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Federal Bureau of Prisons
FCC Petersburg Super ESPC Project

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FCC Petersburg and resource conservation

- Constellation Energy has completed the implementation if a **$10 million comprehensive energy reduction program** for the Federal Correctional Complex in Petersburg, VA.
- The energy savings performance contract was originally structured through a Mid-Atlantic IDIQ contract.
- By taking advantage of this DOE contract, FCC Petersburg is not only going to reduce its energy costs by $1.4 million a year, but will also get significant upgrades to its infrastructure, including **a biomass boiler, geothermal heat pumps, and a solar photovoltaic system**.
- The project will also help Petersburg meet internal and Federally mandated sustainability goals relating to energy and water use.

ECM Overview

- Constellation performed an initial energy audit and submitted an initial proposal featuring 14 energy conservation measures (ECMs), and investigated 7 others which didn't pencil out financially.
- The initial audit and walkthrough revealed particularly high water and sewer costs, in addition to opportunities for HVAC and lighting improvements.
- After discussion and further investigation, Constellation narrowed the ECMs down to 12 measures, which were presented as part of a Detailed Energy Survey.

ECM Summary

Number of ECMs	Capital Investment by CEPS	Annual Dollar Savings for FBOP	Annual Energy Savings for FBOP	Contract Term
12	$10.6M	$1.4M	34,097 MMBtu	17 years

- **Cutting edge** – many innovative ECMs including: biomass, geothermal, solar, and electric cars
- **Enduring** – a Constellation employee will be on-site supporting and monitoring the project throughout the contract term

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ECMs

1. Biomass boiler
2. Dryer heat recovery
3. Electric patrol vehicles
4. Air-cooled chiller
5. Ozone laundry system
6. Steam system upgrades
7. Controls upgrades
8. VSD for chillers
9. Lighting upgrades
10. Water upgrades
11. Ground-source heat pumps (GSHP)
12. Solar photovoltaic system

ECM 1: Biomass Boiler

- Constellation installed a 350-hp biomass boiler, manufactured by ARE, in a dedicated building adjacent to the current power plant.
- The steam generated by the biomass boiler will tie into the existing steam boiler plant that serves the Low Security compound and the Camp compound.
- The new biomass boiler is to operate only during the non-summer season and as a base load contributor to the Central Plant's steam system.
- It will also allow the government to utilize a renewable energy resource and reduce its carbon footprint.

ECM 1: Biomass Boiler Construction Photos

ECM 1: Biomass Boiler Operation Photos

ECM 1: Biomass Boiler Construction Photos

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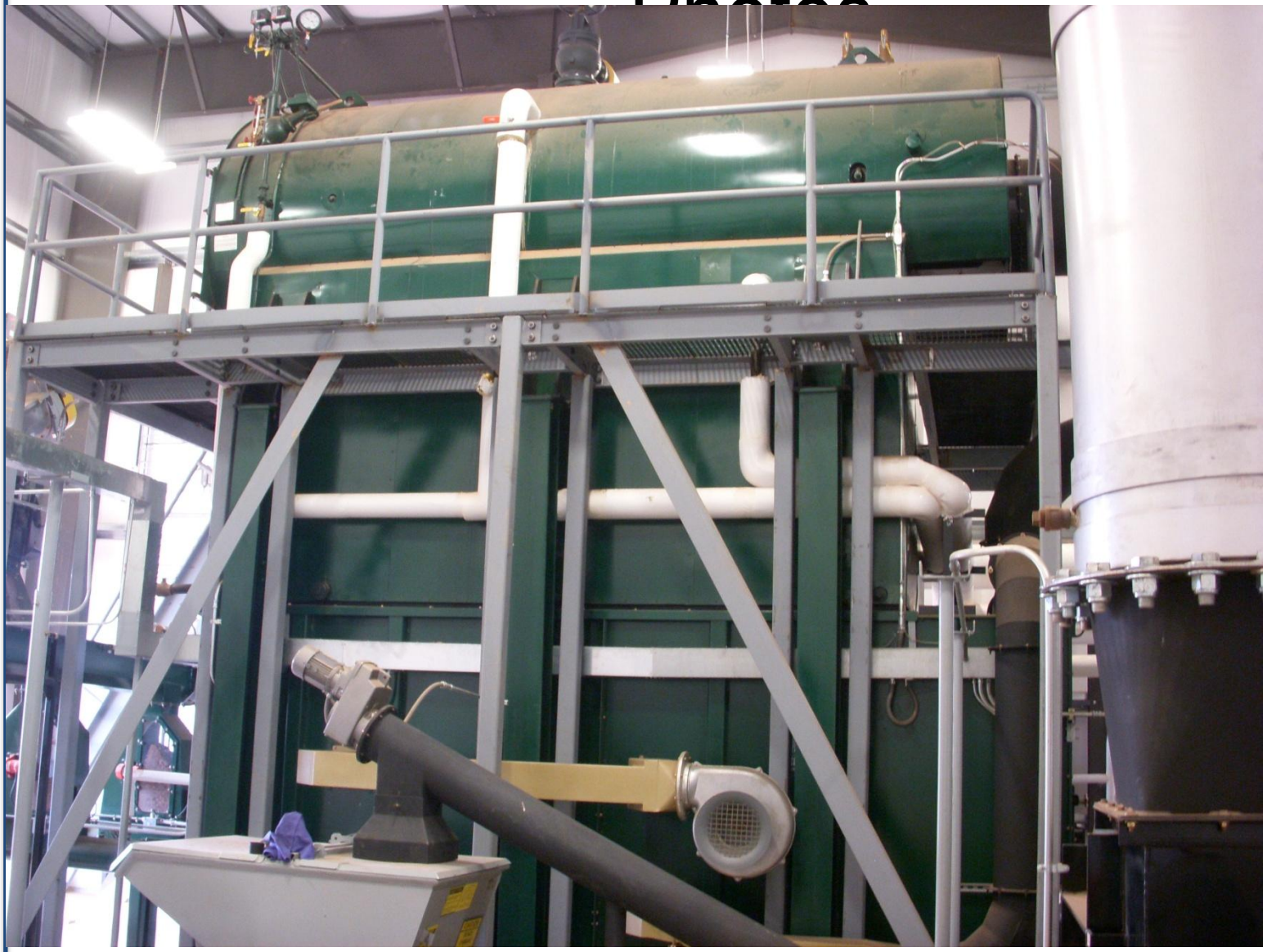


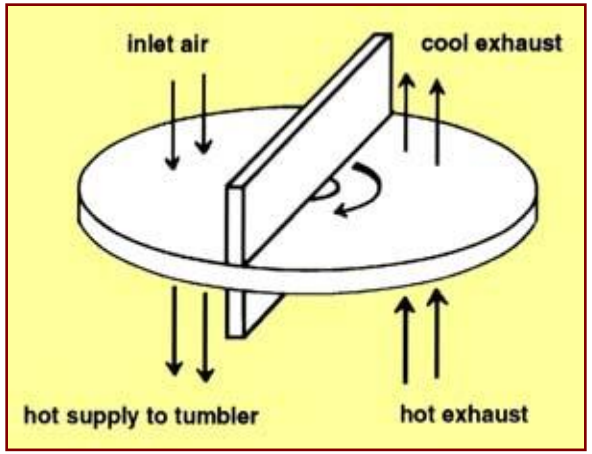
ECM 1: Biomass Boiler Construction Photos

ECM 1: Biomass Boiler Construction Photos

ECM 1: Biomass Boiler Operation Photos

ECM 2: Dryer Heat Recover

- Both the Medium and Low compounds have intensive dryer use. Dryers in both Compounds are used five days per week during a eight-hour shift.
- Typically, dryers immediately discharge heated and moist air into the atmosphere.
- A heat wheel transfers this otherwise wasted heat from the exhaust steam to the dryer inlet (without returning the moisture).
- This results in shorter burner operating cycles and less natural gas consumed.



ECM 3: All-Electric Vehicles

- The Prison is comprised of 569 acres, has 15 miles of roads and buildings totaling 1 million sq. ft. under roof.
- The prison has a flight of six trucks, that support the outside maintence shops .
- By utilizing plug-in all-electric vehicles, FCC Petersburg creates a more energy efficient fleet that saves on fuel costs.

- Electric vehicles use no gasoline and use only 36 kWh of electricity per full charge. They can be charged using a regular power outlet. These trucks are the center piece of a fleet of over 30 electric vehicles that support the mission and reduce fuel consumption.

ECM 4: Air-cooled Chiller

- Two 600-ton chillers in the Central Utility Plant s
Security Administration Building.
- While the computer and IT rooms require coolin
even in the winter, the rest of the building did not. Th
facility was running 600-ton chillers to provide cooling for two rooms that really only needed 10 tons of cooling.
- To fix this inefficiency, Constellation installed an air-cooled chiller dedicated for the two rooms that allowed the 600-ton chillers to be shut down during the winter.

ECM 5: Ozone Laundry

- The prison has an intense laundry operation. By implementing an ozone cleaning system, Constellation improved the operating efficiency and cost of the clothes washing machines.
- The addition of ozone to the wash water reduces water consumption, reduces energy needed to generate hot water, and reduces the quantity of chemicals required to launder clothing and linens.
- In addition, it decreases the wear and tear on clothes that are laundered.

ECM 6: Steam System Upgrades

- The steam system at FCC Petersburg presented a series of challenges and opportunities for improvement:
  - Constellation recommended the installation of new steam, gas, and water meters to allow for more precise and effective building automation, as well as being able to identify problems or issues as or even before they develop.
  - The pre-existing fuel pumps on the boilers and hot water heaters weren't used due to operational problems. New fuel oil pumps dedicated to the hot water boilers were installed, allowing the boilers to be dual-use (gas and oil) and to avoid associated natural gas penalty costs.
  - Defective steam traps were identified and replaced.
  - Cracked burner tubes regularly caused domestic water heater in the Medium facility to fail; these were fixed.
  - The three-deck blending dampers in the multizone air handling units in the Medium Security Complex Housing Buildings were installed incorrectly and have "racked." This resulted in poor or non-existent control of conditioned spaces. New dampers were installed to fix this.

ECM 7: Controls Upgrades

- Constellation upgraded the HVAC controls at the Low, Medium, and Camp facilities.
- This involved two types of work:
  1. General upgrades to HVAC controls, including installation of programmable thermostats and installation of heating water reset controls
  2. Re-commissioning DDC control and upgrading to Tridium-based software
- The Low complex has buildings served by stand-alone equipment, while the Medium complex has a JCI system with a front-end in the central plant.
- The stand-alone controls are inefficient, outdated, and uncomfortable for inmates, while the JCI systems needed to be re-commissioned and upgraded to restore efficiency strategies.

ECM 8: Variable Speed Drives

- Variable Speed Drives were installed on the two York chillers in the central plant.
- The chillers currently control capacity by mechanically throttling refrigerant. VSDs are more efficient at varying refrigerant compressor speed and do so with lower energy needs at part-load conditions.
- In addition, the VSDs also tie into the new building automation/re-commissioning.

ECM 9: Lighting Upgrades

- The majority of lighting in the Camp and Low facilities utilized fluorescent fixtures equipped with linear 4' fluorescent 40W T12 lamps, or 34W T12 lamps running on instant standard and hybrid ballasts.
- Constellation replaced the T12 lamps with high light output, high color rendering 28W T8 lamps with electronic ballast.
- In addition, the Housing units in the Medium prison utilize 400W metal halide fixtures.
- Constellation replaced fixtures with new T5 fixtures to improve energy efficiency, light levels and quality.
- A secondary benefit is improved security: the new fixtures will come to full brightness nearly instantaneously, compared to the existing fixtures that require several minutes to reach full light output.

ECM 10: Water Upgrades

- Many plumbing and kitchen fixtures used more water than necessary. Increased water use meant an added load on the sewage system, and an associated cost to heat the water. High dishwasher water use also means a corresponding chemical and utility cost increases.
- Existing systems at the Low, Medium, and Camp facilities were retrofitted or replaced, including domestic fixtures such as toilets, urinals, lavatory flow controls, and showers.
- In particular, Constellation used I-CON control systems to limit the number of times inmates can flush or the number of minutes they can leave a shower on. An electronic timer shuts of the water flow after a set number of events (or time), all adjustable by the prison staff. The system can also be used to disable any flushes (or water flow) if desired.
- This resulted in substantial savings, as a large part of the water usage was due to inmates' overuse of their facilities.
- In addition to savings almost 70,000 kgal/year and 9,000 MMBtus/year, all of the china from replaced fixtures was recycled.

ECM 11: Ground Source Heat Pumps (GSHP)

- Constellation installed three ground source heat pump system with a capacity of 15 tons of cooling each, and an aggregate of 45 tons of cooling.
- The system will allow FCC Petersburg to reduce their natural gas load by providing a renewable source of heating in the winter and cooling in the summer.
- Vertically bored 60 wells 180’ deep to form a closed-loop, water-cooled system, with each well approximately 15 feet apart (to prevent over-heating/saturation of the ground). The water is cooled or heated as needed by the ambient temperature of the earth.

ECM 11: GSHP Photos

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ECM 12: Solar Photovoltaic System

- The roof of the new biomass boiler is equipped with an 18 kW solar photovoltaic (PV) system.
- The PV system consists of 100 crystalline panels and an inverter in the boiler room.
- The system functions year round and requires minimal maintenance other than sweeping and keeping general debris clear.
- Solar performance data will be monitored by Constellation staff.

ECM 12: Solar Photovoltaic System Photos

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Meeting Sustainability Goals

- Implementation of these ECMs greatly assist FCC Petersburg in meeting its goals for the utilization of renewable energy resources.
- In particular, due to new Federal Energy Management Program (FEMP) guidance, the biomass boiler is entitled to be scored against FBOP's goals on a kWh equivalent basis even though it produces steam.
- The biomass project will generate 14,300,000 kWh equivalent of renewable energy, comparable to 70% of the site's electric energy usage.

Meeting Sustainability Goals

- The remaining ECMs involve more conventional technologies such as lighting, control upgrades, dryer heat recovery, ozone laundry, an air cooled chiller, and VSD for chillers which will produce energy and economic savings.
- Like other ESPC projects, they allow FCC Petersburg to leverage private sector capital to make infrastructure upgrades that otherwise would need to come from budgeted funds.
- Among the more significant measures involved here are ones which will allow the steam plant to be turned off in the summer and the chiller to be turned off in the winter.
- These ECMs will produce both significant cost savings and reduce air emissions.

Meeting Sustainability Goals

- Energy Savings and Emissions Reduction

Description	Energy Million Btu	Gross Sqft	Btu/ Sqft
FY2007 Baseline	230,026	1,015,000	226,637
Savings	31,892	1,015,000	31,420
Post-Installation	198,134	1,015,000	195,217
Savings %	14%	NA	14%

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Meeting Sustainability Goals

- Energy Savings and Emissions Reduction

Description	NOx (lbs)	SO2 (lbs)	CO_2 (Tons)
FY2007 Baseline	178,207	287,523	30,173
Savings	9,599	22,066	6,943
Post-Installation	168,608	265,457	23,230
Savings %	5.3%	7.6%	23%

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