Energy Audit - West Windsor Campus

Prepared For:
Mercer County Community College

Contact
Wendy Lancaster
Director of Purchasing

Prepared By:
Dome – Tech, Inc.

Prepared Under the Guidelines of the State of NJ Local Government Energy Audit Program

August 2009

Dome-Tech, Inc.

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Energy Audit - James Kerney Campus

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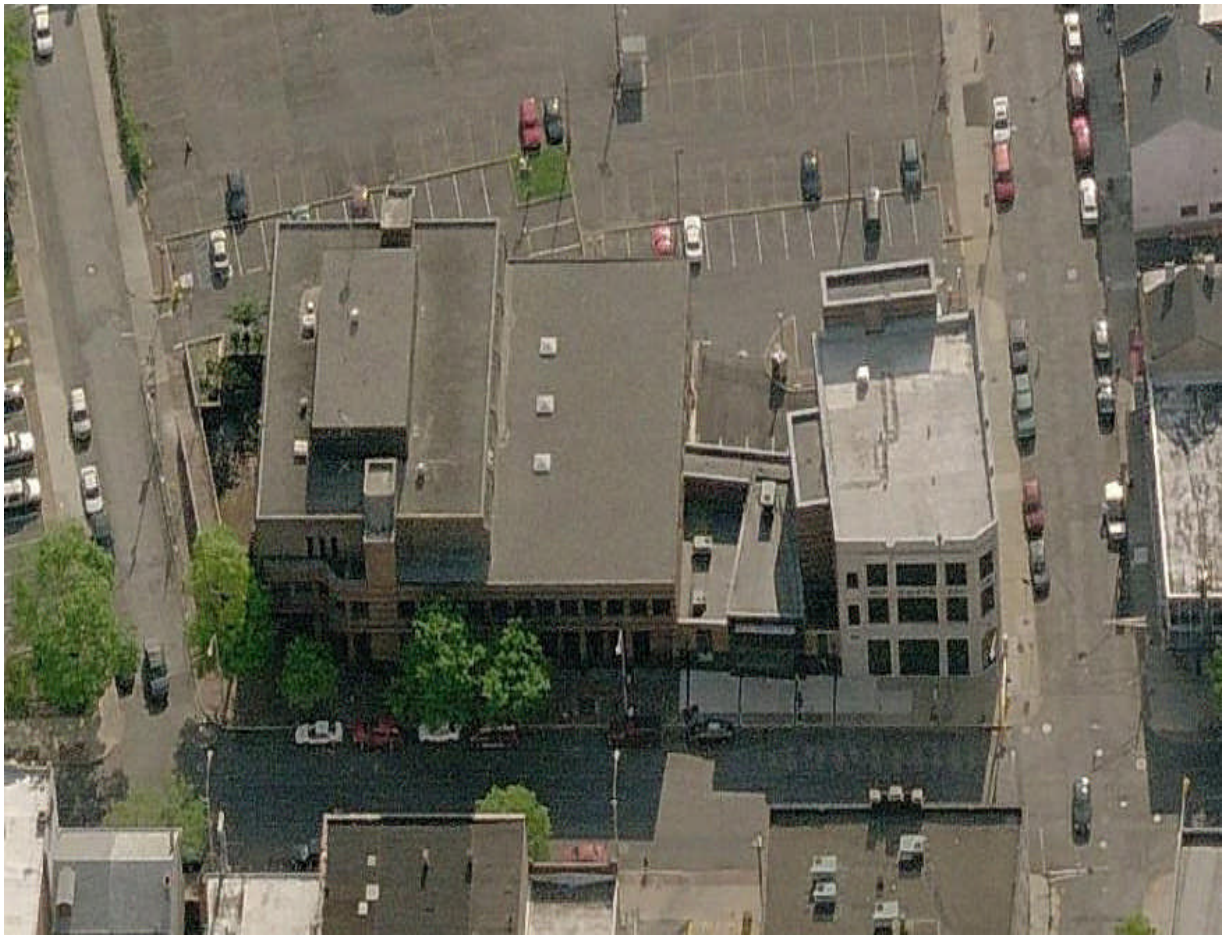
June 1, 2009



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Energy Audit Purpose & Scope

Purpose:

- The objectives of the energy audit are to evaluate the site's energy consumption, establish baselines for energy consumption and identify opportunities to reduce the amount of energy used and/or its cost.

Scope:

I. Historic Energy Consumption: Benchmark energy use using Energy Star Portfolio Manager

II. Facility Description – Characterize building usage, occupancy, size and construction.

III. Equipment Inventory – Detailed equipment list including useful life and efficiency.

IV. Energy Conservation Measures: Identify and evaluate opportunities for cost savings and economic returns.

V. Renewable/Distributed Energy Measures: Evaluate economic viability of various renewable/distributed energy technologies.

VI. Energy Purchasing and Procurement Strategies: Perform utility tariff analysis and assess potential for savings from energy procurement strategies.

VII. Method of Analysis: Appendices

Historic Energy Consumption

Utility Usage and Costs Summary

Time-period: July 2007 – August. 2008

CAMPUS / SCHOOL	Electric			Natural Gas		
	Annual KWH	Annual Cost	$ / kWh	Annual Therms	Annual Cost	$ / therms
West Windsor Campus	14,703,145	$2,122,252.00	$0.14	255,329	$405,498.00	$1.59
Trenton Academic Center	906,094	$127,891.70	$0.14	NA	NA	NA
Trenton Career Center	175,956	$25,065.52	$0.14	910	$1,570.62	$1.73
Total	**15,785,195**	**$ 2,275,209**		**256,239**	**$ 407,069**	

CAMPUS / SCHOOL	District Stream			District Chilled Water		
	Annual Steam Usage (MMBtu)	Annual Cost	$ / MMBtu	Annual ton-hrs	Annual Cost	$ / ton hrs
Trenton Campus	7,386,900	$213,324.93	$0.03	372,170.0	$230,064.00	$0.62

Please see Appendix for full utility data and consumption profiles for the Campus Buildings.

Historic Energy Consumption

ENERGY STAR SCORES

- Energy Star Score is calculated to establish a facility-specific energy intensity baseline.
- Energy Star can be used to compare energy consumption to other similar facilities and to gauge the success of energy conservation and cost containment efforts.
- Buildings with an Energy Star rating of 75, or above, are eligible to apply for an official Energy Star Building label.
- Energy Star scores are only applicable to certain types of buildings (i.e.: schools K-12, or dormitory buildings) and requires the buildings to be individually metered in order to get a rating, therefore the Score column is marked NA.

Campus / Building Name	Total Floor Area	Energy Star Score	Eligible to Apply for ENERGY STAR	Current Site Energy Intensity (kBtu/SF)	Current Source Energy Intensity (kBtu/SF)
Trenton - Academic Center Building	50,158	NA	NA	61.6	205.9
Trenton - Career Center Building	20,351	NA	NA	33.9	103.2
West Windsor Campus	518,124	NA	NA	148.3	377.2

Historic Energy Consumption (continued)

Portfolio Manager Sign - In

- An account has been created for Mercer County Community College in Portfolio Manager. You will have received an email to notify you of the generation of this account and shared access with Dome-Tech. Please use this to read your facility information. Please feel free to alter this information when the report is finalized. We would ask that you leave the sign-in information alone until then. Your college's information is currently shared as read only.
- When the report is finalized the shared access will be changed so that you can use / edit the information and change as you wish.
- Website link to sign-in: https://www.energystar.gov/istar/pmpam/index.cfm?fuseaction=login.Login

➢Username:	MercerCCC
➢Password:	DTMercerCCC
➢Email for account:	lancastw@mccc.edu

Facility Description - West Windsor Campus

Building — Administration

Address:	1200 Old Trenton Road West Windsor, NJ 08550
Gross Floor Area:	36,028 sq. ft.
Year Built:	1975

Construction Features

Façade:	3 story brick and masonry over steel frame
Roof Type:	Approx. 10 years old, grey, flat, metal deck, built-up, ballasted river rock, in good condition
Windows:	Approx. 10 yrs old, covering 30% of building façade, metal frame, fixed, mixture of single and double pane, tinted (30%), in good condition
Exterior Doors:	Approx. 10 years old, metal frame, 30% glazing, in good condition

Major Mechanical Systems

Air Handlers / AC Systems / Ventilation Systems

- Four (4) Trane Air Handling Units - see equipment list for cfm
- Four (4) AC pumps (manufacturer unknown; 54 – 61 gpm); associated motors (0.5 – 5 HP)
- Four (4) Multistack 50 Ton Modular Chillers; R22
- Two (2) US Electric pumps (CW; 342gpm and 615 gpm); 2-10HP associated motors

Boilers/ Heating Systems

- One (1) Rheem domestic hot water heater (80 gal) - Electric

Facility Description - West Windsor Campus

Building

Business Science

Address:	1200 Old Trenton Road West Windsor, NJ 08550
Gross Floor Area:	26,616 sq. ft.
Year Built:	1975

Construction Features

Façade:	3 story brick and masonry over steel frame
Roof Type:	Approx. 10 years old, grey, flat, metal deck, built-up, ballasted river rock, in good condition
Windows:	Approx. 10 yrs old, covering 30% of building façade, metal frame, fixed, single and double pane, tinted, in good condition
Exterior Doors:	Approx. 10 years old, metal frame, with double pane glass, 30% glazing, in good condition; seals in good condition

Major Mechanical Systems

Air Handlers / AC Systems / Ventilation Systems

- One (1) Air Handling Unit (Custom Built); 9350cfm
- Two (2) Multistack 50 Ton Modular Chillers; R22; associated Bell & Gossett (307 gpm; 171 gpm) pumps and US Electric motors(3HP; 5HP)

Boilers/ Heating Systems

- Electric perimeter heat (1st floor, ½ 2nd floor, and ½ 3rd floor); associated pumps
- Hot Water perimeter heat (1/2 2nd floor and ½ 3rd floor); associated pumps
- Two (2) Lochinvar Boilers (information unknown)

Facility Description - West Windsor Campus

- **Building** — **Communication Center**

Address:	1200 Old Trenton Road West Windsor, NJ 08550
Gross Floor Area:	60,482 sq. ft.
Year Built:	1975

- **Construction Features**

Façade:	2 story brick and masonry over steel frame
Roof Type:	Approx. 10 years old, grey, flat, metal deck, built-up, ballasted river rock, in good condition
Windows:	Approx. 10 yrs old, covering 30% of building façade, metal frame, fixed, single and double pane, tinted, in good condition
Exterior Doors:	Metal frame with glass, 30% glazed, in good condition

- **Major Mechanical Systems**

Air Handlers / AC Systems / Ventilation Systems

- Three (3) Trane Air Handling Units; at least three are very old
- Two (2) McQuay Package Roof Top Units; one with broken spill dampers
- Two (2) Split System Evap/Cond units (Trane/York); at least one is new
- Eight (8) Multistack compressors; R22; associated pumps and motors
- One (1) Quincy air compressor; 20 years old
- One (1) Evapco Cooling Tower; about 20 years old

Boilers/ Heating Systems

- Three (3) Lochinvar boilers; new; associated pumps and motors
- One (1) AO Smith domestic hot water heater (119 gal); 5 years old
- One McQuay gas-fired furnace in PRTU; about 12 years old

Facility Description - West Windsor Campus

Building

Engineering Systems

Address:	1200 Old Trenton Road West Windsor, NJ 08550
Gross Floor Area:	14,467 sq. ft.
Year Built:	1975

Construction Features

Façade:	3 story brick and masonry over steel frame
Roof Type:	Approx. 10 years old, grey, flat, metal deck, built-up, ballasted river rock, in good condition
Windows:	Approx. 10 yrs old, covering 30% of building façade, metal frame, fixed, single and double pane, tinted, in good condition
Exterior Doors:	Metal frame with glass, 30% glazed, in good condition

Major Mechanical Systems

Air Handlers / AC Systems / Ventilation Systems

- One (1) Trane Package RTU; very old
- Two (2) Addison Split System condensing units
- Two (2) Liebert Split System condensing units
- Two (2) Lennox Package RTUs
- One (1) York Package RTU
- One (1) Fujitsu Split System evaporator unit & One (1) Fujitsu Split System condensing unit
- One (1) Trane Split System condensing unit
- Two (2) Make up air units/EF system (Greenheck)
- One (1) AHU – no nameplate data

Boilers/ Heating Systems

- One (1) Weil-McLain electric boiler (273,000 BTU/hr); associated pumps

Facility Description - West Windsor Campus

Building — Engineering Technology

Address:	1200 Old Trenton Road West Windsor, NJ 08550
Gross Floor Area:	26,616 sq. ft.
Year Built:	1975

Construction Features

Façade:	3 story brick and masonry over steel frame
Roof Type:	Approx. 10 years old, grey, flat, metal deck, built-up, ballasted river rock, in good condition
Windows:	Approx. 10 yrs old, covering 30% of building façade, metal frame, fixed, single and double pane, tinted, in good condition
Exterior Doors:	Metal frame with glass, 30% glazed, in good condition

Major Mechanical Systems

Air Handlers / AC Systems / Ventilation Systems

- One (1) Liebert Split System Condensing unit – about 20 years old
- One (1) Trane Air Handling Unit
- One (1) York Package Roof Top Unit – about 15 years old
- One (1) Exhaust Fan – No nameplate
- Four (4) Multistack Modular Chillers; associated pumps and motors
- One (1) Evapco Cooling Tower

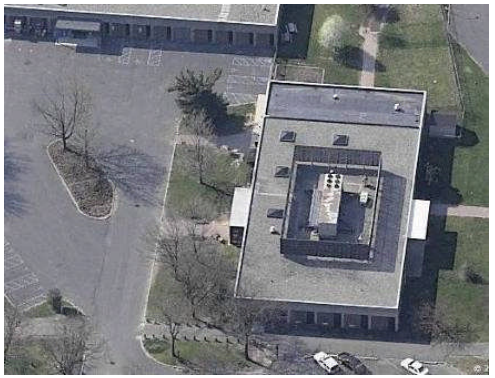
Boilers/ Heating Systems

- Two (2) Lochinvar Powerfin gas boilers
- One (1) State Select domestic hot water heater (50 gal)

Facility Description - West Windsor Campus

Building — Fine Arts

Address:	1200 Old Trenton Road West Windsor, NJ 08550
Gross Floor Area:	11,741 sq. ft.
Year Built:	1975



Construction Features

Façade:	1 story brick and masonry over steel frame
Roof Type:	Approx. 10 years old, grey, flat, metal deck, built-up, ballasted river rock, in good condition
Windows:	Approx. 10 yrs old, covering 30% of building façade, metal frame, fixed, single and double pane, tinted, in good condition
Exterior Doors:	Metal frame with glass, 30% glazed, in good condition

Major Mechanical Systems

Air Handlers / AC Systems / Ventilation Systems

- One (1) Package Roof Top Unit (Airfan) – Indirect Gas fired heating
- One (1) Climate Control Split System condenser – 1 Stage Cooling

Boilers/ Heating Systems

- Electric perimeter heat

Facility Description - West Windsor Campus

Building — Horticulture

Address:	1200 Old Trenton Road West Windsor, NJ 08550
Gross Floor Area:	4,266 sq. ft.
Year Built:	1975

Construction Features

Façade:	1 story concrete block over steel frame plus metal frame greenhouses atop concrete block knee walls
Roof Type:	built up
Windows:	Single gazed greenhouse
Exterior Doors:	Metal clad, 10% glazed, in good condition

Major Mechanical Systems

Air Handlers / AC Systems / Ventilation Systems

- Three (3) Swamp cooler (FRIGIKING)
- One (1) Walk-in cooler with two (2) evaporator fans

Boilers/ Heating Systems

- Three (3) Weil-McLain boilers
  - Four (4) – ¼ HP Bell & Gossett Pumps

Facility Description - West Windsor Campus

Building — Liberal Arts

Address:	1200 Old Trenton Road West Windsor, NJ 08550
Gross Floor Area:	32,780 sq. ft.
Year Built:	1975

Construction Features

Façade:	3 story brick and masonry over steel frame
Roof Type:	Approx. 10 years old, grey, flat, metal deck, built-up, ballasted river rock, in good condition
Windows:	Approx. 10 yrs old, covering 30% of building façade, metal frame, fixed, single and double pane, tinted, in good condition
Exterior Doors:	Metal frame with glass, 30% glazed, in good condition

Major Mechanical Systems

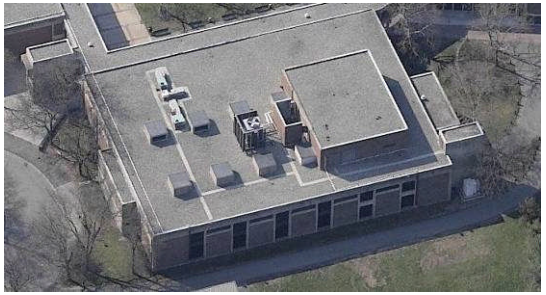
Air Handlers / AC Systems / Ventilation Systems

- Two (2) Air Handling Units (6450/5250 cfm)
- Three (3) Multistack 50 Ton compressors; R22; associated pumps
- One (1) Evapco cooling tower

Boilers/ Heating Systems

- Electric perimeter heat
- Hot Water unit ventilators
- One (1) AO Smith domestic water heater (80 gal)
- Three (3) Lochinvar Power Fin natural gas boilers; about 15 years old

Facility Description - West Windsor Campus



Building — Library

Address:	1200 Old Trenton Road West Windsor, NJ 08550
Gross Floor Area:	47,226 sq. ft.
Year Built:	1975

Construction Features

Façade:	2 story brick and masonry over steel frame
Roof Type:	Approx. 10 years old, grey, flat, metal deck, built-up, ballasted river rock, in good condition
Windows:	Approx. 10 yrs old, covering 30% of building façade, metal frame, fixed, single and double pane, tinted, in good condition
Exterior Doors:	Metal frame with glass, 30% glazed, in good condition

Major Mechanical Systems

Air Handlers / AC Systems / Ventilation Systems

- Four (4) Sanyo Split System condensers; new
- Four (4) Sanyo Split System evaporator; new
- Four (4) Fisen Package Roof Top Units, DX, Electric
- Two (2) York Air Handling Units, equipped with VFDs; new
- Six (6) Multistack compressors; R22; associated pumps
- One (1) Evapco Cooling Tower; 3000MBH; associated pumps

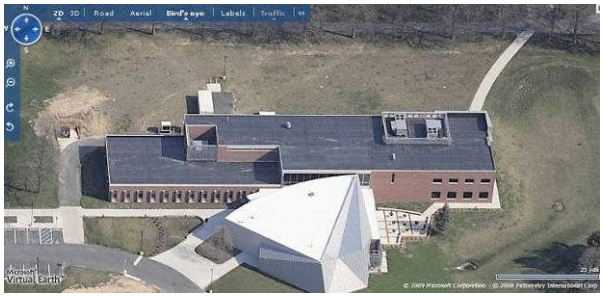
Boilers/ Heating Systems

- Three (3) AO Smith natural gas hot water boilers; associated pumps
- One (1) State Select domestic hot water heater; associated pumps

Facility Description - West Windsor Campus

Building — Conference Center

Address:	1200 Old Trenton Road West Windsor, NJ 08550
Gross Floor Area:	36,792 sq. ft.
Year Built:	2004



Construction Features

Façade:	2 story combination brick and masonry over steel frame and metal panel
Roof Type:	Approx. 5 years old, black, flat, metal deck, built-up, rubber membrane, in good condition
Windows:	Approx. 5 yrs old, covering 30% of building façade, metal frame, fixed, single and double pane, 30% glazing, in good condition
Exterior Doors:	Approx. 5 years old, metal frame, 30% glazing, in good condition

Major Mechanical Systems

Air Handlers / AC Systems / Ventilation Systems

- One (1) Carrier Air Handling Unit; electric preheat; natural gas reheat
- One (1) Carrier Split System condensing unit
- Three (3) Carrier Package Roof Top Units; power exhaust DX; natural gas
- One (1) – REZNOR Gas Reheat Make Up Air Unit – 12 kW Preheat Electric

Facility Description - West Windsor Campus

Building — Math & Science

Address:	1200 Old Trenton Road West Windsor, NJ 08550
Gross Floor Area:	49,170 sq. ft.
Year Built:	1975

Construction Features

Façade:	3 story brick and masonry over steel frame
Roof Type:	Approx. 10 years old, grey, flat, metal deck, built-up, ballasted river rock, in good condition
Windows:	Approx. 10 yrs old, covering 30% of building façade, metal frame, fixed, single and double pane, tinted, in good condition
Exterior Doors:	Metal frame with glass, 30% glazed, in good condition

Major Mechanical Systems

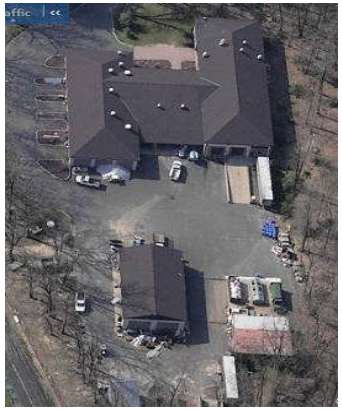
Air Handlers / AC Systems / Ventilation Systems

- Two (2) Trane Air Handling Units
- One (1) Trane Split System condensing unit; new
- One (1) AAON Package Roof Top Unit; new
- Five (5) Multistack - 50 Ton Modular Chillers; R22; associated pumps and motors
- One (1) Evapco Cooling Tower; associated pumps
- Five (5) Lab Exhaust Fans & Eight (8) Lab Fume Hoods

Boilers/ Heating Systems

- Hot Water Heat Univents Perimeter heat 1st Floor
- Three (3) Lochinvar boilers (850,000 BTUH); associated pumps and motors
- Electric coil heat at windows

Facility Description - West Windsor Campus



Building — Maintenance

Address:	1200 Old Trenton Road West Windsor, NJ 08550
Gross Floor Area:	17,582 sq. ft.
Year Built:	1975

Construction Features

Façade:	1 story concrete and masonry
Roof Type:	Pitched, asphalt shingles in good condition
Windows:	Metal frame single pane, 90 % glazed in good condition
Exterior Doors:	Metal frame with glass, 80% glazed, metal clad garage bay doors in good condition

Major Mechanical Systems

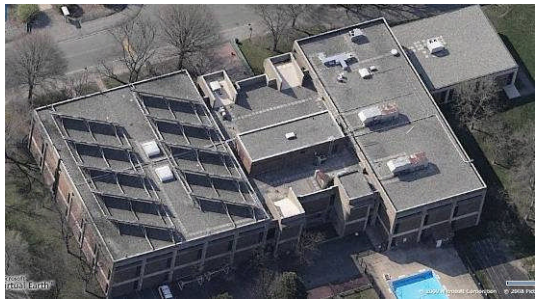
Air Handlers / AC Systems / Ventilation Systems

- One (1) Rupp Industries Air Handling Unit; DX Cooling
- One (1) McQuay AHU; DX Cooling
- One (1) AHU (manufacturer unknown); DX & One (1) Temp Air AHU; DX
- Three (3) McQuay AHUs; heating and ventilation units (HV's)
- Two (2) Technical Services Split System condensing units; 20 years old
- Two (2) Trane Split System condensing units; 10 and 15 years old

Boilers/ Heating Systems

- One (1) AO Smith domestic water heater (120 gal)
- One (1) Lime Tamer domestic water heater
- Four (4) Ceiling Fan powered unit heaters
- One (1) wall fan powered unit heater
- Two (2) electric unit heaters

Facility Description - West Windsor Campus



- **Building** — **Physical Education**
  - Address: 1200 Old Trenton Road, West Windsor, NJ 08550
  - Gross Floor Area: 77,574 sq. ft.
  - Year Built: 1975
- **Construction Features**
  - Façade: 2 story brick and masonry over steel frame
  - Roof Type: Approx. 10 years old, grey, flat, metal deck, built-up, ballasted river rock, in good condition
  - Windows: Approx. 10 yrs old, covering 30% of building façade, metal frame, fixed, single and double pane, tinted, in good condition
  - Exterior Doors: Metal frame with glass, 30% glazed, in good condition
- **Major Mechanical Systems**

Air Handlers / AC Systems / Ventilation Systems

- One (1) Pool exhaust; glycol
- One (1) Trane Split System unit
- One (1) exhaust fan & One (1) air compressor

Boilers/ Heating Systems

- Two (2) Carrier heat pumps; 15 years old
- Two (2) Miller Picking Package Rooftop unit; electric duct heater
- One (1) AAON Package Rooftop unit; DX; natural gas
- Four (4) HV units – one equipped with a heat recovery wheel
- Two (2) Patterson Kelly electric boilers; 39 years old

Facility Description - West Windsor Campus

Building — Student Center

Address:	1200 Old Trenton Road West Windsor, NJ 08550
Gross Floor Area:	60,070 sq. ft.
Year Built:	1975

Construction Features

Façade:	3 story brick and masonry over steel frame
Roof Type:	Approx. 10 years old, grey, flat, built-up, ballasted river rock
Windows:	Approx. 20+ years old, covering 40% of building façade, fixed, single pane, glazed, some renovated with double pane, in good condition
Exterior Doors:	Metal frame with glass, 95% glazed, in good condition

Major Mechanical Systems

Air Handlers / AC Systems / Ventilation Systems

- One (1) Trane Climate Change Air Handling Unit ((41,875 cfm)
- One (1) Sanyo Split System condensing unit
- One (1) Trane AC Unit; three stages of electric reheat
- Five (5) Multistack 50 Ton Modular Chillers; R22
- One (1) Evapco Cooling Tower; associated pumps and motors

Boilers/ Heating Systems

- Two (2) rebuilt cabinet unit heaters
- One (1) Patterson Kelly domestic hot water heater (250 gal)
- Two (2) Lochinvar natural gas boilers

Facility Description - West Windsor Campus

Building — Kelsey Theater Building

Address:	1200 Old Trenton Road West Windsor, NJ 08550
Gross Floor Area:	10,896 sq. ft.
Year Built:	1975

Construction Features

Façade:	2 story brick and masonry over steel frame
Roof Type:	Approx. 10 years old, black and grey, metal deck, built-up, in good condition
Windows:	Approx. 10 yrs old, covering 30% of building façade, metal frame, fixed, single and double pane, tinted, in good condition
Exterior Doors:	Metal frame with glass, 30% glazed, in good condition

Major Mechanical Systems

Air Handlers / AC Systems / Ventilation Systems

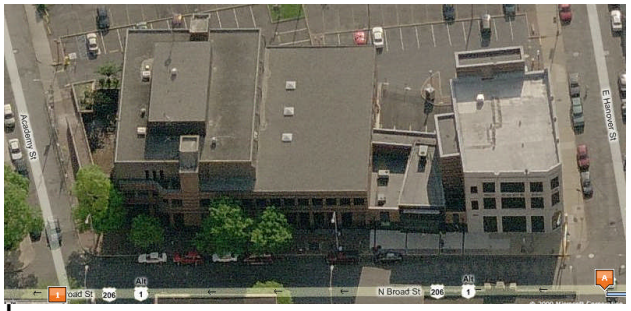
- Three (3) Trane Air Handling Units; at least three are very old
- HV Unit

Boilers/ Heating Systems

- Hot Water Unit Heater

Facility Description - James Kerney Campus

Building — Main Academic Center



Address:	North Broad Street Trenton, NJ 08690
Gross Floor Area:	50,158 sq. ft.
Year Built:	1965

Construction Features

Facade:	4 story concrete masonry with brick
Roof Type:	Flat, rubber membrane, silver coat, in fair condition
Windows:	Metal frame, fixed, dual pane, thermal break, slight tinting with interior blinds, approximately 10 years old, in good condition.
Exterior Doors:	Metal, 80% glazing, in fair condition

Major Mechanical Systems

Air Handlers / AC Systems / Ventilation Systems

- One (1) Environmental Air Handling Unit
- Five (5) Trane Package Roof Top Units; one very old
- One (1) Greenheck Make up air unit/Exhaust Fan system
- One (1) Sanyo Split System condensing unit
- One (1) Greenheck Package Roof Top Unit
- One (1) Captive Aire-System Make up air unit

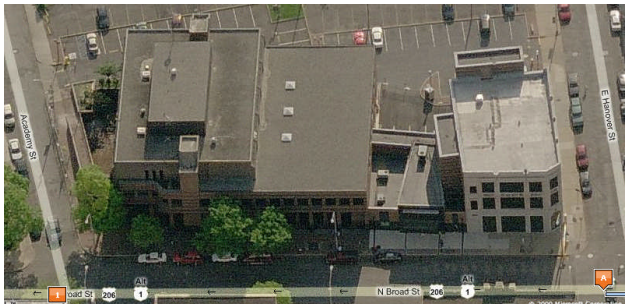
Boilers/ Heating Systems

- One (1) Rheem electric water heater (80 gallons)
- One AO Smith domestic water heater (119 gallons)

Facility Description – James Kerney Campus

Building — Career Center

Address:	North Broad Street Trenton, NJ 08690
Gross Floor Area:	20,351 sq. ft.
Year Built:	1965



Construction Features

Facade:	3 story concrete masonry with brick
Roof Type:	Flat, rubber membrane, silver coat, in fair condition
Windows:	Metal frame, fixed, dual pane, thermal break, slight tinting with interior blinds, approximately 10 years old, in good condition
Exterior Doors:	Metal, 80% glazing, in fair condition

Major Mechanical Systems

Air Handlers / AC Systems / Ventilation Systems

- One (1) McQuay Package Roof Top Unit
- One (1) Environmental Air Handling Unit
- One (1) Greenheck Exhaust Fan

Greenhouse Gas Emission Reduction

Implementation of all identified ECOs will yield:

- 3,868,340 kilowatt-hours of annual avoided electric usage.
- This equates to the following ***annual*** reductions:

- 733 tons of CO_2;

The Energy Information Administration (EIA) estimates that power plants in the state of New Jersey emit 660 tons of CO_2 per MWh generated.

-OR-

- 201 Cars removed from road;

The Environmental Protection Agency (EPA) estimates that one car emits 11,560 lbs CO_2 per year.

-OR-

- 516 Acres of trees planted annually

The EPA estimates that reducing CO_2 emissions by 7,333 pounds is equivalent to planting an acre of trees.

Notes and Assumptions

- Project cost estimates were based upon industry accepted published cost data, rough order of magnitude cost estimates from contractors, and regional prevailing wage rates. The cost estimates presented in this report should be used to select projects for investment grade development. The cost estimates presented in this report should not be used for budget development or acquisition requests.
- Exact age of equipment could not be provided since as-built drawings were not readily available or were found to be non-existent
- The following utility prices provided were used within this study:
  - Electricity Cost ($/kWh): West Windsor $0.13 / Trenton $0.14
  - Natural Gas Cost ($/therm): West Windsor $1.80 / Trenton $1.73
  - Steam Cost ($/MMBtu): Trenton $0.03
  - Chilled Water Cost ($/ton hrs): Trenton $0.62
- The average CO2 emission rate from power plants serving the facilities within this report was obtained from the Environmental Protection Agency's (EPA) eGRID2007 report. It is stated that power plants within the state of NJ emit 0.694 lbs of CO2 per kWh generated.
- The EPA estimates that burning one therm of natural gas emits 11.708 lbs CO2.
- The EPA estimates that one car emits 11,560 lbs CO2 per year.
- The EPA estimates that reducing CO2 emissions by 7,333 pounds is equivalent to planting an acre of trees.

Energy Conservation Measures
ECM #1 – Lower Pool Water Temperature

West Windsor Campus	**Physical Education**
Estimated Annual Energy Cost Savings:	$14,876
Gross Estimated Cost:	$1,500
NJ Smart Start Rebate:	$0
Simple Payback (years):	0.1
Annual Avoided CO_2 Emissions (tons):	38

- Due to the temperature difference between the pool water (87°F) and ambient air (83°F), the pool experiences a significant amount of heat loss and pool water evaporation.

- Lowering the pool water temperature to space temperature will significantly reduce heating costs by minimizing the heat loss.

ECM #2: Time of Day – Exhaust Fans

	LA - West Windsor Campus	MS - West Windsor Campus	BS - West Windsor Campus	ET - West Windsor Campus	ES - West Windsor Campus	SC - West Windsor Campus	LB - West Windsor Campus	PE - West Windsor Campus	CM - West Windsor Campus	AD - West Windsor Campus	FA - West Windsor Campus	**Total**
Estimated Annual Energy Cost Savings:	$160	$6,000	$160	$110	$77	$780	$64	$38	$410	$350	$160	**$8,300**
Estimated Gross Implementation Costs:	$190	$1,600	$190	$190	$260	$260	$130	$64	$520	$260	$190	**$3,900**
NJ Smart Start Rebate:	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**
Net Estimated Implemtation Costs:	$190	$1,600	$190	$190	$260	$260	$130	$64	$520	$260	$190	**$3,900**
Estimated Simple Payback:	1.2	0.3	1.2	1.7	3.3	0.3	2.0	1.7	1.3	0.7	1.2	**1.4**
Annual Avoided CO_2 Emissions (tons):	0	15	0	9	4	2	0	0	1	1	0	**33**

- Although the units are equipped with time of day scheduling controls, the building exhaust fans are currently operating 24/7.
- Energy savings will be realized by programming the exhaust fans to operate according to the buildings' occupancy schedules.

NOTE: Minimal amount of variance from building to building in energy savings and cost to implement.

ECM #3: Time of Day – Ventilation Units

Maintenance Building – West Windsor Campus	
Estimated Annual Energy Cost Savings:	**$1,400**
Estimated Gross Implementation Costs:	**$2,400**
NJ Smart Start Rebate:	**$0**
Net Estimated Implementation Costs:	**$2,400**
Estimated Simple Payback:	**1.7**
Annual Avoided CO_2 Emissions (tons):	**3**

- Although the units are equipped with time of day scheduling controls, the following units are currently operating 24/7:

Unit	Serves
HV	Plumbing Shop
AH 2	Print/Elect/Paint Shop
AH 3	MW Room
AHU 15-1	Morgue
AHU 15-3	Locker Rooms

- Energy savings will be realized by programming the exhaust fans to turn off during unoccupied hours (11PM – 5 AM.)
- Drawbacks to excessive supply and ventilation air:
  - Noise at the diffuser
  - Induces uncomfortable drafts
  - Rapid temperature changes when the heating/cooling elements turn off
- Dome-Tech recommends rebalancing the system to supply air flow rate adequate for ventilation requirements and thermal conditioning.

NOTE: Minimal amount of variance from building to building in energy savings and cost to implement.

ECM #4 – Install Cover Pool & Use Nightly

	Physical Education
Estimated Annual Energy Cost Savings:	$5,980
Gross Estimated Implementation Cost:	$10,000
NJ Smart Start Rebate:	$0
Simple Payback (years):	1.7
Annual Avoided CO_2 Emissions (tons):	15

- Due to the temperature difference between the pool water and ambient air, the pool experiences a significant amount of heat loss and pool water evaporation.

- Placing a cover over the pool during unoccupied hours will significantly reduced energy costs in two ways:
  - Reduce the amount of heat required by the pool water heater
  - Reduce the amount of make-up air required to maintain desired humidity levels

NOTE: Cost to implement is approximate as automatic pool covers are not typically made for Olympic size pools (50' x 80'), as they sag in the middle and are therefore not effective. Generally x3 automatic covers are used going across the shorter width of the pool as the alternate solution.

ECM #5: Vending Machine Power Management

	LA - West Windsor Campus	MS - West Windsor Campus	ET - West Windsor Campus	ES - West Windsor Campus	SC - West Windsor Campus	PE - West Windsor Campus	CM - West Windsor Campus	AD - West Windsor Campus	TH - West Windsor Campus	AC - James Kerney Campus	Total
Estimated Annual Energy Cost Savings:	$2,400	$500	$900	$500	$1,400	$1,800	$1,800	$500	$500	$1,000	$11,300
Estimated Gross Implementation Costs:	$2,450	$350	$700	$350	$1,050	$1,400	$1,400	$700	$350	$700	$9,500
NJ Smart Start Rebate:	0	0	0	0	0	0	0	0	0	0	0
Net Estimated Implemtation Costs:	$2,450	$350	$700	$350	$1,050	$1,400	$1,400	$700	$350	$700	$9,500
Estimated Simple Payback:	1	1	1	1	1	1	1	1	1	1	1.2
Annual Avoided CO_2 Emissions (tons):	6	1	2	1	3	4	4	1	1	2	7

Location	Soda Vending	Snack Vending
LA - West Windsor Campus	5	2
MS - West Windsor Campus	1	0
ET - West Windsor Campus	2	0
ES - West Windsor Campus	1	0
SC - West Windsor Campus	3	0
PE - West Windsor Campus	4	0
CM - West Windsor Campus	4	0
AD - West Windsor Campus	1	1
TH - West Windsor Campus	1	0
AC - James Kerney Campus	2	0

- Dome-Tech recommends installing a VendMiser vending machine power management device on all vending machines.
- The device uses a passive infrared sensor to power down the machine when the area surrounding it is vacant. Then it monitors the room's temperature and automatically re-powers the cooling system at one- to three-hour intervals, independent of sales, to ensure that the product stays cold.
- The microcontroller will never power down the machine while the compressor is running, eliminating compressor short-cycling. In addition, when the machine is powered up, the cooling cycle is allowed to finish before again powering down (reduces compressor wear and tear).

NOTE: Minimal amount of variance from building to building in energy savings and cost to implement.

ECM #6: Install VFDs on Supply Fans

	CM - West Windsor Campus	TH - West Windsor Campus	ET - West Windsor Campus	CC - James Kerney Campus	Total
Estimated Annual Energy Cost Savings:	$10,100	$4,500	$2,200	$1,800	$18,600
Estimated Gross Implementation Costs:	$47,700	$30,700	$15,400	$15,100	$108,900
NJ Smart Start Rebate:	$5,400	$2,400	$1,200	$1,200	$10,200
Net Estimated Implemtation Costs:	$42,300	$28,300	$14,200	$13,900	$98,700
Estimated Simple Payback:	4.7	6.8	7.0	8.4	6.7
Annual Avoided CO_2 Emissions (tons):	25	11	5	4	46

- The air handlers (AC9-1, 2, 3, 4 & 5) in the Communications Building, Career Center (AHU-B4) and Engineering Technologies Building (AC4-1) are variable air volume systems. The fan air flow is currently controlled with inlet vane dampers on the return plenum while the supply fan speed remains constant.

- Controlling fan speed with a variable frequency drive and removing the spill dampers will improve control and provide at least twice the energy savings.

- This ECM requires replacement of the motors as well as installation of VFD. Savings include upgrading motors to premium efficiency models.

- If this ECM is not implemented, Dome-Tech recommends installing new fans with VFD's upon replacement of the units.

NOTE: Minimal amount of variance from building to building in energy savings and cost to implement.

ECM #7: Demand Control Ventilation

	TH - West Windsor Campus	PE - West Windsor Campus	LB - West Windsor Campus	MC - West Windsor Campus	Total
Estimated Annual Energy Cost Savings:	$5,800	$40,600	$10,000	$4,400	$60,800
Estimated Gross Implementation Costs:	$13,780	$41,350	$27,560	$13,780	$96,470
NJ Smart Start Rebate:	$0	$0	$0	$0	$0
Net Estimated Implemtation Costs:	$13,780	$41,350	$27,560	$13,780	$96,470
Estimated Simple Payback:	2.4	1.0	2.8	3.1	2.3
Annual Avoided CO_2 Emissions (tons):	14	101	25	11	151

- Building codes require that a minimum amount of fresh air be provided to ensure adequate air quality. To comply, ventilation systems often operate at a fixed rate based on an assumed occupancy (e.g., 20 cfm per person multiplied by the maximum design occupancy). The result is excessive fresh air volumes which require costly (and unnecessary) conditioning.

- Demand-controlled ventilation controls the amount of outside air based upon the CO_2 levels generated by building occupants. Demand ventilation should be added to any return air system where space occupancy varies dramatically – gymnasiums, auditoriums and common areas.

- By installing CO_2 sensors and controlling the space CO_2 level at less than 1000 PPM, the outside air flow is kept to the absolute minimum while space conditions are kept in compliance with building codes and standards such as the ASHRAE Indoor Air Quality Standard.

NOTE: Minimal amount of variance from building to building in energy savings and cost to implement.

ECM #8: Domestic Hot Water Pump Time of Day Optimization

Communications Building	
Estimated Annual Energy Cost Savings:	$880
Estimated Gross Implementation Costs:	$2,000
NJ Smart Start Rebate:	$0
Net Estimated Implementation Costs:	$2,000
Estimated Simple Payback:	2.3
Annual Avoided CO_2 Emissions (tons):	2

- Currently, the domestic hot water distribution pumps operate 24/7. Unless these units are manually turned off, they operate during unoccupied periods resulting in excessive energy consumption.

- Energy savings will be realized by scheduling these pumps to turn off 11 PM to 4 AM.

ECM #9: Replace Pool HVUs

Physical Education	
Estimated Annual Energy Savings:	$75,000
Gross Estimated Implementation Cost:	$185,000
NJ Smart Start Rebate:	$0
Net Estimated Implementation Cost:	$185,000
Simple Payback (years):	2.5
Annual Avoided CO_2 Emissions (tons):	94

- The two (2) existing Miller-Picking heating and ventilation units (HV units) serving the pool exceed their estimated equipment service life (EESL) per ASHRAE standards by approximately 15 years.
- Replacing these units with modern AHU's equipped with glycol hot water coils, high efficiency fans and controls will significantly reduce HVAC operating costs.

Pool HV unit w/ electric heating coil and heat recovery coil

ECM #10: Replace Electric Boiler with High Efficiency Condensing Boilers

- The Physical Education building has two (2) 250 kilowatt Patterson Kelly electric boilers and the Engineering Systems building has one (1) 80 kilowatt Weil-McLain electric boiler.

- The Patterson Kelley boilers are 39 years old and are nearing the end of the equipment service life (ASHRAE states the service life of similar equipment to be 25 years).

- The boiler's age, size, type and configuration of the boilers do not lend themselves to cost-efficient operation.

- If the existing boilers were replaced with high efficiency gas-fired condensing boilers, savings will be incurred in two ways. Firstly, in modular boiler applications, multiple smaller boilers are installed to meet the overall building load. Each boiler operates independently, eliminating the "all on/all off" operation of single burner boilers. As building load increases only those units necessary to meet the load are fired. This allows each unit to run at optimal efficiency. Secondly, the college's electric cost is $0.13 per kilowatt hour. The equivalent natural gas cost for a 95% efficient (depending on return water temperature) natural gas condensing boiler is $3.60 per therm. The actual price for natural gas is approximately $1.80 per therm.

- Installation of a new boiler would allow boiler runtimes to be equally distributed and would allow for reliable backup capacity should one boiler fail or require repairs.

ECM #10: Replace Electric Boiler with High Efficiency Condensing Boilers (continued)

- High efficiency boilers should be considered when the existing boilers near the end of their useful equipment lives.

Physical Ed Building	
Estimated Annual Energy Cost Savings:	$54,000
Gross Estimated Implementation Cost:	$320,000
NJ Smart Start Rebate:	$0
Net Estimated Implementation Cost:	$320,000
Simple Payback (years):	5.9
Annual Avoided CO_2 Emissions (tons):	76

ECM #11: Lighting Upgrade

All Buildings	
Estimated Annual Energy Cost Savings:	$78,900
Estimated Annual Operations Cost Savings:	$18,700
Total Estimated Annual Savings:	$97,600
Estimated Gross Implementation Costs:	$497,020
NJ Smart Start Rebate:	$27,800
Net Estimated Implementation Costs:	$469,220
Estimated Simple Payback:	4.8
Annual Avoided CO_2 Emissions (tons):	186

- Although most of the current light fixtures have higher efficiency T-8 fluorescent lamps and ballasts, improved light fixture designs will further reduce lighting energy costs by reducing the total number of lamps and fixtures while maintaining the minimum lighting output as per state codes.
- Most of the current lights in the gymnasiums are high intensity discharge lamps, which can be replaced with high output, higher efficiency fluorescent fixtures that are specifically designed for high ceiling applications. Lighting energy will be reduced by nearly 50% in applicable gymnasiums.
- Many classrooms, break rooms and restrooms were observed to have lights on regardless of occupancy. Installing occupancy sensors in these areas will automatically turn lights on/off according to actual occupancy by sensing the presence of people in the room. Occupancy sensors will reduce lighting energy costs by approximately 30%*. *Source: Turner, Wayne, Energy Management Handbook, 1999.

NOTE: Minimal amount of variance from building to building in energy savings and cost to implement.

ECM #12: Install Timers on Hot Water Heaters

	PE - West Windsor Campus	MW - West Windsor Campus	AC - James Kerney Campus	ET - West Windsor Campus	Total
Estimated Annual Energy Cost Savings:	$2,000	$2,000	$300	$1,500	$5,800
Estimated Gross Implementation Costs:	$5,400	$2,700	$2,700	$8,100	$18,900
NJ Smart Start Rebate:	$0	$0	$0	$0	$0
Net Estimated Implemtation Costs:	$5,400	$2,700	$2,700	$8,100	$18,900
Estimated Simple Payback:	2.7	1.4	9.0	5.4	4.6
Annual Avoided CO_2 Emissions (tons):	5	5	1	4	14

- Although the domestic hot water heater tanks are insulated, they experience standby heat loss during off hours. The heating elements turn on throughout unoccupied hours to maintain the desired set point temperature (120°F).

- Placing timers on the units will turn the units off during unoccupied hours and turn them back on two hours prior to occupation. Thus, eliminating the energy needed to make up the standby heat loss.

NOTE: Minimal amount of variance from building to building in energy savings and cost to implement.

Administration Building: Electric Hot Water Heater

ECM #13: Convert Electric Baseboard and Cabinet Unit Heating Coils to Hot Water (MW, PE, ET & AC)

	PE - West Windsor Campus	MW - West Windsor Campus	AC - James Kerney Campus	ET - West Windsor Campus	Total
Estimated Annual Energy Cost Savings:	$2,000	$2,000	$300	$1,500	$5,800
Estimated Gross Implementation Costs:	$5,400	$2,700	$2,700	$8,100	$18,900
NJ Smart Start Rebate:	$0	$0	$0	$0	$0
Net Estimated Implemtation Costs:	$5,400	$2,700	$2,700	$8,100	$18,900
Estimated Simple Payback:	2.7	1.4	9.0	5.4	4.6
Annual Avoided CO_2 Emissions (tons):	5	5	1	4	14

- The Physical Ed's electric cost is $0.13 per kilowatt hour. The equivalent natural gas cost for a 95% efficient natural gas hot water heater is $3.60 per therm. The actual price for natural gas is approximately $1.80 per therm.

- Replacing the electric coils in the unit ventilators and cabinet unit heaters with hot water coils will provide over $5,800 in annual savings. This project will require circulation pumps and distribution piping and will utilize existing hot water boilers.

Electric Radiator

NOTE: Minimal amount of variance from building to building in energy savings and cost to implement.

ECM #14: Remove Unused Pre-Heat Coils

	PE - West Windsor Campus	ET - West Windsor Campus	AD - West Windsor Campus	Total
Estimated Annual Energy Cost Savings:	$ 600	$ 600	$ 600	$1,800
Estimated Gross Implementation Costs:	$ 2,300	$ 2,300	$ 2,300	$6,900
NJ Smart Start Rebate:	$0	$0	$0	$0
Net Estimated Implemtation Costs:	$2,300	$2,300	$2,300	$6,900
Estimated Simple Payback:	3.8	3.8	3.8	3.8
Annual Avoided CO_2 Emissions (tons):	1.5	1.5	1.5	4.5

- Currently, the Administration, Engineering Technologies, and Physical Education building's each have abandoned Preheat coils installed in the ductwork that are no longer used.

- Removal of the three preheat coils will reduce the resistance by approximately 0.25" WC in the ductwork and in turn reduce energy consumption by the supply air fans.

* Marginal Cost = Premium Efficiency Units - Like and Kind replacement

ECM #15: Reduce Static Pressure Setpoint

Theater (AHU-9-5)	
Estimated Annual Energy Cost Savings:	$710
Estimated Gross Implementation Costs:	$7,100
NJ Smart Start Rebate:	$0
Net Estimated Implementation Costs:	$7,100
Estimated Simple Payback:	10.0
Annual Avoided CO_2 Emissions (tons):	2

- Due to the theater air handling unit (AHU-9-5) supplying air at a higher than designed static pressure setting, the building is over-pressurized. The excess pressure is causing the building's doors to be open slightly.
- By reducing the static pressure setpoint from 1.8" w.c. to 1.2" (design), energy savings will be realized from reduced supply fan power.

ECM #16: Kitchen Equipment Fuel Switch

Student Center	
Estimated Annual Savings:	$2,700
Gross Estimated Implementation Cost:	$30,400
Expected Rebate / Energy Efficiency Credit:	0
Net Estimated Implementation Costs:	$30,400
Simple Payback (yrs): (with and w/o rebate)	11.3
Annual Avoided CO_2 Emissions (tons):	2

Pictured: Electric Ovens in Student Center

- Replacing two (2) electric ovens and one (1) electric steam kettle with natural gas models will significantly reduce annual cooking costs.

- The facility electric cost is $0.13 per kilowatt hour. The equivalent natural gas cost is $4.50 per therm (assuming commercial kitchen equipment efficiency of 85%.) The actual price for natural gas is approximately $1.80 per therm.

- The electric ovens and steam kettle are recommended to be replaced with Energy Star labeled natural gas units (where available.) Dome-Tech also recommends checking ventilation and fire code requirements for natural gas fired equipment and the available space under existing hoods before proceeding with this project.

ECM #17: Premium Efficiency Motors

	CM - West Windsor Campus	TH - West Windsor Campus	ET - West Windsor Campus	PE - West Windsor Campus	ES - West Windsor Campus	LB - West Windsor Campus	CC - James Kerney Campus	AC - James Kerney Campus	AD - West Windsor Campus	MS - West Windsor Campus	BS - West Windsor Campus	LA - West Windsor Campus	SC - West Windsor Campus	Total
Estimated Annual Energy Cost Savings:	$900	$200	$200	$600	$100	$100	$300	$300	$200	$100	$20	$50	$1,200	$4,270
Estimated Gross Implementation Costs:	$9,200	$2,200	$3,600	$5,100	$1,200	$2,900	$900	$4,600	$3,900	$3,700	$1,300	$2,800	$8,900	$50,300
NJ Smart Start Rebate:	$700	$200	$400	$400	$100	$200	$100	$400	$300	$600	$100	$200	$600	$4,300
Net Estimated Implemtation Costs:	$8,500	$2,000	$3,200	$4,700	$1,100	$2,700	$800	$4,200	$3,600	$3,100	$1,200	$2,600	$8,300	$46,000
Estimated Simple Payback:	10.2	11.0	18.0	8.5	12.0	29.0	3.0	15.3	19.5	37.0	65.0	56.0	7.4	22.5
Annual Avoided CO_2 Emissions (tons):	2.2	0.5	0.5	1.5	0.2	0.2	0.7	0.7	0.5	0.2	0.0	0.1	3.0	10.6

- Most of the existing motors serving the AHU's and pumps are standard efficiency motors. See the appendix for a detailed list of motors surveyed for this ECO.

Motor Size (hp)	No. Of Motors	Existing Efficiency (%)	Premium Efficiency (%)
5	17	81.5	89.5
7.5	9	87.5	91.0
10	9	88.5	91.7
15	6	91.0	93.0
20	2	90.0	93.0
50	1	90.0	94.5

- Dome-Tech recommends replacing select regularly operated standard efficiency motors (pumps and large AHU's) with new premium efficiency motors. For all other motors, when the motor starts to fail it is recommended that they are replaced with new premium efficiency motors.

NOTE: Minimal amount of variance from building to building in energy savings and cost to implement.

ECM #18: Replace WSHP and Dry-cooler

Engineering Systems	
Estimated Annual Savings:	$5,300
Gross Estimated Implementation Cost:*	$61,800
NJ Smart Start Rebate:	$600
Net Estimated Implementation Cost:	$61,200
Simple Payback (years):	11.5
Annual Avoided CO_2 Emissions (tons):	13

Savings do not include maintenance savings.

- The existing water source heat pumps and dry-cooler are between 15-20 years old and are at or nearing the end of their estimated equipment service life (EESL) per ASHRAE standards. (The EESL for heat pumps is 19 years and 20 years for dry-coolers.)
- Replacing these units with new, higher efficiency units will significantly reduce annual energy and maintenance costs.
- New Jersey SmartStart offers rebates that usually pay for the incremental cost to upgrade to higher efficient units.

Energy Efficiency Ratios*

Unit Capacity (tons)	Existing	Proposed
7.5	8.0	11.4

*Energy Efficiency Ratios: EER is the rating of cooling output (Btu) divided by the electrical energy input (watts). The higher the EER, the more efficient the unit.

Pictured: Typical WSHP Serving Classrooms

ECM #19: Hot Water Temperature Reset

	CM- West Windsor Campus	ET - West Windsor Campus	TOTAL
Estimated Annual Energy Cost Savings:	$890	$520	$1,410
Gross Estimated Implementation Cost:	$4,300	$4,300	$8,600
NJ Smart Start Rebate:	$0	$0	$0
Net Estimated Implementation Cost:	$4,300	$4,300	$8,600
Simple Payback (years):	4.8	8.3	6.6
Annual Avoided CO2 Emissions (tons):	2.2	1.3	1.8

- A hot water reset program will reduce the temperature of the hot water leaving the boilers during low load days. The decrease in temperature will decrease the amount of heat required from the boiler, and decrease the radiant losses in the hot water distribution piping.

- Connecting the boilers to a building management system and implementing a temperature reset program will provide savings of over $1,250 per year.

ECM #20: Elevator Motor Efficiency Controller

	CC - James Kerney Campus	AC - James Kerney Campus	ET - West Windsor Campus	Total
Estimated Annual Energy Cost Savings:	$1,500	$2,300	$1,800	$5,600
Estimated Gross Implementation Costs:	$14,600	$14,600	$14,600	$43,800
NJ Smart Start Rebate:	$0	$0	$0	$0
Net Estimated Implemtation Costs:	$14,600	$14,600	$14,600	$43,800
Estimated Simple Payback:	9.7	6.3	8.1	8.1
Annual Avoided CO_2 Emissions (tons):	4	5	5	14

- The Department of Energy estimates that 44% of the motors in U.S. industry are lightly loaded and operating inefficiently. Electric motors become highly inefficient when they are lightly loaded – when performing less work than they are designed to handle.
- There are several ways to manage motor loading to optimize efficiency. Variable speed drives conserves energy by varying the motor speed in response to the system load. However, many applications with varying motor loads require constant speed. These systems include escalator and elevator motors.
- Another device designed to manage motor energy is a motor power efficiency controller or PEC. PEC's are designed to manage motor efficiency in constant speed systems by varying the power to motor while maintaining a fixed speed.
- A PEC is essentially a soft start with proprietary technology (voltage/amperage control algorithms). The technology senses a lightly loaded motor's inefficiency and reduces the power to the electric motor while maintaining the motor at full operating speed. In numerous tests by independent third parties, the PEC typically saves 20-40% of the electricity used by motors in appropriate applications.
- The Mercer County College has three (3) elevators – two equipped with 40 HP motors and one equipped with 30 HP motor. Since this is a ***newly emerging technology***, Dome-Tech recommends performing a pilot study on one elevator. If effective, this initiative should be implemented on the remaining systems. The presented savings and costs assume a single installation.

ECM #21: Domestic Hot Water Fuel Switch

	CC - James Kerney Campus	MW - West Windsor Campus	CM - West Windsor Campus	ET - West Windsor Campus	ES - West Windsor Campus	AD - West Windsor Campus	SC - West Windsor Campus	LB - West Windsor Campus	Total
Estimated Annual Energy Cost Savings:	$300	$100	$1,300	$200	$100	$100	$100	$300	$2,200
Estimated Gross Implementation Costs:	$8,800	$1,600	$4,400	$4,400	$4,400	$4,400	$4,400	$4,400	$2,200
NJ Smart Start Rebate:	50	50	600	50	50	50	50	140	100
Net Estimated Implemtation Costs:	$8,750	$1,550	$3,800	$4,350	$4,350	$4,350	$4,350	$4,260	$0
Estimated Simple Payback:	29	16	3	22	44	44	44	15	22.7
Annual Avoided CO_2 Emissions (tons):	1	0	3	0	0	0	0	1	1

- The domestic hot water available to building population and kitchens needs are heated by conventional electric storage water heaters.
- The facility electric cost is $0.13 per kilowatt hour. The equivalent natural gas cost for a 85% efficient natural gas hot water heater is $3.60 per therm. The actual price for natural gas is approximately $1.80 per therm.
- All conventional electric storage water heaters (Career Center, Eng Tech, Maintenance, Communications, Eng Systems and Student Center) are recommended to be replaced with conventional natural gas fired storage water heaters.

Picture: Maintenance Building
Electric Hot Water Heater

NOTE: Minimal amount of variance from building to building in energy savings and cost to implement.

ECM #22 – Install Variable Speed Drive on HW & CHW Pumps

	CM - West Windsor Campus	ET - West Windsor Campus	MS - West Windsor Campus	Total
Estimated Annual Energy Cost Savings:	$ 1,900	$ 1,000	$ 1,000	$ 3,900
Estimated Gross Implementation Costs:	$19,630	$9,820	$9,820	$ 39,270
NJ Smart Start Rebate:	$1,600	$800	$800	$ 3,200
Net Estimated Implemtation Costs:	$18,030	$9,020	$9,020	$ 36,070
Estimated Simple Payback:	10.3	9.8	9.8	10.0
Annual Avoided CO_2 Emissions (tons):	4.7	2.5	2.5	9.7

- The heating hot water and chilled water pumping systems are equipped with (2) 5 HP Motors at CM, (1) 5 HP Motor at MS, (1) 5 HP Motor at SC.
- The pumps run at full speed regardless of system hot water demands.
- Annual system pumping cost may be reduced by installing variable frequency drive (VFD) on the pump motors. Pump speed would be based upon system differential temperature.
- The installation cost estimates assume the pump motors and VFD's will be installed on both pump motors.

NOTE: Minimal amount of variance from building to building in energy savings and cost to implement

ECM #23 - Walk-In Cooler Controllers

	CM - West Windsor Campus	CM - West Windsor Campus	Total
Estimated Savings:	$80	$80	$160
Gross Estimated Implementation Cost:	$2,200	$2,200	$4,400
NJ Smart Start Rebate:	$0	$0	$0
Net Estimated Implementation Cost:	$2,200	$2,200	$4,400
Simple Payback (years):	27.5	27.5	27.5
Annual Avoided CO2 Emissions (tons):	0.2	0.2	0.4

- Typically the walk-in cooler evaporator fans run continuously. However, full airflow is only required 50% of the runtime.
- In the most common applications (those that use single-phase power), motors for the fans are typically shaded-pole or permanent-split-capacitor types, both of which are very inefficient.
- Inexpensive controllers are currently available that slow these fans when full-speed operation is unnecessary.
- Reducing the operating speed reduces the energy consumption of the fan. In addition, the motor produces less heat at slower speeds, which means that the compressor has less heat to remove from the refrigerated compartment.

ECM #24: Replace Split AC Systems

Maintenance Building	
Estimated Annual Savings:	$300*
Gross Estimated Implementation Cost:	$28,200
Avoided Cost (Like and Kind Replacement):	$2,700
Net Estimated Implementation Cost:	$25,500
Simple Payback (years):	85.5
Annual Avoided CO_2 Emissions (tons):	1

Savings do not include maintenance savings.

Marginal Cost = Premium Efficiency Units - Like and Kind replacement

- The existing split system AC units are between 15-20 years old and are at the end of their estimated equipment service life (EESL) per ASHRAE standards. (The EESL for split systems is 15 years.)
- Replacing these units with new, higher efficiency units will significantly reduce annual energy and maintenance costs.
- New Jersey SmartStart offers rebates that usually pay for the incremental cost to upgrade to higher efficient units.

Energy Efficiency Ratios*

Unit Capacity (tons)	Existing	Proposed
5	8.9	10.8
7.5	8.9	10.6
10	8.6	10.3

*Energy Efficiency Ratios: EER is the rating of cooling output (Btu) divided by the electrical energy input (watts). The higher the EER, the more efficient the unit.

ECM #25: Replace Electric Unit Ventilators and Heaters with Hot Water Coils

	PE - West Windsor Campus	PE - West Windsor Campus	Total
Estimated Annual Energy Cost Savings:	$600	$600	$1,200
Estimated Gross Implementation Costs:	$2,700	$2,700	$5,400
NJ Smart Start Rebate:	$0	$0	$0
Net Estimated Implemtation Costs:	$2,700	$2,700	$5,400
Estimated Simple Payback:	4.5	4.5	4.5
Annual Avoided CO_2 Emissions (tons):	1.5	1.5	3.0

- The average facility electric cost is $0.13 per kilowatt hour. The equivalent natural gas cost for a 95% efficient natural gas hot water heater is $3.60 per therm. The actual price for natural gas is approximately $1.80 per therm.
- Replacing the electric coils in the unit ventilators and cabinet unit heaters with hot water coils will provide over $1,200 in annual savings. This project will require circulation pumps and distribution piping and will utilize existing hot water boilers.

Electric Radiator

ECM #26 : Replace AHU (AC-52) with Package Rooftop Unit – Eng Systems Bldg

Estimated Annual Savings:	$300
Gross Estimated Implementation Cost:	$11,400
NJ Smart Start Rebate:	$680
Net Estimated Replacement Cost:	$10,700
Simple Payback (years):	35.3
Annual Avoided CO_2 Emissions (tons):	1

*Savings do not include maintenance savings.

- The existing Air Handling Unit (AHU's) on the Engineering Building is at the end of their estimated equipment service life (EESL) per ASHRAE standards. (The EESL for AHU's is 15 years.)
- Replacing these AHU's with new, higher efficiency units will significantly reduce annual energy and maintenance costs.
- New Jersey SmartStart offers rebates that usually pay for the incremental cost to upgrade to higher efficient units.

Energy Efficiency Ratios*

Unit Capacity (tons)	Existing	Proposed
5	9	14
10	8.6	11

*Energy Efficiency Ratios: EER is the rating of cooling output (Btu) divided by the electrical energy input (watts). The higher the EER, the more efficient the unit.

ECM #27: Creation of an Energy Awareness & Education Program

- The Mercer County Community College buildings were observed to have substantial communication materials regarding recycling and environmental measures. The College could benefit from an enhanced program that includes energy efficiency and awareness materials.
- Educational institutions can have a potentially large impact on promoting an energy conscious and conservation-minded society that starts at their college, leading to energy cost reductions, environmental benefits, and national energy independence.
- In addition, colleges can receive recognition for their efforts and possible media coverage, which can contribute to enhanced school spirit, and individual feelings of accomplishment and connection.

Estimated Annual Savings:	2-3%*
Gross Estimated Implementation Cost:	$1500
Expected Rebate / Energy Efficiency Credit:	None
Net Estimated Implementation Costs:	$1500
Simple Payback (yrs): (with and w/o rebate)	Varies
Annual Avoided CO_2 Emissions (tons):	Varies
Cost per Ton CO_2 Reduction ($/ton):	Varies

* Estimated Annual Savings are based on the robustness of the program implemented, maintenance, and annual energy costs.

Renewable/Distributed Energy Measures

Distributed Generation & Renewable Energy

- Distributed Generation (on-site generation) generates electricity from many small energy sources. These sources can be renewable (solar/wind/geothermal) or can be small scale power generation technologies (CHP, fuel cells, microturbines)
- Renewable energy is energy generated from natural resources (sunlight, wind, and underground geothermal heat) which are naturally replenished
- Photovoltaic's (solar) are particularly popular in Germany and Spain and growing in popularity in the U.S.
- Wind power is growing as well, mostly in Europe and the U.S.
- Geothermal applications are used widely in western U.S. (most prominent in the Yellowstone basin and in northern California)

Renewable Energy Technologies: Wind

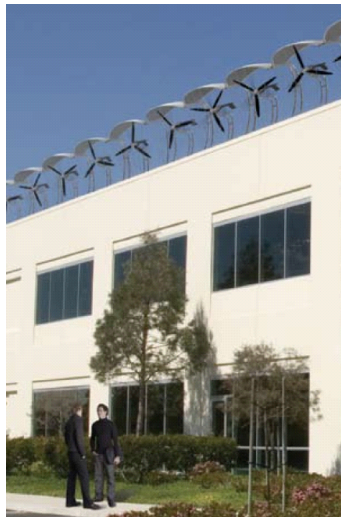
Wind turbines generate electricity by harnessing a wind stream's kinetic energy as it spins the turbine airfoils. As with most renewable energy sources, wind energy is subject to intermittent performance due to the unpredictability of wind resources.

Mercer County College Wind Speed – West Windsor Campus

As previously stated, wind speed is critical to the successful wind turbine installation. According to average wind data from NASA's Surface Meteorology and Solar Energy records, the average annual wind speed for the West Windsor area is 4.6 meters per second. Ideal wind speeds for a successful project should average over 6 meters per second.

For the Mercer County College, Dome-Tech considered three (3) types of wind turbine technologies; building integrated wind turbines (1 kW each) and traditional ground mounted wind turbines (5 kW & 50 kW).

Building Integrated Wind Turbines
Model: AeroVironment AVX1000
Height: 8.5'
Rotor Diameter: 6'
Weight: 130 lbs.
Cut-In Wind Speed: 2.2 m/s
Maximum Generating Capacity: 1 kW



5 kW Ground Mount
Model: WES5 Tulipo
Height: 40'
Rotor Diameter: 16'
Weight: 1,900 lbs.
Cut-In Wind Speed: 3.0 m/s
Maximum Generating Capacity: 5.2 kW

50 kW Ground Mount
Model: Entegrity EW50
Height: 102'
Rotor Diameter: 50'
Weight: 21,000 lbs.
Cut-In Wind Speed: 4.0 m/s
Maximum Generating Capacity: 50 kW

Renewable Energy Technologies: Wind

The project economics and wind turbine pros and cons are presented in the following tables:

Average Wind Speed	5.3	5.3	6.6
Annual Electric Use, kwh	16,010,121	16,010,121	16,010,121
Electric Cost	$0.13/kWh	$0.13/kWh	$0.13/kWh

	Micro	Traditional 5.2 kw	Traditional 50 kw
Number of Units	20	2	1
kW Capacity, per Unit	1 Kw	5.2 Kw	50.0 Kw
kW Capacity, Total	20 Kw	10 Kw	50 Kw
Annual Production Per Unit	1,083 Kwh	7,694 Kwh	153,672 Kwh
Annual Production Total	21,658 Kwh	15,387 Kwh	153,672 Kwh
Annual Savings	$2,880	$2,047	$20,438
Installed Cost per Unit	$6,500		
Installed Cost per Kw		$6,000	$5,000
Gross Installed Cost	$130,000	$62,400	$250,000
NJ Incentive	$54,029	$49,239	$120,036
Net Installed Cost	$75,971	$13,161	$129,964
Simple PayBack	26.4	6.4	6.4
% Energy Use	0.1%	0.1%	1.0%

Wind Turbine Pros & Cons

Pros	Cons
➢Annual reduction in energy spend and use can be potentially reduced by almost $15,100 (0.8% reduction). ➢Typical equipment life span is 15-30 years. ➢Reduction of annual greenhouse gas emissions by 4-28 tons per year. ➢A wind turbine project could be incorporated into science and other curriculums to raise student awareness of energy alternatives. ➢High visible “green” project.	➢Payback period is significant (over 10 years). ➢Average area wind speed is not ideal and impacts performance. ➢Prone to lighting strikes. ➢Bird collisions are likely, but may be reduced with avian guard (building integrate only). ➢Zoning may be an issue. Check with local zoning regulations. ➢Wind turbines do create noise, although below 50 dB (a typical car ride is over 80 dB).

Due to attractive payback and high potential for energy reduction, the 50 kilowatt ground mounted wind turbine project appears to be the most attractive option. Should Mercer County College decide to pursue a wind turbine project, Dome-Tech recommends commissioning a more detailed study.

Renewable Energy Technologies: Solar Photovoltaic

Solar Photovoltaic

- Sunlight can be converted into electricity using photovoltaic's (PV).
- A solar cell or photovoltaic cell is a device that converts sunlight directly into electricity.
- Photons in sunlight hit the solar panel and are absorbed by semiconducting materials, such as silicon. Electrons are knocked loose from their atoms, allowing them to flow through the material to produce electricity.
- Solar cells are often electrically connected and encapsulated as a module, in series, creating an additive voltage. The modules are connected in an array. The power output of an array is measured in watts or kilowatts, and typical energy needs are measured in kilowatt-hours.

Solar Photovoltaic Systems – West Windsor Campus

	Ground Mount
System Capacity, kw-dc	1,114 kw dc
Annual Electric Generation, kwhrs of AC electricity produced	1,658,153 kwh
Total Annual Facility Electric Use, kwhrs	16,010,121 kwh
% of Total Annual Usage	10%
All-In Cost of Electric Year 1	$0.130 / kwh
Annual Electric Cost Savings	$215,560
Estimated SREC Value (Year 1):	$640 / SREC
Estimated Year 1 SREC Revenue:	$1,060,671
Equivalent Annual CO2 Emission Reduction (tons per year)[1]	909 tons/yr
Equivalent Cars Removed From Road Annually[2]	157
Equivalent Acres of Trees Planted Annually[3]	248
System Installed Cost (does not include value of tax credits)	$8,357,625
Simple Payback (includes tax incentives)	7.5
IRR (25 Years)	10%

1. Estimated CO2 Emissions Rate: 1.096 lbs/kWh
2. EPA Estimate: 11,560 lbs CO2 per car
3. EPA Estimate: 7,333 lbs CO2 per acre of trees planted

Solar Photovoltaic System

- ## Non-Financial Benefits of Solar PV
- The implementation of solar PV projects at these facilities will allow the college the opportunity to not only gain experience with this energy technology, but also to win recognition as an environmentally sensitive, socially conscience institution. Additionally, these projects could be incorporated into science education and additional curriculums to raise awareness of current energy alternatives.

Renewable Energy Technologies: CHP/Cogeneration

- CHP (combined heat and power) or cogeneration is the use of a heat engine to simultaneously generate both electricity and useful heat.
- Fuel Cells are electrochemical conversion devices that operate by catalysis, separation the protons and the electrons of the reactant fuel, and forcing the electrons to travel through a circuit to produce electricity. The catalyst is typically a platinum group metal or alloy. Another catalytic process takes the electrons back in, combining them with the protons and oxidant, producing waste products (usually water and carbon dioxide).
- Microturbines are rotary engines that extract energy from a flow of combustion gas. They can be used with absorption chillers to provide cooling through waste heat rather than electricity. Microturbines are best suited for facilities with year-round thermal and/or cooling loads.
- Not recommended for Mercer Community College due to the lack of thermal requirements in the summertime.

MCCC Energy Bill and Purchasing Review: Electricity

- **Accounts and Rate Class:** Mercer County Community College is served by six single electric service/meter behind Public Service Electricity and Gas Company under various rate classes.
- **Electric Consumption and Cost:** The total annual electric expenditure for MCCC is about $2,273,000 and the total annual consumption is about 17,000,000 kilowatt-hours (kWh).
- **Average/Effective Rate per kWh:** For the one year period May07-Apr08, MCCC's average cost per kilowatt-hour ranged from 12 ¢/kWh to 29 ¢/kWh, inclusive of delivery charges. MCCC's overall, average cost per kilowatt-hour during this period was 14 ¢/kWh.
- **Rate Category - Fixed Price versus Hourly Pricing:** Per the resulting legislation set forth by the deregulation of electricity in New Jersey, one of MCCC's account was moved into the category known as "Commercial and Industrial Energy Pricing" (CIEP) category about 2 years ago. This category dictates the account's billing structure and also whether there is an opportunity (or incentive) for an owner to switch to an alternate retail energy supply company for electric generation service. This is presented in more detail on the next slide.

Energy Bill and Purchasing Review: Electricity (cont.)

Hourly Energy Pricing and Retail Energy Shopping

- In August 2003, the State of New Jersey deregulated its retail electric marketplace, and per this process, every electric account for every owner was placed into one of two categories: BGS-FP or BGS-CIEP. BGS-FP stands for Basic Generation Service-Fixed Price; BGS-CIEP stands for Basic Generation Service-Commercial and Industrial Energy Pricing.
- At its first pass, this categorization was based on rate class. The largest electric accounts in the State (those on a Primary or a Transmission-level rate class) were moved into BGS-CIEP pricing. All other accounts (most in NJ) remained on default service, or BGS-FP.
- Each year, the NJBPU continues to move new large energy users into BGS-CIEP by lowering the demand threshold for electric accounts receiving Secondary service (MCCC falls into this category).
- In 2006, MCCC was moved from BGS-FP pricing and into BGS-CIEP pricing because, at the time, its demand (peak load share) exceeded 1,250kW.

Energy Bill and Purchasing Review: Electricity (cont.)

- **As a result of moving to BGS-CIEP, there are two notable differences to the structure of this account's billing, as follows:**

  1. *Hourly Pricing*. ***Facilities on CIEP are charged for energy generation supply based on the real-time PJM market price; this is an hourly price, and is passed directly through from the utility. The kilowatt-hours consumed in each and every hour are charged at that hour's market price for energy. Over the course of a year, the effective monthly cost per kWh will fluctuate and will be unpredictable. The customer is fully exposed to the performance of the market in this scenario.***

  2. *Retail Margin Adder*. ***With the move to hourly pricing, customers that do not switch to a retail energy supplier for service are charged a retail margin adder of $.0053 per kWh. Based on MCCC's annual consumption, this adder would be costing MCCC more than $90,000.00 per year. This charge has been removed from MCCC's bill since it switched to a retail supplier.***

- **As long as MCCC's peak load share remains above the threshold of 1,000kW, Dome-Tech recommends that MCCC continue to shop for electric generation service. MCCC is currently under contract with Hess Energy Services for electric service until June of 2010. MCCC participated in the NJ County College's aggregated electric bid in 2009; by doing so, MCCC has achieved substantial savings versus what it would have paid had it remained with the utility (done nothing).**

Energy Bill and Purchasing Review: Natural Gas

- **Natural Gas Accounts:** **MCCC is served by four natural gas meter behind South Jersey Gas Company.**

- **Natural Gas Consumption and Cost:** **Natural gas is used primarily for winter heating purposes at the College; total annual usage is about 226,000 therms with an annual expenditure of approximately $407,000. The college paid between $1.19 per therm and above $2 per therm in some months.**

- **Current Natural Gas Market Futures Pricing:** **Natural gas commodity futures prices at the time of this report are at about $0.39 per therm for July 2009, and are below $0.60 per therm for the winter of 2009/2010. These are levels that have not been seen in more than 6 years (see graph below). If the District seeks longer-term rate stability, now is an ideal time to entertain it through a fixed-price arrangement with a retail supplier.**

Energy Procurement – Natural Gas

Henry Hub Natural Gas - 12 Month Strip

Operations & Maintenance

- Issue: Various air handling unit (AHU) had clogged/dirty filters.
- Consequence: Dirty filters increase the pressure drop in the AHU and in turn increase the energy consumption of the supply air fans.
- Recommendation: Replace dirty filters with new filters.

PHOTO: CC – AHU1

Operations & Maintenance

- Issue: The duct liner within various AHU have deteriorated and become friable.

- Consequence: Deteriorated and friable duct liner can accelerate the need to replace filters by clogging them quicker than normal operation. Liner after the unit's filters can also clog heating & cooling coils, in turn reducing the performance of those coils. Fibers can also be blown down the airstream into the occupied space of the building.

- Recommendation: Remove deteriorated duct liners. Replace duct liners if the entire AHU is not scheduled to be replaced.

PHOTO: PE – AHU 8-2

Operations & Maintenance

- Issue: The physical barrier separating the exhaust and incoming outside air after energy recovery wheel in the PE building has a missing panel and permanently open bypass dampers.

- Consequence: An opening in the separation between the airflows cause the exhaust air to short circuit and travel back to the supply air fan without ever exhausting from the building or moving across the energy recover wheel.

- Recommendation: Provide a new panel to block the opening and close the bypass dampers to ensure separation of air streams.

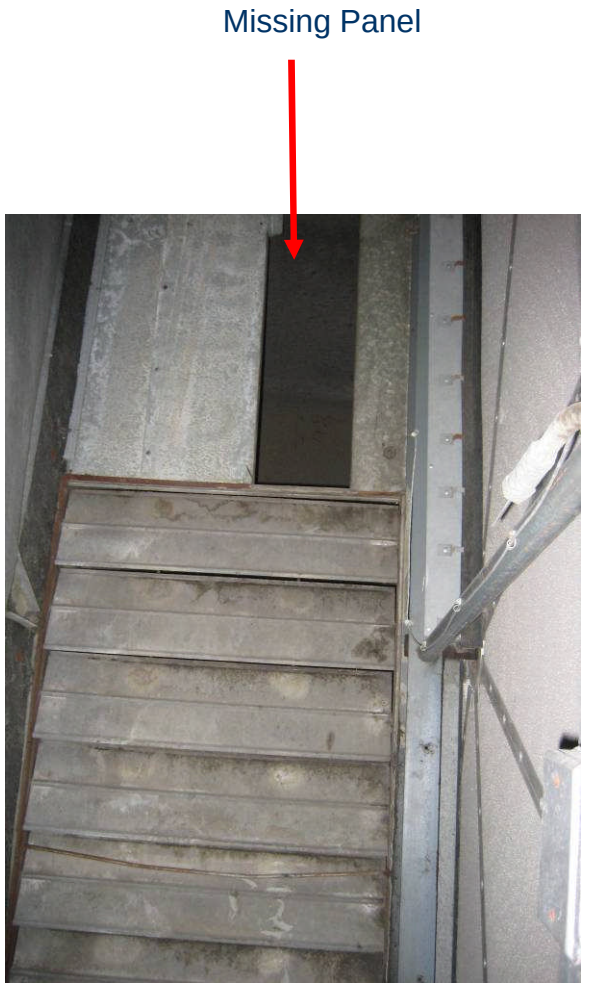


PHOTO: PE – HV-1 & EF 8-1 Energy Recover System

Next Steps

The following projects should be considered for further study and/or implementation:

- Replace pool heating ventilation units (HVU's)
- Replace electric boilers with high efficiency condensing boilers
- Retrofit variable air volume systems to include VFDs on supply fans
- Demand control ventilation
- Chilled Water and Hot Water Pump optimization
- Replace water source heat pumps and drycooler
- Replace split system AC units