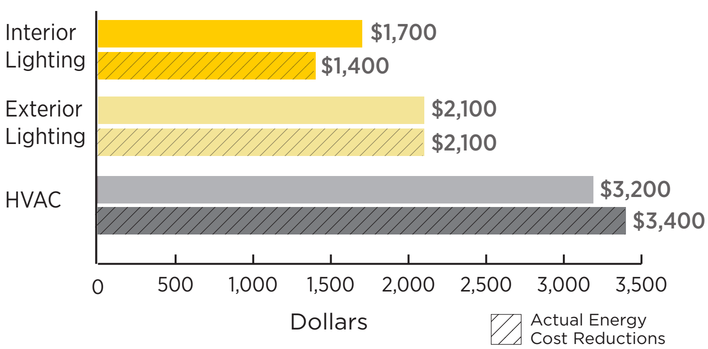
Banking on Energy Efficiency

Bank of America partnered with the Department of Energy (DOE) to develop and implement solutions to build new, low-energy buildings that are at least 50% below Standard 90.1-2004 of the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE), the American National Standards Institute (ANSI), and the Illuminating Engineering Society of North America (IESNA) as part of DOE's Commercial Building Partnerships (CBP) Program.[1] Pacific Northwest National Laboratory provided technical expertise in support of this DOE program.

Bank of America—one of the world's largest financial institutions, serving approximately 53 million consumer and small business relationships with approximately 5,500 retail banking offices and approximately 16,300 ATMs and award-winning online banking with 30 million active users—teamed with DOE to improve market adoption of current energy-saving technologies and produce real-building design solutions. Through the DOE CBP Program, Bank of America and DOE identified energy-saving measures at a new bank branch in Punta Gorda, Florida. Modeling indicated these improvements would reduce costs and provide energy savings of 48% compared to a building constructed at an ASHRAE 90.1-2004 level, with an energy utility cost reduction of approximately $5,400 per year.

The new Charlotte Commons bank branch is one of the lowest energy usage branches in the Bank of America portfolio. The site achieved this status in part from innovative lighting for the bank interior and exterior that used light-emitting diodes (LEDs). The only traditional lighting (T12-HO) in the project was the monument sign. Bank of America is embarking on an in-depth study of LED lighting for all signage.

Energy Cost Reductions



[1] The Commercial Building Partnerships (CBP) Program is a public/private, cost-shared initiative that demonstrates cost-effective, replicable ways to achieve dramatic energy savings in commercial buildings. Through the program, companies and organizations, selected through a competitive process, team with U.S. Department of Energy (DOE) and national laboratory staff who provide technical expertise to explore energy-saving ideas and strategies that are applied to specific building project(s) and that can be replicated across the market.

[2] Average energy cost of $0.103 from similar bank branch bills used to calculate reduced costs.

[3] Greenhouse Gas Equivalencies Calculator: http://www.epa.gov/cleanenergy/energy-resources/calculator.html.

The Charlotte Commons bank branch is expected to be 48% more energy efficient than a minimally compliant branch built to an ASHRAE 90.1-2004 baseline and is projected to be one of the most energy efficient of Bank of America's branches

Project Type	Bank Branch, New Construction
Climate Zone	ASHRAE Zone 2A, Hot-Humid
Ownership	Owner Occupied
Barriers Addressed	• Exterior lighting measures must be balanced with safety and security requirements for bank customers and employees • Incorporating maintenance savings from energy measures into energy calculations provides a better financial analysis but requires detailed operations information
Square Footage of Project	4,200
Expected Energy Savings versus Prototype	35%
Expected/Actual Energy Savings (versus ASHRAE 90.1-2004)	48% / 47%
Expected Energy Savings	68,000 kilowatt-hour (kWh)/year
Verified Energy Savings	67,000 kWh/year
Expected/Actual Cost Reductions (versus ASHRAE 90.1-2004)	$7,000/year[2] / $6,900/year
Project Simple Payback	Initial estimate 5 years Final project costs not available
Estimated Avoided Carbon Dioxide Emissions	Approximately 47 metric tons/year[3]
Construction Completion Date	October 2011

When the CBP project began, the design team initiated a metering and monitoring effort at an existing bank branch of similar size to the planned Charlotte Commons branch and built to the existing branch prototype, with three primary goals:

- Understand the breakdown of energy usage in an existing bank branch—particularly for plug loads including computers, data servers, automated teller machines (ATMs) and other electrical equipment.
- Identify opportunities for energy savings that could be applied to equipment and operations at new and existing bank branches.
- Support the calibration of the new building energy model for the Charlotte Commons branch.

This careful monitoring work led to a well calibrated model. Energy bills averaged 2% below modeled energy consumption in March through June 2012 after some corrections to building operations were made.

Decision Criteria

At Bank of America, the business case for energy measures was evaluated carefully as energy efficiency measures (EEMs) needed to balance safety, security, cost, and energy. The CBP team prepared internal rate of return (IRR) and simple payback estimates for each EEM and for the total project as a package.

Economic

The business case for energy efficiency at Bank of America is based on the following factors:

- New measures would ideally have a simple payback of less than 3 years, although 5 years would be considered in some cases if the IRR was competitive with other internal bank projects.
- In general, projects need to have an equivalent or lower capital cost. For projects like this, creative trade-offs with other building components may be possible. Reduced LED lighting product prices helped reduce capital costs.

EEMs were ranked on simple payback and the IRR. The initial EEM package provided a simple payback of 5 years and 10-year IRR of 16%. The final project costs are not available so these figures were not updated.

Some lessons learned on this project included how to use better information to evaluate measures on future projects. For example, the detailed metering performed on the prototype branch indicated the plug loads were lower than those typically assumed in the design of the mechanical system for the branches. This allowed the design team to reduce the capacity or quantity of heating, ventilation, and air conditioning (HVAC) units, which reduced costs and enabled the team to purchase more efficient units and high-performance lighting.

Operational

Bank of America's approach to improving energy efficiency relies on data and proven cost effectiveness. The bank has a process of searching for hidden energy and cost improvements: utility metering information is collected from bank branches over time and analyzed to identify improvements that could save energy and reduce costs.

The Bank of America team considered a business case that accounted for lifetime maintenance costs. In this project, the exterior lighting is a good example—the new LED fixtures provided significant energy savings, but also had a much longer life. In addition to energy savings, reduced energy costs came from less frequent visits from a maintenance crew to replace the lamps.

Banks are different from many other institutions in that security is a major concern. ATMs, or money access centers, need to be available to the general public 24 hours per day. Therefore, banks often have stringent requirements for exterior lighting related to the ATMs. The building design reduced the exterior lighting installed power by 4 kW for an energy savings of nearly 50% compared to ASHRAE 90.1-2004 while providing the necessary illumination for safety and security.

Policy

For more than 20 years, Bank of America has worked toward more energy efficient operations throughout its network of banking centers, reducing costs by millions of dollars and dramatically reducing its emissions, consumption, and waste in the process.

Bank of America has implemented the following operating measures:

- Forged innovative partnerships with governmental and nongovernmental organizations to conserve natural resources while making communities more energy efficient and environmentally responsible.
- Completed and exceeded the company's 10-year, $20 billion environmental business initiative—deploying $21.6 billion at the end of 2012, more than 4 years ahead of schedule.
- Announced significant, new internal goals to reduce the environmental impact of its own operations:
  - 25% reduction in energy consumption from 2004—equal to eliminating 1.2 million megawatt hours of annual energy use from its portfolio
  - 20% reduction in paper consumption (2010 baseline)
  - 20% reduction in global water consumption (2010 baseline)
  - 70% diversion of global waste from landfill.
- Commenced a 10-year, $50 billion environmental business initiative in January 2013 to address climate change and demands on natural resources, while helping to advance lower-carbon economic solutions.
- Offered retail customers several environmentally friendly products and services and provided incentives to encourage paper-saving online banking.

Energy Efficiency Measures

Building energy improvements at the Charlotte Commons branch included the building envelope, interior and exterior lighting, and the HVAC systems. Reduced energy costs from these measures are presented in the following table where the first section represents the cost analysis performed on the originally proposed EEMs. The second section represents the final EEMs and energy breakout by category. The EEMs are presented ranked by expected annual savings.

Initial EEM Package	Implemented in This Project	Will Consider for Future Projects	Expected Annual Saving		Added Cost $	Expected Internal Rate of Return % (15 years)	Expected Simple Payback yr
			kWh/yr	$/yr			
Prototype Design: 13%							
Envelope: Install R-11 batt insulation in walls, R-30 in roof, and exterior shading*	Yes	Yes	18,000	$1,900	Budgeted design no added cost		
Lighting: Set interior lighting power density at 0.92 W/ft², install interior occupancy sensor and limited daylighting controls. Exterior lighting 5.5 kW versus the ASHRAE 90.1-2004 baseline 5 kW without exterior sign modeled.*	Yes	Yes					
HVAC: Install efficient constant air volume, direct expansion HVAC units; limited demand-controlled ventilation*	Yes	Yes					
Added EEM Package: 34% *(Simple payback of 5 years without prototype design energy savings)*							
Envelope: 5% of Whole Building Savings							
Install R-10 continuous exterior wall insulation*	No	Yes	500	$100	$1,300	-5%	24
Reduce infiltration by 25%*	No	Yes	6,400	$1,000	$15,000	-5%	22
Lighting: 13% of Whole Building Savings							
Reduce exterior lighting power to 3.5 kW	Yes[1]	Yes	7,300	$1,000	$9,200	3%	12
Install daylighting access and controls	Yes[1]	Yes	6,700	$1,000	$7,800	4%	11
Reduce interior lighting to 0.69 W/ft²	Yes[1]	Yes	4,500	$500	$1,400	33%	3
HVAC: 10% of Whole Building Savings							
Replace 5 constant air volume systems with one variable air volume system*	Yes[1]	Yes	6,500	$1,000	$3,200	19%	5
Enhance demand controlled ventilation*	Yes	Yes	6,500	$1,000	$0	NA	0
Install HVAC controls, reduce hours*	Yes	Yes	800	$100	$0	NA	0
Other: 6% of Whole Building Savings							
Reduce plug and other loads by 25%*	Yes[1]	Yes	6,200	$600	$2,800	22%	4
Reduce building area by 4%*	No	No	2,200	$200	-$17,000	NA	NA

* EEM is dependent on climate.

[1] In the final design, these EEMs were changed which changed the potential savings. See next table.

Final EEM Package	Implemented in This Project	Will Consider for Future Projects	Expected Annual Saving		Added Cost $	Internal Rate of Return % (15 years)	Simple Payback yr
			kWh/yr	$/yr[1]			
Prototype Design: 19% *Prototype design unchanged from initial EEM package. Modeling corrections to code baseline and prototype design reduced costs for prototype design. Includes increase of exterior lighting power in both baseline and prototype design, including addition of exterior sign.*							
Envelope: Installed R-11 batt insulation in walls, R-30 in roof, and exterior shading.*	Yes	Yes	27,000	$2,000	Budgeted design no added cost		
Lighting: Set interior lighting power density at 0.92 W/ft², installed interior occupancy sensor and limited daylighting controls. Exterior lighting 7.2 kW versus the ASHRAE 90.1-2004 baseline 7.4 kW including 0.7 kW main sign.	Yes	Yes					
HVAC: Installed efficient constant air volume, direct expansion HVAC units; limited demand-controlled ventilation*	Yes	Yes					
Added EEM Package: 29%							
Lighting: 25% of Whole Building Savings *(Includes HVAC savings due to reduced interior lighting heat gains)*							
Reduced exterior lighting to 3.0 kW (included 0.7 kW main sign). All exterior lighting used light-emitting diode sources except main sign that used fluorescent lighting as in prototype branch. Bank is considering changing signs to light-emitting diode sources for future projects.	Yes	Yes	20,000	$1,700	Actual first costs not available		
Reduced interior lighting to 0.60 W/ft². Nearly all interior lighting used light-emitting diode sources.	Yes	Yes	15,000	$1,300			
Added daylighting access and limited controls in some backs of house areas.	Yes	Yes					
HVAC: 4% of Whole Building Savings							
Installed four single zone variable air volume units and one constant air volume unit. Considered central variable air volume, but did not find a suitable standard unit with approved vendor for size required.*	Yes	Yes	5,200	$400	Actual first costs not available		
Installed four single-zone variable air volume units 15.2 seasonal energy efficiency ratio, improved from 14.8 seasonal energy efficiency ratio constant air volume units*	Yes	Yes					

* EEM is dependent on climate.

[1] Energy costs from utility schedules with different demand charges. Effective energy rate varies from about $0.085 to $0.095 over different models.

Energy Use Intensities By End Use

Following the metering and monitoring effort, the CBP team developed a full energy model for the new bank branch using DOE's EnergyPlus energy simulation software—a powerful and versatile tool that uses data on heating, cooling, ventilation, lighting, and other energy using systems to predict how EEMs will perform. Modeling offered a cost-effective way for Bank of America to measure the potential cost reductions and energy savings of the EEMs at the planned Charlotte Commons branch. The baseline model was calibrated using the detailed metering data from the monitored bank branch, which was important to accurately model the building.

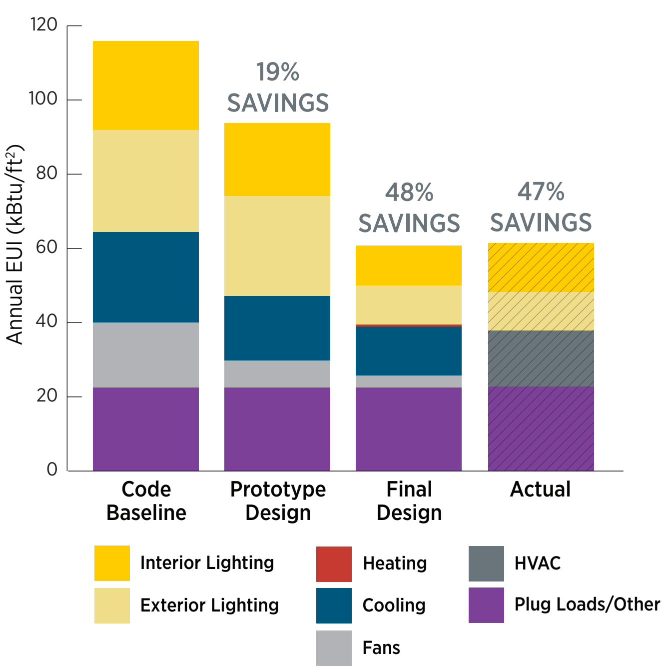
Modeling showed the proposed branch would use 74,517 kWh/year compared to the baseline energy usage of 142,282 kWh/year. In 2012, the new branch was metered to confirm expected energy and cost performance.

To assess whole building savings, three different energy models were created. Model 1 was the code compliant baseline model based on an ASHRAE 90.1-2004 baseline. Model 2 represented an existing branch model that was metered to calibrate the model. Model 3 represented the proposed design based on the energy measures planned for the project.

Model 1 - Code Baseline

The first EnergyPlus model represented the prescriptive specifications in an ASHRAE 90.1-2004 baseline. The baseline had an annual energy use intensity (EUI) of about 116 kilo British thermal units (kBtu)/square foot (ft^2).

Comparing Estimated EUI of Code Baseline, Prototype Design, Final Design Models, and Actual



Model 2 - Prototype Design

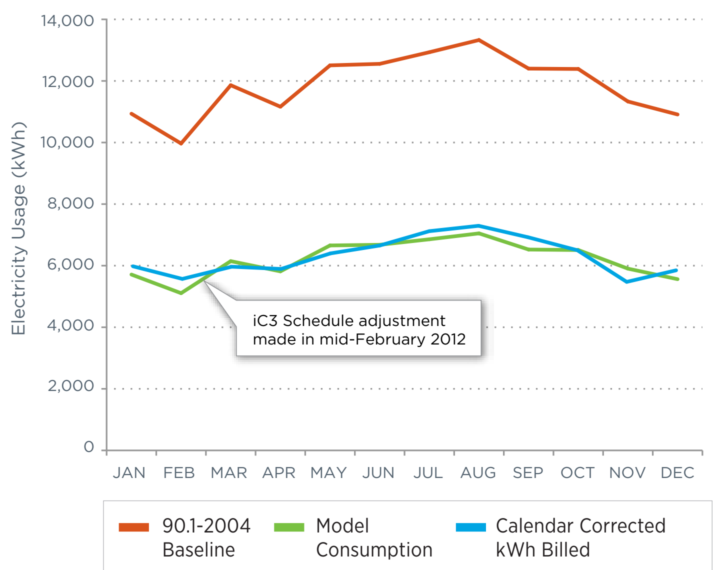
The second EnergyPlus model represented an existing branch that was metered to calibrate the model. This model had an annual EUI of about 94 kBtu/ft^2, which was 19% below code levels. These energy savings resulted primarily from envelope measures.

Model 3 - Final Design

The third EnergyPlus model included the EEMs incorporated into the design. This model had an annual EUI of about 61 kBtu/ft^2 and an annual energy savings of 48% over the ASHRAE 90.1-2004 baseline.

After construction and commissioning were completed on the bank branch in the fall of 2011, a review of the utility statements revealed a few schedule changes that needed to be implemented. These changes were made in February 2012 and since then the bank has operated at an average of 98% of the energy consumption predicted by the model.

Comparing Estimated Energy Use Intensity of Code Baseline, Prototype Design, and Final Design Models



Lessons Learned

Monitor Energy Performance

A database of monitoring information can aid in energy efficiency decisions for large banks that build similar branches in many locations. In this case, early monitoring data were used to calibrate the plug loads for the EnergyPlus model and help design the new branch.

Data gathering also uncovered unrealized energy savings in the way the portfolio energy management system operated. The monitoring data also revealed that plug loads could lead to larger energy savings if controls and timers were used to turn off unrequired equipment overnight. This change was low cost, required no change to the building envelope, and could be implemented in bank branches across the country.

Annual Energy Use and Percentage Savings by End Use

End Use Category	Code Baseline	Prototype Design	Final Design	Actual	
	Annual EUI (kBtu/ft²)	Annual EUI (kBtu/ft²)	Annual EUI (kBtu/ft²)	Annual EUI (kBtu/ft²)	Percent Savings Over Baseline
Interior Lighting	24.1	19.6	10.8	13.1	46
Exterior Lighting	27.4	26.9	10.4	10.5	62
Heating	0.0	0.1	0.6		
Cooling	24.4	17.3	13.2	15.1	64
Fans	17.5	7.3	3.2		
Plug Loads/Other	22.5	22.5	22.5	22.7	0
Total	**115.9**	**93.6**	**60.7**	**61.4**	**47**

Building Energy Savings from Implemented EEMs by End Use versus Code Baseline

Electricity End Use Category	Expected Savings (kWh)	Actual Savings (kWh)
Interior Lighting	16,000	13,000
Exterior Lighting	21,000	21,000
Heating	-1,000	
Cooling	14,000	33,000
Fans	17,000	
Plug Loads/Other	0	0
Electricity Total	**68,000**	**67,000**

Demonstrate Cost-Effective Energy Changes

Bank of America plans to roll out many of the efficiency improvements to other branches, particularly the exterior lighting design that it has found to be one of the most cost-effective enhancements. The monitoring work indicated that additional plug load reductions are possible by incorporating additional timing and controls, which could lead to energy savings of 6,200 kWh per branch annually.

In addition, the solid-state lighting for exterior lighting applications is predicted to reduce the maintenance costs for the system dramatically over the life of the building. The Bank of America team hopes to spread this enhancement to other branches in the Bank of America portfolio. Many techniques for improving energy efficiency—like exterior lighting—may offer cost reductions in maintenance and operation.

Whole Building Packages Have Shorter Simple Payback Periods

In this project, some envelope EEMs had relatively long simple payback periods, while several HVAC measures had an immediate simple payback. The CBP team worked with Bank of America officials to consider these items as a total bank package where the HVAC savings could be used to finance the envelope measures, allowing the whole building design to be more cost effective.

This approach translated to mechanisms for integrated reduced costs in future projects. For example, the detailed metering performed on the prototype branch indicated the plug loads were lower than those typically assumed in the design of the mechanical system for the branches. This allowed the design team to further reduce the number of HVAC units, which reduced costs; these savings were used to purchase more efficient units and high-performance lighting.

Searching for Savings

Most building operators have access to utility bills and more in-depth utility data for the structures they manage. Bank of America uses this data to search for potential energy-saving opportunities. Bank of America collects utility metering data from its bank branches and analyzes it to identify improvements that could save energy and reduce operating costs. Some utility meters provide detailed interval data, with measurements taken every 15 to 60 minutes. An Energy Charting and Metrics Tool is available to help with this type of analysis using simple automated charts in a spreadsheet (Taasevigen, Katipamula, and Koran 2011). Using utility data for this project, the team found that a scheduling adjustment was needed to achieve projected savings levels.

References and Additional Information

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5 Bank of America's website at about.bankofamerica.com

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