC) has taken the lead in this campaign to pursue greener state fleets.

In addition to converting its own fleet, the DEC seeks to lead by example and create a pathway for fleet conversion across all New York State agencies. Part of this leadership effort includes the exploration of innovative financing methods for purchasing ZEVs, which are more expensive than traditional vehicles. DEC administrators have identified a $1 million funding source that can be used for fleet conversion. Rather than using this funding as a one-time expenditure to purchase cleaner vehicles, the DEC wishes to explore the feasibility of a Green Revolving Fund (GRF).

Applied to the DEC's plan for purchasing cleaner fleet vehicles, a GRF would closely track and retain savings from reduced gas and maintenance costs and use the savings to repay the borrowed funds, thus replenishing the fund for other agencies to procure new ZEVs for their fleets. If successfully managed, a GRF could become a self-sustaining financing tool for converting agency fleets. By combining the benefits of innovative technology and innovative financing, the DEC will model a pathway for fleet conversion across state agencies and provide a proof-of-concept demonstration for other institutions as well as the private sector.

This report is intended to serve as a resource and guide for the DEC as it leads the statewide conversion to cleaner fleets. The report includes several in-depth case studies that provide a menu of best practices and strategies for successful GRF development and management. A financial model was developed to test various scenarios for converting fleets using a GRF. In addition, the report provides analysis on the potential for GHG emissions reductions, improved health and air quality, and other external benefits of converting the state's fleet vehicles.

CLIENT BACKGROUND & CONTEXT

Client: New York State's Department of Environmental Conservation

The DEC's mission is "to conserve, improve and protect New York's natural resources and environment and to prevent, abate and control water, land and air pollution, in order to enhance the health, safety and welfare of the people of the state and their overall economic and social well-being."[1] To fulfill this mission, the DEC oversees and enforces environmental laws. This enforcement includes traditional policing enforcement, issuing permits and licenses for outdoor activities, oversight of environmental activities, such as waste management, and developing and funding public environmental programs.

DEC's Current Fleet

The DEC has nine regional offices with over three thousand permanent employees located throughout the state.[2] In addition to employee travel between offices, the DEC's fleet is critical for the agency's programming, enforcement, and oversight responsibilities. In fiscal year 2014, the DEC reported that its 1,772 fleet vehicles traveled a cumulative total of 17,502,784 miles.[3] [4] Administrative sedans make up about 9% of its total fleet.[5]

In 2016, the DEC plans to purchase several new administrative vehicles. According to policy outlined in Clean Fleets NY, half of the agency's new administrative-use vehicles must be battery electric, plug in electric hybrids, or hydrogen fuel cell.[6]

State Vehicle Fleets

As of June 2014, the state's total inventory of light-duty vehicles was approximately 6,700.[7] This inventory is tracked through the statewide Fleetwave system, which tracks fleet vehicle inventories across all state agencies.[8] In general, when public transportation is not available for state employees to carryout state business, the employees may choose to use a fleet vehicle, a rental car, or their personal vehicle and be reimbursed for travel expenses. If an employee uses a personal vehicle, the employee may only claim reimbursement for the least expensive option, as determined by a trip calculator tool.[9]

NYS Procurement Process

The state has a decentralized vehicle procurement model, in which state agencies make procurement and fleet management decisions independently.[10] Within the DEC, each regional and divisional office submits requests for the number and type of vehicles needed for the upcoming fiscal year to the DEC Fleet Manager.[11] Vehicles may be replaced if they meet any of the following conditions:

1. Are more than seven years old;
2. Have traveled more than 125,000 miles;
3. Are emergency response vehicles;
4. Require over $1,500 average annual maintenance;
5. Repair exceeds the vehicle value.[12]

The Fleet Manager will use these requests to develop a business case for the total number of new vehicle purchases needed for the agency and submit the request to the Office of General Services (OGS) and the Governor's Office for review and approval.[13] The request for new vehicles will include information on the size, condition, and use profile of the current fleet, a summary of the agency's vehicle replacement strategy,

a descriptive justification for the requested vehicles, and a proposed procurement approach.[14]

Once the request is approved, the Fleet Manager will coordinate with the DEC's various offices to purchase the vehicles through the NYS Vehicle Marketplace, a bidding system that connects authorized buyers from state government with local auto dealers that bid on vehicle orders. Once the vehicles are purchased, the DEC's Central Office distributes the vehicles to the Regional and Division Offices who submitted requests.

Though state agencies currently submit individual bids for vehicles to the marketplace, the DEC is working with OGS to organize an aggregated purchase of plug-in hybrid vehicles at a reduced price.[15]

Local Operating Budgets

Each Regional and Division Office manages its own operational budget that includes costs associated with operating their fleet vehicles.[16] At the beginning of each quarter, the Regional and Division Offices pay the Central Office for their expected quarterly vehicle usage. Each vehicle type is allocated a unique operating cost based on a per mile rate. This cost accounts for maintenance, insurance, toll charges, and a vehicle's fuel economy.[17] After each quarter, adjustments are made to the prior quarter based on the actual miles traveled.

In the event that a Regional or Division Office experiences operational savings by traveling fewer miles than expected or achieving other efficiencies, the office may use those funds for other expenses in support of its specific mission.[18] However, these offices may experience reductions in their fleet budget in subsequent years based on their ability to lower their fleet expenses. This could represent a disincentive to local offices and agencies pursuing efficiency improvements in their fleet operations.

POLICY BACKGROUND

A Multi-State Effort

In 2013, Governor Cuomo signed a multi-state Memorandum of Understanding (MOU) and Action Plan with seven other states: California, Connecticut, Maryland, Massachusetts, New York, Oregon, Rhode Island, and Vermont.[19] This plan outlines eleven actions that the states have agreed to implement with the goal of having 3.3 million ZEVs on the road in these states by 2025.[20] One of these action steps encourages states to "lead by example through increasing ZEVs in state, municipal, and other public fleets." [21]

New York State Initiatives

New York State has set aggressive environmental goals to address climate change and reduce GHG emissions. Established in 2008, Executive Order 4 (EO4) provides guidance to state agencies on green procurement and sustainability initiatives.[22] All 85 state agencies must follow the guidance outlined in EO4 and designate a Sustainability Coordinator or Green Procurement Coordinator to lead their agency's sustainability program.[23] EO4 also created an Interagency Committee to set standards for agency initiatives, determine purchasing specifications, and develop lists of acceptable green products.[24] The Interagency Committee is co-chaired by the Commissioners of OGS and the DEC. The DEC is charged with overseeing the implementation of EO4.

In the 2015 State Energy Plan, Governor Cuomo pledged to reduce the state's GHG emissions by 40% by 2030 followed by an 80% reduction by 2050, based on a 1990 baseline.

Most recently, in October 2015, Governor Cuomo signed the "Under 2 MOU" pledge, which is an agreement between states, cities, and local municipalities worldwide that commits signees to work towards keeping the earth's average temperature from increasing 2 degrees Celsius by 2100.[25]

Clean Fleets NY

An important aspect of the state's leadership in promoting cleaner vehicles in public fleets is the Clean Fleets NY program, announced in Governor Cuomo's State of the State address in 2015. This program commits state agencies to purchasing battery electric, plug in electric hybrids, or hydrogen fuel cell vehicles for at least 50% of new administrative sedans.[26] The program commences in 2016 with early participating agencies including the DEC, the New York State Energy Research and Development Authority (NYSERDA), and New York Power Authority (NYPA). In addition to purchasing cleaner vehicles, these agencies will be exploring innovative procurement models and sharing these models with other state agencies to accelerate the conversion to cleaner state fleets.

PROJECT DESCRIPTION

Project Objective

The objective of this project is to explore the feasibility of a Green Revolving Fund as a tool for accelerating the conversion of the state's public fleet to electric vehicles. The project will provide research, analysis, and guidance on the DEC's effort to purchase more energy-efficient fleet vehicles using a GRF and will deliver several key foundational documents including this written report, a financial model, and a final presentation to DEC administrators.

Project Methodology

A literature review was conducted in order to provide a background on key technical concepts regarding fund mechanics, the benefits of various vehicle types, and relevant policy and guidance. Case studies, a survey of state-run GRFs, and interviews with practitioners were conducted in order to provide best practices and describe common challenges. A financial model was developed in order to provide a quantitative analysis for various scenarios.

Stakeholders

Primary Stakeholders

Primary stakeholders will be directly affected by the project and its success depends on their roles in the project.

Department of Environmental Conservation
New York State agencies
Office of General Services
Employees of state agencies

Secondary Stakeholders

Secondary stakeholders are presumed to be indirectly affected by the project's outcomes.

Car manufacturers
Elected officials
Citizens of New York
Utility companies
Fossil fuel industry

CLEAN FLEETS

Zero Emissions and Alternative Fuel Vehicles

Traditional vehicles with internal combustion engines emit pollutants during operation, including GHGs, volatile organic compounds, and nitrogen oxides, all of which have a negative environmental impact. These emissions are a result of the combustion of a fuel source, like gasoline, and evaporative emissions from a vehicle during operation and refueling periods.[27] Emissions may also occur during the extraction and distribution of the fuel source.

A zero-emissions vehicle (ZEV) is any vehicle that does not release emissions during operation. The term ZEV was originally created by the California Air Resources Board (CARB), which, in 1990, enacted a ZEV program designed to achieve significant new emission reductions from the state's passenger vehicle fleet.[28] Initially, the program required that 2% of all vehicles produced for sale by large manufacturers in California be ZEVs. The program now requires that ZEVs make up 10% of vehicles produced in the state.

Key Acronyms

EVs (all-electric vehicles) are powered only by one or more electric motors. They receive electricity by plugging into the grid, and they store it in batteries. They consume no petroleum-based fuel while driving and produce no tailpipe emissions.

EVSE (electric vehicle supply equipment) delivers electrical energy from an electricity source to charge a PEV's batteries. It communicates with the PEV to ensure that an appropriate and safe flow of electricity is supplied.

HEVs (hybrid electric vehicles) combine an ICE or other propulsion source with batteries, regenerative braking, and an electric motor to provide high fuel economy. They rely on a petroleum-based or alternative fuel for power and are not plugged in to charge. HEV batteries are charged by the ICE or other propulsion source and during regenerative braking.

ICEs (internal combustion engines) generate mechanical power by burning a liquid fuel (such as gasoline, diesel, or biofuels) or a gaseous fuel (such as compressed natural gas). They are the dominant power source used in on-road vehicles today.

PEVs (plug-in electric vehicles) derive all or part of their power from electricity supplied by the electric grid. They include EVs and PHEVs.

PHEVs (plug-in hybrid electric vehicles) use batteries to power an electric motor, plug into the electric grid to charge, and use a petroleum-based or alternative fuel to power an ICE or other propulsion source.

Source: http://www.afdc.energy.gov/pdfs/51227.pdf

Clean Fleets Overview

In 1998, a survey found that there were more than 75,000 light-duty ZEVs being operated throughout state and local government fleets.[29] Today, clean fleets are recognized as an integral part of environmentally responsible transportation infrastructure for governments and institutions. Many states and municipalities have already made significant progress in this area and have enjoyed the benefits of greater energy efficiency in addition to a reduced carbon footprint. Below is a survey of states and cities pursuing clean fleet agendas.

Washington State

In the state of Washington, the Governor's Executive Order 14-04 set a target of increasing the number of plug-in electric vehicles in the state's fleet to 50,000 by 2020, up from about 10,000 in 2014.[30] As a result of this initiative, the state of Washington is considered a leader in EV adoption.

Massachusetts

Massachusetts is pursuing an ambitious EV infrastructure and procurement plan through two initiatives: Massachusetts Electric Vehicle Task Force and the Massachusetts Electric Vehicle Incentive Program.[31]

California

The California Air Resources Board has launched a Public Fleet Pilot Project to provide increased incentives for public fleets in disadvantaged communities. It offers rebates for the purchase of new ZEVs AND PHEVs. This program strategically targets incentives for public agencies operating in some of most vulnerable and pollution-burdened areas in California.[32]

Texas

Texas Clean Fleet Program (TCFP) caters to both public and private fleets. The TCFP provides incentives to owners of large fleets in Texas to replace diesel-powered vehicles with alternative fuel or hybrid vehicles.[33] This system motivates both public and private fleet owners to switch over from some of the highest polluting vehicles to ZEVs.

Vermont

Vermont's Drive Electric Vermont program is committed to stimulating the proliferation of electrified transportation throughout the state. The program has established relationships with many of the largest employers and other businesses across the state to encourage electric vehicle charging installations.[34]

Sonoma County, California

As of January 2016, Sonoma County owns and operates approximately 1,100 vehicles and machines, 87 of which are PEVs (29 are purely electric).[35] Additionally, over 200 of the vehicles are HEVs, which makes Sonoma County's fleet one of the greenest in the country.[36] Because the county was such an early adopter of EVs, the program has navigated some of the challenges of implementing new technologies, like limited battery range in earlier EV models.[37]

City of Seattle

The city of Seattle started integrating EVs into their vehicle fleet in 2011, making it one of the first states to do so. Of the 4,000 vehicles and machines in the fleet, 148 are electric-powered and an even greater number are hybrids.[38] A recent five year retrospective study on the fleet's battery performance found that the fleet's batteries

were performing at a higher level than fleet managers had assumed.

Despite the success of these initiatives challenges remain, including:

- Range anxiety: According to Seattle's fleet manager, before purchasing EVs, the city was concerned about the vehicle's limited range considering the lack of charging infrastructure and what effect this would have on employees carrying out city business. This is a common concern for fleet managers. In Seattle's case there was some negative impact on city employees driving EVs, including some early EV models falling short on advertised battery range.[39]
- Utilization: Due to range anxiety, drivers are less likely to use EVs, which means that the savings from EVs may be less than anticipated.
- Cost calculations: A major incentive to converting to clean fleets, other than reducing GHG emissions, is the long-term cost savings of operating EVs. Several key variables will affect the projected savings. Fleet managers should consider these variables, which include the cost of infrastructure, the fluctuating price of gasoline, resale value of EVs, and the cost of battery replacement.[40]

Batteries are Getting Cheaper, Better

Though the price of EVs has remained higher than traditional vehicles, that is rapidly changing, mainly due to a significant drop in the cost of batteries, which makes up a third of the cost of an EV.[180] A key metric for battery economics is the cost per kWh. The more kWh stored, the further the car can go on one charge. Thus, as the cost per kWh goes down, so does the cost for building an EV with a more generous range.

The decline in battery costs per kWh is a result of global research and development investments in battery technology.[181] In a major analysis, the Electric Vehicles Initiative (EVI) and International Energy Agency's (IEA) 2015 Global EV Outlook showed total EV spending by governments equaled $16 billion between 2008-2014, helping to reduce battery costs from $1,000/kWh in 2008 to $410/kWh in 2014.[182] The US Department of Energy alone invested $1 billion in battery research and development between 1992-2012. This intensive investment is estimated to have advanced battery technology by six years and to have created $3.5 billion worth of economic value.[183]

Carmakers and tech companies are also investing billions on designing new EV models and reducing battery costs. For example, the cost of battery packs used by market-leading models, like Nissan's LEAF and Tesla's model S, have already dropped to around $300/kWh and are set to fall even further by the end of 2016.[184] Bloomberg New Energy Finance expects EV battery costs to be well below $120/kWh by 2030.[185] Interestingly, the report predicts that if the price of oil were to fall all the way to $20/barrel and remain there, this would only delay mass adoption of EVs to the early 2030s.[186]

Resources for Clean Fleet Management

All around the US, public fleet managers recognize the need for high-quality management of clean fleet programs. There are many resources available to guide and support government agencies in integrating ZEVs into their public fleets. One of these resources is the Alternative Fuels Data Center (AFDC). The AFDC provides a wide-ranging database linked to alternative fuels and vehicles, air quality, fuel efficiency, and other related transportation topics. This system also tracks federal and state laws and incentives.[41]

Another well-respected resource is the National Renewable Energy Laboratory, which provides a convenient interface for state and local level laws and other related incentives data.[42] The annual Advanced Clean Transportation "ACT" Expo brings together more than 3,500 clean transportation stakeholders annually to address the most relevant topics for fleet managers.[43] At this meeting, a panel of fleet managers chose a winner for Public Sector Fleet Manager of the Year Award. The panel reviews candidates in several categories, including business planning, technology implementation, productivity, policies, preventive maintenance programing, utilization management, replacement programing, customer service, fuel management, and safety.[44] Public fleet managers may consider studying past winners as case studies for best practices.

GREEN REVOLVING FUNDS

What is a Green Revolving Fund?

A green revolving fund is an investment vehicle that finances sustainability projects within an organization. GRFs may be used to fully fund projects or to subsidize projects requiring additional financial support. Typically, GRF-funded projects are focused on resource efficiency and GHG emissions reduction and offer an opportunity for operational savings. These operational savings are closely tracked and a portion of the savings are returned to the fund so that new projects can be funded.[45] As borrowed funds are repaid the GRF "revolves" to fund new projects among different groups within an institution.[46] If successfully managed, a GRF can become a self-sustaining financing tool for green investment for universities, state governments, and other institutions that have prioritized green investment.

While traditional investment options are still an important aspect of green investment, GRFs provide an opportunity to promote the measurable return on investment generated by green investments.[47] Instituting GRFs can also help formalize an institution's sustainability program by outlining specific criteria, goals, and priorities that will be supported through investment. In addition, the communal nature of passing on savings from one project to fund another project in a different part of an organization can support a shared culture of goodwill around sustainability projects.

Background: State Green Revolving Funds

A survey found 23 existing GRFs operated by state governments with great variation in management, program design, size, and project types. The first GRF, Texas's LoanSTAR program, was founded in 1988 and was closely followed by the launch of Missouri's Energy Revolving Fund in 1989. Both of these funds were founded with seed funding from Petroleum Violation Escrow Funds, established from money paid by oil companies for violating federal oil price caps in the 1970s.[48]

Between 1990 and 2008 only two GRFs were launched at the state level, Iowa's Alternative Energy Revolving Loan Program in 1996 and Utah's Revolving Loan Fund for Energy Efficiency Projects in School Districts and Political Subdivisions in 2007.[49]

Following this period, 13 funds were founded between 2009 and 2015.[50] This increase over the past decade coincides with the availability of funding from the American Recovery and Reinvestment Act (ARRA) of 2009, which specifically promoted GRFs as one of the ways that states could use the funds to boost economic activity.[51] Of the GRFs surveyed, 42% relied at least in part on ARRA for seed funding. Many of these funds are focused on both energy efficiency and job creation. As a result, agencies and departments that oversee state energy and economic development administer these newer funds. Established funds, like Texas's LoanSTAR program, used ARRA funding to grow its fund and expand its program.

Seed Funding

GRFs are established with seed funding that can originate in a variety of ways. About a quarter of GRFs receive some form of direct state funding, including discretionary funding from the legislature and money from established green funds or trusts.

Many funds utilize multiple sources of seed funding from state, federal, and private sources, including utility assessments, sale of bonds or credits, and revenue from environmental penalties. A university may provide seed money directly from its endowment principal or allocate a portion of the general operating budget.

Fund Management

Funds can be managed in a variety of ways. In general, the three main options include a dedicated fund manager, a committee of stakeholders, or management by an existing department or business unit. These options for fund management may be combined to fit the institution's particular structure or the fund's targeted strategy.[52] Co-administration of GRFs by a central budgetary agency and an environmental or energy agency is common, in part because the state agency that designs the program and its priorities often lacks the authority to distribute and collect money from other agencies.

All funds have some mechanism or revenue stream for covering the administration of the fund, and in some cases incrementally grow the fund. The majority of GRFs utilize an interest rate, though several surveyed funds chose not to charge an interest rate. Rates range from 1% to higher variable rates based on the project and borrower's risk profile. Administrative fees are also utilized as a source of revenue in about one third of funds, with rates ranging from 1% to 6% of the funded amount. These are typically one-time costs applied to the initial loan size. A few funds utilize other fee mechanisms, like underwriting fees and late payment fees, though these fees are much less common.

A Federal Precedent

Established in 1987, the Clean Water State Revolving Fund (CWSRF) is a funding program for state water infrastructure projects.[155] The program opens the door to partnerships between states and EPA in which EPA funds a wide range of water projects through low-interest loans to states. The program allows states to prioritize projects according to state-level needs. Projects have historically included construction of municipal wastewater facilities, storm water treatment facilities, decentralized wastewater treatment systems, green infrastructure projects, protect estuaries, and other water quality projects. Through 2015, the program has distributed more than $111 billion in funding to support more than 36,100 projects in various communities. In 2015, the average interest rate for loans was 1.7%, well below the market rate of 3.8%.[156]

The CWSRF functions as a revolving loan fund. As money is paid back to the fund, the state then makes new loans to fund other water projects.[157] Repayments of loan principals and the additional interest earnings allow the fund to "revolve."

Once a project is approved for funding by EPA, states then provide an additional 20% of total costs to support the project. States operate funds individually and are able to customize loan terms, payback periods, and interest rates. States may also choose to target specific types of projects and encourage the involvement of specific communities within their state.[158] For example, some states have focused on involving smaller, rural communities. Over the life of the program, $24.3 billion in funding has been provided for projects in communities with populations of less than 10,000, and $12.1 billion has gone to projects serving a population of 3,500 or less.[159]

Payback periods are largely determined by project type and size. Most of the GRFs support energy efficiency upgrades, projects with long lifetimes and long payback periods. For the smaller projects, a payback period of less than 10 years may be common, while larger projects could be allowed up to 20 years to repay borrowed funds. As with interest rates, some GRFs have variable payback periods based on the project and borrowing agency. Funds reliant on bonds for seed funding often align their payback period with the maturation of the bond.[53]

Project Selection Criteria

Project selection criteria is based on the fund's specific mission and the scope of projects that it can afford to fund. Successful funds communicate clear selection criteria to potential applicants. Payback period, cost effectiveness against alternatives, and environmental impacts are often key selection criteria. States may include additional selection criteria, like health benefits or engagement of underrepresented minorities, while universities may include educational benefits as an additional criterion.

Tracking and Reporting

The premise of GRFs is that operational savings will accrue and allow the fund to be replenished through repayment of borrowed funds. Therefore, tracking these operational savings is an important part of program design. In general, there are two options for tracking savings: estimated savings or actual savings.[54] Estimated savings relies on a technical analysis of the amount of savings a proposed project will yield. This is a simple, inexpensive way of tracking savings, but it does not capture the variation of actual performance, whether better or worse than planned. In some cases, it may be useful to rely on a manufacturer's estimated savings as a guide, like in the case of a cogeneration turbine, which would likely require in-depth analysis about savings potential. Alternatively, savings may be tracked through actual performance against a historical baseline. This method results in a more accurate and data-rich repayment schedule, but it requires more time and investment to properly maintain. Complex modeling expertise or costly software may be required to accurately track actual performance in light of variables like weather, the volatile price of fossil fuels, and other key variables.

GREEN REVOLVING FUNDS CASE STUDIES

Case Study

Texas LoanSTAR Program

Summary

The Texas LoanSTAR (loans to Save Taxes and Resources) is one of the country's oldest and largest revolving loan funds for energy retrofits.[55] The program's aim is to support energy efficiency upgrades at public buildings including school districts, local governments, and hospitals in order to reduce utility energy costs. It is administered out of the Texas State Energy Conservation Office (SECO), which sits in the Comptroller's Office and also oversees a number of state energy projects. The program's strengths are quality control throughout the project's construction phase to ensure the measures are implemented as designed in their application, energy savings are being realized, loans are repaid, and the fund can support additional investments.

Background

The US Department of Energy (DOE) identified Texas LoanSTAR as a demonstration program for state energy efficiency investments in 1988.[56] The seed funding for the program was the Petroleum Violation Escrow Funds from the federal government, though the program's statute required it to become self-sustaining.[57] Today, the Petroleum Violation Escrow Funds and Federal Funds continue to support the fund, though funding is also generated through loan repayments.[58]

Since its inception, the fund has grown from its original seed funding of $98.6 million to currently holding a balance of approximately $126 million as of 2011.[59]

Originally, loans supported investments with a payback of 4 year or less. In 1995, the loan term was lengthened to 8 years and the DOE removed the "demonstration" label from the program name. Today, the loans allow for a 10 year payback and also cover water conservation investments.[60] When first founded, the fund operated out of the Governor's office, though was moved a number of years ago to the Comptroller's Office.[61] Administration of the loan requires a full time staff to oversee the fund, hours from additional staff to review and track projects, as well as a contracted engineering firm to review proposed energy projects and to conduct onsite inspections to ensure the project is completed as designed.[62]

Operations

SECO releases a Notice of Loan Fund Availability (NOLFA) twice a year for a competitive LoanSTAR application. Each NOLFA may have a different interest rate and loan size.[63] The interest rates partially cover administration costs of operating the fund. In the October 2015 NOLFA, the maximum loan size per applicant was $7.5 million, with a total budget of approximately $19 million. Five million of this budget was from ARRA funds and lend at an annual interest rate of 1% as they require additional loan requirement. The remaining $14 million lend at an interest rate of 2% per annum.[64]

Potential borrowers compile applications over 1.5 months, often with assistance from

partnering ESCOs (energy service companies).[65] These applications can include individual or a package of energy and/or utility cost saving measures. These measures must have a composite simple payback period of 10 years or less and no single measure can have a payback period longer than the measure's economic life.[66] A Professional Engineer must analyze all projects and the energy savings must cover the project cost, loan interest, and measurement and verification costs. In addition, the application must include an investment-grade audit to support the measures and energy savings.[67]

Once the application is submitted, an evaluation committee, including staff from the Comptroller's Office and SECO, will review them for eligibility and conduct interviews if necessary.[68] Applications are awarded additional points for projects in a county with less and 100,000 people, a commitment to share energy savings publically, the use of ENERGY STAR Portfolio Manager to track savings, and previous LoanSTAR submissions that were not funded due to lack of funding.[69]

Successful applicants and the SECO negotiate a loan agreement and, once executed, the borrower can begin designing the measures detailed in their application. The loan agreement will include the loan payment size, based on the energy cost savings identified by the audit and Professional Engineer in their application.[70] SECO is not responsible ensuring these savings are realized, and therefore the responsibility is on the borrower to ensure their design, construction, and maintenance results in the savings that were originally projected.

Loans are dispersed only when borrowers have submitted documentation of invoices to the borrower.[71] Once reviewed, the SECO will disperse the funds and begin charging interest. Borrowers begin repaying loans quarterly after project completion. If a borrower is late in their payment, interest continues to accrue and must be paid in the next scheduled payment.[72] Since the fund began in 1988, no borrowers have defaulted on their loan.[73]

During design and construction, SECO will conduct multiple reviews to ensure the project is implemented as stated in the original application. At project completion, the borrowers must submit a final report. In addition to construction documentation, this report verifies that operation and maintenance, and training requirements have been fulfilled.

Performance

Today, LoanSTAR is one of the largest state-run building conservation programs in the country. It has funded over 237 loans totaling over $395 million dollars.[74] These loans account for over $419 million dollars in energy savings and the projects have prevented over 3.7 million tons of CO2 from being released.[75] As of January 2015, SECO had 64 active loans of over $200 million. Of that, approximately $84 million has been repaid to SECO.[76] SECO states that the process and guidance they have developed for the loan program resulted in the actual energy savings being exceeded by over 20% of the projected savings. With this performance, agencies can repay their loans and retain some of their savings.[77]

Lessons Learned

The Texas LoanSTAR revolving fund's success is a result of quality control, loan structure, location of the fund within the State, and its ongoing flows of external funding.

Loan projects are thoroughly evaluated and verified during application, before loan disbursement, during construction, and after completion. The investment grade audits and historic utility bills help develop realistic projected energy savings to develop loan repayment amounts. Though a similar report does not exist for electric vehicles, reporting will help determine the fuel cost savings. This could include reporting on historic mileage, driving patterns, and expected vehicle uses to calculate the expected annual operating savings. Similar to LoanSTAR, an electric vehicle revolving fund could require submitting invoices and bid documentation before dispersing the loans. This may ensure the loan is going towards a high-quality vehicle at a competitive cost. Finally, LoanSTAR projects are rewarded for publically sharing actual energy costs after a project completion. This data can be used in a number of ways by governments to understand energy use and retrofit impacts. A similar system for electric vehicles can be used to verify fuel savings, improve saving projections, identify best performing vehicles or driving habits, and track successes and failure.

Another strength of the LoanSTAR program that can be applied to electric vehicles is its inclusion of audit, training, manuals, and construction costs within the loan. This recognizes the need of thoughtful pre- and post-project activities for a project's success. Agencies should identify these necessary activities for successful adoption of electric vehicles in public fleets and incorporate their costs into the loan amount. This may include supporting reporting technologies, charging stations, or outreach to employees to ensure these vehicles are driven enough to result in the expected operational savings.

As mentioned, the fund has never experienced a default from borrowers. Accurate projected savings and loan guidance contributes to this success, as well as the funds location in the Comptroller's Office of public accounts. The Comptroller has the ability to cut funding to public agencies. If a public borrower is late on payments, a letter from the Comptroller's office typically results in payments. This mechanism for enforcement, though not used, assists in ensuring regular payments from borrowers.[78]

Finally, though the LoanSTAR program is self-sustaining, it has used other sources of funding including the Petroleum Violation Escrow and ARRA, to support the growing number of projects funded. The fund was receiving PVE funding through 2006, though has not had additional funding since that year.[79] These additional funds likely ensure the program's very low interest rates and sizeable awards. An electric vehicle fund may also need to look to external sources if it supports a growing number of vehicle purchases. To gain funding, the fund will be greatly assisted if documentation, such as referred to earlier, can demonstrate the impacts and benefits of the loans.

Case Study

Oregon's Alternative Fuel Vehicle Revolving Program

Summary

The Alternative Fuel Vehicle Revolving Loan Fund (ZEVRLF) is a revolving loan fund managed by Oregon's Department of Energy for public agencies. The goal of the fund is to increase the procurement of ZEVs throughout the state, thereby reducing GHG emissions. In addition to public bodies, the loan is available to federally recognized tribes and private entities in two areas of the state, including school districts.[80] The fund was established in January 2015 and has not issues any loans to date.

Background

The Oregon State Legislature approved Senate Bill 583 (ORS 470.050) in 2013 in order to "accelerate the market transition to a more efficient, cleaner transportation system by the year 2020."[81] The bill enables the Oregon Department of Energy (ODOE) to facilitate funding and administer the loans. Initial funding for the program was generated from the sale of tax credits by the Oregon departments of Energy and Revenue. This effort raised $3 million. The program was officially launched in January 2015.[82]

The program is an extension of Oregon's existing revolving fund for energy efficiency, the State Energy Loan Program (SELP), also known as the Small-scale Energy Loan Program.[83] SELP has been in existence since the early 1980's. It has distributed more than 860 loans, totaling about $600 million, and has reduced enough electricity, natural gas, and oil to heat over 150,000 Oregon homes annually.[84] Based on this successful revolving loan fund for energy efficiency, the ODOE decided to launch a similar fund for promoting ZEVs in fleet procurement. The design of ZEVRLF is modeled after SELP, including loan terms and interest rates.[85] As of March 2016, no funding had been distributed for the purchase of ZEVs.

Operations

The ZEVRLF is managed by a Project Development Officer in ODOE who also manages SELP. The Project Development Officer facilitates the entire loan process, including the application process, technical review, and project inspection. Each project is considered on terms specific to that project, with the borrower's risk profile and loan demand being important considerations. The fund does not have a maximum loan amount, though no loan can exceed 30% of the total funds available.[86] The application is rolling; the Project Development Officer and ODOE process loan applications upon receipt.

As mentioned above, ODOE will negotiate the terms and interest rate based on a number of factors, including potential reduction in GHG emissions and cost savings for the applicants. The terms and rate proposed are designed to provide a continual source of funding to cover the administrative costs of the program. The loans must be fully amortized within 6 years.[87]

In order to be eligible for a loan, applicants must meet the following requirements, as stated in ODOE's opportunity announcement:

1. *Applicants for this announcement include a public body defined in ORS 174.109, one of Oregon's nine federally recognized tribes, or a private entity that operates a fleet of motor vehicles based in an area described in ORS 468A.390 or 815.300.*
2. *Applicants may use loan funds to:*
    a. *Purchase new alternative fuel vehicles and as a means to provide funding for the incremental cost of purchasing alternative fuel vehicles, which may exceed the cost of purchasing gasoline or diesel fueled vehicles,*
    b. *Convert or modify existing vehicles that use gasoline or diesel to alternative fuel vehicles,*
    c. *Offset cost of purchases and/or conversions made no more than 60 days prior to the department receiving the loan application.*
3. *Applicants must register and use these vehicles in Oregon.* [88]

Applicants for the loan must pay an application fee, which is calculated based on the following schedule: [89]

Loan Fee for Loan Amounts up to $100,000			
Application Amount up to	**Total Fee**	**Amount Due with Application**	**Balance Due at Loan Closing**
$25,000	$500	$100	$400
$50,000	$700	$125	$575
$75,000	$900	$150	$750
$100,000	$1,100	$200	$900

After an application is submitted, it must go through a review process based on the loan amount. Loans over $100,000 must go through a more in-depth project review. Upon receipt of the application, the Project Development Officer will determine whether the application is complete and whether the funding amount is available. Once the preliminary review is complete, the application moves to a technical review.

During the technical review, ODOE determines whether the project is technically and financially feasible.[90] Once the application has passed the review process and the project begins, ODOE may schedule an inspection to ensure that the project is operating as stated.

Challenges

- New program: the program is only about 15 months old. It is possible that agencies are not yet familiar with the program or that they have not had sufficient time to make vehicle procurement decisions and apply for funding.
- Public limitations: loans from one agency to another are based on an interagency agreement without legal backing. Paying back the loan is not strictly required by law.
- Limited private sector scope: loans for private entities are only available in 2 regions: Portland Vehicle Inspection Area and Medford-Ashland Air Quality Maintenance Area.[91]
- Messaging: this revolving fund is managed through another program (SELP) and lacks dedicated literature and messaging to outreach to borrowers. Interested borrowers may find it difficult to learn about the loan and navigate the two programs.

- Unclear loan parameters: the legislation on the fund is fairly broad,[92] sometimes creating a gray area for loan requirements and terms. For example, the loan covers the incremental price increase between a ZEV and conventional vehicle. Unlike a traditional loan which will use the vehicle as collateral, ODOE is loaning again only a portion of the vehicle.
- Lack of infrastructure: this program is limited to increasing the procurement of alternative fuel vehicles. It does not address the infrastructure (i.e. public charging stations) required to support an increase in ZEVs.

Recommendations for Fund Improvement
Based on the challenges of managing the ZEVRLF, ODOE should consider taking the following steps to improve the program:

1. Publish clear literature about the fund, differentiating it from SELP and explaining where the two programs overlap. The literature should include a scorecard which explains what criteria ODOE uses to judge applications from both public and private entities. Increase state agency outreach and outreach to private entities in regions where they can participate. This type of outreach should be applied to all GRFs as participation in the fund is critical for success.

2. Develop stronger loan term language. Though the ODOE may not be able to pursue traditional non-payment repercussions, the ODOE should explore other methods such as making SELP unavailable to borrowers who cannot repay ZEVRLF loans or posting non-payment publically. Relationships with budget offices could assist in this process as seen in the Texas LoanSTAR example. They can issue letters from the comptrollers to assist in payments.

3. Widen the private scope of applicants. Given that ODOE does not have loan applications, they should explore opening the loan program to private borrowers outside of the two current geographic areas. GRFs should not overextend their applicant pools; turning away too many borrowers could also negatively impact loan participation. However, in this case the application pool may not be large enough.

Case Study

Massachusetts Commonwealth Facility Fund for Energy Efficiency (CoFFEE)

Summary

The Commonwealth Facility Fund for Energy Efficiency (CoFFEE) is a revolving fund created by the Commonwealth of Massachusetts with the goal of funding small to medium sized energy and water efficiency projects in public buildings.[93] CoFFEE provides upfront funding for state agencies to implement efficiency projects. After loan repayment, agencies retain a portion of the cost savings achieved through efficiency projects, creating a financial incentive for agencies to participate. This innovative fund supports the state's overall climate goals.

Background

Established in 2007, the state's Leading by Example program promotes investment in energy efficiency programs and outlines goals for GHG reduction.[94] Financing for efficiency projects in Massachusetts has historically targeted larger scale projects, like cogeneration and renewable energy infrastructure. These larger projects have the potential to generate significant energy cost savings and are often funded through General Obligation bonds with longer terms for repayment (typically 10 to 30 years).

The Green Communities Act (GCA), enacted in 2008, includes provisions that increased energy efficiency investment and streamlined the procurement process for energy efficiency projects.[95] With the groundwork laid by the GCA, CoFFEE was established to close this financing gap for small-scale efficiency projects. Smaller buildings collectively make up 8.3 million square feet of the state government's building portfolio and 18% of the state government's total energy use.[96]

Operations

The fund was established in 2014 with $500,000 in seed money from a state energy trust.[97] To qualify for financing a project must have a total cost of less than $100,000 and a payback period of less than 5 years. The administrative fee for the program is 6% of the amount funded. This fee covers inflation and allows the fund to grow slightly over time.

The average cost of funded projects is less than $30,000 with a cap of $100,000; a limitation that allows projects to avoid a lengthy competitive procurement process required by the state for projects over $100,000.[98] This allows the fund to quickly implement projects once they have been approved for funding.

The repayment schedule begins one year after the start of the project in order for agencies to experience energy savings before the burden of repayment begins. Savings are measured against a pre-project baseline. As the agency's energy or water costs are reduced and savings from the project accrue, the CoFFEE fund is repaid. Typically 85% of savings from the project are transferred to CoFFEE with 15% remaining with the agency.[99]

The program also requires that energy savings generated by projects are independently sufficient to repay the

annual debt service of the loan. This requirement reduces the risk of nonpayment, improving the fund's long-term viability.

The fund is administered by a program manager, who also serves as a liaison among the various state agencies and stakeholders that support the fund's operations.[100] In addition to the program manager, the fund established a CoFFEE Project Management Office (PMO) with state employees representing key stakeholder areas, including facilities, environment, finance, and energy. The committee meets monthly for about two hours and supports the fund by evaluating applications and reviewing the program's operations.

To apply for funding, agencies must submit an application during an 8-week open enrollment period. The program manager is available to work with agencies on completing their applications and utilizes a checklist, as seen in *Table 1*, to assure that applications are complete. Applications are reviewed by the PMO and scored according to a selection criteria matrix (see *Table 2*).

Table 1 – Application Checklist

Criteria	Description
Champion	Applicant is or has identified an individual who will manage project operations and see project through to completion.
Project Economics	CoFFEE funding request is no more than $90,000 and estimated project payback is less than 5 years.
Available Baseline Energy Usage Data	Applicant has access to the required baseline/historical energy usage information
Existing Conditions and Savings Potential	Applicant exhibits full understanding of existing condition and provides description of efficiency improvement
Supporting Documentation	Applicant has supplied supporting documentation such as 3rd party audit, in-house cost and savings assessments or a utility incentive commitment.

Table 2 – Selection Criteria Scorecard

Criteria	Description	Weighting
Payback Period	Time it takes for energy/water cost savings to cover project cost	35%
1st year total Resource Benefit	Monetary value of expected annual kWh savings, therms, MMBtus, and reduction in water usage	20%
Confidence/ Timing	Project feasibility and likelihood of successful completion.	20%
Non-Energy Benefits	Reduced lifecycle costs, productivity benefits, community benefits, & improved aesthetics	15%
Educational Value & Innovation	Project Exposure, education benefits & innovative measures	10%

Once a project is approved, the funds are transferred to the agency to implement the project. An Interdepartmental Service Agreement is utilized to allow CoFFEE and the agency to transfer and receive money between them. Both parties also sign a Memorandum of Understanding that outlines key project financials, including costs, incentives, repayment plans, administrative fees, key dates, and relevant project facts.[101]

The program manager conducts site visits during implementation and after the project is complete. In addition, quarterly progress reports must be submitted by funded agencies.

Performance

The program has met its initial goal of establishing a sustainable, affordable funding source for small-scale energy and water efficiency projects. In addition, there has been strong participation in the fund through its first two funding periods. In the program's first funding period four projects were funded to a total of $244,433.[102] These projects are projected to save $95,526 annually. Also, GHG emissions are projected to be reduced by 369 metric tons, and the state will reduce energy consumption by 587,612 kilowatt hours and 16,389 therms of natural gas. In its second funding period, in late 2015, 14 projects were funded and $568,000 was requested.

Lessons Learned

CoFFEE was developed with consultation and advice from several outside parties that contributed to its success. A fellow from the Environmental Defense Fund Climate Corp program provided early support through business planning and financial modeling. During the program's early development, an outside consultant worked closely with the program manager providing research and program design advice. The consultant also assisted in the development of key program documents, including the project funding application, ensuring that the program and its documents were user-friendly. The program relied on a comparative analysis that looked at several successful programs in-depth, informing the program's application process, administrative rules, selection metrics, and financial model.[103] This thoughtful, professional approach to establishing CoFFEE is evident in the writing, research, and documentation available on the program's early design and contributed to the program's successful early rounds of funding.

The success of CoFFEE also supports the targeted approach of the program's focus on small-scale projects. This focus allows the fund to tailor its design to a specific constituency. It provides a limited financial range of $100,000 to allow for "fast-tracked" funding. Designing the fund around the existing budgetary requirements also assisted in its development.

The group designing CoFFEE struggled with the question of whether the program should charge an interest rate to borrowers. With advice from administrators of similar Green Revolving Funds in other states, the group decided against charging an interest rate in order to establish and maintain goodwill among state agencies applying for loans.[104] For similar reasons, the program does not utilize late penalties for tardy loan payments. Furthermore, repayment of CoFFEE loans is not dependent on project outcomes or performance.[105] The repayment schedule is agreed upon from

the outset of the project. This assigns project performance risk to the agency implementing the project, encouraging thoughtful project design from the beginning.

CoFFEE also highlights the importance of the fund administrator's role in advocating, marketing, and problem solving in support of the fund's success. The role was essential to the program's implementation and its ability to become institutionalized and popular among potential customers in state government. One of the key tasks of the fund manager in the early stages of fund development was to solicit feedback from key stakeholders. This early outreach effort allowed potential applicants to participate in program design and also served to promote the fund throughout state government. The program manager also serves as an unofficial advisor to potential applicants, which has improved the quality of proposed projects. By being available to potential applicants during the open application period, the program avoids receiving applications for projects that do not meet the program's criteria.[106]

In the program's early stages, the program manager was involved with project operations, like hiring vendors and sourcing key equipment and materials after projects were selected for funding.[107] This project management workload was eventually returned to the agencies and facilities implementing projects, resulting in a more efficient process and allowing the program to grow in scale without greatly increasing its administrative workload.

The CoFFEE program is currently working to resolve challenges associated with repayment and flow of funds. Specifically, the program is having difficulty carrying revenue from year to year and dispersing money repaid by one agency for funding projects at another agency. In order to address these problems, the fund must be designated as a permanent financing mechanism by the Massachusetts state legislature. This legislation is expected to be passed in early 2016.

Note: See Appendix 2 for details on the CoFFEE program's implementation plan.

Case Study

The City University of New York Energy Efficiency Revolving Loan Fund

Summary

The City University of New York (CUNY) created the Sustainable Investment Fund (SIF), a Green Revolving Fund, with a $1 million grant to finance energy efficiency and renewable energy projects in buildings across its various campuses. The fund was created specifically to implement energy efficiency projects that are not already financed through other capital funding sources.[108] The fund's success can be greatly attributed to its stakeholder engagement.

Background

In 2012, New York Governor Andrew Cuomo issued Executive Order 88, which initiated the BuildSmart NY program to accelerate energy efficiency efforts in state buildings. This program mandated that CUNY achieve a 22% reduction in energy use by 2020.[109] To meet this goal and to realize savings in energy costs, CUNY launched the CUNY Conserves project which gave its 13 senior colleges autonomous control of their energy budgets. CUNY's SIR funds energy efficiency projects throughout its system and ensures that savings are used to repay the borrowed funds and can be retained by the borrower thereafter. The SIR supports projects with a short-payback period of 5-years or less and specifically prefers projects that have a likelihood for rapid implementation.[110]

Operations

CUNY's Sustainability Council is an important part of the institution's overall sustainability and energy efficiency efforts.[111] Sustainability champions, facility directors, and other executive campus managers meet monthly to discuss opportunities, new projects, and sustainability concerns. In addition, when the SIF is ready to fund new projects, this group readily makes suggestions for potential projects. The council is also a part of the project selection process and provides evaluation and assessment of project proposals.

Once a project is selected, there is a financial review to ensure that the applicant has the financial means to repay the funds. The campuses typically contribute around 30% of the project's total cost, either through direct funds or indirectly by using in-house labor.[112]

CUNY's SIR program does not charge a fee for administration. The entire amount of the fund is distributed at each funding cycle, and each subsequent round of funding is dependent upon the repayment of the previous round. Most borrowed funds are repaid within 3 years, though these terms are flexible. Project spending and deliverables are monitored quarterly by the SIF staff. CUNY campuses can track their impact through ENERGY STAR's Portfolio Manager, the NYC Carbon Challenge's tracking tool, or tools developed by the CUNY campuses.

In the unlikely event that a borrower is not able to repay the loan within the contract terms, the executive director of CUNY will collaborate with the financial administrator for that campus to resolve the remaining

payments. As loans are kept within the university system among campuses with working relationships, there is high confidence that non-payment will not be a significant issue.

Performance

There have been two successful rounds of funding. During the second round, over $376,000 was awarded to five campus projects, which included lighting improvements, steam trap replacements, and improved insulation.

In 2016, the SIF received a $250,000 grant from New York Power Authority,[113] bringing its total funds available to about $600,000. The third round of funding will be open for submissions in spring 2016.

Lessons Learned

The SIF's early success is, in part, a result of the strong relationships and open communication among the campus leaders. The Sustainability Council provides a venue for cross-campus communication about the fund and its projects. These relationships and the open communication channels allow the fund to be highly flexible, rather than prescriptive when deciding loan terms and payback schedules. New terms and loan structures can be messaged through the committee to the necessary individuals at each of the campuses. In the same way, open communication and strong relationships allow the funds irregular funding schedule to function effectively, avoiding the potential for disinterest in the fund because of its less predictable application period. The Sustainability Council provides clear messaging and a venue for broad dissemination of important information about the fund.

Another effective strategy led by the council has been the clustering of similar project types, such as lighting or steam repair, for each application round. This allows for projects to act as a cohort and exchange best practices throughout the process. In addition, this clustering provides an opportunity for studying the specific project types across several different implementations.

The fund was not without challenges in its early formation. Seed funding was particularly challenging without a dedicated administrator to advocate for funding and support. Given this challenge, it is recommended that new funds hire an administrator early in the process in order to provide development support.

Case Study

Harvard University's Green Loan Fund

This case study summarizes "Harvard University: Green Loan Fund" by Robert Foley, Senior Research Fellow at Sustainable Endowments Institute, as part of the "Green Revolving Funds In Action: Case Study Series."

Summary

The Green Loan Fund (GLF) at Harvard University was established as an energy efficiency and waste reduction project in 2001. Today, the GLF is a $12 million self-replenishing tool and has been a source of capital for projects that generate operational cost savings and reduce environmental impacts across Harvard's campus and schools.[114] The fund's success can be attributed to its fund committee, strong tracking and reporting capabilities, and loan terms tailored to particular types of projects.

Background

The Resource Conservation Incentive Program (RCIP) was the first green revolving fund formed at Harvard University as a pilot project in the 1990's. It began with a $1.5 million loan from the university president's discretionary budget.[115] The fund initially experienced great success, financing 35 projects and demonstrating the ability to improve environmental performance while producing a high annual return on investment. However, in 1998 the fund was disbanded due to low utilization.[116]

Driven by student, administrative, and faculty feedback, the university created a formal sustainability office in 2001 to support green initiatives including developing a new green loan fund from $3 million in seed funding, which, again came from the administration's discretionary budget.[117] Though the fund is self-sustaining, its incredible growth over the years is due primarily to several rounds of new capital.[118]

Operations

The Green Loan Fund Review Committee resides in Harvard's Office for Sustainability (OFS) and reviews projects and assists with program development. The committee includes individuals with expertise in facilities, energy auditing, and finance, and includes representatives from many of Harvard's academic departments.[119] This committee communicates information about the fund to schools and departments throughout the campus. The committee also provides support and feedback during project selection.

The fund's administration is supported by a 3% fee applied to every loan's principle. This fee was introduced in 2007 to cover administration of the fund and business consulting services for projects.[120]

The key selection criteria for projects are cost savings potential and the ability to track and report outcomes. The fund also requires an engineering review for some of the projects to supports the projected savings.[121] Once a project is approved, the department or school must pay the upfront project costs which the fund will reimburse after the project is completed.[122]

The GLF loans have the following requirements.

- Loans are limited to $500,000;
- Projects must use utility rebates when available;
- Loans include a 3% administrative fee;
- Projects must result in a cost reductions and environmental improvements;
- Loans cover the full cost of a project with a simple payback period of five years or less;

OR

- Loans cover an incremental project cost with an internal rate of return of 9% or higher;

OR

- Loans cover a renewable energy project, though the loan must be repaid in five years.[123]

Loans can support a range of projects including energy efficiency, water improvements, renewable energy investments, and community education initiatives. Funding is available on a "first-come, first serve basis." [124]

Performance

Harvard University's GLF program is widely considered to be successful. The fund has supported nearly 200 projects producing over $4.8 million in cost savings annually and has greatly reduced the university's environmental footprint.[125]

In addition to receiving several rounds of new capital, the fund has grown by encouraging loan applicants to leverage grants, utility incentives, and other funding to complement GLF funding.[126]

Lessons Learned

The GLF has been an effective method for reducing environmental impacts while providing cost savings across Harvard University's campus and facilities. In recent years, GRFs have become increasingly popular on campuses in the United States. This fund has served as a model as other institutions consider starting similar programs.[127]

Some key lessons that can be applied to other funds include:

1. A strong, multi-stakeholder committee

The GLF's committee includes representatives from a number of relevant fields, including energy auditing and finance. It also includes representatives from academic departments and schools across the campus. This participation is critical for developing a fund that best meets the environmental needs of the school and that provides the expertise to select successful projects. The committee also acts as an outreach tool to engage individuals across the school. This ensures that the fund supports a variety of diverse projects from year to year.

2. Strong tracking and reporting mechanisms

The fund requires documentation on projected savings and rewards projects with a strong tracking mechanism. This tracking improves the likelihood that projected savings are met since applicants know that they will be held accountable for their projections. This robust tracking and reporting system may also have contributed to the fund's additional funding over the years as this mechanism demonstrates and measures the fund's impact.

3. Clearly outlined, varied loan terms

One of the strengths of this fund is that it supports a diversity of projects ranging from waste collection initiatives to improvements in maintenance to renewable energy installations. These types of projects have different payback periods and financial metrics. Strict, inflexible loan terms would not support such a diverse project portfolio. Recognizing the need for different loan types, fund administrators have developed several different loan types that applicants may apply to receive. These loan types include loans for full project costs, incremental costs, and renewable energy investments, which require a tailored approach in project and loan design. These varied loan terms could result in confusion for potential applicants, but fund administrators work to clearly communicate the terms and purpose for each type of loan. The fund's committee provides support for applicants navigating these various options.

KEY FINDINGS FROM CASE STUDIES

Key Findings:

Seed Money

Many successful funds have relied on state and federal operating budgets to provide seed funding. This is a logical source for seed funding since successful projects will reduce operating expenses over time[128]. However, capital from environmental penalties, federal funds, or other sources may be more readily available for seeding GRFs.

A key consideration for seed funding is whether to explore the fund's feasibility by "starting small" and then increase funding once the program's initial projects have proven effective. Starting with a smaller amount provides a chance to experiment with the fund with little capital at risk and could provide a proof of concept opportunity before scaling up to a larger fund. For example, Harvard University's Harvard Green Campus Initiative was started with a $3 million investment in 2001 at the direction of the president's office through funds in the central administration budget.[129] This decision to utilize the administrative operating budget was motivated by the importance of institutionalizing sustainability and energy efficiency efforts. This signal of support from a high level helped lead to the program's overall success. As a result, the fund was infused with additional funds twice in the following years. In 2004 the fund was enlarged to $6 million and, again, in 2006 the fund was enlarged to $12 million.[130]

Alternatively, significant initial funding also demonstrates institutional support for the fund and allows the fund to take advantage of economy of scale efficiencies to cover administrative overhead. Larger funds can also sustain early failures of some projects without undermining the legitimacy of the overall program.

The Texas LoanSTAR program benefited from considerable initial funding from the Petroleum Violation Escrow Funds from federal penalties. This early largess allows fund administrators to set ambitious goals and fund larger projects. The fund's long record of success has made it a popular option for funding sustainability and efficiency projects as new funding becomes available. When ARRA funds became available in 2009, Texas used a portion of the funds to increase the LoanSTAR fund, which offered a safe, established mission-based investment. While other states were tasked with creating new programs to support their sustainability goals, Texas has a reliable mechanism for funding and executing these projects.

Key Findings:

Project Selection

In considering which projects to fund, many funds form a selection committee, which is guided by the particular purpose or mission of the fund. While some basic considerations, like the risk profile of the borrower, are applicable in all cases, some programs evaluate projects based on a more nuanced list of criteria. In addition to GHG emissions and energy efficiency,

programs take into consideration specific stakeholder communities or cross-benefits like job creation or health impacts.

In the case of Massachusetts's CoFFEE program, the fund is focused on small to midsize resource efficiency projects. This focus informs the program's overall design, including its selection criteria, which is based on a specific list of criteria each of which are allocated a specific weighting. By distributing these criteria to potential borrowers, the CoFFEE program increases the likelihood that projects submitted for consideration will be appropriately designed to meet these standards. The CoFFEE program also utilizes a multi-stakeholder committee to make project selections, a process that protects against nepotism and accusations of favoritism.

The Texas LoanSTAR program also utilizes a committee to make project selections. The Texas program employs a multi-stage review process that occurs prior to project selection and throughout the life of the project. During the project selection stage, each project is closely examined by a committee member who analyzes the project according to clear guidelines. This close examination is necessary since each project has different parameters. As a result of this practice, projects receive expert guidance from an early stage, increasing the project's chance of success.

Harvard and CUNY have also found success in a multidisciplinary committee or council to support the fund's project selection process.

Finally, project selection can be aided by a clear and simple application process, which should allow for meaningful comparison among projects competing for funding.

Key Findings:

Fund Management & Mechanics

Fund management and financial mechanics are determined largely by program priorities, the fund's founding institution, and the fund's administrators. Strong, collaborative leadership was a consistent theme in the most successful funds. This leadership is important for guiding the project selection process, which often requires diplomacy among multiple stakeholders, and the ability to do outreach and encourage participation in the fund.

Funds may be managed by a group of administrators or by a committee made up of professionals, administrators, citizens, and other stakeholders. For example, Massachusetts's CoFFEE program has a dedicated fund administrator who works directly with a committee of stakeholders to make decisions about project selection.[131] This hybrid management model takes advantage of the broad expertise within state government and establishes regular stakeholder participation, while also centralizing day-to-day management in a single position, avoiding bureaucratic delays.

The CoFFEE program is also noteworthy for its administrator's outreach role, which includes the creation of fund literature for potential participants. A unique strength of the CoFFEE program is the early-stage outreach performed by the fund

administrator, who also guides potential projects through the application process. In the case of Oregon's AFVRLF program, a lack of outreach and clear literature about the program has prevented the fund from distributing any funding since its inception in January 2015.

Another feature of successful funds is that administering agencies wrote clear contracts for loan terms and payback expectations. Issuing clear, transparent expectations in interagency MOUs ensures that agencies are not surprised by their responsibilities for fund repayment. This task is particularly challenging for government organizations because in many instances the administering agency relies on some form of legislation in order to issue an MOU that obligates agencies to adhere to specific repayment schedules. The CoFFEE program's fund administrator described his preference for this type of legislation in order to designate the program's GRF as a permanent financing mechanism and make fund repayment obligatory. This legislation may also resolve the challenge of allowing agencies to retain operational savings.

Finally, most successful funds utilized either a fee or an interest rate to cover the administrative costs of the fund. Whether a fee or an interest rate is selected, it is important that this mechanism remain flexible and adjustable so that the collection of the fee or interest rate does not interfere with the fund's mission. The Texas LoanSTAR program sets a variable interest rate to accommodate the funding of a highly diverse project portfolio that demonstrates the program's mission and priorities.

Key Findings:

Reporting and Tracking

Reporting and tracking fund performance is essential for funds to demonstrate their success and appropriately manage funds over time. Expectations and processes for reporting and tracking information about fleet performance and costs should be described clearly in the fund's MOUs with participating agencies or schools. Also, a well-developed tracking and reporting program ensures that funds are being spent appropriately and protects against potential misuse of funds. CUNY's SIF program requires regular reporting to fund administrators. Weekly progress reports are expected at facility meetings, and written quarterly reports are required.[132] In some cases, project deliverables and timelines may be established in the MOUs with specific milestone achievements outlined.

In addition to clear reporting expectations, using a singular tracking tool is recommended so that data and information collected is standardized across all projects. The Texas LoanStar program requires that all projects are tracked in a shared software system, the ENERGY STAR Portfolio Manager. [133] This centralized tracking system allows fund managers to closely monitor its many projects and easily report on specific projects and the program's overall success.

Description of GRF Model

Introduction of Model

A financial model was developed to explore the feasibility of the proposed GRF for the DEC. The model relies on a set of assumptions and can be used to explore how the GRF will perform under different scenarios.

The GRF provides capital for state agencies to increase the number of ZEVs in their fleets by funding the difference in price between a traditional vehicle and a ZEV. The purpose of this arrangement is to encourage agencies to purchase ZEVs without incurring the burden of increased capital costs. The financial model provides a quantitative analysis of scenarios in which this desired outcome is likely.

How the Fund Works

At the beginning of each fiscal year, participating agencies would submit an application requesting a lump sum that sufficiently covers the incremental costs of purchasing ZEVs instead of traditional vehicles. On a monthly basis, the agencies would use a portion of their monthly estimated operational savings from reduced fuel costs and maintenance to repay a portion of the borrowed funds. This monthly payment will be made over a specified period until the borrowed amount is fully repaid. An eight-year payback period is suggested as it reflects the average life of a fleet vehicle.[134]

As the borrowed funds are repaid, the money would then become available to other agencies for the purchase of ZEVs. This consistent replenishing of the fund is what makes it "revolve."

Interest Rates and Fees

Interest rates or administrative fees are likely necessary for the fund's success and may also be applied as drivers of strategic change. The financial model suggests that either an interest rate or fixed fee should be applied to the principal in order to provide incremental growth for the fund, hedge against inflation, and cover the administrative costs of the program.

An interest rate of 2.5% is suggested for funds used to purchase all EVs, which have a lower capital cost than PHEVs and can therefore absorb the additional costs of an interest rate. PHEV purchases can include a flat fee of 2% on the principal and continue to provide operational savings to agencies, especially if the cost of gasoline increases and expected annual mileage increases. For example, if an agency purchases PHEVs and the price of gasoline is $3/gallon and the annual mileage per vehicle is 17,500 miles, then, the agencies will be able to take on an additional 2% flat fee and still maintain some operational savings.

This arrangement ensures that all funds distributed will return a premium to the fund as repayments are made. The payback burden is weighted toward EV purchases, as the operational savings realized have the capacity to cover larger fees, while agencies could still maintain a healthy portion of the net savings.

Key Model Inputs

Vehicle model types and capital costs were approximated from an analysis of a full year of returned mini-bids in the NYS Vehicle Marketplace, the platform used by state agencies to procure new vehicles. Model types were selected based on those most frequently requested in mini-bids for vehicles in the three categories used in the financial model (EV, PHEV, and ICE). There were no returned mini-bids for EVs found in the Vehicle Marketplace, so a price was obtained directly from the DEC for the Nissan Leaf S, which some state agencies have already procured. The purchase price used for the other two vehicles was determined from an average of returned mini-bid prices for each model type. The model uses an annual mileage of 12,400. This is the default annual mileage from the Alternative Fuel Life-Cycle Environmental and Economic Transportation ("AFLEET") Tool, which is used to compute operational savings. In order to calculate maintenance and fuel cost for each vehicle type the model relies on the AFLEET Tool developed by Argonne National Laboratory. A feature of the AFLEET Tool provides total fuel and maintenance cost variance between ZEVs and ICEs.[135] *Table 3*, below, provides details on model inputs.

Table 3 – Financial Model Inputs

Inputs	Detail	Purchase Price
EV	Nissan Leaf – S	$23,000[136]
PHEV	Chevy Volt – LT	$29,300
ICE	Chevy Impala	$21,000
Annual mileage	AFLEET default[137]	12,400 miles
Fuel Price[138]	6-month average (NYSERDA)	$2.29 per gallon
Electricity	AFLEET 2015 price	$0.11 per kWh
EV MPG[139]	Nissanusa.com	84
PHEV MPG	GRIT	42
ICE MPG[140]	DEC Data	22.6
Capital Seed Funds	Initial amount of funding for the GRF	900,000
Fee	1 time - paid back through the term of the fund	0.00%
Interest (PHEV)	Compounded annually	2.50%
Admin cost	Program monitoring and management	100,000

Outputs and Application in Model

Based on the inputs described above, the AFLEET tool computes the operational costs required for each vehicle type. Maintenance costs are computed based on the estimated annual mileage. Fuel costs are calculated based on fuel and electricity price, miles driven, and fuel economy. These results were applied to the financial model to compute the net operational savings between each of the ZEVs compared to the traditional ICEs.

Table 4, below, shows the capital price variance and operational cost per vehicle based on calculations from the AFLEET tool, as well as the net cost or savings for each vehicle comparison.

Table 4 – Financial Model and AFLEET Outputs

Vehicle type	Model	Purchase price ($)	Fuel cost ($/yr)	Maintenance cost ($/yr)
EV	Nissan Leaf - S	23,000	779	2,191
PHEV	Chevy Volt - LT	29,300	985	2,361
ICE	Chevy Impala	21,000	1,382	2,406
Net cost/(saving) comparison				
ICE vs EV		2,000	(1,544)	(296)
ICE vs PHEV		8,300	(1,338)	(126)

Note: This table uses the average bid price of a Chevrolet Impala from the New York State automobile bid records between September 2015 and March 2016 as a baseline for internal combustion engine vehicles since this vehicle makes up the largest portion of the DEC's current fleet.

Agency Procurement Scenarios

As agencies begin their efforts to comply with mandates to purchase more ZEVs, agency administrators will weigh the costs and benefits of purchasing various vehicles. On the following page, *Table 5* shows the outcomes for various scenarios for three agencies if they were to participate in the GRF program. Based on these hypothetical procurement scenarios, the table compares purchase options for the procurement of 3, 20, and 24 vehicles in the first year of the program.

By computing the annual vehicle savings per unit (annual operational savings – annual interest/fee + principal payment) for each scenario, it is clear that purchasing EVs would yield the greatest savings for each agency. Interestingly, based on the current gasoline price ($2.29), annual mileage (12,400 miles), and payback period of 8 years, a purchase of PHEVs, like the Chevrolet Volt, would cause an operational loss for the agencies. This is a result of the assumption of lower annual mileage and a low gasoline price, which results in lower operational savings. In addition, the amount of time required for full payback erodes the agency's potential operational savings.

Keeping all else equal, by assuming a future gas price of $3/gallon the model suggests that agencies would experience a net zero impact on operational costs. Also, if annual mileage is adjusted to 17,500 miles then the model suggests that agencies would experience a net zero impact on operational costs. However, both cases assume that no premium is added to the payback (e.g. no interests or flat fees are applied). See *Table 5,* below, for details.

Best Case Scenario

Based on the default scenario, altering the payback period for EVs by reducing it from 8 years to 4.5 years would result in the fund receiving an annual payment of $496.68/vehicle. In this scenario, the annual percentage of payment has increased, but the agency is still able to retain 46% of its operational savings. This would allow the fund to support 1,665 EVs by 2025.

Table 6 provides details on various outcomes depending on the number of vehicles purchased by individual agencies.

Table 5 – Agency Scenario Savings Outcomes

Default scenario - Based on 12,400 annual mileage, $2.29/gallon, 8 year payback, 2.5% interest for EV and no interest/fee for PHEV

Annual Savings Retained by Agencies	Unit savings / (loss)	Agency 1 3 Vehicles	Agency 2 20 Vehicles	Agency 3 24 Vehicles
Only EV purchases	$609	$1,827	$12,180	$14,616
Only PHEV purchases	($301)	($903)	($6,020)	($7,224)

Increased mileage scenario - Based on 17,500 annual mileage, $2.29/gallon, 8 year payback, 2.5% interest for EV and no interest/fee for PHEV

Annual Savings Retained by Agencies	Unit savings / (loss)	Agency 1 3 Vehicles	Agency 2 20 Vehicles	Agency 3 24 Vehicles
Only EV purchases	$985	$2,955	$19,700	$23,640
Only PHEV purchases	$3	$9	$60	$72

Increased gas scenario - Based on 12,400 annual mileage, $3/gallon, 8 year payback, 2.5% interest for EV and no interest/fee for PHEV

Annual Savings Retained by Agencies	Unit savings / (loss)	Agency 1 3 Vehicles	Agency 2 20 Vehicles	Agency 3 24 Vehicles
Only EV purchases	$999	$2,997	$19,980	$23,976
Only PHEV purchases	$0.09	$0.27	$1.80	$2.16

Table 6 – Agency Scenario Financial Outcomes

Best Case Scenario	Annual Payment Per Vehicle	Annual Payment as % of Principal	Annual Savings Retained by Agencies (3 vehicles)	Annual Savings Retained by Agencies (20 vehicles)	Annual Savings Retained by Agencies (24 vehicles)
Only EV purchases	$496.68	25%	$1,490	$9,934	$11,920

The Fund Over Time

To estimate the maximum number vehicles that can be purchased using the fund, a fixed annual administrative expense of $100,000 was assumed to cover salary and overhead of the analyst who will administer the fund, as well as expenses associated with the application process and other operational procedures. This administrative expense will need to be taken out of the fund annually.

Based on these assumptions about administrative costs, the total capital available for ZEV purchases was computed using the following formula:

Year 1

[(Annual principal + interest or fee payments from agencies) – $0.1M] = Net revolving fund;
Net revolving fund/Principal amount per vehicle = number of ZEVs that can be purchased for year 2

Year 2

[∑ Year 1 though n, n=year 2 (Principal + interest or fee) + unused balance from the fund in year 1 – $0.1M] = Net revolving fund; Net revolving fund/Principal amount per unit = number of ZEVs that can be purchased for year 3

Based on discussions with the DEC, the total initial seed capital currently identified for the GRF is $1M. Thus, the total available for funding projects is $0.9M after deducting administrative expenses for the first year. Based on the formula above, the $0.9M of initial funding will be able to fund between 156 and 705 ZEVs by 2025, depending on the mix of PHEVs and EVs purchased. In comparison, if the same $0.9M were to be used as a one-time grant, the funding would be able to support between 108 and 450 ZEV purchases.

Is Parity on the Horizon?

A report from January 2016 by McKinsey & Company suggests that stricter emission regulations, lower battery costs, widely available charging stations, and increasing consumer acceptance will create significant momentum for penetration of electrified vehicles in the coming years.[164]

The EV market has seen steady growth over the past five years, but has not yet reached parity with traditional vehicles for two main reasons: high cost and low range. However, recent advances in EV technology have encouraged a stronger outlook on rapid deployment within the decade.[165] For example, sharp reductions in battery costs present a potentially significant decline in the total cost of ownership of EVs.

During the economic downturn in 2008, a number of vehicle manufacturers announced commitments to electrification programs as a strategy for recovery and reinvention.[166] As cities and governments joined the movement in support of emission reduction policies, there were significant efforts made to reduce barriers to wider EV deployment.[167] Also, federal and state policymakers in the United States have recently adopted a variety of policy incentives and regulations to induce drivers to purchase EVs and reduce negative externalities associated with the transportation sector, like GHG emissions and air pollutants.[168]

Electric vehicle demand has grown rapidly worldwide, with an almost doubling of plug-in electric vehicles sold from 400,000 in 2013 to more than 700,000 in 2014.[169] The United States led the way in 2015 with an explosive growth rate of 69% from the previous year, bringing the national total to 290,000 EV units. This means that roughly 1 in 3 EVs are driven on American roads.[170] A study published in February 2016 by *Bloomberg New Energy Finance* forecasts that sales of electric vehicles will hit 41 million by 2040, representing 35% of new light-duty vehicle sales.[171]

Financial Sensitivity Analysis

The fluctuation of fuel prices and annual mileage could have significant consequences to the fund and its ability to revolve as cost savings are generated from lower maintenance costs and fuel savings associated with ZEVs. In order to fully understand the fund's overall feasibility and potential risks sensitivity tests for fuel price and annual mileage were conducted.

For the sensitivity analysis of variant gasoline prices, annual mileage was set at the default 12,400. The fuel price range was set between $1/gallon and $4/gallon based on the ten-year historical low price of $0.949/gallon (February 1999) and the ten-year historical high price of $4.165/gallon (July 2008).[141] Net savings of different vehicle types over variant gasoline prices are shown in *Figure 1*.

EVs could have positive saving when the gasoline price is higher than $1.18/gallon. However, PHEVs could only have positive saving with gasoline prices are higher than $3/gallon, slightly higher than current price of $2.29/gallon (May 2016).

For the sensitivity analysis of variant mileage, the fuel price was set at the current price and the range of annual mileage was set from 12,400 to 20,000. Net savings for this analysis by vehicle type are shown in *Figure 2*. In this study, EVs yield positive savings while PHEVs yield positive savings if the annual mileage is over 17,500.

Though fuel prices are difficult to forecast, the EIA projects that forecast prices will remain low, around $2/gallon, through 2017.[142] If agencies drive around 4,000 miles and fuel prices do not drop below $1.18/gallon EVs could bring positive savings to state agencies under most scenarios. PHEVs would be recommended should fuel prices and annual mileage increase significantly.

Figure 1: Sensitivity Analysis by Vehicle Type with Variant Fuel Price

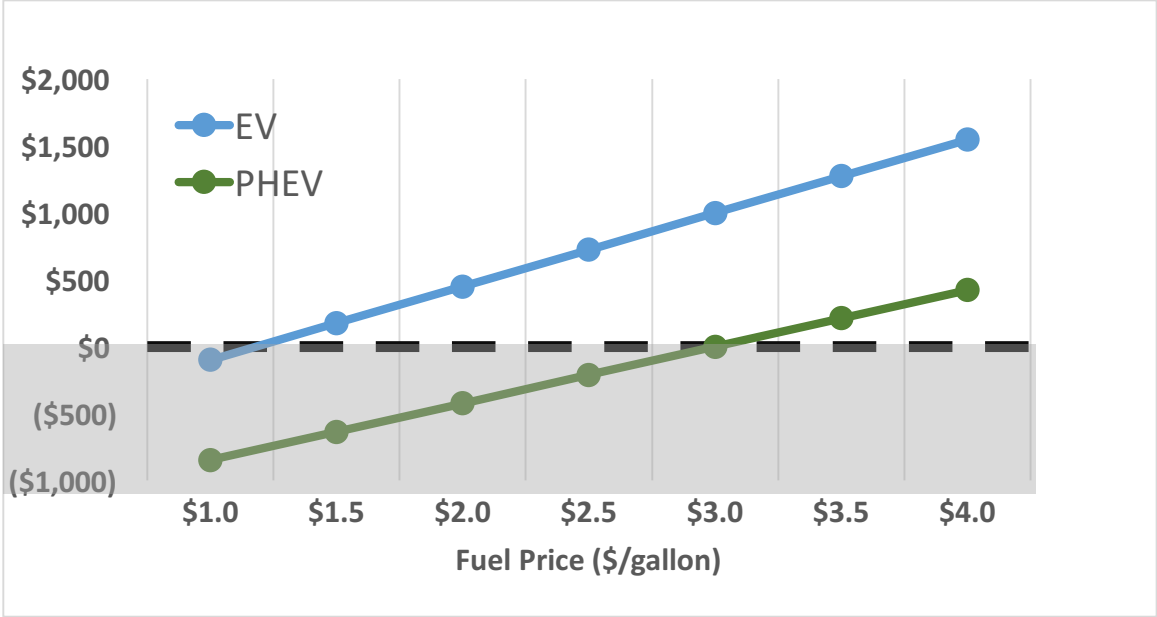
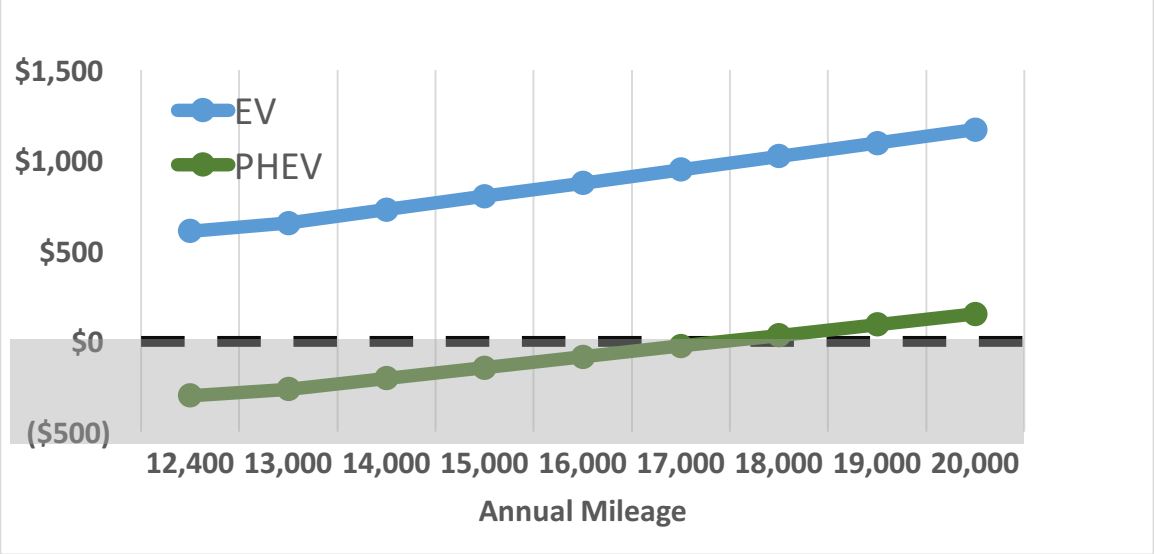


Figure 2: Sensitivity Analysis by Vehicle Type with Variant Annual Mileage



Price Point: EVs versus ICEs

The average ICE car costs $31,000. In order for EVs to reach parity with ICE vehicles, EVs must be priced in the same range for mass-market adoption. Although it's difficult to predict the market, we do know that Tesla, Nissan, and Chevrolet plan to start selling long-range electric cars in the $30,000 range. Tesla announced that their Model 3 will cost $35,000 before credits and will offer a range of about 200-miles. The 2016 Nissan Leaf is priced as low as $29,010 with a 107-mile range. Chevrolet announced in February 2016 that the Chevrolet Bolt (not to be confused with the Volt) will be available for purchase by the end of the year with a 200 mile range and a price point as low as $30,000.

It's important to note that public entities are not eligible for state and Federal tax incentives. Even with no additional state incentives, private sector consumers are allowed tax credits ranging from $2,500 to $7,500 under the Federal Plug-in Electric Drive Vehicle Credit.[173] This disparity between private and public markets means that public fleet procurement managers may need to wait until the price of ZEVs comes down before mass adoption can be achieved.

Regardless of a potential delay in parity for public sector markets, industry analysts including Bloomberg New Energy Finance and Goldman Sachs foresee parity on an unsubsidized basis by the mid-2020's.[174] These predictions even assume a low oil-price and greater fuel efficiency for traditional vehicles.[175] In addition, government investments in EV technology may contribute to further growth and wider adoption as countries face increasingly strict climate change regulations.

Subsidies and incentives effectively encourage EV industry growth in countries like China where pollution problems have led to large subsidies for the country's EV manufacturers.[176] Chinese market research firm CCM International estimated that China's production of power lithium-ion batteries would grow 400% by 2017 as global demand grows.[177] The United States Department of Energy is also contributing to global EV market penetration by working with industry, academia, and its national laboratories to achieve the aggressive goal of producing a battery that costs $125/kWh by 2022.[178]

Broader Impacts of GRF Model & Fleet Conversion

Prospects for GHG Reduction

Electricity Mix

The inputs for electricity generation in the AFLEET GHG model were tailored specifically for New York State using the most current available data from NYSERDA and EIA. These inputs assume that all vehicle charging will occur in New York. According to the EIA website, the current electricity generation mix consists of the following: nuclear (35%), natural gas (35%), hydro (23%), coal (1%), and other renewables like wind, solar, biomass (6%). For projection and modeling input purposes, these figures do not include imported electricity.

This report assumes EIA's growth rates for electricity generation over the next ten years. These NYSERDA forecasts are based on existing forecasts of electricity generation, demand, and consumption as of mid-2014, and do not account for anticipated policy changes. For context, New York's status quo projections (projections that are based on the continuation of existing rates of supply and demand) for 2030[143] present a scenario of nuclear (26%), natural gas (44%), hydro (17%), coal (5%), and other (7%). Nevertheless, New York's energy policy, "Reforming the Energy Vision" (REV) mandates that by 2030 50% of electricity generation must come from renewable energy sources.[144] If the state were to maximize the existing technical potential for renewable energy, NYSERDA presents a preliminary scenario of natural gas (30%), hydro (20%) and other renewables (50%).[145] This targeted shift to renewable energy sources for electricity generation would translate to significant reductions in the environmental impact of ZEVs over their lifecycle. Furthermore, eventually transitioning away from natural gas and relying completely on renewable energy sources poses the greatest GHG reduction benefits for ZEVs.

Methodology

Using the Argonne National Laboratory's (ANL) 2013 AFLEET model for Passenger Cars, GHG emissions were calculated. Wherever possible, data forecasts were updated in the AFLEET model using Energy Information Administration (EIA), EPA, and other federal and state government websites. Conversations with DEC provided data tailored to agency transportation norms, such as average annual mileage and vehicle lifespan. Inputs such as charging, road type, and vehicle load were not adjusted in the AFLEET model. The lifecycle GHG emissions in this report do not account for emissions from vehicle manufacturing, and are limited to downstream and upstream fuel cycle emissions, including transportation, fueling, and driving.

Vehicle Assumptions

The 2016 models of the Chevrolet Impala, Chevrolet Volt-LT, and Nissan Leaf-S were the vehicles selected for comparative analysis. Currently, the two most common administrative vehicles in the State fleet are the Honda Civic and Chevrolet Impala, based on recent data provided by DEC. Though there were more Honda Civics in the fleet, the Chevrolet Impala was selected as the baseline for the traditional vehicle and prioritized for replacement. As a midsize sedan, the Chevrolet Impala has lower fuel efficiency, higher maintenance costs, and higher GHG emissions than compact vehicles like the Honda Civic.

The Chevrolet Volt was selected for the PHEV. The Volt was selected for receiving the highest number of bids in the vehicle class on the state marketplace website. Lastly, the Nissan Leaf, an EV, was included for comparative purposes. Historically, EVs have lacked the necessary driving ranges to fit the business needs of most state agencies. However, NYSERDA and NYPA are collaborating on ChargeNY, an initiative to expand the State's charging infrastructure to further implement the Zero Emissions Vehicle Plan. State initiatives such as these, coupled with improving vehicle technology, will continue to erode EV range-anxiety.

Battery Assumptions

This report assumes that the lithium-ion batteries of the electric vehicles would not need to be replaced. As previously mentioned, vehicles were assigned an eight-year lifespan as part of the state fleet, which falls within manufacturer's stated battery life. The Nissan Leaf, for example, has an 8-year guarantee for the lithium-ion battery and a projected usable battery life of 10 years.[146] The guarantee and usable life prediction are based on consumer reports that suggest drivers will dispose of or replace batteries when they are at 70-80% of original energy storage capacity. However, a study by a team at the Lawrence Berkeley National Laboratory concludes that the effects of battery capacity degradation are more muted and that the batteries can continue to satisfy daily travel needs at as little as 30% of original battery capacity.[147]

Electricity Mix

The inputs for electricity generation in the AFLEET GHG model have been tailored specifically for New York State using the most current available data from NYSERDA and EIA. These inputs assume that all vehicle charging will be done in New York. According to the EIA website, the current electricity generation mix consists of the following: nuclear (35%), natural gas (35%), hydro (23%), coal (1%), and other renewables like wind, solar, biomass (6%). For projection and modeling input purposes, these figures do not include imported electricity.

This report assumes EIA's growth rates for electricity generation over the next ten years. For context, New York's status quo projections for 2030[148] present a scenario of nuclear (26%), natural gas (44%), hydro (17%), coal (5%), and other (7%). These NYSERDA forecasts are based on existing forecasts of electricity generation, demand, and consumption as of mid-2014, and do not account for anticipated policy changes. Nevertheless, New York's energy policy, "Reforming the Energy Vision" (REV) mandates that by 2030 50% of electricity generation must come from renewable energy sources.[149] If the state were to maximize the existing technical potential for renewable energy, NYSERDA presents a preliminary scenario of natural gas (30%), hydro (20%) and other renewables (50%).[150] This targeted shift to renewable energy sources for electricity generation would translate to significant reductions in the environmental impact of ZEVs over their lifecycle.

Public Health Impacts

In a broad sense, converting from traditional ICE vehicles to ZEVs will have a positive impact on human health. There is a close link between climate change and air quality, which directly affects human health. In 2009, EPA found that under the Clean Air Act that GHGs represent a public

health concern and could be regulated as such.[151]

The positive health effects of converting to ZEVs include a reduction in conventional air pollutants and resulting negative health effects, like cardiovascular issues, asthma, and other respiratory diseases.[152] These positive effects are dependent on a cleaner overall energy grid. The best outcomes occur when EVs are powered with electricity from natural gas, wind, water, or solar power. However, vehicles powered by corn ethanol and EVs powered by coal bring about poor results.[153]

The most significant improvement in public health effects from transportation would include an overall strategy to convert to EVs, improve access to public transportation, and increase the use of active transportation like walking and biking. In addition to improving air quality, such a comprehensive strategy would help reduce the negative health effects of obesity, diabetes, depression, and certain cancers.[154]

What about Grid Strain?

A report by the National Rural Electric Cooperative Association (NRECA) claims that if all vehicles in the United States were fueled by electricity, consumer energy spending would shift half a billion dollars daily from the petroleum industry to the electricity industry.[160] Bloomberg New Energy Finance estimates that by 2040, the growth of EVs will represent a quarter of the cars on the road, displacing 13 million barrels per day of crude oil but using 2,700 terawatt hours of electricity.[161] This would be equivalent to 11% of global electricity demand in 2015.[162]

The increased demand for electricity may be welcomed by utilities dealing with stagnated growth from energy efficiency technology but some are concerned with the strain this could put on the grid. With more customers charging their vehicles at home, a "cluster effect" could occur at the local grid level and overload the transformer.[163] One way to avoid utilities having to invest in expensive infrastructure to support this change is to optimize charging to occur during times of low energy demand.

Cultural Change: Shifting State Vehicle Fleets to Electric

In order for the proposed GRF to succeed, there must be an increase in demand for ZEVs among state agencies. Without this demand, the fund will not be used and agencies may not achieve their goals for cleaner fleets. The fund's success will also depend on maximizing the number of miles driven using ZEVs. If ZEVs are purchased but employees choose to drive conventional vehicles for work trips, agencies will not accumulate operational savings. This could result in missed payments or a reduced motivation to participate in the fund if agencies do not achieve expected savings.

Both of these challenges stem from a lack of confidence in ZEV technology and a preference for the predictable technology currently being used. One common concern about this new technology could be range anxiety, which is the anxiety that a driver experiences about not reaching his or her destination before the battery dies and/or concerns about access to charging stations. In some cases, this is a legitimate concern considering the lack of charging stations nationally. One way of managing this anxiety is to invest in a robust charging infrastructure strategy.

Also, implementing a GRF and increasing the number ZEVs will have budgetary consequences since increasing the number of ZEVs in a fleet will lower the operational costs of the agency's fleet. Compact sedans currently have an operational rate of $0.36/mile, while midsized utility vehicles have a rate of $0.39/mile to $0.40/mile.[155] An increase of vehicles with lower operational rates could drive the agency's average rate closer to $0.30/mile, thus reducing the overall operating budgets for fleet management. Ideally theses budget savings can be retained by the agency to be reinvested into programming which would further encourage fund participation.

RECOMMENDATIONS & CONCLUSIONS

Recommendations

Based on the findings from the financial model and lessons learned from case studies, a set of recommendations and a comprehensive strategy were prepared specifically for the DEC as the agency prepares to implement a GRF. These recommendations take into account the DEC's unique organizational structure, capacity for change, and stated targets for results.

1. Implement a Green Revolving Fund

The DEC should establish and implement a GRF to accelerate the transition to cleaner fleet vehicles for NYS agencies. Using the GRF model will allow the DEC to purchase more vehicles over time than if the fund were to be used to make a one-time purchase of vehicles. In addition to purchasing more vehicles, the GRF model provides the DEC with a platform for engagement with other NYS agencies. As the GRF model and its benefits are promoted among NYS agencies, the DEC will position itself as a resource-provider and collaborator among its peer agencies. Finally, the GRF model offers the DEC flexibility from year-to-year and can be adjusted based on changing priorities, like a focus on EV adoption, or changes in external factors, like the price of oil. As these challenges arise, the DEC can adjust several elements of the GRF model, including interest rates and payback terms. This flexibility ensures that the GRF model is continually relevant and meeting the needs of NYS agencies as they improve the efficiency and sustainability of their vehicle fleets.

2. Prioritize All-Electric Vehicles

All-electric vehicles, such as the Nissan Leaf, should be prioritized in the vehicle types eligible for funding from the GRF because they offer a range of benefits. When EVs are purchased at a lower price compared to PHEVs it translates to a lower incremental cost from an ICE and, therefore, a greater total number of vehicles can be purchased. With less money to repay, agencies can repay borrowed funds more quickly, allowing the fund to revolve more rapidly, leading to an even greater number of vehicle purchases over time. In addition, operational savings are greater for EVs, even when an interest rate is applied, whereas operational savings from PHEVs are dependent on gasoline prices and require greater miles travelled. Finally, because a greater number of EVs can be purchased to replace ICEs, pursuing EVs offers the greatest aggregate reduction in GHG emissions.

3. Seek Additional Funding

While it would be advantageous for the DEC to implement a GRF with the potential $1 million fund, this amount of seed funding will not be sufficient to meet the state's goal of converting 25% of light-duty non-emergency fleet purchases to ZEVs by 2025, if the payback period remains set at 8 years. This report's accompanying financial model indicates that the DEC will need $700,000 in additional funding to meet its goal through EV purchases. However, if the DEC reduces the payback period to 4.5 years for EVs, the goal can be reached without additional funding.

If PHEVs were purchased, current external factors indicate that the 8-year payback period is necessary, and an additional $4,600,000 in funding is required to meet

the goal. While it is ideal to secure additional funding prior to the GRF's implementation, infusing the funds at a later time would still improve the likelihood that the state could reach its goal of "25 by 25."

4. Employ Tracking & Reporting Mechanisms

As part of the GRF's initial design, the DEC should establish clear procedures for tracking and reporting fund metrics. These procedures should be outlined in the MOUs with participating agencies to ensure that clear expectations for how information will be tracked and reported are communicated and agreed upon. Establishing a clear plan for data collection will allow the DEC to accurately measure the performance of specific agency vehicle purchases and the success of the program generally. For example, by tracking miles traveled, maintenance costs, and fuel costs, the DEC can compare the performance of its ZEVs to the historical performance of its traditional fleet vehicles. In addition, a strong tracking and reporting system will allow fund administrators to accurately predict the outcomes of potential adjustments to the fund during review periods or as priorities change. Finally, a robust data collection protocol will allow the DEC to demonstrate and communicate the GRF's success, which could support requests for increased funding and expansion of the program.

5. Conduct Robust Outreach

The success of the DEC's GRF will greatly depend on the participation of other agencies. Therefore, it is vital that the DEC conduct robust outreach to other agencies and promote the fund's many benefits. This outreach should be developed and launched prior to the GRF's launch and become a sustained campaign after its launch. The key targets of this outreach campaign should include agency leaders, fleet managers, sustainability champions, procurement decision-makers, and staff charged with financing procurement requests. Outreach materials should emphasize the financial incentives for participating agencies and describe how the fund will accelerate the transition to cleaner fleets and achieving Governor Cuomo's "25 by 25" goal.

6. Create Clear Agreements

By creating a program that lends funds to peer agencies and anticipates savings for those agencies, the DEC exposes itself to the potential for conflict if agencies are unable or unwilling to repay the borrowed funds or if savings are not as significant as anticipated. In order to reduce its exposure to these potential conflicts, it is important that the program's MOUs clearly outline funding terms, incentives, and expectations for repayment. For example, the MOUs should clearly state that participating in the fund does not guarantee savings and that timely repayment is expected regardless of actual savings. The agreements should also emphasize that savings projections and repayment schedules are based on expected vehicle usage, savings from reduced fuel and maintenance costs, and the price of fuel based on the model's assumptions. Therefore, participating agencies should be informed through the MOU that their adherence to these expectations will affect the success or failure of their specific vehicle purchases. Finally, it is recommended that in the unlikely case that participating agencies do not repay borrowed funds or do not comply with essential reporting expectations that

these agencies are barred from future participation in the fund.

Conclusion

This project represents an opportunity for the DEC to demonstrate ambition and leadership in pursuing cleaner, more sustainable transportation options. By utilizing an innovative financial instrument to accelerate the state's conversion to cleaner fleets, the DEC is also providing a proof-of-concept example that can be applied in other scenarios where funding is limited and expectations are high. In addition, the flexibility of the GRF model presents an opportunity for the DEC to remain on the forefront of funding the procurement of cleaner vehicles with a dedicated focus on increasing EV adoption.

Considering that the transportation sector is one of the most significant emitters of GHGs in New York State, the DEC's decision to prioritize conversion to cleaner public fleets is in line with its broader mission of protecting New York's natural resources. In addition, New Yorkers have witnessed the devastating effects of global climate change in recent years with Hurricane Irene and Super Storm Sandy impacting the lives of many citizens. Therefore, combating climate change through diligent policy decisions and innovative strategies, like the GRF, is essential to protecting the environment for the economic and social well-being of all New Yorkers.

APPENDIX

Appendix 1 - Formulas for Key Model Metrics

Base information	Purchase price for ICE = $21,000; EV = $23,000	
	Payback period = 8 years	
	Interest = 2.5%	
	Fee = 0%	
To determine:	Formula	Amount
Purchase price variance	$23,000 - $21,000	$2,000
Principal for Agency	$2,000 * 3 vehicle purchases	$6,000
Interest for Agency	6,000*(1.025^8)-6,000	$1,310
Monthly payment on principal	$6,000/ (8yrs * 12 months)	$62.50
Monthly payment on interest	$1,310 /(8yrs * 12 months)	$13.64
Monthly Operational savings	(Annual Fuel + Maintenance) / 12 * 3 vehicles	526.25
Annual agency retained savings	($526.25 - $62.50 – $13.64)*12months	$450.11

Appendix 2 - Commonwealth Facility Fund for Energy Efficiency (CoFFEE) Implementation Model

Massachusetts RPUB
SEP Competitive
EE0006495
November 2015

Goal: Sustainably fund small to medium sized energy efficiency projects to help meet the aggressive efficiency and GHG emissions reduction targets set forth by Executive Order 484.
Barrier: Lack of sustainable funding model for small and medium sized energy efficiency projects which make up approximately 70% of the sites in the Commonwealth's portfolio.
Solution: Establish a low-cost financing mechanism for funding cost-effective energy and water conservation measures at state facilities.
Outcome: A sustainable small scale energy and water efficiency funding mechanism that will provide a continuous source of efficiency funding

Background:
The Commonwealth of Massachusetts owns and manages more than 80 million square feet of buildings that consume more than 1 billion kilowatt-hours (kWh) of electricity, 22 million gallons of heating oil and 46 million therms of natural gas annually, all of which create more than 1.1 million tons of Greenhouse Gas (GHG) emissions per year.

Over the past 15 years, Massachusetts has aggressively pursued energy efficiency opportunities at state facilities in an effort to combat this enormous footprint, reduce fuel costs and support a number of statewide environmental commitments. In 2007, Executive Order 484 established the Leading by Example Program (LBE) and set aggressive goals for energy use and GHG emissions reductions across state government operations. In 2008, MA enacted both the Global Warming Solutions Act (GWSA), which set GHG reduction targets for the Commonwealth as a whole, and the Green Communities Act (GCA), which included a number of provisions to boost investment in energy efficiency and renewable energy. The significant increase in clean energy resources available combined with the allocation of energy related American Recovery and Reinvestment Act (ARRA) funds served to accelerate the ability of state agencies to tap the potential for energy efficiency improvements in state facilities.

Historically, however, the main focus of these efforts has been on large scale, multi-million dollar projects that typically include bundling a number of clean energy measures such as new boiler plants, site-wide lighting upgrades, combined heat and power systems, solar photovoltaic arrays, wind turbines and building management system upgrades. These bundled projects resulted in significant energy savings but also came with a similarly large price tag. To fund these large projects, **Division of Capital Asset Management and Maintenance (DCAMM)** has used various bond mechanisms as long-term debt financing tools. In particular, DCAMM implemented a successful financing program known as the Clean Energy Investment Program

(CEIP). CEIP utilizes "green" General Obligation (GO) bonds that are specifically allocated for projects that generate sufficient energy cost savings to repay the annual debt service. This financing mechanism is ideal for larger projects due to the long terms (10 to 30 years) associated with these bonds.

In January 2012, to further jumpstart the state's clean energy efforts and by leveraging the success of the programs and processes developed through CEIP and ARRA funds, DCAMM and the Department of Energy Resources (DOER) launched the Accelerated Energy Program (AEP). AEP is a three year initiative targeting energy and water conservation projects across 700 state sites to achieve at least a 25% reduction in energy use. Upon completion, AEP will result in retrofits of essentially all state facilities, both large and small, that had not undergone efficiency improvements in the five years prior to the program launch.

Prior to AEP, there was no comprehensive strategy for addressing energy efficiency in smaller buildings, which comprise 422 of the 700 AEP sites, or 8.3 million square feet, and approximately 18% of state government's total energy use. While there is $425 million available through AEP, only $20 million has been allocated to small and medium sized projects.

The audits conducted at these sites have revealed significant opportunities for energy savings however, only a small amount of projects have been implemented due to the lack of a cost-effective and sustainable financing mechanism. The large projects funded through AEP utilize CEIP financing, a low-cost but long term financing mechanism which is not conducive to projects with relatively quick paybacks (which small and medium scale projects often have). Other types of GO bonds are also not ideal, as they are subject to approval by the Mass Legislature thus their availability is not guaranteed, and similar to CEIP, they have long term debt services up to 30 years. In the past, some agencies may have had access to operating or capital funds for efficiency upgrades but in recent year, operating budgets have been reduced and any excess capital dollars hard to come by, as they are usually devoted to initiatives that serve the core-competencies of the agencies, rather than energy efficiency. Additionally, Energy Services Companies (ESCOs) are not an ideal method of financing small and medium scale projects because any financial benefits realized through energy savings in these projects would be greatly reduced by the high administrative costs associated with ESCOs.

As these funding models are better suited for comprehensive efficiency projects, DCAMM and DOER identified a very specific barrier – the lack of an appropriate and cost-effective financing mechanism for small-scale efficiency projects. Thus, in order to tap the significant energy savings associated with this underserved market and continue its tremendous progress under AEP, Massachusetts was faced with the challenge of finding a sustainable source of financing for its small and medium scale efficiency projects.

Commonwealth Facility Fund for Energy Efficiency (CoFFEE)

To close this financing gap and increase the number of efficiency projects undertaken across state government, DCAMM, in coordination with the Department of Energy Resources (DOER), established the Commonwealth Facility Fund for Energy Efficiency (CoFFEE). CoFFEE provides low-cost financing to state facilities for small and medium scale energy and water conservation measures. To qualify for CoFFEE financing, projects must have a total cost under $100,000 with a payback less than 5 years. In addition, CoFFEE projects must generate enough energy cost savings each year to meet the annual debt service requirements.

One major innovation of CoFFEE when compared to other types of financing is that CoFFEE targets only projects that generate savings or revenue on an annual basis, to ensure there is money available to meet the debt service requirement without relying on additional capital or operational dollars. This strategy, modeled after the extremely successful CEIP program, helps ensure the fund's sustainability by reducing the risk associated with nonpayment. The difference between CoFFEE and CEIP, however, is that the debt service payments made by agencies through CoFFEE go back into the fund, thus replenishing it over time. The money repaid into the fund is then available to support additional energy projects, ensuring the fund's long-term sustainability.

In addition, unlike most state Green Revolving Funds (GRFs), which focus on larger scale projects through the utilization of Energy Services Companies (ESCOs), CoFFEE was specifically designed to target small and medium scale energy and water efficiency projects, a large and underserved market in MA. While CoFFEE projects must be under $100,000, the average project cost is much less, at around $30,000. The total project cost cap of $100,000 was put in place to ensure that these projects were eligible to operate through the Utility Vendor Program, thus avoiding a lengthy competitive procurement and allowing the projects to move forward relatively quickly.

Although these projects are small and might appear to produce little in the way of energy savings compared to the large scale efficiency projects historically targeted by DCAMM, their cumulative impacts are significant and important in furthering the Commonwealth's clean energy progress. Far beyond the completion of AEP, this self-sustaining fund will continue to drive demand for energy efficiency and support the Commonwealth's long-term commitment to reducing its consumption of fossil fuels and associated environmental impacts.

Policies:

Situated in New England at the end of the energy pipeline, Massachusetts recognized long ago the need to reduce its over-dependence on fossil fuels and reign in energy costs by stepping up its clean energy efforts statewide. In addition, as the largest energy user in Massachusetts had to lead the way by addressing the environmental and health impacts associated with its own operations first and foremost. As a result, over the last several years Massachusetts has enacted a number of laws, policies and programs to facilitate a transition to an innovative and clean energy economy. Today, MA is recognized as national leader in clean energy and has secured the number one ranking in the American Council for an Energy Efficient Economy

(ACEEE) energy efficiency scorecard for five years in a row. Some of the policies that have led to this success and to the creation of the CoFFEE program include:

Executive Order 484

In 2007, Executive Order 484 (EO 484) established the Leading by Example program (LBE) and set aggressive targets for state government in the areas of efficiency, greenhouse gas emissions, and renewables. E.O. 484 was an important tool for jumpstarting clean energy investment at state facilities and creating the programs, policies and processes necessary to reach broader statewide energy goals. Through this order, the Commonwealth has invested millions of dollars with impressive results, including a 25% decrease in GHG emissions over the last decade, a 70-fold increase in installed solar capacity at state facilities and a more than 16 million gallon reduction in fuel oil used to heat state buildings. Today, Massachusetts is recognized as a national leader.

E.O. 484 mandates that state government:

- Reduce energy consumption 20 percent by 2012 and 35 percent by 2020 based on Fiscal Year 2004 baseline and measured on a BTU per square foot.
- Obtain 15 percent of total electricity from renewable sources by 2012 and 30 percent by 2020, and
- Achieve a 25 percent GHG emissions reductions by 2012, 40 percent by 2020, and 80 percent by 2050 based on Fiscal Year 2002 baseline

The Global Warming Solution Act

The Global Warming Solutions Act (GWSA), was signed into law in 2008, creating a framework to reduce heat-trapping emissions that cause the negative effects of climate change. The act requires GHG emissions reductions from all sectors of the economy, with a 25% reduction target by 2020 and 80% by 2050, based on a 1990 baseline. This Act is important for Massachusetts as it promotes economic growth through energy efficiency and renewable energy and encourages alternatives to the combustion of fossil fuels.

Accelerated Energy Program (AEP):

AEP was launched in January 2012 to accelerate the implementation of energy and water projects across the Commonwealth and help meet the goals of Executive Order 484. As part of AEP, DCAMM, in coordination with DOER and partner state agencies, set a goal to retrofit 700 state sites and achieve at least a 25% energy reduction.

Additional goals of the three-year program include:

- To expand the energy program to touch/green every site over three years while meeting long-term E.O. 484 targets.
- To communicate effectively with employees and the public in order to inform and encourage participation in the AEP
- To ensure that the Commonwealth maintains its top national energy efficiency ranking (as cited by the American Council for an Energy Efficient Economy) through implementation of innovative and economical energy solutions.

- To employ continuous commissioning (a process that involves facility staff in regular review of equipment performance and calibration) to improve facility operation & maintenance.
- To create sustainable job opportunities across the Commonwealth as a result of this initiative.

To continue the success of AEP, which has completed or initiated projects at all 700 sites, DCAMM has launched AEP 2.0. One of the goals of AEP 2.0 is to ensure the energy efficiency gains made in Phase I continue through continuous commissioning, training and analytics. Additionally, AEP 2.0 will work to promote advanced and innovative technologies and incorporate new initiatives such as resiliency and zero net energy buildings.

Green Communities Act (GCA):
In 2008, Massachusetts enacted a comprehensive piece of energy legislation known as the Green Communities Act (GCA), which includes a number of provisions that have boosted energy efficiency and renewable energy investment across the state.
Some of these provisions include:

- Requirement for utilities to increase investment in energy efficiency measures, which reduce demand and deliver savings to customers
- Mandate for the design and implementation of three-year energy efficiency plans for gas and electric utilities.
- Funding for efficiency measures through the auction of power plants' pollution allowances through the Regional Greenhouse Gas Initiative (RGGI)
- Requirement that 15 percent of electricity is supplied by new renewable power facilities by 2020
- Improved green building design through updated codes, training and assistance

One crucial result of the Green Communities Act was a streamlining of the state procurement requirements for energy conservation projects with a total project cost of $100,000 or less. In the past, before this crucial piece of legislation, all energy projects regardless of size were required to go through an open statewide solicitation period. This required large amounts of time, resources and funding and resulted in small scale projects being less desirable and cost-effective. As a result of the GCA, public entities are able to contract directly with electric and gas utilities or their subcontractors for energy conservation measures with a total project cost of $100,000 or less without further solicitation. This greatly reduced administrative burden has opened the door for greater investment in small scale energy efficiency projects.

DCAMM successfully used this law to create the **Utility Vendor Program**, with the goal of completing energy upgrades at 438 sites, including 2,366 buildings, most of which are less than 10,000 square feet. The majority of the upgrades through this program involve high-efficiency lighting (bulbs, fixtures, lamps, LEDs), lighting controls, HVAC filters, resetting control set points, programmable thermostats, simple weatherization (weather stripping, caulking, window film, etc.) and water conservation. As of January 2016, the program is 75% of complete and a Phase 2 rollout is in the works.

Process:

Creating CoFFEE

In the summer of 2013, a fellow through the Environmental Defense Fund Climate Corp program developed a business plan and financial model for a revolving fund designed to target small and medium scale energy and water conservation projects at state facilities. To further this progress, DCAMM hired a CoFFEE program manager in 2014, a full-time position dedicated the development and administration of the fund. In addition to managing the development of the fund, the CoFFEE manager serves as the liaison between several business units at DCAMM, including energy, finance and legal, as well as to the Federal Department of Energy (DOE) and Massachusetts Department of Energy Resources (DOER). One key responsibility of the CoFFEE manager early on was to procure and manage an outside consultant that would support DCAMM's efforts in developing CoFFEE. Major responsibilities of the consultant included the research of existing green revolving funds, assistance in program design, and the development of financial models and other key program documents such as a user-friendly funding application. DOER, a close working partner of DCAMM, was also essential in providing guidance and recommendations during the development process. Through insight and knowledge gained from the administration of a number of successful clean energy programs, DOER assisted DCAMM in consultant procurement, CoFFEE program design and application review.

Throughout program design, an abundance of coordination was needed in order to ensure CoFFEE met the many financial limitations and operational procedures that existed within state government. In addition to meeting these restrictions, CoFFEE was also designed to meet two core program objectives:

1. Provide energy and water efficiency funding that was sustainable and affordable,
2. Facilitate the demand for new small to medium size energy and water projects.

Primary Agencies

DCAMM is responsible for integrated facilities management, major public building construction, and real estate services. The Energy division of DCAMM works to ensure that facilities attain practicable goals in sustainable design and construction and achieve optimal levels of energy and water efficiency for existing, renovated, and new buildings.

DOER develops and implements policies and programs aimed at ensuring the adequacy, security, diversity, and cost-effectiveness of the Commonwealth's energy supply within the context of creating a cleaner energy future.

Comparative Analysis

GRFs have successfully been developed and implemented in many states and universities throughout the country. Prior to the development of CoFFEE, a comparative analysis (CA) was conducted through research and interviews with several state revolving fund managers. The CA

was a side by side analysis that included an in-depth review of four programs and a high-level review of two additional programs to evaluate various options for the CoFFEE structure and processes, with the goal to set up a structure that mirrors a host of best practices used in other successful programs.. The program managers were very willing to discuss their programs and provide key insights into program development, challenges and lessons learned. The CA served as an evaluation point for many key characteristics of the program such as administration fees, goals and objectives, repayment strategy and loan terms. The coordination of interviews, researching online materials and compiling the CA took one month. Additionally, similar programs in the state were reviewed, including the DEP Drinking Water State Revolving Fund, to further understand Massachusetts-specific rules and requirements.

Interviews were conducted by an outside consultant with the assistance of DCAMM with managers of the seven energy efficiency loan programs listed below. In addition, DCAMM, with the support of the outside consultant, also to reviewed a number of resources including fund-related legislation, websites, applications and other relevant program documentation.

- Texas LoanSTAR (Saving Taxes and Resources)
- Utah State Facility Energy Efficiency Fund (SFEEF)
- Alabama Local Government Energy Loan Program
- Maryland State Agency Loan Program (SALP)
- Kentucky Green Bank
- Harvard Green Revolving Fund
- University of Vermont Energy Revolving Fund

The **Texas LoanSTAR** program is a long-established and capitalized fund that has a refined infrastructure capable of funding large projects. An important lesson-learned from this program was the importance of early buy-in from the finance office, to support facilities/technical staff for program success. The **UTAH State Facility Energy Efficiency Fund (SFEEF)** program was helpful in developing the project selection matrix as well as the application process steps, which can be found via their website (http://dfcm.utah.gov/sfeef.html).

The **Maryland State Agency Loan Program (SALP)** was helpful in establishing how funds flow from an agency's budget back into the central loan account. SALP uses payments for an agency utility budget for repayment and has had success setting repayment terms on a project-by-project basis and allowing prepayment without a penalty. The **Alabama Local Government Energy Loan Program** stressed the importance of maintaining a good relationship with agencies throughout the loan process. Additionally, this program has found success requiring a 3rd party audit or an in-house expert to conduct an audit for the measures prosed in their loan application. The **Kentucky Green Bank** has a loan committee that reviews new applications and continuously evaluates key program characteristics, such as the loan interest rate, selection criteria, and loan amounts. Based on the design of this committee, the CoFFEE manager established a CoFFEE Project Management Office (PMO) with state employees representing facilities, environment, finance l, and energy efficiency. Similar to the

Kentucky Green Bank, the purpose of this committee is to evaluates applications and continuously improving the program's characteristics. The structure and ease of use of the **Harvard Green Revolving Fund's** application was helpful in creating a CoFFEE application that is both user friendly and comprehensive, providing all the necessary information required to make an informed funding selection. The **University of Vermont Energy Revolving Fund** worked closely with their local utility, and the CoFFEE program has done the same to help maximize incentives for projects. Including incentives in COFFEE projects makes them more attractive, from an economic perspective but also by having the backing of a utility company. The **Sustainable Endowment Institute** was an additional helpful resource, as it manages the Billion Dollar Green Challenge, an initiative that encourages colleges, universities, and other nonprofit institutions to invest in self-managed green revolving funds. Through their Green Billions program, several helpful resources are available including an implementation model and case studies of successful GRFs.

The resulting outcome of the CA was a summary of existing state, university or non – profit energy revolving fund programs, including key program characteristics and lessons learned. DCAMM, with the help of the consultant and the PMO, then evaluated the various options and designed CoFFEE using best practices that both met the program goals and objectives and were most suitable for the Massachusetts policy environment.

CoFFEE Establishment

After the completion of the CA, the key takeaways and lessons-learned were used in the development the CoFFEE application process, administrative rules, selection metrics and financials models, with the assistance of the CoFFEE Project Management Office (PMO). The CoFFEE PMO is a review board is made of a set of representatives from State Agencies. The diverse participants allow for different perspectives on the program's direction and funding selections, as well help to promote the fund to a wide range of state agencies. The CoFFEE PMO was selected through various mediums including an open e-mail request to the Massachusetts Facility Managers Associations (MAFMA) list-serve, recommendations for the Energy Director, and contacts from the Massachusetts Department of Environmental Protection (MassDEP), which runs two revolving loan programs for recycling and clean water. The PMO met as needed, usually monthly for approximately 2 hours, to discuss program development, stakeholder engagement and problem solving. In addition, the PMO will be involved in the selection of projects based on each round of CoFFEE applications received. Project scoring is done using selection criteria developed by the PMO. Assisting in the development of the CoFFEE program was in addition to the PMO's normal work related responsibilities so the agenda needed to be concise while still accomplishing the goals of the meeting.

CoFFEE was officially established in December 2014 through the transfer of capital seed money from DCAMM's energy expendable trust. This trust is the central depository for energy credits, incentive checks, and demand response funds meant to be used for updating or outfitting facilities, with priority given to projects with high energy savings or earning potential. As part of support for the application for FOA 0000839, the DCAMM commissioner committed $500,000 for project seed money, as well as an additional 20% of the awarded grant in the amount of

$56,706. The formal process of securing the funds involves sending a memo to the Commissioner asking for funding approval known as a DCAF (DCAMM Commissioner Approval Form). Once approved, the Office of Finance and Administration (OFA) reviews and confirms the amount requested, sources and budget codes and designates funds to the CoFFEE project.

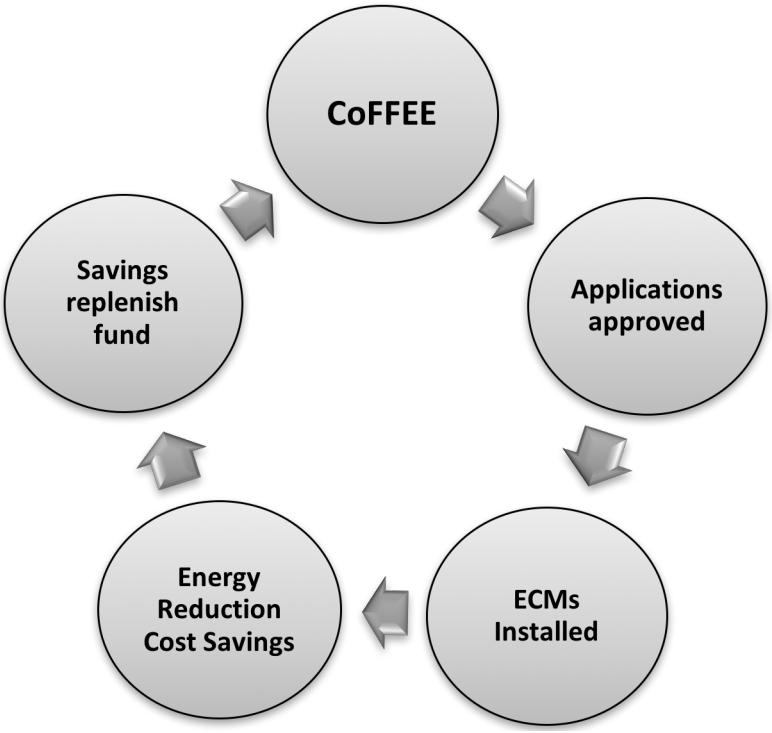
Revolving Fund Flow Chart

CoFFEE provides up-front funds for state agencies implementing energy and water efficiency projects. The cost savings generated through these efficiency upgrades are repaid into the fund on a rolling basis. These funds are then reinvested in new energy and water efficiency projects, creating a sustainable, long-term, and high-impact financing mechanism. Facilities retain a percentage of the cost savings achieved as a result of the implemented projects, thus allowing for an annual net benefit for agencies.

The first step in this process is an open solicitation period, during which agencies submit an application for funding for a particular energy or water efficiency project. Typically, this solicitation period lasts for 8 weeks and applications are accepted on a rolling basis. As applications are received, the CoFFEE manager uses a checklist to ensure all requirements of the application are met, and works with the applicant to retrieve any missing information. Once all applicants have completed the requirements, the applications are reviewed by the PMO. Each member of the PMO provides a score based on the project selection criteria scoring matrix, available here. If the project is approved, the funds are transferred to the agency to implement their energy conservation project. As the energy and/or water cost savings from the efficiency project are realized, the agency's utility bill is reduced. A portion of these savings, usually 85% percent, are repaid back into the central fund on a annual basis, thus replenishing the balance. In addition to the annual payments from cost savings, any utility incentives from these projects are also paid into the CoFFEE fund. Once the CoFFEE fund is sufficiently replenished, the program opens for another round of funding , continuing the revolving fund process

The fund will help maximize the economic and environmental benefits of energy projects at state facilities and it will also provide, through its innovative approach in which debt service is repaid through savings, an affordable and sustainable source of energy efficiency funding that replenishes itself over time.

Revolving Fund Flow Chart



Outreach

CoFFEE built upon the success of past clean energy initiatives by utilizing and expanding the relationships developed over time between DCAMM, DOER and partner agencies. Utilizing these existing relationships helped to ensure successful feedback in the development process and also sufficient interest in the program. In designing the CoFFEE promotion efforts, two simultaneous goals were developed:

- To maximize the inputs of the user agencies in developing the program
- To promote the program in order for agencies to maximize the use of the fund

Implementation Plan

- **To solicit feedback from key stakeholders,** both within DCAMM and from external agencies, to gather information from a diverse audience on the development of CoFFEE, including best practices, barriers to entry and promotion opportunities.
- **To provide access to information,** on key program benefits, contact information, procedures, requirements and upcoming events.

- **To raise awareness and excitement** of the availability a new energy financing mechanism, specifically the low cost funds, financial benefits and target uses.
- **To promote the economic, environmental and non-energy benefits,** including cost savings through decreased utility bills, reduction of greenhouse gasses and improved health and productivity benefits.
- **To provide open and transparent access** to information screening and the selection process, scoring metrics, and funding levels.

DCAMM worked on four types of outreach to gather input and promote the CoFFEE program to ensure success, utilizing any existing resources where available.

- **Outreach Events**
  The CoFFEE manager presented throughout development of the program and during the open solicitation period. These events included: Department of Energy Resources' (DOER) Leading by Example Bi-monthly Council Meeting, DCAMM's Integrated Facilities Management (IFM) Leadership Committee meeting and MAFMA's annual meeting. The audience at these events included facility managers, agency staff, vendors and the public. Using existing events provided an easy opportunity to present to a diverse audience in order to solicit feedback, as well as garner support and excitement for this new energy efficiency funding source.
- **Individual Agency Meetings**
  The CoFFEE manager utilized in person agency meetings to present on CoFFEE, distribute promotion materials, including a flyer with an overview of program, and answer questions. These meetings were highly effective, as they offered an opportunity for the CoFFEE manager to promote the program while also allowing potential applicants, including agency facility managers and finance staff, to discuss concerns and ask questions. These in-person meetings were offered for all agencies.
- **Online Communications**
  A website linked to MASS.GOV was created, in order to provide a single place for all CoFFEE-related information, including key dates, a program overview, current application and any relevant program updates. Additionally, the CoFFEE announcement and overview was included in the Accelerated Energy Program bi-monthly newsletters, sent out to a large list-serve of interested parties and AEP partners, including state agencies, utility companies, contractors and vendors. Lastly, during the open solicitation period, a webinar was conducted to offer potential applicants information regarding the submittal process, provide step by step instructions for filling out the application, and answer any questions. The webinar was recorded and posted on the CoFFEE website for all interested parties to review.
- **Recommendations**

The CoFFEE program relied on referrals and recommendations from a variety of sources, including the COFFEE PMO, DCAMM's energy team staff and any vendors familiar with both the program and facility funding needs. The program was presented to DCAMM Regional Directors and Energy Project Managers to be advocates for the program and drive interest during the course of their own meetings with facilities.

In explaining the program to utility vendors (contractors), the CoFFEE manager described emphasized the value that the CoFFEE program could bring to their business. This, in turn, provided contractors with motivation to target CoFFEE-eligible projects and recommend CoFFEE to facility managers during audits. The CoFFEE manager also created case studies to help market the program by using actual projects that had been completed. Through pictures, project narrative and a quantitative overview, case studies provide real-life examples of the CoFFEE funding process, allowing potential applicants to envision how they might apply the program to their own projects.

Application

The CoFFEE application was designed for ease-of-use to allow facilities to complete it with or without the energy auditor. In addition, the application is compatible with DCAMM's energy database which tracks key metrics from DCAMM managed energy projects, including project costs, cost savings, and Greenhouse gas (GHG) emissions reductions. To ensure easy access for all state agencies, the CoFFEE application is available to download directly from the Mass.gov website.

The application period is open for 8 weeks, during which participants are encouraged to submit questions or reach out for clarification on program requirements. Additionally, during the open solicitation period, the program manager continues the outreach and promotion of CoFFEE through outreach events, facility meetings and webinars.

Project Eligibility

The CoFFEE program is open to any state agency or public campus that incurs energy and water costs in its normal operations. During the initial screening process, the five factors below are reviewed to ensure minimum qualifications are met. The CoFFEE Manager assists the facilities with any missing information before moving the application into the selection phase.

Criteria	Description
Champion	Applicant is or has identified an individual who will manage project operations and see project through to completion.
Project Economics	CoFFEE funding request is no more than $90,000 and estimated project payback is less than 5 years.
Available Baseline Energy Usage Data	Applicant has access to the required baseline/historical energy usage information
Existing Conditions and Savings Potential	Applicant exhibits full understanding of existing condition and provides description of efficiency improvement
Supporting Documentation	Applicant has supplied supporting documentation such as 3rd party audit, in-house cost and savings assessments or a utility incentive commitment.

Project Selection Criteria & Scoring Metrics
All projects that pass the initial screening are reviewed and ranked by the CoFFEE PMO based on the criteria and weighting score itemized below.

Criteria	Description	Weighting
Payback Period	Time it takes for energy/water cost savings to cover project cost	35%
1st year total Resource Benefit	Monetary value of expected annual kWh savings, therms, MMBtus, and reduction in water usage	20%
Confidence/ Timing	Project feasibility and likelihood of successful completion.	20%
Non-Energy Benefits	Reduced lifecycle costs, productivity benefits, community benefits, & improved aesthetics	15%
Educational Value & Innovation	Project Exposure, education benefits & innovative measures	10%

CoFFEE Legislation
The CoFFEE fund is in the process of being approved as a permanent financing mechanism by the Massachusetts legislature. As of December 2015, the legislation is with the Comptroller of the Commonwealth for final comment and is expected to be approved in the Spring 2016. As discussed previously, DCAMM conducts energy conservation projects on a regular basis at state facilities with the primary purpose of allowing the facility to operate at a lower energy usage rate, and, therefore, lower cost. The typical DCAMM energy conservation project has a Total Contract Value of $5-10 million and is funded in part by CEIP funds. Projects also receive additional funding from rebate programs offered by utilities — funds set aside via federal mandate to be disbursed to owners like the Commonwealth that invest in energy conservation projects.

The CoFFEE legislation, drafted by DCAMM in collaboration with DOER, the Comptroller of the Commonwealth Office and the Executive Office of Administration &Finance (A&F), establishes a similar mechanism for smaller energy conservation projects. CoFFEE will serve as a source of funding for small to medium scale energy and water efficiency projects performed by state agencies other than DCAMM. DCAMM is responsible for receiving and reviewing applications and awarding CoFFEE funding to those projects that meet a number of pre-determined criteria. . CoFFEE is designed as a revolving fund, with state agencies repaying the amounts received from CoFFEE out of the cost savings generated by the energy project and, if applicable, utility rebates. As such, the legislation creates an account to be managed by A&F, in consultation with DCAMM, that is able to: (1) receive money from both state agencies and outside parties (i.e. utility companies), and (2) carry the money from Fiscal Year to Fiscal Year and disburse the

money to any agency (i.e. if in FY17 DMH pays money from its operating budget into the fund, that money may be sent to DOC for a project in FY18).

Interdepartmental Service Agreements (ISAs)
Once projects are approved for funding, money is transferred from the CoFFEE fund to the host agency account via an Interdepartmental Service Agreement (ISA). An ISA is a contract that documents the business agreement between two state entities that use the Massachusetts Management Accounting and Reporting System (MMARS) to transfer or receive funding. The agreement must comply with funding language in any appropriation act (GAA, interim or supplemental) funding the ISA, as well as all applicable general and special state or federal laws, regulations, policies and procedures.

Memorandum of Understanding (MOU) DCAMM and the user agency both sign a MOU as part of the ISA process. In this agreement, the project financials, including cost, incentives, repayment amounts, and the administration fee, key dates, and other relevant project facts are summarized. A sample version is posted on the website for potential applicants to review before submitting a request for funding.
Agreed upon terms and inclusions the MOU include:

- Amount of funds transferred
- Specified energy or water efficiency project
- Project complies with all applicable laws and regulations, including Massachusetts General Law, Chapter 25a, section 14 (M.G.L. c. 25A s.14.)
- Procuring and managing the project
- Utility Incentives/rebates will accrue to DCAMM

Repayment
One the application has been reviewed and approved by the CoFFEE PMO, the repayment terms are set based on the projected savings of the installed measures. The host agency takes on the performance risk of the retrofits and repayment amounts remain the same regardless of whether the project realizes more or less energy savings than projected. Facilities can repay the outstanding balance ahead of the scheduled timeframe without any financial penalties. This is beneficial to both the facility involved and the CoFFEE fund, as these funds become available sooner for reinvestment in new projects.
The administrative fee for utilization of CoFFEE is 6% of the amount financed, which is typically the project cost minus utility incentives. The host agency is responsible for paying this fee, which is added into the annual payment. The covers the cost of inflation and allows for a small amount of growth of the fund over time. Repayment periods commence 1 year after the start of project implementation to allow time for the energy savings to accrue.

Measuring Success
The CoFFEE program was designed to provide quantifiable and verifiable data for projects funded. Projected energy savings and cost impacts will be checked against the baseline from two state resources: Mass Energy Insight (MEI), an online utility consumption database, and Enterprise Energy Management Systems (EEMS) a real-time metering program. These programs

were put in place to track usage, identify opportunities to reduce energy consumption, and inform future energy efficiency investments. EEMS consists of 1,200 state-of-the-art real-time energy meters locate throughout the state. MEI is available to any public entity, including local municipalities. Once a public entity enters their utility account number, the usuge will then be pulled directly from the investor owned utility company usage records. These resources are important, as they help the Commonwealth track the large amount of energy consumed by the state and target projects for increased efficiency. Additionally site visits both during and post construction will be conducted by the CoFFEE manager and quarterly progress reports must be submitted by the facilities.

The CoFFEE program evaluates success on a range of metrics including number of applications submitted, number of projects funded, finance charges avoided, total resource benefit, and total cost savings. Additionally, Annual Energy Savings (MMBtu), Annual Water Savings (Gal), and Annual GHG Savings (tonnes CO_2) are tracked CoFFEE projects will be uploaded to the Energy Database to ensure cost and energy savings are included towards the goals of Executive Order 484.

Outcomes

Over the first year of the program, DCAMM successfully completed the first round of CoFFEE, funding 4 projects across the Commonwealth, with an initial investment of $244,433. This initial investment leveraged $107,452 in utility incentives and will result in an annual cost savings of $95,526. Additionally, as a result of CoFFEE-funded energy conservation measures, the Commonwealth will save annually an estimated 587,612 kilowatt hours and 16,389 therms of natural gas, resulting in a GHG emissions reduction of 369 metric? tonnes.

After the successful first round of CoFFEE, a second solicitation period began in November, resulting in new applications covering ECMs at 14 sites across the Commonwealth, with a total funding request of $568,000. ECMs from the second round include LED lighting, demand control ventilation, programmable thermostats and boiler reset controls.

As savings from the first two rounds are reinvested and subsequent capital is added to the fund CoFFEE will be able to support more and larger efficiency projects, resulting in increased savings potential. Although these cost and savings numbers are small in comparison to the overall Commonwealth‘s energy project portfolio, the project has proven successful in meeting the goal of providing a sustainable, flexible, and affordable low-cost financing mechanism for state agencies.

Replicability

The CoFFEE model for small to medium size efficiency projects can be replicated and adapted to meet the unique challenges, goals, and opportunities of the institution. Although many obstacles exist in the financial, administration, technical and project implementation areas, there are resources available to ensure the replicability and success in a variety of sectors. The CoFFEE model can use different monetary sources to implement project allowing for greater flexibility an era where funding is tight throughout many states, in specifically for capital

projects. The CoFFEE model provides funding that both provides savings to the user and ensures these saving are reinvest future efficiency project instead of being lost into the normal operating budget, ensuring a self-sustaining, long-term solution to small scale energy and water efficiency financing.

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