RetroFit
AN RMI INITIATIVE

Project Case Study: Indianapolis City-County Building

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Overview Section

Location: Indianapolis, Indiana
Building owner: Indianapolis Building Authority
Building type: Office, constructed 1959–1962
Building Size: 731,119 gross square feet
Total Cost of Retrofit: $8.17m ($11.17/sf)
Percent Energy Cost Reduction: 46%
Total Cost Savings: $776,674 ($1.06/sf)
Simple Return on Investment: 9.5%
Energy Star Rating: Increased from 52 to 75[1]
Construction Timeline: February 2011 through April 2012
Annual Site Energy Use: Reduced from 113 kBtu/sf to 58.8 kBtu/sf
Energy Services Company: Performance Services, Phil Yuska
Energy Manager (Owner Representative): Edward George Associates, Jack Leicht

Overview

Indianapolis, like cities across the nation, faces the challenge of reducing resource use and saving taxpayer dollars. The retrofit of the Indianapolis City-County Building provided the spark for the Mayor and city staff to begin the process of comprehensively addressing energy use across the entire Indianapolis municipal building portfolio. The profitable 46 percent anticipated reduction in energy usage demonstrated the viability of achieving deep energy savings and the effectiveness of an integrated sustainability strategy for a forward-thinking city.

The City-County Building is guaranteed to reduce pre-retrofit energy costs by 46 percent. The project reduced steam consumption by over 90 percent, which accounted for 32 percent of pre-retrofit utility expenses, and was by far the most volatile utility expenditure. The project will reduce enough steam consumption to eliminate a peak demand charge of $10,000 per month.

For the entire energy retrofit, the project provided a guaranteed $776,674 annual energy cost savings for a 10.5-year payback. The contract did not include any maintenance cost savings or avoided capital costs, which if accounted for would likely improve the financial performance of the project. Indianapolis now boasts a highly efficient building as the flagship of its portfolio, which will yield decades of lower utility bills, improved occupant comfort, and energy savings for the city.

"The changes we are making to the City-County Building and City-owned buildings across the system—and the savings involved—are a perfect example of how the city can become more sustainable while being economical"

–Mayor Greg Ballard

The SustainIndy Program

Cities provide all the benefits of modern-day living—including safety, sanitation, and culture—but do so at a large and growing global cost. Despite covering only two percent of the world's surface area, cities count for three quarters of world energy use and create more than two-thirds of global greenhouse gas emissions.[2]

Within the United States, 40 percent of all yearly energy consumption comes from the spaces in which we live and work. Much of these carbon emissions can be eliminated through energy efficiency retrofits of commercial buildings. Cities such as Seattle, Portland, San Francisco, and New York have implemented diverse and aggressive initiatives to increase sustainability, focusing on the renewal of both public and private buildings. Simultaneously, Indianapolis Mayor Greg Ballard has begun a comprehensive strategy, called SustainIndy, to drive sustainability in his city.

The SustainIndy program, led by the Indianapolis Office of Sustainability, combines efforts to save energy and reduce emissions by funding and supporting

[1] The final Energy Star rating may reach the high 80s as the building operation is optimized.
[2] Clinton Climate Initiative (www.clintonfoundation.org)

water and land use improvements, recycling initiatives, alternative transportation options, and building energy efficiency retrofits. The initiatives seek to build community, minimize impact on the natural environment, and improve quality of life.

A major goal within the program is to save energy and hedge against future energy price increases by completing energy improvements in 61 facilities across Indianapolis. The program instituted $18 million of self-financed[3] efficiency projects in fire stations, public works offices and other government owned buildings. Multiple Energy Service Companies (ESCOs)[4] were required in order to get all the work done on schedule. The City-County Building formed the centerpiece and most comprehensive retrofit within the Sustainable Facilities Initiative, and received a majority of the total funding.

The City-County Building was constructed in 1962 and had had minimal upgrades for energy efficiency. Despite the lack of comprehensive building efficiency investment[5] and an energy-intensive dual duct heating and cooling system, the operations team led by Ron Reinking had managed to operate the building with five percent less energy than a comparable building. However, by 2009 it became apparent that the aging City-County Building was ripe for deep energy savings.

Project Rationale:

The City-County Building offered convincing financial returns and the opportunity to headline the energy efficiency improvements of Indianapolis' building portfolio with a deep energy retrofit. The retrofit project was backed by the SustainIndy program and received top-level support from Mayor Ballard.

During the Innovation Charrette (see section below), participants estimated a potential energy cost savings of ~$700,000 (see Table 1 below) based on the simple assumption that the retrofit could increase the building Energy Star rating to 95. Because the project hurdle rate was 6.7 percent (or a 15-year payback), roughly $10 million could be spent on the retrofit—which translates to a budget of approximately $13 per square foot and is an adequate amount of capital for a deep retrofit. Also, the project allowed the building to preempt necessary equipment replacements and hedge against future energy price increases, which Director of Sustainability John Hazlett considered core objectives.

The Indianapolis City-County Building post-retrofit.

Financing

The city arranged a tax-exempt municipal lease at 3.2 percent for the efficiency improvements in the City-County and other buildings, using ESCOs to guarantee the energy cost savings. After the 15-year term, the city will own the equipment and components installed in the buildings. In addition to the lease, SustainIndy used $2.5 million of a Energy Efficiency and Conservation Block Grant, which primarily went toward retrofitting fire stations. SustainIndy was also able to use smaller rebates through the gas and electric utilities. The opportunity to use municipal leasing, as well as the

Utility	Current Use	Annual Cost	Reduction Potential	Potential Annual Savings	Savings over 15 Years (Undiscounted)
Electricity	94,030 BTU/SF	$1,109,000	40%	$443,802	
Steam	19,389 BTU/SF	$217,600	100%	$217,600	
Water	19,480 Gal/SF	$57,050	30%	$17,115	
				$676,517	**~10,148,000**

[3] "Self-financed" refers to using a financing mechanism that requires no upfront capital, such as an Energy Savings Performance Contract, and the energy savings can pay for the efficiency improvement over the course of the contract.

[4] An Energy Service Company or ESCO provides Energy Service Performance Contracts. Indianapolis contracted with three ESCOs: Performance Services, Johnson Controls Inc., and Energy Services Group to perform SustainIndy upgrades.

[5] Contracts typically specify that the client (not the ESCO) be legally responsible for interest payments to the bank, as the client's credit score is often higher than the ESCO.

opportunities within Indianapolis' portfolio attracted a variety of interested service providers.

"We often find that the building automation system is not being used to its full capacity, or is being used incorrectly. This is because facility managers were never trained properly or they just have too much on their plate."

–Jack Leicht, Energy Manager, City of Indianapolis

Contract

Indianapolis entered into the contract stage with the intention of finding the most profitable self-financing energy solution applicable across its portfolio. While ESCOs typically provide clients with boilerplate energy performance contracts, Indianapolis drove the contract negotiations with Performance Services, Johnson Controls, and Energy Services Group. To streamline the process, and avoid future complications across projects, Indianapolis and the ESCOs ultimately produced three identical contracts.

Performance Services and the two other ESCOs also performed retrofits in a number of other city buildings, including fire stations, parks facilities and public works buildings.

The Indianapolis contracts stipulated very conservative cost calculations regarding eligible savings. Because of its accounting system, the city wanted cash flow estimates limited to energy and water cost savings. As a result the return on investment calculation could not include maintenance savings or avoided capital costs, which are significant. The contract specified a certain level of non-energy performance as well, describing service and comfort standards as well as mechanical equipment standards. Performance Services and the other ESCOs were readily able to comply with Indianapolis' contract requirements.

Performance Services typically offers performance contracts to implement energy efficiency upgrades as part of the energy service company business model. In a typical performance contract, Performance Services would arrange bank financing[6] and guarantee that energy cost savings exceed the payments on the debt issued to complete the project. However, Indianapolis decided to finance the upgrades with a tax-exempt municipal lease arranged by the City's Bond Bank. As a municipal borrowing authority, Indianapolis could receive the favorable tax treatment of a long-term municipal lease[7] and still perform the essential services of an energy service performance contract.

Report-out session during the charrette.

Indianapolis also specified that the guaranteed project savings must payback the initial investment within 15 years. By choosing a longer payback period (and contract length), Indianapolis allowed for the inclusion of more aggressive energy measures providing greater total savings. This follows a general industry trend toward longer contracts among ESCOs and their clients, which is leading to deeper energy savings through performance contracting.

Project Process

Timeline

The project took place from early 2009 to April 2012, and is gathering measured savings in 2012-2013.

- February 2009—Issued request for qualifications
- June 2009—–Set goals for the project and evaluated project approaches during an Innovation Charrette
- October 2009—Selected three ESCOs to retrofit various municipal facilities, including Performance Services for the City County Building projectDecember 2009—Completed efficiency opportunity analysis and held weeklong workshop with facility management to select final efficiency measures
- April 2010—Received city council approval
- October 2010—Secured funding
- April 2012—Retrofit improvements completed (with the startup of the geothermal system and finished installation of energy recovery units)

[6] Contracts typically specify that the client (not the ESCO) be legally responsible for interest payments to the bank, as the client's credit score is often higher than the ESCO.

[7] The lease implies that Indianapolis pays incrementally for the installed efficiency upgrades, and will take full ownership of all equipment at the end of the contract life.

The Innovation Charrette

Rocky Mountain Institute (RMI) was invited in 2009 to convene a "Green City-County Building Development Team" and help launch the retrofit of this iconic Indianapolis building. RMI facilitated an Innovation Charrette where a diverse group of building experts identified opportunities, barriers, and solutions to achieving significant energy savings in the City-County Building. The team discovered that a potential retrofit could address the limited daylight in offices, lack of central lighting controls, and a rapidly growing data center.

The charrette participants also stumbled upon a gold mine of efficiency opportunity in that the city had been pumping over 225 gallons per minute of groundwater from the lower parking deck due to a high water table. This constant water flow, which had been pumped since the building was constructed in 1962, offered an opportunity to serve as a heat exchanger to lower the costs of heating and cooling the building.

The charrette created consensus on the procedural steps required to collect the necessary data, engage occupants, begin outreach efforts, obtain funding, develop the requisite partnerships, and begin the retrofit. The charrette also delineated the required steps to create a City-County Building Comprehensive Master Plan to implement sustainability across the entire Indianapolis building portfolio.

"Even in the last few years we've seen an increase in energy prices after enjoying some of the cheapest prices in the country. This project serves as a hedge against future volatility"

- John Hazlett

Identification and Analysis of Measures:

Indianapolis Director of Sustainability John Hazlett knew that Performance Services would want access to utility bills so that they might begin understanding the building energy use patterns and performance. Unfortunately these bills were not readily available. Hazlett ended up spending three months getting them in order. Ideally he would have used a tool like Energy Star's Portfolio Manager, but was unaware of the possibility at the time.

Performance Services conducted an ASHRAE Level 3 audit[8] to assess possible capital improvement projects, including available savings and predicted costs. The ESCO developed a long list of measures based on the assessment, including ones that address heating, cooling, lighting, and office and other

Operations Lead Ron Reinking and Phil Yuska discuss plans for the building

Performance Services held a weeklong workshop with city staff and Energy Manager Jack Leicht to discuss the impact of the initial recommendations. The team addressed questions on how the building would function, including the methods to assure expected occupant comfort standards. By involving the facilities management staff in the workshop, the project team integrated their hands-on expertise with the building in the ongoing process.

Hiring an Energy Manager:

When Mayor Ballard first conceived the Indianapolis retrofit program and appointed the SustainIndy team to the task, the SustainIndy team realized they needed additional staff and expertise.

The project team hired an energy manager, Jack Leicht of Edward George Associates, as a third-party consultant to assist throughout the process. His scope stretched from initial audits (conducting his own walk-throughs) through design and commissioning, and onto the building operation phase. Leicht also developed the workshop with facilities managers, and guided the City through the process.

Hazlett hired Jack Leicht in order to bring someone onboard with a strong building engineering and retrofit process background. Leicht provided an expert and independent voice to review scope of work, assess retrofit measurement and verification plans, and help with writing schedules for the new building monitoring system. Leicht also provided a long-term and strategic perspective based on his background in utility markets and energy pricing. His compensation was independent of program success, but Indianapolis is interested in the possibility of future incentive programs. Hazlett and the rest of the project team clearly identified Leicht as a key factor in the eventual success of the retrofit.

[8] An ASHRAE Level 3 Audit is a detailed analysis for potential capital projects – involving site data collection and analysis typically used to support major financial decisions.

Implementation:

The budget and construction schedule were achieved as predicted. Building occupants were able to remain in the building for the duration of the retrofit. The scope of the project has not changed over time – due to the upfront planning and workshops performed by the City-County Building team. The only major change to scope was required significant abatement to remove asbestos before any energy efficiency measures could be addressed. The project was originally estimated for 6–8 months of construction, but delays in arranging financing and a period of time awaiting approval pushed back the schedule. However the construction team completed a great deal in a short amount of time – with no major downtime and limited disruption for building occupants.

Ensuring Savings:

The Indianapolis City-County Building took a proactive approach to retraining building managers and occupants to contribute to the effort within the City-County Building. A variety of discussions, online trainings, and collaboration tied together the staff to support the program. The new equipment (including heat recovery and geothermal systems) was managed in new ways to reduce loads and simplify operations.

The CCB's new geothermal heat recovery chiller.

The SustainIndy team carefully reviewed measurement and verification[9] (M&V) protocols proposed by Performance Services. Lighting was recommended to be assessed using Option A M&V, or a simple engineering calculation procedure based on the potential to perform and generative savings. The more complex measures were recommended to use Option B or C, which use measured data at either the component (Option B) or whole building level (Option C). The project team primarily used Option B (by tracking and trending equipment operation) to determine savings and support retrocommissioning.

"Think of this project as a heart and lung transplant in a patient that's not only awake, but also walking around."

- Phil Yuska, Performance Services

Energy Efficiency Measures

The Indianapolis City-County Building includes a number of highly integrated efficiency features. The heating and cooling system utilizes groundwater from the garage–which had already been labeled a liability – to extract and release heat into the water depending on the outside temperature (acting as a heat source in winter and a heat sink in summer). Other heat recovery was also installed. One chiller was removed and a high efficiency variable speed (instead of constant speed) chiller was implemented. A new geothermal heat recovery system was implemented to supplement building heating and cooling. The distribution system for the heating, cooling, and ventilating system were largely kept unchanged. The existing controls system was expanded and optimized for maximum building efficiency.

Systems included in the retrofit:

- Geothermal system, leveraging constant pumping of ground water (225 gallon per minute) due to Indianapolis' high water table to supplement building heating and cooling
- Heat recovery systems for the central plant, data center, and exhaust air
- Heat recovery chiller provides heating for a new domestic hot water tank
- Modified air handlers and domestic water pumps to operate using variable instead of constant flows
- Installed new 400-ton chiller and replaced pumps and drives with variable speed systems and automatic flow control valves.
- Augmentation of existing controls systems to include the new heating and cooling system as well as occupancy sensors for the building's lighting
- Installation of solar thermal and solar PV systems
- Solar and wind powered LED plaza lights

The project also emphasized building outreach and occupant engagement in the energy strategy. In this

[9] Measurement and verification (M&V) is the process of comparing measured energy use before and after implementation of a retrofit. M&V is critical to ensure the building is operating as intended and anticipated savings are being achieved.

effort, Performance Services identified and managed Lucid Design Group in creating a building dashboard that lets any occupant or interested party track the real-time usage of the City-County Building.

Institutional Risk Analysis and Mitigation of Challenges

The City-County Building supports over 2000 people in a very old building, which required a complicated energy retrofit that included asbestos abatement. Early in the process, the project team identified the goal of completing the project with constant occupancy, and strategically managed the risks implied by this objective. Typically, comprehensive energy retrofits (particularly those addressing the shell of the building and the tenant spaces) require the building to empty for at least a year, and often much longer. Timing a retrofit to match a break in occupancy (such as building sale or major tenant turnover) often minimizes the costs of building downtime.

The team found scheduling and performing the work in tenant spaces difficult, while scheduling the switchover of the whole-building central heating and cooling systems posed technical problems. The occupancy sensors (almost 200 in the building) presented a technical and social challenge. Rezoning the building's lighting placed several offices and conference rooms on one occupancy sensor. This initially led to offices having their lights go off when conference rooms went unoccupied, initially creating a disruption to staff and several complaints to facilities management. The project team eventually had to rezone approximately one-third of all lighting zones.

To ameliorate any minor disruption to the building occupants, the team fully explained the construction process with occupants beforehand and responded to feedback promptly. Any potential issues or concerns were discussed prior to construction. To ensure optimal operation of the post-retrofit building, the project team included the facilities management staff throughout the design process and provided them with post-project training on operations for the new control system. The team also provided education (including some online training) to the building occupants.

The highly collaborative nature of the project ensured that all parties (the retrofit team, facilities management, and the building occupants) shared expectations and had an effective role to play. As a result no major roadblocks emerged to keep the project from moving forward as planned. The project team proved, in an impressive fashion, that achieving greater than 40 percent energy savings is possible and profitable, all while maintaining occupancy throughout the process.

Lessons Learned

The City-County Building further proves that deep energy savings are not only possible but also profitable in large commercial buildings. By adapting existing deficiencies (a high water table) into opportunities (a new geothermal system), the project team unlocked hidden value and improved the economics of the retrofit. The project demonstrates that energy service companies, whether working through the vehicle of a performance contract, or through municipal funding, can perform dee[redacted]and create long-lasting value for clients. Third-party energy managers, like Jack Leicht, help interface between the client and service provider, and result in process improvements that make the entire project easier.

An overarching municipal program, such as SustainIndy, can estimate the opportunity to improve buildings across a portfolio and then outline the steps required to capture the cost-effective maximum. Yet, every building within a portfolio will present unique challenges and constraints.