# Upper Occoquan Service Authority
# Centreville, Virginia
## A Case Study

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Energy Systems Group

BLAKE CONSTRUCTION
UPPER OCCOQUAN WWTP
14635 COMPTON ROAD UOSA CONTRACT 54
CENTREVILLE, VA
View: AERIAL

# About the Upper Occoquan Service Authority

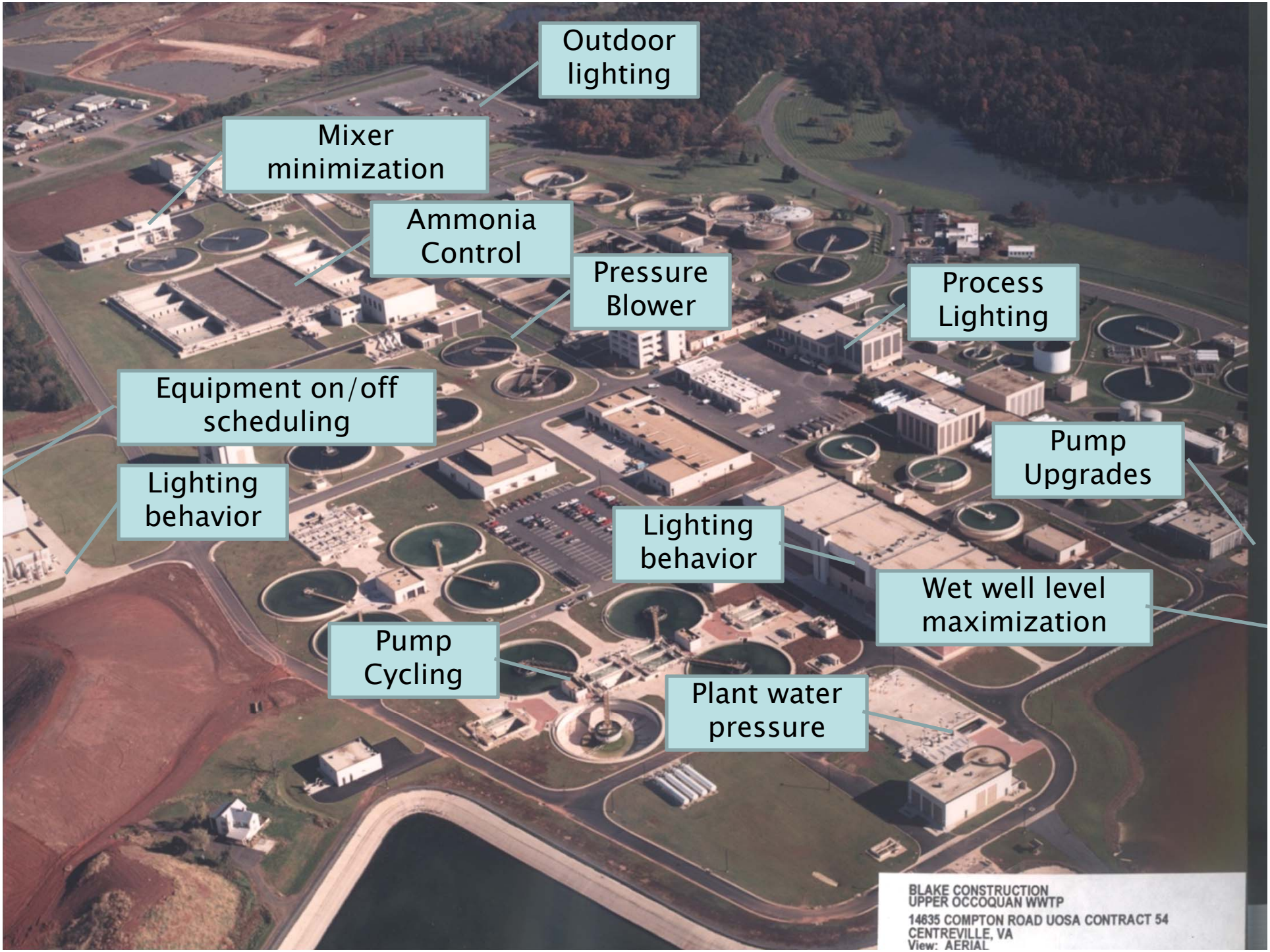
- **54 MGD Advanced Water Reclamation Plant with Indirect Potable Reuse**

- Permit Limits
  - Nitrogen (TKN): 1.0 mg/L
  - Phosphorus: 0.1 mg/L
  - TSS: 1.0 mg/L

Utility Rates
- $.063/kwh
- $1.30/kW
- $1.10/therm

- Primary-secondary treatment with following advanced treatment processes:
  - chemical clarification
  - two-stage recarbonation with intermediate settling
  - multimedia filtration
  - granular activated carbon adsorption
  - chlorination for disinfection and dechlorination

- Final discharge to the Occoquan Reservoir – drinking water for 1.4 million people (20% of reservoir inflow)


Outdoor lighting
Mixer minimization
Ammonia Control
Pressure Blower
Process Lighting
Equipment on/off scheduling
Pump Upgrades
Lighting behavior
Lighting behavior
Wet well level maximization
Pump Cycling
Plant water pressure
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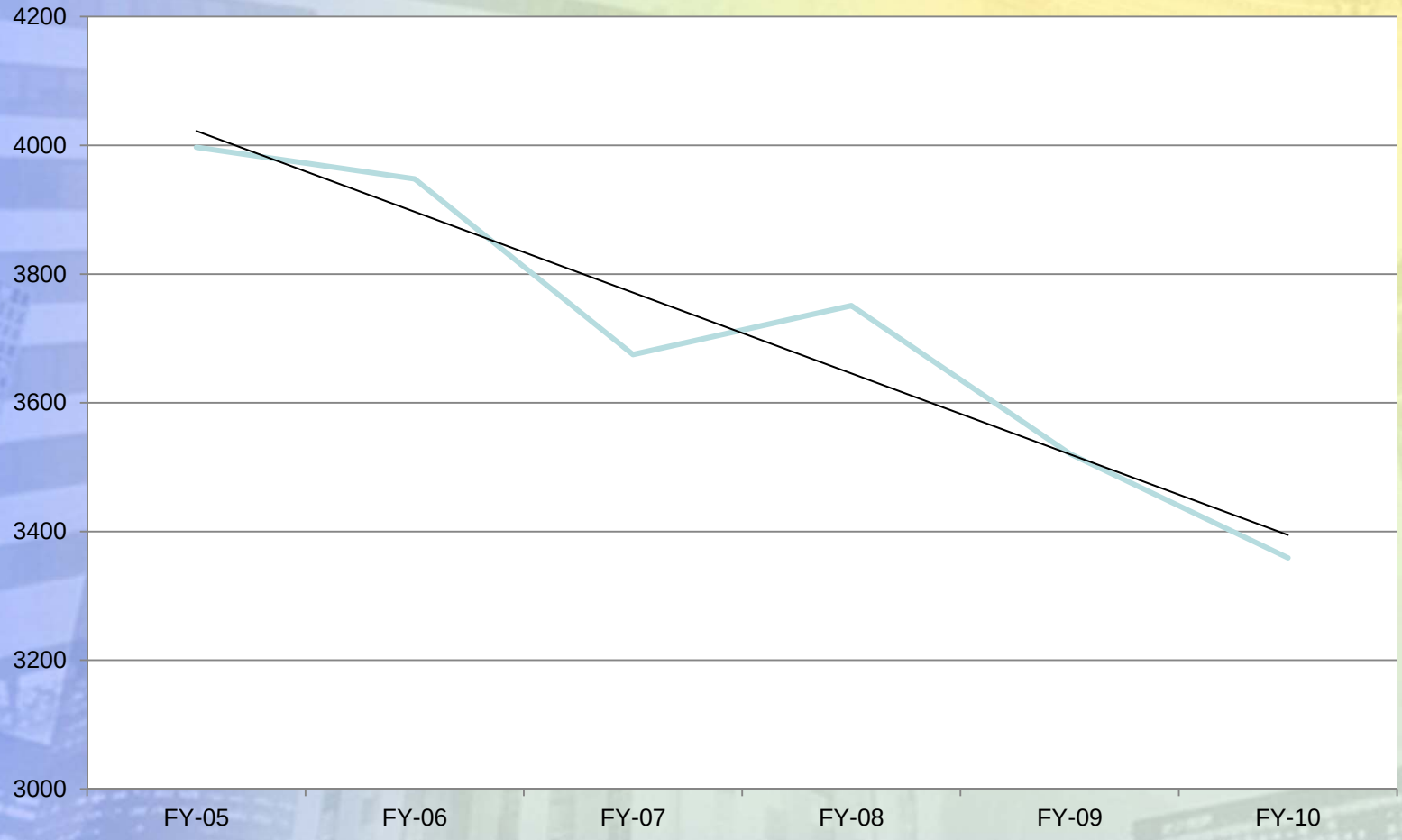
# Impact of Efforts (kwh/MG treated)



# Why a performance contract?

- Big energy projects are beyond in-house capability
- Available funds limited
- Far too many lighting and HVAC projects to tackle
- Unknown unknowns
- Slow

**<u>UOSA's Project Goals</u>**

- Highly interactive
- Bottom-line driven, maximize return on investment
- No bells and whistles
- No concern for greenhouse gas reduction

UOSA — Energy Service Company

## Phase 1
## Request for Proposal or Expression of Interest

- Preliminary analysis that evaluates the viability of opportunities for savings
- Preliminary energy conservation measures
- Preliminary costs and savings
- Preliminary measurement and verification plan
- References
- Project Approach
- Other Company Specific Information

Owner reviews audit and decides to move forward with detailed investigation

## Phase 2
## Project Design & Scope Development

Finalized contract ready for signature that includes:

- Detailed project scope
- Final project price
- Guaranteed energy and dollar savings
- Finalized construction schedule
- Financing package
- System commissioning plan
- Finalized measurement and verification plan
- Staff training plan
- Maintenance plan

Owner approves final project specifics, signs performance contract, and provides "Notice to Proceed"

## Phase 3
## Construction

- Negotiation and execution of subcontracts
- Execution of project financing
- Implementation of project scope
- Training of facility staff
- Commissioning of installed systems

Owner approves substantial and final completion of all construction

## Phase 4
## Performance Management

- Monitoring of energy savings
- On-site measurement
- Measurement and verification reports
- Warranty
- Maintenance

Owner witnesses onsite measurements to verify savings and works with Energy Service Company towards continuous improvement.

# Opportunities for Savings

- Blower and aeration system
- Boiler replacements
- Compressors - review need for DAFs and plant air reqs.
- Condensate use for building heating
- Condensate use for sludge preheating
- Destratification fans for main areas
- Digester gas cogeneration plant
- Eliminate mechanical cooling, use economizer for electric room cooling
- Evaluate electromagnetic control systems in the electrical network
- Evaluate film addition/ window replacement

# And some more…

- Evaluate lab building exhaust and building air balance
- Evaluate where extra hardware (pressure gages etc) is needed to evaluate pump efficiencies
- Filter effluent rather than W-2 for chiller cooling
- Heat recovery of condensate from CO2 quench
- Heat recovery with waste heat off compressors
- Hot start emergency generator block heater
- Hot water jacket in paddle mixer that uses condensate
- Humidity based ventilation control
- Hydroelectric plant at outfall
- Hydro-pneumatic pressure control for plant water distribution system

# And more still…

- Inject carbon dioxide into pipe rather than to the recarb basins
- Install water cooled heat pump with plant water
- Is extra insulation needed to avoid wasting energy cooling the air
- Hyperboloid Mixer for clorination/declorination
- Lighting improvements
- More efficient DAF system
- Onsite mini hypo system
- Optimize plant water distribution system pressure setting.
- Piping repair to optimize hydraulics
- Replace air operated diaphragm pumps

# Just a few more…

- Replace DAFs with alternative thickening approach
- Replace electric heat with natural gas
- Replace old compressors to support overall system
- Review classification of building - has both types of lighting fixtures
- Review dryer operation improvements options
- Review need to run odorous air through scrubbers in the winter
- Review ventilation and heating/cooling requirements
- Steam Traps Repair/Replacement
- Synchronous belts on fans and belt driven pumps
- Timers or push-button controls on unit heaters; review need for unit heaters in semi - occupied spaces

# Flexibility of the Process

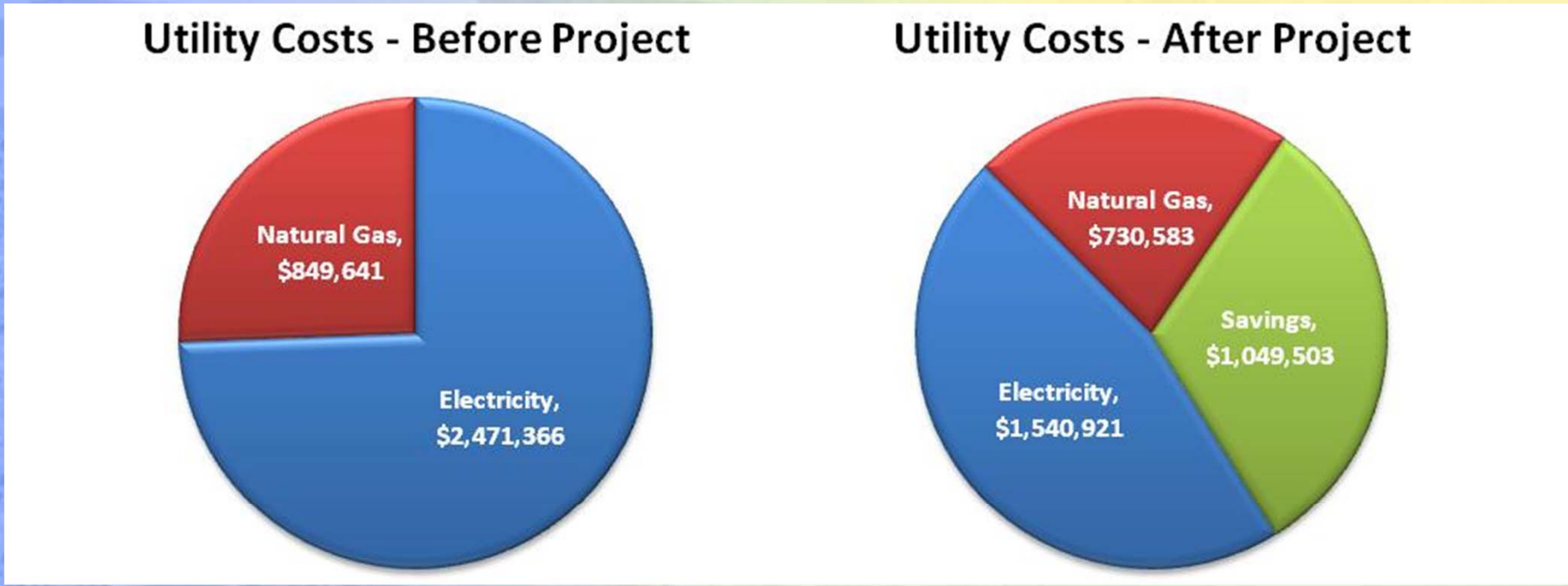
| Blower Replacement Options | Cost | Tax | Markups | Total Price | Difference from Base Price |
|---|---|---|---|---|---|
| 2 600 HP Blowers by Brand A to Replace 2 350 HP Blowers **(Base Scope)** | $923,215 | $39,152 | $115,728 | $1,078,095 | $0 |
| 4 300 HP Blowers by Brand A to Replace 3 350 HP Blowers | $1,106,499 | $46,342 | $138,633 | $1,291,474 | $213,379 |
| 3 350 HP Blowers by Brand A to Replace 3 350 HP Blowers | $905,393 | $36,459 | $113,261 | $1,055,113 | ($22,982) |
| 4 300 HP Blowers by Brand B to Replace 3 350 HP Blowers | $858,499 | $33,942 | $107,319 | $999,760 | ($78,335) |
| 4 300 HP Blowers by Brand B to Replace 4 350 HP Blowers | $868,474 | $34,065 | $108,533 | $1,011,072 | ($67,023) |
| 3 400 HP Blowers by Brand B to Replace 3 350 HP Blowers | $769,393 | $29,659 | $96,089 | $895,141 | ($182,954) |

# Final Project Scope ($12.1M)

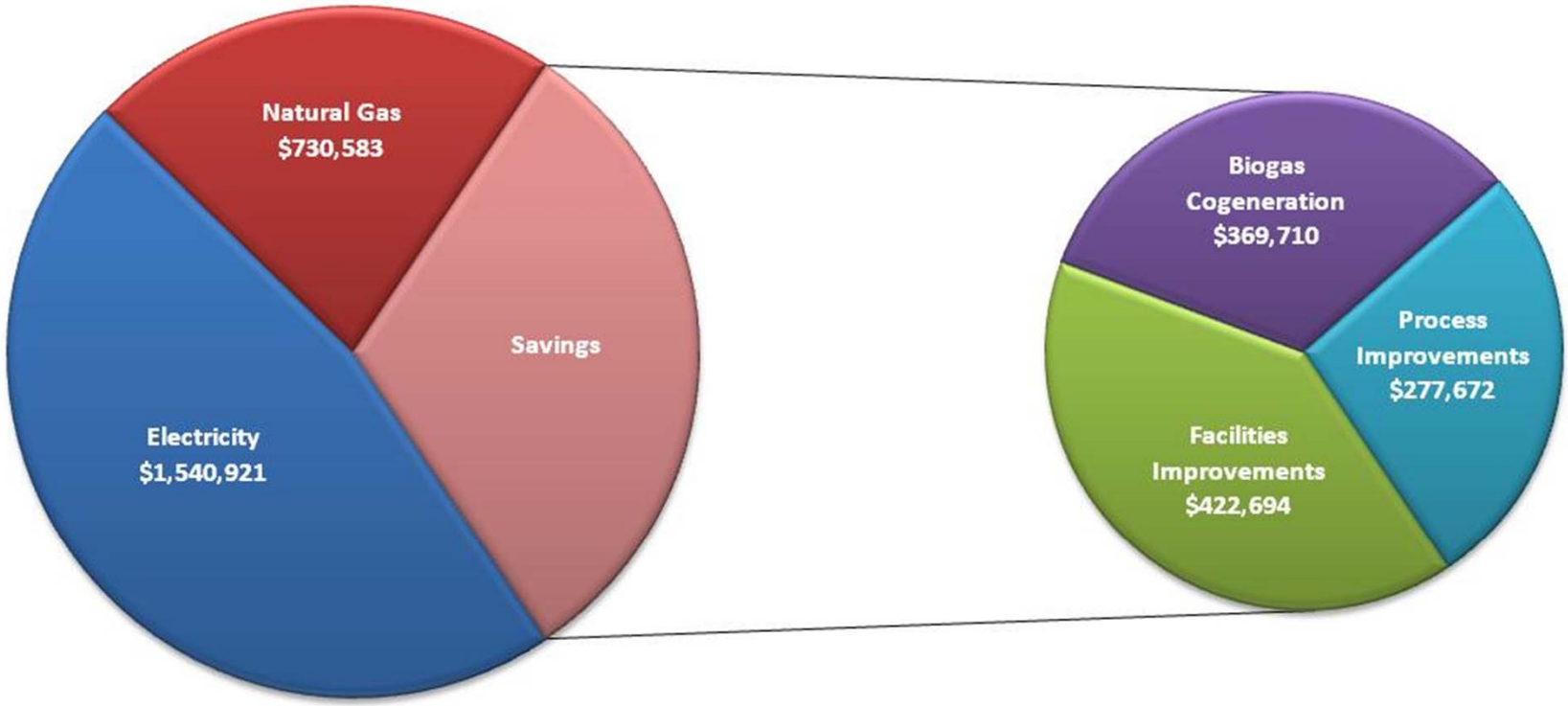
- **Cogeneration**
  - 780 kW Digester Gas Driven Cogeneration Plant
- **Facilities Improvements**
  - Buildings and Exterior High Efficiency Lighting
  - Review Ventilation and Heating/Cooling Requirements
  - Push Button Controls on Unit Heaters
  - Humidity Based Ventilation Control
  - Condensate Use for Building Heating
  - Carbon Dioxide based Ventilation Control for Admin. Areas
- **Process Improvements**
  - Blower and Aeration System Improvements
  - Filter Effluent Piping Improvements
  - Plant Water System Improvements

- **Final Project Scope and Price determined in 10 months.**

# What They'll Achieve

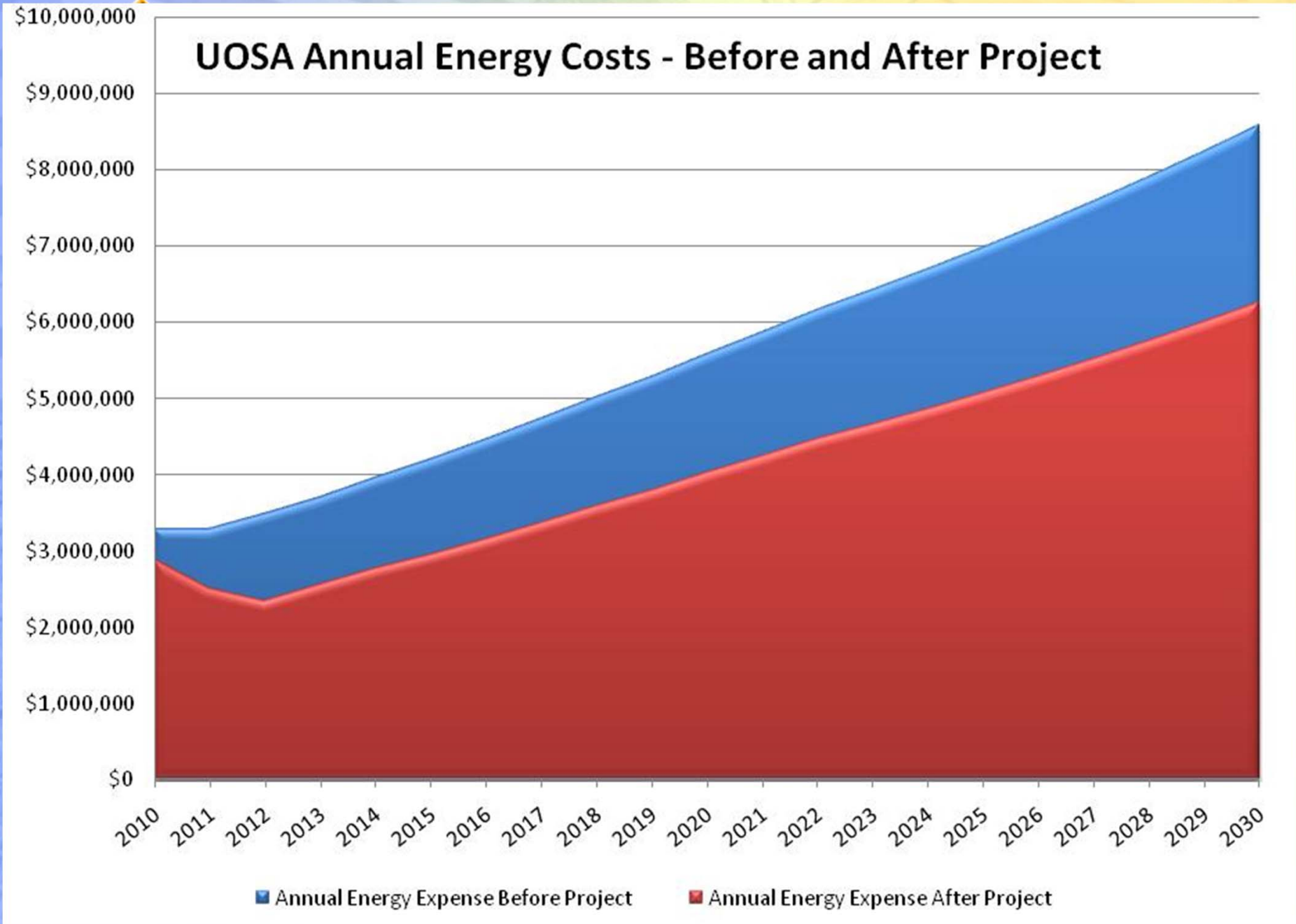


# Sources of the Annual Savings



# Ensuring the Savings

| Energy Conservaton Measure | M&V Method | What is Measured? |
|---|---|---|
| Cogeneration Plant | Measured | Input Gas Flow, Power Output, Gas Sample Analysis, Hot Water Flow Rates, Hot Water Supply, Hot Water Return |
| | | |
| Lighting Retrofit | Measured | Fixture Wattage |
| Review Ventilation And Heating/Cooling Requirements | Measured | Airflow from AHUs |
| Timers Or Push-Button Controls On Unit Heaters | Calculation | N/A |
| Humidity Based Ventilation Control | Calculation | N/A |
| Condensate Use for Building Heating | Calculation | N/A |
| Add $CO_2$ Based Demand Control Ventilation For Admin Areas | Calculation | N/A |
| | | |
| Blower And Aeration System | Measured | Input power at various load conditions |
| Filter Effluent Piping Improvements | Measured | Discharge Head |
| Filter Effluent Rather Than W-2 For Chiller Cooling | Calculation | N/A |
| 2-W Jockey Pumps with Variable Frequency Drives. | Measured | Flow and Power at VFD |


UOSA Annual Energy Costs - Before and After Project
$10,000,000
$9,000,000
$8,000,000
$7,000,000
$6,000,000
$5,000,000
$4,000,000
$3,000,000
$2,000,000
$1,000,000
$0
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
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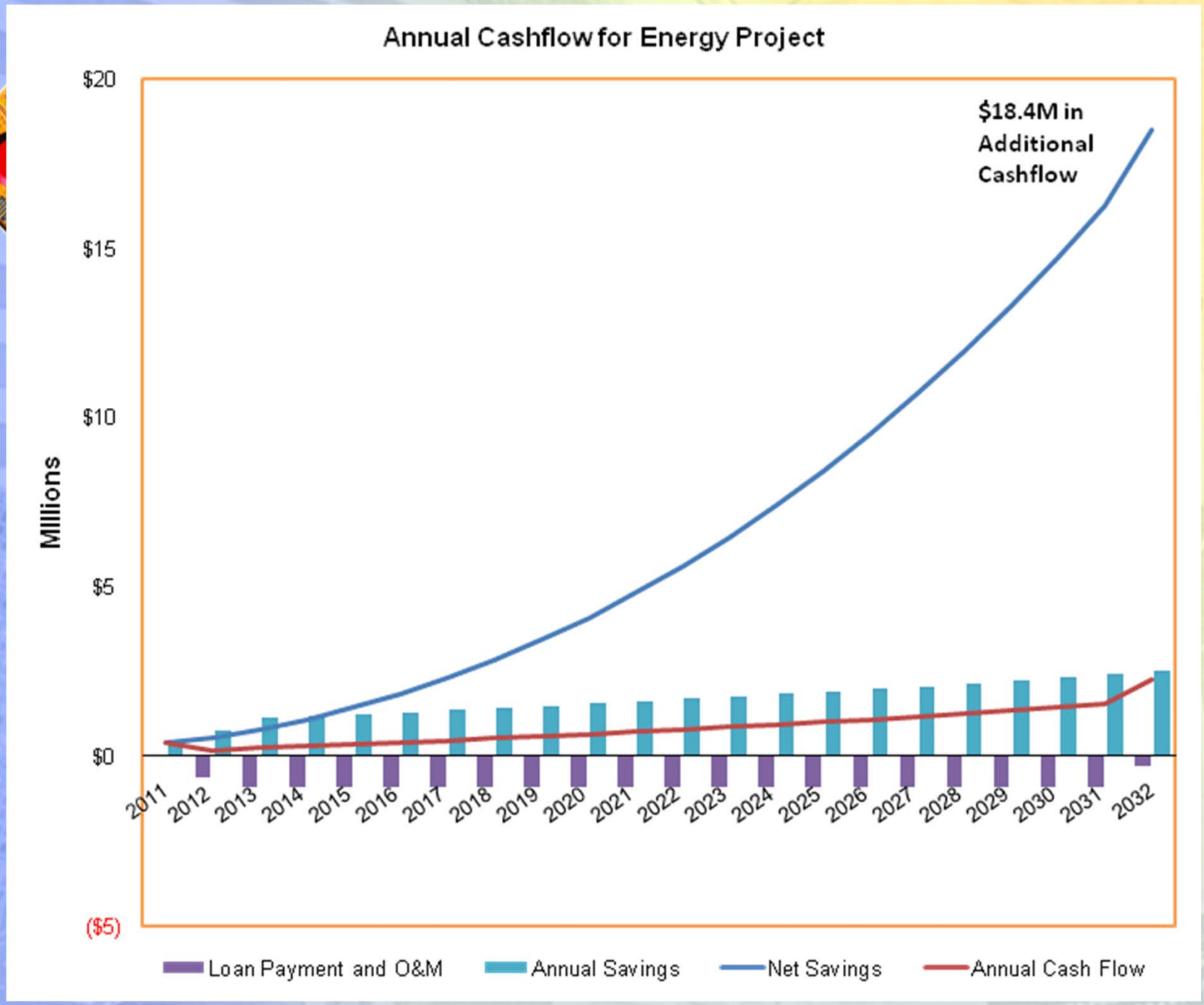
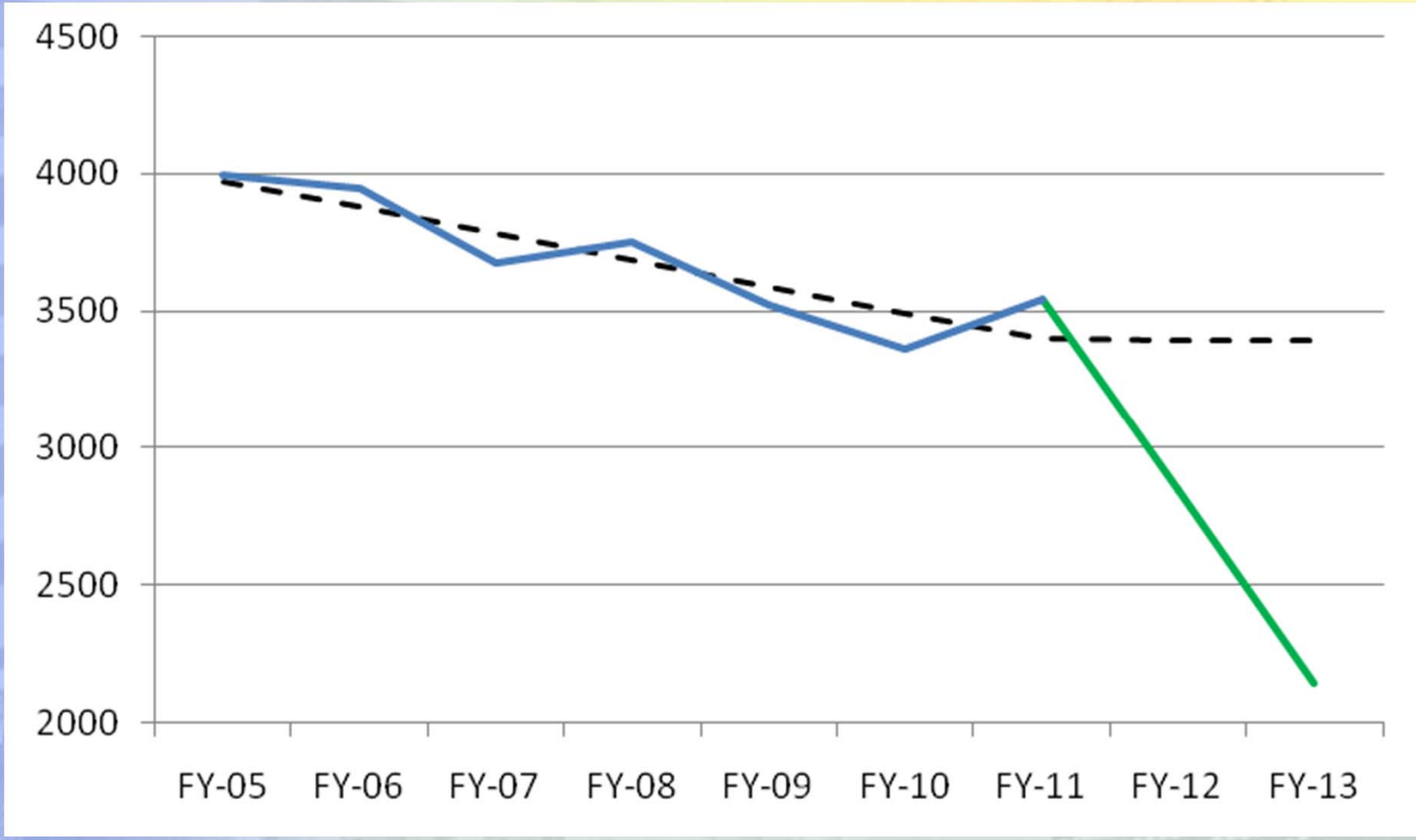
2029
2030
Annual Energy Expense Before Project
Annual Energy Expense After Project


Annual Cashflow for Energy Project
$18.4M in Additional Cashflow
Millions
$20
$15
$10
$5
$0
($5)
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
Loan Payment and O&M
Annual Savings
Net Savings
Annual Cash Flow

# Impact of Performance Contracting



# Questions?

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