SMART LABS: IMPROVING ENERGY AND COMFORT

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CREATING THE NEXT®

GT FACILITIES SUSTAINABILITY FORUM

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WHAT DOES SMART LABS MEAN FOR GT?

Georgia Tech

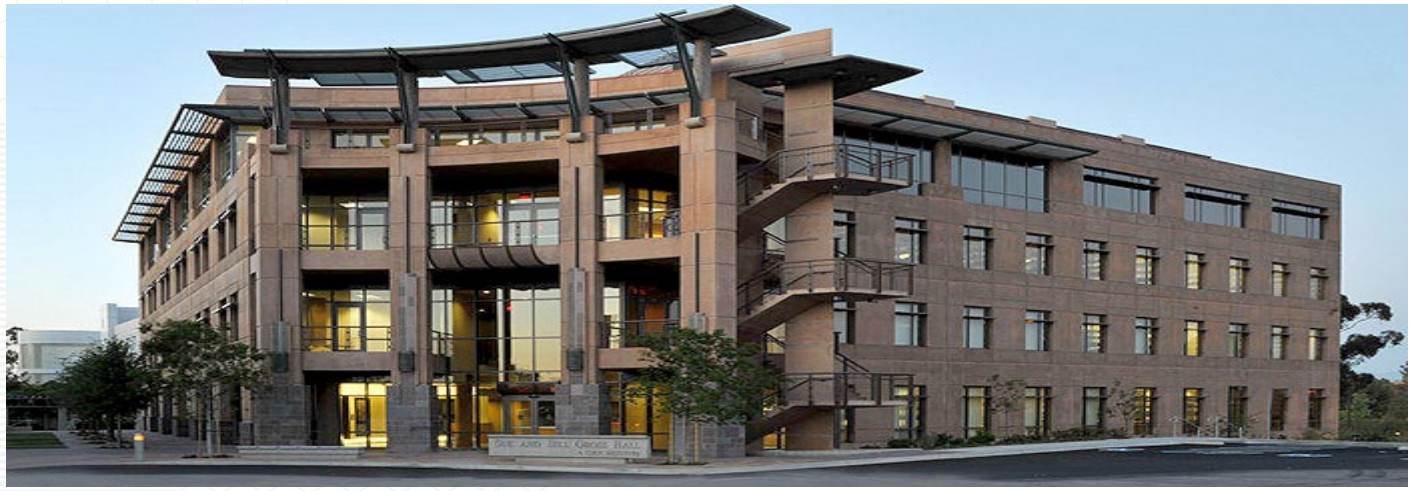
Safer, more reliable and consistent environment to conduct research

Opportunity to address deferred maintenance issues

Significant energy reduction/reduced carbon footprint

THE SEED IS PLANTED...

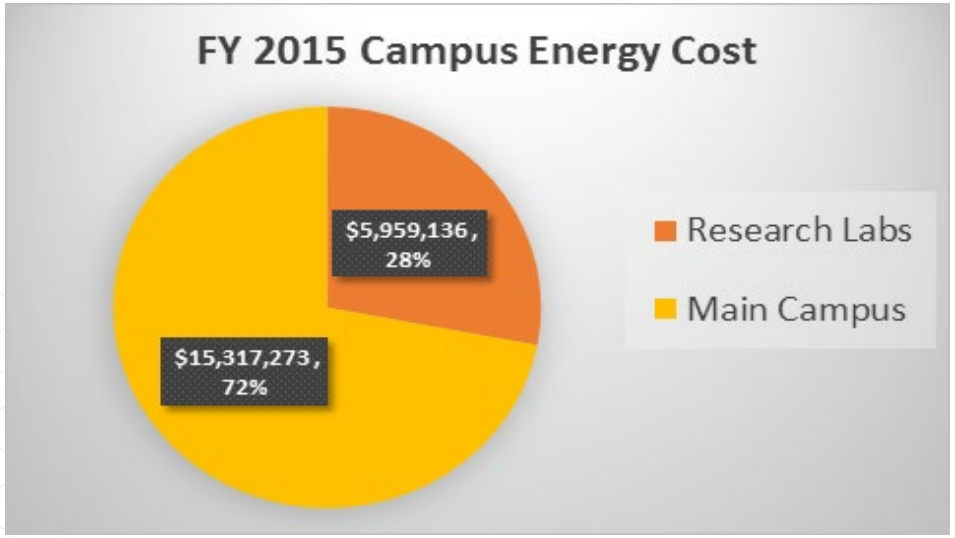
- 2015-2016: GT A&F learns of UCI Smart Labs initiative
  - Mandate for energy cost-cutting in California
  - Huge area of potential in recently-constructed laboratory buildings with additional controls
- 2016: Various GT A&F personnel visit UCI to see the initiative in action and discuss with UCI representatives



Sue and Bill Gross Stem Cell Research Center – University of California, Irvine

Features	Best Practices	Smart Lab
Occupied ACH	6 ACH	4 ACH
Exhaust stack discharge velocity	3,000 FPM	~1,500 FPM
Unoccupied ACH	Usually no setback	2 ACH

GOALS AND MOTIVATION



- "BioQuad" comprises a large portion of our research labs
- 2 other buildings just outside the BioQuad that were also considered
- Huge energy consumption by our research facilities = huge area of opportunity for operation cost reduction(s)

GOALS AND MOTIVATION – PART DEUX

- **$$$$$$$$$$$$$$$$$$**
  - You don't have to be a CPA or stock broker to realize that this up front investment can generate a larger ROI in the future
    - Energy savings as soon as the bullets are live
    - "Smart" system decreases deferred maintenance…at least in theory
  - To put Georgia Tech on the forefront of large sustainable laboratory efforts
    - Be another Institution on the cutting edge of embracing new technologies to make labs safer and more energy efficient
- **A way to address existing problems in each of these research buildings**
  - The Facilities team knew of many existing problems including temperature balance/extremes from one area of the building to another, air pressure issues, and over-ventilation
    - Complaints about doors being hard to open/close, ACH rates as high as 20 ACH, etc.

WHY IN THE WORLD IS EHS CONCERNED??

- **Reduced air changes = increased potential for inadequate ventilation**
  - ❑ What happens when the research changes? How about a gas leak or a chemical spill?
    - Dependence on more gadgets, bells, and whistles…yikes
      - ➢ How dependable are those? What about frequency of maintenance? Cost? Burden on the lab's time?
- **How can EHS do a thorough risk assessment to identify areas of opportunity for ACH reduction?**
  - ❑ Variance of research is huge
    - Chemical work fairly omnipotent…but what about work with animals in vivariums? Biological hazard work? Nanomaterials? Radiological work?
      - ➢ What is the mechanism for thoroughly investigating the scope of research in just one lab? How about a building where lab spaces are open bays and the air is shared?
- **Concern about resistance from the lab personnel**
  - ❑ What's in it for them? Do they reap tangible benefits? Or do they look at it as an unnecessary burden on their time?

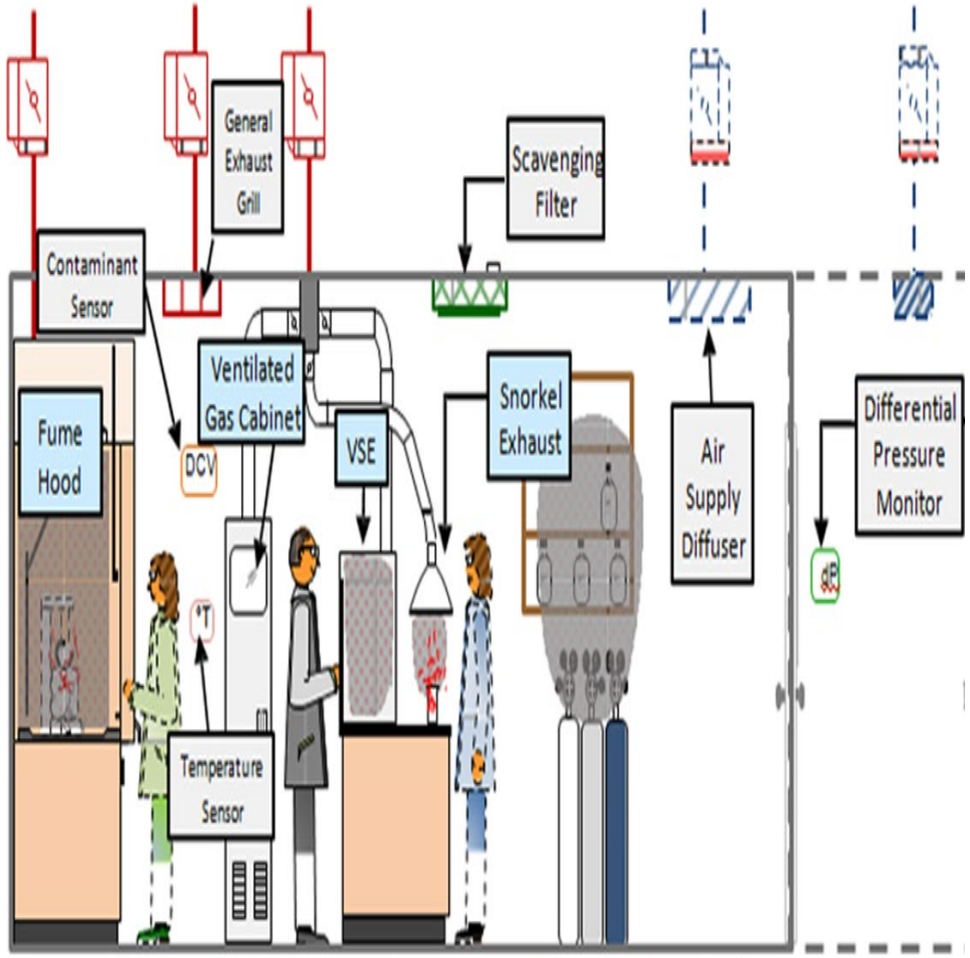


Figure 1 Side view of lab depicting various ECDs and Lab Ventilation Components

THE PLAN (BECAUSE YOU HAVE TO HAVE A PLAN…) PART 1

- Ambient Air Technologies (AAT) brought in to determined atmospheric conditions in the Bioquad; see where turn-down potential exists irrespective of any other efforts made
- Mock-up, small scale version of this area of campus put into wind tunnel in Fort Collins, CO – EHS and Facilities D&C visit

WIND TUNNEL DEMO

CONSULTANT BROUGHT IN FOR MECHANICAL SYSTEMS EVALUATION

- **Consultant brought in to audit current mechanical conditions in Whitaker**
  - We already knew things were quite a bit out of whack...and this confirmed it
  - Huge opportunity to save energy just by fixing existing problems with airflow
    - Systems not properly maintained
    - Huge positive and negative pressure disparities from one area to the other; same with temperature

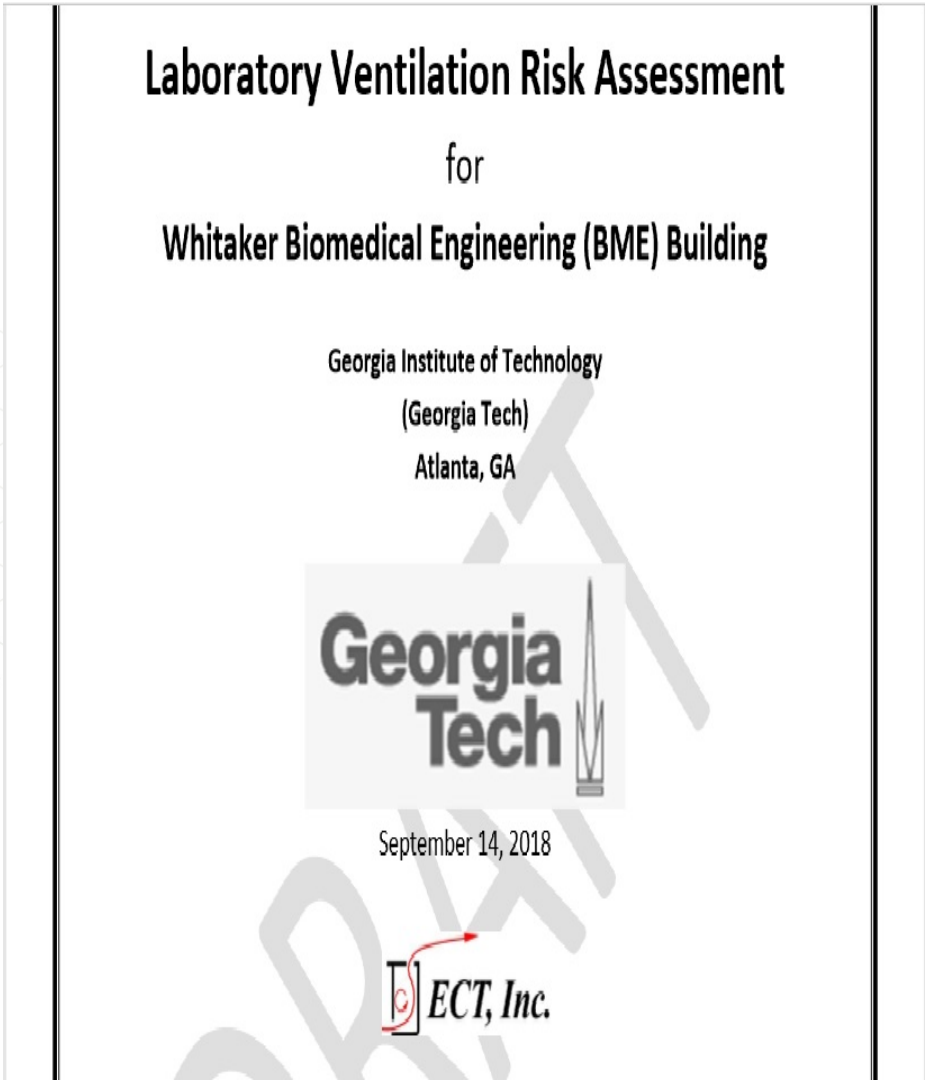
THE PLAN (BECAUSE YOU HAVE TO HAVE A PLAN…) PART 2

- **What building to start the effort?**
  - ❑ Ford Environmental Science and Technology Building
  - ❑ Reverse order this time; LVRA first, then mechanical systems evaluation

- **U. A. Whitaker Biomedical Engineering (BME) Building**
  - ❑ Lots of opportunities due to system maintenance that's already needed; building is new enough (2006) that systems are more able to be modified with new equipment without wholesale changes; The building isn't so new that we aren't getting much bang for the buck
  - ❑ Low-hazard, relatively speaking…or is it?

LAB VENTILATION RISK ASSESSMENT

- LVRA conducted in the Spring of 2018
- EHS personnel accompanying 3rd party personnel conducting LVRA
  - Can't support this enough! Critical piece...
- Draft of report released back to EHS
  - Lab/Chem Safety, Biosafety, and AVP read report; had conference with ECT/3Flow on some of the findings
- Final report issued to GT Facilities powers that be for assessment of their report


Laboratory Ventilation Risk Assessment

for

Whitaker Biomedical Engineering (BME) Building

Georgia Institute of Technology

(Georgia Tech)

Atlanta, GA

Georgia Tech

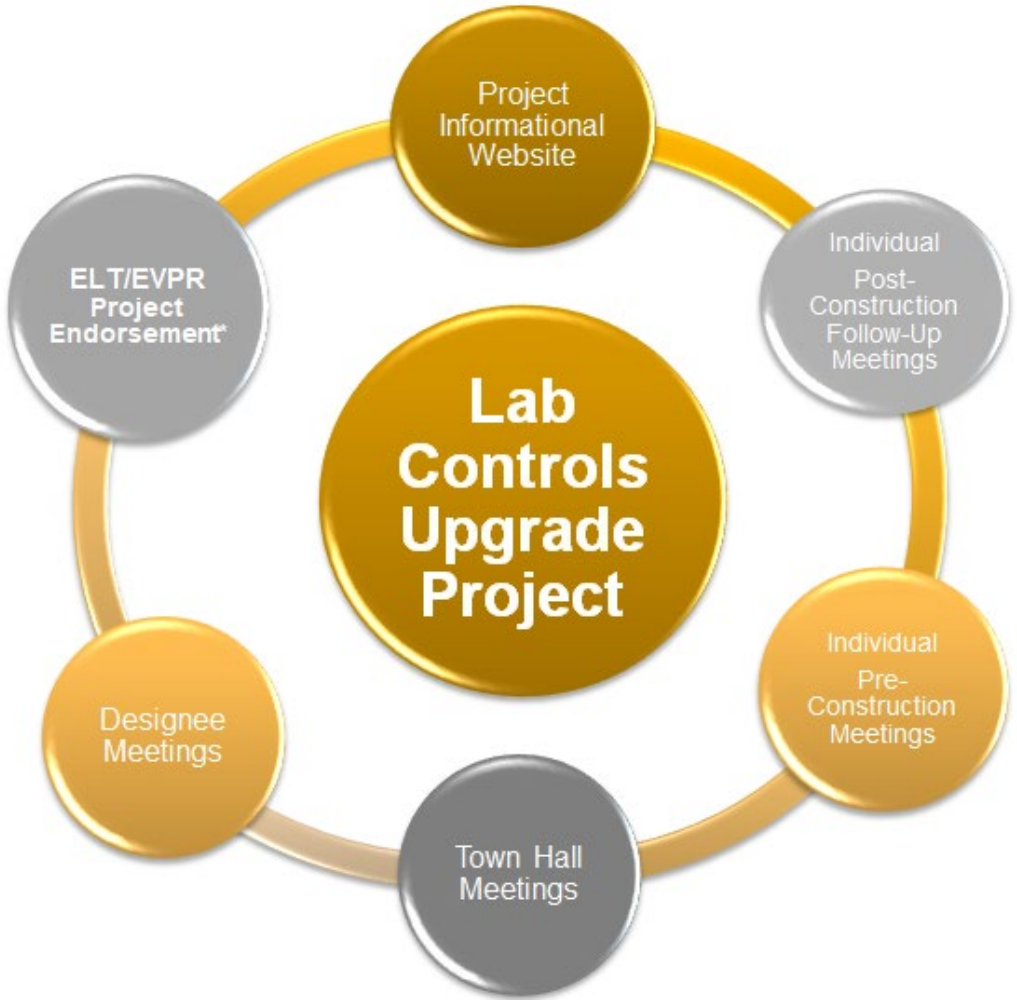
September 14, 2018

ECT, Inc.

PROJECT COORDINATION

Project Communications

- EVPR Support/Meeting with Associate Deans of Research
- Periodic Town Hall/Q & A Meetings
- Departmental Meetings
- Website Communication
- Project Overview & Facts
  - Meeting Minutes
  - Updated Construction Schedule
- Pre-Construction and Post-Construction Meetings with the researchers



DURING CONSTRUCTION

Project Challenges

- **Rigidity of schedule**
  - Contractual construction completion within 15 months
  - Strict FY & BOR schedule leaves essentially 3 months for IGA including pilot
  - Assigned departmental designees to assist with schedule coordination
  - Access to labs during the M & V phase

- **Complexity in Management and Construction Coordination**
  - Over 140 labs completed (under 12 months)
  - Each lab off-line for one full week
  - Minimize disturbance to adjacent labs
  - Modified work hours in UA Whitaker
  - Lab configuration in U A Whitaker (“open-lab” layout)

Georgia Tech Potential Project Flow

Select a period to highlight at right. A legend describing the charting follows. *Revised 12/18/19* Period Highlight:

ACTIVITY	PLAN START	Dept.	Lab PI	Floor	Section	Week	PLAN DURATION	PERCENT COMPLETE
BME Schedule Coordination	28					1/13/2020	1	0%
BME Lower Level								
BME lower Level Floor As-Built, Docs	32					2/10/2020	5	0%
BME Lower Level Floor Drawing Review &	37					3/16/2020	2	0%
BME 0243, 0244	29	BME	Balakrishna	0		1/20/2020	1	0%
BME 0246, 0250	30	BME	Balakrishna/ Rain	0		1/27/2020	1	0%
BME 0245	31	BME	Balakrishna	0		2/3/2020	1	0%
BME 1st Floor								
BME First Floor As-Built, Docs	36					2/24/2020	5	0%
BME First Floor Drawing Review & Finalization	41					3/30/2020	2	0%
BME 1219 & 1246	34	BME	Cheng Zhu/Tsygankov	1		2/10/2020	1	0%
BME 1248 & 1249	35	BME	Cheng Zhu	1		2/17/2020	1	0%
BME 2nd Floor								
BME Second Floor As-Built, Docs	42					3/30/2020	5	0%
BME Second Floor Drawing Review & Finalization	47					5/4/2020	2	0%
BME 2216	36	BME	Dahlman	2		2/24/2020	1	0%
BME 2217, 2218 & 2236	37	BME	2217 Equipment Corridor 2218 Dahlman 2236 Hollister	2		3/2/2020	1	0%
BME 2222, 2235, 2237/2244, 2234	38	BME	2222Shu Jia 2235 Hollister 2237 Margulies 2234Hollister	2		3/9/2020	2	0%
BME 0238 & 2240/2241	40	BME	0238 Shared instructional lab 2240 LaPlaca/Margulies	2		3/16/2020	1	0%
BME 2245	41	BME	LaPlaca	2		3/23/2020	1	0%

DURING CONSTRUCTION

POST-CONSTRUCTION

Ford ES&T -TEL Lab Conversion

General Lab Space Changes
- New TEL Room Controller
- Purge Button
- Area Motion Sensor(s)
- Lab Supply Valve Actuator Change-out (new fast-acting actuator)
- New Lab Supply Differential Pressure Sensors and Probes
- General Exhaust Valve Actuator Change-out (new fast-acting actuator)
- New General Exhaust Differential Pressure Sensors and Probes

Fume Hoods Changes (when applicable):
- TEL Fume Hood Controller
- TEL Auto-Sash Closer with Occupancy Sensor
- Lab Exhaust Valve Actuator Change-out (new fast-acting actuator)
- New Lab Exhaust Differential Pressure Sensors and Probes

Snorkels (Task Exhaust) Changes (when applicable)
- New Fast-Acting Actuator
- On/Off Wall Switch

U A Whitaker-New Upgraded Triatek Controls

General Lab Space Changes
- New/Upgraded Triatek Room Controller
- Area Motion Sensor(s)
- Lab Supply Valve Actuator Change-out (new fast-acting actuator)
- New Lab Supply Differential Pressure Sensors and Probes
- General Exhaust Valve Actuator Change-out (new fast-acting actuator)
- New General Exhaust Differential Pressure Sensors and Probes

Fume Hoods Changes (when applicable):
- New/Upgraded Triatek Fume Hood Controller
- TEL Auto-Sash Closer with Occupancy Sensor
- Lab Exhaust Valve Actuator Change-out (new fast-acting actuator)
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Snorkels (Task Exhaust) Changes (when applicable)
- New Fast-Acting Actuator
- On/Off Wall Switch

POST-CONSTRUCTION

GUARANTEED ENERGY SAVINGS PERFORMANCE CONTRACT

State Agency:	Georgia Institute of Technology				State Project #:	C0378-2018	
ESP Name:	ABM				Date Submitted:	June 04,2019	
Total Financed Project Cost[1]		$6,448,462			Escalation Rates:		
Annual Interest Rate		2.635%	*Planning rate (updated May 03, 2019)*			Utilities[2]	2.50%
Finance Term (years)		11		Fiscal Years		Operational Savings	3.00%
Construction Period (months)		15				Continuing Services	3.00%
Guaranteed Utility Savings to Projected Savings Ratio		91%	*Enter the percentage*				
Guaranteed Operational Savings to Projected Savings Ratio		100%	*Enter the percentage*				

	SAVINGS				COSTS		TOTAL	
Year[3]	Utility Savings[4]	Operational Savings[5]	Total Projected Savings	Total Guaranteed Savings	ECM Continuing Services[6]	Debt Service Payments	Total Cost	Net Cash Flow[7]
FY2020	$43,000	$141,120	$184,120	$180,250		$179,369	$179,369	$881
FY 2021 Q1	$81,213	$105,966	$187,179	$179,870		$179,369	$179,369	$501
FY2021 Q2-Q4	$316,047	$436,586	$752,633	$724,189	$180,180	$538,107	$718,287	$5,902
FY2022	$509,274	$545,726	$1,055,000	$1,009,166	$277,447	$717,476	$994,923	$14,243
FY2023	$522,006	$562,098	$1,084,104	$1,037,123	$304,871	$717,476	$1,022,348	$14,777
FY2024	$535,058	$578,961	$1,114,017	$1,065,882	$332,517	$717,476	$1,049,992	$15,889
FY2025	$548,433	$596,329	$1,144,762	$1,095,403	$360,392	$717,476	$1,077,868	$17,535
FY2026	$562,144	$614,219	$1,176,363	$1,125,770	$393,504	$717,476	$1,110,980	$14,790
FY2027	$576,197	$632,648	$1,208,843	$1,156,985	$421,859	$717,476	$1,139,335	$17,650
FY2028	$590,602	$651,625	$1,242,227	$1,189,073	$440,465	$717,476	$1,157,941	$31,133
FY2029	$605,367	$671,174	$1,276,541	$1,222,058	$448,329	$717,476	$1,166,805	$55,254
FY2030	$620,501	$691,309	$1,311,811	$1,255,985	$428,459	$717,476	$1,145,934	$110,031
FY2031 Q1	$231,447	$178,012	$409,459	$388,629	$175,716	$179,369	$355,085	$33,545
FY2031 Q2-Q4	$404,567	$0	$404,567	$368,156	$242,147	$0	$242,147	$126,009
TOTAL	$6,145,855	$6,405,773	$12,551,627	$11,998,500	$4,006,885	$7,533,495	$11,540,380	$458,120

FY20 M & V Report (Required by GEFA)

- Project completed construction ahead of schedule
- Saved $212,297 in utilities ($192,984 in ES&T and $19,313 in UA Whitaker), which is **$173,167** over the guarantee.
- Received $75,000 in Georgia Power rebates to date and anticipate an additional $139,554.
- High construction savings due to successful implementation. Savings in Year 0 is much lower than years 1-10
- Airflow savings due to higher actual floor rates than predicted at ES&T, and lower at UA Whitaker
- Tale of Two Buildings: ES&T was largely about reducing airflow, while UA Whitaker exposed dysfunctional equipment

Building	Modeled Savings	Measured Savings	% Reduction over Baseline
ES&T	74,880 CFM	112,058 CFM	73.7
UA Whitaker	32,075 CFM	19,927 CFM	52.7

FY21 PERFORMANCE

ES&T	Measured Savings	Compared to Guarantee	$ Savings
July	112,058 CFM	+42,351 CFM	$68,965
August	112,562 CFM	+42,855 CFM	$73,276
September	112,160 CFM	+42,453 CFM	$50,198

UA Whitaker	Measured Savings	Compared to Guarantee	$ Savings
July	19,952 CFM	-9,236 CFM	$12,131
August	20,584 CFM	-8,604 CFM	$12,693
September	18,160 CFM	-11,028 CFM	$7,685

Total Savings FY21 to date $224,948
33% Over Guarantee

WHERE DO WE GO FROM HERE??

Next Steps

- Concentration on Fault Detection & Diagnostic in ES&T and UA Whitaker
- 10 more years of GESPC contract

- IBB Building
  - Pilot
  - Lab Ventilation Risk Assessment

- Smart Lab integration as a standard across campus