

SOLARIZE DUKE



Duke Carbon
Offsets Initiative
DUKE UNIVERSITY



Duke Carbon Offsets Initiative 2015 Annual Report



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Letter from the Program Manager

Looking back on 2015, I can't believe how much we've accomplished in a single year here at the Duke Carbon Offsets Initiative (DCOI). We've written papers, taught classes, designed offset protocols, planted trees, converted swine waste to energy, and the list goes on. Each day brings a different opportunity. For me, the most rewarding moments occurred when working closely with students, staff, and faculty within our community, and I wanted to share a few of these moments with you.

On the top right, David Rosen (undergrad engineering major) and Alex Albert (undergrad English major) have a great time touring our Loyd Ray Farms swine waste-to-energy system! During their time at the DCOI, they worked on unique projects that they otherwise would not have encountered at Duke.

In the middle, energy auditors from Energy Reduction Specialists check the crawl space of Duke employee Alexandra McCormick to identify ways to save energy. Alexandra sent us this picture she took to emphasize how thrilled she was to be part of our DCOI-HEAL pilot energy efficiency program as the program helped her save money on energy, make her house more comfortable, and have a positive environmental impact.

On the bottom right, our Solarize Duke Bass Connections team attend a cooking class as a team building exercise. We were all surprised to learn that Tim Profeta, Director of the Nicholas Institute for Environmental Policy Solutions (3rd from the right), is not only a great professor, but also an excellent cook! This project brought together undergraduate and graduate students, faculty, and staff to learn from each other in and outside the classroom.

It is moments like these that not only make my job enjoyable, but also possible. Each of these Duke community members helped support what we do every day, and without them we could not have achieved everything that is presented in this annual report. I want to thank all of our students, staff, and faculty members for their help in making this year a success!

Looking forward to 2016, our goal is to build upon these successes at Duke and bring these opportunities to communities across North Carolina.

Sincerely,

Charles Blain



Duke Carbon Offsets Initiative



History

In 2007, Duke University signed the American College and University Presidents' Climate Commitment (ACUPCC) and set a target of achieving climate neutrality by 2024. After being aggressive with reducing emissions on campus, Duke will have to offset an estimated 185,000 metric tons per year of carbon dioxide in 2024. The Duke Carbon Offsets Initiative was created as a branch of Sustainable Duke to help Duke University reach climate neutrality. Since its beginning in 2009, it has developed a variety of innovative carbon offset programs in swine waste-to-energy, energy efficiency, solar, and urban forestry.

Vision

To make Duke University a model climate-neutral institution and to lead peer institutions in their efforts to become climate neutral.

Mission

- To meet Duke University's climate neutrality goal by 2024 by **developing and implementing the University's strategy** for identifying, creating, and purchasing carbon offsets.
- To implement the strategy in a way that **provides educational opportunities** for students, faculty, and staff.
- To **prioritize local, state, and regional offsets** that provide significant **environmental, economic, and societal co-benefits** that are beyond the benefits of greenhouse gas reduction.
- To **facilitate and catalyze high-integrity, unique offset projects** by serving as a resource for other institutions.

Residential Solar

250+

Duke employees who received free home solar assessments

29

Duke employees who installed solar on their roofs (a total of 152 kilowatts)

4,500

megawatt hours produced over the next 25 years (estimated lifetime of solar system)



To help get the word out about the program, the students hosted four [informational sessions](#) that were attended by over 100 Duke staff and faculty.

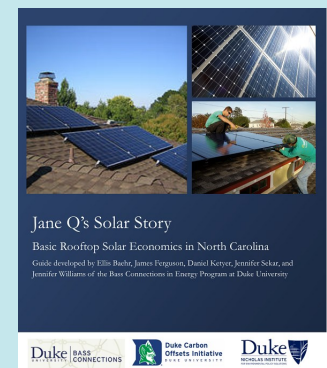


"I can say without a doubt that Bass Connections was the best experience I had at Duke. I look forward to coming back in five years and seeing the solar panels this project helped to install."

Ellis Baehr,
Nicholas School Graduate Student

Program Highlights

- The DCOI's first Bass Connections project
- Internally published "Jane Q's Solar Story" and a guide on the economic and political landscape of residential solar in NC (right)
- Developed Solarize Duke program that helped 29 employees install 152 kilowatts of solar on their roofs
- The student team won the Bass Connections in Energy's Best Poster-Expert Panel award



Jane Q's Solar Story

Project Partners: Bass Connections in Energy | Nicholas Institute for Environmental Policy Solutions | Sanford School of Public Policy | Duke Environmental Law and Policy Clinic | UNC's Environmental Finance Center | NextClimate
Yes! Solar Solutions | Southern Energy Management

Home Energy Efficiency

42

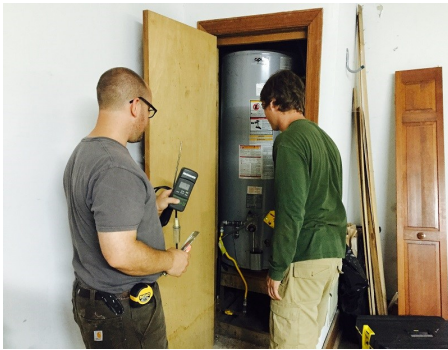
Duke employees who participated in the pre-pilot and pilot programs

\$1,000

is the value of DCOI-provided home energy assessment and test out, per participant

50%

of participants from rounds 1 and 2 who completed home retrofits through this program



ERS
Energy Reduction Specialists
North Carolina of NC Durham
2011 Pennington Drive
Durham, NC 27705
(919) 366-1070
www.ersnc.com

Date: 7/15/2015
Time: 8:30AM
Temp: 72°F
Analyst: Paul Swenson
Mobile: (336) 564-8778
Email: paul@ersnc.com

Customer Info:
Name: [redacted]
Address: [redacted]
Phone: [redacted]
Email: [redacted]

Description:
Year built: 1987
Heated sq ft: 2500 sq ft
Levels: 2
Foundation: Crawlspace
Circulation: None
Exterior material: Siding
Windows: Double-pane
Upstairs HVAC: Heat pump with electric auxiliary heat strips
of zones: 1
Cooling system: Heat pump with gas furnace
of bedrooms: 3
Gas water: Water Heater - gas, tankless
Curtain # [redacted]
Blower door # 3052 CFM @ 50pa

Building Performance Institute Home Tightness Chart

Score	Range	Rating
1-5	1-5	F
6-10	6-10	D
11-15	11-15	C
16-20	16-20	B
21-25	21-25	A

Score: 6.87 (pass results)

This means that 87% of the conditioned air you pay for escapes your home every hour.

Home Energy Assessment Process

Each participant in this program received a free home energy assessment that identified ways to increase energy efficiency. During the assessment, the BPI-certified contractor collects information about each major appliance, conducts a blower-door test and thermal camera scan to identify air and duct leaks, and summarizes all findings and recommendations into an easy-to-read report.



Program Highlights

- Completed third and final round of the program
- Published “Leveraging the Employer-Employee Relationship to Reduce GHG Emissions at the Residential Level” in the book [“Innovations in Home Energy Use: A Sourcebook for Behavior Change”](#) in partnership with UNC’s Environmental Finance Center (left)
- Hosted workshop with local municipalities’ sustainability staff to discuss expanding the program beyond Duke University

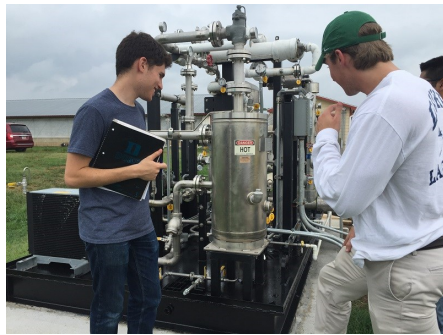
Project Partners:

UNC Environmental Finance Center | Clinton Climate Initiative
ResiSpeak | Duke Energy | NC State Cooperative Extension
Duke Credit Union | The Duke Endowment | Advanced Energy
Energy Reduction Specialists of NC | Home Performance NC

Loyd Ray Farms

35

new students, faculty, and researchers who visited LRF

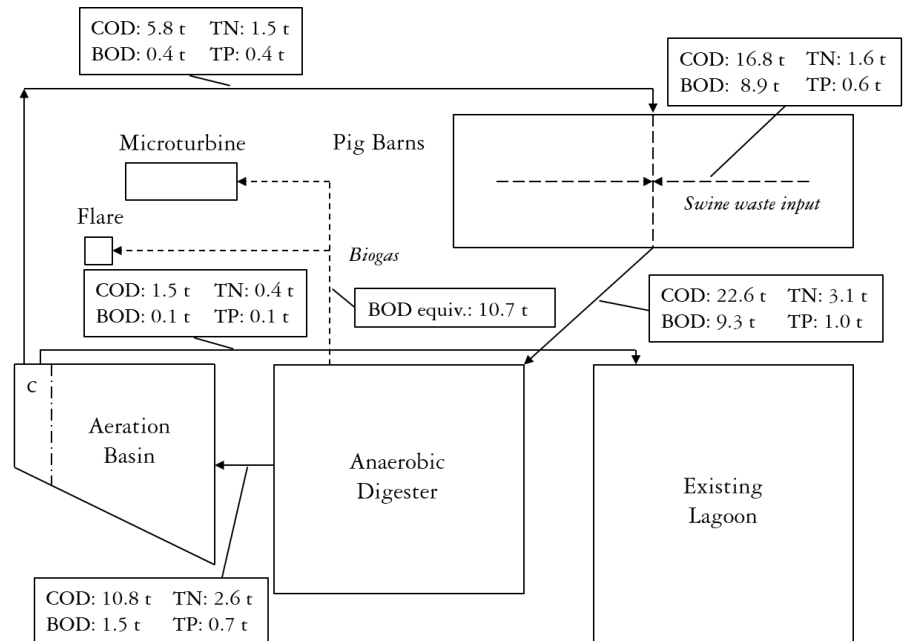


321

megawatts hours of electricity generated on-site by the microturbine

1,988

carbon offsets generated by the system



Weekly material fluxes (in metric tons per week) in the system
 COD = chemical oxygen demand. BOD = biological oxygen demand.
 TN = total nitrogen. TP = total phosphorous.

Program Highlights

- 85% uptime for the microturbine
- Submitted “Design and Assessment of an Innovative Swine Waste to Renewable Energy System” for publication
- System featured in article titled “La Farm’ Méthanisation” in French publication Systèmes Solaires: Le journal des énergies renouvelables
- Determined that the entire system removes greater than 90% of organic matter (see diagram above)



Project Partners: Cavanaugh & Associates, P.A | Duke Energy | Google, Inc.
 US Department of Agriculture | NC Division of Soil & Water Conservation

Other Offset Projects

Urban Forestry



Keep Durham Beautiful volunteers planted 41 trees on a rainy New Year's Eve near Georgetown Manor on Duke Street with help from City of Durham Urban Forestry, Trinity Properties, and the DCOI. Photo credited to Keep Durham Beautiful



Program Highlights

- Finalized Urban Forestry Carbon Offset Protocol
- Partnered with Keep Durham Beautiful to develop a corporate sponsorship program
- Developed new partnerships through Trees Across Durham
- Designed a brochure for Trees Across Durham

Photo credited to Esteban Peralta

Peatland Restoration

Program Highlights

- Partnered with Curt Richardson, professor of resource ecology at the Nicholas School of the Environment and director of the Duke University Wetland Center, to identify the carbon sequestration potential of NC peatlands
- Partnered with the Climate Action Reserve to help develop a draft protocol for peatland restoration

10.8

Metric tons of carbon dioxide equivalent that could be sequestered per acre pre year
([USFWS, 2010](#))

498,000

Acres of degraded peatlands identified in eastern NC that could be restored
([USFWS, 2010](#))

Academic Engagement

Group Master's Project

Designing an Offsets Portfolio

Graduate students from the Nicholas School of the Environment analyzed a variety of offset project types and made recommendations for a future portfolio of carbon offsets based on co-benefits, costs, and sensitivity to changes in the offsets and energy markets. The team published a [report](#) that highlighted three emission reduction portfolios, with the final recommendation being a balanced portfolio made up of six project types.



Students from left to right: Ashley Brasovan, Elena Kazarov, Ellis Baehr, Yee Zhang, and Jing Tan.

Analysis of Potential Projects

Four types of projects were analyzed:

- **Energy efficiency**
Lighting retrofits, student behavioral changes, vending misers
- **Forest Offsets**
Duke-developed or purchased local projects
- **Methane Capture Offsets**
Duke-developed projects, purchased local or vended offsets
- **Renewable Energy**
On-campus installation, Green Source Rider, community solar, REC purchasing, and Bass Connections in Energy projects

Balanced Portfolio

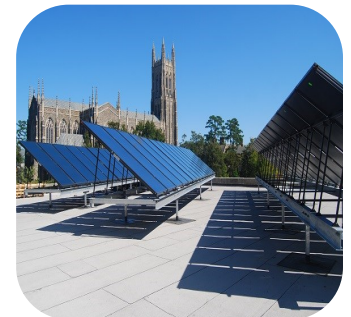
Projects pursued:

- Student behavioral changes
- All forestry offsets
- Duke-developed methane projects
- Local methane projects
- Renewable projects on campus
- REC purchasing (2024 only)

Cost in 2024 per offset: \$13.82

Cost in 2040 per offset: \$15.39

The balanced portfolio was recommended due to its project diversity and inclusion of on-campus renewables energy.

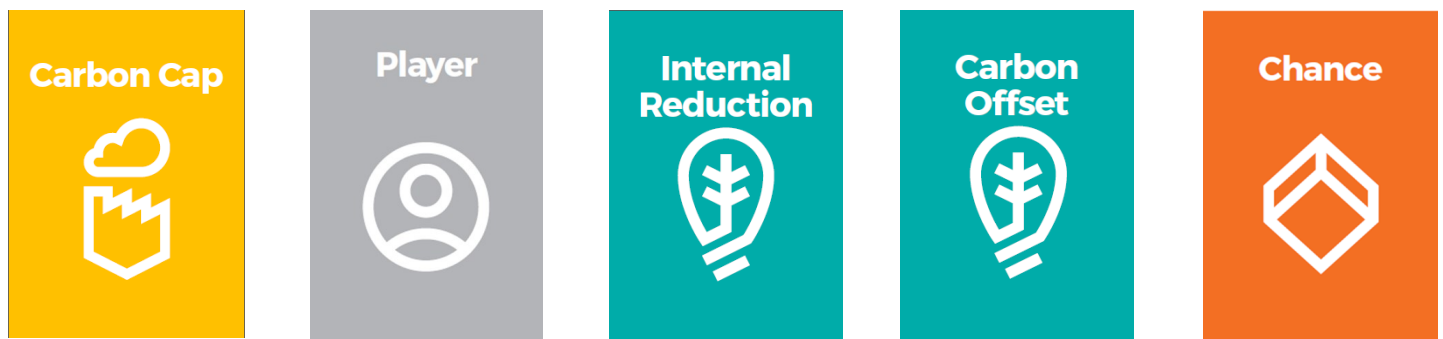


Project Students: Ellis Baehr, Ashley Brasovan, Elena Kazarov, Jing Tan, and Yee Zhang

Faculty Advisors: Tim Johnson and Charlotte Clark

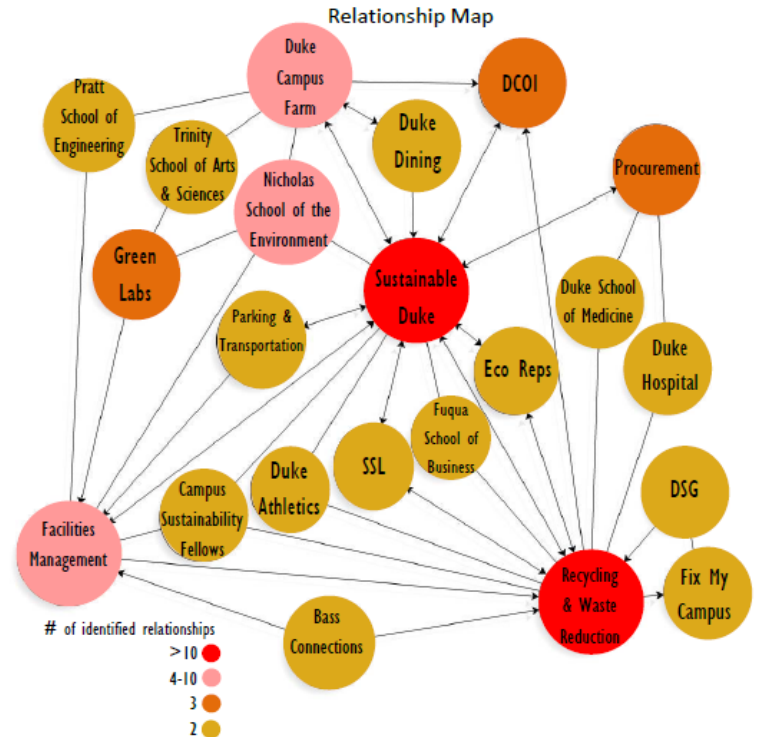
Offset: The Carbon Offsets Game

The DCOI worked with Anne Driscoll, Duke undergraduate student, to develop an educational card game to teach students about cap and trade markets and carbon offsets. The game, entitled “Offset,” was tested and revised with the help of students, staff, and faculty at Duke University. “Offset” is currently being finalized with the goal of having an open-source version by the end of 2016 that other educators can use within their curriculum.



Duke Sustainability Relationship Network Map

In order to better understand how various Duke University organizations engage with Sustainable Duke, the DCOI conducted a social network analysis in collaboration with two undergraduate students, Nicole Bautista-Peralta and Jaclyn Onufrey. This project was designed to identify which organizations have the strongest relationships with Sustainable Duke, and determine areas for future growth. The students conducted and analyzed more than 20 interviews across campus, using Nvivo to trace common themes. The map (right) illustrates the identified relationships between Sustainable Duke, the DCOI, and other organizations on campus.



Working @ the DCOI



"At the DCOI, I developed a networking database for local environmental, educational, and governmental organizations. Working with the DCOI allowed me to develop a greater understanding of the environmental efforts going on in and around Duke and helped me gain skills that will help prepare me for my future."

Madison Barnes, undergraduate Trinity College student at Duke, Spring 2015



"With the DCOI, I gained both technical and interpersonal skills, made connections with faculty and staff on campus, and learned invaluable research techniques. I always felt like my work was an important contribution to the Duke community, both present and future."

Jaclyn Onufrey, undergraduate Trinity College student at Duke, Spring 2015



"Interning with the DCOI took me in a direction I never saw myself going as an engineering student: marketing. Working on marketing analysis for the Clinton Climate Initiative and the DCOI taught me about the psychology of sustainability marketing and how to conduct surveys and focus groups. It was a fun environment, and it reminded me that engineering can't solve all of the world's problems."

David Rosen, undergraduate engineering student at Duke, Summer 2015

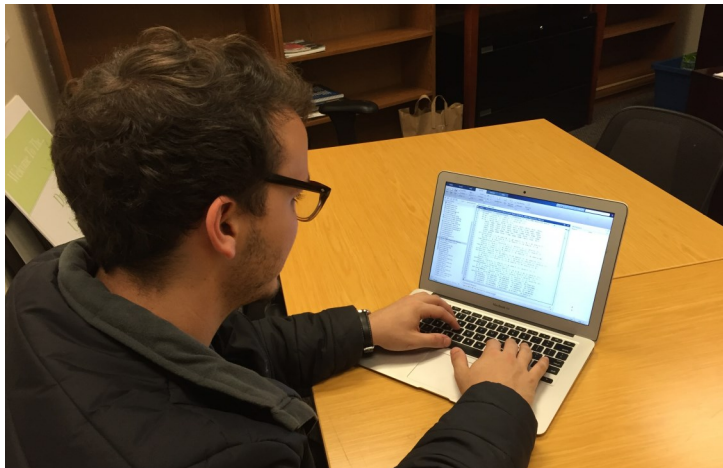


"In the beginning of the semester, I estimated the emissions from Duke's air travel, teaching me to realize the impact extensive travel has on the environment. I then researched the potential use of biomass fuel to replace natural gas at Duke as it is a growing source of renewable energy. My final project was researching the potential of an internal carbon fee to assess the feasibility at Duke."

Brenna Milligan, undergraduate Trinity College student at Duke, Spring 2015

Carbon Offset Purchases

Help My House: Residential Energy Efficiency Project



Above, Aaron Newman, Duke undergraduate student, analyzes energy data from Help My House as part of his work-study position.

The DCOI purchased offsets from the [Help My House](#) program, a rural energy savings program that provides loans to homeowners for energy efficiency upgrades. On average, participating households have reduced their energy use by 35%, save \$400 per year after loan payments, and generate 4 offsets per year. The DCOI's support of this project provides students a hands-on learning experience estimating the emission reductions from energy efficiency improvements.



Shape Up Your Home for Energy Savings

Green Assets: Middleton Place Woodlands Conservation Project



Above, Charles Adair, Tatjana Vujic (former Director of the DCOI) and Brian Murray (Nicholas Institute) accept an award from the Green Assets team honoring Duke University for its commitment to forest conservation.



The DCOI purchased offsets from The Middleton Place Woodlands conservation project, developed by [Green Assets, Inc.](#), to support the first compliance-grade avoided forest conversion offset project recognized by the California Air Resources Board. The project conserves 3,700 acres of southern coastal forest near Charleston, South Carolina.

**For more information on the
Duke Carbon Offsets Initiative, please visit
sustainability.duke.edu/carbon_offsets/**