HARNESSING *the* SUN

A Case Study of Solar Energy Deployment at Agnes Scott College

AGNES SCOTT COLLEGE

Southface

Harnessing the Sun:
A Case Study of Solar Energy Deployment at Agnes Scott College

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On the cover: The solar array at Gellerstedt Field

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By Jennifer Rich Kaduck

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Summary: Case study reveals how Agnes Scott College successfully deployed solar arrays on its campus

Agnes Scott College and Southface Energy Institute have released a case study detailing how Agnes Scott became the first non-profit to produce solar power through Georgia Power's Advanced Solar Initiative (GPASI). This case study, funded by the Turner Foundation, offers specific insight into creative approaches to overcome the challenges non-profits face with regard to solar power projects.

Established in 1889, Agnes Scott is an independent liberal arts college for women located in Decatur, Georgia. In January 2015, Agnes Scott completed its fifth solar photovoltaic (PV) project. The college now has 238 kilowatts (kW) installed, which produce approximately 342,200 kilowatt hours (kWh) per year of solar electricity—enough clean, virtually carbon-free energy to power 31 average-sized U.S. homes each year. The arrays are part of the college's plan to reduce its carbon footprint and become carbon neutral by 2037.

The college's president, Elizabeth Kiss, says implementing solutions to fight climate change fits squarely within the college's mission "to educate women to think deeply, live honorably and engage the intellectual and social challenges of their times." Southface's executive director, Dennis Creech, adds, "These solar projects show what can be done when barriers are removed and a committed non-profit partner takes the lead."

Creative Financing

Through GPASI, approximately 750MW of solar capacity will be installed in Georgia by the end of 2016. Georgia Power will buy the solar electricity for a set price and term. In 2013, Agnes Scott was the only non-profit to successfully build a solar project in the first year of GPASI. Georgia Power received more applications than it could fund and instituted a lottery process to select projects. The college won approval through GPASI to build six arrays, four of which were completed as GPASI projects. Through 20-year, fixed-priced contracts, the solar power produced by the four GPASI arrays at Agnes Scott is inserted onto the electricity grid. The fifth array was financed by Agnes Scott and all the power is used onsite. The sixth array was not built due to the inability to find investor financing.

Agnes Scott College President Elizabeth Kiss

As a non-profit entity, Agnes Scott was unable to use federal tax incentives that shorten the payback period for taxable entities. This meant that if the college financed the solar projects itself, the effective cost of the solar energy would be far greater than a project financed by a taxable entity. Agnes Scott overcame this limitation by securing third-party investment partners that were eligible for the tax incentives.

Four of the five solar arrays were financed by a creative investor model that provides a low-risk investment opportunity at a reasonable rate of return (12-15%) with a payback period of five to six years. The investors paid the upfront costs of the solar generating equipment and installation, and leased the ground or roof space from the college. The investors capture the tax credits, equipment depreciation, and payments by Georgia Power for the energy produced. The college retains the resulting renewable energy credits (RECs), allowing for a reduction of the campus carbon footprint (see box below for more on RECs).

One solar array is owned by the college and the electricity it produces helps power the Bradley Observatory where it is located. This array was funded by the college's Green Revolving Fund, a financing tool that returns utility savings to future efficiency projects. Most importantly, this array provides a hands-on laboratory where students can study physics, mathematics, and astronomy, while learning about the issues associated with climate change and solar energy production.

Innovative Design

Agnes Scott's 100-acre campus is graced by historic buildings and more than 2,000 trees. Old roofs and shade trees presented challenges to the deployment of the arrays. With this in mind, Inman Solar, an Atlanta-based solar company that specializes in medium- to large-scale solar projects, partnered with Agnes Scott to design and install arrays that minimize costs, optimize energy production, and blend with the beautiful campus.

This case study describes the unique design features of each array. Perhaps most interesting is the supporting structure for the West Parking

About Renewable Energy Credits

Over the next 20 years, the five solar arrays at Agnes Scott will provide the college with more than 5,000 tons of greenhouse gas reduction through application of the concept of renewable energy credits (RECs). RECs represent the legal rights to the environmental benefits associated with the generation of renewable energy.

Each megawatt hour (MWh) of renewable electricity reduces the need for one MWh of conventional electricity, thus avoiding the greenhouse gas emissions and other negative environmental effects related to conventional electricity generation.

RECs provide organizations and individuals with a mechanism to keep the legal title to the environmental benefits of renewable energy distinct from the flow of electrons.

In each of the legal documents associated with the solar arrays, Agnes Scott reserved the legal rights to the RECs so that it can subtract the greenhouse gas reductions from the campus carbon footprint.

solar array. It is a new design solution for PV support (or "racking") for canopy-mounted arrays. Inman Solar, Quest Renewables, Georgia Tech Research Institute, and a private investment company partnered with Agnes Scott as the first full-scale demonstration site for this new racking system called the "QuadPod."

This racking system was developed at Georgia Tech's Carbon Neutral Energy Solutions Laboratory, where research funds from the U.S. Department of Energy are used to find solutions for reducing the cost of solar energy.

A Model for Non-profits

This case study can serve as a model for other non-profits seeking to take advantage of solar power. In addition to providing information on how to pursue similar projects, the case study also contains links to sample documents, such as the roof lease between the college and its solar investors.

About Southface

Based in Atlanta, Georgia, Southface is an independent 501(c)3 organization that has promoted sustainable development and green building through education, research, advocacy and technical assistance since 1978 under the governance of a member-elected board of directors.

Southface began as a volunteer organization promoting solar installation in a residential context. Recognizing the connection between energy consumption and environmental impact, the organization has always focused on energy and water efficiency. As the organization developed, Southface engaged more deeply with stakeholders and strategic partners to transform the building market in the Southeast.

Southface partnered with the Greater Atlanta Home Builders Association to launch the EarthCraft program in 1999. Providing a practical blueprint for green building and sustainable development, the EarthCraft family of programs has grown from single-family homes to include multi-family, light commercial, historic building, and community certifications. To date, the EarthCraft program has certified more than 35,000 homes and will reach 40,000 in 2015.

The immense success of the EarthCraft program is largely due to the adoption of green building certification requirements in Georgia's Qualified Allocation Plan. Southface led the advocacy efforts to include the provision in the state's Low Income Housing Tax Credit Program, and this policy has positively affected hundreds of families throughout Georgia. The State of Virginia quickly followed suit, and the launch of EarthCraft Virginia soon followed.

Southface received funding from the U.S. Department of Energy and the Georgia Environmental Finance Authority to open a training center in 2011. The Southeast Weatherization and Energy Efficiency Training (SWEET) Center provides vocational training, certification based training, and continuing education training for building professionals.

The SWEET Center is certified by the International Renewable Energy Council, the U.S. Green Building Council, the Building Performance Institute, and the Department of Veteran's Affairs. The SWEET Center is uniquely equipped to provide building science, construction, design, and safety curriculum for sustainable building practices.

*For more information about Southface, visit **southface.org**.*

Southface

Introduction

Find Out More Online

To learn more about Agnes Scott College, visit **agnesscott.edu** and **agnesscott.edu/sustainability**.

Founded in 1889, Agnes Scott College is an independent, undergraduate college for women in Decatur, Georgia, with just under 1,000 students. The college's mission to "educate women to think deeply, live honorably and engage the intellectual and social challenges of their times" is carried out by providing a dynamic liberal arts and sciences curriculum so that students and faculty can realize their full creative and intellectual potential.

The college fosters an environment in which women can develop high expectations for themselves as individuals, scholars, professionals, and citizens of the world. Agnes Scott also strives to be a just and inclusive community that expects honorable behavior, encourages spiritual inquiry, and promotes respectful dialogue across differences.

Agnes Scott College is classified as a 501(c)3 non-profit institution by the Internal Revenue Service. The college functions as a non-profit in terms of all rules for donations and tax benefits. Because of this status, the college, like all other non-profit institutions, is not eligible for state or federal tax credits. Therefore, Agnes Scott was unable to use federal solar tax incentives that shorten the payback period for taxable entities.

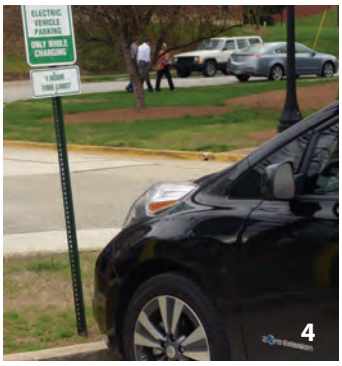
The residential campus, nationally recognized for its beauty, gives students a sense of place, purpose, and responsibility. Since 2007, that sense of place and purpose has focused on sustainability and climate action. These are priorities at the college and an integral part of Agnes Scott's strategic plan.

In addition to the recent inclusion of solar energy production on campus, several other major steps have been taken since 2008 to minimize the negative impacts the college has on the environment (see page 7).

Campus Eco-Initiatives at Agnes Scott College

Since 2008, Agnes Scott has completed several projects designed to advance the college's sustainability goals. These projects include:

- Charter signatory to the American College & University Presidents' Climate Commitment (ACUPCC)
- Climate Action Plan developed to guide Agnes Scott to climate neutrality by 2037
- Carbon emissions reduced by 20%
- Green Revolving Fund created to combine donor funds and projected savings to support energy and water efficiency upgrades
- Environmental studies and sustainability minor established
- Two historic buildings renovated to LEED Silver and Gold standards
- Greenhouse gas inventories performed
- State-of-the-art geothermal heating and cooling system installed at Campbell Hall
- Water use reduced by 35% in Winship Hall through installation of low-flow toilets, which will be installed campuswide by 2017
- Electric vehicle charging station installed
- Eco-themed residential house established to allow students to practice hands-on sustainability
- Award-winning recycling and composting program developed, leading to annual 60-75% waste diversion rate



Campus Eco-Initiatives —
1. A state-of-the-art geothermal heating and cooling system was installed at Campbell Hall.
2 & 3. Campbell Hall was renovated to the LEED Gold standard.
4. A charging station for electric vehicles was installed.
5. An environmental studies and sustainability minor was established.

Gellerstedt Field — Located at the athletic complex

Agnes Scott College's Solar Arrays

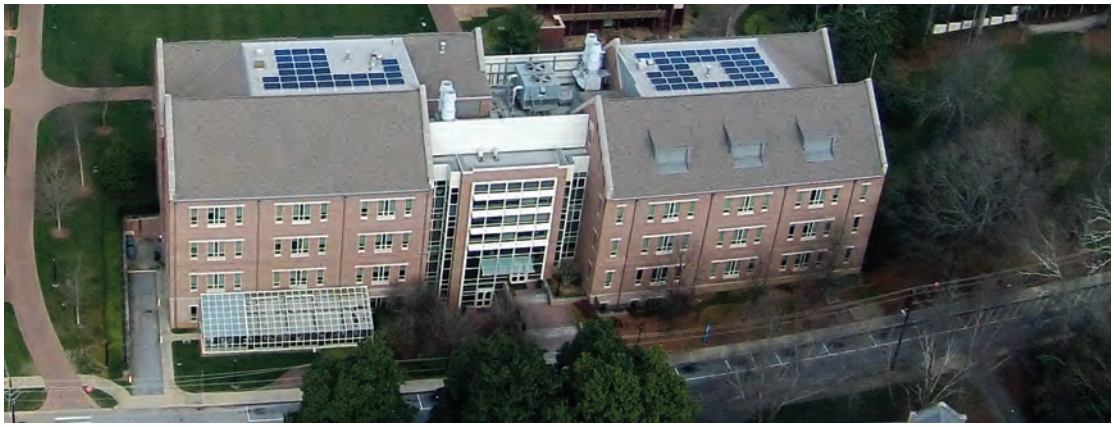
Combined, the five solar arrays at Agnes Scott produce 342,200 kilowatt hours (kWh) of clean, vitually carbon-free electricity per year—enough to power 31 average-sized U.S. homes. Through 20-year, fixed-price power purchase agreements with Georgia Power, most of the solar power produced at Agnes Scott is inserted onto the electricity grid. Four of the arrays were financed by a creative investor model that provided Agnes Scott's investment partners a low-risk investment opportunity with an attractive rate of return.

The **Bullock Science Center array** was the only solar project completed at a non-profit institution during the first year of GPASI (2013). The system is split into a west array and an east array located on separate wings of the science center.

The **Office of Facilities array** was originally chosen in the 2013 GPASI lottery; however, the poor condition of the building's roof required that it be replaced before an array could be installed. The college ran out of time to build this array during the first round, but the project was selected again in the 2014 lottery. The college replaced the roof and the array was completed in 2014.

The **West Parking array** is a unique, first-of-its-kind parking canopy developed at the Georgia Tech Research Institute (GTRI) (see Overcoming Challenges on page 19 for more details). This array was custom designed and installed by Inman Solar, Quest Renewables, and the GTRI research team. The canopy, called the QuadPod, serves as a racking structure for the solar panels and provides shelter for cars parked underneath. The QuadPod was financed by the college and installed by Quest Renewables with construction management by Inman Solar.

With its prominent campus location at the college athletic complex, the **Gellerstedt Field array** allows close-up viewing by students, visitors, and the campus community. Mounted on top of a stone wall that separates the tennis court complex from the soccer field, the PV panels are affixed to a custom designed racking system arranged in two horizontal rows.



Bullock Science Center — Agnes Scott's first solar array, 2013; photo courtesy Inman Solar

Figure 1. Agnes Scott College's Solar Arrays

Combined, the college's five solar arrays produce 342,200kWh of electricity per year (January 2015).

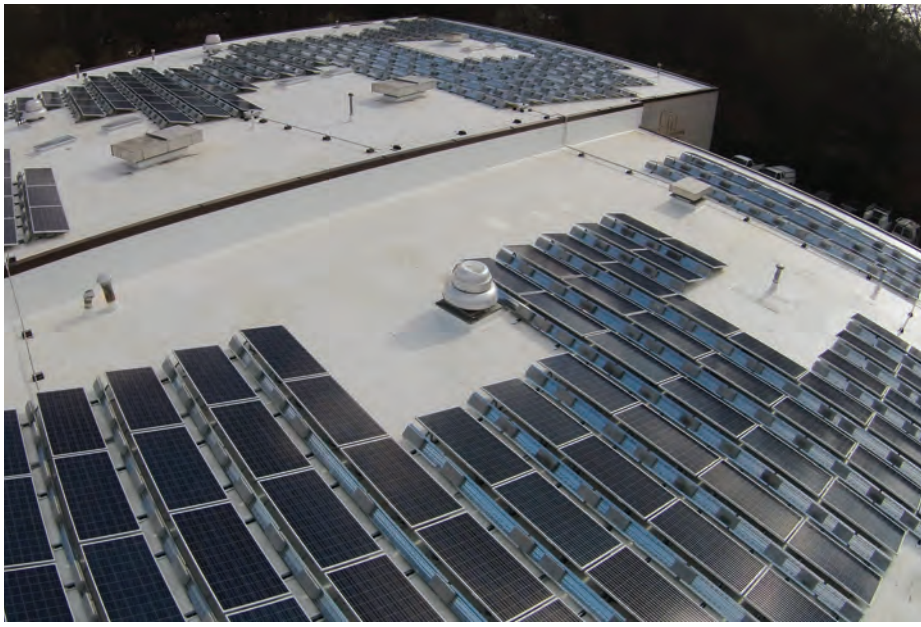
Although the **Bradley Observatory array** was chosen in the GPASI 2014 lottery, the college decided to remove it from the program and use the array as a living laboratory for student learning and research. Instead of selling the electricity to Georgia Power, the college uses the electricity to help power the observatory building.

With teaching and research needs in mind, the system was custom designed by Inman Solar. The array is ballast-mounted on the roof of the observatory near other teaching tools, including the historic 30-inch Beck telescope, modern telescopes of various sizes, the Delafield Planetarium, a weather station, and a light detection and ranging (LIDAR) facility that uses a laser to study atmospheric conditions.

The array adds to this hands-on laboratory where Agnes Scott students and others can study the principles of physics, mathematics, and astronomy, while learning about the issues associated with climate change and renewable energy production.

With grant funding from Porsche AG, Agnes Scott students are designing an interpretive display of all the college's solar arrays that will be housed in the lobby of the observatory. This display will showcase real-time solar energy data from each array, describe the energy and environmental attributes of the arrays, and explain how the arrays reduce carbon emissions.

Technical and cost details of the arrays are summarized in Table 1 on page 10. There is also a link to view and/or download the full technical specifications for each array.



Office of Facilities — Completed in 2014; photo courtesy Inman Solar

Find Out More Online

For the full technical specifications and drawings, click on the array names in Table 1.

To view a video of the arrays, **click here**.

Table 1. Agnes Scott College Solar Array Details*

	GPASI Round	System Type	Size (kW)	Electricity Produced (kWh/yr)	CO_2 Reduced (tons/yr)	Water Saved † (gal/yr)	Georgia Power Interconnection Fee	Installed Cost ‡	Cost per Watt ‡	Payback (years) §	Internal Rate of Return (%) §	Design & Installation	Investor
Bradley Observatory	N/A	Roof-mounted ballast PV	6	8,700	6	5,220	N/A	$16,200 Δ	$2.83	10.5 Δ	5.9 Δ	Inman Solar	Agnes Scott
Bullock Science Center	2013	Roof-mounted ballast PV	20.65	29,900	21	17,941	$3,492	$48,693	$2.36	5	14.7	Inman Solar	Private investment company
Gellerstedt Field	2014	Pole-mounted custom PV	18.585	24,700	19	14,820	$8,747	$48,498	$2.61	5.8	12.1	Inman Solar	Laura and Rutherford Seydel/ Seydel Solar
Office of Facilities	2014	Roof-mounted ballast PV	100	144,700	101	86,820	$361	$230,560	$2.31	4.9	15.1	Inman Solar	Private investment company
West Parking	2014	Canopy-mounted PV	92.72	134,200	94	80,555	$1,852	$213,775 ¶	$2.31 ¶	4.9	15.1	Quest Renewables, GTRI, Inman Solar	Private investment company
TOTAL			**237.955**	**342,200**	**241**	**205,356**	**$14,452**	**$557,726**					

* *From anaylses provided by Inman Solar*

† *Water not consumed at Georgia Power electricity plants*

‡ *Includes Georgia sales tax; does not include tax incentives, Georgia Power interconnection fee, or personal property taxes*

§ *Includes tax incentives*

Δ *As a non-profit, Agnes Scott College is not eligible for tax credits, nor does it pay sales tax*

¶ *Does not include Agnes Scott's cost for structural steel for the QuadPod parking canopy of $106,874*

Georgia's Energy Landscape

Despite its location in the Sun Belt, the production of solar energy in Georgia has lagged behind several states with lower sunlight intensity, such as New Jersey. Laws, regulations, incentives, and other energy policies that play an enormous role in the feasibility of solar energy projects vary widely from state to state.

The primary legal and economic factors in Georgia's particular energy landscape that influenced Agnes Scott's solar projects are detailed below.

Relatively low electricity prices

Consuming more than 8 million kWh of electricity per year, Agnes Scott paid its electrical utility, Georgia Power, an average of 7 cents per kWh for electricity in 2012. To receive this rate, the college manages its electricity use to take advantage of lower off-peak rates and uses Georgia Power's School Load Management, Real Time Pricing, and other rate structures.

Renewable portfolio standards

Like most states in the southeast, Georgia has no mandatory renewable portfolio standards requiring utilities to produce certain percentages of electricity from renewable, low-carbon intensity fuels, such as solar and wind (see Figure 2).

Georgia Power continues to rely primarily on fossil fuels, and in 2014, obtained electricity from the following sources: coal 41%, gas and oil 35%, nuclear 22%, and hydro 2%. Georgia Power is now actively growing a renewable energy mix.

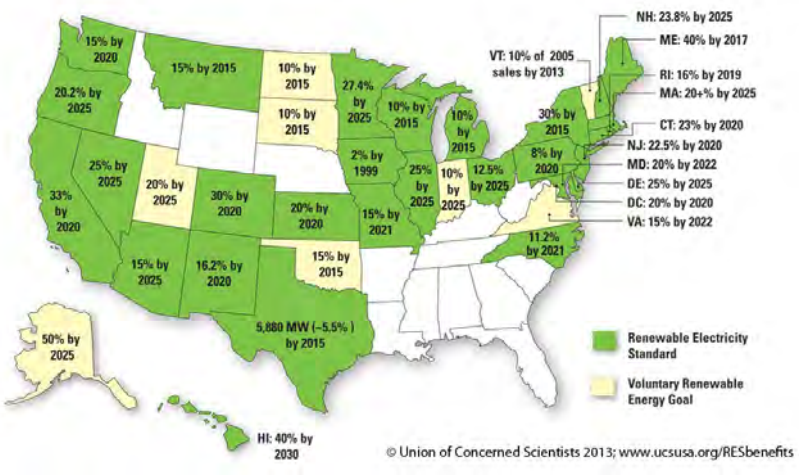
Tax incentives

As a non-profit institution, Agnes Scott is not eligible for the 30% federal tax credit for the cost of solar equipment and installation. This tax credit is one of the most important tools for shortening the payback period of solar projects.

As a non-profit, the college is also not eligible for the federal tax deduction for depreciation of solar equipment, which can reduce the cost of solar projects by an additional 20% or more, depending upon the individual circumstances of the taxpayer.

In 2008, Georgia offered a state tax credit of up to 35% of the total installation cost (up to a maximum of $10,500), but the program ran out of funding. Currently, most counties in Georgia, including DeKalb County where Agnes

Figure 2. State Renewable Electricity Standards



Twenty-nine states and the District of Columbia have renewable electricity standards in place, 17 of which have set targets at 20% or greater. Another eight states have voluntary targets for renewable electricity.

Scott is located, offer no property or sales tax reductions for solar equipment.

The Georgia Territorial Electric Service Act of 1973

During the time that the arrays were completed, Agnes Scott was not able to use a kind of financing called a power purchase agreement, which was available in many states and allows non-profit operations to take advantage of federal tax incentives. Electric utilities in Georgia claimed the exclusive right to sell electricity under a Georgia law commonly known as the Territorial Act.

Georgia Power Advanced Solar Initiative

Created in 2012, this initiative provided a unique window of opportunity for Agnes Scott and others to install solar PV arrays, subtract the renewable energy credits from their carbon footprints, and insert clean low carbon intensity electricity onto the state electrical grid. Because of the 20-year, fixed-price contracts of 13 cents per kWh for small scale projects, this power purchase program provided an incentive and enabled the college to find third-party investors.

Solar Power Free-Market Financing Act of 2015

Enacted after Agnes Scott completed its five solar projects, this law removed a major obstacle to the distributed generation of solar power. The Act expressly authorized third-party financing for residential and commercial solar electric systems through power purchase agreements.

This state law applies to the generation of solar energy to be used onsite by retail customers or to be fed back to the grid. However, it limits solar capacity to 10kW for residential systems and caps commercial system capacity at 125% of a site's power use.

Find Out More Online

To learn more about the Georgia Power Advanced Solar Initiative, visit **georgiapower.com** and **psc.state.ga.us**.

The West Parking array (left) features the innovative QuadPod racking design. The Bradley Observatory array (right) is used by students and faculty as a hands-on teaching tool. Photos courtesy Inman Solar.

Agnes Scott's Rationale for Campus Solar Energy Deployment

For Agnes Scott to commit to solar development on campus, the following underlying factors were critical.

Consistency with Agnes Scott's Mission

The climate crisis creates unprecedented opportunities for education, research, and leadership. Taking responsibility for and facing up to the challenge of making significant reductions in our greenhouse gas emissions fit squarely within the college's mission to "educate women to think deeply, live honorably, and engage the intellectual and social issues of their times."

Consistency with Agnes Scott's Strategic Plan

Because of the deliberative and inclusive nature of the strategic planning process, Agnes Scott's efforts to become climate neutral received early support from students, faculty, staff, alumnae, the college president, and the Board of Trustees. Climate action falls under the commitment of "Living Honorably," which is one of six strategic goals of the college.

Consistency with Agnes Scott's Climate Action Plan

In 2009, Agnes Scott's Board of Trustees adopted a climate action plan (CAP) to guide the college to climate neutrality by 2037 (see box on page 14 for details on the CAP). Without this long-term commitment to change the sources of energy on campus, the college would not have been prepared to undertake solar so quickly.

Importance of Other Environmental Benefits

In addition to reducing harmful greenhouse gas emissions, Agnes Scott's reduced demand for traditional electricity reduces water consumption and toxic air pollution at Georgia Power's electrical plants. Each year, this reduced demand cuts water consumption by 205,356 gallons and reduces air pollution through the elimination of 3,035 pounds of nitrogen oxide and 706 pounds of sulfur oxide that would otherwise have been emitted to the atmosphere. Over the next 20 years, the five solar arrays at Agnes Scott will save more than 4 million gallons of water and eliminate more than 5,000 tons of greenhouse gases and 75,000 pounds of other types of air pollutants.

Potential for Educational Benefits

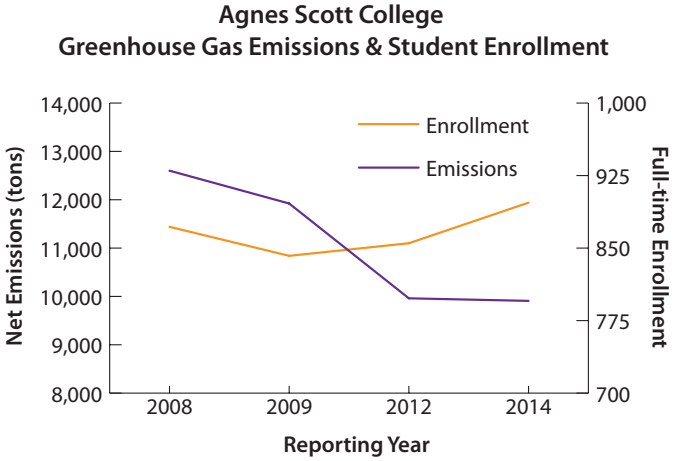
The solar arrays on campus are visible signs of climate action and leadership by a non-profit institution, thus serving a broad educational purpose. They show that Agnes Scott is overcoming the challenges associated with renewable energy production as part of its commitment to combat climate change and provide a model for others to follow.

The Gellerstedt Field, West Parking, and Bradley Observatory arrays, which are all clearly visible to visitors, draw attention to the climate change issue and provide inspiration that renewable energy solutions are indeed possible.

The willingness of the college to take risks and try the new concepts associated with these

About Agnes Scott's Climate Action Plan

On October 29, 2009, Agnes Scott's Board of Trustees adopted a Climate Action Plan to achieve climate neutrality by 2037. To set reduction goals for the college's first CAP, the college's Sustainability Steering Committee agreed to three phases of action.



Phase 1 strategies include energy conservation through behavioral change, education, and incentives; energy efficiency through mechanical retrofitting and maintenance programs; design, renovation, and construction of efficient buildings; alternative transportation programs for commuters; and reduction of waste to landfills through green purchasing, recycling, and composting.

Phase 2 strategies incorporate renewable energy technologies.

Phase 3 strategies focus on purchasing green power and renewable energy credits or carbon offsets.

The CAP established a gradual reduction in carbon emissions from all sources of greenhouse gas (GHG) emissions, including all direct emissions from sources owned or controlled by the college; indirect emissions from purchases of electricity, steam, heating, and cooling; and all other indirect emissions. At 68% of all total emissions, the second category — indirect emissions from purchases of electricity, steam, heating, and cooling — is the college's largest source of GHG emissions.

From 2008 to 2012, the college focused on Phase 1 and reduced its GHG emissions by more than 20% (see graph above). This was achieved through various energy conservation efforts at the college, weather variations, and reduced use of coal at Georgia Power plants.

With the establishment of solar energy generation on campus in 2014-2015, the college has begun implementing Phases 2 and 3. The five arrays reduce the carbon footprint of the college by 241 tons each year, a 2.5% overall reduction in GHG emissions compared to 2012 levels.

Find Out More Online

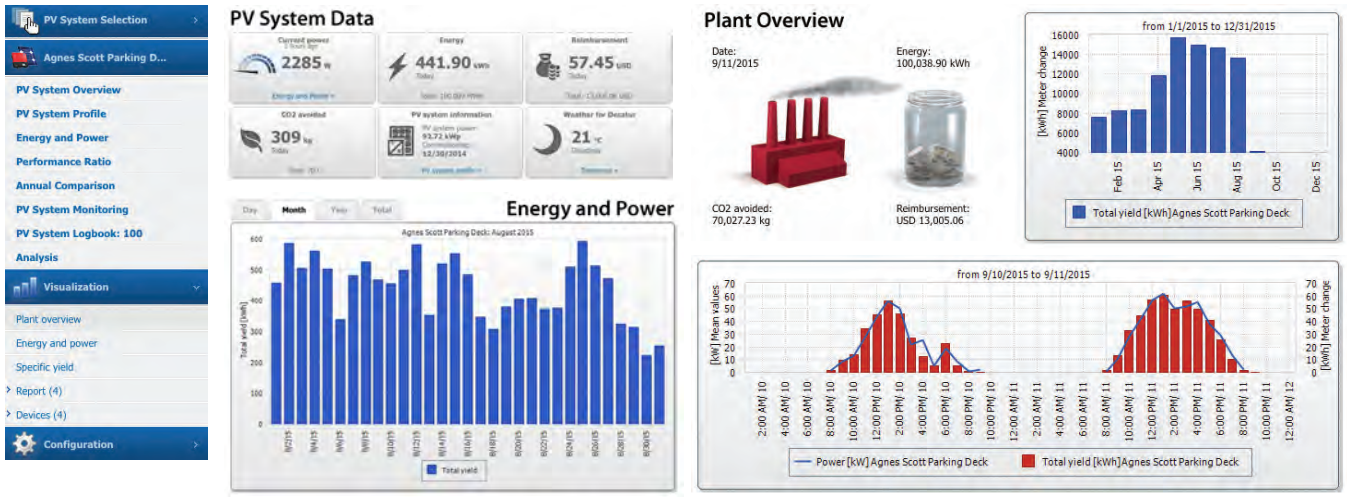
To learn more about Agnes Scott College's Climate Action Plan, and those of other participating colleges and universities, visit **acupcc.org**.

projects show the college's determination to live honorably in a community where justice and integrity are important. More specifically, Agnes Scott's five solar arrays provide long-term educational opportunities as a living laboratory for multidisciplinary teaching and research.

Students, the campus community, and visitors can learn how solar energy is produced and the extent to which it can replace traditional forms of energy and reduce greenhouse gas emissions. The Bradley Observatory array, which is owned by the college, not only helps power the observatory building, but more importantly functions as a hands-on laboratory where students can study physics, mathematics, and astronomy, while learning about the issues associated with climate change and solar energy production.

Student and faculty involvement was an integral part of the planning and implementation of the arrays. Drawing inspiration from Agnes Scott's physics and astronomy professors,

About Sunny Portal



The performance of Agnes Scott's solar arrays is monitored through Sunny Portal, a web-based system from SMA Solar Technology AG. It continuously collects, analyzes, and displays real-time and historical data, including array type and size, energy generated, weather conditions, dollars earned from the sale of solar electricity to Georgia Power, and the amount of CO_2 avoided. The password protected site is accessible to authorized Agnes Scott students, faculty, and staff. The figures above show data from the West Parking array.

who had installed a small solar and battery backup to solve the problem of powering the rotating dome of Bradley Observatory, the college focused on how the new arrays could be incorporated into the curriculum.

With faculty guidance, students are designing interpretive materials for the lobby of the observatory to explain the solar arrays and the college's use of renewable energy to reduce conventional electricity. Students will have access to real-time energy production data and will be able to calculate the greenhouse gas emission reductions of this project, as well as future projects, that will reduce the college's climate footprint even more.

Serving as a research demonstration site, the West Parking array is the first location in the world to deploy the new QuadPod, a technology that will lower the cost and speed up solar deployment worldwide. Agnes Scott students and others can learn about emerging solar technologies at this array.

Examples include an economics student who designed the form for evaluating energy projects (such as the Bradley Observatory array) that are being considered for funding by the college's Green Revolving Fund and a mathematics-engineering dual-degree student who analyzed data collected from the "Sunny Portal" website (see box above). Gaining valuable work experience, three sustainability fellows employed at the college's sustainability office after graduation provided considerable technical assistance over the last two years as the solar projects unfolded.

Centrally located on campus, the West Parking array is easily accessible to the college community and visitors. Photo courtesy Inman Solar.

Keys to Success

Find Out More Online

To view news coverage of Agnes Scott's solar arrays, **click here**. To read a *New York Times* column about how colleges and universities, including Agnes Scott, are using revolving funds to pay for energy efficiency projects, **click here**.

A number of factors contributed to the success of the solar projects at Agnes Scott. Each of these elements of success can help other non-profits as they approach installation of solar arrays.

Long-range Planning

Agnes Scott identified renewable energy as a component of the college's strategic plan and CAP. These long-range plans laid a foundation of high-level support for reducing carbon emissions and implementing renewable energy projects years before the solar projects were developed. This planning made the eventual approval process for the solar arrays much easier, because college leadership already understood and supported the underlying reasons for the projects.

Research

Two types of research were critical to the successful installation of the solar arrays: 1) research regarding the college's carbon footprint and its options for carbon reduction, and 2) research into the feasibility of renewable energy on campus. Each type is summarized below.

Agnes Scott's carbon footprint

A close look at Agnes Scott's GHG inventory made it clear that GHG emissions from purchased electricity composed the largest portion of the college's carbon footprint. Therefore, reducing the use of purchased electricity would be essential to reach climate neutrality by 2037. An effort to determine what GHG reductions were likely to occur in Georgia Power's fuel mix over the next 20 years found no clear answers. However, carbon intensity will likely be reduced over time, depending on the outcome of the U.S. Environmental Protection Agency's "Clean Power Plan," an initiative that aims to reduce national CO_2 emissions from the utility power sector 32% below 2005 levels by 2030.

Feasibility of on-campus renewable energy

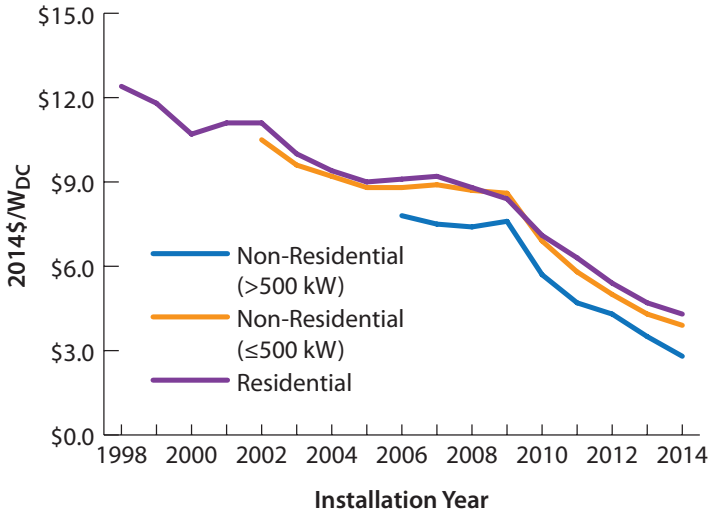
In 2008, Agnes Scott's Office of Sustainability began researching the feasibility of renewable energy production on campus, including biomass, solar, wind, and geothermal technologies. This led to the deployment of solar and geothermal systems in 2013 and 2014. Research continues on possible wind energy opportunities for the campus. Biomass has been eliminated from further consideration due to its high carbon intensity.

In 2011, the college returned to a campus solar evaluation done in 2009 and began researching updated solar technologies, costs, trends, and successful solar projects. While the research showed that the cost of solar PV energy deployment had fallen significantly (see Figure 3), in 2012 it appeared that solar PV was still too expensive for the college, as a non-profit institution that could not take advantage of the federal solar tax incentives.

Seizing a Unique Opportunity

In late 2012, Agnes Scott learned about the new solar incentive program, GPASI, being considered by the Georgia Public Service Commission. As details of the new program were revealed, it became apparent that GPASI created a unique window of opportunity for the

Figure 3. Median Installed PV Price Trends Over Time



Source: Barbose, Galen and Naïm Darghouth. 2015. Tracking the Sun VIII: The Installed Price of Residential and Non-Residential Photovoltaic Systems in the United States. Berkeley, CA: Lawrence Berkeley National Laboratory.

college to build a solar array, sell the electricity at a fixed price, and retain the renewable energy credits in order to reduce the college's carbon footprint.

With no funds to hire outside experts, and lacking the internal expertise needed to develop a solar project and complete an application, the college sought technical advice from a volunteer who had previously worked in the solar industry.

The college then chose two locations for potential small-scale (100kW) arrays and assembled the technical information required for the applications. The Office of Sustainability, including a part-time consultant who assists the college with renewable energy projects, worked with the college's vice president of business & finance to clarify all legal and financial issues that might arise so that he could confidently sign off on the two applications. The applications were uploaded to the GPASI online application portal, with attention to all details, and the application fees were submitted in accordance with program guidelines.

Because Agnes Scott believed that many more applications for projects would be submitted than could be approved, the college submitted applications for two projects, located on two separate parcels of land, in hopes that one would be chosen in the lottery. Also, the college anticipated that there would be less competition in the small-scale project category than in the medium- and large-scale categories.

In April 2013, Agnes Scott learned that both applications were selected in the GPASI lottery. Of more than 1,000 applications submitted for small- and medium-scale projects, only 129 were approved for construction.

External Partnerships

Agnes Scott's solar projects were particularly challenging because they were too small to take advantage of the "economies of scale" for larger projects, and because the college could not benefit from the tax incentives available to for-profit entities. These challenges were overcome with the help of five crucial external partners, whose expertise and support made the projects a reality.

Inman Solar

An Atlanta-based solar company specializing in medium- to large-scale solar PV projects, Inman Solar developed, designed, and installed all five arrays. Inman offered invaluable technical information, financial analyses, and advice. Inman also provides long-term operation, maintenance, and monitoring of the PV systems, and continues to help Agnes Scott with technical support associated with solar energy in the academic curriculum. The company also provided assistance in connecting the college to a potential third-party investor.

Georgia Power

In addition to running the GPASI program, Georgia Power provided technical assistance at several key points in the process. Most critical was the utility's assistance in connecting the college to a potential third-party investor.

Third-Party Investors

Third-party investors were crucial to the success of these projects. Without investors who understand that solar projects can be very sound financial investments, Agnes Scott's projects would have most likely failed. An anonymous private investment company supported three arrays and Laura and Rutherford Seydel/Seydel Solar supported one.

Georgia Tech Research Institute

GTRI contributed important new technology that significantly lowered the cost of the West Parking array. Agnes Scott's partnership with the Institute allows student research and collaboration to continue at this array.

Quest Renewables

Quest Renewables brought GTRI's new engineering technology for solar parking canopies to market and constructed the world's first full-scale QuadPod solar panel racking system for the West Parking array.

The West Parking array (above) showcases the QuadPod racking system; photo courtesy Inman Solar. College president Elizabeth Kiss (left in photo) and Laura and Rutherford Seydel attend the ribbon cutting for the Gellerstedt Field array that they funded in conjunction with Seydel Solar (right); photo courtesy Georgia Power.

Overcoming Challenges

Internal Support

Renewable energy projects often never make it past the conceptual stage. One reason is that internal decision makers may not fully understand all the benefits—especially when faced with competing demands for limited resources. Solar energy production is often poorly understood, and some decision makers may be biased against it due to outdated or inaccurate information. The value of thoroughly researched, clear and concise briefing materials, presented in a timely manner, cannot be overstated.

Specifically, the leadership and active support of President Elizabeth Kiss inspired Agnes Scott's team to overcome the many challenges these projects faced. Vice President for Business & Finance John Hegman's assistance with legal and budget issues helped ensure that the projects were fiscally sound and in the best long-term interest of the college. Working closely with external partners, the college's small team of administrators, faculty, staff, students, and alumnae achieved the desired goal—to make clean solar energy production at this small college a reality.

Financial Challenges

Agnes Scott is a financially sound institution, but its budget is, by necessity, focused on the basics of meeting the academic and operational requirements of a small, non-profit college. Like most older colleges and universities, Agnes Scott faces major costs to maintain, renovate, and repair aging historic buildings and campus infrastructure. The college needed to finance the solar projects in a way that had minimal impact on the operating budget, no impact on other college fundraising efforts, no indebtedness, and no use of the college's endowment.

Another funding challenge was the tight deadline to get the solar projects operational. GPASI projects were required to complete construction and start producing solar power within six months from the date of project approval. This quick turnaround meant that the college had no time to raise funds from traditional sources, such as grants, that require longer lead times.

Non-profit entities in Georgia have no financial incentives to build renewable energy projects. And, even if there were state or local tax incentives in Georgia for solar projects, as a non-profit, such incentives would not have been available to Agnes Scott. As discussed earlier, because it is a non-profit, the college could not take advantage of the considerable cost benefit provided by the 30% federal tax credit and the approximate 20% additional savings from the federal tax deduction for depreciation of solar equipment and installation. This meant that if Agnes Scott financed the solar projects itself, it would pay ***nearly double the price that a taxable entity would pay***.

Agnes Scott realized that the only way to get its GPASI projects built was to form a partnership with one or more private sector investors with sufficient "tax appetite" to benefit from the federal tax incentives and make a respectable return on investment. This funding model would commit the college to hosting four investor-owned solar systems for 20 years. This

potential funding mechanism was an untried, completely "out of the box" idea for the college to consider.

Initially, Agnes Scott believed local solar development companies would be eager to finance the solar projects. However, the projects were considered too small and several solar developers turned down the opportunity.

The college soon learned that most solar developers, and others interested in renewable energy investments, want projects that are at least 1MW in size to take advantage of the "economies of scale" provided by larger projects. The college's GPASI 2013 projects were only 100kW each, and because of the small size of the campus, developers may have seen that there was also limited opportunity for future large-scale projects.

Unwilling to give up on the window of opportunity for the GPASI projects, the college, with help from Inman Solar, created an information packet about the solar investment opportunity, complete with cash flow analyses. This packet was provided to several potential investors with ties to the college. While some expressed interest in the projects, most were generally unfamiliar with solar energy, possibly because such systems are rare in Georgia. Therefore, they were not confident about investing in the project.

Through its national contacts in the ACUPCC, Agnes Scott began discussions with a renewable energy investment group in New York that had heard about the college's projects. However, these potential investors had the same concerns as local investors—Agnes Scott's projects were deemed too small to be worth the investment.

Eventually, two investors were found who believed the educational value of the Agnes Scott solar arrays, combined with an attractive return on investment, was worth their relatively small size.

Addressing Legal Issues

Another challenge was the lack of a solar roof lease model to provide the legal platform for a third-party investment scenario. No solar lease agreement set up under Georgia law could be found. Legal fees associated with creating a lease from scratch could have been exorbitant—potentially costing so much that the small projects would no longer make business sense.

Agnes Scott, Inman Solar, and the investor pooled their resources to create the new lease. Inman Solar had access to solar lease language from other states that was used as a starting point. Through the good faith and cooperation of all the parties, a solar rooftop lease was created, negotiated, and executed within a period of a few weeks—another project breakthrough. Key provisions of the lease include:

- 20-year term (matching the GPASI term)
- Legal description of the leased area
- Access and how the area may be used
- Operation and maintenance of the solar arrays
- Transfer of the power purchase agreement to the investor
- Rights to environmental attributes, including renewable energy credits, to Agnes Scott
- Liability provisions
- Insurance coverage
- Publicity and confidentiality

Solar leases are often held as confidential information; however, the parties have agreed to publish the lease as part of this case study as a model for others who may be contemplating similar third-party solar financing mechanisms (see link at left).

Technical Challenges

Limited space

Because the campus is only 100 acres, there is limited space for solar arrays, which are most economic when placed in open areas on relatively inexpensive ground-mounted poles or on racking systems that can be affixed directly on the ground. Institutions with more land and

Find Out More Online

To download a copy of Agnes Scott's solar lease, **click here**.

Agnes Scott successfully navigated several challenges to solar array installation, including protecting its more than 2,000 trees (left) and numerous historic buildings dating to 1889 (above).

open space have much greater flexibility on where and how solar arrays can be placed, and can do it at a lower cost.

Trees

Solar arrays cannot coexist with shade. Agnes Scott has more than 2,000 trees that provide beauty and a sense of peacefulness beyond price. Designated as a Tree Campus USA, the college treasures its trees and is not willing to remove them to create open space for installing solar panels. The trees' respiration adds oxygen and removes carbon dioxide from the atmosphere. Their shade and transpiration reduce the need for air conditioning. Their root systems hold soil in place and keep polluted storm water from entering nearby streams. The trees also provide habitat for many birds, animals, and other forms of wildlife.

Historic buildings

Established in 1889, many of the 30 buildings on campus are historically significant. From a structural, aesthetic, and historical standpoint, most of the buildings are not good candidates for rooftop solar panels.

Roofs

Because they usually will not need replacement or significant repair in the near term, roofs that are less than 10 years old are typically considered for solar PV installations. But even roofs in excellent condition with a projected long life can be unsuitable. High, steeply pitched, slate roofs, like many at Agnes Scott, can be dangerous to work on and the extra safety precautions required can make solar PV cost infeasible.

Flat or low-pitched roofs that are easily accessible and free of obstruction are good locations for solar arrays. Roofing material also impacts the cost of installing solar panels. Slate roofs are particularly difficult surfaces on which to install PV panels.

West Parking canopy

The top level of the college's parking deck is one of the few large, flat open areas on campus that is unobstructed by trees. It is large enough to accommodate about 400kW of PV panels. However, the parking spaces are too valuable to sacrifice for deck-mounted solar panels. This necessitated the use of an elevated solar parking canopy.

Providing weather protection to cars parked underneath, solar parking canopies have been used for years. However, they are expensive to build due to the large amount of steel and labor needed. The additional cost of a traditional solar

Because many of its buildings have high, steeply pitched slate roofs, which are not suited to solar PV arrays, the college had to look for alternative locations on campus.

parking canopy for the Agnes Scott parking deck was $160,000. While the investor would pay for all the solar panels, inverters, and other solar generating equipment, the additional cost of the elevated canopy created an unacceptable rate of return on investment.

The college turned to the Georgia Tech Research Institute for engineering expertise and found a unique, innovative, and cost-effective parking canopy. GTRI's research engineers were seeking a demonstration site to install new equipment they had designed for the U.S. Department of Energy's Sunshot Initiative. This initiative funded research for new technologies to lower the price of solar equipment and spur faster solar deployment.

GTRI had worked for three years to develop cheaper, faster, and safer racking systems for solar PV panels. Its new parking canopy, called the QuadPod, had passed all structural tests, including wind tunnel testing, and was ready for full scale deployment. It also cost about $50,000 less than a traditional parking canopy. This minimized the expense to the college and did not require use of the endowment.

The design allows the canopy to span longer lengths compared to traditional canopies and results in a lighter, stronger canopy with a clean, appealing architectural aesthetic that was important to Agnes Scott.

Partnering with Quest Renewables, a new company formed to market the QuadPod, Agnes Scott, the solar investor, GTRI, and Inman Solar worked as a team to get the QuadPod built on time to meet the operational deadline. Agnes Scott is the first location in the world to deploy this important new solar technology. It serves as a living laboratory for learning and teaching about renewable energy engineering. Agnes Scott and GTRI are continuing their partnership at the West Parking array QuadPod through student research.

Potential roof damage

Roof-mounted arrays can potentially cause damage and void the roof's warranty. Experienced, professional installers like Inman Solar take great care to make sure no problems occur. An important design feature of the roof-mounted arrays at Bullock Science Center, the Office of Facilities, and Bradley Observatory, is the use of ballast-mounted solar PV panels.

Ballast mounts do not penetrate the roof deck like some racking systems. Instead, they are held

Ballast-mounted solar PV panels, like those installed on Bullock Science Center (above), use concrete to hold the array to the roof. This mounting option reduces the potential for roof damage. Photo courtesy Inman Solar.

down with concrete ballasts that fit into the racking system that holds the PV panels.

Inaccurate construction records

A discovery during construction of the array at Bullock Science Center almost derailed the solar project. When engineers cut into the roof, they found that the roof supports were not built in accordance with the as-built construction drawings. Because of concern about the structural stability of the roof, the size of the array was scaled down from 100kW to 21kW. While the project was completed on time, this inaccurate information could have caused the college to miss its operational deadline.

Interconnection fees

Spanning the distance from the array to the utility's electrical grid will affect the cost of solar projects that feed power into the electricity grid. The arrays must be carefully interconnected to the grid in a way that will not interfere with distribution. The interconnection fees can significantly increase the overall cost of the project. Even if the array is close to the grid, the interconnection fees can be high if additional electrical equipment, like a larger transformer, is needed.

High interconnection fees derailed Agnes Scott's plans for a proposed 25kW solar array on top of the gymnasium that had been accepted into the GPASI 2014 program. No investor was found who was willing to finance the array due to the high interconnection fee. High interconnection fees almost derailed the soccer field array. Project designer Inman Solar worked with Georgia Power to modify the infrastructure and bring down the interconnection cost enough to attract an investor.

Internet issues

Solar production at Agnes Scott is measured and analyzed in real time by a web-based monitoring system called Sunny Portal. If the location for the solar array does not have internet access, there could be an extra cost to establish an internet connection.

An "Old Roof" Challenge at the Office of Facilities

While the 100kW array at the college's Office of Facilities was chosen in the 2013 GPASI program, construction was delayed by more than a year because of the age and condition of the roof. Budgetary and scheduling problems meant the building could not be re-roofed in time to meet the GPASI operational deadline.

Fortunately, the project was selected again during the 2014 GPASI lottery and the college was able to replace the roof in time for the ballast-mounted solar array to be constructed and begin operation by the deadline.

Going Forward

Agnes Scott is actively searching for additional solutions to reach carbon neutrality by 2037 and is planning to submit a revised Climate Action Plan to ACUPPC in 2016.

Significant increases in renewable energy, both on and off campus, will be necessary to reach this goal. If GPASI continues to buy solar electricity from small projects and the RECs are available to the non-profit customer, the college will continue to submit applications. The Solar Power Free Market Financing Act of 2015 may open new possibilities for additional solar installations on campus.

The college will also pursue significant decreases in energy use through behavioral changes and efficiency upgrades. Currently, an expansion of the Green Revolving Fund to a $1 million investment fund is underway, with potential support from the Grants to Green program of the Community Foundation for Greater Atlanta.

All building renovations on campus will achieve a LEED Silver rating or greater, offering more opportunities for investment in energy efficiency.

Lessons Learned

Agnes Scott and Southface have analyzed the success of this solar effort and offer the following advice to other non-profits.

Do Your Homework
Identify the organization's goals and reasons for deploying solar. Determine if solar fits with the strategic plan. Research technologies and costs. Have an informed idea of the types of systems and locations where solar might work on your property. Ask for donated solar prospecting advice from solar developers.

Find Your Organization's Solar Project Leader
An internal solar project champion/coordinator is essential, preferably at the decision-maker level.

Get the Highest Possible Level of Support
Work on winning the confidence of the organization's top leaders, including those in the finance department, as early as possible.

Assemble a Solar Team
Input and support from the policy, technical, financial and legal departments of the organization are necessary.

Don't Let the Project Get Bogged Down
Make decisions as quickly as possible and provide timely follow-up.

Ask Experts for Help
Commit to a reputable, experienced solar developer/installer. Their expert advice will be needed throughout the process.

Get Help from Other Trusted People for Advice
Don't be afraid to ask questions of anyone who could offer good insight. A list of helpful organizations is provided on page 26.

Focus on Financing Options Early
Solar developers can be helpful advisors for non-profits navigating financing options.

Don't Be Intimidated by Legal Issues Involving Solar Roof or Ground Leases
Be diplomatic and flexible with investors when negotiating leases. Fine points of the lease can make or break the deal.

Anticipate Technical Problems
No project is flawless. Be especially aware of potential unexpected roof problems that may derail an otherwise great solar project.

Don't Be Blindsided by High Interconnection Fees
Ask your electricity provider to reconsider the engineering work associated with the interconnection fee. Rely on your solar developer to help you negotiate a lower fee or design a cheaper solution.

Maintain Close Communications with Your Electricity Provider
Your electricity provider is a key partner in the success of your project. Tell your account manager the goals for the project and ask for help reaching them.

Expect Setbacks and Don't Give Up
If renewable energy projects were easy, everyone would have them. As more non-profit organizations undertake solar and share their success, it will get easier.

Find Out More

Agnes Scott College — agnesscott.edu

American College & University Presidents' Climate Commitment — acupcc.org

Georgia Environmental Finance Authority — gefa.georgia.gov

Georgia Power Company — gapower.com

Georgia Public Service Commission — psc.state.ga.us

Georgia Solar Energy Association — gasolar.org

Georgia Tech Research Institute — gtri.gatech.edu

Inman Solar — inmansolar.com

Intergovernmental Panel on Climate Change — ipcc.ch

National Renewable Energy Laboratory — nrel.gov

Quest Renewables — questrenewables.com

Southface — southface.org

Union of Concerned Scientists — uscusa.org

U.S. Department of Energy — energy.gov

U.S. Energy Information Administration — eia.gov

U.S. Environmental Protection Agency — epa.gov/climatechange

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