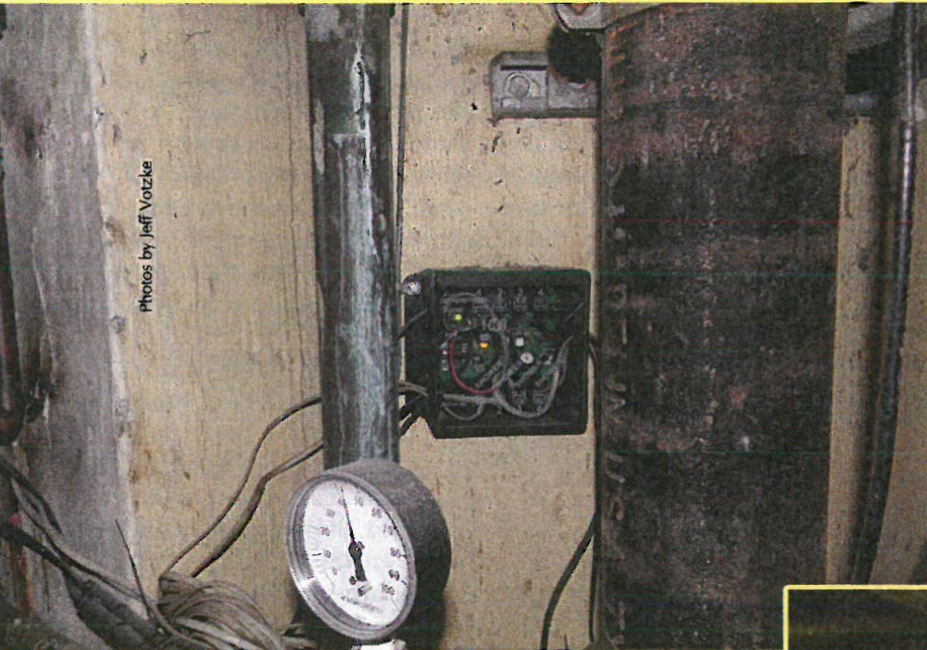


ENERGY PERFORMANCE PROJECTS YIELD GREENING AND SECURITY BENEFITS

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Photos by Jeff Votzke

An I-CON flush controller was installed in Parnall Correctional Facility's 10 Block.

Parnall Correctional Facility's 10 Block.



Buildings in the U.S. consume a great deal of energy, and prisons are no different. All building types combined account for 41 percent of the primary energy consumption in the U.S.¹ Commercial buildings (which include correctional facilities and jails) account for nearly half of this use.² While the U.S. Department of Energy does not track energy consumption specifically for

prisons and jails, an analysis of their Commercial Building Energy Consumption Survey (CBECS) data reveals that these facilities are in the upper half of all commercial building types for energy intensity (energy use per square foot). Average energy intensities between 120,000 and 221,100 British thermal units (BTUs) per square foot were recorded for buildings of the “public order and safety”

type in the CBECS survey,³ such as state-reported data for correctional facilities in Wisconsin (193,400 BTUs per square foot)⁴ and California (163,000 BTUs per square foot).⁵

The bottom line from this data is that correctional facilities consume a significant amount of energy per square foot of building area. Combined with the fact that state correctional agencies are typically the largest property-managing departments in their respective states, their total energy use is a large percentage of the total for state-operated buildings. Despite this, and a decline in energy use in many correctional facilities (even while square footage is increasing slightly in some cases), the percent reduction tends to lag behind other state agencies.

Several reasons have been offered for this lag effect. Corrections departments often have relatively small physical plant staffs, both at the facility and central office levels. The large number of facilities and their building areas further compounds staff shortages, and results in the majority of efforts working toward baseline facility operation tasks. Prison and jail retrofit projects are also very complex — the technical solutions and building system components must consider their impact on facility security in addition to project performance. This also includes security considerations during the construction phase of the project. Increased staff time (often on overtime schedules) and increased daily mobilization and demobilization time due to facility security procedures add complexity for contractors and overhead costs to project budgets. Finding technically qualified contractors who also have an understanding of these security considerations can be a difficult task in many states.

A final contributing factor for this energy efficiency lag effect in correctional facilities has been attributed to shrinking state budgets, with particular attention focused on cuts to correctional agencies. Several states have reduced, if not eliminated, capital outlay funding across the board, and corrections departments must allocate these reduced funds over millions of square feet. The need and desire to save utility costs to ease this funding pressure requires a mechanism to fund necessary building envelope repairs along with the replacement of aging infrastructures. A building envelope is the walls, roof, windows and related systems — those elements of the building that provide structure and keep the elements out and help to maintain the indoor environment.

Energy Performance Contracting

One such unique financing mechanism where up-front project costs are financed through deferred payback on guaranteed savings resulting from a retrofit project is called performance contracting. Energy performance contracting (EPC) is an equivalent term for such project financing when the guaranteed savings and financing options are based on increases in energy efficiency that yield savings in utilities and operation costs.

The EPC process is typically led by an energy service company (ESCO), which typically has the capacity to design/develop, construct, verify and arrange for the financing of projects that seek to reduce resource consumption and operations and maintenance costs at a wide

variety of facility types. ESCOs emerged in the 1970s in response to the global energy crisis and rising fuel prices, which have seen particularly rapid growth in the past decade. ESCO revenue topped \$4 billion in 2008 and was projected to top \$7 billion last year.⁶ The vast majority of this revenue (69 percent) in the U.S. has come from projects with municipal and state governments, universities and colleges, K-12 schools and hospitals, with 75 percent of this revenue coming from energy efficiency projects.⁷

The EPC process has been described a number of different ways, but basically the process mirrors the design-build process for delivering construction projects, with the inclusion of a performance guarantee as well as a measurement and verification component. Unlike traditional construction projects, performance contract-based projects may be delivered as turnkey projects by an ESCO, where energy auditing, contracting, and measurement and verification activities are all issued under a single contract. Other projects may divide these activities into multiple phases and involve different entities in each phase. The EPC process addresses key funding limitations that might prevent retrofit projects from getting off the ground. A common element of EPC is the incorporation of financial incentives offered by utilities as a means to generate additional capital. The performance guarantee itself can also mitigate the risk that projected savings through efficiency will not meet minimum return on investment thresholds established by many public entities. These projects also address the challenge of capital outlay funding shortages by offering low-interest financing and payment of project costs through the recapture of savings by an ESCO until the project costs are covered. At that point, the institution keeps all of the savings. This risk reduction and savings guarantee has been effective. A 2005 study found that 72 percent of EPC projects reported greater savings than what was guaranteed.⁸

The Michigan Department of Corrections (MDOC) has been involved with EPCs since the 1990s, when it became involved with an ESCO to deliver retrofit projects at numerous prisons in Ionia, Jackson, Marquette and Muskegon in 1993. The Marquette and Muskegon facilities were selected because they had higher-than-average energy intensities at 310,726 BTUs per square foot and 284,258 BTUs per square foot.⁹ Projects in these two prisons were designed for a seven-year payback period and included lighting upgrades; installation of an energy management system; programmable thermostats; zone control for heating, ventilation and air conditioning (HVAC); variable speed motor drives; motorized dampers; enhanced attic insulation; and blow-down heat recovery on boilers. The two projects returned 16 percent more savings than projected, and had a simple payback period of 3.71 years.¹⁰ Furthermore, these projects were conducted under Michigan Public Act 122 of 1987, which allowed up to 75 percent of avoided energy costs to be returned to state departments to fund future energy efficiency projects. These factors led to a favorable opinion of the EPC process by corrections and construction decision-makers and led to the interest to pursue other projects.

During the past two years, MDOC has piloted three projects utilizing the EPC delivery method at three different facilities (see Table 1). These three facilities are located in

Table 1. Michigan DOC Energy Performance Contract Pilot Facility Characteristics

Facility Name [Years Built] Total Building Area (SF) [EPC Project SF]	Construction Types and General Information	Security Levels	Project Components	Project Value [Guaranteed Savings/Year]	Payback Period
G. Robert Cotton Correctional Facility [1985-2002] 426,675 [426,675]	<ul style="list-style-type: none"> Weatherized pole barns with sealed concrete floors and plaster-board walls Brick, mortar, steel and glass 	I, Secure I, II, IV	<ul style="list-style-type: none"> Lighting Retrofit Building Envelope Water Efficiency Boiler Retrofit 	\$1,307,859 [\$186,837]	7 yrs
Kinross Correctional Facility [1954-1999; opened as a prison in 1978] 324,570 [320,000]	<ul style="list-style-type: none"> Primary structures are brick, pre-cast concrete block, steel, and glass Additional housing units are weatherized pole barns with sealed concrete floors and plaster-board walls Former Air Force Base Largest fenced area (113 acres) of any state prison in Michigan 	I and II	<ul style="list-style-type: none"> Lighting Retrofit HVAC Controls Water Efficiency Decentralize Steam Plant 	\$3,212,703 [\$326,469]	10 yrs
Parnall Correctional Facility [1925-2002] 905,220 [250,000]	<ul style="list-style-type: none"> Primary structures are brick, pre-cast concrete block, steel, and glass Additional housing units are weatherized pole barns with sealed concrete floors and plaster-board walls 	I	<ul style="list-style-type: none"> Lighting Retrofit Water Efficiency Retrofit HVAC 	\$12,890,098 [\$1,195,334]	10 yrs

two different climate zones; feature different building ages, construction types and a range of security levels; and incorporated a variety of energy conservation measures (ECMs). These projects were entered into with the understanding that while an energy performance project cannot fund all physical plant needs, there are many potential secondary benefits to be gained. The following case study of three correctional facility projects highlights these secondary benefits gained through the execution of an EPC approach.

MDOC – Pilot Projects Case Study

The primary goals of the pilot project were to mitigate costs arising from utility rate increases and the replacement of obsolete and outdated mechanical equipment. Pilot projects had payback periods of seven and 10 years, with overall values of between \$1.3 million and \$12.9 million. In addition to stated efficiency goals, the projects also qualified the state of Michigan for utility incentive rebates totaling \$96,448.54 (electricity and gas) at Parnall, \$22,565.88 (electric) at Cotton and \$11,674.40 (gas and electric) at Kinross. These funds supplemented financing for additional energy projects performed by facility physical plant staff. Additionally, the performance contracting

process yielded secondary benefits related to enhanced security outcomes, specifically connected to thermal comfort and reduced inmate grievances, domestic water system controls and instant-strike lighting. Instant-strike lighting is lighting that comes to full brightness as soon as the light is turned on.

HVAC controls lead to enhanced comfort and security.

The Parnall Correctional Facility had a serious and long-term issue with the steam heating system for Blocks 9 and 10, which are older five-tiered cell blocks. Seasonal temperature variations from the ground level to the fifth level of the block were 15-20 degrees Fahrenheit. As a result, comfort-related grievances were logged during the winter months due to temperature-related issues — it was too cold near ground floor entrances and the top gallery was too hot due to the open architecture of the cell blocks.

The EPC addressed the energy-savings issue of the cell block HVAC system through enhanced controllability, which had an additional benefit of resolving the temperature variations between the ground floor and top galley of Blocks 9 and 10. Steam radiators fed from the central power plant were replaced with new locally installed hydronic boilers with new perimeter hot water radiant and new electronic central controls. The cell block temperature varied no more than a few degrees in all areas from December 2011-February 2012. Furthermore, summer temperature

variations were also an issue and facility staff noticed that temperature variations were reduced in summer 2012. This was particularly noteworthy considering that summer temperatures were significantly above average in 2012. However, temperature variations between the top and bottom floors was again within a few degrees after installation of the ECMs. This work also brought facility ventilation into compliance with current codes and standards.

These changes reduced vertical temperature variation in Blocks 9 and 10, which in turn led to a reduced number of inmate grievances. This has virtually eliminated temperature-related grievances from an annual average of nine grievances per year for the past four years. According to Debra Scutt, warden at Parnall, "While making rounds, I have noted the temperatures between the base, first and fourth gallery, and the difference is within two to three degrees, with the temperature comfortable for all."

Water controls net savings and contraband. Water reduction measures were installed for showers, lavatories and toilets at all three pilot sites. This included the use of flow restrictors and centralized flush controls with inline flush restrictors installed on cell toilets. The flush controls allow for two toilet flushes within a five-minute period. Toilet flushing is locked out if a toilet is flushed a third time in those five minutes, thereby discouraging inmates from using toilets for anything other than their intended purpose. As a result, not only were financial savings realized from less water consumption, but facility staff have noticed a reduction in the amount of cell garbage items being disposed of using prisoner cell toilets. In the past, physical plant staff have found food wrappers, fruit peels and general cell-related garbage in the plumbing system. At some facilities, this can lead to financial penalties to the institution related to sewage throughput — the amount of water and foreign debris exiting a facility and entering the wastewater treatment system. This has been all but eliminated at those prisons where electronic central flush controls were installed.

These controls also created a security benefit. Security staff can now electronically shut down flush valves prior to a mobilization or performing routine cell inspections (shakedowns). This prevents prisoners from flushing weapons and other contraband down the toilets. The water conservation measures also reduce, if not eliminate, instances of cell flooding or systemwide failures resulting from the flushing of contraband. Scutt noted, "We have seen a significant reduction in the misuse of this system. Prisoners are no longer able to keep the water continuously flowing (to keep items cold and for white noise), nor able to do multiple flushes to get rid of contraband."

Unfortunately, all three projects had failures related to the community bathroom lavatory faucet flow restriction measures. The only security-rated faucets that accomplish water savings at this time incorporate a restriction device with an aerator. Inmates found ways at all three facilities to remove these aerators, regardless of the installation measures taken by physical plant staff to prevent their removal. Staff tried to tighten the aerators, and installed set screws and pipe thread locking fluid. One faucet manufacturer is identifying custom solutions to this problem to permit successful installation and use of these aerators.

MDOC has found that taking on several shorter payback period projects has enhanced its ability to make additional capital improvements.

Light controls help identify immediate threats. Like many agencies, MDOC is exploring ways to improve perimeter lighting and attempting to fit them into an Energy Performance Project. The current thinking is to use dimmable lighting fixtures with instant-strike capabilities. Retrofits involving LED, induction and T-5 fluorescent lights were examined. However, despite the significant energy savings over the currently used high-intensity discharge lights, the payback period would not fit into a 10- to 12-year model. As a result, MDOC has been looking at dimming controls interconnected to perimeter security devices and cameras with analytics for motion detection that would bring light levels from dim to full brightness instantly. While this has the potential to be a significant energy-saving measure, security is also enhanced. An instant light strike to full light level immediately draws the attention of correctional officers without the need for control center staff to intervene in the alarm process.

Conclusion

MDOC has found that taking on several shorter payback period projects has enhanced its ability to make additional capital improvements. Contract specifications allow for up to a 12-year cumulative average payback period for these projects. The intent has been to use the shorter payback period projects (like converting T-12 fixtures to T-8 fixtures) to help fund some of the longer payback projects. In addition to the technical aspects of these contracts and the fact that work performed in the ECMs has met a variety of facility needs, MDOC physical plant staff learned that information had to be provided to facility administrators and staff early in the process in order to secure their understanding and acceptance. As a result of this, as well as secondary benefits that have helped this project exceed initial performance requirements, MDOC is currently in the process of developing additional EPC contracts for other facilities during the next several years.

ENDNOTES

¹ U.S. Department of Energy. 2011. *Buildings energy data book*, Chapter 1: buildings sector. Washington, D.C.: Author.

² Ibid.

³ U.S. Department of Energy. 2011. *Buildings energy data book*, Chapter 3: commercial sector. Washington, D.C.: Author.

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⁶ Satchwell, A., C. Goldman, P. Larsen, D. Gilligan and T. Singer. July 14, 2010. *A survey of the U.S. ESCO industry: Market growth and development from 2008 to 2011*. Washington, D.C.: Lawrence Berkeley National Laboratory.

⁷ U.S. Department of Energy. 2011. *Buildings energy data book*, Chapter 3: Commercial sector. Washington, D.C.: Author.

⁸ Hopper, N., C. Goldman, J. McWilliams, D. Birr and K. McMordie-Stoughton. March 2005. *Public and institutional markets for ESCO services: Comparing programs, practices and performance*. Washington, D.C.: Lawrence Berkeley National Laboratory.

⁹ Michigan Energy Office. 2001. *MI department of corrections Muskegon/Marquette prisons energy performance contract: Saving energy in state of Michigan facilities*, Case Study 01-0026. Lansing, Mich.: Author.

¹⁰ Ibid.

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Ohio Implements Energy Conservation and Sustainability Initiatives

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- By continuing to track natural gas, water and electric usage in the Enterprise Information Management, staff are highlighting strengths and weaknesses throughout the system and identifying target areas for improvement;
- ODRC has shared the Three-Year Strategic Sustainability Plan with the Ohio Department of Administrative Services to incorporate all future projects;
- A partnership with the Vera Institute of Justice, Franklin County Reentry Task Force and other organizations recently resulted in a Second Chance Act award to pilot a demonstration project focused on green technology and weatherization training for offenders. The project will include hands-on work experience to improve the energy efficiency of the facility and will compare program implementation costs with energy cost-savings;
- Recycle Force, an Indiana-based electronics recycling company that employs ex-offenders, received a grant to expand operations to Ohio; and

- A new partnership with the Washington-based Sustainability in Prisons Project will help bring science and nature into prisons, mirroring the Washington State Department of Corrections' successful conservation projects with Evergreen State College. This model assists in reducing the environmental, economic and human costs of prisons by encouraging sustainable practices.

ODRC has made great strides, and efforts like these will ensure that operations and programs reduce the agency's environmental footprint while saving the department money in these tough economic times.

Jenny Hildebrand is the energy conservation and sustainability administrator for the Ohio Department of Rehabilitation and Correction. For more information on the Three-Year Strategic Sustainability Plan, visit http://www.drc.ohio.gov/web/Sustainability_Plan.pdf.