



Comprehensive Plan

Fiscal Years 2017 and 2018





Comprehensive Plan

July 2016

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1. Executive Summary

In June of 2011, in a near unanimous bipartisan manner, the Governor and the General Assembly set clean energy policy on a new course in Connecticut.¹ A major piece of that public policy was the creation of the nation's first "green bank" – the Connecticut Green Bank (the "Green Bank"). Over the past couple of years, the Green Bank has become a model for other states – as well as counties and countries – that are seeking to use public resources in a smarter way to attract more private capital investment in the acceleration and deployment of clean energy in our economies. Approaching \$1 billion of capital mobilized in clean energy deployment in Connecticut in its first five years, the Green Bank is delivering on its vision:

To lead the green bank movement by accelerating private capital investment in clean energy deployment for Connecticut to achieve economic prosperity, create jobs, promoted energy security, and address climate change.

Experts suggest that an investment gap of \$1 trillion a year – or the so called "clean trillion" – exists until 2030 for green infrastructure growth to address important environmental challenges such as global climate change.² The emergence of "Cli-Fi" (or climate finance) in an Intergovernmental Panel on Climate Change (IPCC) report,³ acknowledges the scale of investment and finance needed to transition electric power generation technologies to a global low carbon economy at \$360 billion a year in order to stay within the two-degree Celsius safety zone. The Center for American Progress estimates that the U.S. needs at least \$200 billion in renewable energy and energy efficiency investment annually for 20 years to reduce carbon emissions and avert climate disaster.⁴ Whatever the level of investment is, we know that it is substantial in order to achieve our national and global priorities, and that repercussions for not addressing them can be felt locally here in Connecticut.

Although this global capital challenge seems daunting, believe it or not, Connecticut has an important role to play in the grand scheme of things. In a recent economic analysis by FiveThirtyEight.com of metropolitan areas in the United States,⁵ the cities of New Haven (#1) and Hartford (#3) are the most representative of a "normal America" based on the following demographic indicators – age, education attainment, race and ethnicity. The impact Connecticut can make to help citizens invest in clean energy will advance our clean energy economy, while serving as an example for the rest of the country. The Natural Resources Defense Council and the

¹ Public Act 11-80 "An Act Concerning the Establishment of the Connecticut Department of Energy and Environmental Protection and Planning for Connecticut's Energy Future"

² Kaminker, C. et al. (2013), "Institutional Investors and Green Infrastructure Investments: Selected Case Studies", *OECD Working Papers on Finance, Insurance and Private Pensions*, No. 35, OECD Publishing. *Note: The authors define "infrastructure" as energy, power, road, rail, water, waste, buildings and agriculture systems.*

³ *Climate Change 2014: Mitigation of Climate Change* by the IPCC in Chapter 16 "Cross-Cutting Investment and Finance Issues" (April 12, 2014).

⁴ "Green Growth: A U.S. Program for Controlling Climate Change and Expanding Job Opportunities" by the Center for American Progress (September 2014)

⁵ 'Normal America' Is Not a Small Town of White People by Jed Kolko of FiveThirtyEight.com (April 28, 2016)

Coalition for Green Capital estimate that based on Connecticut's market size, growth rate, and public-private leverage ratio, a green bank in every state across the country would yield \$200 billion a year in annual investment in clean energy within five years – with 90% of the funds coming from private capital sources and all public contributions being returned over a 10- to 20-year period. Currently, the Green Bank mobilizes clean energy investment of approximately \$100 per person per year (with households contributing about \$10 to the Green Bank).⁶ In order to scale-up investment to achieve the target identified by the Center for American Progress, the Green Bank needs to mobilize 6 to 7 times more investment in Connecticut's clean energy economy – or the equivalent of \$2.4 billion a year.

President Obama said it best:

“We’ve got public banks like Connecticut’s Green Bank and private banks like Goldman Sachs ready to invest billions of dollars in renewable energy.”⁷

The Green Bank issued its first green bonds in FY 2017. As a tool to raise capital to support the clean energy policies of Connecticut, green bonds bring great promise for attracting more private capital investment in the state. There have been nearly \$17 billion of green bonds issued in 2016 YTD – with about three-quarters of those funds being invested in each of the following three areas of projects – energy efficiency, renewable energy, and clean transportation. The Green Bank will be utilizing its bonding capability and capacity to raise funds enabling it to increase its impact by blending its financing with private capital investors.⁸

Beyond its current areas of investment, there are several emerging areas of opportunity for the Green Bank, including:

- Clean alternative fuel vehicles and infrastructure;
- Renewable thermal technologies; and
- Grid modernization

If one simply looks at Connecticut's greenhouse gas emissions inventory and the public policy goal of reducing emissions to 80% below 2001 levels by 2050, one can see that a significant level of investment is going to be needed in the fuels we use for transportation (i.e., about 40% of emissions) and how we heat our buildings (i.e., nearly 40% of emissions).⁹ This requires looking at the electrification of vehicles (i.e., electric and hydrogen fueled passenger vehicles and busses) and heating of buildings (i.e., deploying renewable thermal technologies in our homes, businesses, and institutions) – by using emission-free energy sources like solar PV and lower emission generation technologies like fuel cells. In order to secure renewable energy's place in the future, advances in battery storage and other distributed energy resources will be required to modernize

⁶ Through a 1 mill surcharge called the Clean Energy Fund.

⁷ President Barack Obama in a speech on American Energy on May 9, 2014.

⁸ *Trending: Blending* in The Economist (April 23, 2016)

⁹ Connecticut Greenhouse Gas Emissions Inventory 2012 – Executive Summary by the Department of Energy and Environmental Protection.

the grid and seamlessly integrate cleaner, cheaper, and more reliable source of energy into our infrastructure.

The future of clean energy is bright in Connecticut! However, we need to ensure that clean energy is accessible and affordable to everyone. Low to moderate income families in Connecticut are struggling to manage their energy costs, as variable energy expenses that reduce household income can strain families that are struggling to make ends meet. The aging of residential buildings in Connecticut is leading to health and safety concerns as a result of asbestos, mold, lead, knob and tube wiring, and other adverse factors. In its efforts to mobilize more investment in clean energy, the Green Bank must ensure that clean energy is accessible and affordable to everyone, while at the same time coordinating with other stakeholders to ameliorate health and safety issues along the way.

Within this Comprehensive Plan (the “Comp Plan”) is a detailed overview of the Green Bank, including various clean energy public policies in Connecticut supporting clean energy market development. As we begin to pursue the issuance of green bonds, we have included a new and succinct summary of our Evaluation Framework in the Comp Plan which describes the logic behind the green bank model. We delve into the integral financing and marketing efforts of the Green Bank from capitalization and customer acquisition to collaboration and learning. The structure of our organization and the programs and products that we offer is built around three market segments: infrastructure (i.e., behind the meter and grid tied solutions); residential (i.e., single family and multifamily); and commercial, industrial, and institutional. Within each market segment, the reader can get a better sense of the public policy drivers, market potential, product offerings, and performance indicators and targets. And lastly, we have included a new Research and Development (R&D) section in this Comp Plan to highlight emerging market opportunities.

This Comp Plan is the formal document required by statute to guide the decisions made by the Board of Directors and staff of the Green Bank. As you will read, the Green Bank will continue its efforts to accelerate the growth of clean energy deployment in Connecticut and lead the green bank movement across the country and around the world.

2. Organizational Overview

The Green Bank¹⁰ was established by the Governor and Connecticut's General Assembly on July 1, 2011 through Public Act 11-80 as a quasi-public agency that supersedes the former Connecticut Clean Energy Fund. As the nation's first state "Green Bank", the Green Bank leverages public and private funds to drive investment and scale-up clean energy deployment in Connecticut.

The Green Bank's statutory purposes are:

- To develop programs to finance and otherwise support clean energy investment in residential, municipal, small business and larger commercial projects and such other programs as the Green Bank may determine;
- To support financing or other expenditures that promote investment in clean energy sources to foster the growth, development and commercialization of clean energy sources and related enterprises; and
- To stimulate demand for clean energy and the deployment of clean energy sources within the state that serves end-use customers in the state.

The Green Bank's purposes are codified in Section 16-245n(d)(1) of the General Statutes of Connecticut and restated in the Green Bank's Board approved [Resolution of Purposes](#).

2.1 Vision

To lead the green bank movement by accelerating private capital investment in clean energy deployment for Connecticut to achieve economic prosperity, create jobs, promote energy security and address climate change.

2.2 Mission

To support the Governor's and Legislature's energy strategy to achieve cleaner, cheaper and more reliable sources of energy while creating jobs and supporting local economic development.

2.3 Goals

To achieve its vision and mission, the Green Bank has established the following four goals:

1. To attract and deploy private capital investment to finance the clean energy policy goals for Connecticut.
2. To leverage limited public funds to attract multiples of private capital investment while returning by reinvesting public funds in clean energy deployment over time.
3. To develop and implement strategies that bring down the cost of clean energy in order to make it more accessible and affordable to customers.

¹⁰ Public Act 11-80 repurposed the Connecticut Clean Energy Fund (CCEF) administered by Connecticut Innovations, into a separate quasi-public organization called the Clean Energy Finance and Investment Authority (CEFIA). Per Public Act 14-94, CEFIA was renamed to the Connecticut Green Bank.

4. To support affordable and healthy buildings in low-to moderate income and distressed communities by reducing the energy burden and addressing health and safety issues in their homes, businesses, and institutions.

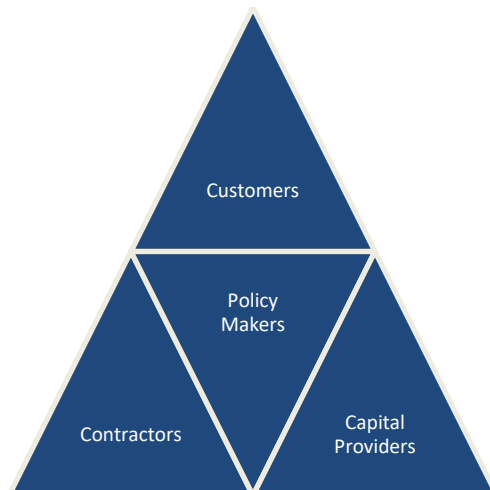
These goals support the implementation of Connecticut’s clean energy policies be they statutory (i.e., Public Act 15-194, Public Act 13-298), planning (i.e., Comprehensive Energy Strategy, Integrated Resources Plan), or regulatory in nature.

2.4 Stakeholders

The Green Bank identifies four (4) primary stakeholders (see Figure 1) that are the focus of its programs, products, and services, including:

- Customers
- Capital Providers
- Contractors
- Policy-Makers

Figure 1. Stakeholders - The Three C's (Capital Providers, Customers, and Contractors) and Policy-Makers



Customers

A key Green Bank objective is to eliminate the financial barriers to clean energy investment faced by customers by facilitating the transition to innovative low-cost financing of clean energy deployment using private capital. Customers of all types (i.e., homeowners, renters, businesses, not-for-profits) seek cheaper, cleaner and more reliable sources of energy, yet often face informational gaps and financial challenges in their efforts to acquire these energy resources. Contractors must be able to provide customers with cost-effective and comprehensive (i.e., “deeper”) energy solutions while capital providers must offer customers immediate cash flow positive returns by financing their investments. The Green Bank plays an important role in bringing customers and contractors together by providing them with easy access to affordable capital so that they can implement clean energy solutions for their homes, businesses, or institutions.

Capital Providers

As a key goal is to attract private capital to finance the clean energy goals for Connecticut and to develop and implement strategies that bring down the costs of clean energy to make it more accessible and affordable to consumers, working in partnerships with capital providers is vital to the success of the green bank model. There are local (e.g., community banks and credit unions), state, regional, and national banks, as well as equity, tax equity, and other institutional, foundation, and crowd-sourced investors that seek to invest in clean energy projects in Connecticut. The Green Bank's role is to use the limited public funds it receives and leverage it to attract more private capital investment in clean energy deployment in Connecticut. The Green Bank provides several channels for capital providers to get into clean energy investing in Connecticut while earning a reasonable rate of return.

Contractors

Working in partnership with qualified and certified contractors is also vital to the success of the green bank model, for the same reason as noted above. Qualified contractors (including the full gamut from smaller and more local businesses to the largest of energy services companies, or "ESCOs", that operate on a regional, national and even global scale) must have access to working capital to support the growth and operations of their businesses – including creating new jobs – while providing quality, timely, cost-effective and comprehensive clean energy solutions and financing options for customers.

Policy-Makers

The Green Bank was established by policy-makers to leverage public funds to attract more private capital investment to scale-up clean energy deployment in Connecticut. Through its Board of Directors, the Green Bank has established this Comprehensive Plan that will guide the implementation of the objectives of policy-makers, including the Department of Energy and Environmental Protection (DEEP), Department of Economic and Community Development (DECD), and other state agencies, to deploy more clean energy at a faster pace while more efficiently managing public funds and attracting significantly more private investment. As the implementer of the Conservation & Load Management Plan (C&LM Plan), the Electric Distribution Companies (EDCs) and Natural Gas Companies (LDCs), the Energy Efficiency Board (EEB) and Electric Distribution Companies (EDCs) are important stakeholders for the Green Bank as well, including through the Joint EEB-Green Bank Committee.

2.5 Governance

Pursuant to Section 16-245n of the General Statutes of Connecticut, the powers of the Green Bank are vested in and exercised by a Board of Directors that is comprised of eleven voting and two non-voting members each with knowledge and expertise in matters related to the purpose of the organization (see Table 1).

Table 1. Board of Directors of the Connecticut Green Bank

Position	Status	Voting	Name	Organization
State Treasurer (or designee)	Ex Officio	Yes	Bettina Bronisz	Treasurer's Office
Commissioner of DEEP ¹¹ (or designee)	Ex Officio	Yes	Robert Klee ¹²	DEEP
Commissioner of DECD ¹³ (or designee)	Ex Officio	Yes	Catherine Smith ¹⁴	DECD
Residential or Low Income Group	Appointed	Yes	Pat Wrice (Ret) Betsy Crum	Operation Fuel Women's Institute for Housing & Economic Development
Investment Fund Management	Appointed	Yes	Norma Glover (Ret)	NJG Associates
Environmental Organization	Appointed	Yes	Matthew Ranelli ¹⁵	Shipman & Goodwin
Finance or Deployment of Renewable Energy	Appointed	Yes	Thomas Flynn	Environmental Data Resources
Finance of Renewable Energy	Appointed	Yes	Reed Hundt ¹⁶	Coalition for Green Capital
Finance of Renewable Energy	Appointed	Yes	Kevin Walsh	GE Energy Financial Services
Labor	Appointed	Yes	John Harrity	IAM Connecticut
R&D or Manufacturing	Appointed	Yes	Mun Choi (Ret) Gina McCarthy	University of Connecticut Former EPA Administrator
President of the Green Bank	Ex Officio (non-voting)	No	Bryan Garcia	Connecticut Green Bank
Board of Connecticut Innovations ¹⁷	Ex Officio (non-voting)	No	(unfilled)	(unfilled)

There are four (4) committees of the Board of Directors of the Green Bank, including:

- Audit, Compliance and Governance
- Budget and Operations
- Deployment
- Joint Committee of the Energy Efficiency Board and the Green Bank¹⁸

To support the Joint Committee of the Energy Efficiency Board and the Connecticut Green Bank, the following is a principal statement to guide its activities:

The Energy Efficiency Board and the Connecticut Green Bank have a shared goal to implement state energy policy throughout all sectors and populations of Connecticut with continuous innovation towards greater leveraging of ratepayer funds and a uniformly positive customer experience.

¹¹ Department of Energy and Environmental Protection

¹² Vice Chairperson of the Board of Directors and Chairperson of the Budget and Operations Committee

¹³ Department of Economic and Community Development

¹⁴ Chairperson of the Board of Directors

¹⁵ Secretary of the Board of Directors and Chairperson of the Audit, Compliance and Governance Committee

¹⁶ Chairperson of the Deployment Committee

¹⁷ It should be noted that several members of the Board of Directors of the Green Bank currently serve on the Board of Directors of Connecticut Innovations, including Mun Choi and Catherine Smith.

¹⁸ Pursuant to Section 16-245m(d)(2) of the Connecticut General Statutes

To expand the impact of Connecticut’s energy efficiency programs, the Green Bank will continue to leverage public funds, including through the Connecticut Energy Efficiency Fund programs, to attract more private investment in the state through its financing programs.

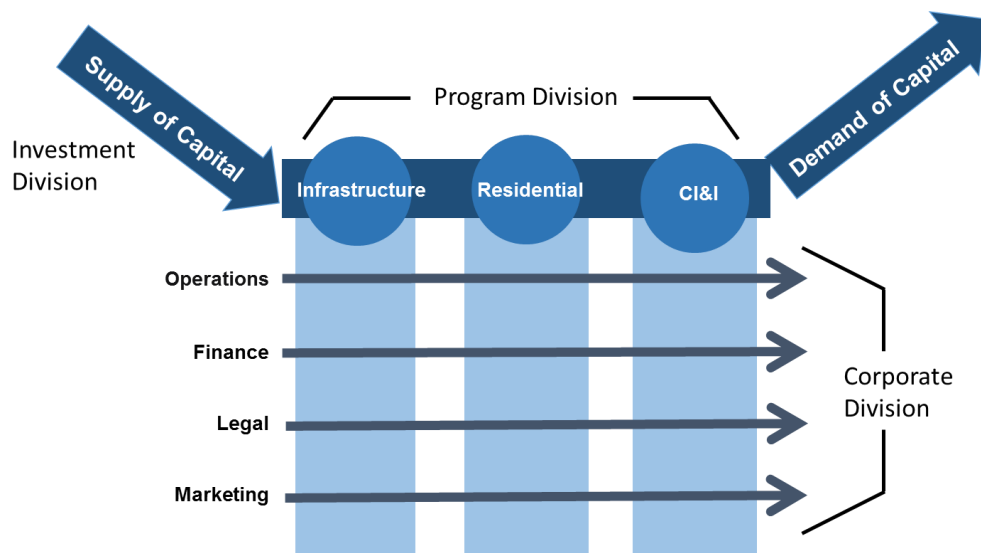
The Board of Directors of the Green Bank is governed through enabling legislation, as well as by an [Ethics Statement](#) and [Ethical Conduct Policy](#), [Resolutions of Purposes](#), [Bylaws](#), [Joint Committee Bylaws](#), and Comprehensive Plan. All meetings, agendas, and materials of the Green Bank’s Board of Directors and its Committees are publicly available on the organizations website.^{19,20}

2.6 Organizational Structure

The organizational structure of the Green Bank is comprised of three parts (see Figure 2):

- **Investment Division** – this division is responsible for investing limited ratepayer and other public funds into the clean energy market while *attracting capital* to finance the clean energy policy goals for Connecticut, including the issuance of green bonds.
- **Program Division** – in collaboration with marketing, this division is responsible for *deploying capital* to meet the clean energy policy goals for Connecticut. There are three (3) program divisions –Residential (including single family and multifamily), Commercial, Industrial, and Institutional (i.e., including Municipal, Universities, Schools & Hospitals (“MUSH”)), and Infrastructure.
- **Corporate Division** – this division is responsible for providing administrative, accounting, legal, marketing and operational support services to the investment and program divisions, as well as the President and C.E.O. to help the organization meet its goals.

Figure 2. Organizational Structure of the Connecticut Green Bank



¹⁹ <http://www.ctgreenbank.com/about-us/board-member-resources/connecticut-grboard-meetings/>

²⁰ <http://www.ctgreenbank.com/about-us/board-member-resources/connecticut-grittee-meetings/>

The Green Bank staff is attentive to the needs of its stakeholders, committed to the vision and mission of the organization, and conducts itself in a collaborative and professional manner that demonstrates its knowledge and leadership of clean energy policy, finance, marketing and technology.

An Employee Handbook and [Operating Procedures](#) have been approved by the Board of Directors and serve to guide the staff to ensure that it is following proper contracting, financial assistance, and other requirements.

2.7 Comprehensive Annual Financial Report (CAFR)

A Comprehensive Annual Financial Report (CAFR) is a set of government financing statements that includes the financial report of a state, municipal or other government entity that complies with the accounting requirements promulgated by the Governmental Accounting Standards Board (GASB). GASB provides standards for the content of a CAFR in its annually updated publication *Codification of Governmental Accounting and Financial Reporting Standards*. A CAFR is compiled by a public agency's accounting staff and audited by an external American Institute of Certified Public Accountants (AICPA) certified accounting firm utilizing GASB requirements. It is composed of three sections – Introductory, Financial, and Statistical. The independent audit of the CAFR is not intended to include an assessment of the financial health of participating governments, but rather to ensure that users of their financial statements have the information they need to make those assessments themselves.²¹ To date, the Green Bank has issued three CAFR's, including:

- [Fiscal Year Ended June 30, 2014 \(Certificate of Achievement\)](#)
- [Fiscal Year Ended June 30, 2015 \(Certificate of Achievement\)](#)
- [Fiscal Year Ended June 30, 2016 \(Certificate of Achievement\)](#)

As the “gold standard” in government reporting, the CAFR is the mechanism the Green Bank uses to report its fiscal year financial and investment performance – including societal benefits – to its stakeholders.

Beyond the CAFR, the annual reports of the Green Bank are compiled by the marketing staff and include consolidated financial statement information and narratives of various program achievements in a condensed format that can be widely distributed. To date, the Green Bank has issued five annual reports, including:

- [Fiscal Year 2012 Annual Report](#)
- [Fiscal Year 2013 Annual Report](#)
- [Fiscal Year 2014 Annual Report](#)
- [Fiscal Year 2015 Annual Report](#)

²¹ The Government Finance Officers Association (GFOA), founded in 1906, represents public finance officials throughout the United States and Canada. GFOA's mission is to enhance and promote the professional management of governmental financial resources by identifying, developing, and advancing fiscal strategies, policies, and practices for the public benefit. GFOA established the Certificate of Achievement for Excellent in Financial Reporting Program (CAFR Program) in 1945 to encourage and assist state and local governments to go beyond the minimum requirements of generally accepted accounting principles to prepare comprehensive annual financial reports that evidence the spirit of transparency and full disclosure and then to recognize individual governments that succeed in achieving that goal.

- [Fiscal Year 2016 Annual Report](#)

3. Public Policy Overview

The Green Bank's role is to support the implementation of public policy on clean energy in Connecticut by attracting and deploying capital to finance the achievement of those goals. Over the course of the legislative history on clean energy in Connecticut and specifically the last decade, there have been significant public policies passed that guide the programs of the Green Bank, including, but not limited to:

- **Public Act 78-262** – “An Act Establishing a State Energy Policy” is Connecticut’s original energy policy from 1978. The original energy policy declared the following matters as important and are the focus of the policy – engaging in energy conservation, energy efficiency, renewable energy deployment, energy diversification, reducing reliance on interruptible sources of energy, reducing energy costs, assuring that low-income households have essential energy services, public education and consumer awareness, and including financial and technical assistance.
- **Public Act 98-28** – “An Act Concerning Electric Restructuring,” deregulated the generation component of the electric utility industry and opened it up to competition, established the Class I and Class II Renewable Portfolio Standards, and created the Conservation and Load Management (C&LM) Fund to be administered by the electric distribution companies (EDCs) and the Renewable Energy Investment Fund (later called Clean Energy Fund) to be administered by Connecticut Innovations (CI) (and later on by the Green Bank).
- **Public Act 05-01** – “An Act Concerning Energy Independence,” established the Class III Renewable Portfolio Standard for CHP and energy efficiency, Project 100 requiring the electric distribution companies to sign long-term power purchase agreements for no less than 100 megawatts of Class I renewable energy sources developed in Connecticut, and the joint committee of the Energy Conservation Management Board (ECMB) and Connecticut Clean Energy Fund (CCEF) to coordinate on programs and activities.
- **Public Act 07-242** – “An Act Concerning Electricity and Energy Efficiency,” expanded Project 100 to Project 150, requires the municipal utilities to submit a comprehensive report to the CCEF on the actions to promote renewable energy sources, and modifies the definition of clean energy for the CCEF. The act also addresses energy improvement districts, interconnection standards, property, sales, and use tax exemptions for clean energy, a definition for weatherization, and modifies the Class I and III RPS.

Definition of Clean Energy

Clean energy means solar photovoltaic energy, solar thermal, geothermal energy, wind, ocean thermal energy, wave or tidal energy, fuel cells, landfill gas, hydropower that meets the low-impact standards of the Low-Impact Hydropower Institute, hydrogen production and hydrogen conversion technologies, low emission advanced biomass conversion technologies, alternative fuels, used for electricity generation including ethanol, biodiesel or other fuel produced in Connecticut and derived from agricultural produce, food waste or waste vegetable oil, provided the Commissioner of Energy and Environmental Protection determines that such fuels provide net reductions in greenhouse gas emissions and fossil fuel consumption, usable electricity from combined heat and power systems with waste heat recovery systems, thermal storage systems, other energy resources and emerging technologies which have significant potential for commercialization and which do not involve the combustion of coal, petroleum or petroleum products, municipal solid waste or nuclear fission, financing of energy efficiency projects, projects that seek to deploy electric, electric hybrid, natural gas or alternative fuel vehicles and associated infrastructure, any related storage, distribution, manufacturing technologies or facilities and any Class I renewable energy source, as defined in section 16-1.

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- **Public Act 11-80** – “An Act Concerning the Establishment of the Department of Energy and Environmental Protection and Planning for Connecticut’s Energy Future,” created the Department of Energy and Environmental Protection (DEEP) and charged it with energy and policy planning and regulation, including increasing the use of clean energy and technologies that support clean energy. The act also creates the Green Bank, sets energy reduction targets for state facilities of 20% by 2018, initiates a 3-year pilot anaerobic digester and combined heat and power program administered by the Green Bank, establishes a residential solar investment program administered by the Green Bank, and creates a zero-emission renewable energy credit (ZREC) and low-emission renewable energy credit (LREC) reverse auction program for long-term contracts administered by the EDCs.
 - **Public Act 12-2** – “An Act Implementing Certain Provisions Concerning Government Administration,” established the Commercial Property Assessed Clean Energy (C-PACE) Program to be administered by the Green Bank, modifies the definition of clean energy for the Green Bank, permits the Green Bank to issue up to \$50 million in bonds backed by a special capital reserve fund (SCRF) to support bond financing for the Green Bank,²² and clarifies the quasi-public status of the Green Bank.
 - **Public Act 13-298** – “An Act Concerning Implementation of Connecticut’s Comprehensive Energy Strategy,” reinforces key findings from DEEP with regards to the implementation of

²² Sec. 161 of PA 12-2 of the June Special Session contains the SCRF bonding provisions.

the Comprehensive Energy Strategy (CES) and includes the Green Bank in numerous instances, including coordination with ECMB, implementation of community-based marketing campaign pilots for natural gas conversions and energy efficiency, and the development and implementation of an on bill repayment program for residential customers using private capital. The act also makes important adjustments to the C-PACE program to support lender consent, further defines critical facilities for micro grid purposes, and clarifies language with respect to virtual net metering, sub-metering, and energy improvement district policy.

- **Public Act 14-94** – “An Act Concerning Connecticut’s Recycling and Materials Management Strategy, the Underground Damage Prevention Program, and Revisions to Energy and Environmental Statutes,” renames the Clean Energy Finance and Investment Authority to the Green Bank, allows micro grid projects as eligible for C-PACE financing, and provides cost recovery mechanism for the residential on bill repayment program. The bill also requires the Green Bank to conduct a study on residential property assessed clean energy (R-PACE), updated high performance building standards for state facilities and state funded construction, and authorized a limited liability company to be a thermal energy transportation company, regulated by PURA, for a district heating loop in Bridgeport which the Green Bank is involved in.
- **Public Act 15-1** – “An Act Authorizing and Adjusting Bonds of the State for Capital Improvements, Transportation and Other Purposes” increases, from \$50 million to \$100 million, the amount of bonds the Green Bank may issue that are backed by a special capital reserve fund (SCRF). It also allows electric companies to build, own, or operate demonstration projects under DEEP approval to investigate how distributed energy resources can be optimally integrated into the electric grid. The proposal must be complimentary to the existing ecosystem of programs.
- **Public Act 15-194** – “An Act Concerning the Encouragement of Local Economic Development and Access to Residential Renewable Energy” expands the state’s residential solar PV deployment target from no less than 30 MW to no more than 300 MW under RSIP. Under the law, 15-year Solar Home Renewable Energy Credits (SHRECs) are generated from qualifying residential PV systems and owned by the Green Bank, which sells SHRECs to electric distribution companies under a master purchase agreement negotiated by the parties. The Green Bank may fund its incentive program using the proceeds of the sale, and the electric companies may seek cost recovery from the Public Utilities Regulatory Authority (PURA). Also, municipalities must prepare for more residential solar PV applications by incorporating these systems into their building permit application process.
- **Public Act 16-212** – “An Act Concerning Administration of the Connecticut Green Bank, the Priority of the Benefit Assessments Lien Under the Green Bank’s Commercial Sustainable Energy Program and the Green Bank’s Solar Home Renewable Energy Credit Program” makes changes to a variety of Green Bank statutes. It creates new, direct statutory

authority for the Green Bank so that it no longer needs to derive powers through a statutory link to Connecticut Innovations, Inc.; in the process it removes a potential complication to financial transactions. It also clarifies electric distribution companies' purchase obligations for SHRECs, makes power purchase agreements eligible for RSIP incentives, and adjusts RSIP to only apply to the first 20 kW of installed solar PV. Lastly, it clarifies the C-PACE lienholder consent provisions.

The Future of Residential Solar PV – Grid Modernization

There have been several recent developments in state and federal incentives for residential solar PV. With the passage of the SHREC policy in 2015, and subsequent revisions in 2016, incentives offered through the RSIP will continue to decline. With the extension of the federal ITC at the end of 2015, tax incentives will also continue to decline:

- **State:** The PA 15-194 SHREC policy phases out the RSIP through a declining block incentive structure, which must cease either by the end of 2022 or after 300 MW of deployment.
- **Federal:** The 30% Investment Tax Credit for residential and commercial projects runs through the end of 2019 before dropping to 26% in 2020 and 22% in 2021. It then drops permanently to 10% for commercial projects and 0% for residential projects.

The future of residential solar PV not only depends upon lowering installed costs – particularly “soft costs” from customer acquisition and permitting – and continuing to improve easier access to affordable private capital investment and financing, but it will also require sharing the benefits of behind-the-meter policy with the rest of those tied to the grid. Through various policy and technology approaches, including but not limited to rate structure and design (i.e., Time of Use Rates and demand charges) along with battery storage and smart inverters, residential solar PV systems can continue to deliver cost-effective benefits to households and the electric grid.

As the state continues its efforts to reduce GHG emissions to 80% below 2001 levels by 2050, the deployment of renewables both utility scale, and residential solar PV will help to further enable emission free transportation (e.g., EV) and deployment of renewable thermal technologies (e.g., air source heat pumps and ground source heat pumps).

These statutes comprise a majority of the public policies that seek to advance clean energy in Connecticut and fall within the sphere of the Green Bank.

Beyond these statutes, there are various planning documents as well as regulatory decisions that also serve to inform the clean energy policies of the state. The public policies outlined in the 2013 CES and the 2014 IRP developed by DEEP's approval of the 2016-2018 Electric and Natural Gas C&LM Plan, and their impact on the programs of the Green Bank, are highlighted within each of the three programmatic sectors below. The Green Bank also interplays with the administrators of the Conservation and Load Management Fund (i.e. Eversource Energy and Avangrid) and the Energy

Efficiency Board through coordination of our staff as well as a Joint Committee to continue to work to harmonize programs and initiatives to support the implementation of public policy goals.

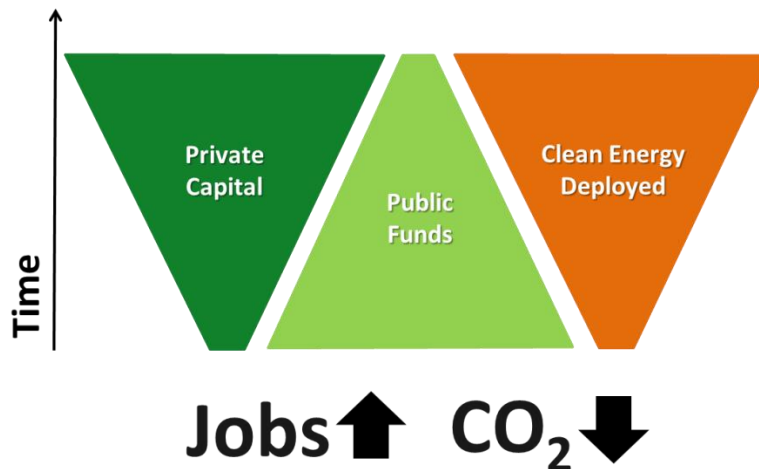
4. Evaluation Framework

The Evaluation Framework²³ of the Green Bank is intended as an internal Green Bank document to provide staff with the guidance on how to approach the evaluation and assessment of its programs' impacts. As the Framework document notes, "These impacts can broadly be viewed within two categories: 1) energy savings and clean energy production supported by the Green Bank programs and the resulting societal impacts or benefits arising from clean energy investments; and 2) market transformation impacts from Green Bank programs that lead to new opportunities to support clean energy projects, ultimately through the increase in private capital investment in clean energy."²⁴ It also recognizes the importance of continuously evaluating program impacts along the way (e.g., RSIP) that may be required by statute or requested by the Board.²⁵

4.1 Green Bank Model

The high level, long term Green Bank financial market transformation objective – to rely increasingly on private capital to deploy increasing amounts of clean energy resources, increase jobs, and reduce greenhouse gas emissions – can be graphically represented in the following figure. This graphic also presents the green bank model of public-private partnerships which envisions public funds being leveraged more and more over time – for example, achieving a high leverage ratio for every \$1 of public funds invested by the Green Bank attracting \$10 of private capital investment. The Green Bank will also seek to recover the \$1 of investment it makes over time through its financing offerings, including its cost of capital.

Figure 3. Green Bank Model - Public and Private Partnerships for Clean Energy Deployment



²³ Evaluation Framework – Assessing, Monitoring, and Reporting of Program Impacts and Processes (July 2016)

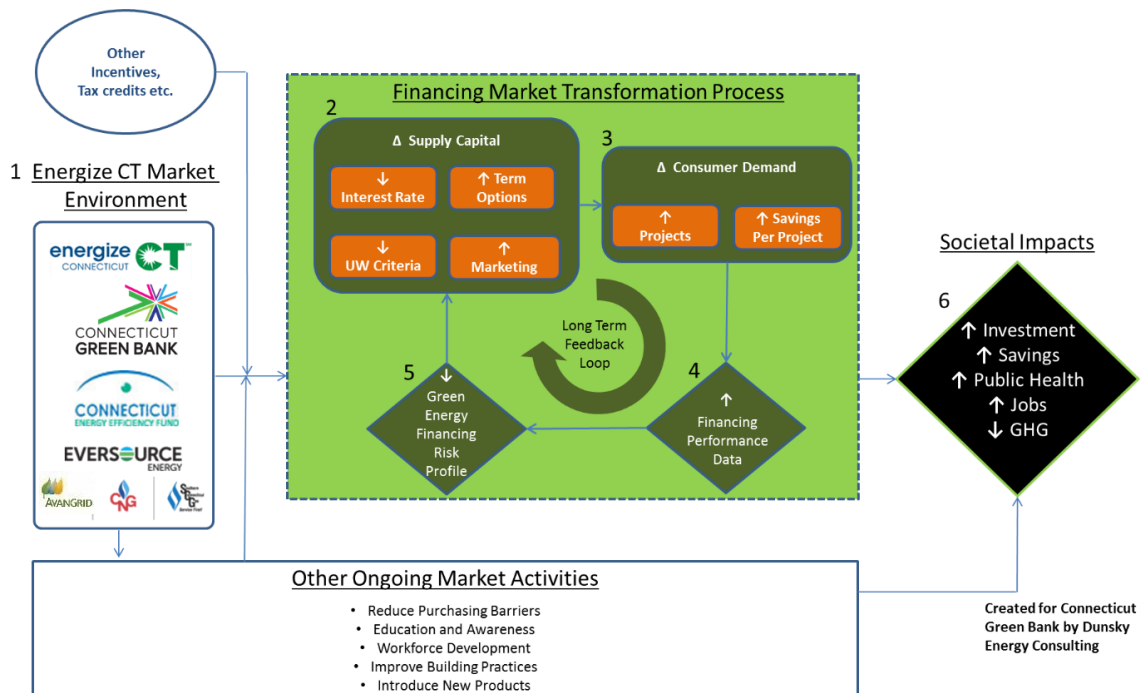
²⁴ Ibid. p. 5

²⁵ Cost-Effectiveness Assessment of the Residential Solar Investment Program (March 26, 2016) by Cadmus

4.2 Program Logic Model

A Program Logic Model (PLM) is a “graphical representation of the causal links between program activities, short-term responses to those activities among market actors and longer-term market effects. Logic models flow from decision-makers’ hypotheses of how a program intervention strategy addresses barriers or market failures. A logic model can provide the basis for establishing metrics that indicate progress toward program goals and help program administrators, policymakers, and stakeholders assess the likely timeframe within which the theorized transformation might be realized.”²⁶ Figure 5 below presents a generalized market transformation and impact logic model of the Green Bank’s program activities that can be adapted to apply to any of the Green Bank’s specific programs, in alignment with the market transformation and associated evaluation strategies are developed. The Green Bank recognizes that a more formalized and detailed structure is typical of industry logic models, and that this is simply a high-level presentation. The PLM includes three parts: Energize CT Market Environment (including Other Ongoing Market Activities); Financing Market Transformation Process; and Societal Impacts.

Figure 4. Connecticut Green Bank Program Logic Model



²⁶ State and Local Energy Efficiency Action Network (2015). *Making it Count: Understanding the Value of Regulated Energy Efficiency Financing Programs*. Prepared by: Chris Kramer, Emily Martin Fadrhonc, Charles Goldman, Steve Schiller, and Lisa Schwartz of Lawrence Berkeley National Laboratory (pp 53). [click here](#)

EnergizeCT Market Environment

Energize CT is an initiative of the Green Bank, the Connecticut Energy Efficiency Fund, the State (i.e., DEEP), and the local electric and gas utilities. It provides Connecticut consumers, businesses and communities the resources and information they need to make it easy to save energy and build a clean energy future for everyone in the state.

Financing Market Transformation Process

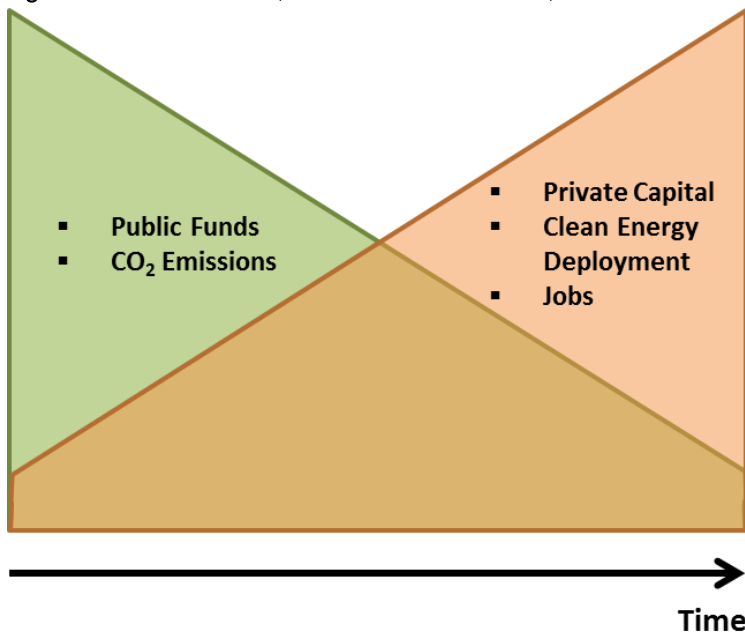
The efforts of the Green Bank are exemplified through the financing market transformation process, which focuses on accelerating the deployment of clean energy – more customers and “deeper” more comprehensive measures being undertaken – by securing increasingly affordable and attractive private capital. The Green Bank can enter the process at a number of points, such as supplying capital through financing offers, marketing clean energy financing, offsetting clean energy financing risk by backstopping loans, or sharing loan performance data.

- **Supply of Capital** – financing programs aim to increase the supply of affordable and attractive capital available to support energy savings and clean energy production in the market place.
- **Consumer Demand** – in combination with a comprehensive set of clean energy programs under the Energize CT initiative, the Green Bank drives demand for clean energy by marketing financing programs and increasing awareness of the potential benefits stemming from clean energy projects.
- **Financing Performance Data** – the Green Bank gathers and communicates the performance of clean energy financing either through its own programs or for other financing options in the market place.
- **Financing Risk Profile** – the Green Bank can help reduce clean energy financing risk profiles in a number of ways. For example, it can absorb a portion or all the credit risk by providing loan loss reserve (LLR) funds and guarantees or taking the first-loss position on investments (i.e., subordinated debt). It can also channel or attract rebates and incentives to finance energy saving projects, thus improving their economic performance and lowering the associated performance risk. In the long run, by making clean energy financing performance data available to the market, Green Bank programs increase lenders’ and borrowers’ understanding of clean energy investment risk profiles, which may allow them to (1) design more affordable and attractive financing products and/or (2) select projects for financing to reduce risks.

Societal Impacts

The efforts to accelerate and scale-up investment in clean energy deployment by the Green Bank lead to a myriad of societal impacts and benefits – among them economic development (e.g., job creation) and environmental protection (e.g., reduction of greenhouse gas emissions, improvement in public health, etc.). The transition to a cleaner energy Connecticut with the resulting societal benefits can be represented by the following figure:

Figure 6. Societal Benefits, Environmental Protection, and Economic Development from a Cleaner Connecticut



For more information on Societal Impacts, visit the Strategy and Impact page of the Green Bank website.²⁷

²⁷ <http://www.ctgreenbank.com/strategy-impact/impact/>

5. Financing

A major focus of the Green Bank is to attract private capital to finance the clean energy policy goals of Connecticut and ensure that customers and contractors are able to access and deploy cleaner, cheaper and more reliable sources of energy. Meeting these policy goals for the residential and commercial sectors alone, which do not begin to consider industrial, municipal or institutional potential, could require more than *\$10 billion* in investment over the next 5-10 years. Thus, reaching these goals will require a combination of private and ratepayer capital sources. Through a combination of ratepayer incentives alongside increasing low cost and long-term private capital investment, the market for clean energy will expand and customers will pursue deeper measures. Recognizing that ratepayer resources are limited, achieving greater uptake of measures by providing customers with easy access to affordable capital will result in a larger impact. Attracting low cost and long-term private capital will make clean energy more accessible and affordable to customers, resulting in greater and accelerated deployment.

The green bank model, which works by designing and implementing innovative financing, security and collection structures, has already enabled Connecticut to use its limited ratepayer and taxpayer resources to attract hundreds of millions of dollars in private investment from local, regional and national sources. This model offers Connecticut and other states the most promising route to source the capital required to achieve ambitious public policy objectives and to transition the state to a sustainable clean energy marketplace driven by private sector investment. Acknowledging the importance of attracting more and more private capital to help Connecticut meet its clean energy policy goals, DEEP established a policy to ensure that subsidized financing products aren't unfairly preventing private capital from entering the market.

“The ratepayer-supported C&LM financing products should be positioned in the market in such a way that they do not undermine financing products offered by the private market.”

*Final Decision on the 2013-2015 C&LM Plan
Department of Energy and Environmental Protection
October 31, 2013*

5.1 Ratepayer and State Funds

The Green Bank is capitalized through a number of public – state and ratepayer – sources.

Systems Benefit Charge

As its main source of capitalization, the Green Bank through C.G.S. § 16-245n(b) receives a 1 mill surcharge called the Clean Energy Fund from customers of Eversource Energy and Avangrid. The fund has been in existence since Connecticut deregulated its electric industry in the late 1990's. On average, the Clean Energy Fund cost households about \$10 a year and generates about \$27 million a year to support the programs and initiatives of the Green Bank.

Regional Greenhouse Gas Emission Allowance Proceeds

The Green Bank receives a portion of Connecticut's funds from the Regional Greenhouse Gas Initiative (RGGI). As a result of Regulation of Connecticut State Agencies § 22a-174-31(f)(6)(B), the Green Bank receives all of the state RGGI funds for renewable energy (i.e., Class I RPS renewable energy sources). The Green Bank uses these carbon allowance proceeds from the nation's first cap and trade program to provide financing for energy improvement projects through its Commercial Property Assessed Clean Energy (C-PACE) program for commercial, industrial, non-profit, and multifamily buildings. Connecticut is the first state to use carbon emission allowance revenue as financing for C-PACE in order to (1) attract private capital investment, and (2) return funds back to the Green Bank for future reinvestment to lower energy costs and improve the competitiveness of its businesses and institutions.

Special Capital Reserve Fund

As part of C.G.S. § 16-245n(d)(1)(C), the Green Bank has access to the Special Capital Reserve Fund (SCRF), which allows quasi-public agencies to issue bonds for self-supporting projects or programs that are backed by the State of Connecticut, lowering the cost of capital for the program – in essence, having a no-cost insurance policy. The Green Bank has received \$100 million in SCRF authorization that can be placed on bonds issued for clean energy programs.

Connecticut State Treasurer's Office

The Green Bank will work cooperatively with the State Treasurer's Office to explore opportunities to co-invest in Connecticut projects that can deliver appropriate risk-adjusted returns for Connecticut pension assets, reduce the emissions of greenhouse gases, and contribute to job creation.

5.2 Federal Funds

Alongside public funds made available through state channels, the Green Bank has access to and/or expects to pursue federal funds including stimulus monies, revolving loan funds, and competitive grant solicitations as well as loan guarantees, in order to bring private capital to these sources.

American Recovery and Reinvestment Act

The American Recovery and Reinvestment Act (ARRA) of 2009 awarded the Green Bank, and its predecessor the CCEF, \$20 million for its programs and initiatives. About \$8.25 million of those funds are currently being used as credit enhancements (i.e., loan loss reserves and interest rate buy-downs) for the Green Bank's residential financing programs including the Energize CT Smart-E Loan and CT Solar Loan. These funds have already been received and are being used to attract private capital investment in products that support the policy goals of Connecticut.

Clean Water State Revolving Fund

The Clean Water State Revolving Fund (CWSRF) serves as the nation's largest water quality financing source, helping communities across the country meet the goals of the Clean Water Act. The CWSRF programs provide low interest and long-term loans for many things including water quality protection projects for wastewater treatment. Recently, a nexus has been drawn in New York (e.g., Green Jobs and Green New York) between energy and water that permits programmatic guarantees for financing energy efficiency projects that results in a reduction of air emissions from stationary power plants, and thus deposition of airborne pollutants into our

waterways. The Green Bank will explore with DEEP and the Treasurer’s Office how the CWSRF can be leveraged to bring in more private capital for investments in key areas (e.g., food waste and sludge from waste water treatment plants to energy through anaerobic digester projects).

Loan Guarantees

Through the U.S Department of Energy and U.S. Department of Agriculture, potential sources of loan guarantee or low interest and long-term loans from the U.S. Treasury are accessible. The Green Bank will pursue – as necessary and appropriate – access to federal resources to attract more private capital investment in clean energy deployment in Connecticut.

5.3 Green Bonds

Green Banks have an essential role in leveraging limited public funds with private capital to drive investment and scale-up clean energy deployment in order to achieve climate goals, create green jobs and promote economic development. While co-investment with banks has been a key element of its ability to leverage its core capital resources, C.G.S. § 16-245n(d)(1)(C) is the enabling statute that allows the Green Bank to issue revenue bonds to support its investments in clean energy. Bonds offer several advantages over co-investment with banks and other investors offering loan facilities. While interest on long-term loans are often structured with interest rates priced as a spread over a variable index, such as LIBOR²⁸, bonds generally allow the issuer to lock in a long-term interest rate for the entire duration of the bond.²⁹ In addition, an issuer of bonds can repay the principal borrowed over 15, 20, 30 years or more, far beyond the reach of typical bank facilities, which are in most cases limited to 7, 10 or 15 years at the maximum.³⁰ The ability to raise funds for fixed interest rates for longer maturities make bonds a useful and attractive financing tool for the Green Bank’s clean energy projects and programs.

Green Bonds are bonds whose proceeds are used for projects or activities with environmental or climate benefits, most usually climate change mitigation and adaptation.³¹ Labeling a bond “green” makes it easier for institutional investors to identify green investments.³² The size of investment required and revenue streams from clean energy infrastructure required under various government clean energy policies lend themselves well to bond structures. The Green Bank is a natural issuer of green bonds given its mandate to provide financing solutions to increase uptake of clean energy measures within Connecticut. Issuing green bonds can provide the Green Bank a lower-cost, longer-term source of capital, enabling the Green Bank to further leverage the ratepayer funds at its disposition. Given that the yields on investment-grade project bonds are generally lower than project finance rates available from commercial banking institutions with more generous maturities, the use of green bonds can not only contribute to a lower cost of capital, but also can ease annual debt service requirements, improving clean energy economics.

²⁸ London Interbank Offered Rate

²⁹ Variable interest rate bank loan interest can be converted to fixed interest rates using interest rate swaps but add a degree of complexity and execution cost to the overall financing arrangement.

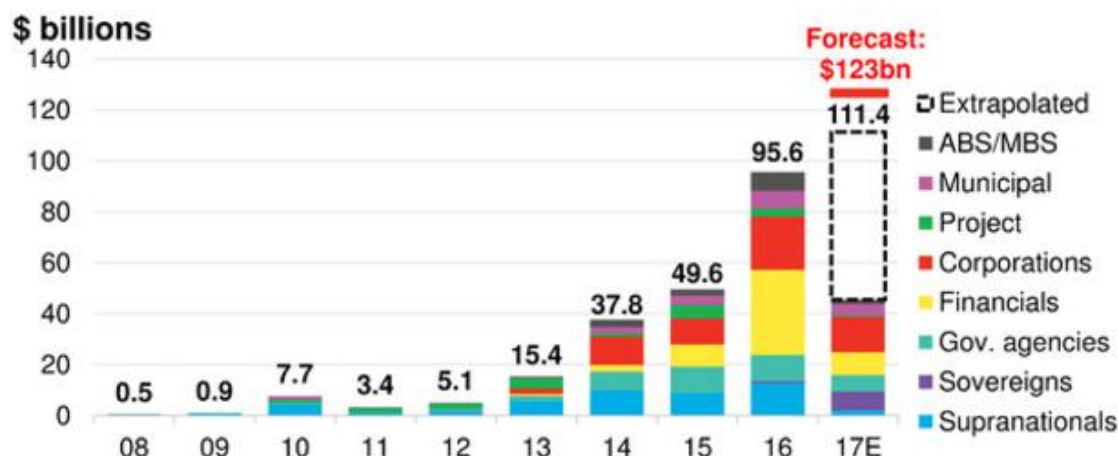
³⁰ In 2014, the District of Columbia Water and Sewer Authority sold \$350 million of bonds with a 100-year maturity.

³¹ Climate Bonds Initiative, “Scaling Up Green Bond Markets for Sustainable Development,” (September 2015) www.climatebonds.net

³² Climate Bonds Initiative, *ibid.*

Growth in green bond issuance has continued to accelerate with \$58 billion of green bonds issued in the first half of 2017.³³ As of July 2017, in total over \$233 billion of green bonds has been issued by approximately 320 separate entities.³⁴ Total green bond issuance for 2017 could reach as high as \$123 billion, which would bring global outstanding issuance to around \$340 billion by the end of the year³⁵.

Annual green bond issuance by issuer type (\$ billions)



Source: Bloomberg New Energy Finance

Table 3. Types of Green Bonds³⁶

Type	Debt Recourse
Green "Use of Proceeds" Bond	Standard recourse-to-the-issuer debt obligation linked to issuer's lending and investment operations for eligible projects.
Green "Use of Proceeds" Revenue Bond	Non-recourse-to-the-issuer debt obligation in which credit exposure of the bond is to the pledged cash flows of the revenue streams. Use of proceeds of bond can be related or unrelated to the project cash flows.
Green Project Bond	Project bond for single or multiple green project(s) for which investor has direct exposure to the risk of the project with or without potential recourse to the issuer.
Green Securitized Bond	Bond collateralized by one or more specific projects, including covered bonds, ABS, and other structures. First source or repayment is generally cash flows of the assets. This type of bond covers asset-backed securitizations of rooftop solar PV and/or energy efficiency assets, for example.

Environmentally responsible investments are becoming more widely pursued every year. Green bonds attract a diverse investor base as investors seek the environmental attributes of the bonds. However, as with any emerging financial product there are also inherent risks. One of the most recognized risks associated with green bonds is that of "greenwashing," when environmental

³³ <https://www.climatebonds.net/>

³⁴ Climate Bonds Initiative, Labelled Green Bonds Database, Accessed June 3, 2016. Available at: https://www.climatebonds.net/cbi/pub/data/bonds?items_per_page=All

³⁵ Bloomberg New Energy Finance, Green Bonds Monthly – May 2017. June 2, 2017.

³⁶ Climate Bonds Initiative, *Explaining Green Bonds*, <https://www.climatebonds.net/market/explaining-green-bonds>

claims are made irresponsibly or without supporting evidence. The Green Bond Principles (GBP) and Climate Bond Standards (CBS) have been set up largely as a means to mitigate against greenwashing by providing guidelines for what constitutes a “green bond” and a standardized means to evaluate the bonds against these guidelines.

The Green Bond Principles specifically focus on four components:³⁷

1. Use of proceeds – types of projects and their environmental benefits should be clear;
2. Process for evaluation and selection of projects funded with proceeds;
3. Management of proceeds – proceeds and disbursements for “green” projects should be housed in separate, easily trackable accounts leaving a clear audit trail; and
4. Reporting – use of proceeds should be reported and updated at least annually stating the disbursements and expected environmental impact.

The Climate Bond Standards were created as a certification scheme to verify the green credentials of a bond. The certification standards align with the Green Bond Principles and are guided by a panel of climate and energy experts. Other services providing independent reviews and/or third-party assurances have sprung up off the back of the Green Bond Principles and Climate Bond Standards as well.

Methodologies for evaluating the “greenness” of green bonds have also emerged, such as CICERO’s ‘Shades of Green’ assessment and the Alliance to Save Energy’s CarbonCount™ quantification of emissions and energy reduction impact of bonds. Detail of these evaluation techniques is included in the below table (see Table 4). In addition, the Green Bank has been providing input into the design of the Climate Action Reserve’s Climate Impact Score framework (currently in development) which can be used to score the climate impact of green financing.

Table 4. Green Bond Evaluation Techniques

Name	Summary	Focus
Qualitative Evaluation of Managerial Aspects of Bonds (use of proceeds, management process, reporting/disclosure, etc.)		
Green Bond Principles (GBP)	Voluntary guidelines to promote transparency and disclosure	<ul style="list-style-type: none"> •Use of proceeds •Process of project evaluation and selection •Management of proceeds •Reporting
Moody’s Green Bond Assessment (GBA)³⁸	Qualitative assessment ‘rating’ using similar parameters to GBP	<ul style="list-style-type: none"> •Use of proceeds •Organization structure & decision •Disclosure on use of proceeds •Management of proceeds •Ongoing reporting & disclosure

³⁷ <http://www.icmagroup.org/Regulatory-Policy-and-Market-Practice/green-bonds/green-bond-principles/>

³⁸ https://www.moodys.com/research/Moodys-launches-new-Green-Bond-Assessment-service--PR_346590

Climate Bond Initiative's Climate Bond Standard (CBS) ³⁹	Certification scheme to verify green credentials of a bond, aligns with GBP; Guided by panel of climate and energy experts; focus on corporate issuers	<ul style="list-style-type: none"> •Monitoring, reporting, and assurance of conformance with Climate Bonds Standards •Decision making process of underlying projects' eligibility •Internal process & controls (use and tracking of proceeds) •Reporting (disclosure prior to issuance) •Post-issuance reporting and disclosure
Evaluation of Environmental Impact of Bond		
CarbonCount ^{TM40}	Quantitative metric to evaluate green impact of bonds	<ul style="list-style-type: none"> •Quantitative analysis of forecast power generation and/or energy savings •Uses investment grade audit or independent engineer's analysis of underlying projects •Estimates emissions impact using EPA's AVERT model and/or other EPA emissions factors •Derives annual carbon savings per \$1,000 (face value) of bond to normalize emission savings
CICERO ⁴¹	Provides 'Shades of Green' qualitative assessment (dark, medium, light) on climate and environmental 'ambition' of bonds	<ul style="list-style-type: none"> •Grading is based on a broad qualitative assessment of each project, according to what extent it contributes to building a low-carbon society.

The Green Bank, in effect, enabled the issuance of “green bonds” when it securitized \$20 million of commercial PACE benefit assessment liens with Clean Fund. During FY2017, the Green Bank issued or participated in additional green bond issuances as follows:

- Approximately \$3 million in New Clean Renewable Energy Bonds (New CREBs) backed by the state’s Special Capital Reserve Fund and purchased by Bank of America to fund the first Archimedean screw generator to produce hydroelectric power for the City of Meriden;
- Approximately \$2 million in Qualified Energy Conservation Bonds (QECBs) issued by the Connecticut Housing Finance Authority and purchased by Bank of America to provide debt capital to the Green Bank for solar PV energy to more than a dozen housing authorities under power purchase agreements.

During FY2018, the Green Bank expects to issue several millions of dollars of green bonds to support the Residential Solar Investment Program (RSIP) using revenues from contracted sales of Solar Home Renewable Energy Credits (SHRECs) to Eversource and Avangrid.

5.4 Public-Private Partnerships

The foundation of the green bank model rests on Connecticut’s achievement of a legislative and regulatory policy framework that makes it possible for financing, security and collection structures and mechanisms to be put in place in order to facilitate significant pools of private capital into the

³⁹ <http://www.climatebonds.net/standards/standards-V2.0>

⁴⁰ <http://www.ase.org/resources/carboncounttm-quantitative-carbon-scoring-system-green-bonds>

⁴¹ <http://www.cicero.uio.no/en/posts/news/cicero-grades-climate-friendly-bonds-with-shades-of-green>

marketplace to finance a diverse array of clean energy investment across all sectors. Since its formation, the Green Bank has attracted hundreds of millions of dollars in private investment from local, regional and national sources. These investments are the quintessential public private partnerships for clean energy finance, and include investments such as:

- **Dominion Bridgeport Fuel Cell Park** – Green Bank financing in support of the largest fuel cell in North America – a 15 MW project on an old brownfield site in a distressed community using a technology manufactured in Connecticut – attracted \$65M in initial investment from Dominion Resources.
- **CT Solar Lease** – a unique combination of a tax equity investor, a syndicate of debt providers and the Green Bank to create a \$70 million fund for rooftop solar PV (i.e., residential lease financing for solar PV and commercial leases and PPAs for solar PV).
- **CT Solar Loan** – a \$5 million pilot public-private partnership between the Green Bank and Sungage Financial resulting in the first crowd-funded solar loan program in the country and graduating to a \$100 million pool of capital from the Digital Federal Credit Union to enable citizens to own solar PV systems installed on their homes.
- **Energize CT Smart-E Loan** – a second-loss reserve provided by the Green Bank to attract private capital investment for Energize CT Smart-E Loans offered by local community banks and credit unions offering state-wide coverage and supporting the implementation of the CES.
- **PosiGen** – a \$5 million subordinated debt investment, with an additional \$5 million option from the Green Bank, into a total fund of \$27 million to support a solar PV lease and energy efficiency energy savings agreement (ESA) product for 1,000 homes in the low-to-moderate income market segment.
- **C-PACE** – an offering by the Green Bank of C-PACE funded transactions that resulted in attracting \$24 million in private capital using \$6 million of Green Bank investment to fund a \$30 million securitization of commercial, industrial, non-profit, and multifamily projects. A follow-on \$100 million public-private partnership with Hannon Armstrong increased access to capital for C-PACE.
- **Private Foundations** – as a result of C.G.S. § 16-245n(d)(2)(C)(iii), the Green Bank can receive grants and investment (e.g., Program Related Investments, or PRIs) from philanthropic foundations.
 - **MacArthur Foundation** – In partnership with the MacArthur Foundation, the Green Bank is supporting a \$5 million PRI to support clean energy deployment in the affordable multifamily market segment.
 - **Kresge Foundation** – The Green Bank is supporting the deployment of solar PV and battery energy storage systems for affordable housing and community institutions in Connecticut with funding from the Kresge Foundation in the form of a PRI for up to \$3 million and associated grant funding of 5% of the loan amount.

These partnerships with private capital are positive signs that the capital is ready, willing and able to be supplied to the clean energy marketplace in Connecticut.

Cost of Capital

It is not sufficient for private capital to be supplied into the market for clean energy and energy efficiency investment. Capital “at any cost” will not permit the market to scale-up to levels required to enable Connecticut to achieve its public policy goals. This is particularly true in Connecticut where the marketplace has become conditioned to subsidized interest rate loans, particularly for energy efficiency. To date, much success has been observed in the Green Bank’s ability to attract capital at rates that are viewed by consumers as both reasonable and affordable. The Green Bank’s Energize CT Smart-E loan for homeowners is available at 5-year rates not-to-exceed 4.49% (4.24% from at least one lender). For homeowners without access to home equity financing, these rates compare quite favorably to unsecured lending rates, which frequently range from 9-12% or more. The C-PACE program is attracting funding at a level of approximately 300 basis points (100 basis points = 1%) over long term swap rates. An even lower rate was achieved for the debt funding associated with the leveraged solar lease fund. Crowd-funding could provide funding at even lower yields, but the potential for crowd funding is too uncertain at the present time to be relied upon as a meaningful supply of capital for clean energy projects.

Maturity

To date, the Green Bank has been successful in attracting capital for terms that enable consumers of all types to make the desired investments in clean energy with no cash investment upfront in most cases. In fact, Green Bank programs have demonstrated that lengthening the maturity of the loan can be an effective way to raise more capital for these projects. For instance, it would require a reduction in interest rate from 5% to nearly 0% to have the same impact as a one-year extension in repayment terms (i.e., from 6 years to 7 years) to finance a home oil-to-gas conversion with a new boiler/furnace for about the same \$100 per month outlay. The benefits of extended terms become even more significant for financing comprehensive energy efficiency retrofits called for by the CES that cost more to implement and deliver benefits to the homeowner over somewhat longer payback periods. In these cases, the 10, 12 and even up to 20 year maturities for the Smart-E loan and the 15 and 20-year maturity for the Sungage solar loan permit homeowners to become cash flow positive either throughout the life of the loan or after a modest fraction of the total loan payments have been made. With C-PACE, commercial and industrial property owners are able to finance their investments at periods extending to 25 years with a statutory requirement that expected energy savings exceed financing obligations levied on their property tax bill.

Private Investment and Leverage Ratio

In the end, these public-private partnerships are efforts by the Green Bank to attract private investment to finance Connecticut’s clean energy policy goals. In doing so, the Green Bank uses a diverse array of financial structures and instruments to facilitate co-investment with a host of capital providers, participating in every level of the capital stack, from equity, to subordinated debt and senior debt (i.e., earning returns that range from “concessionary rates” to “market” rates of return). The Green Bank will also provide other credit enhancements, such as loss reserves, guarantees, funding warehouses, and other forms of support where such support for the sector or achieving Connecticut’s policy goals is warranted. The Green Bank has no formula for the manner or level of support or credit enhancement it ultimately provides, but seeks to provide the least amount of

support necessary to result in the highest possible levels of private financing for the projects concerned or to meet programmatic goals.

That said, the Green Bank has been successful in leveraging ratepayer and other forms of public capital from 4:1 to 12:1. For example, the Green Bank leverages ratepayer capital in various ways through its products, including a 5:1 leverage ratio through the CT Solar Lease whereby \$10 million of ratepayer capital was used to initially attract \$50 million in tax equity and debt investment.

Another example is yielding an 11:1 leverage ratio to support the growth and sustainability of a local residential solar PV contractor market, through the Energize CT Smart-E Loan whereby a \$2.5 million second loss reserve is attracting \$28 million of long-term and low-interest loans from local community banks and credit unions to help finance energy improvements in homes that are consistent with the CES.

5.5 Green Bank Network

The Green Bank Network is a new global organization and platform that will enable Green Banks and network participants to share experience, best practices and data around innovative green infrastructure financing activities. At the Conference of the Parties (COP) 21 conference in Paris, France in December 2015, the Green Bank joined with the UK Green Investment Bank, the Australian Clean Energy Finance Corporation, the Japan Green Fund, Malaysia Green Technology Financing Scheme, and the New York Green Bank to announce the formation of the Green Bank Network. The Green Bank Network is coordinated by two non-profit organizations, the National Resource Defense Council (NRDC) and the Coalition for Green Capital (CGC) with start-up funding from ClimateWorks for 2016.

The Green Bank Network will collect, organize and share know-how through virtual and in-person platforms. This will allow green banks, development finance institutions and other intermediaries to collaborate and learn from one another and will equip the global clean energy finance community with advanced tools and practices based on an “open source banking” model. Over time, the network aims to help private sector investors and developers partner with Green Banks, and to drive standardization in clean energy markets to increase the flow of capital to the sector and increase the scale, scope and efficiency of financing activities.

6. Marketing

As the Green Bank continues to grow and evolve from a grant distribution model to one whose success is increasingly measured by private market participation, the role of marketing and communications necessarily must too. Consequently, a great deal of effort has been focused on marketing innovation in order to raise stakeholders' awareness of, and engagement with, the Green Bank brand and its programs.

The Green Bank's marketing efforts support the organization's drive to attract private capital to finance the clean energy goals for Connecticut, as well as facilitate the deployment of more green energy throughout the state. Through various marketing channels including our utility partners, local lenders and contractors, on the ground community efforts, as well as our online assets, the Green Bank is helping more and more consumers receive access to cleaner, cheaper, and more reliable sources of green energy.

6.1 Brand

The Green Bank brand was officially launched to the public on April 15, 2015. While a noticeable departure from CEFIA's previous visual identity, the new brand is much more than a distinctive logo and creative copy. It serves as a valuable asset designed to drive market activity, increase stakeholder engagement, and project the Green Bank's team-centered approach to achieving Connecticut's clean energy policy goals.

Many participated in the brand development process which included quantitative and qualitative research designed to capture stakeholder attitudes about the Green Bank and its predecessor CEFIA. Accordingly, it was only through the collective input of stakeholders that we were able to discover, and in turn, amplify Green Bank's authentic brand voice. As an organization, the Green Bank also strove to ensure the new brand properly expressed staff's commitment to being skilled listeners, connectors, and facilitators. To that end, the process not only revealed considerable insight into external stakeholders' perceptions of the Green Bank but also served as a touchstone for its corporate culture and identity.




When asked to describe the Green Bank, research efforts often observed respondents employing metaphors such as "catalyst" and "spark". As self-identified agents of change, this particular insight resonated strongly with internal stakeholders, and for good reason. Certainly, one of the most important roles of the Green Bank is to catalyze Connecticut's green energy market. However, many internal and external stakeholders viewed the Green Bank's mission and impact through a much broader lens. Several survey participants expressed that the Green Bank was responsible for "sparking a movement." Thus, the catalyst metaphor was heavily leveraged to underscore the new Green Bank brand identity.

Pillars

Supporting the Green Bank's new brand platform are three mission-driven pillars. They are: Innovate, Educate, and Activate. As the foundation of the brand, the pillars' collective role is to facilitate the acceleration of clean energy deployment in Connecticut; individually however, they serve to articulate the organization's commitment to engage all stakeholders on multiple levels.

Through innovation, the Green Bank is making clean energy investment safer, more affordable and accessible. By educating Connecticut residents and businesses, we are helping to illuminate the benefits of green energy in order to drive interest. And finally, by inspiring people to make green energy a part of their lives, we are activating consumer behavior change and accelerating clean energy market growth throughout the state.

Table 5. Pillars of the Connecticut Green Bank

 <p style="text-align: center;">Innovate</p> <p>We are making clean energy investment safer, more affordable and accessible with our innovative model.</p> <ul style="list-style-type: none"> ▪ Innovations in finance: Creative financial solutions that make green energy affordable and rewarding ▪ Innovations in green technology: Invest in cleaner, greener and more reliable sources of energy for a healthier economy and healthier planet ▪ Innovations in public-private collaborations: Work with local contractors and lenders to help businesses and homeowners access affordable financing 	 <p style="text-align: center;">Educate</p> <p>We are helping to make the benefits of green energy clear to drive interest.</p> <ul style="list-style-type: none"> ▪ Empower residents and businesses to discover how to access green energy financing by providing education and answers ▪ Train and certify Connecticut Green Bank partners about green energy financing ▪ Raise community awareness of the benefits of green energy for a thriving Connecticut 	 <p style="text-align: center;">Activate</p> <p>We are inspiring people to take action and make green energy a part of their lives.</p> <ul style="list-style-type: none"> ▪ Give residents and businesses the confidence to take action by helping them navigate the process ▪ Help them realize their goals by finding a solution that's right.
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Brand Promise

Energy is essential to grow and thrive. Energy powers your life, your business, your community. And green energy, leveraging energy efficiency and renewable energy sources, guarantees an enduring future. You want to make a change, but are uncertain how to navigate the process of making green energy a part of your life. The Green Bank lowers barriers to make green energy financing more accessible and affordable. We introduce an innovative model that leverages public and private dollars to accelerate the growth of green energy. With this model, we create a robust marketplace that brings down the cost of energy so that Connecticut citizens thrive and businesses grow. We innovate to educate and activate people to accelerate the growth of green energy. We create jobs. We grow businesses. We promote healthier communities. We help people thrive. By creating a flourishing marketplace, we contribute to a better quality of life, a better environment and a better future for all.

Customer Classifications

In order to achieve the ambitious energy policy objectives of Connecticut, it is important to ensure that consumers are not only becoming increasingly educated and aware of what they can do to improve their personal energy habits, but, more importantly, to use public incentives and financing from private capital sources to take action and do more with less. Increasing consumer education and awareness by making strong impressions and generating leads will drive more consumers to install clean energy technologies and use more private capital to finance those projects.

- **Impressions** – an impression is the earliest stage of consumer education and awareness. It includes things such as earned media, website hits, event attendance and customer relationship management. Impressions are a leading indicator of consumer action.
- **Leads** –an expressed interest by a consumer in wanting to understand the opportunity further. It includes less tangible things such as signing an interest list or having a site visit or audit, to more action oriented things such as submitting an application for approval on incentives and/or financing.
- **Installations** –a clean energy project that has received approval for an incentive (e.g., RSIP), in construction, or commissioned. Installations are expressed in terms of the number of consumers reached, renewable energy produced (e.g., kW installed, kWh generated), and energy saved (e.g., MMBTUs), along with the associated societal benefits that come with those installations (e.g., GHG emission reductions, jobs).
- **Financings** –a closed loan, lease, PPA, ESA or other financing transaction where the Green Bank is repaid (versus a subsidy), including the number of transactions, size of transactions, credit scores of borrowers and the trends towards increased financing over time.

6.2 Energize Connecticut

Energize ConnecticutSM is an initiative dedicated to empowering Connecticut citizens to make smart energy choices, now and in the future. It provides Connecticut consumers, businesses and communities the resources and information to make it easier to save energy and build a clean energy future for everyone in the state. It is an initiative of the Connecticut Energy Efficiency Fund, the Green Bank, the state, and the local electric and gas utilities. The Green Bank's Smart-E loan is marketed under the Energize Connecticut brand. The Green Bank, in conjunction with its Energize Connecticut partners, has developed a statewide marketing plan for the brand to raise awareness as well as realizing the goal stated in the CES:

“To create a culture that understands the value of and therefore demands energy efficiency, establishes standards that enable consumers to easily ascertain the efficiency profile of their own homes or buildings, and makes financing for energy efficiency measures both easily accessible and affordable.”

For more information, go to www.energizect.com

6.3 Channel Marketing

The Green Bank works on the ground in communities throughout the state with its channel marketing partners including the utilities, local lenders and contractors, and volunteer citizens and community-based organizations. It also engages consumers online through www.ctgreenbank.com, www.energizect.com and other campaign-based or programmatic platforms like www.gosolarct.com, www.solarizect.com, and www.c-pace.com.

Utility Partners

The electric (i.e., Avangrid, Eversource Energy, and Connecticut Municipal Electric Energy Cooperative) and natural gas (i.e., Connecticut Natural Gas, Southern Connecticut Gas, Yankee Gas, etc.) distribution companies are an important channel marketing partner. As administrators of the Connecticut Energy Efficiency Fund, our utility partners are helping consumers reduce their energy consumption, lower peak electric demand, and provide consumers with opportunities to access natural gas. Through the Conservation and Load Management Fund, the administrators of the CEEF are developing a customer engagement platform that can be used to target key market segments with various incentives and financing. Green Bank works with CEEF and DEEP to share data to better inform marketing tactics to acquire customers for clean energy improvements.

Local Lending Partners

The Green Bank partners with local lenders including credit unions, community development finance institutions, community, state, regional, and national banks. Through credit enhancements – including subordinated debt, loan loss reserves, and interest rate buy downs – the Green Bank supports local lenders in providing customers with easy access to affordable capital. With low interest loans that have long maturities, customers can receive immediate positive cash flow returns from their energy improvements as their energy savings exceed debt service payments.

Local Contractors

The Green Bank supports local contractors installing clean energy systems in the residential, commercial, industrial, and institutional sectors. Contractors serving renewable energy, energy efficiency, and natural gas conversion projects – all components of the CES – are supported with access to private capital sources to support the growth of their businesses through working capital, as well as easy access to affordable capital for their consumers.

Community-Based Campaigns

Community-based campaigns provide an opportunity to engage local residents, businesses and institutions in advancing the clean energy policy goals of the state. Over the years, the Green Bank, and its predecessor the CCEF, have been involved in the creation of several community-based campaigns that are attracting foundation contributions and winning federal grants by accelerating the deployment of clean energy in communities across the state, including the Clean

Energy Communities program,⁴² Neighbor to Neighbor Energy Challenge, Solarize Connecticut, and Energize Norwich.

Automated Marketing Platform

The Green Bank recently implemented an automated marketing platform that enables our private sector marketing partners to easily and cost effectively create, distribute and measure the impact of their green energy related marketing efforts. As a means to promote the Green Bank's products, this new marketing technology infrastructure houses professionally developed marketing assets designed to help channel partners improve their sales efforts through the distribution of high quality, Green Bank co-branded marketing collateral. The platform's library currently stocks a variety of customizable collateral for our channel partners to leverage in their own campaigns, with many more pieces expected to be added throughout the course of the year. The automated platform also offers several step-by-step guides designed to help our channel partners develop, execute and ultimately measure the effectiveness of their marketing efforts.

Digital and Online Media

As part of the Green Bank branding effort, the marketing unit conducted a thorough audit of all existing digital marketing assets and tools. As a result, the former CEFIA website was replaced with the much more user-friendly and "on-brand" CTGreenBank.com. Design of the new website experience was heavily influenced by a desire to create an environment that was easily navigable for all users across our diverse stakeholder base. Informed by the success of community-centric campaigns such as Solarize and Neighbor-to-Neighbor, another priority of the site was to present compelling stories and video testimonials that illustrate the benefits and relative ease of financing renewable energy upgrades with the Green Bank.

Still another digital communication and marketing channel that continues to command ever more attention is social and online media. Over the past decade, much has changed with regards to providing consumers with easier, quicker, and more substantive access to information through the internet and things such as Google, Facebook, LinkedIn and Twitter. Often in real time, the Green Bank employs these tools to increase the level of awareness and education of consumers to help them take action to receive cleaner, cheaper, and more reliable sources of energy.

6.4 Green Bank University

The well-documented success of the Green Bank and green energy finance in general has generated significant demand for more information about the creation, administration and ultimate evaluation of the quasi-public green bank model. As such, the Green Bank, Coalition for Green Capital, and Yale Center for Business and the Environment have seized the opportunity to leverage their collective experience and create resources that will support a Green Bank University to advance the green energy finance movement. Taking the form of an in-person and

⁴² The U.S. Environmental Protection Agency and U.S. Department of Energy awarded the CCEF and SmartPower with the Green Power Pilot Award for the Connecticut Clean Energy Communities Program in 2006. Such programs were supported by contributions from the Emily Hall Tremain Foundation, John Merck Fund, Pew Charitable Trusts, Rockefeller Brothers Fund, Surdna Foundation, and others.

online experience, careful consideration has been given to both the nature and scope of its content and message. Equally important still, has been the determination by the partners of what purpose(s) the university does not intend to serve. Both are cited below:

Key roles of the Green Bank University:

- Establish standardization of green bank processes and procedures
- Memorialize institutional wisdom / knowledge
- Provide insight into green bank operations
- Present an overview of successful financial innovations and marketing strategies
- Establish parameters around the scope of a green bank
- Illustrate the lifecycle of a green bank
 - documentation of key success factors pertaining to policy, implementation & adaptation
- Facilitate the proliferation of the green bank model
- Underscore the urgency of implementing the green bank model

The University does not intend to:

- Be a guide for state banking
- Position green banks as a vehicle driven by profit maximization
- Confine or limit green banks' roles to that of market animators or solely as mechanisms for capital deployment
- In broad terms neither endorse, favor, nor condemn the value of public-private partnerships (PPP) over privatization or government-only run programs but demonstrate when and where a PPP like a green bank may be most effective at advancing/achieving policy goals.

In June of 2017, the [Ash Center](#) of the Harvard Kennedy School of Government named the Connecticut Green Bank winner of its [2017 Innovations in American Government Award](#). Along with the honor of being included among the 7 finalists selected from over 500 submissions, as the winner, the Green Bank also receives a \$100,000 grant from The Ash Center. The monetary award, in addition to a matching sum approved by the Green Bank's board of directors, are being allocated to both development and subsequent operations of the Green Bank University.

7. Infrastructure Sector – Behind the Meter and On the Grid

The Infrastructure Sector is focused on implementing statutorily mandated programs⁴³ as well as infrastructure projects⁴⁴ that provide cheaper, cleaner and more reliable sources of energy while creating jobs and supporting local economic development.

Comprehensive Energy Strategy and Integrated Resource Plan

The Infrastructure Sector programs support the implementation of the 2012 CES and 2014 IRP. Specifically, the deployment of clean energy supports many of the strategy recommendations in Chapter 2 (i.e., Industry Sector Strategy) and Chapter 3 (i.e., Electricity Sector Strategy) of the CES that better enable Connecticut residents and businesses to take advantage of the opportunities. Programs such as the U.S. Department of Energy SunShot Initiative Rooftop Solar Challenge are but a few examples where the Green Bank's Infrastructure Sector is supporting the implementation of the CES. The pending release of and finding within the 2016 CES will be incorporated into the future Comprehensive Plan of the Green Bank.

Reducing the costs of the Class I RPS by deploying more cost-effective in-state and regional resources is a focus of the 2014 IRP. An additional challenge noted in the IRP is the need to reduce peak demand in the summer and winter months to release some of the cost pressures as a result of increasing peak demand.

The programs of the Infrastructure Sector are intended to support the implementation of the strategies and recommendations outlined in the CES and IRP.

Conservation and Load Management Plan

The Infrastructure Sector programs support the implementation of programs in the 2016-2018 C&LM Plan and vice versa. Specifically, the deployment of solar PV systems through the Residential Solar Investment Program (RSIP) assists with the implementation of several programs in Chapter 3 (i.e., Residential Programs) of the C&LM Plan, including, but not limited to:

- **Home Energy Solutions (HES)** – every residential solar PV project is required to undertake a HES assessment or an equivalent energy audit (e.g., BPI audit). Currently, approximately 55% of all RSIP projects undergo a HES assessment and 45% a BPI audit.
- **Water Heating** – as a result of the HES assessment or the BPI audit requirement for residential solar PV projects, opportunities for more efficient water heating systems are being identified.

⁴³ Examples of statutorily mandated programs would be, but are not limited to, Section 103 of PA 11-80 (i.e., anaerobic digester and combined heat and power pilot programs) and Public Act 15-194 (i.e., solar home renewable energy credit).

⁴⁴ Examples of infrastructure projects include Section 26 of Public Act 05-01 (i.e., Project 100) which resulted in the Dominion Bridgeport Fuel Cell Park or Section 127 of Public Act 11-80 (i.e., 30 MW of grid tied renewable energy projects sited in Connecticut) which resulted in Colebrook Wind.

- **Space Heating** – the increase in deployment of residential solar PV is providing an opportunity for homeowners to convert from heating oil furnaces to electricity powered air source and ground source heat pumps.

The combination of solar PV with renewable thermal technologies for water and space heating such as solar thermal hot water, air source heat pumps, and ground source heat pumps present a significant opportunity to support Connecticut’s long-term greenhouse gas emission reductions policy. Solar PV can provide the electricity production needed to offset the additional electricity usage associated with deployment of renewable thermal technologies such as air source heat pumps, reducing overall energy usage and in particular, fossil fuel based energy usage. A recent evaluation of the RSIP program further illustrates the opportunity to deploy solar PV in combination with energy efficiency measures including HVAC upgrades, as well as other emerging energy solutions.

The Cadmus Group has conducted two evaluations of RSIP⁴⁵, the second of which focused specifically on the cost-effectiveness of RSIP through program step 7. The key findings from this study were:

- RSIP is cost-effective from the perspective of program participants, the Green Bank, from a total resource perspective, and for society as a whole.
- RSIP has increasingly made efficient use of program funds by reducing incentives while supporting market growth through financing, marketing, outreach and education.
- RSIP benefits sufficiently outweigh costs to allow for bundling of residential solar PV with emerging technologies such as energy storage and the latest generation of renewable thermal technologies, while maintaining cost-effectiveness.

The following table illustrates increasing benefit/cost ratios as incentives decrease over program steps 1 through 7, with respect to the PACT or program administrator cost test, while the PCT or participant cost test remains level, reflecting similar economics for the participant through all steps – see Table 6. Similarly, the Green Bank Objective Function (OF) reflects increasing benefits (kWh’s generated) per program dollar invested.

⁴⁵ Residential Solar Investment Program Evaluation (January 30, 2015) – [click here](#)
Cost-Effectiveness Assessment of the Residential Solar Investment Program (March 26, 2016) by Cadmus – [click here](#)

Table 6. Cost-Effectiveness of RSIP by Step

RSIP 2012-2015	Installed Capacity (MW)	PACT Benefits	PACT Costs	Net PACT Benefits	Net Benefits/MW	PACT Benefit/Cost Ratio	PCT Benefit/Cost Ratio	OF (kWh/\$ invested)
Steps 1 & 2	7.4	\$18,646,724	\$12,435,693	\$6,211,031	\$839,329	1.50	1.72	18.1
Step 3	13.3	\$32,714,259	\$15,784,621	\$16,929,638	\$1,272,905	2.07	1.80	25.7
Step 4	20.5	\$47,901,194	\$18,200,235	\$29,700,959	\$1,448,827	2.63	1.83	33.4
Step 5	14.8	\$33,822,171	\$9,467,372	\$24,354,799	\$1,645,594	3.57	1.80	45.3
Step 6	14	\$31,078,515	\$6,021,396	\$25,057,119	\$1,789,794	5.16	1.80	67.0
Step 7	21.4	\$46,247,561	\$7,148,375	\$39,099,186	\$1,827,065	6.47	1.80	83.9
Total	91.3	\$210,410,423	\$69,057,692	\$141,352,731	\$1,546,529	3.05	1.80	38.7

With the PACT benefit/cost ratio for RSIP Step 7 in the above table approaching 7, solar PV has sufficient extra benefits relative to costs by itself or in combination with utility-supported energy efficiency measures (which are also cost-effective) to support deployment of other technologies which may or may not be as cost-effective. For example, solar PV bundles well with renewable thermal technologies or with emerging technologies such as energy storage or smart meters to provide more comprehensive energy solutions and savings to participants while maintaining program and participant cost-effectiveness. Programs in Vermont already encourage participant adoption of energy storage in combination with solar PV, or solar PV along with energy efficiency measures and renewable thermal and other heating and cooling improvements. The Green Bank has been seeing the beginning of activity in the Connecticut market looking to incorporate energy storage solutions. The Green Bank currently supports bundling of solar PV with energy efficiency measures for residential customers through the Smart-E loan offer, and has recently included energy storage as an eligible measure for the Smart-E bundle in recognition of strong interest and developments in this market.

TAM and SAM

For the Infrastructure Sector, the Total Addressable Market (TAM), Serviceable Addressable Market (SAM) and Share of Market (SOM) scenarios with respect to residential solar PV and anaerobic digesters are presented below.

Residential Solar PV

Per Public Act 15-194, the Green Bank is to structure and implement a residential solar investment program which shall result in no more than 300 megawatts of new residential solar photovoltaic installations located in Connecticut on or before December 31, 2022. In order to assess the market potential for residential solar PV to determine if the goal established by the legislature is achievable, the Green Bank worked with Geostellar⁴⁶ to use big-data geomatics to determine the technical and economic viability (i.e., TAM and SAM, respectively) and market penetration (i.e., SOM) in Connecticut (see Table 7).

⁴⁶ www.geostellar.com, or click here for the report "The Addressable Solar Market in Connecticut" (December 6, 2013)

Table 7. Residential Solar PV Market in Connecticut and Market Penetration – By Capacity, Generation and Customers

Market Definition	Market Size (GW, 2015)	Market Size (MWh/yr.)	Market Size ⁴⁷ (# of customers)	Penetration (MW, 2015)	Penetration (MWh/yr.)	Penetration ⁴⁸ (# of customers)	% Market Penetration (based on MW)
Residential Sector Total	12.7	14,462,760	1,454,651	129.6	147,588	17,128	1.0%
Residential - Technically Viable Rooftops	6.51	7,413,588	659,312	129.6	147,588	17,128	2.0%
Residential - Economically Viable Rooftops	3.89	4,429,932	506,714	129.6	147,588	17,128	3.3%

Given the existing federal and state subsidies, according to Geostellar, more than 500,000 residential rooftops can carry solar panels that produce a net present value gain for the residences taking solar electricity off their own roofs. The potential market represents more than 40% of households in the state. - and more than 12 times the legislative target of 300 MW. At saturation, the total investment would be about \$12 billion and create about 70,000 to 100,000 job years within the state. Geostellar has also estimated that the size of the market will grow to 650,000 rooftops, as solar costs decline. These rooftops would generate 6,599 GWh per year, equivalent to approximately 22% of total electricity consumption in the state, able to satisfy the state’s Class I RPS.

It should be noted that the Green Bank support of the residential solar PV market through the RSIP is to deliver no more than 300 MW – or reach approximately 40,000 residential rooftops before the end of 2022. In its efforts to meet the public policy objective, the Green Bank will also work to help the residential solar PV market transition itself by making it efficient and effective to connect the homeowner or third party owner to the Class I RPS.

Anaerobic Digesters

The three common types of AD projects that can readily be deployed in the state are: Source-Separated Organic Matter (primarily Food Waste); Waste Water Treatment Facility (WWTF) sludge; and Animal Waste (Farm). Because of the availability and economics of processing feedstock (i.e., food waste, sludge and animal waste), these projects take more time than other energy projects to develop.

⁴⁷ The TAM and SAM calculated by Geostellar are both based on 659,312 customers whereas the market sizes in terms of installed capacity (GW) differ because the SAM is based on average, economically viable system sizes while the TAM maximizes system sizes based on technical viability.

⁴⁸ As of the RSIP Market Watch report, May 6, 2016, 129.6 MW or 17,128 projects were completed, in progress or approved, not including an additional 2,019 projects that were installed through the Green Bank’s predecessor organization, the Connecticut Clean Energy Fund (CCEF), bringing total market penetration up to 19,147 residential solar PV projects.

The available food waste market assessment was based on information taken from the DEEP State-Wide Solid Waste Composition and Characterization Study and the DEEP Food Residual Generation Mapping Study (September 2001, updated for DEEP by US EPA in Spring 2012)⁴⁹ identifying all Connecticut large food waste generators. Per the source-separated organics recycling legislation (Public Act 11-217, as updated by Public Act 13-285, and codified at CGS 22a-26e) large commercial food waste generators are required to bring their source-separated organic materials to a recycling facility, unless there is not a suitable facility within a 20-mile radius of the generator. Large food waste generators subject to this requirement are identified as commercial food wholesalers or distributors, industrial food manufacturers or processors, supermarkets, resorts or conference centers that each generate an average projected volume of not less than one hundred four tons per year of source-separated organic materials (SSOM). The purpose of the law is to signal to investors and prospective facilities that a large volume of feedstock is quantified and available for composting and anaerobic digestion facilities. DEEP estimates the total food generation within Connecticut to be in excess of 320,000 tons/year, with additional tonnages of other SSOM available as well. If all the available food waste from the large generators was made available for waste to energy plants, it could support up to 9.6 MW of generation capacity.

For WWTF, the TAM and SAM are limited to the number of facilities in the State. A WWTF study assessment done by Fuss & O'Neill (F&O) for the Green Bank⁵⁰ identified a total of 84 WWTF throughout Connecticut. The total available market capacity of all the facilities is 551-million gallons of sludge per day (MGD). However, the serviceable market, based on F&O's assessment of what criteria WWTF use as their guide for acceptable paybacks for capital investments (between 5 and 10 years), identifies facilities with greater than 5 MGD as required to achieve these paybacks. This leaves the serviceable market size at 102 MGD which accounts for less than 20 of the 84 total WWTF. The market size in the table reflects the serviceable market size based on installed generation capacity of up to 2.7 MW.

Data used to determine the potential market size for animal waste, primarily cow manure, was estimated using information provided by the agriculture department at the University of Connecticut as well as the Department of Agriculture. The dairy cow population has not changed significantly in Connecticut since 2007. This TAM is directly correlated to the dairy cow population, which currently is estimated to be around 19,000. The market estimates below were based on information gathered in 2012 from several agricultural studies as well as recent information gathered from several site visits to operating farm AD systems both in Ohio and Massachusetts. Data gathered from these studies estimates that the manure from approximately 1,000 cows can provide enough methane to support a generator capacity of 250 kW. Determining the serviceable available market in Connecticut is a bit challenging because 60% of the dairy farms are either 100 cows or less. So in order for any of these farms to make an AD installation feasible, it would

⁴⁹ *Updated Mapping of Food Residual Generation in Connecticut* by the Department of Energy and Environmental Protection (Spring 2012)

⁵⁰ *Report to CEFA of Results of Anaerobic Digester Project* by Fuss & O'Neill for the Connecticut Green Bank (January 21, 2014)

require partnering and aggregating feedstock with other neighboring farmers and/or co-digest using food waste or other organic feedstock.

Based on Connecticut’s farm size numbers established in the studies there are only a handful of farms that are even large enough, 800 plus cows, to economically consider a small-scale AD project without supplementing (co-digesting) the feedstock with food waste or other organics. For the purpose of better estimating the total available market we will assume that the medium size CT dairy farms, with 400 to 800 cows, will co-digest with some percentage of food waste. There are also significant financial as well as performance benefits to co-digesting manure with food waste. Digester biogas quality and yields can be significantly improved by just adding small percentages of food waste to the farm digester feedstock recipes. Also, the economics of a farm based AD project can be significantly enhanced with the addition of tipping fees from bringing in the food waste. The more accounted-for revenue, the fewer incentives farmers require to make these AD projects feasible. Medium sized dairy farms in this size range account for approximately 20% of the 159 operating dairy farms in CT.

Currently the USDA, DOE and EPA agencies are working to promote biogas utilization through their existing programs by aligning incentive programs, research plans and standards to support these efforts.

Connecticut Farm Energy has recently sent out surveys to all registered dairy farms in the state to gauge the level of interest for farm digesters. They are currently compiling the data as the surveys come in and are expecting to have the results by the end of June 2016. This information will also provide them with a better sense of the size of the farms that are interested in digesters.

Both food waste and waste sludge are dependent on the number of feedstock generators (see Table 8). The table below shows a preliminary estimate of the market by annual electricity generation for projects using the feedstock.

Table 8. Anaerobic Digester Market in Connecticut for Food Waste, Waste Water Treatment Sludge, and Animal Waste

Market Definition	Market Capacity (MW)	Market Size (MWh)	Current Penetration
Food Waste (SSOM)	9.6	75,923	67%
WWTF Sludge	2.7	21,318	30%
Animal Waste (Farm)	5.9	46,516	0%
Total	18.2	143,757	

Product or Program Overview and Objectives

The Infrastructure Sector has established the following program objectives for FY 2017 (see Table 9):

Table 9. Infrastructure Sector Fiscal Year 2017 Objectives

Program	Projects	Capital Deployed	Clean Energy Deployed (MW)
RSIP	8,500	\$282,302,000	64.6
AD	1	\$18,000,000	1.6
Total	8,501	\$300,302,000	66.2

Meeting these targets would generate 85,480 MWh of clean energy (or 291,445 MMBtu's) in the projects first year of generation and 2,137,002 MWh of clean energy (or 7,286,131 MMBtu's) over the life of the projects.

After gauging market performance, the Green Bank revised its Fiscal Year 2017 target in January 2017 to the following (see Table 10):

Table 10. Revised Infrastructure Sector Fiscal Year 2017 Objectives

Program	Projects	Capital Deployed	Clean Energy Deployed (MW)
RSIP	6,000	\$173,165,071	47.4
AD	1	\$18,000,000	1.6
Total	6,001	\$191,165,071	49.0

Table 11. Infrastructure Sector Fiscal Year 2018 Objectives

Program	Projects	Capital Deployed	Clean Energy Deployed (MW)
RSIP	4,431	\$136,300,000	37.0
Anaerobic Digester	1	\$20,000,000	1.6
Strategic Investments	1	\$15,000,000	3.7
Total	4,433	\$171,300,000	42.3

Residential Solar Investment Program

The RSIP requires that no more than 300 MW of new residential solar PV be installed in Connecticut on or before December 31, 2022, at a reasonable payback to the customer all the while developing a sustainable market for contractors. The RSIP provides to residential customers, via solar PV contractors, direct financial incentives in the form of expected performance-based buy-down incentives (EPBB) and performance-based incentives (PBI) for the purchase and/or lease of qualifying residential PV systems.

In an assessment conducted in December of 2014, it was identified that solar PV deployment in the low-to-moderate (LMI) household market segments were not performing as well as the non-LMI market segment.⁵¹ Back then, the LMI market needed to deploy between 2 to 10 times more solar PV to be on par with the non-LMI market segment. Thus, the RSIP now includes an LMI PBI to provide additional incentive to support the growth of solar PV deployment in this underserved market segment.

⁵¹ Market Analysis of Residential Solar Deployment and Housing Characteristics of CT's Low Income Sector (December 12, 2014)
– [click here](#)

Since December of 2014, progress has been made deploying solar PV in the LMI market segment (see Table 12).

Table 12. Residential Rooftop Solar PV Distribution by Income-Banded Census Tract as of June 30, 2017

Income Level (AMI)	# of Census Tracts	Tract Pop.	Tract Households (HHs)	# of Projects	Installed Capacity (kW)	Projects per 1,000 People	Projects per 1,000 HHs	Watts/Tract HHs
Less than 60%	171	662,619	240,062	1,781	11,004	2.7	7.4	45.8
60-80%	109	493,438	193,791	2,635	17,953	5.3	13.6	92.6
80-100%	153	659,934	269,711	4,537	33,123	6.9	16.8	122.8
100-120%	140	625,478	237,488	5,617	42,914	9.0	23.7	180.7
More than 120%	251	1,143,854	411,504	10,046	80,801	8.8	24.4	196.4
Total	827	3,585,323	1,352,556	24,642	186,016	6.9	18.2	137.5

Benchmarks

Below are some of the Benchmarks to be used to compare the Residential Solar Investment Program with other states in the region (see Table 13). The below table reflects installed costs for homeowner-owned projects. Pricing for third party owned projects is structured differently and described in the next paragraph.

Table 13. State Benchmarks of Residential Solar PV Program Incentives for Homeowner Owned Projects, Q1 2017⁵²

Benchmarks	CT	MA	NJ	NY
Electric Retail Rate (\$/kWh)	\$0.193	\$0.196	\$0.158	\$0.173
Installed Cost of Homeowner Owned System (\$/W)	\$3.70	\$4.00	\$3.67	\$3.98

⁵² Calculated by Statutory and Infrastructure Sector program staff in March 2017. Installed costs (\$/W) are for Q1 2017. CT cost data are from the RSIP dataset. MA data are from the Massachusetts Clean Energy Center (<http://www.masscec.com/get-clean-energy/production-tracking-system>), the MA Solar Carve-Out Program (<http://www.mass.gov/eea/energy-utilities-clean-tech/renewable-energy/solar/rps-solar-carve-out/current-status-of-the-rps-solar-carve-out-program.html>), and the Mass Solar Loan Program (<http://www.masssolarloan.com/program-performance>). NJ data are from the New Jersey Clean Energy Program (<http://www.njcleanenergy.com/renewable-energy/project-activity-reports/project-activity-reports>). NY data are from the NYSERDA NY Sun Program (<https://www.nyserda.ny.gov/All-Programs/Programs/NY-Sun/Solar-Data>). CT and NY have direct incentives for which averages are provided in program installation data, and are also reflected on program web sites (<http://www.nyserda.ny.gov/All-Programs/Programs/NY-Sun/Megawatt-Block-Dashboards/Residential-Small-Commercial-MW-Block>, <http://www.energizect.com/your-home/solutions-list/residential-solar-investment-program>, and <http://www.gosolarct.com/>). SREC prices for MA and NJ are as reported by SRECTrade, Flett Exchange, and the NJ Clean Energy Program for Q1 2017 (<http://www.sretrade.com/>, <http://markets.flettexchange.com>, and <http://www.njcleanenergy.com/renewable-energy/project-activity-reports/srec-pricing/srec-pricing>) taken on a net present value basis over 15 years for NJ and 10 years for MA, assuming a 5% aggregator fee and PV degradation rate of 0.5%. MA has a state tax credit of the lesser of \$1000 or 15% of system costs and NY has a state tax credit of 25% of system costs capped at \$5000 (<http://www.mass.gov/dor/businesses/help-and-resources/legal-library/regulations/62-00-income-tax/830-cmr-6261-residential-energy-credit.html>, https://www.tax.ny.gov/pit/credits/solar_energy_system_equipment_credit.htm). All state incentives including SRECs were assumed to reduce the tax basis for the federal ITC for consistency and simplicity, though the tax treatment varies across states and is based on individual tax decisions. Installed Watts for 2016 are from SEIA/GTM, U.S. Solar Market Insight Full Report, 2016 Year in Review (<http://www.seia.org/research-resources/solar-market-insight-report-2016-year-review>). The electric retail rate is from EIA's Electric Power Monthly, Table 5.6.A. Average Price of Electricity to Ultimate Customers by End-Use Sector, by State, for January 2017, cents per kilowatthour (http://www.eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_5_6_a). Population data is from Census Bureau, CY16 population estimate (<https://www.census.gov/quickfacts/>).

State Incentives (\$/W)	\$0.40	\$2.59	\$2.10	\$1.06
Federal Incentives (\$/W) ⁵³	\$0.99	\$0.42	\$0.47	\$0.88
Net Cost to Customer	\$2.31	\$0.99	\$1.10	\$2.05
Net Cost as % of Installed Cost	62%	25%	30%	51%
Installed Capacity in CY 2016 (MW)	59	165	165	206
Installed Capacity in CY 2016 per Capita (W)	16	24	18	10
Installed Capacity per State Incentives Invested (W/\$)	3	0.4	0.5	0.9
Energy Efficiency Requirement	energy audit required for all projects	energy audit required if using Mass Solar Loan	none	none

A third-party owner of a residential solar PV system retains state and federal incentives for these projects, including the 30% federal investment tax credit as well as the MACRS⁵⁴ depreciation benefit. The homeowner pays for electricity on a per kWh basis through a power purchase agreement (PPA) or will make a monthly lease payment for an estimated amount of electricity produced from their leased system. These per kWh rates and monthly payments vary among lease and PPA providers, and depend on many factors including location, utility service territories (and associated electric retail rates), site characteristics, and the terms of the lease/PPA contracts. The below table provides a few benchmarks for comparison of homeowner owned and third party owned system costs and market penetration (see Table 14).

Table 14. State Benchmarks of Residential Solar PV Program Incentives for Third Party Owned Projects, Q1 2017⁵⁵

Benchmarks	CT	MA	NJ	NY
Electric Retail Rate (\$/kWh)	\$0.193	\$0.196	\$0.158	\$0.173
Installed Cost of Homeowner Owned System (\$/W)	\$3.70	\$4.00	\$3.67	\$3.98
Installed Cost of Third Party Owned System (\$/W)	\$3.49	\$3.46	\$3.65	\$4.34
Installed Cost Overall - Weighted Average (\$/W)	\$3.53	\$3.61	\$3.65	\$4.19
State Incentives for Third Party Owned System (\$/W)	\$0.32	\$2.46	\$2.10	\$1.09
Percentage of Third Party Owned Projects (CY 2016)	81%	72%	85%	59%

Performance Indicators

Below are several Performance Indicators that will be used to measure the success of the RSIP.

- Number of projects submitted, approved, and completed
- Total MW (name plate)
- First year and lifetime generation (MWh)
- Installed cost (\$/W)
- Incentive (\$/W) and percent of incentive as installed cost
- Investment Tax Credit (ITC) (\$/W) and percent of ITC as installed cost
- Ratio of ITC to incentive

⁵³ Includes 30% Federal Investment Tax Credit for homeowner-owned system, not MACRS (accelerated depreciation) which is only available to third party system owners.

⁵⁴ MACRS (Modified Accelerated Cost Recovery System) is a Federal tax benefit that allows businesses to claim the depreciated value of solar assets as a tax deduction over a five-year period. For more information: <http://www.seia.org/policy/finance-tax/depreciation-solar-energy-property-macrs>.

⁵⁵ Percentage of homeowner owned versus third party owned projects was estimated based on the program datasets referenced in the prior table.

- Net cost to the customer (\$/W)
- Aggregate levelized cost of energy to customer (\$/kWh)
- Aggregate payback to customer
- Aggregate internal rate of return to customer
- Percentage of third party owned versus homeowner-owned systems

Anaerobic Digester Program

Per Public Act 11-80 Section 103, the Green Bank is to develop a three-year pilot program for AD by setting aside \$2 million a year for three years – for a total of \$6 million. Funds to support the pilot programs can be used as grants, power purchase agreements or loans. There are to be no more than five (5) AD projects, each no more than 3 MW in size at a support for projects of no more than \$450 per kW on a grant basis.

To date, five AD projects have been approved or are seeking approval by the staff from the Green Bank Board of Directors for a total of 8.4 MW (five projects) and \$14 million (four projects) in sub-debt.

Benchmarks

AD using food waste and other organics is relatively new to the New England region. The Massachusetts Clean Energy Center (MassCEC) has recently awarded \$2.3 million in FY 2013 for Organic-to-Energy projects, studies, and services relating to the development of new AD facilities in an effort to divert food waste from its landfills and incinerator facilities. Of the total amount awarded, \$1.75 million was awarded in grants to develop 5 new AD facilities throughout Massachusetts and remaining funds were awarded to 12 public entities and 1 non-profit for studies and other services leading up to the development of new AD facilities.

Performance Indicators

Below are the Performance Indicators that will be used to measure the success of the AD pilot.

- Number of projects submitted, approved and completed
- Total MW (name plate)
- First year and lifetime clean energy generation
- Amount of food waste diverted from landfills and incinerators
- Installed cost (\$/kW)
- Loan to private capital ratio
- MWh's generated and/or saved per \$1 of ratepayer funds at risk

Other Areas of Strategic Importance

U.S. Department of Energy SunShot Initiative Rooftop Solar Challenge and SunShot Prize

The DOE's SunShot Initiative⁵⁶ goal is to achieve cost reductions for solar PV systems in the United States of 75% by 2020 to enable solar electricity to be cost-competitive with other forms of energy without subsidies. Two rounds of the SunShot Initiative's Rooftop Solar Challenge have supported progress in reducing the non-hardware or soft costs associated with rooftop solar energy systems through improved permitting, financing, zoning, net metering, and interconnection processes for residential and small commercial photovoltaic (PV) installations.⁵⁷ As overall solar PV costs continue

⁵⁶ <http://energy.gov/eere/sunshot/sunshot-initiative>

⁵⁷ <http://energy.gov/eere/sunshot/rooftop-solar-challenge>

to decline, and as subsidies are reduced and eliminated, reduction of soft costs will continue to be critical to improvement of solar PV economics and scaling of the market.

The Green Bank has applied for and won two Rooftop Solar Challenge funding awards totaling almost \$850,000. In FY 2013, the Green Bank led a collaborative Connecticut Rooftop Solar Challenge Round I team to analyze and document soft cost reduction opportunities in Connecticut, resulting in a Final Project Report and development of recommendations to improve permitting, planning and zoning, and interconnection processes for solar PV.⁵⁸ In FY 2014, the Green Bank partnered with four other New England states, under the leadership of the Clean Energy States Alliance (CESA), to continue soft cost reduction efforts under the Rooftop Solar Challenge II. In this second round of the program, the Green Bank has finished development and production of a Connecticut Rooftop Solar PV Permitting Guide⁵⁹ which completes and packages permitting recommendations and tools developed or begun in Round I.

FY 2015 and 2016 activities have focused on outreach to municipalities, solar PV installers and other stakeholders to implement the Permitting Guide and achieve soft cost reductions. Through these initiatives the Green Bank has trained over 400 Connecticut code officials and 700 fire officials on solar PV technologies, developed and released a solar PV permit application endorsed by the Office of the State Building Inspector, and supported the passage of legislation that requires municipal building departments to incorporate residential solar PV into their municipal permit processes.⁶⁰ In FY16 the Green Bank contracted with Yale University's Environmental Performance Index to develop a municipal solar-friendly score card system for Connecticut. The score cards rate municipalities on their efforts to encourage residential solar PV adoption in their communities across five indicator categories, including the municipal solar permit process. The score cards, released in Q4 of FY 2016, encourage streamlined and efficient permitting practices for solar PV, and drive standardization in municipal permitting throughout the state.

In FY 2016 a team led by the Green Bank was accepted into the DOE's SunShot Prize *Race to 7-day Solar* competition⁶¹. This national competition challenges local governments, solar installers and utilities to collaborate towards improving the "going solar" experience, and reducing the total time it takes to complete solar PV installations. The Connecticut team includes the state's investor-owned utilities, seven solar contractors and 10 municipalities. The team will use a data-drive approach to further identify and implement soft-cost reduction strategies and reduce the total time taken to permit, install and interconnect solar PV projects in Connecticut. To date, the team has been awarded \$50,000 from the DOE through the competition. The team will continue to compete in the SunShot Prize until the competition concludes in March 2017.

The Green Bank's Solarize program has already contributed to soft cost reductions of about 20% through customer acquisition. Efforts to streamline permitting could result in an additional 5-10% or more in soft cost reductions in the near term, and significantly more in the long term, in addition to removing or reducing market barriers associated with permitting and planning and zoning processes and rules. Interconnection improvements implemented by Connecticut's utilities will further add to soft cost reductions. While DOE funding under the Rooftop Solar Challenge II

⁵⁸ Final Project Report is available for download at www.energizect.com/sunrisene.

⁵⁹ See the Permitting Guide tab at www.energizect.com/sunrisene.

⁶⁰ <https://www.cga.ct.gov/2015/sum/2015SUM00194-R02HB-06838-SUM.htm>

⁶¹ <http://energy.gov/eere/sunshot/sunshot-prize-race-7-day-solar>

program concludes in Quarter 1 of FY 2017, the Green Bank will continue to support municipalities and utilities in further improving processes to achieve soft cost reductions in FY 2017 and 2018.

Emerging Technologies and Opportunities

As of 2016, the Green Bank anticipates emerging technology areas and approaches that offer growth opportunities with respect to market transformation for distributed generation and further aligning Green Bank efforts with state climate change reduction strategies as well as efforts to modernize the grid. Some of these opportunities are described here, though these developments in these technology areas are expected to continue to quickly evolve.

Based on the results of Cadmus' cost-effectiveness evaluation of RSIP and signs of an emerging market for energy storage, the Green Bank is looking at opportunities to support deployment of energy storage and other technologies that will provide comprehensive energy solutions for customers as well as contribute to utility and stakeholder efforts to improve and modernize the grid. These opportunities may include pilot projects with utilities to deploy solar PV, energy storage and other technologies at strategically beneficial locations. Developments in the area of smart meters and advanced metering infrastructure would also be beneficial in supporting clean energy deployment and better integrating distributed generation into the grid.

As previously noted, programs in Vermont are encouraging adoption of solar PV with energy efficiency, energy storage, and renewable thermal technologies. Deployment of solar PV along with renewable thermal technologies such as heat pump hot water heaters and air source heat pumps presents a particularly beneficial opportunity to reduce overall customer energy use and in particular fossil fuel use and move Connecticut further towards its climate change reduction goals.

The Green Bank is looking at opportunities to support deployment of alternative fuel vehicles and infrastructure as an emerging technology solution for reducing greenhouse gas emissions from fossil fuel combustion in the transportation sector. Electric vehicles are becoming more affordable and attractive to consumers and are on the cusp of wider-scale adoption. Solar PV will continue to be important to provide clean electricity to enable this shift towards zero emissions in the transportation sector.

The Green Bank participates in the ISO New England (NE) Distributed Generation (DG) Working Group that provides yearly forecasts of the penetration of distributed generation in the New England region, in particular solar PV which is anticipated to have the greatest impact on transmission and distribution planning. One of the findings is the need for smart inverter technologies as market penetration of solar PV increases. Smart inverters can provide grid stability by allowing solar PV to better "ride-through" events that would otherwise cause large-scale shut downs of solar PV. Another area of consideration is the "duck curve" phenomena whereby increasing penetration of solar PV shifts utility peaks to later in the day, also creating a steeper ramp-up to those peaks. Utilities in California are developing multiple approaches to ameliorate this effect, one possible solution being the installation of solar PV on west facing roofs to help meet loads occurring later in the day. A pilot project in Rhode Island is incentivizing west-facing deployment of solar PV. While these effects have not yet been closely examined in Connecticut, the Green Bank is staying abreast of these regional and national developments.

Membership and participation in activities led by the Clean Energy States Alliance (CESA) is important to the Green Bank's programs including in the area of residential solar PV. For example,

CESA is taking leadership in areas such as consumer protection at a time when customers are still relatively new to financing as well as third party ownership models of solar adoption, and when incentives are decreasing and program oversight is lessening relative to increasingly higher volumes of solar PV deployment. CESA is also providing leadership on soft cost reduction strategies, such as through SunShot Rooftop Solar Challenge projects, has a strong research arm focused on advancing energy storage, and is active in many other areas of importance to the advancement of clean energy.

8. Residential Sector – At Home

The Residential Sector is focused on deployment of residential financial products for renewable energy, energy efficiency projects, and natural gas conversions serving residential 1-4 unit and multifamily (5 or more unit) dwellings, as well as programs and platforms that support the scaled growth of those instruments in order to provide cheaper, cleaner and more reliable sources of energy while creating jobs and supporting local economic development.

Comprehensive Energy Strategy and Integrated Resource Plan

The Residential Sector programs support the implementation of the 2013 CES and 2015 IRP. Specifically, they support the implementation of the energy efficiency, electricity, and natural gas strategy recommendations in Chapters 1, 3 and 4 of the CES.

As identified in the CES, buildings constitute 58% of the state's energy use and 87% of its electricity, with residential buildings as a whole consuming 70% more than their commercial counterparts. Due to the lack of significant residential home construction in the state, the existing opportunity for energy improvements in the residential sector is in existing housing stock, 50% of which are heated by oil, and only one-third by natural gas. Further, while 322,000 state residents have participated in the HES and HES-IE program through April 2016 (23% of eligible customers statewide), approximately 28% of those who complete the HES audit in 2014-2015 time-period go on to install recommended deeper energy savings measures. A significant additional opportunity exists to maximize the program's gross impact through a strong call to action supported by low-cost financing.

DEEP's 2014 Integrated Resources Plan calls for the state's electricity sector to mitigate the impact of expected increases in Class I RPS costs beginning in 2017 and the potential for increases in peak demand for both summer and winter peaks, with winter peaks being a particular area of focus.

Conservation and Load Management Plan

The 2016-2018 Conservation and Loan Management Plan highlights the following priorities that relate to the residential sector:

- Driving comprehensive and deeper savings;
- Scaling and broadening the reach of its programs to underserved markets;
- Expanding the impact of its funding including leveraging Green Bank financing;
- Continuing the transformation of the HES program to a market-based program that can drive more comprehensive upgrades;
- Reinforcing the connection between energy efficiency and renewables;
- Mainstreaming efficiency through supply channels and the broader marketplace, including working with the Green Bank; and
- Researching demand response and other new technologies.

With respect to financing, the C&LM plan notes the “key objective of the Companies’ and Green Bank’s financing programs is to provide attractive financing options to customers, while maximizing cost-effective energy efficiency and achieving more and deeper energy savings.” It further notes the “Companies expect that the Green Bank can identify and will secure the least cost sources of capital in order to provide sustainable and attractive customer financing options.”

The Residential Sector team has established ongoing collaboration with the EEB, DEEP and utility staff, including the following:

- Monthly residential financing working group coordination meetings with DEEP, EEB consultants and members, electric and gas utility staff – the primary forum for aligning products, marketing, and outreach across the various residential financing options;
- Quarterly reports on the Green Bank Residential Sector progress to the Residential Committee of the EEB; and
- Joint Committee of the Energy Efficiency Board and Green Bank and the Single-Family and Multifamily Working Groups of the committee.

The residential sector goals adopted by the Joint Committee are below.

Residential Sector: Single Family

1. Per Public Act 11-80 Section Identify coordinated strategies for expanding comprehensive loans for the 2016-2018 period. Calibrate incentive and buy-down levels to achieve more comprehensive projects while reducing program costs.
2. Pursue all cost-effective energy efficiency in the residential sector, using financing and increasing the amount of private sector capital where effective (and a simplified approval process where possible and appropriate), to leverage up ratepayer funds and achieve more and deeper savings.
3. Increase financing in the HES/HPwES channel to meet needs and drive deeper energy savings and more projects.
 - a. Increase HES projects with completed follow-ons per the C&LM plan, using financing as one of the tools to increase completed follow-ons.
 - b. Increase the adoption of the Smart E-bundle and CHIF comprehensive loans

In addition to the above formally adopted goals, the single-family sector-level coordination document developed by the Single-Family Working Group of the Joint Committee contains additional areas of coordination that the Companies and the Green Bank are expected to work on over the 2016-2018 time period. These include, but are not limited to, the following:

- Exploring options to expand alternative underwriting and simplified approvals where possible and appropriate to reach more customers while reducing hassle and delays, including customers below 80% area median income and credit-challenged customers;

- Developing solutions that incorporate financing where effective and appropriate to address health and safety or other remediation issues; and
- Exploring and developing strategies for driving energy efficiency through the solar channel, and vice versa.

Residential Sector: Multifamily

1. Reduce energy consumption and costs in multifamily properties consistent with goals in the Green Bank’s plan and the Conservation and Load Management plan. (MMBTU’s per unit).
2. Establish, align and fund financing programs to fill current unmet needs and gaps including projects driven by energy efficiency improvements where capital improvements are a subcomponent. Complete the tasks from the work plan from the May 2015 Lean event.
3. Fund and complete a market analysis of certain sectors to quantify and qualify this segment and identify gaps, opportunities and best ways to serve by the end of 2016. Hard to reach sectors include certain rural areas and non-subsidized, non-rent restricted multifamily housing that is privately owned and serving low-income tenants (also referred to as naturally occurring affordable properties).

TAM and SAM

Residential Housing Market

For the Residential Sector, a discussion of the TAM and SAM must first be grounded in a description of the housing and income characteristics of the state’s residents. The diverse characteristics of housing and income across the state inform the types of upgrades that are needed and the range of financing solutions and strategies that are required to adequately address this market.

The Green Bank, working with the state’s housing agencies and a variety of other stakeholders, has defined low income for its programs to be 80% of Area Median Income (AMI) or lower and low to moderate (LMI) income to be 100% of AMI or lower. These AMI cutoffs may either be at:

- a) the census tract level, for high level Green Bank reporting purposes;
- b) actual household income for Green Bank program reporting purposes where household income is collected (limited number of programs);
- c) the household level for program eligibility purposes, in which case household size and area of state is used (referencing Connecticut Department of Housing (DOH) income tables); or
- d) the multifamily property level, where a percent of residents and a certain AMI limit are used to determine program eligibility.

There are 3,592,000 residents in the state living in 1,356,000 housing units (see Table 15). Of these units, about 1,125,000 are single family, also known as residential 1-4 (i.e., approximately 83%), and 230,000 are multifamily, 5 or more units (i.e., approximately 17%).

Table 15. Estimate of the Distribution of Housing Units by Income and Ownership

Housing Units 1,360,000					
Non-LMI 685,000 (≥100% AMI)		LMI 695,000 (<100% AMI)			
		Moderate Income (80-100% AMI) 230,000 34%		Low Income (<80% AMI) 445,000 66%	
Own	Rent	Own	Rent	Own	Rent
559,000 82%	126,000 18%	148,000 64%	82,000 36%	162,000 36%	283,000 64%

Figure 5 shows a breakdown of the 1,1250,000 single family housing units for each of the income groupings, categorized by owner occupied homes, owner-occupied 2-4 unit buildings, or 1-4 unit rental properties. These categories of single family housing are relevant for the types of financing that are typically available, particularly whether the property is owner occupied or not. Figure 6 shows a breakdown of the 240,000 multifamily housing units for each of the income groupings, categorized by the size of the rental properties, whether 5-9 units, 10-19 units, or 20 or more units. These categories of multifamily properties are relevant for the types of financing that work best for each.

Figure 5. Single Family Housing Type and Income Breakdowns

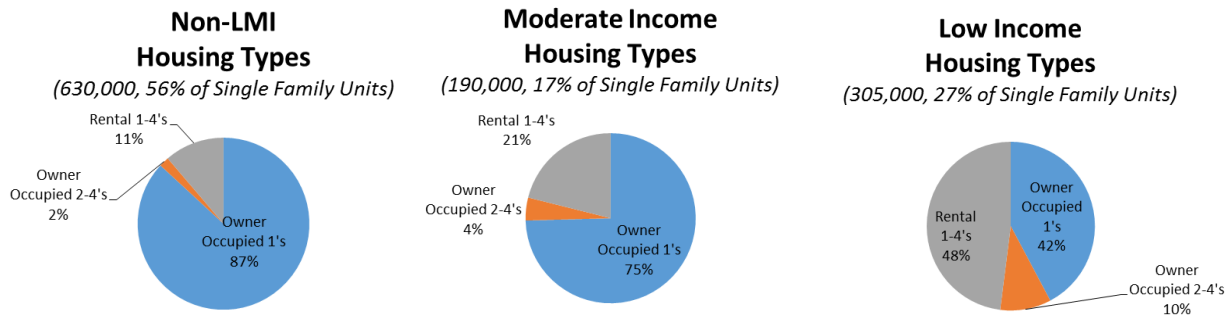
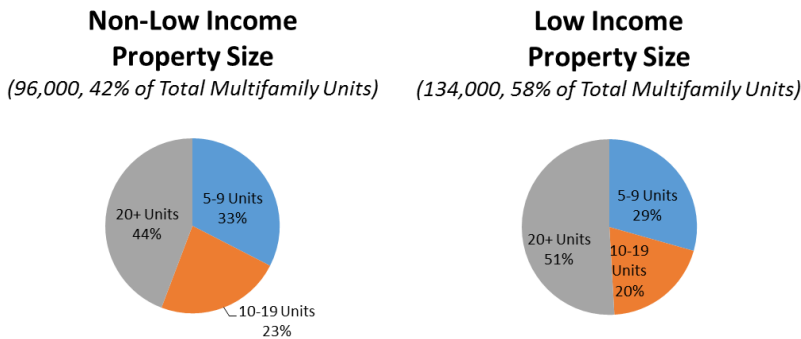


Figure 6. Multifamily Property Type and Income Breakdowns



Beyond the distribution of housing units in Connecticut, the Green Bank’s December 2014 Housing Market Analysis provided several key insights into the overall challenges for our low income and multifamily market segments, shown in Figure 7.

Figure 7. Housing Market Insights and Characteristics

Physical Characteristics	Health & Safety Issues	Low Income Households	Subsidized Multifamily	Large Multifamily Geography
<ul style="list-style-type: none"> •Old aging housing stock in need of capital improvements •85% of units are more than 35 years old •50% built between 1940-1979 •23% built before 1939 	<ul style="list-style-type: none"> •Numerous challenges in older stock preventing energy upgrades •Estimates of 15-35% of units impacted •Asbestos •Lead Paint •Leaks and mold •Knob and tube wiring •Carbon monoxide off-gasing •Radon 	<ul style="list-style-type: none"> •Broadly dispersed around state •No longer urban or rural issue, suburban too •Majority living in single family homes or small rentals •Suffer most from aging, poor condition, health & safety issues •Challenges in targeting and serving this market 	<ul style="list-style-type: none"> •90,000 units are assistend/rent restricted •CHFA, Dept. of Housing or HUD support •State supported properties located in the ring cities and rural/suburban communities •Many are assisted living serving elderly, campus style, low-rise, owner paid central heating 	<ul style="list-style-type: none"> •90% of 20+ unit bldgs. concentrated in 38 municipalities •~50% are in 5 core cities of Stamford, Hartford, New Haven, Bridgeport and Waterbury •High concentration of HUD assisted units in 5 cities

For the single-family owner occupied market segment, homeowners have many options for financing clean energy improvements (e.g., solar PV, natural gas conversions, energy efficiency, etc.) including cash, savings, credit cards, vendor/equipment financing, mortgages, and home equity loans or lines of credit. While estimates for a reasonable market share for energy financing programs vary, one suggested rule of thumb from one of the largest state energy programs to date for energy efficiency and natural gas conversions is Pennsylvania’s Keystone HELP program, where about a third of customers doing energy upgrades in the state use cash or credit cards, another third use some other loan product (e.g., vendor, equipment, mortgage or home equity), and a third used the state’s energy program. For solar PV financing in Connecticut, currently no less than 4 in 5 projects finance projects through a third-party owner through a lease or power purchase agreement.

Solar PV – Single Family Owner Occupied Properties (1-4 Units)

For Solar, the TAM is calculated to be the total number of residences with rooftops that are economically viable (i.e., 506,714 households) for siting a solar array (see Table 4). Of the economically viable households for rooftop solar PV, over 17,000 have already installed clean energy systems leaving approximately 490,000 households – or the SAM. Assuming that the market potential follows the current make-up of third-party owned systems versus homeowner

owned systems, then the potential for financing solar PV projects is substantial at greater than \$10 billion (see Table 16).

Table 16. SAM for Residential Solar PV Financing in Connecticut

	Homeowner Owned	Third-Party Owned	Total
% of the Current Market	20%	80%	100%
# of Households Left	98,000	392,000	490,000
Investment Needed ⁶²	\$2.7 billion	\$9.0 billion	\$11.7 billion

Approximately 75% of Connecticut’s residents meet the minimum credit requirements in order to qualify for Green Bank financing that was available through the middle of 2015. However, 2015 was a year of transition for solar financing options. Having graduated two products off the Green Bank balance sheet, CT Solar Lease and CT Solar Loan, the Green Bank was only focused on offering solar financing for purchases (currently through the Smart-E Loan program and potentially in the future through residential PACE), and for leasing through an LMI targeted offering with alternative underwriting (non-traditional credit requirements) that was launched in mid-2015 in partnership with PosiGen. With the addition of PosiGen’s offering in the market we can now serve nearly 100% of Connecticut residents with a solar financing option.

From 2013 through March 30, 2016 the Green Bank financed 1,905 solar projects through one of its offerings, representing 0.38% of the TAM and 11.1% of the approximately 17,000 systems installed to date. From 2015 through April of 2016 there were 1,645 solar-owned/purchased systems and 164 were financed by the Green Bank representing 10.0% of the purchase market in that period.

Natural Gas Conversions – Single Family Owner Occupied Properties (1-4 Units)

The CES characterizes the state’s market for natural gas conversions, dividing prospective residential end-users into three classifications, Segment A, B, and C. Prospective consumers in Segment A are comprised of residential – low use and residential – on main, while Segment B prospective consumers are comprised of residential – off main (see Table 17).

Table 17. Estimate of the Residential Natural Gas Conversion Market in Connecticut

Segment	Type	Prospective Consumers
A	Residential, Low Use	39,000
A	Residential, On Main	161,000
B	Residential, Off Main	51,500
Total		251,500

Given the present payback economics, the TAM is limited to Segment A, 200,000 residences in total and with an average installed cost of \$7,500 for a conversion, the TAM requires \$1.5 billion of investment. Using the rule of thumb that one third of customers will use a state financing program

⁶² Based on homeowner owned installed cost of \$3.88/W, third-party owners installed cost of \$3.27/W and assuming an average system size of 7 kW.

and that 85% of customers can meet our credit criteria, the SAM represents 56,000 projects and \$420 million of investment. Providing households that seek to convert to natural gas with access to low-cost and long-term private capital will support the implementation of the CES and Natural Gas Expansion Plan. Based on Smart-E project data through February 29th, 2016, Green Bank financing has resulted in 72 natural gas conversions, or 0.13% of the SAM. The Green Bank's Smart-E financing for natural gas conversions currently competes against the gas companies' Energize CT Heating Loan product. DEEP's stated policy is that ratepayer-subsidized products should be positioned such that they do not undermine products backed by private capital. This is an ongoing area of focus for DEEP, the Green Bank, the utilities and EEB.

Deeper Energy Efficiency – Single Family Owner Occupied Properties (1-4 Units)

The CES and the C&LM Plan both call out the need for deeper energy efficiency measures to be undertaken in Connecticut homes. The Green Bank sees an opportunity to support high efficiency heating, cooling and hot water equipment upgrades. Additionally, there is a growing focus on whole home performance as an industry in the state. The TAM is 870,000 consumers (the approximate number of owner occupied 1-4 unit homes in the state) and \$7 billion of investment, assuming an average installed cost of \$8,000 per project. Industry estimates indicate that 1 in 7 homeowners pursue an upgrade or replacement that impacts energy consumption each year⁶³, or approximately 124,000 homes per year in Connecticut. The SAM represents 35,000 homeowners and \$280 million of investment each year, assuming about one third of consumers will use state financing and 85% can credit qualify for Green Bank financing.

Based on Smart-E project data through February 2016, the Green Bank has financed 421 projects incorporating high efficiency heating, cooling, hot water equipment, insulation, windows and other efficiency measures. The Green Bank's share of the TAM is 0.05%, and 0.40% of the annual SAM on average over the last three years. The Green Bank's Smart-E financing for deeper residential energy efficiency projects currently competes against the EnergizeCT Heating Loan, and through June 2016 also competed against the Connecticut Housing Investment Fund's (CHIF) Residential Energy Efficiency and Energy Conservation Loan financing programs. Both are ratepayer-subsidized financing products, with the Heating Loan legislatively mandated through 2019; however, CHIF will be joining the Smart-E program in July 2016. DEEP's stated policy is that ratepayer-subsidized products should be positioned such that they do not undermine products backed by private capital. This is an ongoing area of focus for DEEP, the Green Bank, the utilities and EEB.

All Energy Upgrades – Multifamily Properties (5+ Units)

There are approximately 240,000 multifamily units in the state representing the TAM, about 150,000 of which are low income units. To date, the focus of the Residential Sector multifamily programs has been on the affordable assisted/rent restricted multifamily market, about 90,000 units (40,000 of these are financed by CHFA, with the remaining supported by DOH or HUD). The

⁶³ From Renovate America May 2016 presentation at ACEEE Finance Forum

other area of focus has been on larger properties of 20 or more units, representing about 110,000 units.

The Green Bank has provided pre-development or technical assistance support on for 5 properties and 310 units through April 30, 2016, representing 0.13% of the total units. Additionally, the Green Bank has provided financing for 21 properties comprising 1,122 units, representing 0.47% of the total units.

Product or Program Overview and Objectives

Table 18 presents a breakdown of the single family and multifamily product and program objectives for FY 2017 of the Green Bank.

Table 18. Residential Sector Fiscal Year 2017 Targets

Program	Projects	Capital Deployed	Clean Energy Deployed (MW)
Energize CT Smart-E Loan ⁶⁴	538	\$9,039,000	1.1
LMI Solar PV Leases and EE ESA's	500	\$15,250,000	3.4
Multifamily Term Loans	55	\$12,310,000	0.9
Multifamily Pre-Development Loans	36	\$570,000	N/A
Total <i>(not including Pre-Development Loans)</i>	1,093	\$36,599,000	5.4

After gauging market performance, the Green Bank revised its Fiscal Year 2017 target in January 2017 to the following (see Table 19):

Table 19. Revised Residential Sector Fiscal Year 2017 Targets

Program	Projects	Capital Deployed	Clean Energy Deployed (MW)
Energize CT Smart-E Loan ⁶⁵	254	\$5,873,447	1.1
LMI Solar PV Leases and EE ESA's	500	\$15,250,000	3.4
Multifamily Term Loans	17	\$11,140,000	0.9
Multifamily Pre-Development Loans	4	\$299,167	N/A
Total <i>(not including Pre-Development Loans)</i>	771	\$32,263,447	5.4

The following are Fiscal Year 2018 targets for the Residential Sector (see Table 20).

⁶⁴ Includes the new CHIF/HES channel (250 loans) and existing channels for solar PV (143 loans), and HVAC/energy efficiency upgrades (145 loans).

⁶⁵ Includes the new CHIF/HES channel (250 loans) and existing channels for solar PV (143 loans), and HVAC/energy efficiency upgrades (145 loans).

Table 20. Residential Sector Fiscal Year 2018 Targets

Program	Projects	Capital Deployed	Clean Energy Deployed (MW)
Energize CT Smart-E Loan ⁶⁶	440	\$8,153,050	1.3
LMI Solar PV Leases and EE ESA's	720	\$20,087,746	4.5
Multifamily Term Loans	16	\$7,550,000	0.6
Multifamily Pre-Development Loans	9	\$188,400	N/A
Total	1,185	\$35,979,196	6.4

The following is a breakdown of the single family and multifamily product and program overviews. These include options for both LMI and non-LMI housing.

Energize CT Smart-E Loan

In partnership with Connecticut's community banks, credit unions, and a local CDFI, homeowners, include those that are credit-challenged, are offered low-interest (between 4.49% to 6.99%) and long-term (5 to 12 year terms, and up to 15-20 years for qualified borrowers) unsecured financing for a range of credit quality consumers (580 FICO or above) through unsecured loans backed by a second loan loss reserve from the Green Bank. Financing is available for all measures that the CES supports (e.g., energy efficiency, renewable energy, natural gas conversions, alternative fuel vehicle infrastructure) as well as up to 25% of a loan can be used for healthy home measures (e.g., asbestos remediation, lead abatement) and other related improvements. A special "Smart-E Bundle" is being offered to support multi-measure and comprehensive renewable energy and energy efficiency projects by lowering the interest rate to 0.99-2.99% for eligible measures for the 5, 7 or 10 year terms. Another special offer is available for natural gas conversions for high efficiency heating or hot water equipment by lowering the interest rate to 0.99-2.99% for the 5, 7, or 10 year terms. The Smart-E Loan program uses \$7.8 million of repurposed ARRA-SEP funds and Green Bank funds for a second loan loss reserve and interest rate buy-downs to attract nearly \$31 million of private capital.

LMI Solar PV Lease and Energy Efficiency ESA – PosiGen

This program was launched in partnership with PosiGen Solar Solutions in mid-2015, supporting low-to-moderate income residents to go solar and install energy efficiency measures using an innovative solar lease and energy savings agreement financing model. The offer is open to households regardless of income or credit, utilizing alternative underwriting approaches that examine factors such as bill payment history and bad debt and bank databases. Green Bank support for PosiGen includes an initial \$5 million of subordinate debt (with an option for an additional \$5 million investment) and a higher level of solar incentive for income verified low-to-moderate income households. PosiGen is targeting an initial 1,000 installs in a \$27 million fund.

⁶⁶ Includes the new CHIF/HES channel (250 loans) and existing channels for solar PV (143 loans), and HVAC/energy efficiency upgrades (145 loans).

Through a combination of a solar PV lease and energy efficiency energy savings agreement (ESA) financial product structure in the low-to-moderate income market segment, HES/HES-IE is also being conducted on 100% of projects⁶⁷ – and, in addition, 65% of projects are “going deeper” on energy efficiency by paying \$10 more per month to purchase an ESA that installs additional measures like insulation and thermostats. Customers who take the ESA option also get a savings guaranty.

Low Income Multifamily Energy (LIME) Loan

Through a partnership with Capital for Change (formerly known as Connecticut Housing Investment Fund), the LIME loan provides up to 20 year terms for an unsecured low interest loan product geared towards mid-cycle energy improvements and serving properties where at least 60% of units serve renters at 80% or lower of Area Median Income. Projected energy savings are used to cover the debt service of the loan. The Green Bank supports LIME with a \$325,000 loan loss reserve and provided \$3.5 million to capitalize the initial \$5 million loan fund.

C-PACE for Multifamily

C-PACE is available for multifamily properties where lender consent is available, typically market rate or naturally occurring affordable properties. The Green Bank was pleased to see HUD issue guidance in 2017 that would allow C-PACE on HUD financed affordable multifamily properties. See the “At Work” section below for more information.

Solar-Only Financing for Multifamily

Solar financing is available for multifamily properties through the CT Solar Lease facility (both leases and power purchase agreements are supported). See the “At Work” section below for more information. Of particular note is a partnership with CHFA and their State Sponsored Housing Portfolio, a Solarize-style group purchasing model to drive down aggregate solar PV costs on housing authorities.

Affordable Multifamily Catalyst Loan Fund

Through a partnership with Housing Development Fund and MacArthur Foundation, who has provided a \$5 million program related investment, and with additional support of \$1.5 million of Green Bank funds and \$1.5 million of DEEP Regional Greenhouse Gas Initiative Funds, a gap financing fund is available at concessionary rates to support energy projects that otherwise would not pencil out or that require remediation of health and safety upgrades. This fund is intended to be blended with other project financing to lower the overall rate for the project.

⁶⁷ Except for those homes that can't be served due to health and safety issues.

Benchmark CT – Performance Measurement

This initiative is offered through a partnership with CHFA, where WegoWise will benchmark 1,600 multifamily properties and guide building owners through an analysis to identify opportunities. The first year of benchmarking is offered for free. An initial 500 properties were benchmarked in partnership with New Ecology, Inc. between 2014 and 2015. The Green Bank and CHFA will leverage the benchmarking results to identify the highest priority targets across the portfolio for either pre-development or term financing.

Residential Property Assessed Clean Energy (R-PACE)

In 2016 the Green Bank – working with the Department of Banking – proposed a Residential Property Assessed Clean Energy program (R-PACE) that was not successful due to concerns regarding FHFA's stance on sales of mortgages to FNMA and FHLMC that have PACE liens. In light of pending guidance from HUD on treatment of R-PACE benefit assessment liens that are subordinated to first mortgages - and following from the success of the Green Bank's nation-leading Commercial PACE program – a proposal to update Connecticut's existing R-PACE statute will be a top state legislative priority in the 2017 legislative session. With a program expected to draw national players to Connecticut, and with longer terms (up to 20 years) and interest rates that are expected to affordably finance cash flow-positive energy improvements, R-PACE enablement could be a key strategy in achieving deeper energy upgrades in the residential 1-4 market. Furthermore, it can contribute to achieving more market uptake in the LMI sector, since underwriting is to the property (e.g. collateral based), as opposed to the consumer, based on credit.

An R-PACE policy in Connecticut would not only attract more private capital investment to support clean energy deployment, but it would also result in considerable jobs and local economic development.

Multifamily Pre-Development Energy Loan Program

In a traditionally difficult sector to address, multifamily projects have a significant need for pre-development financing, trusted technical support, and streamlined access to funding programs. In 2015, the Green Bank developed pre-development energy loan programs to support property owners in identifying high-quality technical assistance providers, and to fund the work needed to scope and secure financing for deeper, cost effective energy upgrades. There are two versions available – a high-touch version through partner New Ecology called the Sherpa Loan and an owner managed version called the Navigator Loan. The Green Bank is working to change the model of pre-development and technical assistance from one that is primarily grant-funded in the affordable housing space to one that is loan driven. Owners can petition for loan forgiveness, if for some reason a project is unable to proceed to implementation. This program is supported by a \$650,000 revolving loan fund for loans of 0.0% to 2.99% and up to two year terms. The affordable multifamily version of this program is housed at the Housing Development Fund, a local CDFI, and part of a \$5 million program related investment from MacArthur Foundation is being used to support the program.

Performance Indicators

Below are the Performance Indicators that will be used to measure the success of the residential financing programs for FY 2017.

Single Family

- Number of applications received
- Application approval rate
- Average FICO and DTI (where applicable)
- Average loan size, term and rate
- Performance stats (delinquency and default rate, scheduled to actual collected)
- Average energy savings/production per project
- Average system size (solar)
- Percent of projects with multiple measures (Smart-E)
- Number of eligible contractors
- Contractor engagement – percent of eligible contractors bringing in applications/repeat applications
- Market penetration by income band/census tract and distressed community
- RSIP market penetration;
- Ratio of public to private capital deployed
- Successful innovation in marketing and outreach (ex: performance-based customer acquisition)

Multifamily

- Number of applications received
- Application approval rate
- Average loan size, term and rate
- Performance stats (delinquency and default rate, scheduled to actual collected)
- Average energy savings/production per project
- Average dollar savings by unit
- Average system size (solar)
- Affordable vs. market rate breakdown
- Market penetration by income band/census tract and distressed community
- Ratio of public to private capital deployed

Other Areas of Strategic Importance

Energy Burden Reduction for Low to Moderate Income Communities

Our goals for our low to moderate income work are to:

1. Reduce the clean energy affordability gap for low to moderate income residents, bringing their energy burden as a percent of household income in line with national targets for household energy spend and on par with what more affluent households spend in the state.
2. Ensure low to moderate income communities aren't left behind and have access to the same clean energy future that higher communities do.

The state's high energy prices have the greatest impact on our most vulnerable citizens. The energy affordability gap is the difference between how much a household actually spends on energy each year versus what is considered to be an affordable amount. National housing targets for an affordable rate of energy spend is 6% of household income. Lower-income households in Connecticut have a significantly higher energy burden than higher-income households do, ranging from an affordability gap of \$1,500 to \$2,500 per year over the past few years, based on the price of heating oil and natural gas in a given year⁶⁸. This is money that could be spent on much needed medicine, or education, or paying other bills or building savings – residents are being forced to make tough decision around basic needs.

In developing strategies for the LMI market, the Green Bank seeks solutions that will improve the financial sustainability of low-to-moderate income families who are most susceptible to rising energy costs by reducing their energy consumption and assure that implemented measures deliver on the projected performance. We have taken a partnership based approach to the development of solutions with partners including local CDFIs (HDF and CHIF), MacArthur Foundation (providing a program related investment), state and federal housing agencies (CHFA, DOH, HUD), the utilities, DEEP, Connecticut Housing Coalition, municipalities, and community-based organizations. These partners are organized around a common goal to achieve comprehensive, deeper energy improvements that help owners and tenants save energy, reduce costs, increase property values, and provide healthier and more comfortable housing.

⁶⁸ Operation Fuel conducts a study of the state's affordability gap periodically. The 2015 report can be found [here](#).

Other Areas for Development

While a solid foundation has been laid for making demonstrable progress in low-to-moderate income communities, we have already identified additional area that will need to be developed to reach all the segments that make up our LMI market. The following areas of product development will require further work and/or investigation:

- **Credit-builder and “energy savings accounts” products** for LMI consumers who finance energy upgrades and use their repayment experience to improve their credit and build wealth.
- **Additional multifamily products** including financing support for smaller properties (2-9 units) and project sizes, energy savings agreements, and a savings guaranty product.

The following areas of policy development will require further work:

- **Clean energy upgrades as a “way in” to community development and neighborhood revitalization and/or stabilization**, including exploration of integration of Green Bank programs with federal HOME and CDBG funds to weave housing and energy funding together. The excitement around solar is proving to be a powerful catalyst for driving interest in broader community investment that targets not just housing, but nonprofits, institutions and small businesses.
- **Energy + Housing + Health nexus**, covered in the next section.
- **Community Solar** – moving beyond the pilots being run by DEEP through 2017 and towards a statewide policy. This will be a critical piece in the longer term to making the benefits of solar available to all LMI residents, especially renters and those who can’t go solar given roof conditions or siting. It is an open question whether community solar is a better solution for the small rental market rather than direct installs.
- **Sub-metering policy** – regulators have clarified rules around the sub-metering of tenants, establishing maximum allowable rates sub-metered tenants can be charged for access to renewable distributed generation.
- **Modifications to utility allowances in subsidized multifamily properties** at both the state and federal level to remove disincentives for owners to pursue energy upgrades when they are also seeking funding from state and federal housing programs.

Energy + Health + Housing Nexus

Connecticut’s housing stock is aging, with 83% of housing units built before 1980. Older housing stock is most prevalent within lower income communities, and suffers from decades of deferred maintenance. Numerous health and safety challenges in that older building stock prevent energy upgrades from moving forward. These include health-related items such as the presence of asbestos, lead paint, mold from leaks, radon, carbon monoxide off-gassing, safety issues such as knob and tube wiring, and lack of safety rails and ramps for an aging population. Estimates from the state’s Home Energy Solutions program range from 15-35% of housing units can’t even pursue a blower door test due to a health or safety issue.

The Challenge

There is no sustainable, scalable funding source to address these health and safety issues – HUD’s lead abatement and Healthy Homes programs, while still available, have had their funding cut by Congress in the last 20 years, and the Connecticut Department of Public Health (DPH) is not funded to provide remediation services. Furthermore, even when there are limited funds available

for health and safety, they are not coordinated with energy and housing funding streams. *This is a preservation of affordable housing units issue*, for if nonprofit multifamily developers or homeowners can't afford holistic upgrades, then private developers or investors come in and make improvements but in the process convert the units to market rate. The silos of funding available are illustrated below (see Figure 7).

Figure 7. Funding Silos - Energy, Housing, and Health and Safety



The Opportunity

By linking improved, greener and healthier housing to improved health outcomes in our low-income communities, it may be possible to tap into a whole new funding source in the public health sector to address these issues. Considerable research has been done on the link between energy upgrades and improved indoor air quality, for example, improved asthma outcomes are linked to improved air quality in the home. Improved health outcomes are also tied to higher income levels, as are energy upgrades and reduced household energy burdens.

The state's DPH Healthy Homes Initiative published the Connecticut Healthy Homes Data Book in July 2012⁶⁹, shedding light on the most pressing health concerns tied to our homes:

- Asthma is costly to the state and concentrated:
 - \$112 million is spent for acute asthma care each year, 41% of this in the state's five largest cities, where the majority of low income residents live (Bridgeport, Hartford, New Haven, Stamford, Waterbury)
 - An additional \$80 million is spent on hospitalizations and \$32 million on emergency room visits associated with asthma events;
 - 75% of each of those occurs in the five largest cities and is paid for by Medicaid or Medicare
- Falls, largely among the elderly, led to 8,800 hospitalizations and 96,000 ER visits.

⁶⁹ The Connecticut Healthy Homes Data Book, July 2012 can be found [here](#) and the Healthy Connecticut 2020 State Health Improvement Plan (March 2014) can be found [here](#) (relevant sections include Lead, Healthy Homes, Asthma & Chronic Respiratory Disease, and Falls). The state's health performance dashboard can be found [here](#).

Our public health sector is going through a massive transformation with the passage of the Affordable Care Act (ACA). There is a huge focus on driving down the costs in our health care system, but figuring out who, exactly, is willing to pay for cost reductions is very complex. We need to figure out how to engage the health sector as a funder – there is a case to be made for an integrated funding and service delivery model for green and healthy housing upgrades for low income communities, if we can figure out who to work with.

Required Research

The following research is needed around the opportunities that exist within the ACA:

- **Nonprofit hospitals** – Community Health Needs Assessment required every 3 years. There is an IRS requirement to invest “profits” and as ACA covers more uninsured, more dollars become available for community benefits/community investment. Comprehensive housing upgrade programs in low income communities are a great community investment that also link to health outcomes.
- **Medicaid** – Ability for doctors to prescribe things like energy/environmental assessments for respiratory illnesses through a waiver the state applies for from the federal government. Medicaid Healthy Home allows for coordinated care professionals (not just physical health) and gets additional Medicaid payments. Accountable Care Organizations are new in the Medicaid world and have a per capita payment based on health outcomes. The requirement that all children be tested for lead could be covered by Medicaid.
- **Pay for Success Models** – Focused on population health management, reducing “frequent flyers”, which insurers (and/or hospitals?) now get penalized for. There could be an opportunity to tie payments to reductions in emergency room visits/hospitalization for asthma/other respiratory illnesses, trips and falls for elderly, etc.

The Green Bank will pursue foundation funding to assist in this initiative. New York and Rhode Island are also working to address these challenges, providing an opportunity to explore regional approaches with funders.

Real Estate Ecosystem Support

An outreach initiative to realtors was begun in early 2015 in conjunction with DEEP and the utilities. The focus is on educating realtors about trends in energy improvements and available programs, rebates and financing, recent studies on how energy improvements contribute to home values, strategies for marketing energy improvements to potential buyers, and what to expect during a home sale or mortgage refinancing if there is leased or owned solar on the property. This outreach will be expanded to include appraisers, inspectors, and mortgage lenders. Mortgage lender outreach may also include exploring ways in which the Green Bank can support new energy mortgage products such as the FNMA HomeStyle Energy Mortgage.

9. Commercial, Industrial and Institutional Sector – At Work

The Commercial, Industrial and Institutional Sector is focused on the development and deployment of programs that support investments in energy efficiency and renewable energy projects in all commercial and industrial properties as well as institutional facilities, including schools, hospitals, houses of worship, and other non-profits in order to provide cheaper, cleaner and more reliable sources of energy while creating jobs and supporting local economic development.

Comprehensive Energy Strategy and Integrated Resource Plan

The CES relies heavily on C-PACE financing to accomplish its goals for the CI&I sector in Connecticut. The Executive Summary of the CES notes the goal to: “Leverage private capital through innovative financing mechanisms including Connecticut’s first-in-the-nation Green Bank (the Clean Energy Finance and Investment Authority), standardized energy efficiency performance contracts, and the state’s new Commercial Property-Assessed Clean Energy (C-PACE) program.”

- In addition to referencing C-PACE financing as a way to meet the state’s goals in the C&I sector around energy efficiency, the CES also notes several policy goals that would ramp up demand for C-PACE financing such as decoupling, benchmarking and energy efficiency standards.
- Throughout the CES, there is an expanded commitment to cost effective energy efficiency and a goal of deeper efficiency gains in heating, air conditioning, ventilation, insulation, windows, furnaces, boilers, etc. C-PACE enables these deeper projects, with the average C-PACE project becoming 45-55% more efficient.
- The CES notes that the development of financing programs is critical to moderate ratepayer costs of energy efficiency programs over time. To that end, the Green Bank is working closely with the EEB to optimize incentives and ensure that the rebates and incentives are leading customers to do larger projects, possibly financed by C-PACE.

The CES has been of great benefit to the Green Bank in its research on the building composition in Connecticut. According to the CES, residential and commercial buildings are the largest users of energy in Connecticut, collectively accounting for 58% of the State’s energy usage and 87% of its electricity usage annually. In a business-as-usual scenario (which assumes modest energy efficiency savings per year), consumption is projected to grow to 550 trillion BTUs per year in 2050, nearly 20% higher than today's energy use of approximately 468 trillion BTUs. While buildings in Connecticut vary in their ownership and size, commercial and residential buildings consume energy in very similar ways. Over 60% of the energy used in buildings is for heating and cooling. The next highest uses are water heating in residential buildings and lighting in commercial buildings, representing about 15% of energy usage in each respective building type. Of the primary energy (that is, energy produced from raw fuels or otherwise found in nature) used by buildings today, 59% comes from electricity, 21% from oil, and 20% from natural gas. Electricity and natural gas use has increased while oil and biomass consumption has declined. Another common feature across building types is the prevalence of existing building stock (as opposed to new construction).

C-PACE, Lead-By-Example and other CI&I financing products are an important tool to help the state pursue several of the resource strategies outlined in the 2014 Integrated Resource Plan. The IRP recognizes the important benefits the Green Bank provides to Connecticut in pursuing its goal of a reliable, clean, and cost-effective energy supply. Among the several resource strategies outlined, the Green Bank will play a direct role in improving cost-effectiveness and increasing energy savings from C&LM program and state buildings, supporting increased deployment of CHP and Class I renewables, and procuring resources to address winter peak demand.

Conservation and Load Management Plan

The 2016-2018 Conservation and Load Management Plan outlines several priorities that overlap with the Green Bank's Commercial, Industrial and Institutional (CI&I) goals and opportunities for collaboration. The plan shares the following top priorities with the CI&I sector:

- **Delivering comprehensive and deeper savings for Commercial and Industrial customers.** Through its financing products, the Green Bank provides an important tool to help customers pay for more comprehensive projects.
- **Stretching and expanding the impact of funds from Commercial and Industrial customers.**
The Green Bank will work with the C&LM programs to maximize the use of Green Bank financing products, which leverage ratepayer dollars to bring private capital into the Connecticut clean energy market. By accessing this funding, the C&LM programs expand the impact of their ratepayer dollars.
- **Scaling and broadening the reach of programs to provide services to new or underserved markets.**
The Green Bank's financing products can help overcome the cost barrier to efficiency for those in new or underserved markets. The Green Bank will work with the C&LM programs to refine its new and existing products to help penetrate these markets.
- **Mainstreaming efficiency and continued shift toward changing the energy efficiency marketplace.**
The Green Bank works to transform the clean energy marketplace toward greater use of private capital to finance improvements. By demonstrating the performance and benefits of energy efficiency as investments, and improving access to data for lenders, the Green Bank aims to shift the market and allow incentives and programs to continue to scale meet the shared goal of implementing state energy policy throughout all market segments and populations.

Working through the Joint Committee of the Connecticut Energy Efficiency Fund Board and the Green Bank board, the following joint goals for the CI&I sector were adopted to realize these priorities and ensure that the principles of leveraging ratepayer funds and continuously improving the customer experience are recognized in each organization:

Government

- 1) **Improve the Customer Experience.** Ensure seamless service delivery that is responsive to State and local governmental and institutional needs, including:
 - i. Integration of appropriate Green Bank and other related services, especially for those who aren't currently served by Lead By Example ("LBE")- Energy Savings Performance Contracts ("ESPC"); and
 - ii. Providing technical support and incentives from the Connecticut Energy Efficiency Fund and the Green Bank's capability to finance ESPC projects at scale. Establish and communicate a process for customers undertaking ESPCs to receive technical support through internal utility resources and contracted "owner's representative" services.
- 2) **Establish Sustainable and Cost-Effective Financing Mechanisms.** Develop sustainable and cost-effective funding mechanisms for both the preparatory and permanent project financing needs of government sector energy-saving projects.
- 3) **Develop New Products to Fill Market Gaps.** For example, develop a financing vehicle for the aggregation of small-scale, comprehensive energy-saving projects at municipal or other institutional facilities that are individually too big for the Small Business Energy Advantage ("SBEA") financing program, but too small to be standalone ESPC projects.

Small Business

- 1) **Improve the Customer Experience.** Ensure seamless service delivery between services of the Connecticut Energy Efficiency Fund and the Green Bank that is responsive to customers' needs, including integration of appropriate Green Bank and other allied small business services, especially for those that aren't currently served by the SBEA financing program.
- 2) **Identify and Engage Alternative Capital Sources to Lower the Cost of and Increase Opportunities for Project Financing.**
- 3) **Examine Ways to Couple SBEA and C-PACE (or Other Financing Offerings).** Promote more comprehensive projects (especially among higher energy usage customers) and longer term payback measures.

Medium and Large Business

- 1) **Improve Understanding of Opportunities Within this Market for Deep Energy-Efficiency Improvements.** Build on available knowledge and analysis to develop effective and sustainable incentive and financing strategies for stimulating deeper energy investments and that meet all cost-effective energy-efficiency goals.

- 2) **Increase Customer Savings and Benefits from the C&I Programs.** Drive more projects with deeper energy savings, supported with increased financing options (including C-PACE) to help ensure comprehensive investment and closure of financing gaps.

- 3) **Cross-Leverage Connecticut Energy Efficiency Fund and Green Bank Programs.** Develop and implement communication and marketing strategies to ensure maximum cross-leveraging of these opportunities to help achieve the state goals of acquiring all cost-effective energy efficiency and expanded renewable deployment through highly effective leveraging of customer funds

TAM and SAM

Commercial and Industrial

In 2013, the Green Bank contracted HR&A Advisors to do an analysis of the Commercial and Industrial (C&I) market in Connecticut. Table 17 outlines the TAM for the C&I sector as a whole.

For the Commercial Property Assessed Clean Energy (C-PACE) program, the TAM is defined as the square feet of C&I buildings in towns that have opted into the C-PACE program, outlined in table 21. 93% of the total C&I market is within the TAM of C-PACE and the Green Bank continues to expand the program into new towns with the goal of bringing 100% of Connecticut buildings into the C-PACE market.

Table 21. C&I and C-PACE TAM

	Hospitality	Industrial	Retail	Commercial Office	Total
C-PACE (Square Foot)	18,113,030	263,807,383	180,545,900	162,649,498	625,115,811
C-PACE (Percent of Square Foot)	97%	92%	91%	96%	93%
Total	18,724,855	287,180,874	197,739,420	169,989,282	673,634,431

Institutional

Estimates of the Total Addressable Market (TAM) are based on known and estimated data on the number of facilities, square footage, and estimated energy expenditures. Estimates of the Serviceable Available Market (SAM) are primarily based on market penetration studies for the energy savings performance contracting industry, as a proxy for comprehensive retrofits that would be undertaken under any financing mechanism that uses energy savings to finance investments in upgraded equipment. Market potential in terms of energy and dollars are based on percentage energy savings from comprehensive retrofits applied to estimates of energy use intensity per square foot.

To calculate the Institutional sector TAM (see Table 22), data that exist on various unit measures of the municipal, university, school and hospital (MUSH) market segments are used, including number of state buildings, population, and lists of facilities from trade associations for private colleges and schools and hospitals. However, robust square footage data varies and is not widely available.

Square footage of state buildings was quantified by OPM in the most recent State Building Inventory (March 2014). Square footage estimates for municipalities are based on average per capita square footage for some known Connecticut towns and cities, extrapolated to the entire

Connecticut population. While preliminary, these estimates appear to be in line with available estimates of Level of Service Standards for municipalities in other parts of the country. Estimates for square footage of hospital facilities are based on national estimates of square footage per available hospital beds. Estimates for private colleges and schools are based on average building square footage per student for some known schools in Connecticut, extrapolated to the total number of schools.

Overall, the institutional sector encompasses about 300 million square feet. At an average estimated energy cost of between \$2 and \$3 per square foot, the MUSH sector in Connecticut spends approximately \$550 million per year on energy.

Table 22. Institutional TAM

Market Segment	#	Units	Million ft ²	Estimated Annual Energy Use (million MMBtu)	Estimated Annual Energy Expenditures (million \$)
State Facilities	3,200	Buildings	60.5	9	\$200
UCONN and State Colleges	23	Campuses	29.5	4.4	\$89
Municipal Facilities	169	Towns	104.5	15.5	\$314
Private K-12 Schools	97	Schools	30	4.5	\$90
Private Colleges and Universities	47	Schools	82	12.3	\$247
Hospitals	37	Hospitals	22	5	\$67
Total	3,550		300	46.6	\$917

Lawrence Berkeley National Laboratory (September 2013) issued a report on the current size and remaining market potential of the U.S. energy service company (ESCO) industry. Data on market penetration was obtained from surveys of ESCO companies (see Table 19). Median values of market penetration (as a percentage of total floor area) that were reported for the Northeast are presented below. This data supports the Green Bank’s assessment that traditional performance contracting, with associated debt commitments for bond or lease financing commonly used, has been most successful to the segments of the MUSH sector with good credit (i.e. state and local facilities including K-12 schools).

Table 23. Market Penetration

Market Segment	Median Estimate of ESCO Market Penetration Since 2003 (% of total market floor area)
K-12 Schools	45%
State and Local	39%
Universities and Colleges	25%
Health and Hospitals	10%

For purposes of estimating SAM, we assume that K-12 schools represent mostly public schools which were included in the TAM under the municipal facilities market segment. Further, we know that the standardized ESPC program in Connecticut was only recently developed, and that state facilities in Connecticut, including public colleges and universities, have not used performance contracting since 2003. Therefore, we have adapted LBNL’s estimates of the market opportunity

to estimate the SAM, based on square footage. To estimate the market potential in terms of lifetime MMBtu saved, we have assumed a 25% reduction in energy consumption over 15 years (see Table 24).

Table 24. Institutional SAM

Market Segment	Estimated TAM (million ft ²)	Estimated Market Penetration	Estimated SAM (million ft ²)	Estimated Lifetime Savings (million MMBtu)
State Facilities	60.5	0%	60.5	34
Municipal Facilities	104.5	43%	59.5	59
Private K-12 Schools	30	25%	22.5	17
Private Higher Education	82	25%	61.5	46
Hospitals	22	10%	19.8	19
Total	300		224	175

Product or Program Overview and Objectives

The Commercial, Industrial and Institutional Sector has established the goals outlined in table 25 for fiscal year 2017.

Table 25. Commercial, Industrial, and Institutional Fiscal Year 2017 Targets

Program	Projects	Capital Deployed	Clean Energy Deployed (MW)
C-PACE	79	\$45,550,000	11.1
CT Solar Lease	30	\$22,500,000	7.5
Total⁷⁰	94	\$56,800,000	14.8

After gauging market activity, the Green Bank revised targets in January 2017 as follows (see Table 26):

Table 26. Revised Commercial, Industrial, and Institutional Fiscal Year 2017 Targets

Program	Projects	Capital Deployed	Clean Energy Deployed (MW)
C-PACE	66	\$35,430,000	9.8
CT Solar Lease	28	\$21,000,000	7.0
Total⁷¹	84	\$48,930,000	14.3

The following are Fiscal Year 2018 targets for the Commercial, Industrial, and Institutional Sector (see Table 27).

Table 27. Commercial, Industrial, and Institutional Fiscal Year 2018 Targets

⁷⁰ The C-PACE goals includes CT Solar Lease projects that are secured using C-PACE. They have been removed from the total to avoid double-counting.

⁷¹ The C-PACE goals includes CT Solar Lease projects that are secured using C-PACE. They have been removed from the total to avoid double-counting.

Program	Projects	Capital Deployed	Clean Energy Deployed (MW)
C-PACE	51	\$24,000,000	6.4
CT Solar Lease	25	\$15,000,000	6.3
Total of existing programs⁷²	67	\$34,000,000	10.4
SBEA	1,600	\$28,000,000	n/a
Total with SBEA⁷³	1,667	\$62,000,000	10.4

As in the previous comprehensive plan, the program’s focus will be the deployment of clean energy through its primary financing products, C-PACE and the CT Solar Lease. However, C-PACE is not a fit for all sectors or buildings. For instance, many public purpose buildings such as hospitals or universities have bond financing which makes consent for a C-PACE lien difficult. The CI&I program will continue to work on developing alternative products or options to expand the financing options available to the sector.

Commercial and Industrial Property Assessed Clean Energy (C-PACE)

C-PACE provides 100% upfront financing for up to 25 years for clean energy upgrades to commercial, industrial and non-profit buildings. The financing is then repaid as a benefit assessment to the building owner’s property tax bill. Energy savings offset the financing payments over the life of the upgrades, unlocking positive cash flow for the building’s owner and increasing the building’s value. C-PACE financing is available for a wide range of clean energy and energy efficiency improvements, including new boilers and chillers, upgraded insulation, new windows or solar installations. Energy audits, appraisal fees, construction costs and ancillary non-energy-saving improvements, such as roof replacements, that are integral to deploying energy efficiency projects can also be financed through C-PACE.

Since the Green Bank introduced the program in January 2013, C-PACE has been a notable success in deploying clean energy throughout the state. 120 Connecticut municipalities, together accounting for over 90% of the state’s commercial and industrial building stock, have signed onto the program. The Green Bank has closed financing agreements on 111 projects totaling \$73.6 million, partly financed by a warehouse facility using the Green Bank’s balance sheet and working in concert with third-party capital providers. This has resulted in the deployment of 15.4 MW of clean energy and countless energy efficiency projects that will lead to an estimated 2.8 million MMBTU over the lifetime of the projects. Total avoided electric and fuel cost savings from these projects will exceed \$172 million in aggregate for the benefited property owners.

The program has garnered attention nationwide, with state and local governments taking the Green Bank’s C-PACE model and emulating it in their communities. In its three years, the program has enjoyed several notable successes:

- Completed the first securitization of commercial energy efficiency loans in the country, issuing \$30 million in C-PACE backed bonds in 2014 which were purchased by Clean Fund, leveraging RGGI funding at a 4:1 ratio;

⁷² The C-PACE goals includes CT Solar Lease projects that are secured using C-PACE. They have been removed from the total to avoid double-counting.

⁷³ There remains some uncertainty with the Green Bank arranging financing for the SBEA program.

- Opened the C-PACE platform to allow capital providers to fund C-PACE projects directly in Connecticut. To date, two C-PACE private capital providers are active in the state;⁷⁴ and
- Negotiated a partnership with Hannon Armstrong to bring up to \$100 million in C-PACE financing to Connecticut, leveraging RGGI funding at a 9:1 ratio.

The Green Bank offers a pre-development loan for up to \$30,500 to building owners. This loan can be used to cover project development work, such as audits or feasibility studies, in advance of a C-PACE loan.

CT Solar Lease

The Green Bank launched the CT Solar Lease 2 program (“SL2”) as a combined residential and commercial solar tax equity fund designed to provide low-cost, long-term PPAs and leases to Connecticut homeowners, municipalities, and commercial and nonprofit customers. SL2 has expanded opportunities for greater solar access by allowing local developers to serve an increasingly broad spectrum of customer credits. Specifically, for non-investment grade nonprofit and commercial customers, who traditionally have been excluded from the solar financing market, SL2 has opened the door to solar via by utilizing C-PACE as a security and collections mechanism. By the time that SL2 is fully subscribed (anticipated in Q1 of FY17), C-PACE-secured credits will make up nearly 25% of the fund, with over two dozen projects financed.

Due to continuing demand for this kind of commercial-scale financing, the Green Bank expects to raise a new fund modeled on SL2. This “CT Solar Lease 3” (“SL3”) program will aim to foster partnerships that will help achieve continued growth of the commercial solar market in Connecticut. In creating SL3, the Green Bank will build upon the success of SL2 with a facility that will originate, develop through construction, and own commercial solar installations with (or without) Green Bank participation as an investor. In crafting SL3, the Green Bank will prioritize the following goals (1.) minimizing the overall cost of capital of the SL3 fund, (2.) maximizing the flexibility of SL3 to support various underlying commercial projects and credits, including the use of C-PACE for credit enhancement, (3.) maximizing the amount of private capital leveraged per dollar of Green Bank capital expended, and (4.) recapturing Green Bank programmatic and administrative costs.

Performance Indicators

Below are the Performance Indicators that will be used to measure the success of the commercial, industrial and institutional financing programs for FY 2017.

- Number of applications received
- Number of C-PACE towns opting in

⁷⁴ Clean Fund and Greenworks Lending

- Application approval rate
- Size of the project and level of energy savings
- Ratio of public to private capital deployed
- Growth into new markets (e.g., multifamily)
- Successful innovation in marketing and outreach (e.g., relationship managers)
- Number of trained contractors
- Number of new contractors bringing in applications
- Number of jobs created and environmental emissions reduced
- Amount of dollars saved by building owners

Other Areas of Strategic Importance

Small Business Energy Advantage (SBEA)

The Small Business Energy Advantage program (SBEA) in Connecticut is a proven model for financing small-scale energy efficiency projects. While the program is well-matched, due to its four-year, zero interest financing that can be paid back on bill, to small commercial, industrial, non-profit, and municipal customers, there are opportunities to lower the cost of the program for ratepayers and capture increased energy efficiency for customers. The Green Bank is working with the EEB and our utility partners to develop solutions that decrease the cost of the program by sourcing lower-cost capital and provide new ways to encourage customers to implement more comprehensive clean energy projects thereby increasing the impact of this already successful program.

Alternative Commercial & Industrial Financing Product

The Green Bank continues to explore development of an additional financing solution for commercial, industrial and institutional customers for whom C-PACE is not an accessible solution. For example, despite great interest in implementing clean energy upgrades, the terms connected with existing debt at “public-purpose facilities” such as education, healthcare, senior living, and recreation frequently present obstacles to successful completion of a C-PACE project.

The Green Bank is pursuing an alternative solution that retains key characteristics of C-PACE such as 100% upfront financing, off-balance-sheet treatment, and ability to finance capital-intensive deep energy retrofits. The Energy Services Agreement (ESA) is a model that offers promise for financing deep retrofits at facilities that are capital constrained, credit challenged, or both. While the 100% financing and off-balance sheet characteristics are achievable with standard ESAs today, there are challenges to packaging an ESA that is performance-based (i.e. the investment is paid for through energy savings) and can be used to invest in deep energy retrofits.

At the end of 2016, the Green Bank participated in a pilot Energy Services Agreement to finance clean the energy upgrades sought by a school in Bridgeport that previously was unable to finance such measures through C-PACE. The Green Bank is following closely the progress and performance of this pilot project and an earlier ESA investment through Campus Efficiency Now. Through these projects and ongoing engagement with building owners, ESA providers, contractors, regional lenders, and insurance providers, the Green Bank will determine the viability of a programmatic and scalable approach to ESAs for meeting the unmet financing need in the “public purpose” sector.

Clean Energy Storage

The market for energy storage in the United States grew 222% from \$134 million in 2014 to \$432 million in 2015. A leading analysis projects annual storage deployment to grow from 221MW in 2015 to more than 400MW in 2018 and nearly 1.7GW by 2020.⁷⁵ Rapidly decreasing prices for lithium ion batteries, policies and incentives to encourage deployment, and the extension of extension of the federal Investment Tax Credit (ITC) for solar and Production Tax Credit (PTC) for wind are all significant factors driving projections for growth. When energy storage systems are paired with renewable generation like solar and wind, the ITC and PTC can be applied to the cost of the storage system at varying levels depending on the proportion of system charging that comes from renewable (with a minimum requirement of 75%).

In the face of changing tariff structures for small-mid-sized C&I customers that reduce net metering benefits and declining ZREC prices, deployment of storage alongside solar could help improve the long-term economics by enabling more strategic consumption of clean energy through peak demand shaving and time-of-use arbitrage. In 2015, the Green Bank worked with building owners with solar systems financed through C-PACE and leading storage providers to analyze interval load and solar production data and assess the economic potential for retrofitting energy storage to existing solar system to reduce energy costs and provide energy resiliency. The Green Bank will continue to monitor and work with current and prospective Green Bank customers, energy storage companies, and lenders to identify cost-effective approaches for incorporating storage at commercial, industrial, institutional and multifamily residential facilities.

⁷⁵ GTM Research/Energy Storage Association, U.S. Energy Storage Monitor: 2015 Year in Review, www.greentechmedia.com/research/subscription/u.s.-energy-storage-monitor.

10. Research and Development

As the Green Bank implements its Comprehensive Plan, there will be a number of opportunities that arise that deserve further research and development (R&D) – think of these initiatives as catalytic investments. With the lessons being learned and best practices being discovered in financing, marketing, and other areas, the Green Bank’s ability to deliver more societal benefits requires understanding potential opportunities and the development of pilot programs and initiatives to increase impact, for example:

- Could the creation of a CDFI or other affiliated entity serve the interests of scaling up clean energy investment in underserved market segments?
- Could the legislative broadening of its “clean energy” definition open up new market segments for confronting climate change and environmental protection through alternative fuel vehicles and infrastructure, renewable thermal technologies, and other areas of sustainability (e.g., food, resilience, waste, water, etc.)?

The Green Bank’s R&D efforts are intended to open up new market channels for private investment in Connecticut’s clean energy economy through studies, pilot projects, royalty arrangements, and other initiatives that have the potential for expanding the impact of the Green Bank. Below are just a few examples of the catalytic areas we are exploring.

10.1 Community Development Financial Institution (CDFI) or Other Affiliated Entity

A Community Development Financial Institution (CDFI) is a specialized financial company that invests and lends in target markets with community development as their primary mission. They can be banks, loan funds and even non-profits, but they must be certified as a CDFI by the CDFI Fund, a branch of the U.S. Treasury Department. In order to be certified as a CDFI a company must have a primary mission of promoting community development and must have 60% of its activities and 50% of its assets directed to low-income target markets. All CDFI’s are private-sector organizations with no government affiliation. CDFI’s attract capital from private (e.g., corporations, individuals, religious institutions, and private foundations) and public sources. CDFI’s have helped banks reassess their initial perceptions of risk in underserved markets and help them enter niche markets, cultivate future customers, and deliver mainstream and alternative financial products and services to underserved communities.

Per C.G.S. Section 16-245n(d)(2)(A) the Green Bank may seek to qualify as a CDFI under Section 4702 of the United States Code. If approved as a CDFI, the Green Bank would be treated as a qualified community development entity for purposes of Section 45D and Section 1440N(m) of the Internal Revenue Code.

In an effort to expand its impact in underserved market segments (i.e., households and buildings in low income and distressed communities, credit-challenged consumers or owners with unrated credits), the Green Bank will undertake research as to whether it should create a CDFI or some other form of an affiliated entity for the purposes of providing greater access to clean energy

upgrades, reducing energy burden, improving health (i.e., remediation of asbestos, mold, lead, radon, etc.) and safety (i.e., knob and tube wiring, resiliency, safety rails and ramps for the elderly, etc.) of buildings in Connecticut, and if replicable and scalable, across the region.

10.2 Emerging Markets for Clean Energy

The following areas – Grid 2.0, alternative fuel vehicles and infrastructure, and renewable thermal technology – are “clean energy” resources that the Green Bank can support.

Grid 2.0 – Infrastructure Modernization

The Green Bank continues to empower Connecticut homeowners and business owners in adopting distributed energy resources (DERs) to reduce and shift their energy consumption through improved efficiency and demand response and energy generation technologies like solar PV, wind, small hydro, and combined heat and power. Deploying resources that also make energy more reliable requires innovation that gives consumers options not only for reducing energy consumption and choosing cleaner sources, but also controlling when they use that energy and improving the likelihood of that energy being available when most needed. These goals are one element of a broader transition of our energy grid — often referred to as Utility 2.0 — in which our homes and businesses are active participants on the grid. Buildings connected in a Grid 2.0 world can manage two-way flows of energy from the grid and out to it, and can communicate in real time with other participants and grid operators to optimize and balance use of available energy resources.

The Green Bank is successfully contributing to transformation of the grid in Connecticut into one characterized by increased deployment of DERs. We are poised to make important contributions in several areas that usher in a more interactive, efficient, and reliable grid.

Locational Value and the Value of Information

Collection, management, and sharing of real-time data is a key underpinning of realizing the Grid 2.0 vision of an internet for energy that appropriately values energy resources on the grid at a given time and location. The Green Bank’s requirement to deploy revenue-grade meters with all Green Bank supported rooftop solar PV in Connecticut allows us access to real-time solar production data that in many instances exceeds what is available to the utility companies working to efficiently integrate those resources. To better understand the geographic and local implications of DER deployment, we are partnering with the innovative spatial and energy analytics firm Kevala to develop a publicly available platform that enables both Green Bank staff and the public to visualize on a map and analyze the impact of Green Bank supported projects across the state. The platform will also enable closer collaboration with the utilities in Connecticut in analyzing the Green Bank’s activities relative to location-specific needs and opportunities on the grid as well as the locational value of DERs.

In the fall of 2015, the Connecticut DEEP announced a proceeding to solicit pilot concepts from the utilities for grid-side system enhancements to integrate DERs. In 2016, the Green Bank and

SmartPower are partnering with AVANGRID to identify circuits in AVANGRID's territory to target for high level of penetrations of DERs such as solar PV, smart inverters, and energy efficiency and storage. Goals for the pilot include optimizing the value of DERs by incorporating them into grid planning and operations and assessing the use of DERs to defer more traditional infrastructure investments.

Competing for Federal and Philanthropic Resources

The Green Bank's demonstrated ability to incubate new markets and scale clean energy investments in Connecticut makes us a sought-after partner and highly competitive contender for federal and philanthropic funding in the area of Grid 2.0 and resilient clean energy.

In the summer of 2016, the Green Bank was invited to join a funding proposal with researchers at major universities to develop a distribution network platform to enable integration of high levels of solar PV penetration. The proposal is in response to the U.S. Department of Energy's (DOE) Enabling Extreme Real-Time Grid Integration of Solar Energy (ENERGISE) funding opportunity. The Green Bank's role would be as a conceptual partner and a data provider, leveraging multiple years of robust rooftop solar PV energy production data available through our solar PV monitoring platform. With or without funding from DOE, the Green Bank is collaborating with Connecticut's universities and utilities to better understand the impacts and value of DER integration on the grid. The Green Bank is applying to the Kresge Foundation for low-interest loan capital and a direct investment to accelerate deployment of resilient solar PV plus battery storage in affordable housing in Connecticut's urban and coastal communities. The proposed project will leverage the Green Bank's Solar Lease offering and programmatic strength in the multifamily sector to benefit Connecticut communities and achieve the Kresge Foundation's goal of strengthening energy resilience and delivering low-carbon energy to low-income populations.

Grid 2.0 Technology: Focus on Energy Storage

Approximately 226 MW of energy storage were deployed in the U.S. in 2015. Industry projections point to reaching 281 MW of deployment in 2016 and a market size of almost nine times that — 2,081 MW and approximately \$2.9 billion — in the year 2021. Since 2013, more than 90% of all energy storage deployments have occurred in California or the PJM service territory (not including New Jersey).⁷⁶ Rapid growth of the energy storage market is attributable to several factors, including generous state-level incentives; opportunities to reduce electrical bills through peak-shaving, demand reduction and load shifting; and monetizing ancillary services such as providing frequency regulation to the grid.

During the last year, we have taken a close look at the technology and market landscape for behind-the-meter battery energy storage in Connecticut, where deployment has been limited, to understand what is restraining storage deployment and what challenges the Green Bank might

⁷⁶ GTM Research/Energy Storage Association, U.S. Energy Storage Monitor: Q2 2016, www.energystoragemonitor.com.

address to accelerate deployment of storage in Connecticut. We have worked with commercial and industrial building owners and storage providers to assess the potential for deploying storage at facilities with existing solar PV systems. Fortunately, precipitous reductions in the cost of battery cells and energy storage systems hold the potential to improve the economics of energy storage in Connecticut and support greater deployment in the near term, possibly within the horizon of this Comprehensive Plan.

On the residential side, we recently completed a study in partnership with the Cadmus Group that suggests a technology bundling approach would allow for cost-effective deployment of small-scale, behind-the-meter energy storage in the residential sector in combination with solar PV and or energy efficiency measures. Such a bundled technology package could provide a more comprehensive energy solution for customers and offer added value to the grid.⁷⁷

We remain continually engaged with Connecticut building owners, contractors, energy storage providers and the utilities to assess the demand for and value of energy storage in our state and explore the potential of the Green Bank to provide financing, create new approaches and work with stakeholders to accelerate energy storage deployment.

Our Future, Smarter Grid

The Green Bank is accelerating the arrival of Grid 2.0 through continued deployment of DERs across Connecticut. In the next two years, we will continue to explore new technologies and innovative approaches with a range of partners to ensure that the energy grid is transitioning to become smarter, more interactive, and more efficient. These efforts, combined with pursuit of first-class pilot and demonstration projects that lead to replicable and scalable solutions, will help deliver energy that is cleaner, cheaper and more reliable and sustainable.

Alternative Fuel Vehicles and Infrastructure

Connecticut's transportation sector is over-reliant on oil-based fuels, and accounted for 40% of the state's greenhouse gas emissions in 2014. The Global Warming Solutions Act of 2008 set a goal for the state to achieve an 80% reduction in greenhouse gas emissions below 2001 levels by 2050, and meeting these targets requires steep, economy-wide emissions reductions - particularly in the transportation sector. These reductions can be achieved by catalyzing greater deployment of alternative fuel vehicles and the associated infrastructure to support them.⁷⁸

The Green Bank, having identified the need to cost-effectively support a cleaner and more efficient transportation system, is working with Atlas Public Policy, Cadmus Group, and DEEP to study the Alternative Fuel Vehicle space and provide guidance on potential high-impact areas of

⁷⁷ Cost-Effectiveness Assessment of the Residential Solar Investment Program, The Cadmus Group, Inc., www.ctgreenbank.com/wp-content/uploads/2016/03/RSIP_Evaluation_I_Final_Report_and_cvr_ltr.pdf.

⁷⁸ It should be noted that the definition of "clean energy" for the Green Bank includes "alternative fuel vehicles and infrastructure".

opportunity. Research commenced in the winter of 2015 and is expected to conclude in the summer-fall of 2016 on a six-to-nine-month contract. Phase I of the study has been completed, assessing the market potential for the use of alternative fuels⁷⁹ in on-road vehicles in Connecticut using four criteria (i.e., “cleaner, cheaper and more reliable, while creating jobs and supporting local economic development):

- Near-term market feasibility;
- Environmental performance;
- Cost-effectiveness; and
- Local economic benefits

Passenger plug-in electric vehicles are seen through these criteria to be the most promising vehicle and fuel technology focus to help the state realistically and cost-effectively meet its statutory emissions targets. The lowest cost option for Connecticut drivers - when considering current federal and state incentives – would be an electric vehicle powered by solar PV. Hydrogen fuel cell vehicles are an attractive longer-term option if infrastructure is deployed and the costs of the fuel and vehicles decrease significantly.

Phase II of the study will generate policy recommendations for the Green Bank to consider and act upon to create dynamic, in-state markets supporting alternative fuel vehicles and infrastructure. This research will provide a regional assessment of deployment, policy developments, and regulatory standards and proposals, with emphasis on the New England States. Phase II will also review federal and state incentive mechanisms, and opportunities to leverage public funds to attract private capital investment – helping to “crowd-in” the market. Finally, it will assess industry preparedness and barriers to market entry, including barriers in the capital markets and access to financing. Based on all these analyses Atlas Public Policy will recommend next steps to advance the Green Bank’s alternative fuel vehicles strategy.

Once complete, the study will allow for the Green Bank to understand where in the transportation sector it can meaningfully leverage its core strengths in developing public-private partnerships and experience in scaling nascent clean energy markets.

Renewable Thermal Technology

Over 60% of the energy used in residential and commercial buildings is for space heating and cooling.⁸⁰ Changing from fossil fuels to renewable thermal technologies (RTTs) in heating and cooling buildings, as well as heating industrial processes, has the potential of providing a valuable contribution to Connecticut’s target of reducing greenhouse gas emissions to 80% below 2001 levels by 2050.

Renewable thermal technologies (RTTs) are technologies that provide heating and cooling services based on renewable energy resources – as opposed to fossil fuel sources coming from

⁷⁹ “Alternative fuels” are battery-electric; biodiesel from waste oils; renewable diesel; E85; landfill or wastewater gas; dairy biogas; propane; compressed natural gas; liquefied natural gas; and hydrogen.

⁸⁰ 2013 Connecticut comprehensive energy strategy: http://www.ct.gov/deep/lib/deep/energy/cep/2013_ces_final.pdf

natural gas, heating oil, and through electricity. RTTs can deliver energy for thermal purposes; domestic hot water, process heating, heat and power, cooking, space heating and cooling. RTTs utilize a broad range of renewable energy sources which often have low alternative value. For the purpose of this project, RTTs include:

- Heat pumps such as Air Source Heat Pump and Ground Source Heat Pumps
- Solid biomass, such as wood chips, wood pellets and cord wood
- Liquid biomass such as biogas and biodiesel
- Solar thermal
- Waste heat technologies

RTTs can range from small domestic applications to large scale applications used in industrial processes and district heating and cooling networks. As RTTs often utilize locally available energy resources to meet the on-site heating and cooling demand of one or several buildings, customized solutions often are required.

The Green Bank's RTT efforts focus on Connecticut and the Northeast Region.

Connecticut

Working with Yale University's Center for Business and the Environment (CBEY), as well as DEEP, Eversource Energy, and Avangrid, we are assessing the potential deployment of RTT, to provide a realistic estimate of the contribution of RTTs to reduce Connecticut's greenhouse gas emissions by 2050, and to establish the necessary knowledge for qualified policy choices and strategies to advance RTT in Connecticut. This research project will focus on whether or not RTTs are "cleaner" than alternative heating and cooling technologies, whether or not RTTs are competitive or "cheaper" in various situations, and hence the potential for private capital investments, and to what extent they might improve energy security and "reliability" in the Connecticut energy system.

Northeast Region

States across the Northeast are currently at different stages in investigating the feasibility of RTTs and its potential role in achieving states' climate change efforts. A common theme in each investigation is the idea that RTTs can play an essential role in the mix of climate actions. Working with CBEY and New York State Energy Research and Development Authority (NYSERDA), the Green Bank is leading and cooperating in the development of a regional renewable thermal market through joint efforts and sharing of information between different public and private (e.g., utilities and developers) stakeholders in the Northeast, including those in New England and New York. In order to ensure that each state can learn from the experience of others in real time, an extended framework of a regional cooperation is being established as each state explores how RTTs fit into their energy system with a focus on standardization (i.e., contracts, definitions, etc.), EM&V and data, and innovation.

10.3 Sustainability

The Green Bank is demonstrating how the green bank model can be applied to increase private capital investment in and accelerate the deployment of clean energy in Connecticut. Can the green bank model go beyond clean energy on the customer side of the meter and be applied to utility scale clean energy deployment and infrastructure – or what about sustainability broadly (e.g., local food systems, efficient transportation, waste water treatment, waste reduction, etc.)?

There are examples where the green bank model is broader than just behind the meter clean energy deployment, including:

- **Australian Clean Energy Finance Center** – has programs that provide affordable loans to corporate, government and non-profit fleet buyers to choose low emission and electric passenger and light commercial vehicles.
- **California Infrastructure and Economic Development Bank** – has programs that provide financing to public agencies and non-profit corporations for streets and highways, water supply and flood control, parks and recreational facilities, ports and public transit, and a number of other important infrastructure facilities.
- **Rhode Island Infrastructure Bank** – has programs that use funds to make loans, issue bonds, and receive interest earnings or other capital from public and private sources to finance projects that clean water.
- **UK Green Investment Bank** – has programs that leverage public funds to attract more private investment not only in utility scale renewable energy resources, but also waste reduction facilities from anaerobic digesters processing food waste to large scale waste to energy plants diverting large amounts of household waste from landfills to generate renewable energy.

Green Banks across the country and throughout the world are demonstrating how the smarter use of public resources can attract more private capital investment in the modernization of infrastructure that is providing the essential services we need every day in a manner that is environmentally and economically sustainable.

11. Budgets for FY 2017 and FY 2018

FY 2017

The fiscal year budget can be found at – [click here](#). The financial statements for FY 2017 will be available at the end of 2017.

FY 2018

The fiscal year budget can be found at – [click here](#).

12. Key Definitions

Alternative Fuel Vehicles and Associated Infrastructure

Per Public Act 14-136, an amendment to C.G.S. §4a-59 defines “clean alternative fuel” as natural gas, propane, electricity, or hydrogen when used as a motor vehicle fuel. C.G.S. §14-212(5) defines “motor vehicle” as all vehicles used on the public highways. “Associated infrastructure” is defined by the Green Bank as structures, machinery, and equipment necessary and integral to refuel an alternative fuel vehicle.

Class I Renewable Energy

Conn. Gen. Stat. §16-1(a)(26) defines “Class I renewable energy source” as: “(A) electricity derived from (i) solar power, (ii) wind power, (iii) a fuel cell, (iv) geothermal, (v) landfill methane gas, anaerobic digestion or other biogas derived from biological sources, (vi) thermal electric direct energy conversion from a certified Class I renewable energy source, (vii) ocean thermal power, (viii) wave or tidal power, (ix) low emission advanced renewable energy conversion technologies, (x) a run-of-the-river hydropower facility that began operation after July 1, 2003, and has a generating capacity of not more than thirty megawatts, provided a facility that applies for certification under this clause after January 1, 2013, shall not be based on a new dam or a dam identified by the commissioner as a candidate for removal, and shall meet applicable state and federal requirements, including applicable site-specific standards for water quality and fish passage, or (xi) a biomass facility that uses sustainable biomass fuel and has an average emission rate of equal to or less than .075 pounds of nitrogen oxides per million BTU of heat input for the previous calendar quarter, except that energy derived from a biomass facility with a capacity of less than five hundred kilowatts that began construction before July 1, 2003, may be considered a Class I renewable energy source, or (B) any electrical generation, including distributed generation, generated from a Class I renewable energy source, provided, on and after January 1, 2014, any megawatt hours of electricity from a renewable energy source described under this subparagraph that are claimed or counted by a load-serving entity, province or state toward compliance with renewable portfolio standards or renewable energy policy goals in another province or state, other than the state of Connecticut, shall not be eligible for compliance with the renewable portfolio standards established pursuant to section 16-245a.”

Class II Renewable Energy

Conn. Gen. Stat. §16-1(a)(27) defines “Class II renewable energy source” as: “energy derived from a trash-to-energy facility, a biomass facility that began operation before July 1, 1998, provided the average emission rate for such facility is equal to or less than .2 pounds of nitrogen oxides per million BTU of heat input for the previous calendar quarter, or a run-of-the-river hydropower facility provided such facility has a generating capacity of not more than five megawatts, does not cause an appreciable change in the river flow, and began operation prior to July 1, 2003.”

Class III Renewable Energy

Conn. Gen. Stat. §16-1(a)(44) defines “Class III source” as: “the electricity output from combined heat and power systems with an operating efficiency level of no less than fifty per cent that are part of customer-side distributed resources developed at commercial and industrial facilities in this state on or after January 1, 2006, a waste heat recovery system installed on or after April 1, 2007, that produces electrical or thermal energy by capturing preexisting waste heat or pressure from industrial or commercial processes, or the electricity savings created in this state from conservation

and load management programs begun on or after January 1, 2006, provided on and after January 1, 2014, no such programs supported by ratepayers, including programs overseen by the Energy Conservation Management Board or third-party programs pursuant to section 16-245m, shall be considered a Class III source, except that any demand-side management project awarded a contract pursuant to section 16-243m shall remain eligible as a Class III source for the term of such contract.”

Clean Energy Fund (CEF)

A fund formed pursuant to Conn. Gen. Stat. 16-245n which is supported by a one mill per kilowatt hour charge to each end use customer of electric services in the state plus any federal funds as may become available to the state for clean energy investments. The fund is used by Green Bank to promote investment in clean energy in accordance with a comprehensive plan developed by Green Bank to foster the growth, development and commercialization of clean energy sources, related enterprises and stimulate demand for clean energy and deployment of clean energy sources that serve end use customers in this state and for the further purpose of supporting operational demonstration projects for advanced technologies that reduce energy use from traditional sources.

Comprehensive Energy Strategy (CES)

Pursuant to Conn. Gen. Stat. § 16a-3d, the comprehensive energy strategy is developed by DEEP every three years which assesses and plans for all energy needs in the state, including, but not limited to electricity, heating, cooling, and transportation, includes the findings of the IRP, C&LM Plan, CP, and Energy Assurance Plan.

Comprehensive Plan (CP)

Pursuant to Conn. Gen. Stat. § 16-245n, the comprehensive plan is developed by the Green Bank to foster the growth, development and commercialization of clean energy sources, related enterprises and stimulate demand for clean energy and deployment of clean energy sources that serve end use customers in the state as well as support operational demonstration projects for advanced technologies that reduce energy use from traditional sources.

Connecticut Energy Efficiency Fund (CEEF)

A fund formed pursuant to Conn. Gen. Stat. § 16-245m, supported by a charge of up to three mills per kWh on electric bills which is used to implement cost-effective energy conservation programs and market transformation initiatives in accordance with the Conservation and Load Management Plan approved by the Energy Efficiency Board and DEEP.

Connecticut Renewable Portfolio Standards (RPS)

Pursuant to Conn. Gen. Stat. § 16-245a, each electric supplier and electric distribution company is required to demonstrate by January 1, 2020 that not less than twenty per cent of the total output or services of any such supplier or distribution company shall be generated from Class I renewable energy sources and an additional three per cent of the total output or services shall be from Class I or Class II renewable energy sources.

Critical Facilities

Conn. Gen. Stat. § 16-243y(a)(2) defines “critical facility” as: “any hospital, police station, fire station, water treatment plant, sewage treatment plant, public shelter, correctional facility or production and transmission facility of a television or radio station, whether broadcast, cable or satellite, licensed

by the Federal Communications Commission, any commercial area of a municipality, a municipal center, as identified by the chief elected official of any municipality, or any other facility or area identified by the DEEP as critical.” It should be noted that DEEP considers grocery stores and gas stations as “other critical facilities” as well as part of the micro grid initiative.

Distributed Energy Resources (DER)

Conn. Gen. Stat. § 16-1(a) (49) defines DERs as any (A) Class I renewable energy sources or Class III sources that can either be grid-tied or on the customer side of the meter, and (B) customer-side distributed resources that reduce demand for electricity through conservation and load management, customer-side energy storage systems, or resources connected to the distribution system or a microgrid.

Economically Viable

Economically viable means the costs are cheaper than the grid. For example, what makes solar viable?

- A large system with economies of scale resulting in a lower installed cost
- Panels must receive enough sun
- Installed cost must be low enough or the subsidy high enough
- Price of the alternative, grid-power, must be high enough.

Energize Connecticut

Energize Connecticut is an initiative of the Energy Efficiency Fund, the Clean Energy Finance and Investment Authority, the State and your local electric and gas utilities dedicated to empowering Connecticut citizens to make smart energy choices, now and in the future.

Green Connecticut Loan Guaranty Fund

A fund formed by the Green Bank pursuant to Conn. Gen. Stat. § 16a-40e and Conn. Gen. Stat. § 16a-40f. The Green Connecticut Loan Guaranty Fund provides the Green Bank with access to \$18 million to attract lending institutions to participate in clean energy financing programs for individuals, non-profit organizations, and small businesses through a first loss credit enhancement. The program is to be designed in consultation with the ECMB and CHEFA.

Integrated Resources Plan (IRP)

Pursuant to Conn. Gen. Stat. § 16a-3a, the integrated resource plan is developed by the DEEP, in consultation with the electric distribution companies, for the procurement of energy resources, including, but not limited to, conventional and renewable generating facilities, energy efficiency, load management, demand response, combined heat and power facilities, distributed generation and other emerging energy technologies to meet the projected requirements of customers in a manner that minimizes the cost of all energy resources to customers over time and maximizes consumer benefits consistent with the state's environmental goals and standards.

Interest Rate Buydowns (IRB)

An IRB is a payment made to a lender on behalf of a borrower that lowers the borrower's interest rate. This can be structured to pay out at the same intervals as a borrower's payments to the lender.

Levelized Cost of Energy (LCOE)

Levelized cost of electricity (LCOE) is a summary measure of the overall competitiveness of different generating technologies. It represents the per-kilowatt hour cost (in real dollars) of building and operating a generating plant over an assumed financial life and duty cycle. Key inputs to calculating LCOE include capital costs, fuel costs, fixed and variable operations and maintenance (O&M) costs, financing costs, and an assumed utilization rate for each plant type.

Loan Loss Reserves (LLR)

An LLR is a portion of cash or cash equivalents set aside to cover estimated potential losses in a loan portfolio.

Low Emission Renewable Energy Credit (LREC)

An LREC is a Class I Renewable Energy Credit from a low-emissions project as defined in Conn. Gen. Stat. § 16-244t. LREC-qualified projects are Connecticut generation projects that are located behind company customer meters, achieve commercial operation on or after July 1, 2011, and have emissions of no more than 0.07 pounds per megawatt-hour (MWh) of nitrogen oxides, 0.10 pounds per MWh of carbon monoxide, 0.02 pounds per MWh of volatile organic compounds, and one grain per 100 standard cubic feet. To qualify for the LREC/ZREC Program, LREC projects may not be larger than 2,000 kilowatts (kW).

Low to Moderate Income (LMI)

The Green Bank, working with the state's housing agencies and a variety of other stakeholders has defined low income for its programs to be 80% of Area Median Income (AMI) or lower and low to moderate (LMI) income to be 100% of AMI or lower. These AMI cutoffs may either be at the census tract level; actual household income where data is collected; household level for program eligibility purposes, in which case household size and area of state is used (referencing Connecticut Department of Housing (DOH) income tables); or the multifamily property level, where a percentage of residents and a certain AMI limit are used to determine program eligibility.

Micro Grid

Conn. Gen. Stat. § 16-243y(a)(5) defines "microgrid" as: "a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid and that connects and disconnects from such grid to enable it to operate in both grid-connected or island mode."

Multifamily

Greater than or equal to 5 residential housing units.

Net Metering

Pursuant to Conn. Gen. Stat. § 16-243h net metering is the process by which electric suppliers and electric distribution companies are required to interconnect and give a credit for any electricity generated by customers from Class I renewable energy sources or hydropower facility of less than two megawatts. The amount of electricity the customer produces shall be deducted from the amount the customer uses in each monthly billing period and any excess generation shall be credited toward the next monthly billing period. At the end of each year, the electric distribution company or electric supplier shall compensate the customer-generator for any excess kilowatt-hours generated, at the avoided cost of wholesale power.

Renewable Energy and Efficient Energy Finance Account

The Renewable Energy and Efficient Energy Finance Account of \$8 million may support grants, investments, loans or other forms of financing assistance to clean energy projects. The program is to be designed in consultation with the DEEP, DECD, and the Office of the Treasurer and priority shall be given to projects that use major system components manufactured or assembled in Connecticut.

Renewable Energy Credit (REC)

A REC represents the property rights to the environmental, social, and other nonpower qualities of renewable electricity generation. A REC, and its associated attributes and benefits, can be sold separately from the underlying physical electricity associated with a renewable-based generation source. Connecticut Statutory Framework - Pursuant to Conn. Gen. Stat. § 16-245a, RECs are used to satisfy the Class I, II, and III RPS obligations mandated by Conn. Gen. Stat. §§ 16-245; 16-243q. Electric suppliers may procure RECs by long-term contracting mechanisms, purchasing eligible certificates issued by the New England Power Pool Generation Information System or by purchasing eligible renewable electricity and associated attributes from residential customers who are net producers. Additionally, there are two subcategories of RECs.

Serviceable Addressable Market (SAM)

SAM is a market for which the technology makes economic sense. A SAM is a segment of the TAM that should be targeted and must meet select criteria of what makes the market serviceable. TAM and SAM are not static. In other words, what is technically possible or economically viable today will change in the future. TAM and SAM represent measurements at a point in time.

Single Family

Between 1 to 4 residential housing units.

Solar Home Renewable Energy Credit (SHREC)

SHREC means a Class I renewable energy credit created by the production of one megawatt hour of electricity generated by one or more qualifying residential solar photovoltaic systems with an approved incentive from the Green Bank on or after January 1, 2015.

Special Capital Reserve Fund (SCRF)

SCRF allows quasi-public agencies to issue bonds for self-supporting projects or programs that are backed by the State of Connecticut, lowering the cost of capital for the program. SCRF has historically been used to help launch new financing programs in Connecticut, including CDA, CHESLA, CHFA, CHEFA, CRRA, and UCONN student fees. Pursuant to Conn. Gen. Stat. § 16-245mm, the Green Bank received \$100 million in SCRF authorization, for self-sufficient financing for energy efficiency/clean energy programs.

Total Addressable Market (TAM)

TAM is maximum technical potential of a market. A TAM describes a goal in relation to a market. Focusing on a market permits identification of customers. Market definition permits comparison of financing goals. TAM helps the Green Bank understand how market size changes in relation to subsidy level, technology cost, and financing costs. The Green Bank uses the TAM data to make tailored financial offerings to each customer, listing terms and savings that demonstrate economic gains of clean energy.

Zero Emission Renewable Energy Credit (ZREC)

A ZREC is Class I Renewable Energy Credit from a zero emissions project as defined in Conn. Gen. Stat. § 16-244r. ZREC-qualified projects are Connecticut generation projects that are located behind company customer meters, achieve commercial operation on or after July 1, 2011, and emit no pollutants. To qualify for the LREC/ZREC Program, ZREC projects may not be larger than 1,000 kW.