Financing Energy Efficiency-Based Carbon Offset Projects at Duke University

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UNC ENVIRONMENTAL FINANCE CENTER

Duke Carbon Offsets Initiative
DUKE UNIVERSITY

About the Environmental Finance Center

The Environmental Finance Center at the University of North Carolina, Chapel Hill (EFC) is part of a network of university-based centers that work on environmental issues, including water resources, solid waste management, energy, and land conservation. The EFC at UNC partners with organizations across the United States to assist communities, provide training and policy analysis services, and disseminate tools and research on a variety of environmental finance and policy topics.

About the Duke Carbon Offsets Initiative

Duke University established the Duke Carbon Offsets Initiative (DCOI) in June 2009 to help meet its goal of climate neutrality by 2024. The University will need to offset approximately 185,000 tons of carbon dioxide-equivalent emissions per year, starting in 2024. The Initiative is responsible for developing the University's strategy for meeting its offset goals in a way that provides significant local, state and regional environmental, economic, and societal co-benefits beyond the benefits of greenhouse gas emission reductions.

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INTRODUCTION

Duke University has made a voluntary commitment to be carbon neutral by 2024.[1] The University has estimated that it can reduce its projected 366,000 metric tons carbon dioxide equivalents (mtCO_2e) annual emissions by nearly half through conservation, energy efficiency and green building initiatives, solar photovoltaic installations and improvements in transportation. However, even with an aggressive push to reduce on-campus carbon emissions, Duke will need to find ways to offset the remaining 183,000 mtCO_2e, which it plans to accomplish through local greenhouse gas (GHG) emission reduction projects, called carbon offsets.[2] To find the types of high-quality and innovative projects that the University would like to use to meet its offset needs, the Duke Carbon Offsets Initiative (DCOI) was established in 2009. To prepare for the carbon neutrality commitment, the DCOI focuses on a variety of project areas that it considers most promising in terms of volume, cost-effectiveness and benefits to the local, state and regional community, including other environmental, economic and social benefits. Of the project types in which Duke is interested, residential and small commercial energy efficiency projects are particularly intriguing due to the ability to benefit the local Durham community in terms of reduced energy costs and building improvements.

As part of the DCOI's work to find appropriate carbon offsets that will comprise the University's offsets portfolio, it strives to reduce costs to achieve each ton of carbon dioxide equivalent reduced or sequestered, which entails improving practices, reducing costs and identifying creative approaches to financing. The DCOI partnered with the Environmental Finance Center at the University of North Carolina-Chapel Hill to help it identify opportunities and challenges related to particular energy efficiency-related carbon offset projects, which presently can cost upwards of $100 per ton of carbon offset achieved. To that end, this report summarizes and compares seven types of energy efficiency projects that the University could consider, proposes different financing mechanisms to fund each project type, and suggests ways to reduce the costs of each project type, primarily through innovative financing techniques not normally applied. The analysis will focus in depth on an employee-based residential energy efficiency program, a pilot of which DCOI has underway.

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[1] Duke University President Richard H. Brodhead signed the American College & University Presidents' Climate Commitment (ACUPCC) in June 2007, committing the university to development of an institutional plan to achieve climate neutrality. At this time, all carbon emission reductions are made on a voluntary basis and are not state- or federally-mandated.
[2] Board of Trustees, "Duke Climate Action Plan," Duke University (October 2009)

The projects that will be reviewed include:

1. **Multi-Family Housing Energy Efficiency Retrofits**
2. **Multi-Family Housing New Construction**
3. **Duke University Employee Loan Programs for Residential Energy Efficiency Retrofits**
4. **K-12 School and Non-Profit Energy Efficiency Retrofits**
5. **Community-Based Energy Efficiency Retrofits**
6. **Residential Water Heater Replacement Program**
7. **Energy Improvement Management (EIM) Fellowship Program**

In addition, the DCOI may also wish to consider renewable energy projects, particularly distributed solar generation, as an add-on component to the first five project types listed. The DCOI would either count the GHG emission reductions achieved by using renewable energy as a carbon offset or consider applying any energy generated by renewable energy add-ons against its emission baseline essentially by counting the renewable energy as a renewable energy certificate (REC), which, in turn, would reduce the number of carbon offsets the University needs by reducing its carbon emissions baseline.

Understanding Energy Efficiency-Based Carbon Offsets

A carbon offset represents the reduction, removal, or avoidance of greenhouse gas (GHG) emissions from a specific project that is used to compensate for GHG emissions occurring elsewhere. One offset credit represents one metric ton of carbon dioxide equivalent ($mtCO_2e$). In 2012, the average price for a voluntary carbon offset (or Verified Emission Reduction) was $5.90 per $mtCO_2e$.[3] However, this price varies depending on the type of project, the geographic location, the associated risk, the amount of third party verification required and, perhaps most importantly, the demand for the offsets.

Additionality Test

In order to qualify as a carbon offset, the carbon dioxide-equivalent emission reductions associated with a project must be considered “additional.” There are many tests for additionality, but essentially additionality means that the emission reductions must be above and beyond those that might be expected under a “business-as-usual” approach.[4] The notion of additionality is important because Duke University must be satisfied and must satisfy others that a real reduction in emissions is occurring for every offset that is achieved. In order to meet the additionality requirement, tests have been developed to help ensure that each offset project results in a real reduction in emissions that would not have occurred under normal business conditions.

There are two types of tests generally used when testing for additionality: project based additionality testing and performance standards. For the purposes of this analysis, the type of additionality test will not be examined, however, it is important to keep in mind that additionality is a required element in proving that an offset has occurred. With respect to energy efficiency-related offset projects in particular, where a

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[3] Maneuvering the Mosaic: State of the Voluntary Carbon Markets 2013, Ecosystem Marketplace and Bloomberg New Energy Finance, June 20, 2013, http://www.forest-trends.org/documents/files/doc_3898.pdf, p. vii.

[4] One common approach to determining additionality relies on financial additionality, which depends upon whether the project would not have occurred but for the sale of the carbon offsets it generates – if it would have happened anyway, then the project is not additional under this financial test.

variety of incentives already exists to encourage energy efficiency that would overlap with offsets-motivated approaches, additionality can be difficult to ascertain. Hence, Duke University will need to take special care in ensuring that additionality is satisfied for any energy efficiency-based offset projects.

Measurement and Verification of Carbon Offsets

Generally, a carbon offset project must use an approved carbon offset standard or protocol before the offsets can be sold in a marketplace. However, formally registering and verifying carbon offsets comes at a price, and, because Duke has made a voluntary commitment to neutralizing its carbon emissions and its offsets will not be traded in the marketplace, it could build and apply its own protocol for energy efficiency that adheres to protocol requirements but avoid the costs of formal registration and verification.

There are multiple certification standards that have been developed to measure and verify carbon offsets that the DCOI could use to guide its approach to energy efficiency-based offsets, and one in particular that applies to energy efficiency. Specifically, the DCOI most often looks to the Climate Action Reserve (CAR), which has developed standards adopted by California's regulated carbon market, the American Carbon Registry (ACR), and, for energy efficiency, the Verified Carbon Standard (VCS), which is the only organization to have developed a protocol for verifying energy efficiency-based carbon offset projects.[5]

Regarding use of the VCS protocol as a model for Duke's approach to energy efficiency-based carbon offsets, the Maine State Housing Authority developed a protocol for VCS in 2010 ("VM008") that quantifies the GHG emissions reduced by implementing energy efficiency measures in single family and multi-family dwellings. Energy efficiency can be achieved by taking actions including, but not limited to, adding and/or improving insulation, sealing the building envelope, or replacing appliances and central heating/cooling components. Although Duke University ultimately might choose to take its own unique approach to verifying energy efficiency-based carbon offsets, the following methodology outlines the key criteria that must be met in order to qualify as an offset under VCS and thus provides guidance for the university's approach.

VCS Methodology - Weatherization of Single Family and Multi-Family Buildings[6]

1. **Document the Baseline Scenario** – The baseline scenario represents the conditions most likely to occur in the absence of a project. For whole-building retrofits, the baseline consists of fossil fuel and electricity consumed for heat and cooling load and the appliance plug load prior to project implementation. For the replacement of appliances, the baseline scenario consists of electricity consumed by the appliance to be replaced prior to project implementation.

2. **Demonstrate Additionality** – For energy retrofits and appliance upgrades, this standard uses the performance method of demonstrating additionality, that is, does the practice improve the performance of the building in terms of energy use as compared to similar buildings. This method establishes performance benchmark metrics for determining additionality and creating a baseline.

[5] Ibid, page 36.

[6] Adapted from Verified Carbon Standard Methodology VM008, Version 1.1, http://v-c-s.org/sites/v-c-s.org/files/VM0008%20v1.1%2C%20FINAL.pdf.

Projects that meet or exceed a pre-determined level of performance metrics may be deemed additional.[7]

3. **Quantify Emissions Reductions and Removals** - Emission reductions are calculated using one of five approaches: (a) the adjusted consumption approach; (b) the pre-and post-retrofit audit approach; (c) the control group approach; (d) the deemed savings approach; and (e) the mobile homes approach. These methods result in a simplified and accurate estimation of project emissions normalized for weather and electricity correction factors. For energy retrofits and other efficiency upgrades, either the adjusted consumption approach, the pre-and post-retrofit audit approach or the control group approach may be used. For appliance upgrades, the deemed savings approach is used.[8]

VCS Emission Reduction Calculation Approaches (excluding the mobile homes approach)[9]

1. **Adjusted Consumption Approach -** In this approach, a building's baseline energy consumption is corrected for changes in electricity demand over time and adjusted for Heating/Cooling Degree Days. A sample group is used to measure energy consumption pre-retrofit. To estimate the post-retrofit emission reductions, the project's energy consumption is subtracted from the adjusted baseline consumption and the resulting number is multiplied by an emission factor for the fuel or electricity used in the baseline. A control group of non-retrofitted dwellings is used as a quality assurance measure to ensure that actual reductions are being achieved.

2. **Pre- and Post-Retrofit Audit Approach -** In this approach, emission reductions are based on the data generated by pre- and post- retrofit energy audits for a sample of the dwellings. For single family buildings, a pre-retrofit audit takes place before project implementation for every dwelling and a post-retrofit audit takes place after the retrofit has been completed for a sample of the dwellings. In every multi-family building, a representative sample of the dwellings undergoes a pre- and post-retrofit audit. The pre-retrofit audit determines the electricity demand and heat load in the baseline, which is then compared to the post-retrofit electricity demand and heat load. The difference is used to calculate emission reductions created by the project.

3. **Control Group Approach -** In this approach, a control group and a sample group are used to calculate the difference in energy consumption. The control group is comprised of dwellings from the same building stock that are not, and are not planned to be, weatherized. The sample group is comprised of dwellings to be weatherized. Electricity and fuel bills are collected for both groups annually throughout the project crediting period. The difference in the energy consumption between the control group and the sample group each year establishes the fuel and electricity savings for all dwellings in the project for that year and serves as the basis for calculating emission reductions.

[7] Verified Carbon Standard Guidance for Standardized Methods, v3.1, May 1, 2012, http://v-c-s.org/sites/v-c-s.org/files/VCS%20Guidance,%20Standardized%20Methods,%20v3.1.pdf.
[8] Verified Carbon Standard Methodology VM008, Version 1.1, http://v-c-s.org/sites/v-c-s.org/files/VM0008%20v1.1%2C%20FINAL.pdf.
[9] Adapted from the Verified Carbon Standard Methodology, VM008, Version 1.1, http://v-c-s.org/sites/v-c-s.org/files/VM0008%20v1.1%2C%20FINAL.pdf

4. **Deemed Savings Approach -** This approach is primarily used for appliance upgrades. The electricity demand (rated capacity) of both the appliance to be replaced and of the replacement appliance is determined from the nameplate, manufacturer's specification sheet, or direct metering. The typical annual hours of operation of the appliance to be replaced in the project area is recorded and the emission reductions from an individual appliance is calculated by comparing the electricity demand of the replacement appliance with that of the replaced appliance, multiplied by annual hours of operation and by the grid emission factor.

Carbon Offset Verification for Duke University

Given the types of energy efficiency-based carbon offset projects under consideration by Duke University, a number of the VCS approaches outlined above could be used to verify the carbon emission reductions associated with each project. For example, for projects in which utility bills are readily available and provided to the university by the building owner, the pre- and post-audit approach gives Duke the most accurate measurement of the carbon emission reductions achieved by the retrofit. This method of verification, however, can be a manual and time-consuming process if an automated method of collecting the data is not provided by the utility. On the other hand, in projects with multiple residential houses or in a multi-family housing project, the control group approach might be the most appropriate, whereby an aggregated calculation for the emission reductions could be obtained without the need to collect data on each individual unit. While not as exact a calculation as the pre- and post-audit approach, the control group approach could provide the university with a solid estimation of the carbon emission reductions with less administrative cost. Finally, for appliance replacement projects, such as water heaters or Energy Star-rated equipment, the deemed savings approach could be used to calculate the carbon emission reductions applicable to the specific appliance and not to the building itself. This can be easily calculated using product information from the manufacturer.

Because the carbon emission reductions Duke University pursues are undertaken voluntarily and are not intended to be formally registered or sold in the marketplace (other than to satisfy internal community demand), the university need not meet each and every verification criteria. Rather, provided that it meets basic additionality requirements and is satisfied that its internal standards are sufficiently stringent to defend the reductions to the outside world, it has the freedom to develop its own measurement and verification methods. The methods that Duke employs therefore can depend on the type of project that is undertaken and can incorporate ways to reduce the administrative costs of collecting and analyzing the data. One potentially significant way for the university to reduce project costs would be to partner with local utilities such as Duke Energy and PSNC Energy to obtain customer usage data electronically, which would substantially reduce the cost of verification and could result in a more accurate calculation of carbon emission reductions. Many other practices could be employed to reduce costs, which could also be incorporated into Duke's methodology.

TYPES OF PROJECTS

As part of its carbon offset strategy, Duke University has the opportunity to develop energy efficiency-based carbon offset projects that will not only reduce carbon emissions, but also provide benefits to the surrounding community, enhance student educational experiences and enable faculty research initiatives. Therefore, the universe of possible projects identified here has been offered not only based on the quality and quantity of carbon emissions that are generated, but on a number of other qualitative factors (see "Comparison of Projects" for more detail). Offsets from each of the listed project types can be achieved using two approaches:

1. **Self-Generated Offsets**: Duke University could develop the program from the ground up and keep all associated offsets. This approach results in benefits to the school in terms of offset generation and can be targeted to projects within the local community at Duke's choosing. However, as the sole developer, it requires Duke to provide a larger share of the upfront capital investment and to support ongoing administration costs.

2. **Purchased Offsets**: Duke University could purchase carbon offsets from a third party developer. While lowering the upfront out of pocket cost for the university, this approach may result in higher costs in the long term because of additional third-party administrative costs and less community-focused offsets because the projects are chosen for their potential to generate carbon offsets at the lowest cost, rather than considering other non-monetary benefits.

The following analysis summarizes the types of energy efficiency projects that were considered as carbon offset opportunities for Duke University and provides examples and cost estimates for programs in other parts of the country. Financing mechanisms that can be used to fund these projects will be more broadly examined in the next section, "Discussion of Financing Mechanisms."

A. Multi-Family Energy Efficiency Retrofits

Due to the volume of student housing units located around the campus, there is an opportunity for Duke University to make a large impact in the multi-family energy efficiency market. By looking at successful retrofit programs like Chapel Hill/Carrboro's Worthwhile Investments Save Energy (WISE) program and other national multi-family programs such as Chicago's Energy Savers program, the DCOI could develop an incentive program for local apartment management companies interested in investing in building envelope improvements and higher efficiency equipment. In return, the university would receive credit for all carbon emission reductions achieved by the improved efficiency of the buildings. Incentives might include "free" energy audits, rebates on qualifying energy efficiency improvements, a pre-qualified network of contractors, technical support and access to a low-interest loan program.

EXAMPLE: CHICAGO AREA ENERGY SAVERS PROGRAM

In 2007, CNT Energy in Chicago, IL, established the Energy Savers program, which offered free energy audits, technical support, and energy retrofit financing for owners of low-to-moderate income multi-family residential buildings in the city of Chicago. By the winter of 2012, the program had upgraded 9,760 units in 295 buildings, reducing energy use by approximately 30% or 2.3 million therms, leading to the avoidance of over 11,500 mtCO_2e annually – the equivalent of 1.2 mtCO_2e per unit – or 115,000 mtC0_2e over 10 years.

Over $9.3 million in financing was provided for the program from private investment, foundations and public institutions[10], equating to an offset price of $81 per mt$CO_2$e.

B. Multi-Family New Construction

As new multi-family units are being constructed in the Durham community, the DCOI could assist the management companies with investments in higher efficiency equipment (e.g., boilers, HVAC, windows, lighting), leading to ENERGY STAR certification. Carbon offsets would be based on the improved efficiency of the equipment.

Example: ENERGY STAR Water Heaters

According to the American Council for an Energy-Efficient Economy (ACEEE), ENERGY STAR qualified heat pump water heaters can save the average household over $250 per year on its electric bills compared to a standard electric water heater.[11]

Water Heater Type	Efficiency (EF)	Installed Cost	Annual Energy Cost
Minimum Efficiency Electric Storage	0.90	$750	$463
High-Efficiency Electric Storage	0.95	$820	$439
Electric Heat Pump Water Heater	2.20	$1,660	$190
Solar Water Heater with Electric Back-Up	1.20	$4,800	$175

Source: ACEEE, http://aceee.org/consumer/water-heating

Given the average user, an investment in an ENERGY STAR-qualified electric heat pump with an efficiency rating of 2.20 results in over 1,500 kWh in energy savings a year (as compared to a standard minimum efficiency electric storage water heater).[12] This equates to an annual reduction in carbon emissions of approximately 1.1 mtCO_2e, or $83 per offset over ten years.[13]

C. Duke Employee Loan Programs for Residential Retrofits

A relatively new type of energy efficiency investment program is being offered by companies to their own employees. Similar to a 401(k) or an employee health flexible benefit plan, an energy efficiency-based employee benefit loan program could be established to provide Duke employees with access to unsecured,

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10 CNT Energy, 2012 Fall/Winter Energy Savers update, http://www.cntenergy.org/media/energy_savers_update_2012_111.pdf, accessed 5/9/13.

11 Energy Star website, http://www.energystar.gov/index.cfm?c=heat_pump.pr_savings_benefits, accessed 10/25/13.

12 Based on a deemed savings calculation using a residential water heater calculator provided by Eric Calhoun, HomeWellness, LLC. An increase in efficiency from 0.90 to 2.20 results in 1,576 kWh annual reduction in electricity usage.

13 EPA Greenhouse Gas Equivalencies Calculator. http://www.epa.gov/cleanenergy/energy-resources/calculator.html. A 1,576 kWh reduction in electricity use is equivalent to a 1.1 metric ton reduction in carbon dioxide equivalents. The estimated cost to upgrade from a standard electric water heater to an electric heat pump is $910 (ACEEE, http://aceee.org/consumer/water-heating).

low-interest loans from the Duke Employee Federal Credit Union for energy efficiency improvements in their homes. The loans could be used for new appliances, weatherization retrofits or renewable energy investments and would be repaid through employee payroll deduction, making repayment easier for the employee and reducing the potential for default. The DCOI has been working with the Clinton Climate Initiative (CCI) to develop an employee loan program pilot tailored to the university and based on carbon offset outcomes. Details of the CCI's Home Energy Awareness Loan (HEAL) program are outlined in the example below. Interest in the CCI HEAL program was borne from earlier projects undertaken by DCOI to assist employees with low-cost energy efficiency upgrades to test the ability to achieve and track GHG emission reductions.

This option is particularly attractive because of the very large pool of employees to which the program could be offered. Duke employs over 35,000 people throughout the university, medical school and hospital system. As the DCOI-HEAL Pilot is currently conceived, qualifying employees would receive a home energy evaluation, a customized explanation of potential projects and access to a pre-qualified network of energy contractors. Once energy efficiency upgrades are installed (or a home proves to meet certain energy efficiency standards), the university could consider helping the homeowner finance distributed solar generation as an additional mechanism to achieve carbon offsets or generate renewable energy to be used to reduce the university's emissions baseline.[14] Brought to scale, an employee-based energy efficiency retrofit program could play an important role in achieving the carbon offsets needed by Duke on an annual basis, which could be substantially increased if rooftop solar projects were an option for employees.

EXAMPLE: HOME ENERGY AFFORDABILITY LOAN (HEAL) PROGRAM

The Clinton Climate Initiative, a program of the Clinton Foundation, launched an employee benefit program – the Home Energy Affordability Loan program – that helps to facilitate a commercial retrofit to employers' buildings, the savings from which are used to provide loan funds to employees for home energy audits and energy efficiency upgrades. Through the program, employees receive an energy audit and a personalized energy plan from a qualified local contractor. Homeowners can choose to make their home more energy efficient through improvements and appliance upgrades, which allow them to lower their home's utility bills. HEAL helps employers institute payroll deductions by which employees repay the loans that finance the retrofits. CCI estimates that the residential retrofits cost the homeowner approximately $2,500 and result in average annual carbon emission reductions of 1.5 mtCO_2e per house. Given a $450 investment from the employer (either a free energy audit or a reduction in interest rate), the average cost per offset over ten years is approximately $30 a year. The program's success rests on the fact that the HEAL program removes the barriers to implementation, including lack of knowledge and access to trusted contractors and lenders, that commonly prevent homeowners from making cost-saving energy efficiency upgrades.

D. K-12 School and Non-Profit Retrofits

Working with Self-Help Credit Union or other local financial institutions, the DCOI might also consider offering incentives to local schools and other community organizations to upgrade HVAC and other equipment. The cost to implement these programs would vary depending on the type of improvement, but incentives could be in the form of an interest rate buy-down or a loan-loss reserve program. These types of programs might be a good partnership opportunity with Advanced Energy, which performs energy audits

[14] The DCOI will be investigating a distributed solar generation add-on to the employee-based energy efficiency program in the 2014-15 academic year. This program has the potential to significantly increase the emissions reductions achievable by Duke University but is beyond the scope of this report.

for many schools and local governments, or NC GreenPower, a state-wide program that connects interested residential and commercial investors to renewable energy certificates and carbon offsets.

EXAMPLE: ALABAMASAVES - BARBER VINTAGE MOTORSPORTS MUSEUM

AlabamaSAVES is a revolving loan program established for institutional customers in Alabama by the Energy Division of Alabama Department of Economic Development and Community Affairs (ADECA). One project funded by the program - a vintage motorsports non-profit museum in Birmingham – implemented energy efficiency upgrades to the museum's 144,000 square foot building with the potential to reduce its energy cost by an estimated 30%. The upgrades included a lighting retrofit, chiller replacement and an upgrade to HVAC controls. The project was funded by a $716,853 loan through the AlabamaSAVES program and utilized an interest rate buy-down mechanism to reduce the interest rate to 1%. When complete, the project is estimated to reach annual energy savings of 2,780,000 kWh, equal to $80,190 in annual energy cost savings and emissions reductions of 1,961 $mtCO_2e$/year[15], which equates to roughly $36 per offset annually.

E. Community-Based Retrofit Projects

Another option for the DCOI to consider is partnerships with community-based organizations – particularly those with an emphasis on the low-income housing market (e.g., North Carolina Housing Coalition, Habitat for Humanity, Builders of Hope). This program could perform residential energy efficiency retrofit upgrades in the low-income housing market to include homeowners that do not meet the Federal Government's Low Income Home Energy Assistance Program (LIHEAP) criteria for weatherization assistance, but would benefit from improvements in energy efficiency.

EXAMPLE: COMMUNITY POWER WORKS, SEATTLE, WA

Community Power Works (CPW) is a non-profit organization that has partnered with the City of Seattle, local utility Seattle City Light and Craft3, a community development financial institution, to provide energy efficiency retrofits to residential, small business and commercial customers in the Seattle area. CPW provides a "one-stop shop" for energy upgrades in single-family homes by offering low-cost energy assessments, rebates, financing, and pre-approved contractors. In addition, they partner with HomeWise, the City of Seattle's low-income weatherization program, to fund energy efficiency improvements in low-income multifamily buildings. As of October 31, 2013, CPW had completed upgrades in 2,954 single family homes, 46 small business buildings, 3 major hospitals and 14 City of Seattle buildings. The cost of the program to date is $18,667,907, resulting in estimated carbon emission reductions of 157,300 $mtCO_2e$.[16] Annualizing these reductions, this equates to approximately $30 to $40 per offset.[17]

F. Residential Water Heater Replacement Program

Local natural gas utility PSNC Energy currently offers a $100 rebate for residential customers who replace an inefficient water heater with a more efficient appliance. Duke University could partner with PSNC and the City of Durham to develop an appliance upgrade loan program that would provide homeowners with easy access to low-interest financing for the new appliances. By offering a credit enhancement (i.e.,

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[15] Abundant Power website, http://www.abundantpower.com/Files/PR.2013.05.09.pdf, accessed 5/9/13.

[16] Community Power works website, http://www.communitypowerworks.org/about-community-power-works/impact/, accessed 12/5/13.

[17] Community Power works calculates their carbon reductions cumulatively, therefore an accurate estimate of annual reductions in CO_2e is unavailable at this time. However, based on program costs and the length of time that the program has been running, the cost per offset is estimated to be in the range of $30 to $40 annually.

interest rate buy-down or loan loss reserve) to a local financial institution, the DCOI could incentivize this investment by reducing the interest rate on the loan. In addition, on-bill repayment could be used to allow the loan to be repaid through the utility bill - making repayment easier for the homeowner and reducing the potential for default. If a partnership were to occur with the Duke University Federal Credit Union, repayment could be made via payroll deduction.

Alternatively, Duke University could partner with the City of Durham to develop a solar hot water heater upgrade program to help homeowners take advantage of the state and federal solar tax credits. The DCOI would fund the program and receive the carbon offsets achieved from the improved efficiency of the water heaters. If an employee-based program were to be implemented, the university could combine the water heater replacement with the energy efficiency program and/or include a solar hot water heater option.

EXAMPLE: LUMBEE RIVER ELECTRIC MEMBERSHIP CORPORATION

The Lumbee River EMC, located in the southern part of North Carolina, offers incentives to its members to upgrade to more efficient hot water heaters. Members can choose from four different types of hot water heaters and are given a choice of a rebate or a low-interest loan as an incentive to make the switch. The incentive to upgrade to a solar water heater is either an $850 rebate or an interest rate of 1.50%.[18] Given the average user, an investment in a solar water heater with an efficiency rating of 1.20 results in over 667 kWh in energy savings per year as compared to a standard minimum efficiency electric storage water heater.[19] With an incentive cost of $850, this equates to an annual reduction in carbon emissions of approximately 0.47 mtCO_2e, or $180 per offset over ten years[20].

G. Energy Improvement Management Fellowship Program

As an educational institution, Duke University is committed to offering learning opportunities for its students. Through the DCOI, co-curricular programs could be created to advance community sustainability efforts across the Duke University and Durham community by supporting student fellowships for community sustainability, research and service. Undergraduate and graduate students from a range of majors could be trained and advised by Duke faculty or staff in collaboration with community partners (either nonprofit or governmental) to conduct sustainability research during both the academic year and summer months.

In addition to conducting hands-on improvements, students could be deployed to local businesses and nonprofit organizations to develop energy savings plans that could be implemented at the discretion of the company or nonprofit (depending on return on investment and access to capital to make the improvements). The Nicholas School of the Environment developed such a program using stimulus funds and many companies took advantage of the students' expertise to institute cost saving energy efficiency and production efficiency measures. For the university's climate neutrality purposes, the program's benefits could be translated to carbon reductions and applied to the University's neutrality goals, all for the

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[18] Lumbee River Electric Membership Corporation website, http://www.lumbeeriver.com/files/energyservices/LumbeeRiverWaterHeaterIncentivesbrochure.pdf, accessed 12/5/13.

[19] Based on a deemed savings calculation using a residential water heater calculator provided by Eric Calhoun, HomeWellness, LLC. An increase in efficiency from 0.90 to 1.20 results in 667 kWh annual reduction in electricity usage.

[20] EPA Greenhouse Gas Equivalencies Calculator. http://www.epa.gov/cleanenergy/energy-resources/calculator.html. A 667 kWh reduction in electricity use is equivalent to a 0.47 metric ton reduction in carbon dioxide equivalents.

cost of student internships. This program is similar to the Environmental Defense Fund's Climate Corps program.

EXAMPLE: DUKE EMPLOYEE PILOT PROGRAM

In 2012, the DCOI received funding from The Duke Endowment and the Piedmont Natural Gas Partners Program to develop and implement a small energy efficiency pilot program for Duke employees to test the extent of emission reductions that could be achieved via minimally invasive weatherization upgrades and the efficacy of using supervised students to perform the work. The pilot was very similar in concept to the employee-based energy efficiency based program described above, except that energy efficiency upgrades were primarily performed by students supervised by experienced contractors and DCOI staff, and audits were not performed on the households.

For the pilot, the DCOI recruited two undergraduate student fellows from Duke University to help weatherize employees' homes. Between 2012 and 2014, twelve Duke employees received upgrades, which were limited to sealing duct work in crawl spaces and attics, with some of the work being completed by outside contractors after the fellowships ended. One year of historical energy use data were collected from each house as a baseline. Preliminary data indicate that air and duct sealing alone reduced energy use by an average of 10 to 15%. Given an average cost of $1,000 per home and an annual reduction in carbon emissions of 0.75 $mtCO_2e$, the cost of an offset via this type of program comes to about $133 per year. Coordination of students and contracts proved challenging for DCOI staff, indicating high staff costs to administer a student-based program.

COMPARISON OF PROJECT TYPES

Each of the project types described above has been evaluated using several factors to help to understand how they align with the DCOI's mission to provide locally meaningful, high-integrity carbon offsets at a reasonable cost. Based on the results, short and long-term strategy recommendations were developed by which the DCOI could incorporate energy efficiency-based carbon offsets into its portfolio. A summary of the comparison undertaken between the project types can be found in Table 1. The factors considered in evaluating the options included:

- ✓ Ability to leverage the practice with existing, proven programs
- ✓ Ease of tracking energy savings and carbon emission reductions
- ✓ Ease of administration for the DCOI and Duke University
- ✓ Probability of adoption by targeted participants
- ✓ Replicability by other universities and local organizations
- ✓ Ability to reduce the price of offsets (price per ton) over time
- ✓ Availability of high quality energy efficiency offsets in the local community that would indicate a need for Duke University's involvement
- ✓ Upfront capital requirement

TABLE 1: COST PER OFFSET COMPARISON OF FINANCING MECHANISMS

	Leverage Existing Programs	Ease of Tracking	Ease of Administration	Probability of Participation	Replicability	Ability to Reduce Price per Ton	Local Offset Availability	Low Upfront Capital Investment
Multi-Family Energy Efficiency Retrofits	✓				✓		✓	
Multi-Family New Construction Upgrade		✓			✓			
Duke Employee Loan Program - Weatherization	✓	✓	✓	✓	✓	✓	✓	✓
Duke Employee Loan Program – Solar Thermal and PV					✓	✓	✓	
Energy Efficiency Retrofits (K-12 and Non-Profits)	✓		✓	✓	✓		✓	
Community-Based Energy Efficiency Retrofits	✓	✓				✓	✓	
Residential Water Heater Replacement Program	✓	✓		✓	✓		✓	✓
Energy Improvement Management Internship Program	✓			✓	✓		✓	

While all types of projects have attributes that might be attractive to Duke University, the program that meets all of the criteria that the DCOI has indicated it desires in a program is an employee loan program for weatherization upgrades. With a pool of over 35,000 employees, the program has the potential to be scalable, relatively low-cost at \$30/mtCO_2e, and offers Duke the ability to test different methods of implementation and measurement strategies for long-term success in carbon offset generation.

Thanks to funding from The Duke Endowment, a pilot of this type of project is currently under development between DCOI and the CCI HEAL program and will begin in mid-2014. To hew with other objectives of the university to encourage employees to live closer to Duke to reduce commuting distances, the university will be prioritizing participation by Durham county residents and could consider recruiting employees by the distance they commute or method of commuting as the DCOI determines actual interest in the program by targeted participants.

DISCUSSION OF FINANCING MECHANISMS

Once the type of carbon offset project has been determined, the next step is to determine how to finance its implementation. While there are many creative financing mechanisms available to help fund energy efficiency projects, not all mechanisms are right for a carbon offset investment. The criteria used to narrow the options include:

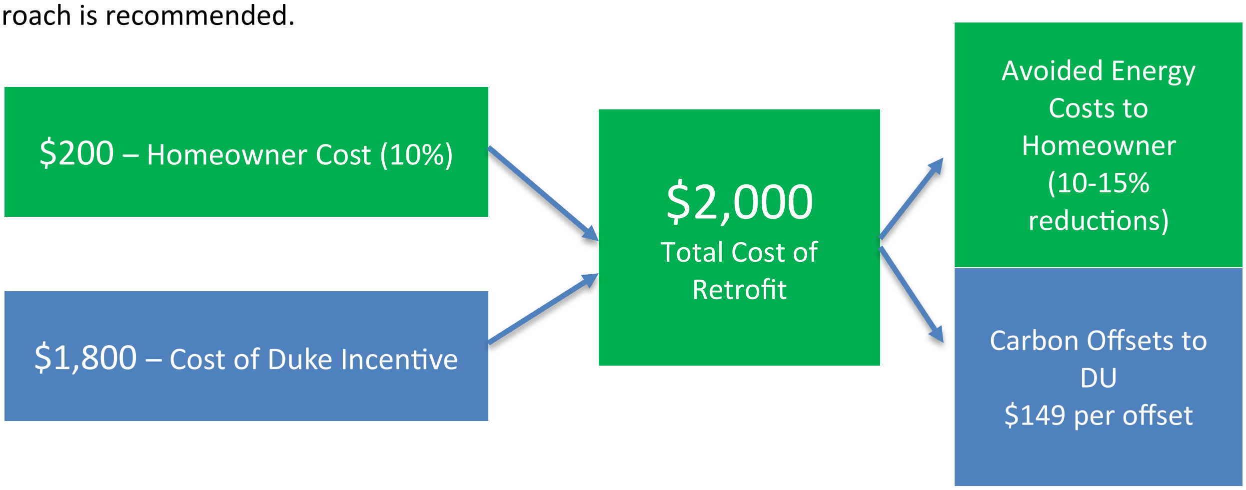
- ✓ Ability to leverage existing programs with proven success records
- ✓ Ability to be launched with a modest amount of investment
- ✓ Ability to be implemented within the university's time frame for reaching carbon neutrality
- ✓ Ease of administration for the university
- ✓ Reduction of financial risk to the university

The following comparison summarizes the types of financing mechanisms that could be used to fund the energy efficiency projects that are being considered as carbon offset investment opportunities for Duke University. Each of these mechanisms is explained in more detail in the following sections. Each explanation includes a comparison of how each mechanism might be used by the DCOI for the employee-based energy efficiency carbon offsets loan program, which already has been identified as having the most promise for fulfilling Duke's requirements for an energy efficiency-based carbon offset. To ease comparison, each funding mechanism example assumes participation by 100 residential homes.

A. Self-Financing Using Cash and Grants

A commonly used financing mechanism for energy efficiency-based carbon offset projects is the use of existing sources of cash. A university may self-finance its projects on a "pay-as-you-go" basis using money carved out of its existing utility or capital budget. Alternatively, universities may apply for grant funding from a number of private, federal and state organizations. Self-financing energy efficiency-based carbon offset projects that use internal cash or grant sources work best for low-cost projects. Often, a college can use internal funds and grants to help seed other types of financing mechanisms, such as a green revolving loan fund, or use the funds to reduce the amount of debt needed to implement larger, more capitally intensive and expensive projects. Funds are needed up front because the biggest barrier to implementation is usually the up-front capital required to make the improvement. Hence, purchase of offsets achieved is not being considered under this scenario.

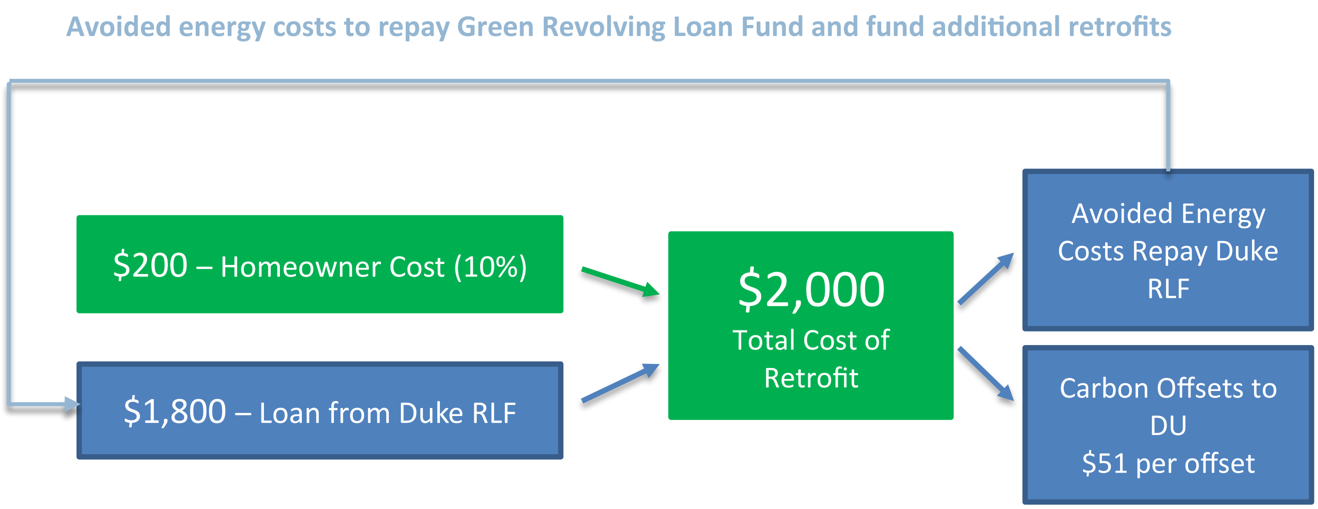
Very recently, Duke University used grants from The Duke Endowment and PNG to finance a small-scale pilot program to improve the energy efficiency of twelve households owned by Duke University employees. While the small-scale pilot proved helpful in testing a limited number of non-invasive energy efficiency strategies that could be implemented by students, it is difficult to scale them to the level that will be needed to help the university accomplish its carbon neutrality commitment due to the high upfront cost (i.e., $1,000 to $2,000 per house for a limited amount of weatherization) and time involved in coordinating the retrofits. When the overall cost per offset is taken into consideration (almost $150 per offset in Duke's pilot program), this type of financing tends to be more costly than other mechanisms. Even with a percentage of cost share by the homeowner, in a self-funded scenario, the majority of the offset investment is borne by the university upfront and cannot be recovered. Thus, a different financing approach is recommended.



B. Green Revolving Loan Fund

A green revolving loan fund is a financing mechanism designed to leverage investment from one or more sources for environmentally-based projects and is sometimes referred to as “seed money”. The investments from the green revolving loan fund are paid back either through energy savings – or a portion of the savings – that result from each project or from the repayment of the loan by the party that receives funds from the revolving loan fund. These payments are returned or “revolved” back into the fund and can be used to finance new projects. Green revolving loan funds can be established using one type of initial investment (i.e., from a grant), but a blended, multi-capital approach is often required to create an appropriately capitalized financial mechanism with enough funds to cover the upfront costs of the program.

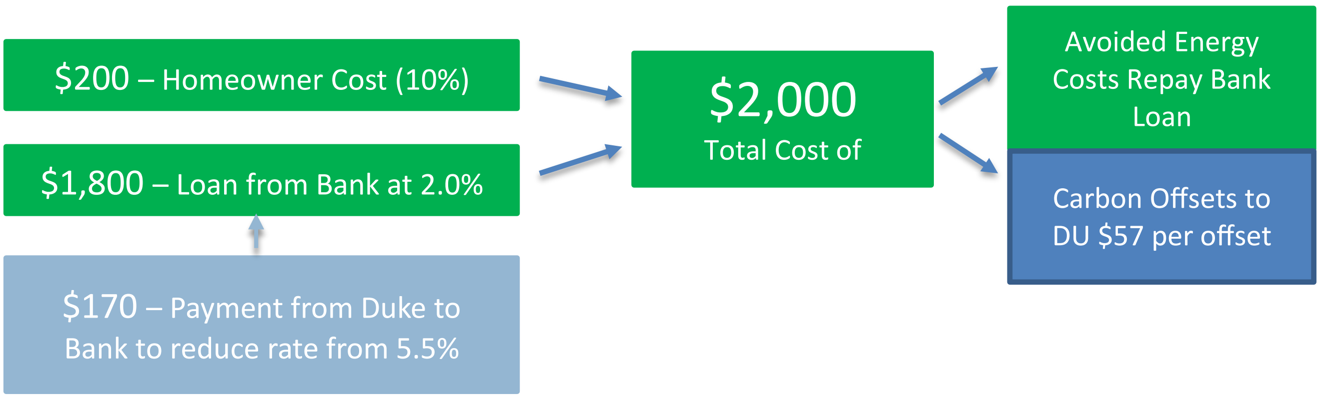
While a green revolving loan fund does require a large amount of seed capital to start a loan program, it can leverage funds from multiple sources to complete energy efficiency-based offset projects on a rolling basis over time – thereby reducing the overall cost of financing offsets. Once the green revolving loan fund is established, the DCOI can use it to make investments or lend to different types of offset projects with different payback periods with the resulting avoided energy cost savings being used to pay principal and possibly interest back into the fund for the DCOI to make available to future recipients. As funds become available from other sources, for instance from grants, student fees, or alumni donations, they can be added to the fund and increase the university’s capacity to complete offset projects and perhaps be used for more capital-intensive, but higher GHG emission reduction yielding, projects that have a much lower overall price per $mtCO_2e$ reduced.



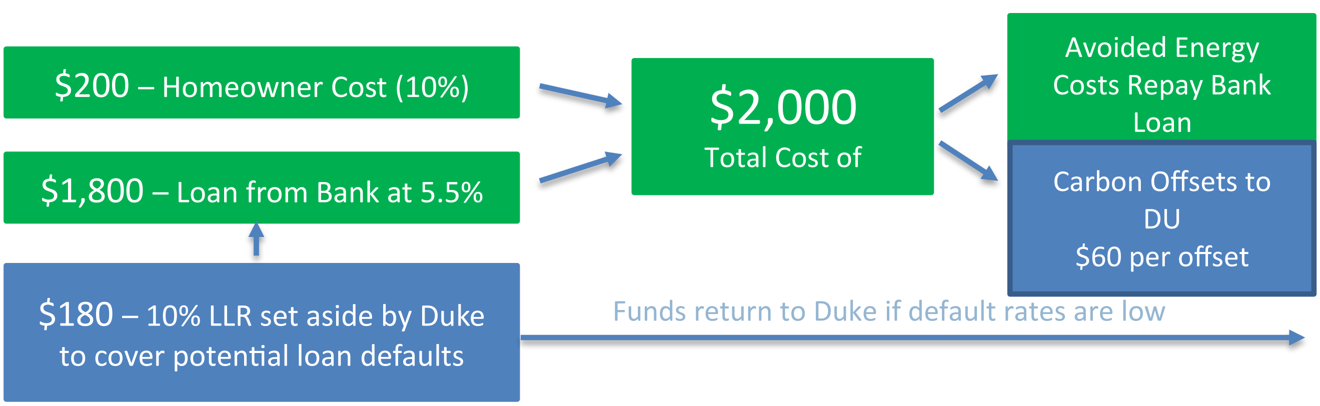
C. Credit Enhancements

A number of credit enhancement mechanisms have been designed to use public or private funds in a way that lowers the effective cost of capital for borrowers and gives financial institutions more reassurance that they will be repaid. Using credit enhancements, the university could provide incentives to private lenders to offer and administer loans to its employees, such as a loan loss reserve to protect against defaults, which would allow the lender to offer loans, sometimes at lower-than-market interest rates. Credit enhancements reduce the risk of default for financial institutions and provide a way for the university to leverage a limited amount of funds, thereby providing a robust offset program and lowering administration costs. The credit enhancement option could help to reduce the cost of a loan for the employee residential energy efficiency program.

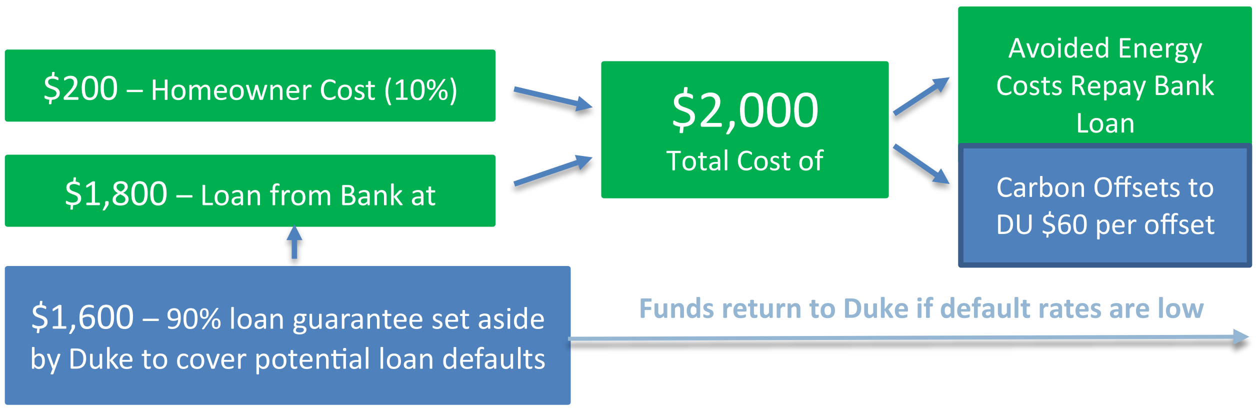
1. **Interest Rate Buy-Down Programs**: An interest rate buy-down program typically occurs by paying investors an upfront lump sum equal to the present value of forgone interest payment reductions over the life of the loans. The amount of funds expended for an interest rate buy-down depends on the loan term, the unsubsidized interest rate, and the target subsidized interest rate to borrowers. The use of an interest rate buy-down would enable the university to offer a lower interest rate to borrowers, while using the financial institution's existing infrastructure to reduce the university's cost of administering the loans. The money used to buy down an interest rate is an upfront cost to Duke University that is used to incentivize the borrower to take the loan to complete the energy efficiency project and the financial institution to lend the money. It does not get returned to the University.



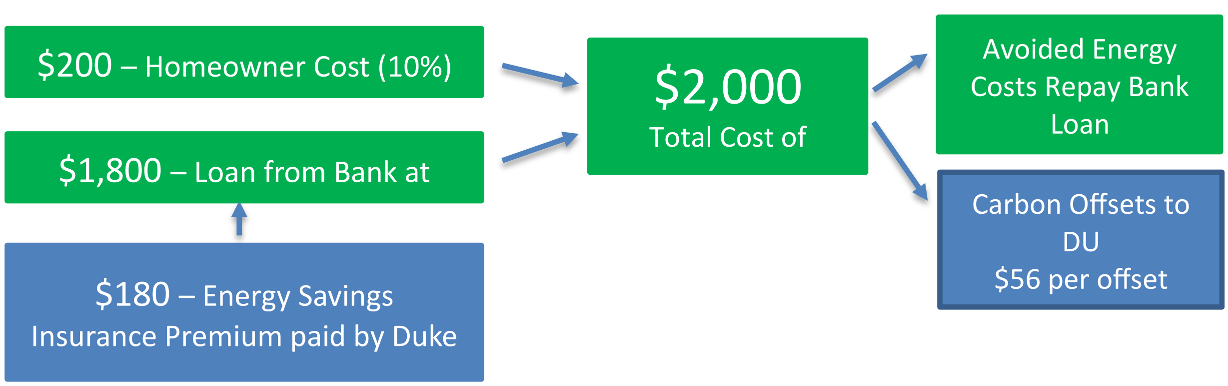
2. **Loan Loss Reserve Fund:** A loan loss reserve fund is an account that is established by loan program sponsors to incentivize financial institutions to make loans that they might otherwise consider risky (e.g., unsecured loans, loans to borrowers with low credit scores, minimal lender experience with the type of loan). A loan loss reserve reduces the risk of non-payment for the financial institution and can result in a lower capital cost for borrowers. The program sponsor keeps a percentage of outstanding loans, generally 5 to 10 percent, in a separate account to cover any loan losses that result from loan default. If interest payments on a loan have not been made for a reasonable period, usually 90 days, a financial institution may draw upon the reserve to cover the expected loss, which is normally the outstanding amount of the loan in default. This type of program uses a financial institution to administer the loans, and, if default rates for loans are low, the total cost to the University to offer the program is minimal because it does not need to set aside much capital in the loan loss reserve fund.



3. **Loan Guarantee Programs:** Loan Guarantee Programs are another type of credit enhancement mechanism typically offered by government agencies, such as the Department of Energy and the U.S. Small Business Administration, but can also utilize private funding. The loan guarantee is a more elaborate version of the loan loss reserve fund because the guaranteeing organization fully or partially guarantees payment for a loan, thereby eliminating the lender's risk. Loan guarantees can be used to motivate financial partners to offer a new type of loan program (such as an energy efficiency loan program) or reduce credit underwriting criteria to include borrowers that have a lower credit rating. Similar to a loan loss reserve fund, if default rates for loans are low, the cost to the university would be minimal because the financial institution would not need to use funds to cover loan losses, and any remaining funds would be returned to Duke, presumably to loan to new participants.



4. Credit Insurance Products: Credit insurance products are another type of credit enhancement offered by specialized insurance companies in order to reduce the risk associated with a loan or to supplement an energy savings guarantee. Like private mortgage insurance, a monthly premium is charged to protect the lender from future losses that might occur if actual reductions in energy costs are less than expected. The premium (generally between 2 to 5 percent of the expected energy savings over the life of the loan) is charged either to the bank, the contractor, or the program sponsor, which in this case would be Duke University.[21] Currently these products are offered primarily to the commercial market as insurance for energy savings performance contracts. However, they could possibly be used to provide insurance for a large-scale residential neighborhood program.

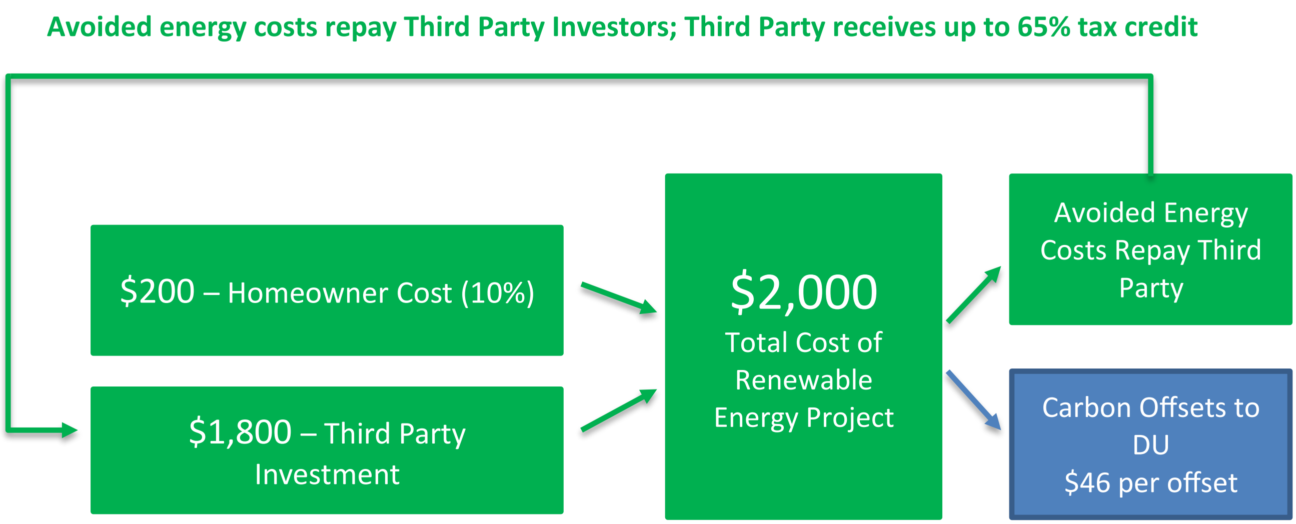


[21] Pricing provided by Angela Ferrante, Vice President, Energi, Inc, in an email dated Dec. 11, 2013.

D. Third Party Investment / Tax-Credit Investors

The federal government and many states, including North Carolina, offer tax credits for some types of energy efficiency and renewable energy projects. Tax credits can be used to offset the cost of the energy efficiency or renewable energy project undertaken and lower the total amount of funds needed to complete the project. Private investors (either individuals or for-profit companies) can take advantage of the tax credits and often partner with non-profit organizations to help reduce the overall investment into the project.

As a non-profit organization, Duke University cannot take advantage of the federal and state tax credits available in North Carolina. Private investors, such as alumni or other third party investors, however, could establish an investment pool of capital to be used to fund carbon reducing energy efficiency and renewable energy projects. In addition, homeowners can take advantage of tax credits for improvements and renewable energy investments made to their homes and thus serve as the private investor. Because the federal tax credit for residential energy efficiency improvements is 10 percent (with a ceiling of $500) and 30 percent for residential renewable energy projects (no ceiling for most residential projects including distributed solar), this financing mechanism is more attractive for renewable energy projects. In North Carolina, the tax credit incentive for residential renewable energy is 35 percent, bringing the total possible tax credit for renewable energy projects to 65 percent.[22] The Database of State Incentives for Renewables & Efficiency ("DSIRE") provides extensive information about state and federal tax credits.[23]



[22] Database of State Incentives for Renewables and Efficiency (DSIRE) website, http://www.dsireusa.org, accessed Dec. 11, 2013.
[23] The DSIRE website can be accessed at http://www.dsireusa.org.

E. Crowd-Funded Alumni Investment Program

Crowd-funded investment programs rely on small amounts of capital investment from a large number of individuals. Building on popular neighbor-to-neighbor assistance programs and crowd funding websites such as Mosaic and KickStarter, the DCOI could develop a program targeted to alumni who want to invest in energy efficiency and renewable energy projects in the Durham community. As a facilitator of the program, the cost of investment for Duke University would be minimal, and Duke would receive the carbon offsets generated from the energy efficiency measures or RECs from the renewable energy projects. The flow of funds in crowd-funded programs is similar to the third party investment example outlined above, except that there are typically more investors – at smaller amounts – and, in the case of special interest groups like alumni donors, the payback on the investment might be at lower interest rates or considered a donation for tax purposes and not repaid at all.

F. Comparison of Financing Mechanisms

To evaluate the relative costs and benefits of each type of financing mechanism, the EFC developed an Excel-based spreadsheet model to compare each of the mechanisms using a sample residential energy efficiency program. For this analysis, it is assumed that 100 Duke University employees will participate in the program each year for five years, with a total of 500 employees. The cost for each retrofit is assumed to be $2,000, with each homeowner contributing 10% and receiving a utility rebate of $250 for weatherization improvements. It is also assumed that for every participant, Duke University will pay a program cost of $450, which represents $350 for a home energy audit and $100 for a quality assurance check after the retrofit has been completed. All assumptions are outlined below:

Program Assumptions	
Annual Number of Duke University Employee Participants	100 Participants
Number of Program Years	5 Years
Average Annual Carbon Reduction per House	1.50 $mtCO_2e$/year
Average Cost of Retrofit (per household)	$5,000
Percent Paid by Homeowner	10%
Utility Rebate/Incentive	$250
Amount of Loan/Grant	$4,250/house

Duke University Program Costs (one-time)	
Energy Assessment / Audit	$350/ house
Quality Assurance / Test Out	$100/ house

Administrative, Marketing and Support Costs	
Program Administrator (DCOI Staffer)	$20,000/year
Supplies / Meeting	$1,500/year
Marketing Costs	$1,000/year
Data Management	$1,200/year

Financing Mechanism Assumptions

Term of Loan to Homeowner (in years)	5 years
Market Interest Rate - Unsecured Loans	5.50%
Loan Charge-Off Rate	5.00%
Program Interest Rate (Revolving Loan Fund)	3.50%
Program Interest Rate (Loan Loss Reserve)	4.00%
Program Interest Rate (Interest Rate Buy Down)	2.00%
Loan Loss Reserve (% of Total Loans Outstanding)	10%
Amount of Losses Lender Permitted to Recover (%)	90%
Loan Guarantee (% of Loan Guaranteed)	90%

A comparison of the start-up costs and cost per carbon offset is summarized in the table below.

TABLE 2: COST PER OFFSET COMPARISON OF FINANCING MECHANISMS

Type of Financing Mechanism	Funds needed for loan program in year 1	Total Cost to Duke University over 5 years	Reduction in carbon emissions over 10 years (MTCO2e)	Carbon Offset Cost ($/MTCO2e)
Self-Financing Using Cash and Grants	$ 223,700	$ 1,118,500	7500	$ 149
Revolving Loan Fund	$ 155,000	$ 379,174	7500	$ 51
Loan Loss Reserve Fund	$ 15,500	$ 450,859	7500	$ 60
Interest Rate Buy-Down	$ 17,064	$ 428,820	7500	$ 57
Loan Guarantee Program	$ 139,500	$ 450,859	7500	$ 60
Credit Insurance	$ 15,500	$ 421,000	7500	$ 56
Third Party Investors / Crowd-Funding	$ -	$ 343,500	7500	$ 46

The mechanisms that appear to be the best fit with the university's objectives in the short term are the interest rate buy-down and loan loss reserve fund options. Both of these programs can be established relatively quickly with a partnering financial institution, require a minimal amount of funds from the university to start the program, and require minimal university administrative costs. In addition, by partnering with a financial institution to perform the underwriting for the loans, the university reduces the internal risk of borrower default and keeps the financial transaction at arm's length.

Based solely on cost per offset, there are two less-costly options for the university to consider – a revolving loan fund and third party investors. Both of these options, however, will require a considerably longer (e.g., six month to one year) start-up time and higher administrative costs for the university. However, both of these options result in a lower cost per offset and should be considered for longer-term initiatives. Finally, the DCOI could consider issuing a request for proposals that identifies a cost per ton target with criteria tailored to the University's objectives (i.e., locally-based projects that target low-income housing communities) to create a purchasing option for Duke. The DCOI could use the pricing parameters established in Table 2 to set a realistic price per ton for offsets provided by a third party developer. The DCOI is experimenting with this approach through a partnership with the South Carolina Co-Operatives Help My House program and could pursue a similar approach with organizations such as NC GreenPower. The university will need to decide if it prefers to outsource carbon offset development by taking more of a procurement approach or prefers to retain direct control over project development. It may also consider being more involved at the outset and stepping back into a procurement role as it is satisfied that the project is developing appropriately.

CONCLUSION AND RECOMMENDATIONS

Duke University is on the leading edge for research and investment into carbon emission reduction strategies from energy efficiency projects. While the energy industry has grown tremendously over the last few years, the use of energy efficiency as a carbon offset instrument is still in its infancy and may face hurdles for widespread adoption in more formal settings such as compliance markets. Data from residential, multi-family and commercial projects has just started to be collected and analyzed, and Duke University has the opportunity to be a university leader in how energy efficiency-based carbon offset projects are developed, measured and reported, and could do the same for renewable energy projects from which the university could garner RECs to apply against its emissions baseline.

Although there are many types of energy efficiency projects in which Duke University could choose to invest, an employee benefit program focused on residential energy efficiency upgrades has emerged as the leading candidate for Duke's short- and long-term carbon offset objectives. With over 35,000 employees, the university is a trusted employer in the City of Durham and has the ability to generate high quality carbon offsets while making an investment in the local community. Using the Clinton Climate Initiative's HEAL program as a foundation, the university plans to pilot an employee benefit program in mid-2014 to test all the elements of a successful energy efficiency project including home energy evaluations, a qualified contractor network, access to low-interest financing and a simplified process for measurement and verification of carbon emission reductions. The results of the pilot – both behavioral and carbon emissions reductions – will be used to form recommendations for wider implementation of the program to Duke's employee pool to help the university reach its 2024 climate neutrality goal. Overall, an employee-based energy efficiency program realistically could provide 25 percent of the University's emission reduction needs.

Because the HEAL program is based on a proven model, it leverages existing methodologies and procedures, enabling the university to implement a pilot program quickly and efficiently. With the lessons learned from the pilot, the university can modify and enhance the program for larger scale investment into the community and potential replication by other higher education institutions. In addition, by partnering with a local financing partner – the Duke University Federal Credit Union – the University can reduce the financial risk and upfront cost of the program. Without any credit enhancements, the credit union has approved a 5.5 percent interest rate to offer to employee participants and has offered the university the option of using an interest rate buy-down mechanism to further reduce the rate to incentivize employee participation. The collaboration between the university and the credit union will also enable hassle-free loan payments through payroll deduction. This type of financing arrangement reduces risk to the university and further lowers the overall cost per offset.

Finally, EFC's analysis coupled with the DCOI's unique combination of objectives leads to the conclusion that the DCOI-HEAL employee-based energy efficiency benefit stands as the best short term solution for meeting Duke University's carbon offset objectives, with the pilot providing further insight into opportunities and challenges of an employee-based energy efficiency program. However, even by bringing the employee-based energy efficiency program to scale, the DCOI still will need considerably more offsets to meet annual demand after 2024. Even with 5,000 Duke employees participating in the program, the estimated total number of carbon offsets generated over 10 years is 75,000 mtCO_2e, which is not enough to offset the remaining 183,000 mtCO_2e needed annually after 2024.

To increase the amount of offsets and continue to bring the cost of offsets down, the university must look to larger-scale community projects that include investment in renewable energy projects (including distributed solar, large scale solar, and swine waste-based directed biogas) as well as consider more capitally intensive financing mechanisms such as a revolving loan fund or third party investment. These mechanisms, although more financially attractive, will require additional administrative support, possibly from a third party administrator. In the long run, the university should also consider participation in a voluntary carbon offset marketplace, possibly in partnership with NC GreenPower or another non-profit organization that could act as an aggregator of carbon offsets from around the state and help to bring the price of offsets down over the long term.