

FDA BUILDING ONE



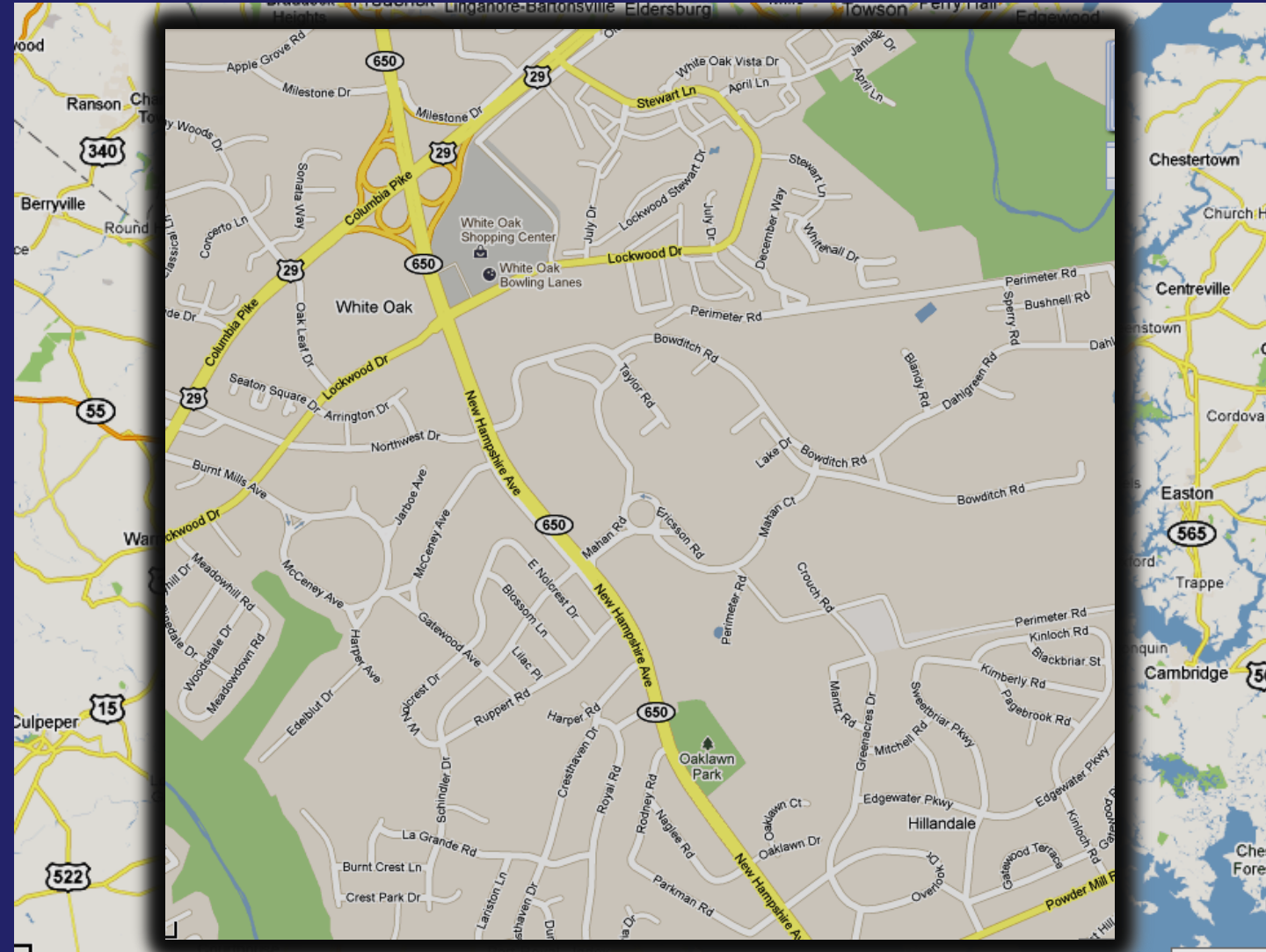
R. ANDY PAHWA

FACULTY ADVISOR: JIM FREIHAUT/DUSTIN EPLEE

AGENDA

- **PROJECT BACKGROUND**
- **EXISTING MECHANICAL SUMMARY**
- **DESIGN OBJECTIVES**
- **MECH: PHOTOVOLTAIC IMPACT**
- **CM: POWER STORAGE**
- **ELEC: DC DISTRIBUTION**
- **FINAL RECOMMENDATIONS**

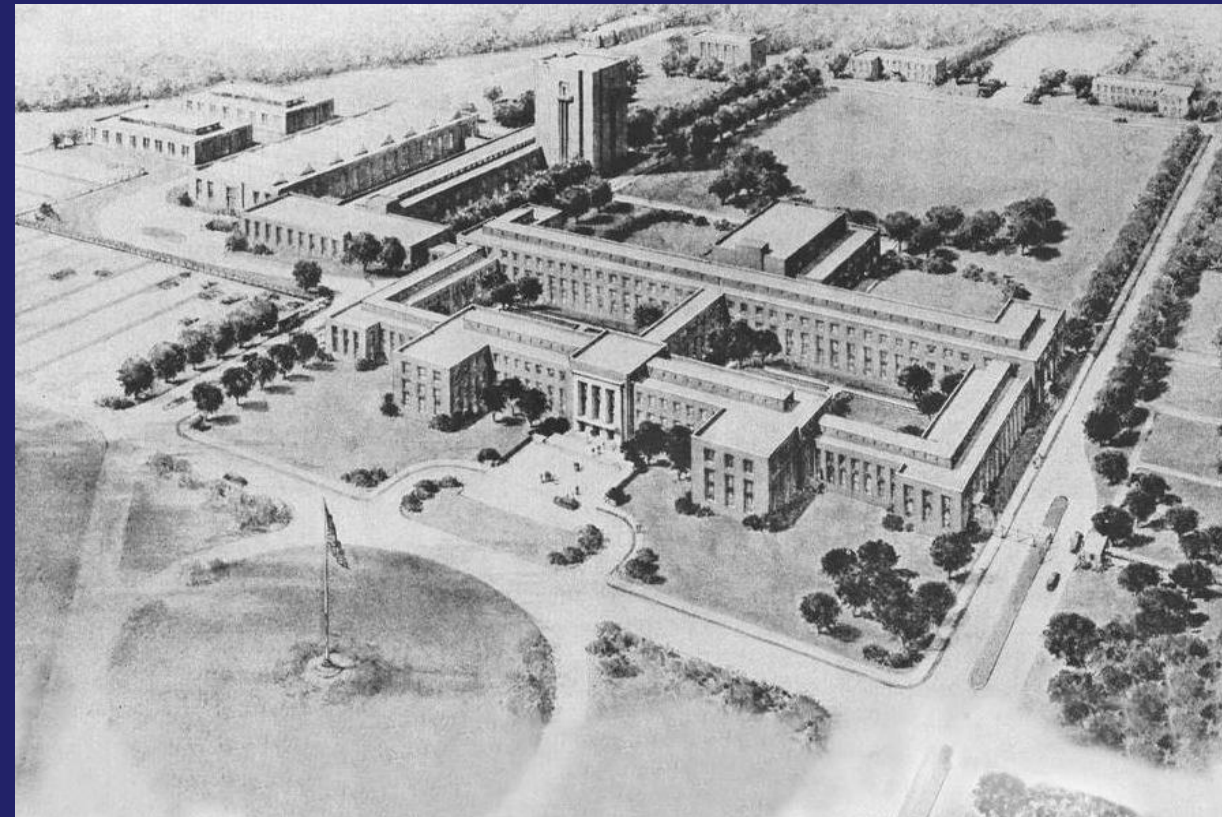
PROJECT BACKGROUND



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PROJECT BACKGROUND



ORIGINALLY THE HEADQUARTERS OF THE
NAVAL SURFACE WARFARE CENTER

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PROJECT BACKGROUND

FUNCTION TYPE:	OFFICE BUILDING
SIZE (GSF):	102,000 SF
NUMBER OF STORIES:	4 STORIES ABOVE GRADE + PENTHOUSE
DATE OF CONSTRUCTION:	9/25/2007 – 11/15/2008
CONTRACT AMOUNT:	\$36,444,302



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PROJECT BACKGROUND

CONSTRUCTION OVERVIEW:

- MODERNIZATION
- PORTIONED – SECURITY PAVILION, ATRIUM CONNECTOR LINK, EXISTING BUILDING, FAÇADE RESTORATION, SITE MODIFICATION
- EXCAVATIONS OF SECURITY PAVILION & ATRIUM CONNECTOR SIMULTANEOUS WITH STRUCTURAL MODIFICATIONS

ELECTRICAL OVERVIEW:

- 13.8 KV, 3-PHASE POWER
- 480/277V DRY TYPE TRANSFORMER
- UPS FOR EMERGENCY BACK-UP

STRUCTURAL OVERVIEW:

- SPREAD FOOTINGS
- NEW BORING FOR ADDITIONS
- EXISTING STRUCTURE REINFORCED

SECURITY & FIRE PROTECTION OVERVIEW:

- CARD ACCESS / ID CLEARANCE
- CCTV'S
- IR MOTION DETECTORS
- VIDEO INTERCOM STATIONS
- WET PIPE SPRINKLER
- RECESSED PENDANT FIXTURES

LIGHTING OVERVIEW:

- FLUORESCENT T5'S AND CFL'S
- PHOTOCELL DIMMING, OCCUPANCY SENSORS
- USE OF DAY-LIGHTING

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EXISTING MECHANICAL

OUTSIDE AHU:

- 5300 CFM
- 100% OA
- ENERGY RECOVERY WHEEL

SERVES:

PERIMETER FCU'S
SOME VV BOXES W/
REHEAT IN INTERIOR
AREAS

AHU - 1:

- 19,000 CFM
- 30% OA

SERVES:

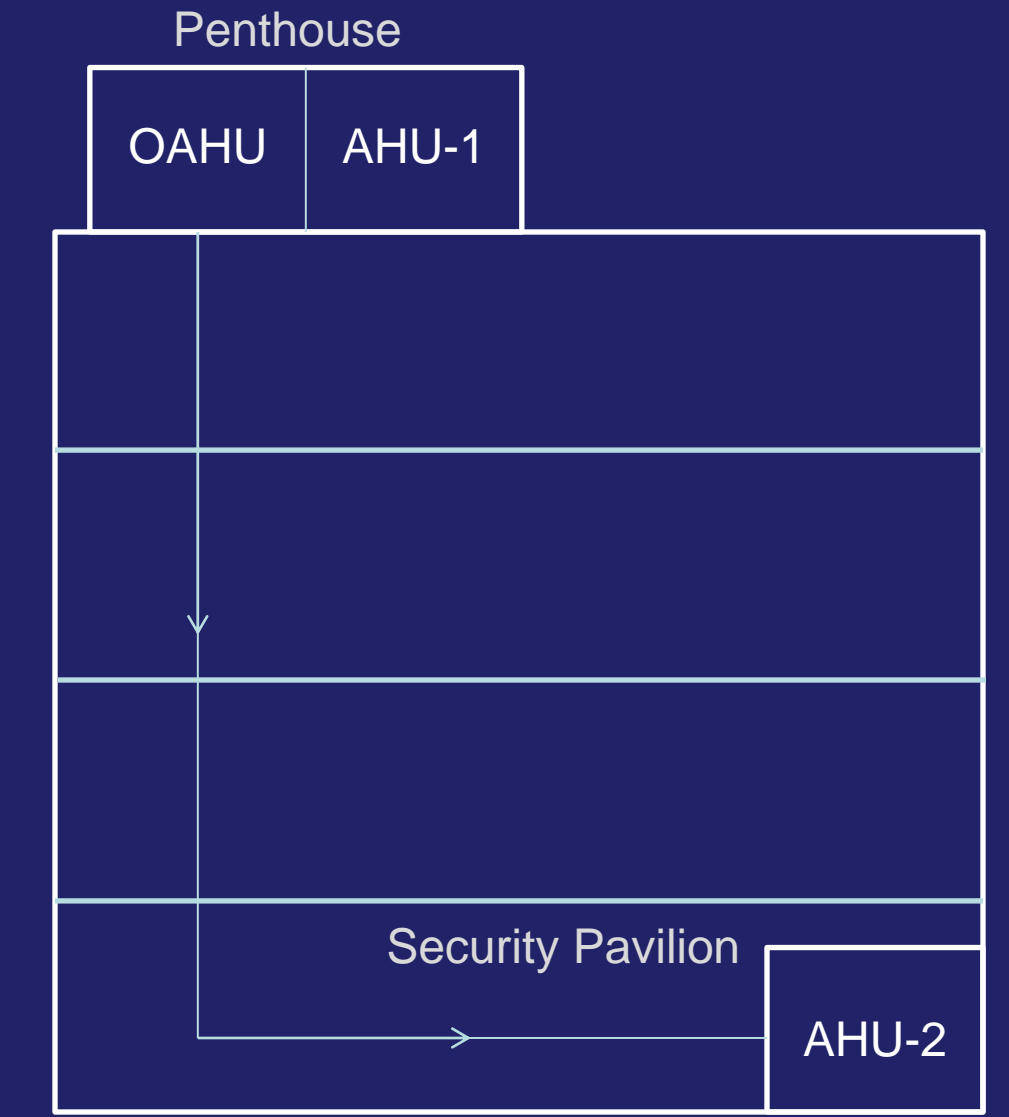
PERIMETER CV
BOXES
DUAL DUCT TU'S IN
CONFERENCE ROOMS
VV BOXES W/
REHEAT IN CORE
ZONE

AHU - 2:

- 7,350 CFM
- MIN OA BY OAHU

SERVES:

SECURITY PAVILION,
KEPT AT CONSTANT
VOLUME, NO
ASSOCIATED RETURN



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EXISTING MECHANICAL

COMPUTER ROOM AC-1:

-5,250 CFM
-TEMP SET: 61° F

SERVES:
ELECTRICAL ROOM

COMPUTER ROOM AC-2:

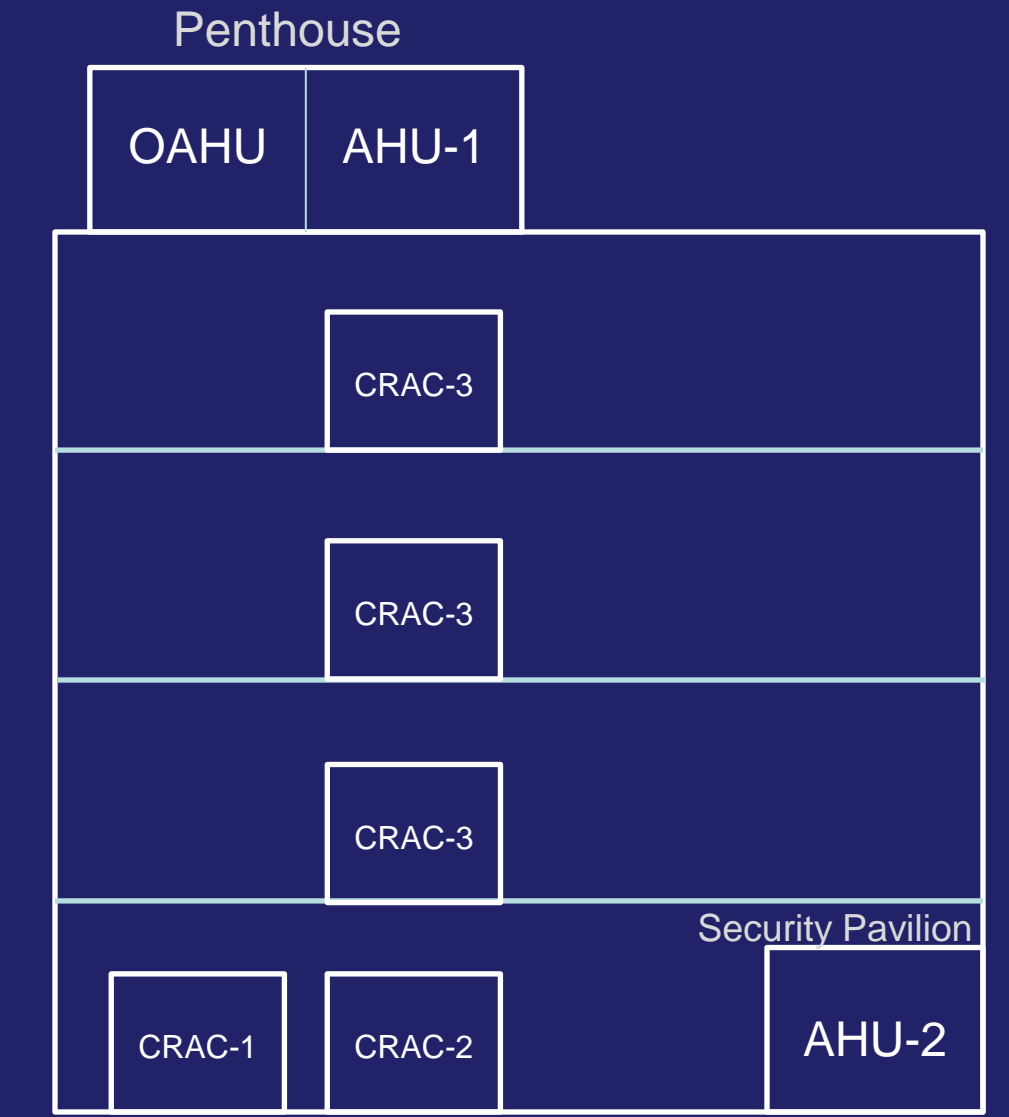
-6,050 CFM
-TEMP SET: 55° F

SERVES:
TELECOM ROOM

COMPUTER ROOM AC-3:

-2,800 CFM
-TEMP SET: 55° F

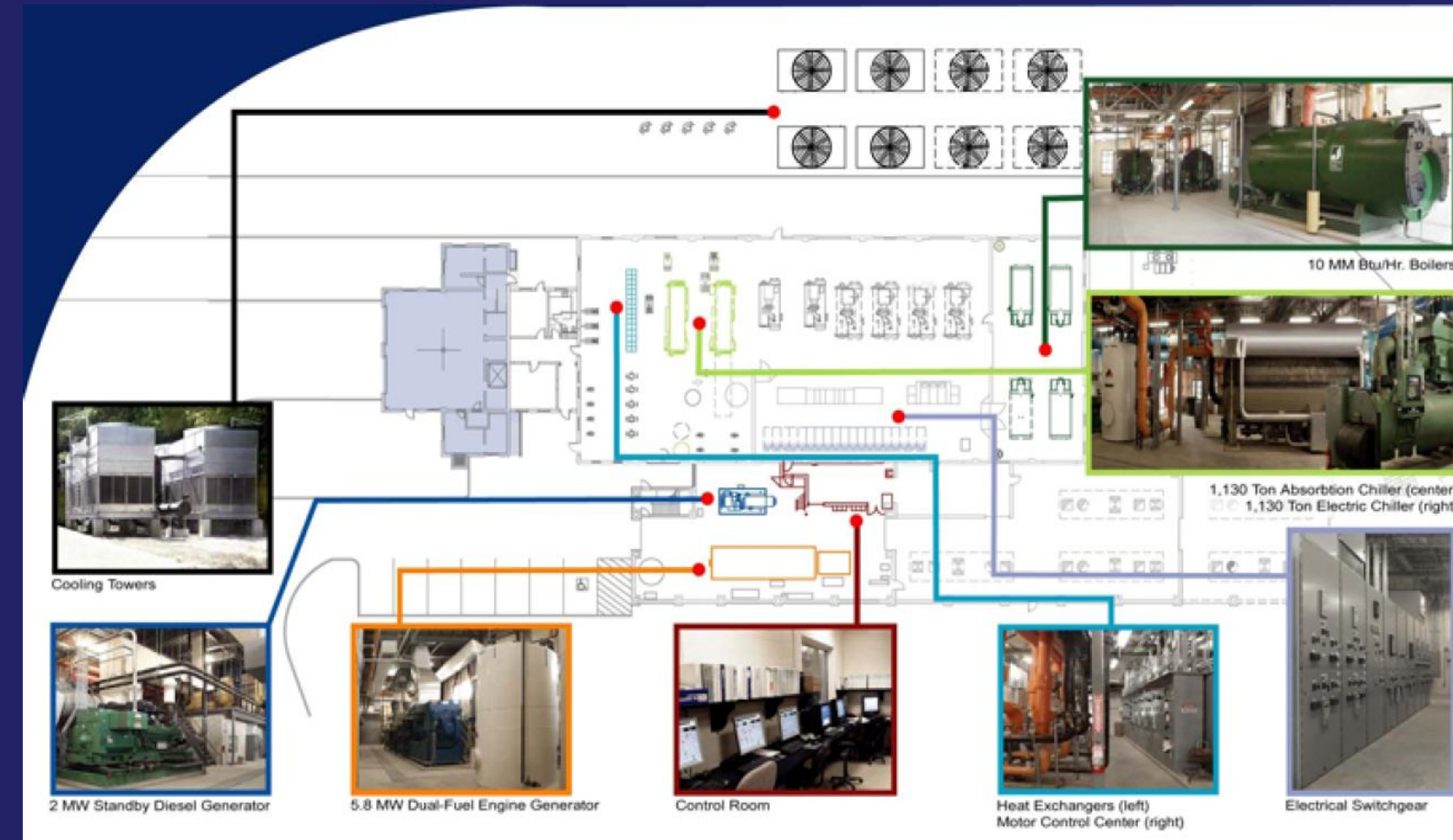
SERVES:
LAN ROOMS



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EXISTING MECHANICAL



TOTAL PLANT EFFICIENCY: 70%

CENTRAL UTILITY PLANT:

- 20 MW COGEN
- 5.6 MW DUAL FUEL ENGINE (NATURAL GAS & DIESEL)
- THREE 4.5MW NATURAL GAS TURBINES
- TWO 1 130-TON ABSORPTION CHILLERS
- TWO 1 130-TON & THREE 1980-TON ELECTRIC CHILLERS
- THREE 10MMBTU/HR HOT WATER BOILERS



DELIVERS:

- 13.8 KV 3-PHASE ELECTRICITY
- 200F HOT WATER
- 39F CHILLED WATER

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EXISTING MECHANICAL

LEED FEATURES:

- HEAVY REUSE OF RAW MATERIALS – CORE, SHELL, PUBLIC AREA FINISHES, RESTORATION OF ORIGINAL BRICK & LIMESTONE EXTERIOR
- LOW VOC MATERIALS
- OPERABLE, INSULATED, LOW-E STEEL WINDOWS, INTEGRATED W/ HVAC SYSTEM AND CONTROLS
- HIGH SOLAR REFLECTIVE INDEX ROOF
- NATIVE, LOW WATER PLANTS
- SHUTTLE SERVICE PROVIDED, DEDICATED HYBRID/CARPOOL PARKING

9	3	2	Sustainable Sites	14 Points
2	2	1	Water Efficiency	5 Points
12	1	2	Energy & Atmosphere	17 Points
4	2	7	Materials & Resources	13 Points
14	0	1	Indoor Environmental Quality	15 Points
2	0	3	Innovation & Design Process	5 Points
43	8	16	Project Totals	69 Points

NOTES:

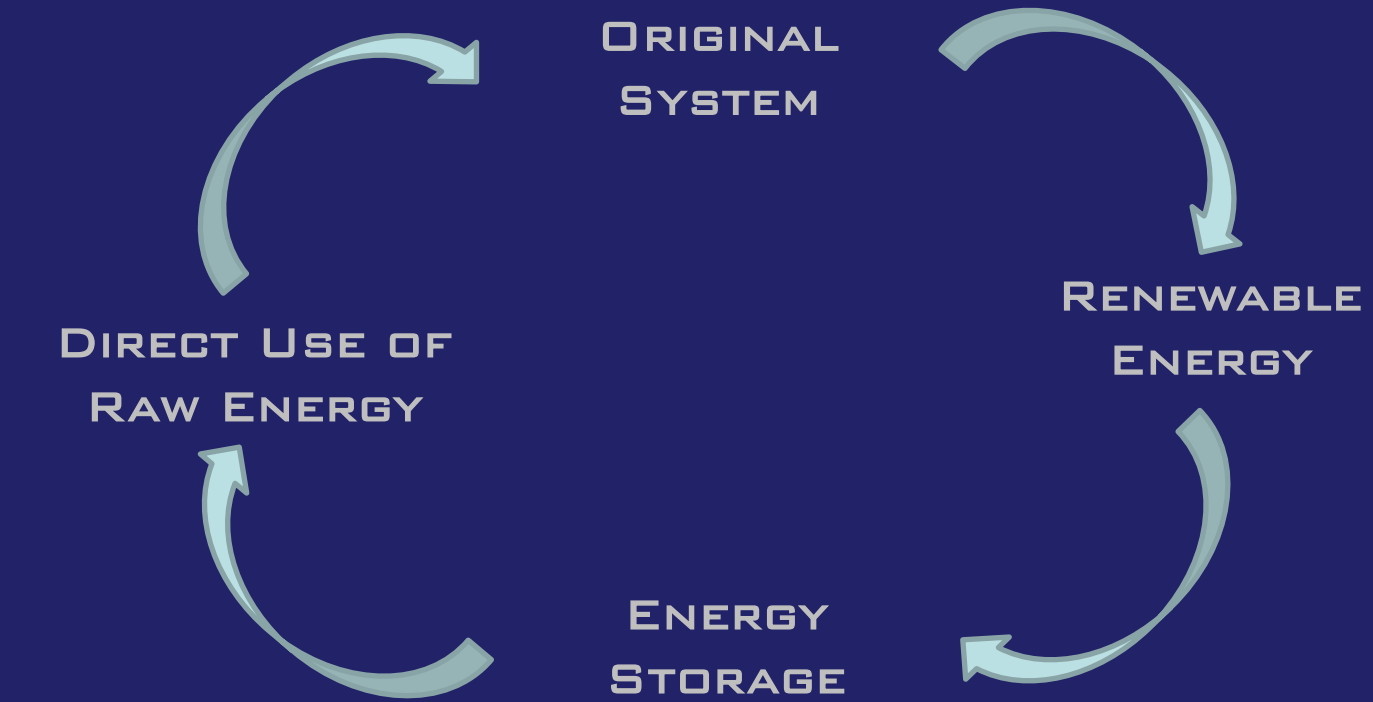
- DESIGNED TO LEED SILVER STANDARD, AWARDED LEED **GOLD** IN JANUARY 2010
- ACHIEVED 36% ENERGY COST SAVINGS BELOW ASHRAE 90.1 BASELINE

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DESIGN OBJECTIVES

- REDUCE DEMAND ON CENTRAL UTILITY PLANT
- FIND EFFICIENCIES WITH LEAST IMPACT ON DESIGN
- PUSH THE BOUNDARY WITH AVAILABLE TECHNOLOGY



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PHOTOVOLTAIC SYSTEM

-CURRENT DEMAND

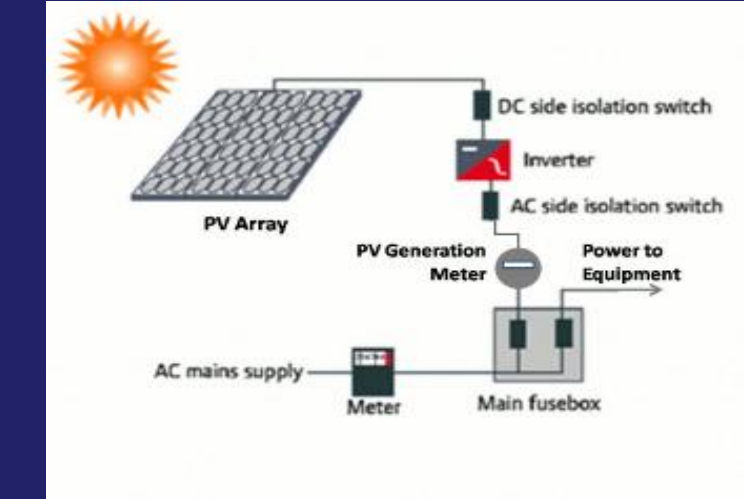
1,000 MM BTU PER MONTH

109,000 KWH PER MONTH

-PV SIZING

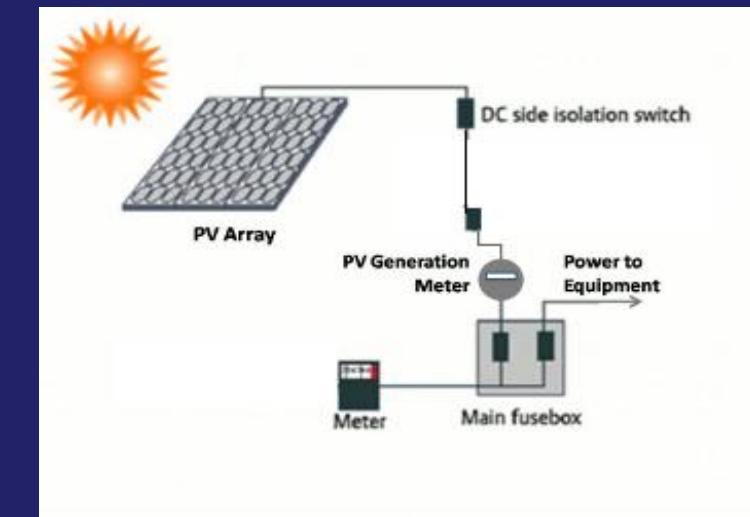
BASED ON 24,000 SF ROOF AREA AVAILABLE

TARGET: ~40% OF ELECTRICITY DEMAND



VARIATION:
REMOVE INVERTER

IMPACT:
↑ EFFICIENCY BY 8%
↓ COST BY 10%



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PHOTOVOLTAIC SYSTEM

-CURRENT COST OF UTILITIES
\$10,000-\$14,000 PER MONTH DEPENDING ON FUEL COST

\$15,000 IF ELECTRICITY WERE TO BE PURCHASED

-PV SYSTEM COST
\$1,225,000 W/ INITIAL TAX CREDITS

-WITH DEPRECIATION, CONTINUOUS GOVT. SUBSIDY CREDITS
AND ASSUMED 4% INCREASE IN UTILITY COST

BREAKEVEN WITHIN 5 YEARS

AVERAGE UTILITY SAVINGS OF \$8,000 PER MONTH



SUNPOWER CORP T5 ROOF TILE
WITH E19 PANEL
(19% EFFICIENCY)



SOLAR PANEL + FRAME + MOUNTING SYSTEM =
ONE PRE-ENGINEERED UNIT

QUICK INSTALLATION, NO ROOF PENETRATION
NEEDED, 30 YEAR LIFE GUARANTEE, FLEXIBILITY
AND DURABILITY UNPARALLELED

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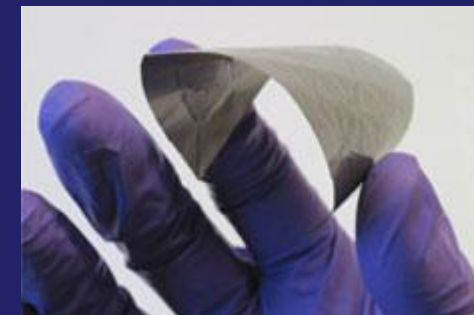
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THIN FILM BATTERY

ELIMINATED INVERTER FROM PV SYSTEM, INCREASED EFFICIENCY, REDUCED UP FRONT COST OF ENTIRE SYSTEM AND O&M OVER LIFE OF THE SYSTEM

DRAW ELECTRICITY FROM STORAGE INSTEAD OF DIRECTLY FROM PV SYSTEM TO REDUCE VOLTAGE SPIKES FROM PV GENERATION

EMBED THIN FILM BATTERY INTO WALL INSULATION



ADVANTAGES:

- 2X ENERGY DENSITY THAN COMMERCIAL SUPERCAPACITORS
- HIGH CYCLE RATE AT HIGH VOLTAGE
- CUSTOM PATTERN A.K.A. CUT TO FIT AVAILABILITY
- LONG LIFE CYCLE (>>30,000 CYCLES) WITH HIGH STORAGE EFFICIENCY
- BIODEGRADABLE

DISADVANTAGES:

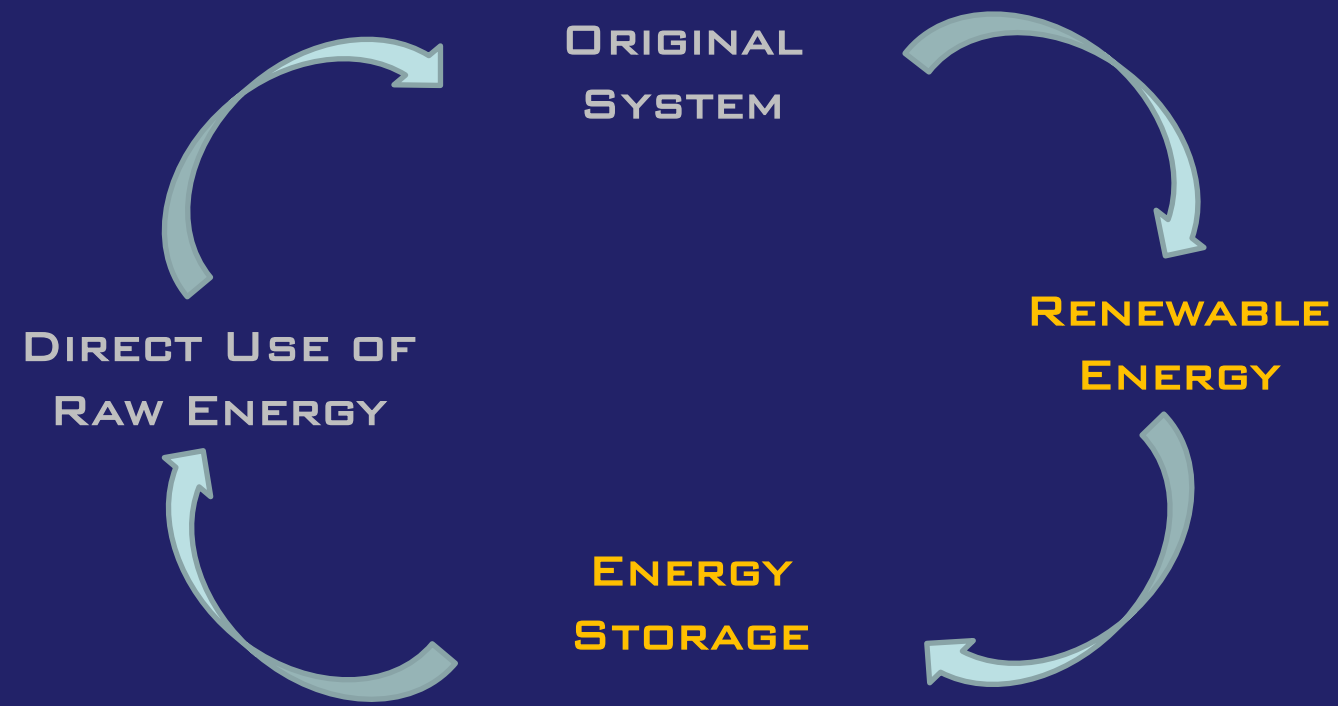
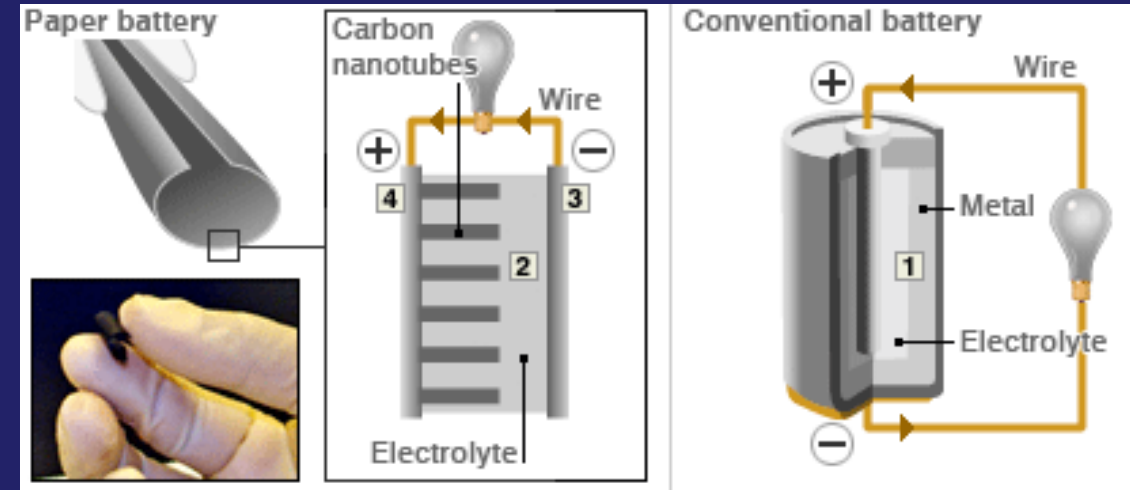
- VERY NEW TECHNOLOGY
- LONG LEAD TIME
- WILLINGNESS OF SUBCONTRACTOR TO INSTALL
- UP FRONT COST



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THIN FILM BATTERY



PROPERTY OF PRODUCT KEEP R-VALUES NEGLIGIBLE
 AVAILABLE IN ROLLS, EASY TRANSPORTATION TO SITE
 INSTALL BETWEEN INSULATION AND DRYWALL

FLOATS BUILT INTO SCHEDULE – 13-22 DAYS PER WING
 (NORTH/SOUTH) PER FLOOR

TO LINE THE ENTIRE BUILDING : \$2,160,000

FOR JUST PV SYSTEM CAPACITY: \$263,000

COST CAN BE AMORTIZED INTO PV SYSTEM

NO. OF TIMES OF REPLACEMENT OF TRADITIONAL BATTERIES
 ALONE COULD JUSTIFY THE COST

\$263,000 vs. \$540,000

OVER LIFETIME OF SYSTEM

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DIRECT CURRENT DISTRIBUTION

EXISTING DC BASED AVAILABLE SYSTEMS:

ELECTRONIC BALLASTS

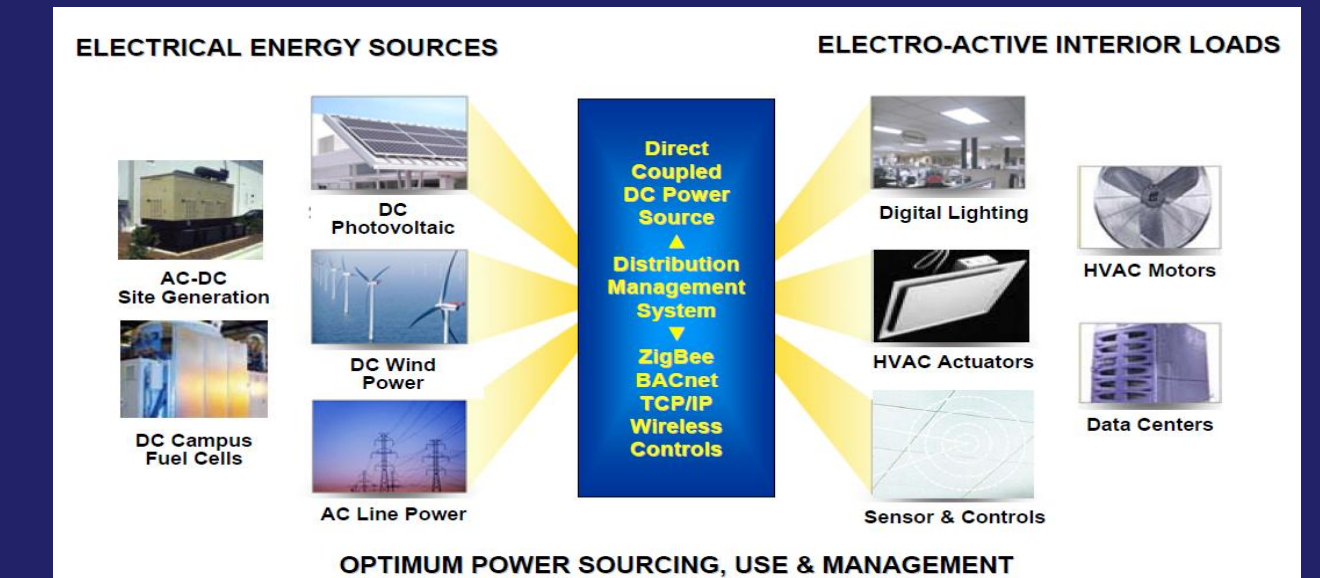
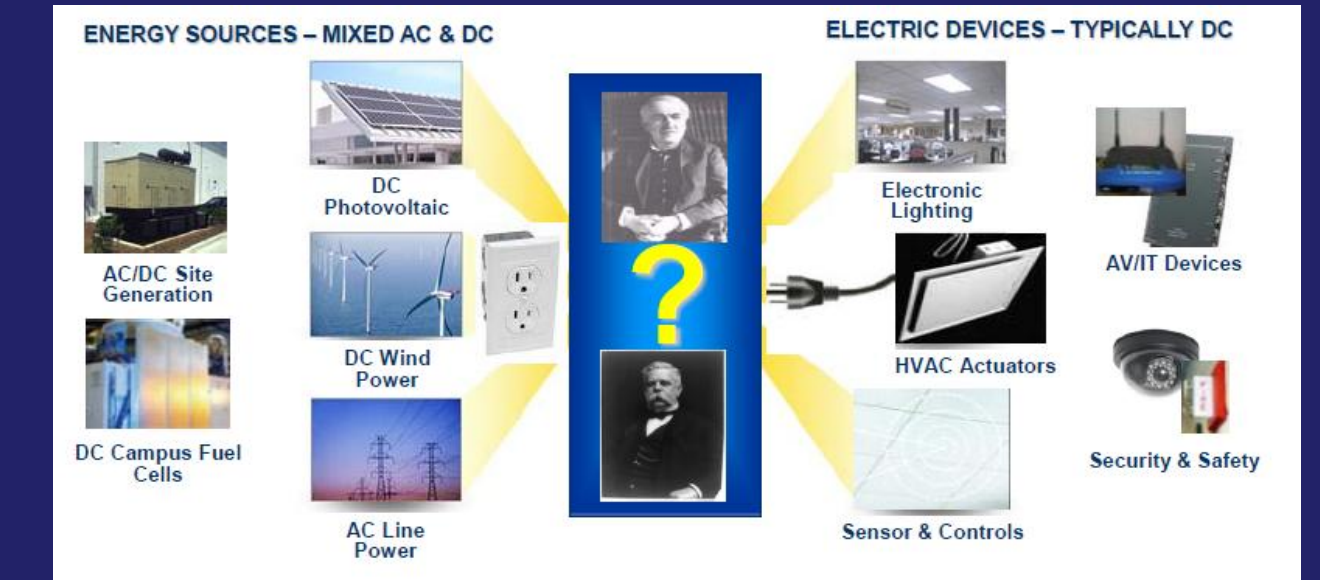
ENERGY MANAGEMENT, CONTROL SYSTEM

ADJUSTABLE SPEED DRIVES FOR HVAC & PUMPING

COMPUTER, IT EQUIPMENT

PORTABLE, PERSONAL ELECTRONICS

INEFFICIENT POWER CONVERSIONS ARE NEEDED FROM THE BUILDING'S FIXED AC INFRASTRUCTURE TO POWER THESE DC DEVICES...



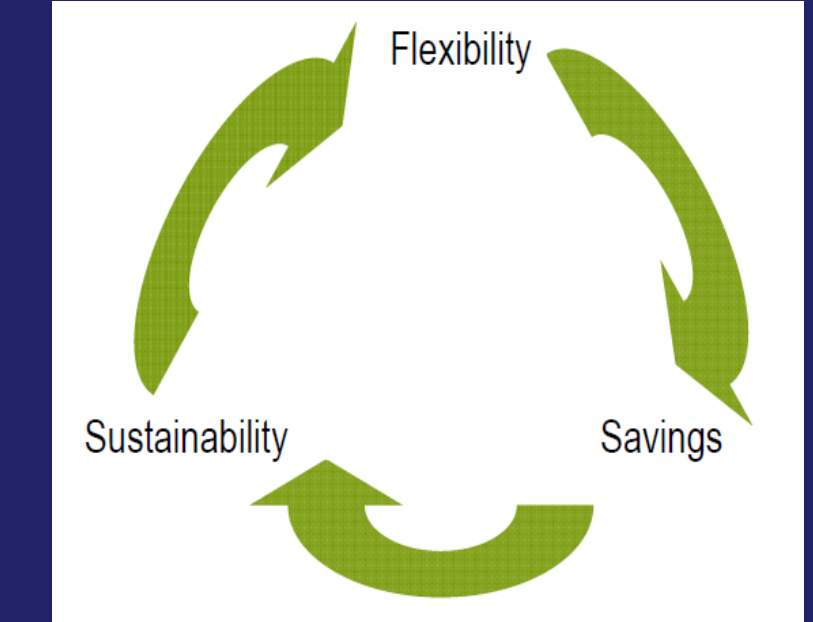
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DIRECT CURRENT DISTRIBUTION

USING DC 'MICRO GRID'

- SAFE 24VDC AT DEVICE INTERFACE
- ENABLES SELECTIVE & SCALABLE USE
- BACKWARD & FORWARD COMPATIBLE
- EASILY INSTALLED BY CUSTOMARY TRADES
- PROMOTES ALTERNATIVE ENERGY WITH HIGHER SYSTEM EFFICIENCY



INTEGRATE VARIOUS SOURCES OF ENERGY ON COMMON DISTRIBUTION BUS

SIMPLIFIED DIRECT USE OF DC

ELIMINATE MULTIPLE DC-AC AND AC-DC CONVERSION LOSSES

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DIRECT CURRENT DISTRIBUTION

EVALUATING LIGHTING SYSTEM ON DC IN FDA BUILDING ONE

TOTAL COST AS INSTALLED: \$835,000

DC SYSTEMS (+25%): \$1,045,000

INCREASED EFFICIENCY ACHIEVED WITH DC: +11%

ANNUAL UTILITY SAVING: \$13,000

SIMPLE PAYBACK: 16 YEARS

CASE STUDY: USGBC HEADQUARTERS

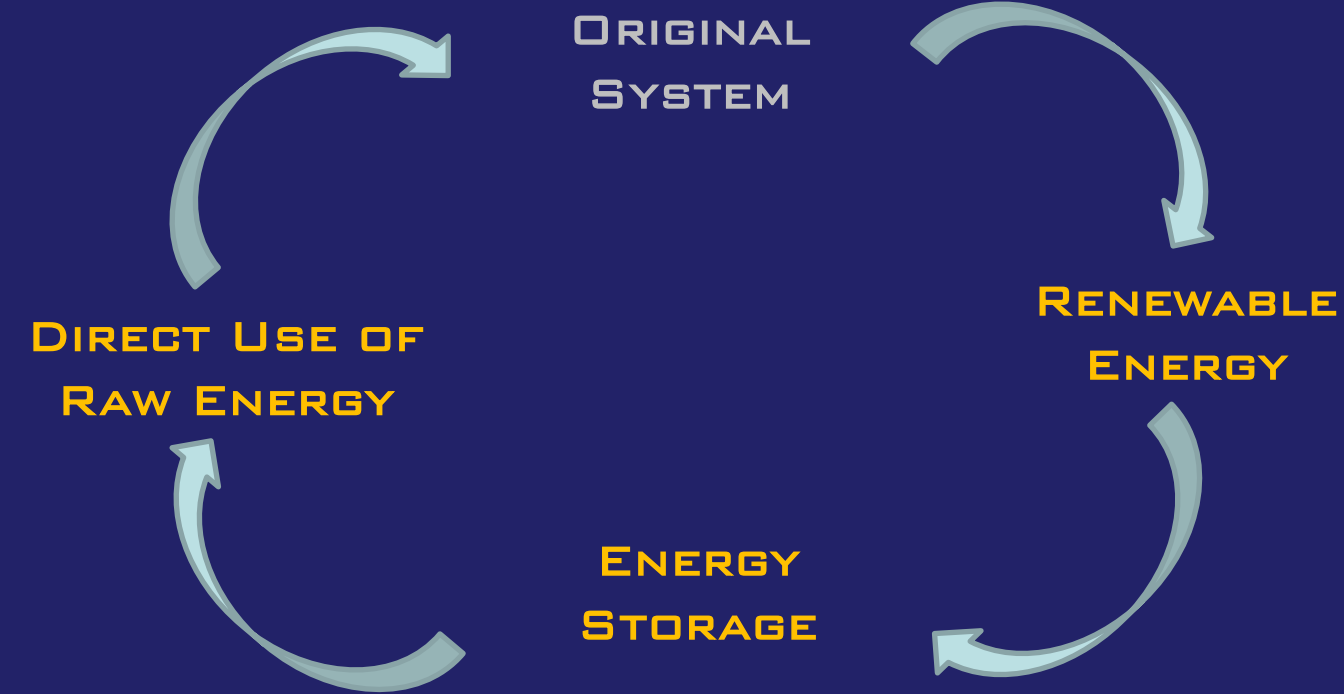
- CONTINUOUS HIGH LIGHT REFLECTIVITY ACOUSTICAL CEILING
- DC MULTI-CHANNEL POWER SERVERS
- FLUORESCENT LIGHTING W/ DC BALLASTS
- WIRED CONTROLS, TOUCH PANEL INTERFACE
- DAYLIGHT, OCCUPANCY, DIMMING FUNCTION

LEED PLATINUM FOR COMMERCIAL INTERIORS

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DIRECT CURRENT DISTRIBUTION



MECHANICAL IMPACT OF DC DISTRIBUTION SYSTEM

PUMPS ON DIRECT CURRENT:

- REDUCED HEAD LOSS, 15% MORE EFFICIENT
- DIRECT COMPARISON SHOWED 10% COST SAVING BY SIZING DOWN PRIMARY PUMPS
- LEAVING STANDBY PUMPS AS-IS
- IMMEDIATE REALIZATION OF \$70,000 SAVING



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- **CONCLUSION**

CONCLUSION

PHOTOVOLTAIC SYSTEM

PRACTICAL, COST EFFECTIVE

THIN FILM BATTERY

SUSTAINABLE, HIGH COST

DC DISTRIBUTION

WORTHWHILE, COST JUSTIFIED



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THANK YOU

QUESTIONS?



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- DESIGN OBJECTIVES
- ALTERNATIVE DESCRIPTIONS
- PHOTOVOLTAIC IMPACT
- POWER STORAGE
- DC DISTRIBUTION SYSTEMS
- ENERGY ANALYSIS & PAYBACK
- FINAL RECOMMENDATIONS

