On-Bill Repayment:
Repaying Clean Energy Investments on Utility Bills

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Lincoln Institute of Land Policy
Working Paper

Lincoln Institute Product Code: WP14JF1

Abstract

Clean energy investing is a proven yet mostly untapped opportunity for improving Americas' economic and environmental prospects. There is massive potential for profitable investment in energy efficiency (EE) and localized distributed generation (DG), but there are fundamental challenges. Environmental Defense Fund's (EDF) proposed solution—on-bill repayment—enables building owners and renters to repay clean energy investments on their monthly utility bills.

In this Working Paper, EDF describes how on-bill repayment (OBR) can help the New York metropolitan region to achieve, and exceed, clean energy goals. OBR is an evolutionary step forward from inherently limited on-bill *financing* and thus will help to harvest the great reservoir of economically attractive energy efficiency and distributed energy resources, such as rooftop photovoltaic electricity generation. On-bill financing (OBF) has proven successful, but it relies on ratepayer or taxpayer funds, which undermine its ability to achieve significant scale. Unlike OBF, OBR uses no public or ratepayer funds while providing a simple and scalable platform for private investment.

This paper lays out EDF's proposal for OBR as a way to enhance investment in energy efficiency and localized distributed generation in order to meet regional goals for renewable energy, carbon reduction, and affordability. We present the qualitative and quantitative benefits of OBR in terms of job generation, investment dollars, avoided energy costs and avoided pollution. We outline several cornerstone program elements identified by EDF for a successful, scalable on-bill repayment program.

This paper is one in a series of Working Papers produced by the joint program of the Lincoln Institute of Land Policy and Regional Plan Association originally presented on June 26, 2013 in New York City.

Keywords: clean energy investment, energy efficiency, distributed generation, green jobs

About the Author(s)

Environmental Defense Fund is dedicated to protecting the environmental rights of all people, including the right to clean air, clean water, healthy food and flourishing ecosystems. Guided by science, we work to create practical solutions that win lasting political, economic and social support because they are nonpartisan, cost-effective and fair.

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Executive Summary

Clean energy investing is a proven yet mostly untapped opportunity for improving Americas' economic and environmental prospects. There is massive potential for profitable investment in energy efficiency (EE) and localized distributed generation (DG), but there are fundamental challenges. From the view of the building owner or occupant, access to information and capital are two key constraints. From the capital provider side, EE investments are seen as risky and DG is hampered by high costs and limited access to a niche of customers. EDF's proposed solution—on-bill repayment—enables building owners and renters to repay clean energy investments on their monthly utility bills.

In this report, EDF describes how on-bill repayment (OBR) can help the New York metropolitan region to achieve, and exceed, clean energy goals. OBR is an evolutionary step forward from inherently limited on-bill *financing* and thus will help to harvest the great reservoir of economically attractive energy efficiency and distributed energy resources, such as rooftop photovoltaic electricity generation. On-bill financing (OBF) has proven successful, but it relies on ratepayer or taxpayer funds, which undermine its ability to achieve significant scale. Unlike OBF, OBR uses no public or ratepayer funds while providing a simple and scalable platform for private investment.

This paper lays out EDF's proposal for OBR as a way to enhance investment in energy efficiency and localized distributed generation in order to meet regional goals for renewable energy, carbon reduction, and affordability. Chapter one introduces the OBR opportunity and lists on-bill programs around the country. Chapter two details barriers to clean energy investing and how OBR helps to overcome them. In the third chapter, we present OBR in context of the clean energy goals and financing programs in the New York metropolitan region. The fourth chapter presents the qualitative and quantitative benefits of OBR in terms of job generation, investment dollars, avoided energy costs and avoided pollution. EDF notes significant uncertainty in our estimates, and thus to arrive at the bounded estimates summarized in Table ES-1. Though uncertain, we are confident these are conservative. The upside could be much bigger. We conclude with a fifth chapter that identifies four key features for a successful OBR program. Several cornerstone program elements identified by EDF for a successful, scalable on-bill repayment program are provided in table ES-2, below.

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Table T.ES-1: Potential Benefits of OBR over the Next Decade in the NY Metropolitan Region

Potential Benefits over a decade in Tri-State Region	Rooftop Solar PV	Energy Efficiency
Jobs **(Job-Years)**	40,000 (12,000 – 63,000)	110,000 (25,000 – 29,000)
Clean Energy Investments **($2012 Billions)**	$3 (1 – 5)	$14 (3 – 5)
Emissions **(million metric tons GHGs)**	Not calculated	195 (39 – 64)
Ratepayer and state energy bill savings from avoided energy purchases **($2012 Billions)**	Not calculated	$98 (19 - 32)
New Installed Rooftop PV **(MW)**	1,200 (400 – 2,000)	Not applicable

Based on EDF OBR Benefits model version: May 08, 2013

Benefits accrue over a 12-year period ("about a decade") based on a 12-year McKinsey dataset of EE potential for residential, commercial and combined heat and power.

McKinsey & Co. estimate that $500 billion in efficiency investments through 2030 could net $700 billion in avoided energy costs nationally (Granade 2009), and Aanesen (2012) estimate that the $100 billion global rooftop solar industry will install up to 600 GW of new capacity within the next two decades even if the trends in declining production costs cannot be maintained. However, it takes money to make money, and a recent survey of business leaders by the PEW Center on Global Climate Change finds that access to financing is the largest barrier to clean energy investments (Prindle 2010).

OBR investments are underwritten and financed by private, third-party capital providers, such as banks and credit unions. The program creates a marketplace for clean energy lending, allowing contractors to provide customers with an integrated package of building upgrades and financing. If done correctly, OBR can lower the financing and customer acquisition costs of clean energy projects, expand the pool of investors and economically attractive investments, and put people to work on good jobs that deliver real value.

Table T.ES-2: Key Attributes of EDF On-Bill Repayment

Program Attributes	**Why this is Important**
Private financing for qualifying Energy Efficiency and Renewable Energy projects	Private capital allows for capital at competitive rates of interest and with longer repayment schedules. This will provide substantially larger pools of capital than would be available through the public sector. Furthermore, the program does not use ratepayer or tax payer money
Loan is repaid on utility bill	Default (i.e., nonpayment) rates on utility bills tend to be far lower than for other debts, such as mortgages and credit card balances. By utilizing this attribute of utility bills, lenders will be able to offer substantially lower rates, longer maturities and better terms for an OBR loan relative to conventional EE loans
Repayment obligation becomes tariff on meter	The OBR program can be structured as a tariff that stays with the meter when the current owner or tenant moves. This program attribute overcomes an important barrier to investing in energy efficiency projects: that the project may have a useful life and payback period that exceeds the duration of the current ownership of the property. A tariff on the meter also enhances the quality of the loan because the obligation survives bankruptcy. Upgrades with long payback periods can be considered without worrying about sale or change in tenant.
Projects originated by contractors	Government certified, neutral third-party overseers would need to verify that expected energy savings exceed debt service and the total bill will likely decline from previous levels. The new tenant or owner would both benefit from the upgrade and be required to continue to make payments.
Projects required to produce net monthly savings	Customers will pay a single monthly bill for both energy and debt service that will be lower than their previous bill. This linkage should make it easier for customers to weigh the benefits of energy investments against anticipated savings
Utilities follow standard collection procedures	Credit losses on utility bills have historically been quite low and existing programs have seen strong repayments, with default rates of less than 1%. Standard collection procedures further strengthen the credit of the loan, while also ensuring that the lender is removed from disconnection decisions
Promote flexibility in allowing for range of eligible project types, property types, and financing structures	OBR is a network, not a prescriptive program. By maximizing program flexibility, OBR allows lenders, contractors, and property owners to choose the best go-to-market strategies, provides more choice for customers.

ES.B. How OBR Works

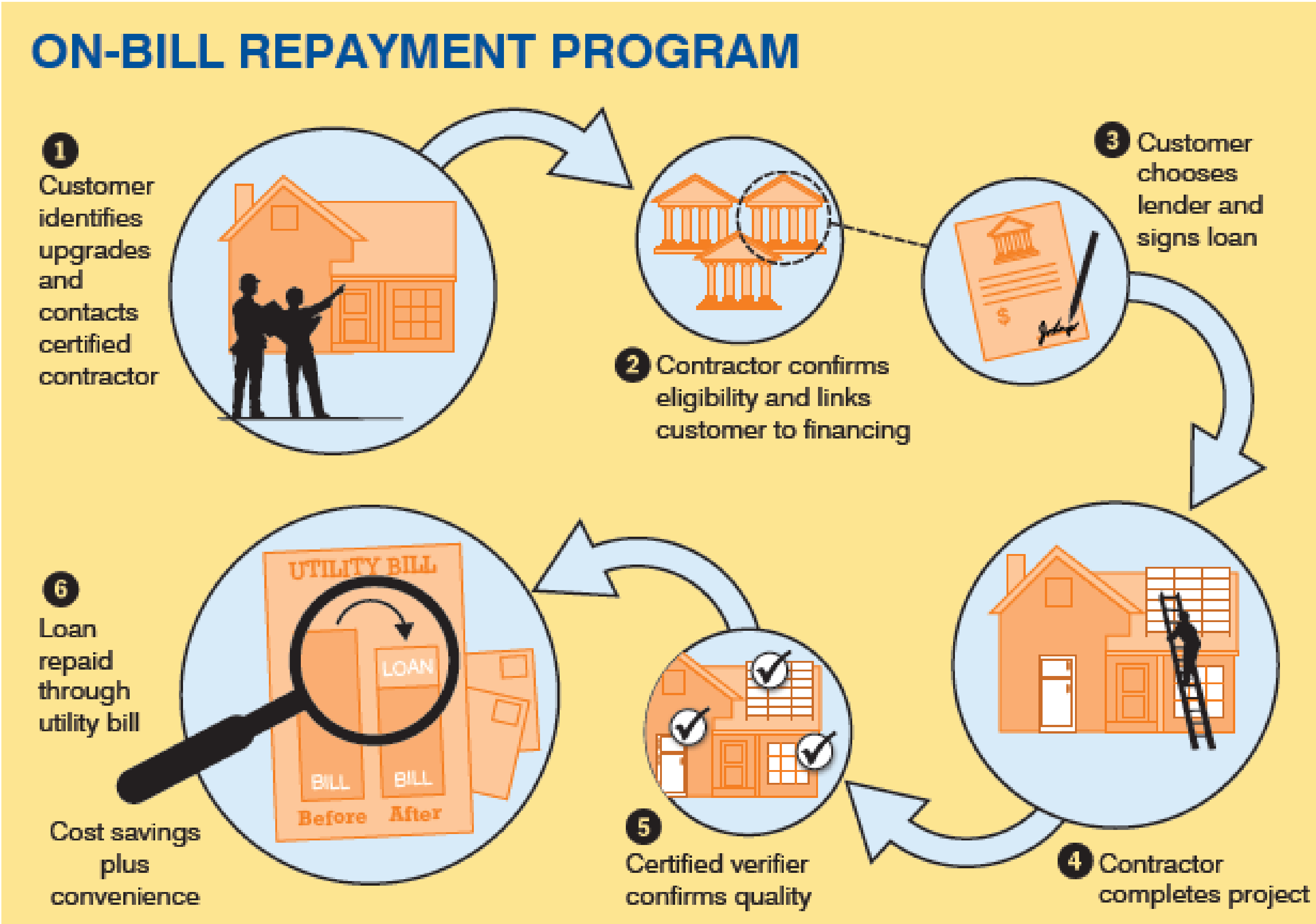
OBR involves several steps detailed here for a hypothetical project. These steps are shown in the following schematic; however, steps may differ in practice depending on specific program requirements.

First, certified contractors identify investments for a building, giving their client (the building owner or occupant) an estimate of the expected monthly energy savings and up-front project costs. If the customer is interested in proceeding, the contractor would help apply for a loan from an approved bank or other financial institution. Once financing investment capital is in hand, the contractor executes the project. After the project is installed, the program could require that the utility or other third party inspector confirm that the contractor properly installed the project and that savings estimates were calculated in accordance with program rules. The customer would ask the local utility to include repayment in future utility bills as part of the rate tariff attached to the meter.

To ensure that customers see a reduction in their monthly utility bill, an independent inspector (certified by the utility and/or a government agency) validates the contractor’s estimate of energy savings before the project starts. Specifically, the inspector determines whether the forecasted average energy savings are likely to exceed the average monthly loan repayment before the project starts. Finally, an independent expert inspector confirms that the contractor has installed energy-efficiency upgrades properly.

In repaying the investment for the project, homeowners pay their regular monthly energy bill, which charges for energy use and the clean energy investment. The energy savings should exceed the monthly payments, so customers see a reduction in their utility bills. However, some programs, such as the Oregon Clean Energy Works, do not require estimated energy savings to match or exceed repayments.

Figure F1 On-Bill Repayment Program



Introduction to On-Bill Repayment

Investment Opportunities in Clean Energy

The focus of this report is how to bring investment dollars to the table at scale and with attractive terms for clean energy investments. EDF's solution is on-bill repayment (OBR), a mechanism to arrange repayment of private clean energy investments as tariffs on energy meters such that they show up as line items on utility bills.

OBR is an evolutionary step forward from well-tested successful on-bill financing (OBF). While on-bill financing has been wildly popular, it relies on ratepayer funds and is not available to residential customers. Although it uses the technique pioneered by OBF, OBR does not require ratepayer or taxpayer funding.

OBR Benefits for Energy Efficiency

Energy efficiency (EE) is among the quickest and most cost-effective ways to improve economic and environmental prospects for Americans. McKinsey & Co. estimate that $500 billion in efficiency investments thru 2030 could net $700 billion in avoided energy costs (Granade 2009). However, it takes money to make money, and a recent survey of business leaders by the PEW Center on Global Climate Change finds that access to financing is the largest barrier to investing in energy efficiency (Prindle 2010).

If implemented at scale, EDF estimates OBR can achieve the following benefits for energy efficiency investments over a decade in the tri-state region:

- $14 billion investment in energy efficiency
- $98 billion direct avoided electricity costs to consumers from avoided energy use
- Over 100,000 high wage, non-exportable job-years[1]
- 200 million metric tons of avoided greenhouse gas (GHG) emissions.

We describe these benefits, and our estimate methods, in Chapter 4, as well as Appendices A and B. While these benefits will depend on overcoming a variety of barriers in addition to access to capital, it illustrates the massive potential for positive economic and environmental returns of well-designed OBR. And these are just for energy efficiency; the potential is equally large for distributed generation investments.

[1] A "job-year" is a full time job for the period of one year.

OBR Benefits for Distributed Generation

In addition to energy efficiency, OBR can be used for local, distributed renewable electricity generation projects. Electricity generation from photovoltaic and solar thermal technologies is currently a $100 billion marketplace, and installed capacity is forecasted by grow ten-fold in the next 20 years (Aanesen et al. 2012). While rooftop solar thermal and electricity are growing quickly, we posit that OBR can further buoy growth by sweetening the deal for both lenders and building owners/occupants, and by expanding the pool of investment worthy buildings. Of course, access to capital is not the sole challenge for making distributed generation economically attractive. There are many well documented barriers, but OBR helps to ameliorate the challenges of attractive investment capital, high transactional costs and lender risks.

We have significant experience with California's solar roofs initiative that we use to develop estimates for OBR-enabled projects in the New York metropolitan region. Over the next decade in New York, Connecticut and New Jersey, EDF estimates that OBR financing at scale for rooftop PV can yield the following benefits:

- Over 40,000 high wage, non-exportable job-years
- $3 billion in new project investments
- 1,200 MW in new rooftop PV capacity.

We describe these benefits, and our estimation method in Chapter 4, but we caution that these estimated benefits are certainly conservative. Our numbers pertain only to OBR-enabled multifamily and single family residential and small scale (<10 kW capacity) commercial rooftop solar investments. Clearly, OBR can be beneficial for larger projects, such as rooftop PV on larger commercial buildings, such as malls, and from additional services, such as demand response

On-Bill is Everywhere

On-Bill Financing has emerged as an innovative financing solution for energy efficiency and renewable energy projects, with at least 20 states currently housing some form of a line-item billing program. However, there is significant variation in program design amongst them. Capital sourcing, administrative structure, project eligibility guidelines, target customers, and shutoff procedures (in case of loan defaults) are choices to be made during program design that will have significant influence on the efficacy of outcomes and scalability.

At present, several states use on-bill financing and repayment at modest scales because they rely on utility—rather than private—funding sources. This is a key distinction: on-bill finance programs are financed by utility or ratepayer funds, while on-bill repayment programs use third-party capital. Most existing programs are on-bill finance programs and are available mainly for businesses and government buildings, not residential buildings.

In this section, we provide a review of on-bill programs around the country, and a review of programs in the RPA region. Nationally, as listed in table T1, there are about a dozen on-bill finance (OBF) programs currently operating successfully. Only a few, however, offer more than $10 million of financing per year.

Program design must consider unique utility regulatory structures and the business environment, as well as the existence of alternative access routes for public or private capital for clean energy investments. This chapter highlights the diversity of design components among two exemplary on-bill programs, and presents EDF's on-bill repayment proposal for comparison.

The following table lists on-bill programs by state. Several states are now beyond pilot programs and beginning to pass legislation enabling on-bill financing programs. Illinois, Hawaii, Oregon, California, Kentucky, Georgia, South Carolina, Michigan and New York all have adopted laws to support the implementation of on-bill financing. Illinois, Michigan, Hawaii and New York are poised to begin pilot programs.

Table T1. On-Bill Programs in the United States

State	Program Name	Program Administrator	Administrator	Utility Type	Customer Type	Reference
AL	ERC Loan Program	Dixie Electric Cooperative	Utility	Coop	Residential, Commercial	www.federatedrea.com/Member_Programs/Programs/Energy_Resource_Conservation_Loan_Program/index.html
AR	Home Improvement Loan Program	First Electric Cooperative	Utility	Coop	Residential	www.firstelectric.coop/products-and-services/home-improvement-loans
CA	On-bill Financing Program	SoCalGas and SDG&E	Utility	IOU	Non-residential + owners of multifamily units	www.socalgas.com/for-your-business/rebates/zero-interest.shtml
CA	On-bill Financing Program	SoCal Edison	Utility	IOU	Commercial, Industrial, Agricultural and Non-Partner Governmental & Institutional	www.sce.com/business/onbill/about-on-bill.htm
CT	Small Business Energy Advantage	United Illuminating and Connecticut Light and Power		IOU	Commercial and industrial	www.cl-p.com/business/saveenergy/services/energyadvantage.aspx
CT	C&I Financing Program	United Illuminating	Utility	IOU	Commercial and industrial	www.cl-p.com/business/saveenergy/services/energyadvantage.aspx
CT	Home Energy Solutions	United Illuminating and Connecticut Light and Power	Utility	IOU	Residential	www.cl-p.com/home/saveenergy/rebates/homeenergysolutions.aspx
GA	On-bill Financing	ECG (Electric Cities of Georgia)	Service Company	Muni-cipal	Residential	www.ecoga.org/Content/Default/24/105/0/energy-services/eecbg.html
GA	On-bill Financing	Municipal Gas Authority of Georgia	Non-profit	Muni-cipal	Residential	www.gefa.org/Index.aspx?page=476
GA	On-bill Financing	Oglethorpe Power Corporation	Utility	Coop	Residential	

State	Program Name	Program Administrator	Administrator	Utility Type	Customer Type	Reference
HI	On-bill Financing	Public Benefits Fund Administrator	PUC	IOU	Residential, Small Commercial	
IL	Illinois On-Bill Programs	AFC First Financial	Lender	IOU	Residential	energyloan.net/
IN	Indianapolis Super Bowl Legacy BetterBuildings Project	City of Indianapolis	Govern-ment	IOU	Residential	www1.eere.energy.gov/buildings/betterbuildings/neighborhoods/indianapolis_profile.html
KS	Kansas How$mart	Midwest Energy	Utility	Coop	Residential	www.mwenergy.com/howsmart.aspx
KY	How$mart Kentucky	MACED	CDFI	Coop	Residential, Small Commercial	www.maced.org/howsmart-overview.htm
MA	Small Business Program	National Grid	Utility	IOU	Small Commercial	www.nationalgridus.com/masselectric/business/energyeff/3_small.asp
MA	Residential Program	National Grid	Utility	IOU	Residential	https://www1.nationalgridus.com/StateLandingMA-MA-RES
MI	Michigan Saves	Michigan Saves	Non-profit	Coop	Residential, Commercial	www.michigansaves.org/
MN	Shared Savings	Alliant	Utility	IOU	Commercial	www.alliantenergy.com/SaveEnergyAndMoney/AdditionalWaysSave/FinancingOptions/029922
NH	NHEC SmartStart	New Hampshire Electric Cooperative	Utility	Coop	Commercial	www.nhec.com/business_energysolutions_smartstart.php
NH	PSNH SmartStart	Public Service of New Hampshire	Utility	Coop	Municipal	www.psnh.com/SaveEnergyMoney/For-Business/Municipal-Smart-Start-Program.aspx
NH	Small Business Program	National Grid	Utility	IOU	Small Commercial	www.nationalgridus.com/granitestate/business/energyeff/3_small.asp
NH	Residential Program	National Grid	Utility	IOU	Residential	https://www1.nationalgridus.com/StateLandingNH-NH-RES

State	Program Name	Program Administrator	Administrator	Utility Type	Customer Type	Reference
NJ	SAVEGREEN: 0% APR On-Bill Repayment Option	NJNG	Utility	IOU	Residential	www.savegreenproject.com/o-apr-on-bill-repayment-program
NY	On-Bill Recovery Financing Program	NYSERDA	State Energy Agency	IOU	Residential	www.nyserda.ny.gov/en/Page-Sections/Statewide-Initiatives/On-Bill-Recovery-Financing-Program.aspx
OR	Clean Energy Works	Clean Energy Works Oregon	Non-profit	IOU	Residential	www.cleanenergyworksoregon.org/
OR	MPower	City of Portland Housing Bureau	City Govern-ment	IOU	Residential	
PA	Keystone Help	AFC First Financial Corporation	Lender	IOU	Residential	www.keystonehelp.com/
RI	Small Business Program	National Grid	Utility	IOU	Small Commercial	www.nationalgridus.com/narragansett/business/energyeff/3_small.asp
RI	Residential Program	National Grid	Utility	IOU	Residential	https://www1.nationalgridus.com/StateLandingRI-RI-RES
SC	Rural Energy Savings Program	Electric Cooperatives of South Carolina	Utilities	Coop	Residential	www.eesi.org/resp
WI	Shared Savings	Alliant	Utility	IOU	Commercial	www.alliantenergy.com/SaveEnergyAndMoney/AdditionalWaysSave/FinancingOptions/029922

The Challenge of Clean Energy Investing

OBR, in conjunction with other financing techniques, has the potential to help overcome major market barriers that limit investment in EE and DG projects for commercial and residential buildings (Aanesen et al. 2012). These challenges include:

- High loss rates for unsecured loans
- Borrower's with relatively low credit scores
- Split incentives between the renter and building owner
- Commercial mortgages generally have limitations on additional indebtedness
- Competing priorities for would-be investors
- Poor time alignment between upfront costs and longer term benefits.

In this section, we discuss how OBR addresses each of these challenges.

Investor Risks

Lenders are reluctant to make unsecured loans at attractive rates to people with poor credit or financial history. Most commercial buildings are owned by limited liability companies that are protected from debts on the building. A creditor only has recourse to the asset, not the owner(s), so even if a loan is permitted by the first mortgage holder, it would be subordinated to the first mortgage and would often be perceived as having poor credit quality. That is, lenders would see these loans as high risk, and thus they would command higher rates of interest.

Under the terms of most commercial leases, tenants often pay for operating expenses including energy costs. Landlords, on the other hand, must absorb various capital expenses. For an EE project this may mean that landlords pay for the project but tenants capture the bulk of the savings. As a result, projects that yield a clear return are not undertaken.

Most commercial buildings have a first mortgage that includes a limitation on additional indebtedness or additional liens. OBR skirts this challenge as a subordinated investment as a tariff on the meter, not a lien on the property.

Lenders seek a scalable, proven investment strategy. To date, the market for underwriting EE investments has been small with few successfully established business models; it is an emerging industry without a proven track record

Borrowers with Low Credit Scores

Energy users are frequently reluctant to invest their own capital in EE projects because of competing business or household priorities. They often seek "turn-key" structures with zero or low initial cost, when available. For homeowners with high debt-to-equity ratios, home equity loans are not available.

Owner or tenant turnover rates can be faster than the repayment period of some efficiency upgrades. Longer-term investments that stay with the building rather than a particular owner or tenant are needed to capture these savings, and will be critical to financing deeper EE upgrades. By matching future savings with repayment obligations, an OBR program allows a current owner (tenant) to consider projects with payback periods that may extend beyond their ownership (tenancy).

OBR enables longer term investments, with customers realizing benefits from day one—and the financing stays with a building's utility bill even when there is a change in ownership or occupancy. Lenders see the OBR mechanism as a key to high quality credit. Since building owners have an obvious incentive to pay their utility bills, lenders benefit from greater confidence in the likelihood of the loan being repaid. Thus, OBR can greatly reduce the cost of credit while increasing its availability to more borrowers.

EDF has developed OBR to address these barriers to achieving large scale investments in energy efficiency, as well as to financing distributed generation investments. In some instances, OBR might be a silver bullet to enable customers to afford a more efficient appliance, such as an emergency hot water heater replacement. In many cases, however, OBR is just one piece of a complex set of solutions.

Tri-State Goals and Programs for Clean Energy Investing

This chapter describes significant clean energy goals and financing programs in New York, New Jersey, and Connecticut. State governments and utilities, in partnership and in parallel to federal and local programs, implement numerous programs. We summarize some of these programs and evaluate them relative to the economic potential and scale of aspiration in the state goals, where they exist.

The majority of energy efficiency programs channel public and ratepayer funds that are currently of insufficient scale and not capable of achieving significantly larger scales. The sun-setting of the American Recovery and Reinvestment Act (ARRA) initiatives for energy efficiency and renewable investment signals a significant reduction in federal funds.

The briefing book from New York Governor Andrew Cuomo's latest State of the State Address presciently assessed the emerging challenge facing clean energy financing the region:

"it is becoming evident that [subsidies] alone cannot achieve the level of clean energy deployment necessary."[2] *(Cuomo 2013, p. 27)*

This chapter reviews the major strategies employed by the states of New York, New Jersey and Connecticut to achieve clean energy objectives. In terms of goals, we examine New York's Energy Efficiency Portfolio Standard (EEPS), New York's Renewable Energy Portfolio Standard (RPS), New Jersey's RPS, and Connecticut's RPS. Initiatives on clean energy financing that we discuss include:

- The NY-Sun Initiative
- The Green Jobs-Green New York Program
- New York's Existing On Bill Recovery program
- New York's Proposed "Green Bank"
- New Jersey's SREC registration program
- The Connecticut Energy Efficiency Fund
- The Connecticut Clean Energy Finance and Investment Authority
- Energize Connecticut
- Connecticut's Commercial PACE Financing Program
- Connecticut's Home Energy Solutions Program
- Regional Greenhouse Gas Initiative (RGGI).

Connecticut's programs include the first-in-the-nation "green bank", which distinguishes the state as a leader in clean energy finance. However, New York and New Jersey have meritorious programs as well. New York has pioneered On-Bill Financing for residential customers and provided a successful blueprint for other states to emulate. New Jersey's rooftop photovoltaic market is second only to California.

While all three states recognize the need for private capital in clean energy financing, it is evident that New Jersey's approach differs quite significantly from those of New York and Connecticut. New Jersey's recent s withdrawal from RGGI does not bode well for the adoption of robust goals or measures for energy efficiency and renewable energy.

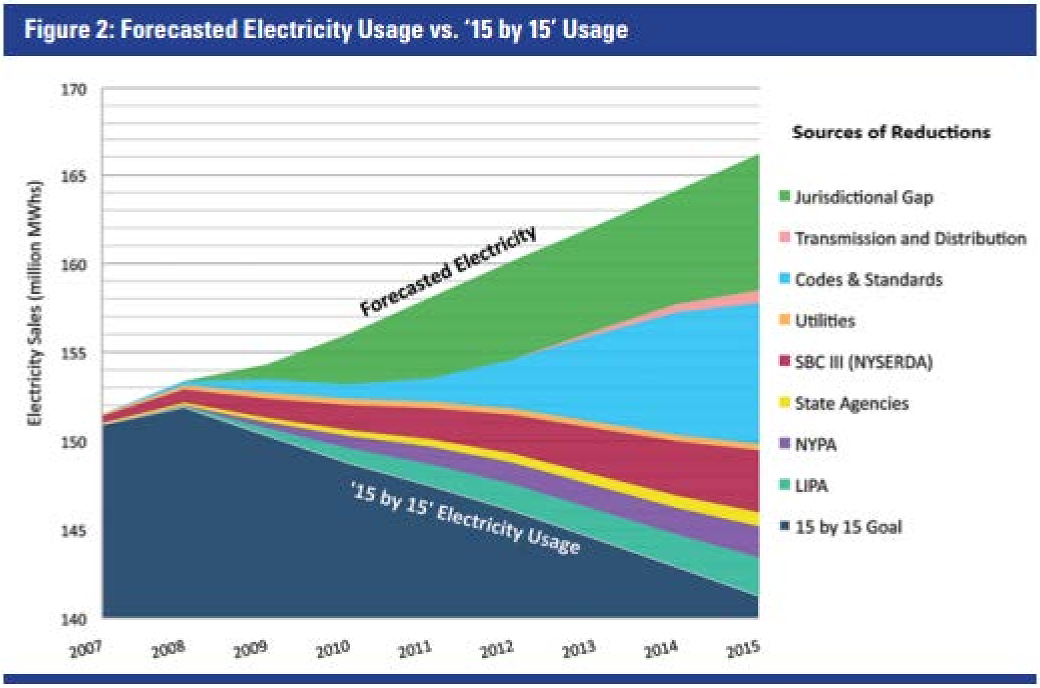
State Energy Goals

New York

The New York State Energy Planning Board is developing the 2013 State Energy Plan with leadership members of the New York State Energy Research and Development Authority (NYSERDA), NYS Department of Environmental Conservation, the Empire State Development Corporation, and NYS Public Service Commission (PSC) (New York State Energy Planning Board 2013). At present, the state has implemented both an Energy Efficiency Portfolio Standard (EEPS) and a Renewable Portfolio Standard (RPS).

New York's EEPS sets a goal of 15 percent below "business-as-usual" energy demand in 2015, commonly known as the '15 by 15' goal. According to a 2012 study by Pace University (Figure F1), a reduction of 15 percent versus projected demand by 2015 would require annual energy savings of approximately 24 million MWh in 2015 (Stutt and Morris 2012). Despite a large potential for energy savings through energy efficiency programs and energy code revisions (an estimated 37,000 GWh for the 2008–2015 period as calculated by Optimal Energy Inc. 2008), New York State only achieved 54 percent of its 2008–2011 EEPS target of 3,943 GWh (Stutt and Morris 2012).

Figure F2. 15 by 15



Source: The Pace University Energy and Climate Center, October 2012.

Note: "Jurisdictional Gap" refers to the entities under the jurisdictional of the Public Service Commission (NYSERDA and the state utility providers)

The PSC issued a May 2009 order to set a natural gas reduction target of 14.7 percent versus projected demand by 2020 (Case 07-M-0548),[3] but it is not on track to get there. The target equates to a savings of 4.35 billion cubic feet (Bcf) per year from 2009 to2011 and 3.44 Bcf annually for the period from 2012 to2020. Although these savings would total to 44.1 Bcf per year in 2020, reductions would have to be 112 Bcf by 2020 to meet the 14.7 percent target (U.S. DOE DSIRE database).

In 2010, the PSC updated New York's RPS to 30 percent renewable electricity consumption by 2015; previously it had been of 25 percent by 2013. NYSERDA is responsible for securing new renewable resources using an RPS fund. The New York RPS specifies a Main Tier and a Customer-Sited Tier. Of the 30 percent goal, 20.7 percent will be met with existing renewable facilities that began operating after 2002, and 1% will be met through voluntary green power sales. Of the remaining 8.3 percent of energy to be produced from renewable sources by 2015, 91.56 percent of that energy is expected to be generated from Main Tier facilities (utility scale renewable projects), while 8.44 percent is anticipated to be produced from the Customer Sited Tier. Programs designed to achieve these EEPS and RPS goals are administered by the state utility providers and NYSERDA.

[3] Order (Case 07-M-0548)

Funding for EEPS and RPS-related programs comes from several sources. Principally, retail consumers of electricity and natural gas in New York fund clean energy programs through a System Benefits Charge (SBC) paid on their utility bills. In 2011, total program collections were $286 million. Anticipated contributions to the SBC charge are estimated to average about $295 million annually from 2012 to 2015. Additionally, New York receives EE/RE funding through its participation in the Regional Greenhouse Gas Initiative (RGGI) and through various federal grant programs.

New Jersey

New Jersey has 20.38 percent Renewable Portfolio Standard for energy year 2020–2021.[4] To achieve the 20.38 percent RPS set by the state Board of Public Utilities (BPU), New Jersey is permitted to utilize Class I (Solar, wind, wave, hydro < 3MW, geothermal, landfill gas, anaerobic digestion, fuel cells, and sustainable biomass) and Class II (hydro > 3 MW, Municipal Solid Waste to Energy) renewables. A distinguishing characteristic of New Jersey's RPS is its specific targets for solar-electric and off-shore wind. New Jersey's solar "carve-out" is 4.1 percent solar-electric by energy year 2027–2028, while the off-shore wind carve-out is 1,100 MW with no immediate timeline due to the regulatory uncertainty surrounding off-shore wind implementation in the United States.

For utilities failing to meet their RPS generation obligations, the RPS may alternatively be met with the purchase of Class I Renewable Energy Certificates (RECs), Class II RECs, Solar RECS (SRECs), Offshore Wind RECs (ORECs). While SRECs must be purchased from within New Jersey, all other RECs may be purchased from REC generators in the PJM Regional Transmission Organization (PJM) comprised of utilities in 13 states and the District of Columbia. According to the 2011 New Jersey Energy Master Plan, 87 percent of Class I RECs used to satisfy the annualized EY 2011 RPS target were produced out of state. To the extent that more SRECs can be generated within New Jersey or the tri-state region, be it a result of OBR or other policies, the benefits will be kept within the region.

While New Jersey does not have an EEPS, in 2003 the Board of Public Utilities created the Office of Clean Energy (OCE) to implement energy efficiency programs and encourage the adoption of renewable energy resources. The OCE is responsible for implementing the state's "Clean Energy Program", which includes overseeing the state's Clean Energy Fund, as well as administering rebates, incentives, and green jobs training (NJCEP). The OCE is perhaps best known for its role in making New Jersey a national leader in solar energy through the SRECs registration program.

Connecticut

The Connecticut Public Utilities Regulatory Authority (PURA) set an RPS totaling 27 percent by 2020 and specifies three classes of clean energy resources:

[4] Energy Year 2021 runs from June 2020 to May 2021.

1. Class I (solar, wind, fuel cells, landfill methane, anaerobic digestion, ocean thermal power, wave, tidal, low-emission advanced renewable energy conversion technologies, hydropower facilities ≤ 5MW, and sustainable biomass); must comprise 20percent of energy generation in 2020.

2. Class II (municipal solid waste to energy, certain biomass facilities not included in Class I, and certain hydropower facilities not included in Class I).

3. As of 2010, 4percent of generation must come from Class III commercial/industrial customer-sited CHP systems (U.S. DOE DSIRE).

Although Connecticut has no standalone EEPS, the Connecticut Department of Energy and Environmental Protection (CT DEEP) has identified that a strategy of implementing all cost-effective energy efficiency solutions could save 4,339 GWh annually by 2020 when compared against a business-as-usual projection (CT DEEP 2012, 36). The 2012 Integrated Resource Plan for Connecticut attributes the potential for additional energy savings, among other things, to the growing availability of project financing through the state's first-in-the-nation "green bank", the Clean Energy Finance and Investment Authority (CEFIA).

The green bank will complement existing efficiency and renewable funding administered through the Connecticut Energy Efficiency Fund (CEEF) by the Energy Efficiency Board (EEB). Created in 1998, CEEF has been funded through a systems benefit charge and more recently through proceeds from RGGI. CT DEEP estimates that by increasing the EEB budget for conservation and load management to $206 million/year from a business as usual budget of $105 million/year, the state could achieve energy savings of two percent annually from 2012 to2020, resulting in monetary savings of $534 million annually by 2020 (CT DEEP 2012, 43).

Existing State Resources and Programs

New York

New York State has a significant track record of investment in energy efficiency and renewable energy through NYSERDA, NYPA, LIPA, the Division of Housing and Community Renewal, the Department of State, and the PSC's oversight of the utilities. In 2010 alone, the state's electric utilities and energy efficiency programs saved more than 1,200 GWh, and in 2011, the American Council for an Energy Efficient Economy (ACEEE) State Energy Efficiency Scorecard estimated that statewide funding for electric energy efficiency topped $1 billion. Since June 2008, the state Public Service Commission (PSC), responsible for overseeing New York's utilities, has approved over 100 programs for electric and gas efficiency. During the period of 2012 to2015 the programs associated with the state's EEPS standard are expected to reach funding levels of $3 billion and achieve energy savings of 11,360 GWh (ACEEE 2011).

The NY-Sun Initiative coordinates the various solar initiatives of NYSERDA, LIPA, and NYPA in their efforts to grow solar energy in New York. Through those entities, the initiative intends to channel $800 million through 2015, with the lion's share dedicated to expanding solar PV deployment incentives (NY-Sun Initiative Fact Sheet 2012). For example, the initiative aims to quadruple customer-sited solar photovoltaic capacity from 2011 levels, by the end of 2013. The remaining $50 million in funding to 2015 will be put to work lowering the Balance of System costs (BOS) for PV in New York through research and development. NY-Sun, in partnership with LIPA, introduced New York's first feed-in tariff system, which will encourage distributed generation by allowing Long Island utility customers to sell up to 50 MW of on premises generated solar back to LIPA. In his most recent State of the State address, Governor Cuomo proposed extending funding for the NY-Sun initiative through 2023 (NY Office of the Governor 2013).

New York's participation in the Regional Greenhouse Gas Initiative (RGGI) has also supported investments in energy efficiency and renewable generation resources. Between 2009 and 2011, RGGI funds from the sale of carbon credits contributed $327.6 million to the state of New York. Of that funding administered by NYSERDA and the PSC, $163.7 million, or about half went to energy efficiency programs, energy audits, and benchmarking. Nearly $17 million was invested directly in renewables. Another $8.6 million went to Education, Outreach, and Job training (Hibbard et al. 2011). One specific beneficiary of RGGI funding is the Green Jobs-Green New York Program (GJGNY), which administers EE audits and financing through a revolving loan fund, while also providing workforce training and generating green jobs. GJGNY is now home to New York's On Bill Recovery program, administered through NYSERDA.

Two years after the Green Jobs-Green New York Act established GJGNY, the Power NY Act of 2011 created the legal framework for an on-bill repayment mechanism in GJGNY (NYS Assembly Bill A08510—"Power NY Act of 2011"). As part of Home Performance with Energy Star and GJGNY, NYSERDA began offering "On-Bill Recovery loans" to finance home, small business, and not-for-profit energy efficiency improvements in January 2012. The program incorporates many distinctive features of OBR: low interest repayment (3.49 percent) through the monthly utility bill, transferability of the debt obligation upon sale of the property, and monthly payments designed not to exceed the energy savings of the improvements.

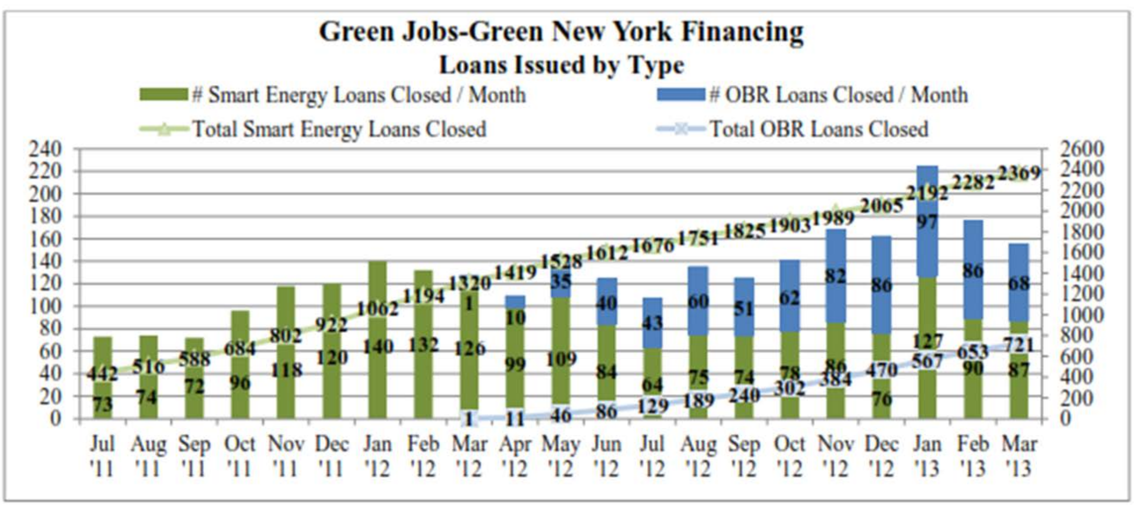
While New York's OBR program represents a huge step forward in EE/RE financing mechanisms, the On-Bill Recovery Financing Program has yet to be scaled to meaningful proportions (Figure F2). As shown in table T3, through March 2013, the program has closed 721 loans amounting to $7.7 million. While this program is the clear predecessor to any expanded OBR efforts to come, the upfront loans are still provided from ratepayer and public funding, a major impediment to the program's scalability. In order for NYSERDA's OBR program to achieve statewide scale, it seems necessary to pair the mechanism with abundant private capital.

Table T3. Green Jobs — Green New York: Monthly Update (March 2013)

	Tier 1	Tier 2
Applications Received	2,878	224
Applications Approved	1,574	156
Approval Rate	54.7%	69.6%
Loans Closed	650	71
Value	$7,005,889	$707,540
Loans Awaiting Closing	202	25
Value	$2,128,064	$227,099
Loans Pending	29	1
Loans Denied	762	33
Loans Withdrawn	579	61

Note: As of the March 2013 Progress Report, 9 Small Business/Not-For-Profit OBR Loans had been approved amounting to $304,029. No loans had yet been closed.

Figure F3. Green Jobs-Green New York Monthly Update March 2013



NYSERDA 2013 Green Jobs-Green New York, Monthly Update

New Jersey

The cornerstones of New Jersey's clean energy strategy are its commitment to solar-electric (photovoltaic, PV) energy through the Office of Clean Energy, the Board of Public Utilities, and the SREC registration program. Although there are no rebates available for solar installation in New Jersey, there is a reliable stream of income for solar adopters through the sale of Solar Renewable Energy Certificates (SRECs).

Due to the state RPS standard's "carveout" for solar—4.1 percent of electricity by FY 2027–2028—theoretically, there should be a growing demand amongst utility providers for SRECs to meet their solar obligations. Before installation, individuals and businesses must announce their intent to the SREC program. Upon installation and approval of the responsible Electric Distribution Company, each MWh of energy produced generates an SREC that is registered in the PJM Generation Attribute Tracking System (GATS). SRECs are sold on an open market, and solar installations remain eligible to produce SRECs for 15 years from the date of installation. One issue that New Jersey has faced in recent years is the dropping price of SRECs as more capacity has come online and demand has stagnated. SREC prices have dropped from $410.48 in August 2011, to $312.37 in August 2012, to $195.57 in March 2013 (NJCEP 2013).

Solar and other on-site renewable systems also benefit from a 2008 statute that exempts those systems from local property taxes. Additionally, solar equipment is exempt from the state's seven percent sales tax. Still, upfront funding to finance such projects is in short supply. For example, in 2012, the Clean Energy Solutions Energy Efficiency Revolving Loan Fund had funding of $17.6 million. For comparison, the analogous low interest Smart-E Loan program in Connecticut, a state with less than half the population of New Jersey, is funded at the level of approximately $30 million.

Certain programs like the New Jersey Natural Gas SAVEGREEN on-bill financing program make upfront capital available, but not from private sources that can be scaled up dramatically. The loan amounts are limited and not for everybody. Customers can qualify for $2,500 to $10,000 at zero percent APR for a period of 10 years for investments in gas efficiency. This existing program demonstrates that there are opportunities to increase the availability of such funding sources by expanding to on-bill repayment.

Table T4. NJ Clean Energy Program 2012–2013

	Approved Budget*	Expenditures To Date 2/28/13	Committed Expenditures	Prorated 18 Month	% Projected Completion
Energy Efficiency Programs	$387,713,328	$178,111,210	$95,316,151	$351,549,465	90.7%
Renewable Energy Programs	$38,631,421	$15,387,456	$9,349,636	$31,804,833	82.3%
EDA (Economic Development Authority) Programs	$49,045,281	$3,344,510	$17,010,743	$26,171,040	53.4%
Office of Clean Energy	$14,186,401	$5,992,932	$0	$7,705,199	54.3%
TRUE (Temporary Relief for Utility Expenses) Grant	$21,789,874	$5,812,014	$15,977,860	$28,015,553	128.6%
Total	**$511,366,306**	**$208,648,123**	**$137,654,390**	**$445,246,088**	**87.1%**

NJ. Clean Energy Program. Monthly Progress Report on Progress Towards Goals. February 2013,

Table T5. Energy Efficiency Programs — NJ Clean Energy Program 2012–2013

	Approved Budget*	Expenditures To Date 2/28/13	Committed Expenditures	Prorated 18 Month	% Projected Completion
RESIDENTIAL ENERGY EFFICIENCY PROGRAMS					
Residential HVAC - Electric & Gas	$26,891,450	$16,856,346	$0	$21,672,444	80.6%
Residential New Construction	$20,264,931	$12,077,220	$8,371,023	$26,290,598	129.7%
Energy Efficient Products	$22,137,799	$16,066,447	$0	$20,656,860	93.3%
Home Performance with Energy Star	$39,358,735	$27,971,079	$6,077,867	$43,777,217	111.2%
Marketing - Residential EE	$1,743,976	$1,278,555	$0	$1,643,857	94.3%

Sub-Total: Residential Energy Efficiency Programs	$110,396,892	$74,249,646	$14,448,890	$114,040,976	103.3%
RESIDENTIAL LOW INCOME					
Comfort Partners	$50,000,000	$36,091,483	$0	$46,403,336	92.8%
Sub-Total: Residential Low Income	$50,000,000	$36,091,483	$0	$46,403,336	92.8%

C & I ENERGY EFFICIENCY PROGRAMS					
C&I New Construction	$5,524,122	$1,955,797	$678,078	$3,386,411	61.3%
C&I Retrofit	$57,257,019	$23,667,267	$21,972,909	$58,680,226	102.5%
Pay-for-Performance New Construction	$7,610,818	$1,150,977	$3,168,443	$5,553,540	73.0%
Pay-for-Performance	$50,055,958	$9,696,476	$29,556,578	$50,468,213	100.8%
Combined Heat & Power (CHP)	$17,000,000	$191,367	$3,602,000	$4,877,186	28.7%
Local Government Energy Audit	$5,000,000	$2,979,705	$2,125,091	$6,563,309	131.3%
Direct Install	$60,632,162	$25,529,126	$11,176,772	$47,193,297	77.8%
Marketing - Commercial & Industrial EE	$1,575,000	$1,278,154	$0	$1,643,341	104.3%
Large Energy Users Pilot	$20,835,057	$308,297	$8,587,389	$11,437,311	54.9%
Sub-Total: C & I Energy Efficiency Programs	$225,490,135	$66,757,165	$80,867,261	$189,802,833	84.2%
OTHER ENERGY EFFICIENCY PROGRAMS					
Green Jobs and Building Code Training	$386,450	$280,151	$0	$360,195	93.2%

Sustainable Jersey	$1,439,851	$732,764	$0	$942,125	65.4%
Sub-Total: Other Energy Efficiency Programs	$1,826,301	$1,012,915	$0	$1,302,320	71.3%
TOTAL	$387,713,328	$178,111,210	$95,316,151	$351,549,465	90.7%

Note: Program budget period is actually 18 months, Jan 1, 2012 through June 30, 2013

Connecticut

With a relatively small industrial base, residential and commercial buildings dominate Connecticut's energy demand, accounting for nearly 90 percentpercent of electricity consumption (CT DEEP 2013a, 9, 13). Connecticut's 2013 Comprehensive Energy Strategy called a focus on the energy efficiency retrofits "essential" and emphasizes energy efficiency investment. Like New York and New Jersey, Connecticut relies on a surcharge "system benefits" fee and RGGI auction proceeds to fund its energy programs.

Statewide investment in electric and natural gas energy efficiency totaled $140 million in 2011 (CT DEEP 2013a). Contributing to that funding was a $0.003/kWh System Benefit Charge, as well as a portion of Connecticut's $51.7 million in RGGI proceeds between 2009 and 2011. While CEEF funded a number of clean energy programs with that money in 2011, the state more notably made history that year by establishing the Clean Energy Finance and Investment Authority, the nation's first state-level "green bank" designed to "leverage public money with private sector funds and expertise (Berlin et al. 2012)."

Public Act 11-80 established CEFIA with the charge of "developing programs to leverage private sector capital to create long-term, sustainable financing opportunities to support residential, commercial, and industrial sector implementation of energy efficiency and clean energy measures" (CT DEEP 2013b, 8). Of its early achievements, CEFIA has teamed up with CEEF to create Energize CT, an outreach initiative designed to connect residents, businesses, non-profits, and municipalities with the relevant clean energy resources. "Energize Connecticut is now the overarching public-facing brand that represents programs and services supported by the [EEB] and the [CEFIA]" (Connecticut Energy Efficiency Board 2012)." Energize CT, like NYSERDA's outreach efforts, seeks to efficiently present EE/RE choices to all manners of consumer. CEFIA holds so much promise because, rather than employing a predominately grant-based system, as was the prevailing financing model of the ARRA days, it distinguishes itself through its organizational mission of establishing a robust connection between EE/RE projects and the upfront capital of private investors (Berlin et al. 2012).

Property-Assessed Clean Energy (PACE) financing allows municipalities to extend low interest loans to homeowners and businesses, which are paid off over an up to 15-year period as an item on the recipient's property tax bill. Typically, because the clean energy financing payments are attached to the property tax, the payments will stay with the property, rather than the owner if the owner decides to sell the property. The transferability of PACE financing between owners is an important feature shared by EDF's proposed OBR program structure.

PACE financing emerged as a promising way for cities and municipalities to extend clean energy financing to the relatively untapped market of residential and commercial renters. To date, 28 states (including New York, New Jersey, and Connecticut) have passed PACE-enabling legislation. However, a July 2010 statement issued by the Federal Housing Financing Authority, acting as conservator of Fannie Mae and Freddie Mac, advised the two home mortgage giants to limit the types of mortgages available to homeowners in municipalities participating in PACE programs. Because PACE loans were deemed to act as first liens over pre-existing mortgages, mortgages with PACE liens were regarded by the FHFA as bearing substantial additional risk in comparison to the typical mortgage. "This ruling has effectively ended residential PACE financing, with many local governments suspending their programs as a result" (CT DEEP 2013a).

The Connecticut legislature took an innovative step forward amidst the unresolved legal quagmire of residential PACE by establishing Connecticut's Commercial PACE (C-PACE) program in June 2012. The program is open to commercial, industrial, and multifamily buildings. C-PACE is "owner-arranged" in that the property owners transact with private capital directly to acquire the requisite financing. The municipality still assesses the building owner on their property tax bill, and the payments still stay with the property, rather than the owner. The fact that the financing is owner-obtained allows the municipality to avoid the legal uncertainties of traditional residential PACE financing. CEFIA administers PACE and is tasked with enrolling municipalities. As of January 2013, 12 towns had enrolled.

Recent Developments and the Market for Clean Energy Financing

New York

New York has announced its intention to found a Green Bank to attract private capital to clean energy investment. In his January 2013 State of the State Address, Governor Cuomo announced his intention to use public/ratepayer funds amounting to $1 billion to leverage private sector capital towards investments in the clean energy economy.

Overseeing the development of the proposed Green Bank will be the newly appointed Chairman for Energy Policy and Finance, Richard Kauffman. The new cabinet level position will be responsible for coalescing the numerous institutional stakeholders that administer New York's EE and RE programs around the specific goals and objectives of state's comprehensive State Energy Plan.

Governor Cuomo has also mentioned the growing importance of distributed generation (DG) in ensuring the state's energy security: "Utilizing distributed generation resources, or on-site power generation, reduces dependence on the electric distribution system that is susceptible to damage during a natural disaster. Distributed generation resources, such as solar and wind, can also contribute to a cleaner electricity supply" (Cuomo 2013, 27, 220–221).

A 2008 report cited by the 2009 State Energy Plan conducted under Governor Patterson estimates that New York's maximum achievable end user electricity efficiency through 2015 is 26,000 GWh in reductions over the 7 year period from 2009–2015, a reduction of 14percent below projected energy usage; improved building and appliance codes over the 7 year period could potentially provide an additional 11,000 GWh reduction from projected (5.7percent) (New York State Energy Plan 2009, 12). The '15 by 15' is demonstrably achievable, if not cost effective solely through public funding. Governor Cuomo acknowledges the limits of public funding and potential of third party financing: "through the use of bonding, loans and various credit enhancements (e.g., loan loss reserves and guarantees), a Green Bank is a fiscally practical option in a time of severe budget condition" (Cuomo 2013, 29). On Bill Repayment, while not yet widely implemented at large scale, seems to be one suitable mechanism through which to efficiently channel the public and private funds of New York's nascent Green Bank.

New Jersey

The environment for energy efficiency and renewables funding in New Jersey is quite different than that of New York. Following the administration of Governor Jon Corzine (D), Governor Chris Christie (R) significantly altered the course of the state's clean energy policy. Most notably, Governor Christie announced in May 2011, that New Jersey would withdraw from the Regional Greenhouse Gas Initiative. The Governor set a course forward for New Jersey's Clean Energy Program independent of RGGI and any funding it might provide (Navarro 2011). Notably, New Jersey did not use any of its 2009–2011 RGGI proceeds for energy efficiency programs; it used 22.9 percent of its $118.3 million in RGGI funds for renewable energy investment and retained 63.4percent of the proceeds for the purpose of funding the state government during that period (Hibbard et al. 2011).

The alternative clean energy financing philosophy to which New Jersey currently subscribes is one that downplays the role of government and seeks the minimal cost effective use of taxpayer dollars for the implementation of its clean energy programs. The New Jersey EMP of 2011 recognizes a different, more restricted set of tools at the state's disposal to meet its clean energy goals.

> In light of New Jersey's fiscal challenges, efforts must be made to strip away any largesse that constitutes a transfer of wealth from New Jersey's ratepayers to EE/Demand Response program developers. While the Administration remains committed to increased EE/DR penetration to meet the State's planning goals, […] EE and DR programs are being evaluated to determine if PJM wholesale markets already provide adequate compensation to ensure program success, thereby obviating the need for continued State sponsorship and assistance.
> (New Jersey Energy Master Plan 2011, 116)

The report goes on to explain, "the Christie Administration encourages reliance on third-party providers that have the requisite "know-how" and access to capital to structure DR programs that obviate the need for capital investment by the State" (New Jersey Energy Master Plan 2011), 116). This alludes to the NJ Office of Clean Energy's reliance upon two private companies, Honeywell and TRC, to administer the state's more than $300 million in clean energy program funding in 2012 (NJCEP 2012).[5] If New York and Connecticut are determined to leverage existing sources of clean energy funding to attract private capital, then New Jersey is seeking to stretch each ratepayer dollar much, much further.

While it seems likely that the Christie Administration would consider adopting an equivalent of Governor Cuomo's proposed $1 billion Green Bank to fall into the category of "largesse", it is reasonable to conclude it would have fewer objections to wide scale implementation of another New York's clean energy tool: OBR.

Despite New Jersey's relative reluctance to tap into ratepayer and public funding, it nonetheless seems conceptually well-suited to OBR. The EMP acknowledges New Jersey's search for a "new way to provide capital for EE and renewable energy programs that can eliminate the need for cost incurrence through SBC" (New Jersey Energy Master Plan 2011, 120). The form of upfront financing for which the EMP advocates, revolving loan funds, are compatible with OBR. The EMP concludes that once these funds begin to leverage private capital, the state could perhaps reduce or even eliminate its surcharge.

[5] New Jersey's Clean Energy Program Budgets and Filings. http://www.njcleanenergy.com/filings

Connecticut

Connecticut is perhaps best positioned for OBR. Governor Malloy's Comprehensive Energy Strategy touches on a common theme in clean energy financing today:

> […] establishing and sustaining a consistent, sufficient level of investment is critical to realizing the State's goal of capturing all cost-effective efficiency. While Connecticut has increased funding for natural gas and electricity efficiency programs over the years, the levels fall short of what is needed to achieve an all cost-effective efficiency goal. (CT DEEP 2013a)

Connecticut's leadership in establishing its first-in-the-nation green bank further distinguishes it as a trailblazer in clean energy financing. "Created as a key component of a broader energy law that received almost complete bipartisan support, CEFIA is a quasi-public clean energy finance authority that combines several existing state clean energy and energy efficiency funds, enables the new entity to make loans, and to leverage its capital with private capital, permitting private investment in and alongside the bank with the investors receiving a reasonable rate of return on their investments. As such, CEFIA holds out a flexible and attainable model for states to employ in constructing clean energy finance banks" (Berlin et al. 2012). As in the case of New York and New Jersey, Connecticut affirms the need for private capital in clean energy financing. However, the state's early adoption of a clean energy finance bank, CEFIA, positions Connecticut to realize this goal.

In April of 2013, Connecticut launched a pilot program as a first step towards fulfilling the capital-attracting mission of CEFIA. Using $2.5 million of ARRA-SEP funding from DEEP as a loan loss reserve fund, CEFIA has secured approximately $27.8 million in committed funding from community banks and credit unions around the state (CEEF 2013). "This Smart-E pilot program will offer affordable interest rates and enable a five to twelve year payback period for the homeowner. Participating lending institutions will provide unsecured loans of up to $25,000 to qualifying residential borrowers to finance comprehensive energy assessments and efficiency retrofits, in addition to qualifying renewable energy improvements and fuel and equipment conversions. All contractors qualified under CEFIA, the utilities, or CEEF are eligible to participate. Customers can finance all measures that qualify for a rebate under CEFIA, CEEF, or the utilities, as well as other measures that increase the energy efficiency or renewable energy production of a home" (CT DEEP 2013). The program launched in Norwich, CT as a cooperative effort of Norwich Public Utilities, CEFIA, CorePlus Credit Union, and Eastern Savings bank. Soon, the entire pool of funding will become available to the rest of the state. Through Smart-E, residents are eligible for over 40 potential home energy improvement measures, including natural gas conversion and high efficiency natural gas equipment (Norwich Public Utilities 2013). By introducing private lending entities to energy efficiency investments, Connecticut is taking a huge step towards growing the marketplace. "OBF programs, with default rates typically lower than 2percent, can offer a unique opportunity for financial institutions to safely tap into traditionally underserved markets by leveraging the utility's relationship with the customer to provide safe, cost-effective investments with steady returns (ACEEE 2012, 3).

Connecticut has experience with both OBF and OBR. The Connecticut Utilities (Connecticut Light & Power, United Illuminating, Connecticut Natural Gas, Yankee Gas, and Southern Connecticut Gas) ran a pilot OBF program as a part of the state's residential Home Energy Solutions (HES) from June 2010 to May 2011. With interest rates of 0.0 to 4.99 percent, the program issued approximately $15.5 million in loans to 1,350 residents. After the pilot expired, the Utilities were challenged by PURA to develop a cost effective, scalable OBR program to administer HES upgrades. They chose to "outsource [financing the residential loans] to a [non-profit third party lending institution], [the] Connecticut Housing Investment Fund (CHIF)" (Koch 2012).

Eight energy upgrades (detailed below) are covered by the program at 2.99percent or 4.99percent depending on the procedure. While United Illuminating chose to require On Bill Repayment for this subsection of the HES program, Connecticut Light & Power (the larger electric utility) opted to offer consumers the choice of financing approaches.

As of May 2012, UI and CL&P had issued 70 loans amounting to $750,000. "The current program is working, but all involved hope it can be expanded to include more measures" (Koch 2012). Although Connecticut has yet to scale up its OBR efforts, it appears to have satisfied many of the preconditions for establishing an innovative program that will ultimately be funded "primarily through third party financing, such as local, regional or money-center banks rather than ratepayers" (CT DEEP 2013a). OBR is a natural fit for such a system.

Conclusion

Although New York, New Jersey, and Connecticut have significantly different circumstances surrounding their respective clean energy goals and financing strategies, they have similar disconnects between opportunity, aspiration and implementation.

Connecticut and New York have demonstrated eagerness to link private capital to clean energy investments. New Jersey similarly prefers private investment over government subsidies. OBR fits all three state circumstances.

Connecticut needs to scale up clean energy financing through CEFIA; New York likewise requires a mechanism to funnel funding through its new Green Bank; New Jersey is seeking an avenue through which to channel third party financing to its residents and business. OBR satisfies the requirements of all three states while offering the potential to expand the marketplace to underserved utility customers and private sources of capital looking for low-risk investment opportunities.

Benefits of OBR

Benefits to Households and Small Businesses

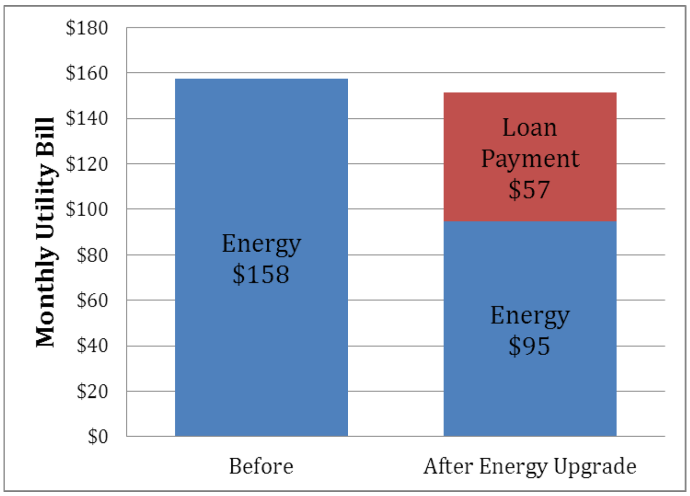
For single family homeowners, OBR offers the chance to transform the marketplace by offering them a simple way to finance energy efficiency. A useful rule of thumb, based on study of

California homes, is that an average homeowner needs to invest $7,200 to achieve at least a 25 percent energy use reduction (Harcourt Brown & Carey Inc. 2011).

Given today's housing market—where 30 percent of homes are still under water, and 50 percent of all home sales are distressed, most homeowners probably do not have easy access to the capital necessary to reduce their home energy consumption. OBR offers a solution for providing that capital to homeowners.

Figure 3 illustrates the monthly utility bill costs before and after OBR. Assuming a homeowner makes an OBR investment that reduces her monthly bill by 1/3 using capital from a private lender that is to be repaid at a 5 percent per year rate of interest over period of 15 years, she can save a total of $1,080 as she pays off the loan, and save more than $60 per month thereafter for the lifetime of the investment. For example, rooftop PV, insulation and window replacements can last 30 years or longer.

Figure F4. Energy Upgrades Repaid On-Bill Can Lower Utility Bills



In the multifamily/multi-tenant arena, OBR offers owners of master-metered buildings the chance to access currently scarce, standalone low-cost capital. OBR also helps tenants in individually metered buildings finance improvements to their respective units while building owners make improvements to common areas. Tenants prefer energy efficient residential space since they would then pay less for utilities; hence, OBR also helps landlords to increase the appeal of their rental property.

OBR can be designed to provide financing for commercial, public and residential buildings including multi-family rental buildings. OBR will also significantly improve the credit quality of a wide variety of financing mechanisms including loans, leases, Energy Services Agreements ("ESAs") and Power Purchase Agreements ("PPAs").

As OBR helps firms to become more energy efficient, they gain additionally from improved company image, and longer appliance working life. Firms that use electricity intensively, such as those in the industrial sector, further benefit from the reduced electricity cost volatility that comes with higher energy efficiency. Buildings that perform better on energy will have inhabitants that perform better as well.

Benefits to Utilities

OBR offers utilities a way to meet their state-mandated energy efficiency and renewable portfolio goals. It will complement and build upon existing programs without using utility or ratepayer funds. Utilities may not have sufficient expertise to evaluate the risk of a particular investment, whereas third party financiers are experts in risk evaluation and management. Utilities may also receive fees from lenders in exchange for providing billing services. Utilities can provide this billing service at very low marginal cost, especially once billing systems have been modified for the pilot on-bill financing programs.

Benefits to Society from OBR-Enabled EE and DG Investments

Economically attractive efficiency investments thru 2030 could net $700 billion in avoided energy costs (Granade 2009). Electricity generation from photovoltaic and solar thermal technologies is currently a $100 billion marketplace, and installed capacity is forecasted by grow ten-fold in the next 20 years (Aanesen et al. 2012).

While rooftop solar thermal and electricity are growing quickly, we posit that OBR can further buoy growth by sweetening the deal for both lenders and building owners/occupants, and by expanding the pool of investment worthy buildings. Of course, access to capital is not the sole challenge for making distributed generation economically attractive. There are many well documented barriers, but OBR helps to ameliorate the challenges of attractive investment capital, high transactional costs and lender risks.

The simple step of allowing building owners and occupants to repay loans through utility bills overcomes several important hurdles to clean energy investment:

- High capital costs, particularly for customers will FICA credit scores below 650 and for customers without access to home equity loans
- High costs of customer acquisition for EE and DG service providers
- Payback timelines misaligned with investor preferences and expected length of renter occupancy
- Split incentives between building owners and tenant/occupants, particularly where renting tenant pays the utility bill.

EDF estimates that a well-constructed OBR program can overcome these hurdles. Below we quantify these benefits based on the following key assumptions:

- Reduced default risk so the interest rate on investment funds is reduced from 15 percent per year to 5 percent per year

- Expanded pool of eligible customers to include those with FICA scores between 600 and 650

- Reduced cost of customer acquisition by 50 percent as an outcome of new customer offerings in a new competitive marketplace where service providers (building contractors and rooftop solar PV installers) develop turnkey solutions in partnership with lenders (banks and credit unions).

When OBR is applied to increased energy efficiency and distributed generation investment, it is possible to compute potential societal benefits, as summarized in Table T6.

Table T6. Tri-State Benefits of OBR over Next Decade

Potential Benefits over a decade in Tri-State Region	**Rooftop Solar PV**	**Energy Efficiency**
Jobs **(Job-Years)**	40,000 (12,000 – 63,000)	110,000 (25,000 – 29,000)
Clean Energy Investments **($2012 Billions)**	$3 (1 – 5)	$14 (3 – 5)
Emissions **(million metric tons GHGs)**	-	195 (39 – 64)
Ratepayer and state energy bill savings **($2012 Billions)**	-	$98 (19 - 32)
New Installed Rooftop PV **(MW)**	1,200 (400 – 2,000)	-

Based on EDF OBR Benefits model version: May 08, 2013

Benefits accrue over a 12-year period ("about a decade") based on a 12-year McKinsey dataset of EE potential for residential, commercial and combined heat and power.

We calculate benefits associated with OBR-enabled energy efficiency for each of the three states, and compare to the national potential in Table T7.

Table T7: OBR Benefits from Energy Efficiency

Benefits over a decade	National	NJ	CT	NY
Jobs **(Job-Years)**	600,000 (560,000 – 660,000)	27,000 (25,000 – 29,000)	8,000 (7,500 – 9,000)	75,000 (67,000 - 83,000)
Emissions **(million metric tons GHGs)**	1,200 (900 – 1,400)	52 (39 – 61)	15 (11 – 19)	128 (95 – 160)
Ratepayer and state energy bill savings **($2012 Billions)**	$590 (440 - 740)	$24 (18 - 30)	$8 (6 – 10)	$66 (49 - 84)
Clean Energy Investments **($2012 Billions)**	$87 (80 – 94)	$3 (3 – 4)	$1 (0 – 1)	$10 (9 - 12)

Based on EDF OBR Benefits model version: May 17, 2013.

Benefits accrue over a 12-year period ("about a decade") based on a 12-year McKinsey dataset of EE potential for residential, commercial and CHP.

Building and Appliance Energy Efficiency

In this section we provide quantitative estimates of the benefits of OBR with respect to increased investment in energy efficiency and rooftop solar PV. We develop separate spreadsheet-based models; details for each are provided in Appendices A and B.

For a bounded estimate of energy efficiency investments attributable to OBR, EDF constructed a financial model with two sets of inputs to represent the two scenarios—with and without OBR. We modeled the deployment of energy efficiency using two main levers (1) reducing the cost of capital, and; (2) lowering the transaction costs and other barriers. To estimate the values of these inputs, we relied on empirical studies and expert judgment.

The model's key outputs—energy savings, and the associated cost savings and carbon dioxide emission reductions—under the two scenarios can then be compared to obtain the effect of OBR. We go one step further by estimating the new jobs that could be created as a result of investments enabled by OBR.

We used as our underlying data of energy savings, investment amounts, cost savings, emission reductions the findings by McKinsey & Co. in its study of the economic potential of US energy efficiency nationwide (Granade 2009). Our model thus uses a top-down approach in four steps.

1. We estimate the internal rate of return (IRR) of energy efficiency upgrades in several subsectors in the economy by using the investment and savings estimates made by McKinsey & Co.

2. By comparing the IRRs against estimated market lending rates with and without OBR, we project the nationwide benefits from OBR in terms of energy savings, cost savings, and carbon dioxide emission reductions, which result from the increased investments in energy efficiency.

3. We analyze the further impact of these investments, including the potential direct benefits, such as jobs, and indirect benefits, such as from avoiding future fossil fuel use.

4. Finally, we translate these into household- and firm-level benefits.

To obtain the implied IRRs from McKinsey's aggregate estimates for upfront investment and savings, we made assumptions about the timing of these investments and savings. To obtain two IRR point estimates for each subsector in the economy, we used two scenarios: (1) all investments take place in the first year of analysis, and (2) investments occur in a linearly declining fashion.

To represent the variation in project returns, we further assume that each point estimate represents the mean of a normally distributed profile of IRRs. We thus create a range of IRRs for each subsector, which in turn drives the range of benefits estimated. For an in-depth discussion on our benefits estimation methodology.

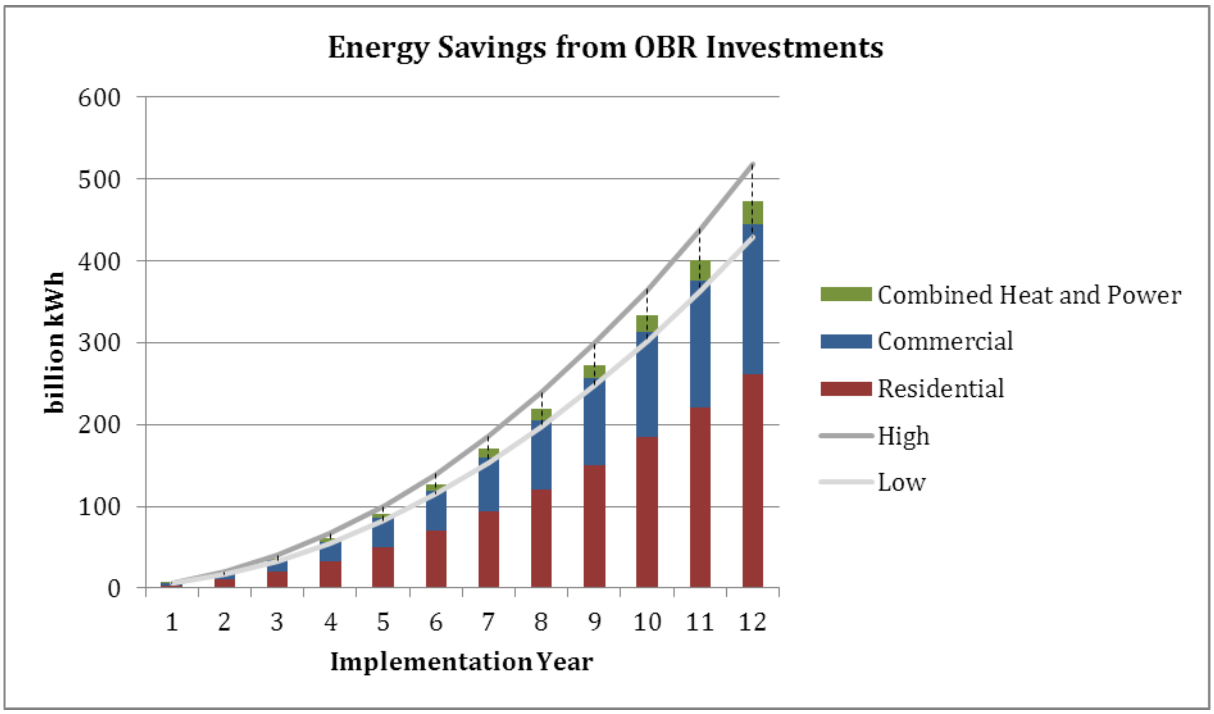
Interest rates for unsecured investments in energy efficiency upgrades are likely to be in the range of credit cards, which are currently about 16 percent per annum. Firms are likely to be able to borrow at a slightly lower rate of about 15 percent. With OBR, we believe based on extensive consultation with the lending industry that these borrowing rates can be reduced to slightly above current home equity loan rates, i.e. about 5 percent.

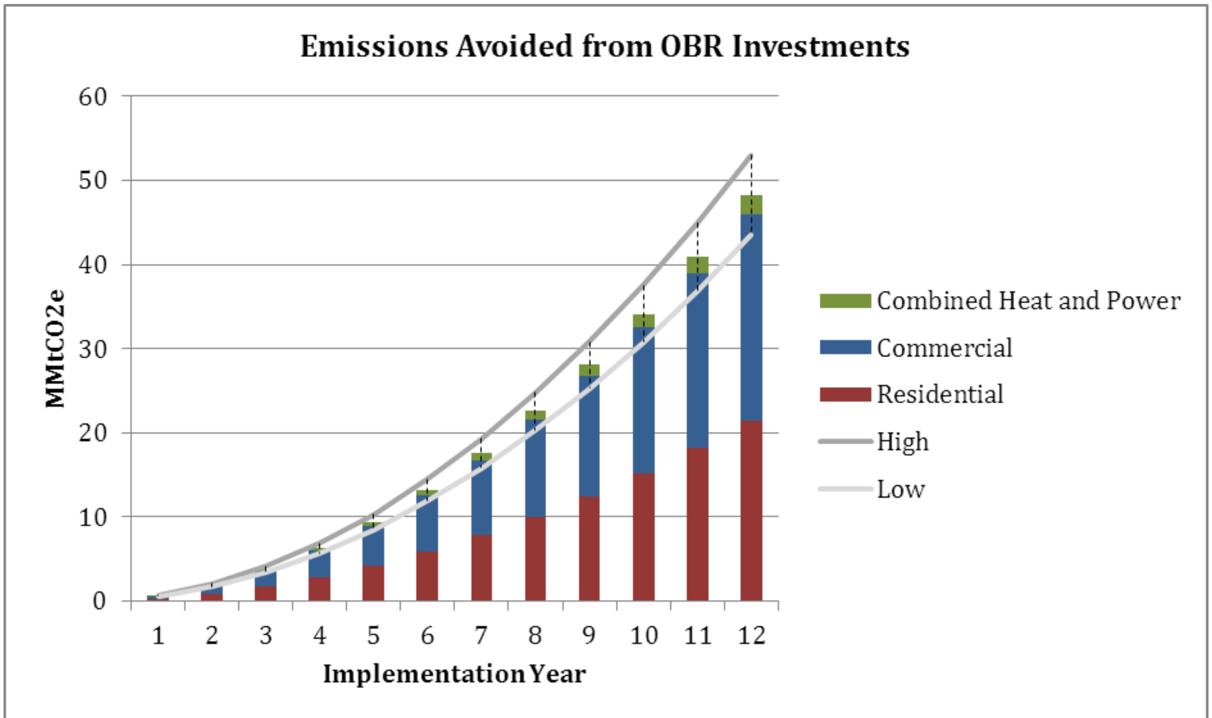
While empirical studies estimating transaction costs of energy efficiency projects are limited, they indicate that as a proportion of total project cost, transaction costs range from 8–36 percent for the residential sector, 15–40 percent for the commercial sector, and 2–8 percent for the industrial sector. As with investment rates, these estimates are project-dependent. With OBR, we believe that transaction costs for EE investments can be reduced by 70 percent for each sector. As estimates are not available for the CHP sector, we used the same transaction cost percentages as the existing homes category under the residential sector.

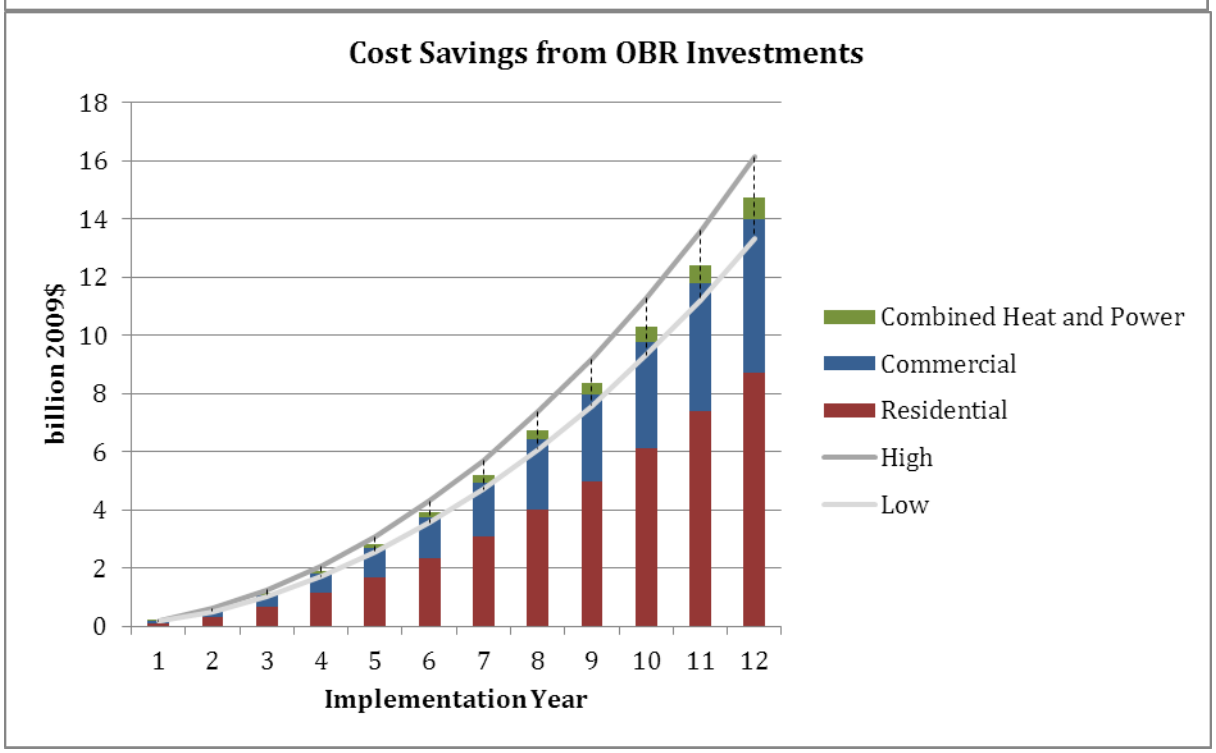
As shown in the following four figures, assuming these input values, our model shows that with OBR, energy savings in the US could reach 520 billion kWh by the twelfth year of program implementation, avoiding 55 million metric tons of carbon dioxide emissions in that same year.

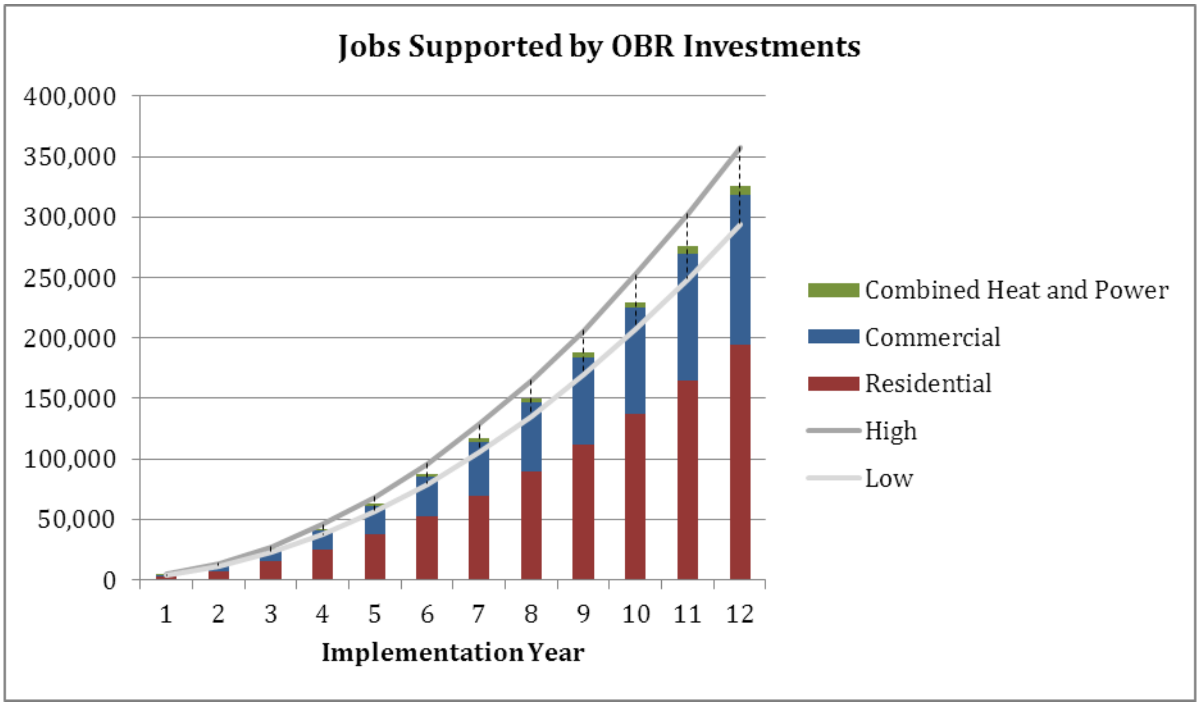
The energy savings correspond to more than $15 billion in utility bills saved. Under our analysis, the residential and commercial sectors will be the main beneficiaries of OBR. The industrial sector will see little benefit from OBR for two key reasons. First, not all energy-consuming activities in the industrial sector are eligible for OBR because they do not use utility-generated electricity. Second, of the eligible activities, returns from efficiency upgrades are already high enough to incentivize firms to take up investments at market rates; the fact that such efficiency opportunities are not yet realized suggests that other barriers exist for industries; for example, more efficient versions of machinery are not easily available on the market and must instead be custom-made.

Figures F5 thru F8: Societal Benefits from OBR-enabled EE Investments




Emissions Avoided from OBR Investments
MMtCO2e
Implementation Year
Combined Heat and Power
Commercial
Residential
High
Low


Cost Savings from OBR Investments
billion 2009$
Implementation Year
Combined Heat and Power
Commercial
Residential
High
Low



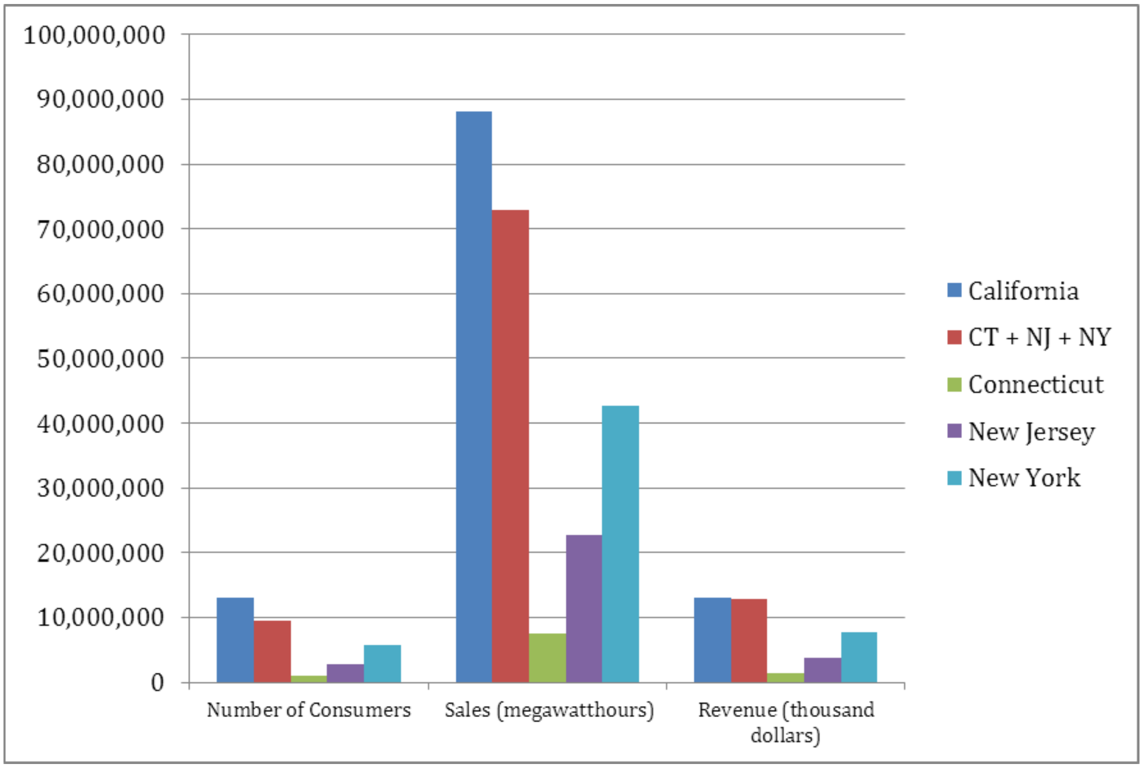
The job creation benefit of OBR is difficult to estimate but potentially substantial. One study indicates that national employment in the energy efficiency sector could quadruple to nearly 400,000 jobs by 2020 (Goodman et al. 2010). By dividing the total investment by the average wage of a worker in the energy efficiency sector, we estimate that up to 360,000 jobs could be created as a result of OBR in the program's twelfth year.

While we try our best to quantify as much of OBR's impact using the model, it is difficult to put figures to benefits such as OBR's ability to align incentives and the increased customer awareness from promoting OBR. Nor have we attempted to quantify the broader and longer-term social benefits of the incremental energy efficiency OBR brings about, such as lower electricity prices and their effect on the poor and avoiding the costs of the worst effects of climate change.

Distributed Generation

EDF also developed a bounded analysis (with high and low scenarios) to forecast the uptick in rooftop PV projects in tri-state region due to OBR. Extensive details are provided in Appendix B. In addition to adding demand (by expanding eligibility to borrowers with lower FICO scores) and shifting costs downward, we consider recent trends for rooftop PV installation. We translate our findings from California based on our observation of the policy setting in the tri-state region, as detailed in Chapter 3. We also observe that New Jersey has seen a recent boom in DG investment (NJCEP 2013b). Finally, we observe that New Jersey, Connecticut and New York, when combined, are quite similar in scale to California, as shown in Figure F8. Though a bit smaller by all measures, the tri-state region has another important economic forcing function for EE and DG investments: significantly higher average electricity prices.

Figure F9. Comparison of California to Tri-State Region



The low scenario assumes flat (zero) growth in rooftop installations such that investments continue at levels observed in 2012. The high scenario has growth continuing on the trend established from 2007 through 2012.

We find a range of 70,000 to 170,000 new rooftop PV projects between 2013 and 2022 as a result of OBR effects in New Jersey alone. This is corroborated by the recent boom in rooftop PV, such that New Jersey outpaced California to become the top installation state in the country in 2012 (NJCEP 2013b). The benefits from the potential OBR-enabled rooftop PV investments are shown in the table, including between 6,000 and 21,000 jobs, and $1.5 billion in new investments in rooftop PV.

When combined with Connecticut and New York, the potential OBR-enabled rooftop solar PV projection also grows. While New York has a much larger customer base, it also has a less well-developed solar incentive program, and less solar resource in its northern reaches. Still, combined, the three states could enjoy between 100,000 and 400,000 new rooftop solar PV investment projects with OBR in place.

Foundational Features of OBR

EDF has identified several foundational design features for an OBR program, based on our outreach to building, lending and real estate stakeholders. These features seek to minimize transactional costs while providing confidence for consumers, lenders, ratepayers and utilities. A successful program will attract significant private capital by creating a marketplace for underwriting energy efficiency investment.

Presenting Scalable Opportunity for Lenders

OBR can be designed and made available for all building sectors. It can overcome the traditional split-incentive barrier to EE investment in rentals, where tenants pay utility bills while building owners incur the capital costs of EE upgrades. Therefore, single family, multi-family, commercial and industrial building owners could be eligible for participation, including owners of leased buildings. Both single measure (with some minimum value) and whole-building interventions could be eligible for OBR-enabled investments. Public spaces within multi-family dwellings, such as court yards with lighting or pool pumps, are particularly well-suited for OBR, in cases where the public spaces are metered separately.

In addition to the types of buildings, a diversity of financial arrangements ought to be eligible. For example, in addition to loans, leases may qualify to be repaid on utility bills. This may be particularly important because many residential rooftop solar installations are structured as leases. Similarly, energy services agreements and power purchase agreements can be transacted through OBR.

Ensuring Consumer and Lender Confidence in Energy Efficiency

While rooftop PV has no moving parts and relies principally on sunshine for long term performance, it is relatively easy to calculate investment returns for a self-generation system. For energy efficiency, however, both borrowers and lenders need assurance that when a borrower agrees to make repayments on his/her utility bill, he/she has invested in reasonable measures at reasonable costs, and that projects have been properly designed and installed. To provide this assurance, several program features focus on reliable investments, robust verification and careful guidance to installers and verifiers.

Government agencies may choose to provide a list of approved energy efficiency and renewable generation measures that can be funded with OBR. Projects must also meet tests for financial viability—customers must expect to see their energy bills decline, and this expectation must be based on an accurate forecast (with some margin of error).

The list of approved measures can initially be based on measures that currently receive rebates and are fixtures (i.e., not easily removed from the premises). The list should be updated continually to reflect new technologies, to remove measures that are ineffective or not cost effective, and to codify a growing body of experience that pushes toward deeper upgrades. Measures with highly variable performance or measures highly dependent on customer behavior may also be excluded or severely discounted when calculating forecasted costs and benefits.

As a financial threshold to protect both the borrower and lender, debt service should be no more than estimated savings from the EE project, with an adequate margin of safety. That is, projects must be reasonably forecasted to lower energy bills more than the installment repayments for the clean energy investment. This might involve several steps. The contractor can be required to provide customers with a well-formatted, written estimate of average monthly energy and dollar savings for the project, compared against the monthly investment payment.

When distributed generation, electric vehicles and/or storage are added to the project, the analysis of cost and benefits is necessarily complex but still worthwhile.

Once the project is installed, it should be inspected by an independent, expert inspector. Inspectors could be local city building inspectors, or a private third party, but there must be no conflicts of interest between inspector and installer. Both the inspector and the contractor should also be required to meet eligibility criteria and certification requirements.

Another means of providing confidence for a burgeoning clean energy industry is methodological guidance for contractors and inspectors to estimate energy savings for energy measures. The U.S. EPA and U.S. Department of Energy are contributing to a growing record of building and appliance energy efficiency best practices. A robust methodology will have several attributes:

- Savings estimates will take into account historical usage patterns for the building and/or building type.

- Calculations will be conservative to ensure that most customers will experience better than forecasted energy savings.

- For projects that do not meet forecasted energy savings, the contractor may be given the option of remedying installation and/or reducing project price so that debt service will be within program criteria.

Other features to protect lenders and consumers can be considered. For example, all investments can be fully pre-payable at any time by arrangement between the lender and utility. All investments will also be subject to standard consumer lending protection laws applied to the investment originator (e.g., bank or leasing company). Furthermore, the PUC or CEC might maintain a database of failed inspections and revoke program eligibility for a contractor with repeated failed inspections.

Providing for Long Term, Low Interest Rate Investments

To provide attractive investment terms, lenders must have confidence that borrowers have a strong incentive to repay their investments. If the capital for investments is seen as unsecured consumer debt, however, lenders will expect terms similar to credit cards (i.e., high rates of interest, short repayment schedules). Interest rates and other terms will reflect lender perception of risk.

OBR can minimize lending risks by making the repayment obligation a rate tariff on the meter, and by keeping that obligation with the meter in the event of change in occupancy or ownership. Without these features, lenders would see less benefit from using an OBR structure and the less attractive investment terms would result in lower demand for investment capital.

An OBR structure in which the repayment is a rate tariff on the meter will give confidence to lenders that these are investments of high quality—that they are likely to be repaid in full and on time. While delinquencies on credit cards and, recently, mortgages have been relatively high, utility bill defaults tend to be much lower. As such, lenders will view investments repaid via OBR as lower risk, and thus be willing to provide more attractive rates of interest.

A secondary element of lender confidence pertains to the treatment of partial payments. To the extent that customers pay only a portion of a utility bill that includes a clean energy investment repayment, the repayment should be proportionally allocated pro rata to the energy and loan line items. In the event of continual incomplete payment, the utility will follow all standard consumer protection processes for delinquent accounts prior to disconnection. As a means to further provide lender and consumer confidence, another source of funds could be used to establish a loan-loss reserve that serves as a safety net for consumers and lenders alike.

OBR can eliminate the concern that a current owner or occupant might not remain in the property long enough to personally recoup EE investments. A tariff on the meter that remains when ownership or occupancy changes will facilitate long-term repayment schedules. As such, monthly payments can be lower, and projects with payback periods that exceed the expected residency of the current occupant can be underwritten. This design feature also overcomes the "split incentive" faced by rental and multi-tenant properties, where the property owner is not motivated to make capital expenditures because the tenant(s) pays utility bill(s).

Affixing a long-term repayment to the meter would require disclosure and consent procedures at time of building sale or change of occupancy. These procedures will need to be developed and strongly enforced. The new owner/tenant should be provided with the original estimate of savings from the project as well as the terms of the remaining obligation. The debt obligation would be effectively assigned to the new buyer or tenant through the mechanism of a continuing rate tariff. Similarly, a rate tariff covering on-bill-repayment continues for a new owner after foreclosure. This is appropriate and equitable, since the new owner or tenant receives continued bill savings from the upgrades while paying remaining debt service.

Avoiding Indebtedness on Property

Many commercial buildings mortgages prohibit additional indebtedness. Even if additional investments were allowed contractually, they would be seen as subordinate to mortgages, and therefore would be considered unsecured from the perspective of lenders. Attaching the investment repayment obligation to the meter avoids placing additional debt on the property.

Appropriate Role and Compensation for Utilities

The OBR program can be integrated into existing energy efficiency programs. By providing investments at attractive terms, OBR should increase the cost-effectiveness of existing programs. Marketing efforts by contractors and lenders may also increase consumer awareness and market integration of EE measures.

The utility will provide a valuable billing service for the lender for which it should receive appropriate compensation. This could take the form of a monthly payment origination fee from the lender. The utility can also play a role in these areas: marketing; reporting program outcomes: contractor and project qualification; and inspection. Utilities can also collect and maintain a performance database of project outcomes, while aggregating data sufficiently to prevent sharing of confidential information. PUCs will consider whether to also collect information about changes in occupancy to enhance the value of the database. For utilities, interfacing with a large number of lenders might be seen as burdensome and administratively costly. If so, a transaction processing company could provide a single interface for all utilities. This would allow each bank to also have a single point of interface. The transaction processing company would be paid for by the lenders.

Enabling an Innovative Marketplace

The goal of OBR is to facilitate a robust, competitive marketplace for underwriting building energy efficiency investments. This suggests a programmatic objective of creating an open, competitive marketplace that allows various business models to develop attractive solutions to meet a variety of customer needs. For example, insurance products could be developed that guarantee project performance for a fee. A variety of contractual arrangements could be embraced, as well as many different contractor-lender business models. These creations should be allowed to flourish while ensuring that relevant stakeholders are protected.

Conclusion: EDF's On-Bill Repayment Proposal

An on-bill repayment program allows building owners to repay loans for eligible energy efficiency and renewable electricity generation projects through their monthly utility bills. The investments are underwritten and financed by private, third-party capital providers, such as banks and credit unions, while utilities provide a billing service. The program creates a marketplace for clean energy lending, allowing contractors to provide customers with an integrated package of building upgrades and financing.

An OBR program can mobilize billions of dollars in private capital for EE investments in existing buildings, thereby avoiding millions of tons of greenhouse gas emissions while providing consumers net economic savings. A well-designed OBR would have these key features:

- Savings Matched with Costs: Customers will pay a single monthly bill for both energy and loan payments that together are lower than previous utility bills.

- Obligation Tied to Meter: Loan repayment is a tariff that stays with the meter to enable upgrades with long payback periods without worrying about sale or change in tenant.
- Lower rates and Better Terms—Default (i.e., nonpayment) rates on utility bills tend to be far lower than for other debts, such as mortgages and credit card balances. Utilizing this attribute for EE loans will attract capital with substantially lower interest rates, longer maturities and better terms.

- Flexibility: OBR can be designed to provide financing for commercial, public and residential buildings including multi-family rental buildings. Additionally, OBR will significantly improve the credit quality of a wide variety of financing mechanisms including loans, leases, Energy Services Agreements ("ESAs") and Power Purchase Agreements ("PPAs").

We find that OBR has significant promise as innovative approach to connect private capital to previously underserved residents and businesses in the New York metropolitan region and that, for various yet different reasons, each state is well positioned to lead the evolution from on-bill financing to on-bill repayment.

While the States in the New York metropolitan region have state-level renewable energy and energy efficiency goals, and on-bill programs, there remain disconnects between the aspiration of the state goals, available sources of financing, and economic opportunity. OBR has the potential to align investors and funds at the scales needed to achieve and even exceed goals on the books today.

Appendix A: Benefits Estimation Methodology for Energy Efficiency

This appendix describes how EDF arrived at an estimate of the benefits of OBR with respect to additional investment in energy efficiency. We translate OBR-enabled investments into benefits measured in terms of dollars of investment, job creation, avoided electricity consumption, avoided consumer spending on energy and avoided greenhouse gas pollution.

Economic Potential of Energy Efficiency in the U.S.

We obtain our underlying data for the potential of energy efficiency projects from McKinsey & Co.'s 2009 report "Unlocking Energy Efficiency in the U.S. Economy" (Granade 2009). In its study, McKinsey & Co. estimates the energy savings and emissions reductions from energy efficiency improvements in fourteen subsectors, and aggregates them into four broad economic sectors: residential, commercial, industrial, and combined heat and power (CHP).

For the residential and commercial sectors, as well as CHP, we assume that energy efficiency improvements identified by McKinsey & Co. can be attained through OBR, while for the industrial sector, we assume that only the reductions under the "buildings" category within the "energy support systems" cluster can be attained. The other energy efficiency improvements deemed not applicable to OBR in the industrial sector include those from steam systems, motor systems, and energy-intensive and non-energy-intensive industry processes.

Energy Efficiency Potential in the Tri-State Region

To obtain the corresponding figures for the tri-state region containing the 31 counties of the New York metropolitan region, we scale down the national data from the McKinsey analysis using energy consumption data.

For the residential sector, we use data from the Renewable Energy Consumption Survey (RECS). For the "existing non-low-income homes" and "existing low-income homes" clusters, we define low-income homes as those with incomes at or below 150percent of the poverty line and scale the respective data from each cluster down by the share of each type of home located in the tri-state area containing the RPA counties. To analyze benefits at the level of individual states, we scale down national data by the share of electricity consumption for home appliances and lighting in the region for the "electrical devices and small appliances" cluster, and by the share of electricity consumption for space heating, air conditioning, water heating, home appliances and lighting for the "lighting and major appliances" cluster.

For the commercial sector, we use data from the Commercial Building Energy Consumption Survey (CBECS). Since state-level energy consumption data is not readily available, we calculate the share of energy consumption in the tri-state area encompassing the metro region's counties by multiplying the energy intensity per square foot by the square footage of each building type, except for the "community infrastructure" cluster. Since data is not readily available for this last cluster, which includes outdoor lighting, water services, and telecom infrastructure, we approximate the share attributable to the tri-state's share of national population.

Since projections for residential and commercial construction are not available at the state level, we approximate the share of "new homes" and "new private buildings" as the share of national population growth through 2020 that occurs in the study region, using data from the Census Bureau.

For the industrial sector, the McKinsey analysis also gives data to the industry level, including cement, iron and steel, refining, pulp and paper, and chemicals. We use data from the Manufacturing Energy Consumption Survey (MECS) to scale down each of these using the share of energy consumption in these industries that takes place in the region.

The McKinsey analysis attributes the CHP potential to the industrial and commercial sectors. We use the sectoral and census-region-level geographical breakdown of CHP potential given in the McKinsey report, and scale these down using the respective shares of industrial and commercial electricity consumption in the East Census Region.

We translate the expected energy savings into cost savings using a projected average electricity rate. Since the McKinsey analysis assumes no change in national system-wide emissions intensity between 2008 and 2020, we scale down the region's annual emission reduction figures in proportion to the state's emissions intensity pathway through 2020.

Why isn't Energy Efficiency Embraced if it Pays for Itself Many Times Over?

McKinsey's study estimates the economic potential of energy efficiency, i.e. what makes economic sense, but did not quantify the market barriers such as low consumer awareness, access to capital, and transaction costs. That energy efficiency projects are NPV-positive but are not undertaken points clearly to the significant magnitude of these barriers faced by households and firms.

OBR addresses at least three of these major barriers. First, OBR lowers the barrier of access to capital by obtaining lower-than-market loan rates for ratepayers planning to undertake energy efficiency projects. This is particularly important for small-medium-enterprises and low-income households, which have less access to capital and credit. By facilitating loan repayments to be made directly from electricity bills, OBR reduces investors' exposure to default risk. Investors then become more willing to lend to customers they otherwise would not give a loan to, specifically for energy efficiency upgrades. In our analysis, we capture this direct effect by calculating the incremental emission reductions and cost savings from the estimated lower loan rate OBR could obtain from investors as compared to the usual market rate.

Second, OBR reduces transaction costs. We simplify our analysis by treating all barriers other than access to capital as a collective cost, which we refer to as transaction costs. The marketing effect from promoting OBR reduces the barrier of low consumer awareness on two levels—by bringing to their attention the potential savings from energy efficiency, and by highlighting OBR as a convenient practical measure of reaping these savings. OBR also lowers search costs for consumers and third party financiers as described in Chapter 2A. The magnitude of transaction costs is a key input to the model that directly drives our results. Hence, we were careful in selecting what we analyze to be reasonable cost values, approximating the range of the limited empirical literature available. We use higher cost values for the residential sector than the commercial and industrial sectors, which benefit from economies of scale and are more likely to have business relations with equipment suppliers.

Comparing the Returns and Capital Costs of Investment

We use the McKinsey & Co. figures to estimate the internal rate of return (IRR) for the energy efficiency projects in each subsector. The IRR tells us the return of a project in percentage terms, much like how we would think of the returns from holding an equity share or bond when deciding whether to invest in these instruments. Energy efficiency projects typically require ratepayers to invest a high upfront cost. Large projects might require loan financing to be feasible, especially for firms that need to consider their cash flow. The IRR allows us to compare the return from investing in energy efficiency to its financing cost, i.e. the cost of capital or market loan rate. A project that has an IRR higher than the cost of capital is a worthwhile investment. Because OBR directly lowers the cost of capital for energy efficiency improvement projects, we can evaluate the amount of energy efficiency potential that can be realistically captured with and without OBR by comparing the respective loan rates against the project IRRs. Projects with IRRs at least equal to the OBR loan rate but lower than the market rate make financial sense only if OBR is available. We then sum the relevant metrics of these projects, to obtain OBR's total impact.

To obtain the implied IRRs from McKinsey & Co.'s aggregate estimates for upfront investment and savings, we need to make assumptions about the timing of the projected investments; the timing of projected savings follows accordingly. We use two scenarios with different assumptions of when the McKinsey study expects investments in energy efficient capital to be made. The first scenario assumes that all investment occurs in the first year, the second assumes that investments decline linearly. The rationale for these two scenarios is as such: since McKinsey estimates the economic potential of energy efficiency using a bottom-up approach, most of the "backlog" of upgrades that should have already occurred, but have not, would be calculated as taking place in the first year of the analysis. The investment in reality is thus likely to lie somewhere between the parameters of the two scenarios. Since investments in later years are discounted, the first scenario produces lower IRR estimates than the second scenario. Under the two scenarios, we obtain two point estimates for the IRRs of energy efficiency investments for each subsector in the economy. In reality, upgrade projects in each subsector vary widely, as do their returns. To represent this variation, we further assume that project IRRs are normally distributed around the point estimates, which we take to be the mean, with a standard variation of 2 percentage points. In other words, we think that the normal distribution is a good approximation of the profile of IRRs in a particular subsector, i.e. most (38 percent) of upgrades in a subsector yield IRRs of 1 percentage point higher or lower than the mean, another large proportion of upgrades (30 percent) yield IRRs of 2 percentage points higher or lower than the mean, and very few types of upgrades give very high or very low returns.

Deployment Rate

To project OBR's impact over time more realistically, we assume that program uptake will increase linearly. Our estimate assumes that the entire potential estimated in McKinsey & Co.'s study and profitable due to OBR financing will be employed within a twelve year period, the duration studied in the McKinsey & Co. analysis (2009–2020).

Potential Impact on New Jobs

We calculate the potential impact of OBR on job creation using industry-specific ratios on the average revenue per employee as reported by the 2002 Economic Census, adjusting for inflation. We apply these to the present value of upfront investment in each energy efficiency improvement category as identified by McKinsey & Co.

Limitations

Certain aspects of consumer borrowing behavior are not captured in this analysis. For instance, we might observe a discontinuity in the loan rate to total loan value function at the 10 percent rate, i.e. the incremental increase in consumers willing to take up a loan when the borrowing rate is lowered from 10 percent to 9.9 percent is likely to be much larger than when the rate is lowered from 10.1 percent to 10.0 percent, and from 9.9 percent to 9.8 percent. Neither does this analysis take into consideration the rebound effect, i.e. the increase in energy consumed when improved energy efficiency reduces a consumer's total energy expenditure.

Appendix B. Benefits Estimation Methodology for Distributed Generation

This appendix describes how EDF arrived at an estimate of the benefits of OBR with respect to additional investment in distributed generation, such as rooftop PV on commercial and residential rooftops.

We translate OBR-enabled investments into benefits measured in terms of dollars of investment, job generation, and generation capacity installed. avoided (for EE) and created (for distributed generation). For EE, we further estimate avoided consumer spending on energy and avoided greenhouse gas pollution.

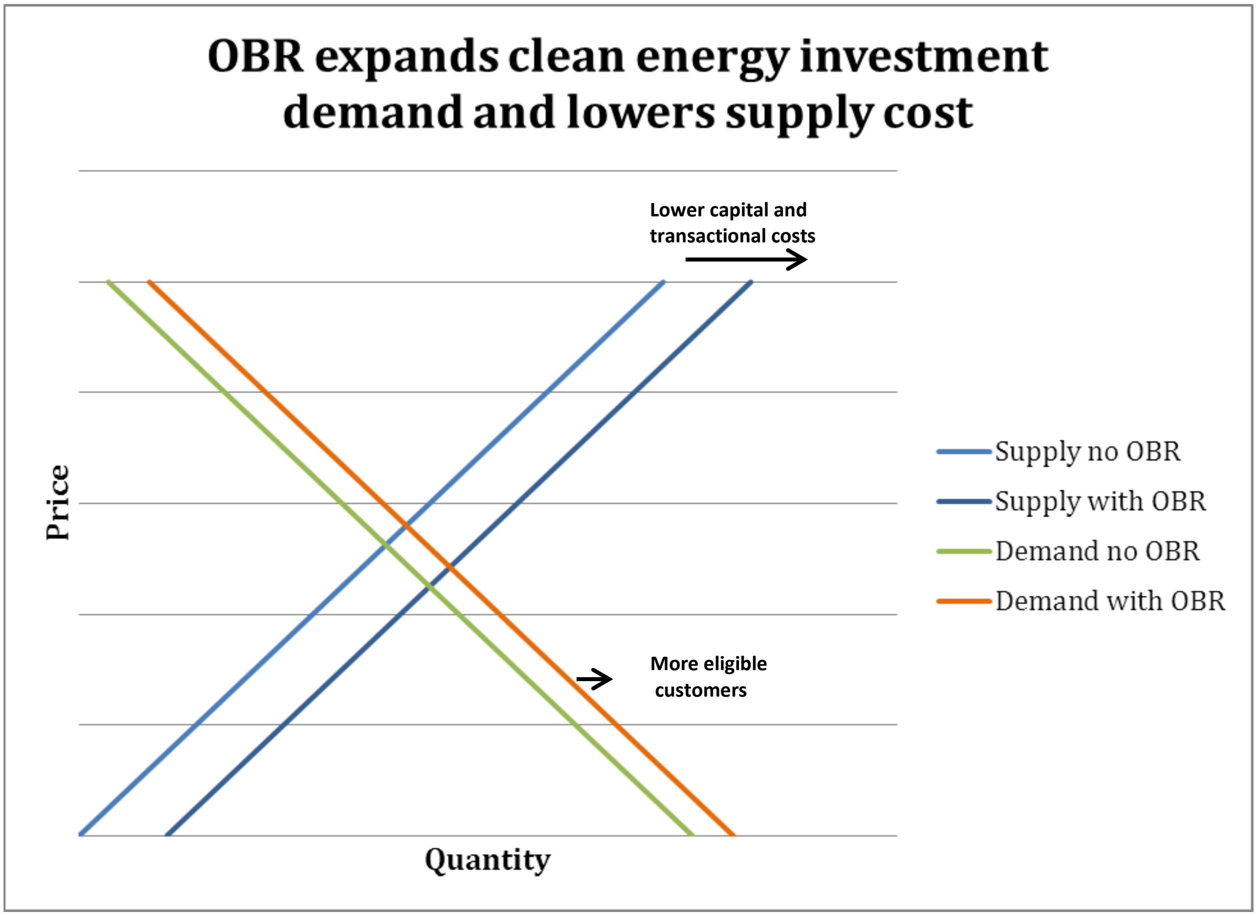
Distributed Generation — Rooftop Solar

For calculating distributed generation investments made economically feasible by OBR, we begin with the goals of the program:

- OBR can expand the pool of eligible customers.
- OBR can lower the cost of financing a DG investment
- OBR can inspire turn-key consumer product offerings that dramatically reduce the transactional costs of marketing and customer acquisition

OBR has the potential to make more projects economically viable for more customers by lowering the cost of capital (i.e., loan interest rate) and expanding the pool of eligible borrowers. These OBR consequences are shown in the theoretical graph of supply and demand. When these shifts occur, the equilibrium between supply and demand will involve more quantity of product.

Figure B-F1: OBR Expands Demand & Supply for Clean Energy Investments



Using real marketplace observations of historical investments in rooftop PV—California's Solar Initiative data—and forecasts of declining costs, we can tease out the additional investments to be spurred by OBR. That is, we estimate how cost reductions attributable to OBR would incrementally increase DG investments using historical demand data, while adjusting for recently observed and expected cost declines. We base our analysis on the robust dataset of rooftop solar (PV, photovoltaic) projects in California.

Although we develop a bounded estimate for the value of OBR in the rooftop solar industry, it is an incomplete and thus conservative estimate of the potential value of OBR in spurring more DG investment. We do not consider how more attractive OBR might spur other types of DG, including storage, demand response and DG co-located with electric vehicles.

To estimate how OBR will increase DG investment, we develop a bounded estimate by studying historical demand and forecasted costs. Furthermore, we consider evidence in the context of traditional new technology market penetration rates.

Rooftop PV Costs are Declining While Demand is Rising

Using California Solar Incentive data for residential and small commercial rooftop PV, we derive a demand curve observed from 2007 through 2011. It reveals increasing demand for each price bin in each successive year, even as the CSI subsidy amount has declined dramatically. Initially at $2.50 per watt, the CSI subsidy has dropped to $0.20, a 92 percent decline. While the overall project financing does benefit from a persistent federal tax credit, demand for rooftop PV has grown robustly while subsidies have production costs and subsidies have declined.

We identify relationship between growth in commercial and residential rooftop PV project applications to the California Solar Initiative program and production cost trends; extrapolate past relationships to structural financing costs enabled by OBR. (Essentially, this is an analysis of first derivatives: how much does change in demand change as a function of change in cost?). To represent OBR—and associated uncertainty inherent in this broad brush approach—we represent OBR as reducing both lending costs (interest rates paid on the investments) and transactional costs (marketing and customer acquisition).

1. DG Supply Estimates: We examine other estimates of localized DG and reanalyze potential using cost enhancements of OBR.

2. Traditional technology market penetration rates and the potential for OBR to improve the rate of market penetration of rooftop PV.

For the cost-demand relationship, we examine how demand for rooftop solar electricity has grown as costs have declined. Then we extrapolate growth for various assumptions about how OBR lowers project costs. Finally, we overlay recent experience with DG growth rates against a traditional curve for new technology market penetration to forecast penetration levels in the future.

Cost-Demand Relationship

We seek to understand the cost trajectory for installed rooftop PV so that we can estimate how OBR might spur more projects by affecting costs. We study California's small residential and commercial rooftop PV projects (by number and total project value) over the past five years to understand demand and cost trends. As well we identified cost components for PV projects.

It is logical to bound the potential benefits of OBR for DG investments by isolating a portion of DG potential that becomes viable only with OBR. This is the approach we use to estimate OBR benefits in the context of energy efficiency investments. For EE, however, we have McKinsey & Company estimates of EE potential (See Appendix A).

While many factors influence the realization of an installed project, there remains a fundamental relationship between supply cost and customer demand. We don't claim a direct causal link between cost and demand in this context due to many other factors. It is nevertheless illustrative to estimate the potential benefits of OBR by asking: how might demand grow incrementally as a consequence of an incremental decline in cost?

Figure B-F2 shows cost trends reported by Lawrence Berkeley Laboratory and the California Solar Initiative, as well as a cost forecast from Black and Veatch. Clearly, costs are on the decline and are forecasted to drop significantly in the coming decades. We also show the US Dept of Energy's Sunshot program goal for rooftop PV: $1 per watt in total, with half in soft costs. OBR could significantly help to meet the goals of the Sunshot program.

Figure B-F3 begins with cost components estimated by the US Dept of Energy's Sunshot Program and then shows how OBR might reduce them. In EDF's judgment, OBR scenario considers a one-third reduction in costs of financing and customer acquisition/marketing. Shown in the bar charts is how OBR has the potential to reduce both transactional and financing costs. In this respect, OBR can make a significant contribution toward meeting Sunshot goals for residential rooftop solar PV.

Soft project costs in year 2010 were estimated to be $2.50 per watt and $2.00 per watt for residential and small commercial rooftop PV; where hard costs are approximately twice soft costs, the total project range is $6 to $8 per installed watt of rooftop PV. OBR has the potential to reduce soft costs of customer acquisition and financing through scaling and partnership with service providers (e.g., building contractors, rooftop PV installers). At a one-third soft cost savings, total project costs could decline in the range of $0.50 to $1.00. This could represent a 20 percent project cost decline as other cost components fall too. In developing scenarios for low and high benefits from OBR, we consider soft cost declines of $0.50 per installed watt and $1.00 per installed watt, respectively.

Figure F-B4 is the demand curve for rooftop solar PV in California. It plots the number of projects (n ~ 65,000) at each price point between 2007 and the end of 2011. (This is a cumulative histogram with $0.25 bins plotted horizontally to look like a demand curve.). These two figures show the large and growing demand for rooftop PV in California. Most forecasts show consistent exponential growth through 2020.

Figure B-F2: Cost Trends for Residential Rooftop Solar PV

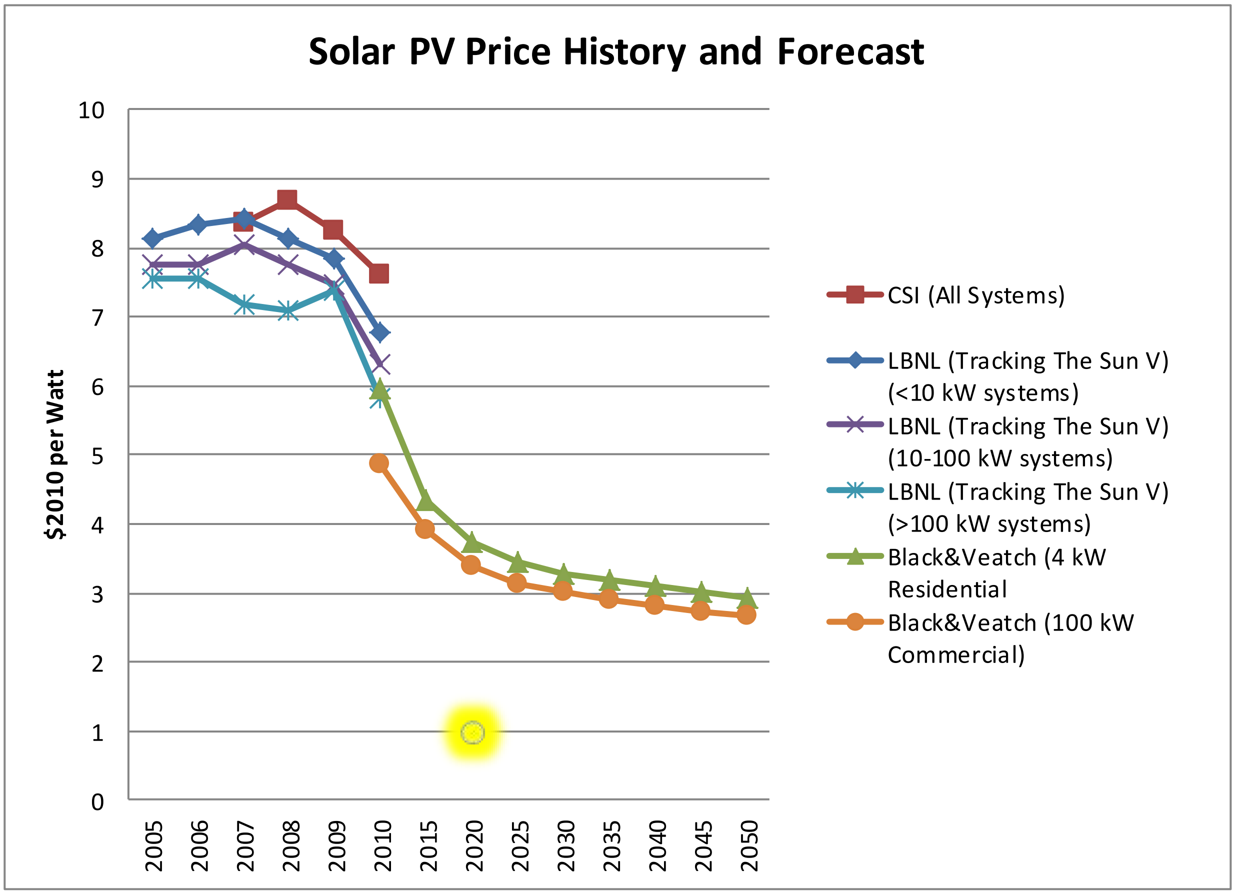


Figure B-F3: Cost Components for Rooftop Solar PV

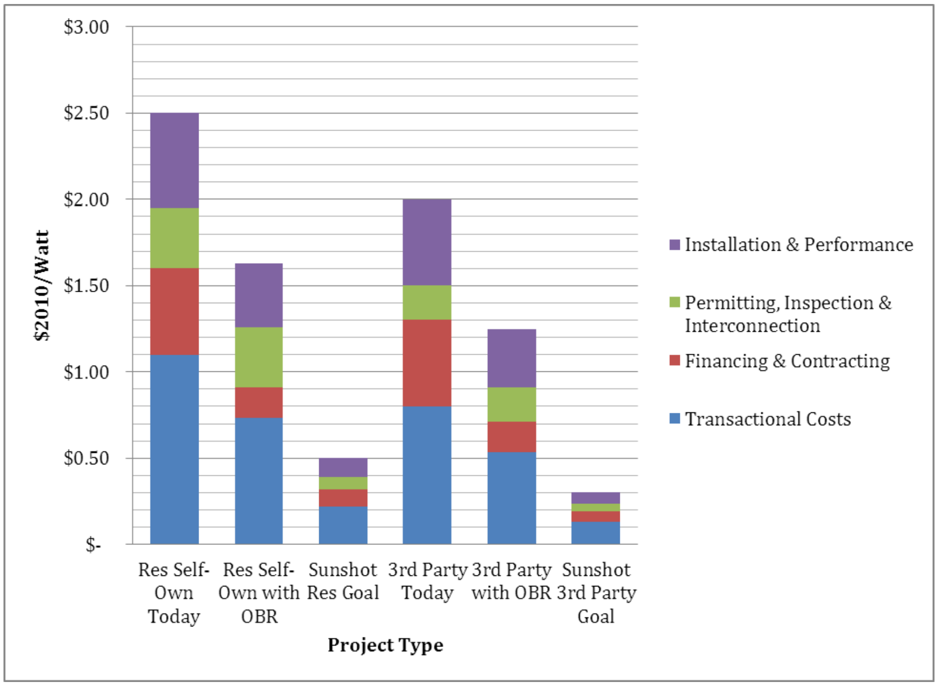
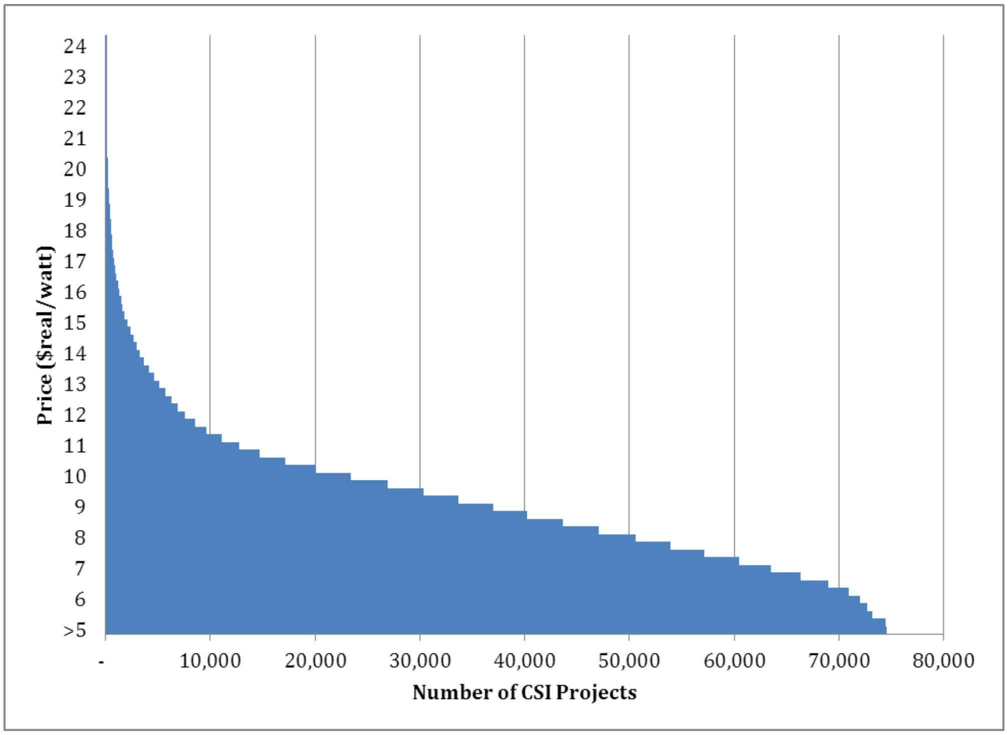


Figure B-F4: Aggregate California Rooftop PV Demand, 2007–2011, Residential and Small Scale (< 10 kW capacity) Commercial (Based on number of projects reported in California CSI database.)

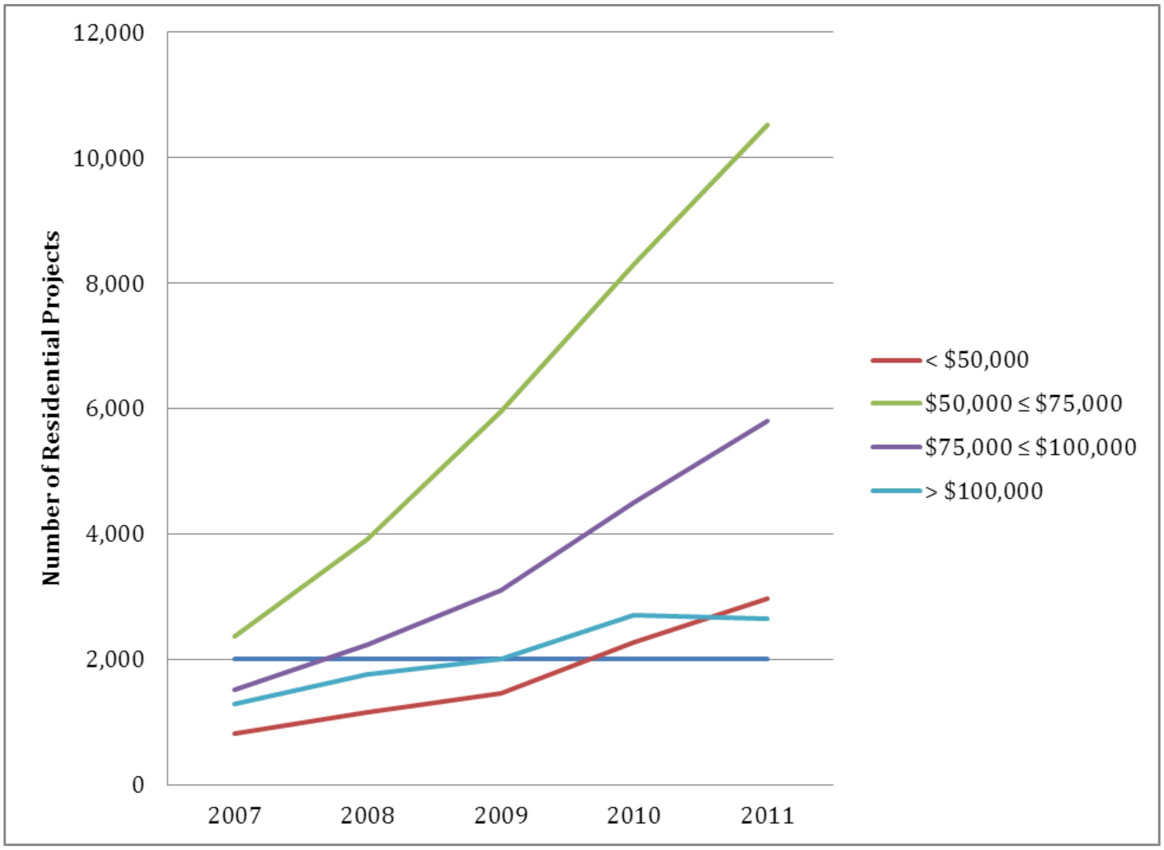


The CSI program has a goal of 2 GW of installed rooftop PV by 2016. In 2011 the CSI program will be halfway toward the goal, with over 1 GW installed capacity across over 100,000 sites.

Between $6 per watt and $11 per watt there is a fairly consistent slope in the aggregate demand graph. Based on this relationship, we can predict a change in demand when price changes; essentially, for each $1 per watt price decline, demand increases by 15,000 projects for the period 2007 through 2012. For example, there were 23,000 projects at or above $10 per watt and an additional 15,000 projects between $10 per watt and $9 per watt.

Figure B-F5 shows the number of CSI projects over time by household income category; clearly, there is an upward trend in all homes. However, CSI applications for year 2012 show a slight cooling from the growth trends of prior years.

Figure B-F5: California Residential PV Projects, CSI Program, 2007–2011, by Household Income



Bounded Estimate of OBR-Enabled Rooftop Solar

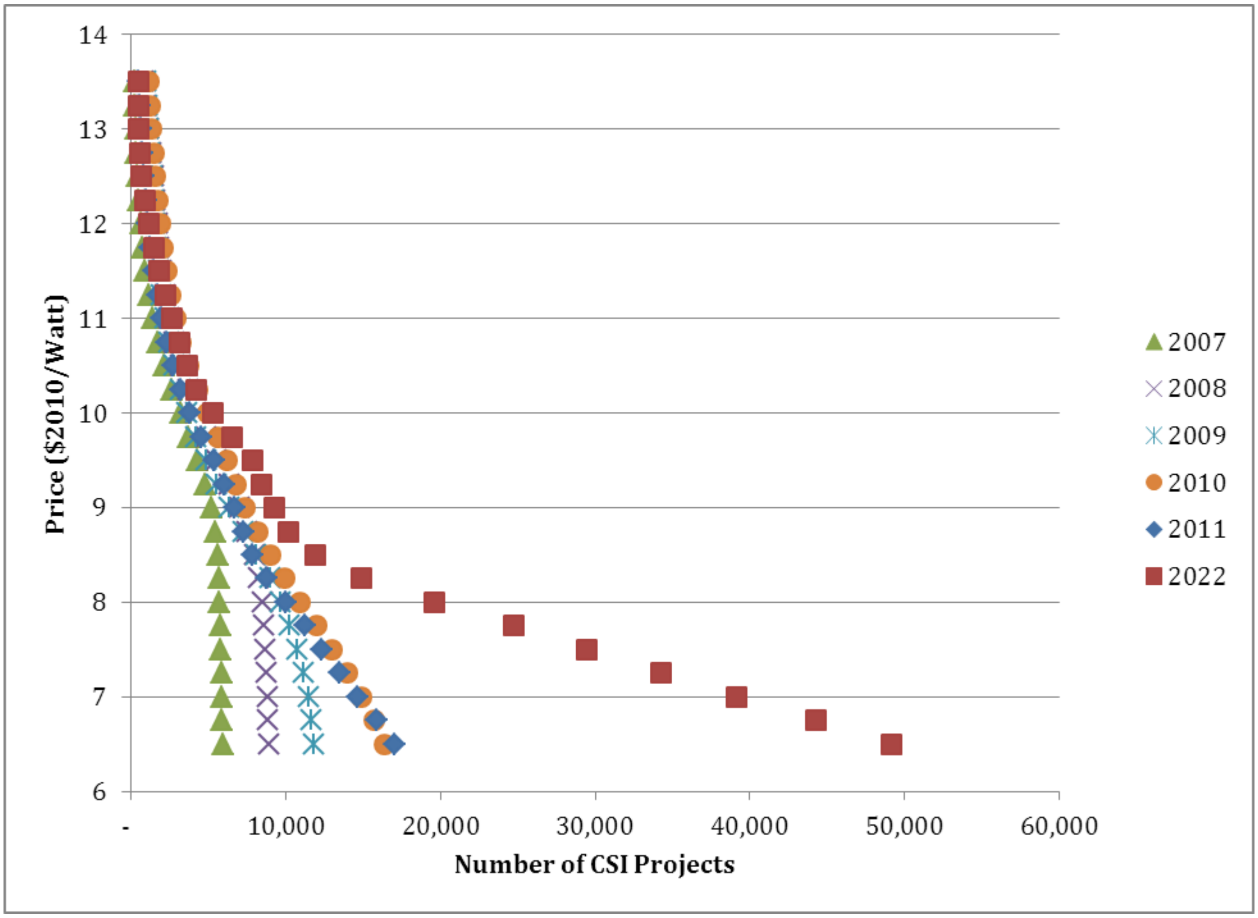
Having now described cost components and recent trends in the rooftop PV investment, we are ready to calculate a bounded estimate of the potential benefits of OBR for rooftop PV investments. We begin with a demand trajectory through 2022, approximately one decade into the future, and explore how OBR creates additional demand by lowering credit score requirements. Second, we consider the downward trend in costs, and explore how OBR further shifts costs downward to spur additional projects. This is consciously a "marginal analysis" to explore how much extra rooftop PV investment OBR can deliver in the face of current trends.

<u>Supply Side OBR-Benefits for Rooftop PV</u>

Figure B-F6 shows forecasted California demand for small commercial and residential rooftop PV projects in 2022 based on trends from 2007 through 2011. In the prior section, we used DOE Sunshot data to estimate that OBR could lower project soft costs (financing, marketing and other transactional costs) in the range of $0.50 per watt to $1.00 per watt. This would have the effect of making future projects more attractive, and making some projects attractive that otherwise would be noneconomic to execute. This OBR-related cost decline can be seen as capturing a new set of projects. Essentially, this is a short-hand, transparent approach to considering a full shift in the cost curve as shown conceptually in Figure B-F1.

At a $0.50/watt cost decline, we estimate approximately 23,000 additional rooftop PV projects enabled by OBR. At a $1/watt cost savings, PV projects due to OBR ticks up to 75,000.

Figure B-F6: Extrapolated CSI Demand for 2022 based on 2007–2011 Trends.



Demand Side OBR-Benefits for Rooftop PV

Figure B-F7 shows that approximately 25percent of homes have FICO credit scores between 600 and 700. In hearing from lenders, EDF believes OBR can expand the pool of eligible borrowers to include homes with FICO scores below 650. We bound our estimate of OBR-enabled demand increases by considering the expansion of eligible homes. At a low end of the range, we consider just a 15percent expansion of eligible homes, and a high scenario as a 25percent demand increase.

There were 11.5 million, 12.2 million and 12.6 million households in California in 2000, 2009 and 2011, respectively (U.S. Census)[6]. This represents an annual growth rate of approximately

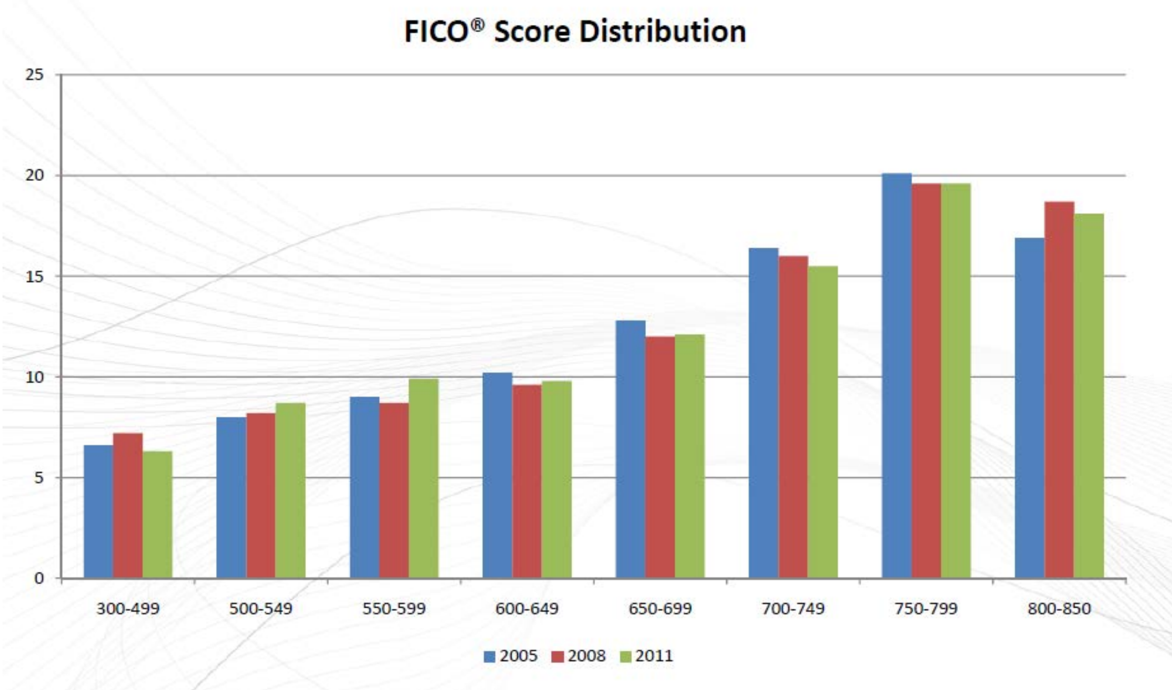
[6] U.S. Census.

6.5percent per year. If this trend continues, California will experience a doubling of households in the next decade.

It is reasonable to envision a second reason for expanding rooftop PV projects due to OBR, that due to additional customers. An addition of 15percent of California homes with access to rooftop PV financing due to OBR equals almost 2 million homes today and over 3.5 million homes in 2022.

Approximately 6 million California households have FICO scores above 700, a pool of homes that has dominated demand for rooftop PV. Expanding the population of loan-worthy homes by 2 million (low scenario) to 3.5 million (high scenario) will increase the pool of potential rooftop PV customers up to 60percent. To be conservative, EDF's low scenario considers a 15percent demand increase, whereas the high scenario considers a 25percent increase.

Figure B-F7. Distribution of FICO scores as proportion of U.S. households.



Low and High Scenarios for OBR-Benefits

We develop two scenarios to forecast the uptick in rooftop PV projects due to OBR. In addition to adding demand (by expanding eligibility to borrowers with lower FICO scores) and shifting costs downward, we develop a bounded forecast. The low scenario assumes flat (zero) growth in rooftop installations such that investments continue at levels observed in 2012. The high scenario has growth continuing on the trend established from 2007 through 2012.
We find a range of 70,000 to 170,000 new rooftop PV projects between 2013 and 2022 as a result of OBR effects.

What would 60,000 or 170,000 new rooftop PV projects mean for California's economy and environment over the next decade? A 2009 study estimated that PV projects generate 42 jobs per installed MW nowadays, but that employment intensity will drop to 19 jobs per installed MW in 2025 (Friedman 2009). We consider 30 jobs per installed MW of solar PV in our analysis. Results are summarized in Table B.T1.

Table B.T1. Estimate of OBR Benefits for Rooftop PV in California

Benefit Scenario	**Low**	**High**
Rooftop PV Industry Growth	Flat at 2011 thru 2022	Trend from 2007 thru 2011 continues thru 2022
Cost Decline due to OBR	-$0.50	-$1.00
Demand Increase due to OBR	15%	25%
Number of OBR-Enabled Projects, 2013 through 2022	**59,000**	**169,000**
Rooftop PV Project Size (kW)	4.11	4.11
Total Cost ($/watt)	$3.25	$2.75
$2012 Invested, all projects	$788,000,000	$1,910,000,000
New Installed PV Capacity (MW)	200	700
Annual Generation from Installed PV (GWh)	300	1,050
Job per Installed PV Capacity (jobs per MW)	30	30
Job Generation (Job-years)	6,000	21,000

As a secondary effect, OBR can avoid costly electricity generation and infrastructure costs and can eventually contribute to economies of scale, notably lowered marginal costs of production. Of course, by avoided electricity generation, OBR avoids air pollution from conventional generation resources.

Limitations of Benefit Estimation Method

OBR is a way to finance a variety of benefits; we've captured only rooftop PV in our estimate for DG benefits. Our estimate of rooftop PV projects enabled by OBR is a conservative approach for several reasons:

- We consider only rooftop PV, not the solar thermal or other localized DG markets

- We exclude significant opportunities to harvest OBR-enabled benefits from combined heat and power, electric vehicles and other forms of storage, and demand response.

- We study only 2014 thru 2022, benefits may accrue for many decades thereafter

- Our assumptions are conservative whenever a range is not used, such as jobs per installed PV capacity.

The forecasts for PV industry growth suggest a very dynamic marketplace. Any attempt at precise prediction is folly. We remain grounded in a diversity of peer-reviewed forecasts, and direct observation from California's rooftop PV industry. Still, the future is certain to be different—production cost will decline, policy will constrain and spur innovation, and customers will procrastinate and react, often in illogical crowd-following ways. New technologies will pair with new business models, any one pairing might be a game-changer, just as the rooftop leasing model has changed the game in California in a few short years.

Investments in cost-saving efficiency and distributed generation can be sweetened. For example, demand response—by short term load shifting when called upon to provide system-wide peak load mitigation or to provide ancillary services—can be integrated with variable energy resources like rooftop PV. These combinations, and the role of OBR in financing them, remain largely unexplored.

The market for demand response (DR) is already robust in many parts of the country. California utilities are counting on increasingly large amounts of DR resources from residential, commercial and industrial customer (PG&E Co. 2012). While we do not attempt to quantify how OBR can deliver addition benefits through demand response, such benefits have the potential to be real and significant.

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