Woodcliff Lake Public Schools

Woodcliff Lake, New Jersey 07677

Energy Audit

Prepared For:
Woodcliff Lake Schools

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

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Energy Audit Purpose & Scope

Purpose:

- The objectives of the energy audit are to evaluate each site's energy consumption, establish baselines for energy efficiency 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 2010 – June 2011

Buildings	Electric - PSE&G				Natural Gas - PSE&G			
	Account Number	Annual Consumption kWh	Annual Cost	$ / kWh	Account Number	Annual Consumption CCF	Annual Cost	$ / Therm
Dorchester Elementary School	42 009 073 05	500,880	$76,593.90	$0.153	42 009 073 05	26,133	$24,933.89	$0.954
Woodcliff Middle School	65 315 950 00	728,265	$117,501.42	$0.161	65 315 950 00	55,832	$53,270.70	$0.954
	TOTAL	**1,229,145**	**$ 194,095.32**	**$0.158**	**TOTAL**	**81,964**	**$ 78,204.59**	**$0.954**

* Note that natural gas energy rate for Dorchester Elementary School is estimated to be equal to that of Woodcliff Middle School. Due to gas meter failure in 2010, natural gas bills from this period are not representative of typical billing rate.

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

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/score of 75, or above, are eligible to apply for an official Energy Star Building label.

Facility 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)
Dorchester Elementary School	78,920	59	NA	55.4	108.8
Woodcliff Middle School	78,005	24	NA	92.3	144.4

* Note that the Energy Star Score for Dorchester Elementary School is an estimate only. It is based partialy on natural gas bills from 2009- due to gas meter failure in 2010. 2009 monthly data was entered in Portfolio Manager under the 2010 time perio

Historic Energy Consumption (continued)

Portfolio Manager Sign - In

- An account has been created for Woodcliff Lake Public Schools 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 district'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: ***WoodcliffLakePS***
- Password: ***DTWoodcliffLakePS***
- Email for account: ***mlynaugh@woodcliff-lake.com***

Facility Information

- **Building Name:** **Woodcliff Middle School**

Address: 134 Woodcliff Avenue, Woodcliff Lake, NJ 07677

Gross Floor Area: 78,005

Year Built: Original building was built in 1895. Various additions since: Media Center in 1998, Gym in 2005.

Occupants: The school has approximately 50 staff and 300 students.

Usage: The school is open from 7:30AM-2:30PM with partial student/staff occupancy until 3:15PM. Maintenance staff arrives at 6AM and final shift leaves at 10:15PM. There is no summer occupancy except for cleaning and maintenance crew.

- **Construction Features:**

Façade: Brick façade, stone, and brick façade with concrete blocks.

Roof Type: White membrane, black membrane, grey ballasted rock, shingle (being replaced as of the date of the audit), slate, metal standing seam (on gym). The black membrane roof has cracks and bubbles above classrooms 40 - 47.

Windows: Dual pane windows on the ground floor with both aluminum and vinyl frames. Single pane windows in basement.

Exterior Doors: Twenty metal double doors in good condition and three metal single doors. Almost all doors have some missing weather stripping. One overhead door in garage.

Facility Information

Major Mechanical Systems

Air Handlers / AC Systems / Ventilation Systems

Woodcliff Middle School is conditioned with twelve (12) rooftop units (RTU's).

Five (5) Packaged AC units serving separate classrooms are under the control of the Andover Controls building management system.

The new Gym area is served by one (1) Energy Recovery Unit with heat recovery wheel and eight (8) Cabinet Heaters serving various areas in and around the new Gym.

The cafeteria is served by HV-1 and RTU-6.

Boilers

The school is heated by two (2) natural gas fired Smith cast iron hot water boilers, rated at 3,920 MBH each unit. These boilers operate in a lead/ lag sequence. The hot water system is served two (2) 10 horsepower hot water pumps.

Domestic Hot Water

The majority of the school's domestic hot water is provided by an AO Smith, natural gas fired, domestic hot water heater, located in the boiler room. It has a rated capacity of 72 gallons and an output of 75 kBTUh. A separate electric AO Smith Boiler water heater (30 gallon tank) serves the locker rooms.

Controls

Equipment in the school is controlled by both Johnson Controls *Metasys* and Andover *Continuum* energy management systems. The Johnson Controls *Metasys* system controls the central boiler plant and older sections of the school, including six (6) rooftop units. The Andover system controls equipment in newer sections of the school, including six (6) rooftop units, and the energy recovery ventilator.

The Johnson Controls front end equipment is in the process of being upgraded summer of 2011.

Facility Information

Building Name: Dorchester Elementary School

Address:	100 Dorchester Road, Woodcliff, NJ 07677
Gross Floor Area:	78,920
Year Built:	Originally built in the 1950s. Upper wing was built in 1968, and new wing added in 2005.
# Occupants:	The school has approximately 50 staff and 600 students.
Usage:	The school is open from 7:30AM-2:30PM with partial student/staff occupancy until 3:15PM. First shift maintenance staff arrives at 6AM and leaves at 10:15PM. There is no summer occupancy except for cleaning and maintenance crew.

Construction Features:

Facade: Brick façade with a significant amount of blanked off windows.

Roof Type: Flat roof with white membrane and grey ballasted rock.

Windows: Windows in the original section appear to be original single pane with metal framing. In good condition for their age.

Exterior Doors: Eleven (11) Double doors, primarily metal and glass. Eight (8) Single doors, primarily metal.

Facility Information

Major Mechanical Systems

Air Handlers / AC Systems / Ventilation Systems

Dorchester Elementary School has four (4) RTUs under the control of the control of the Andover Controls system.

Ten (10) Packaged AC units serve separate classrooms and one (1) Packaged AC unit with local controls serves the art room.

The Gym is served by two (2) H&V units with local pneumatic controls.

Boilers

There are three (3) AO Smith cast iron boilers, natural gas fired, hot water boilers. Two (2) have 3-HP motors and the third boiler has a 5-HP motor. The hot water system is served two (2)10 HP hot water pumps.

Domestic Hot Water

There are two (2) natural gas fired domestic hot water heaters serving the general domestic hot water system. One is a RuudGlas and the other is an AO Smith. A separate instantaneous electric Ariston hot water heater is install in under the sink in Room 60.

Controls

The building is controlled by a mixture of time clocks (primarily for unit ventilators), pneumatic controllers (for Gym H&V units) and thermostats for packaged units and BMS controls for four (4) RTUs.

Greenhouse Gas Emission Reduction

Implementation of all identified ECMs will yield:

- 345,535 kilowatt-hours of annual avoided electric usage.
- 16,290 therms of annual avoided natural gas usage.
- This equates to the following ***annual*** reductions:

- 209 tons of CO2;

  -OR-

- 36 Cars removed from road;

  -OR-

- 57 Acres of trees planted annually

The Energy Information Administration (EIA) estimates that power plants in the state of New Jersey emit 0.666 lbs CO2 per kWh generated.

The Environmental Protection Agency (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: Seal and Insulate Abandoned Exhaust Fans

	Dorchester Elementary	Woodcliff Middle School	TOTALS
Estimated Annual Savings:	$730	$2,190	**$2,920**
Gross Estimated Implementation Cost:	$1,450	$1,700	**$3,150**
NJ Smart Start Rebate:	$0	$0	**$0**
Net Estimated Implementation Cost:	$1,450	$1,700	**$3,150**
Simple Payback (years):	2.0	0.8	**1.1**
Annual Avoided CO_2 Emissions (tons):	4	13	**17**

View down open exhaust duct at Dorchester Elementary.

- There are approximately a dozen unused exhaust fans on the roof of the two schools. Some fans have been abandoned in place and electrically disconnected. Others have been removed and roof curbs topped with fiberglass covers.
- Exhaust ductwork has not been sealed. Staff report cold air "dumping" through ductwork in winter.
- The fans should be removed from the rooftop and their curbs should be capped, sealed, and insulated.

ECM #2: Replace Kitchen Equipment with Energy Star Rated Equipment

	Dorchester Elementary	Woodcliff Middle School	TOTALS
Estimated Annual Savings:	$560	$360	**$920**
Gross Estimated Implementation Cost[1]:	$740	$560	**$1,300**
NJ Smart Start Rebate:	$0	$0	**$0**
Net Estimated Implementation Cost[1]:	$740	$560	**$1,300**
Simple Payback (years):	1.3	1.6	**1.4**
Annual Avoided CO_2 Emissions (tons):	1	1	**2**

[1] Implementation costs shown above are the incremental costs of energy efficient Energy Star rated equipment, versus standard equipment.

- Most of the kitchen equipment (reach-in coolers/freezers, refrigerators) in the schools are older (approximately 10 years) and less efficient than new equipment.
- Replacing cooling equipment with higher efficiency Energy Star labeled units will provide at least $920 in annual savings.
- Improvements in new freezers include lower idle rates, better insulation- which reduces the amount of standby losses through sides and top, and high efficiency fan motors.

Reach-in Freezer

ECM #3: Controls Retro-Commissioning

	Dorchester Elementary	Woodcliff Middle School	TOTALS
Estimated Annual Savings:	$7,870	$9,890	**$17,760**
Gross Estimated Implementation Cost:	$16,320	$16,070	**$32,390**
NJ Smart Start Rebate:	$0	$0	**$0**
Net Estimated Implementation Cost:	$16,320	$16,070	**$32,390**
Simple Payback (years):	2.0	1.6	**1.8**
Annual Avoided CO_2 Emissions (tons):	20	28	**48**

- Based on the field audit, a number of retro-commissioning issues were identified in both schools where the energy management systems are in place to control HVAC systems and save energy, but are not working optimally. These will save large amounts of energy for a small cost and improve comfort as well.
- A more detailed retro-commissioning study will undoubtedly uncover additional issues. Resolution of these issues will ensure that the buildings are operating at peak efficiency.
- Below are a few observed EMS issues, that can be resolved through the retro-commissioning process:
  - No limits on thermostat sliders
  - Excess equipment run hours
  - Simultaneous heating and cooling
  - Pneumatic Leak Survey

ECM #3: Controls Retro-Commissioning (Cont.)

Woodcliff MS Room 21 room temperature of 66°F

Woodcliff MS Room 21 thermostat with slider to the left on full cold

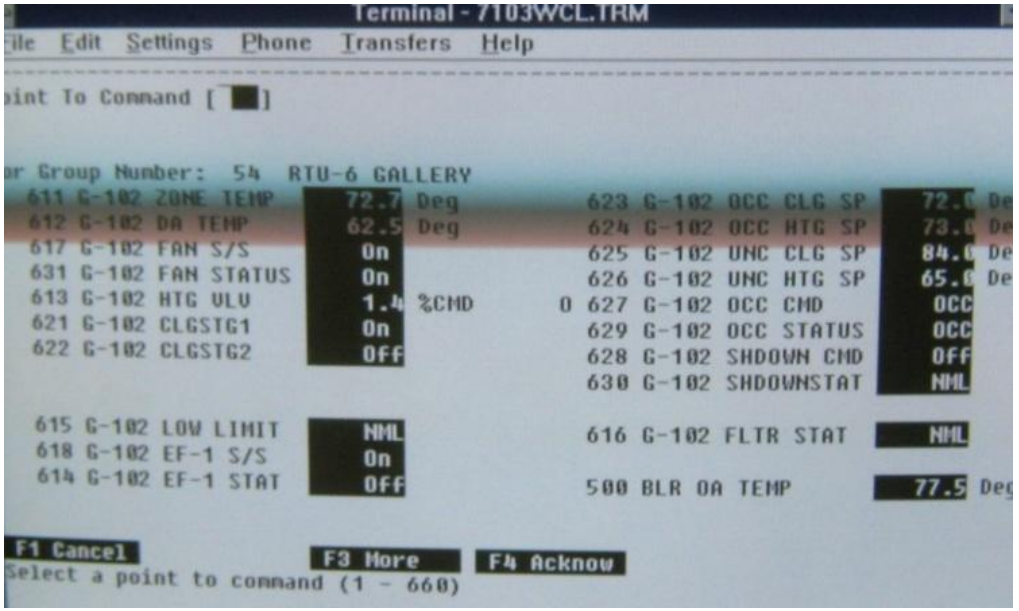
- Limit Thermostat Adjustment:
  - There appears to be at least a +/-4 degree adjustment allowed in spaces via slider adjustment on thermostats. Setting thermostats all the way in either direction can increase both heating and cooling costs.
  - Dome-Tech recommends decreasing the allowable adjustment to a +/-1 degree range (via EMS programming).
- Optimize Time of Day Equipment Scheduling
  - A review of schedules in the energy management system revealed an opportunity to optimize the time of day schedules to reduce air handler and exhaust fan run hours.
  - Existing controls appear to start and stop equipment based on time of day only; there is no differentiation between school days and weekends, holidays, summer day, etc.
  - Dome-Tech recommends reviewing the equipment schedule for each unit (e.g. air handler, unit ventilator, exhaust fan) and revising it based on the necessary run hours for the particular piece of equipment.

	On	Off	Hrs/ Day	Days/ Yr
Existing	6:00 AM	4:00 PM	10	365
Proposed	7:00 AM	3:15 PM	8	180

Typical existing and proposed equipment schedules

ECM #3: Controls Retro-Commissioning (Cont.)

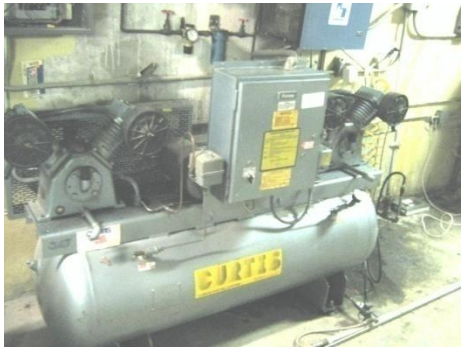
- Prevent Simultaneous Heating and Cooling
  - At the time of the walkthrough, Roof Top Unit 6 at the Middle School was simultaneously heating and cooling; due to incorrect heating and cooling setpoints (73 and 72 respectively).
  - This caused the RTU to constantly attempt to both heat and cool the air at the same time, wasting a significant amount of energy.
  - All other units were checked- no other simultaneous heating/ cooling issues were found.
  - Dome-Tech recommends changing heating and cooling setpoints (via EMS programming)



Screen shot of Johnson Control system: showing simultaneous heating and cooling for RTU-6.

ECM #3: Controls Retro-Commissioning (Cont.)

- Pneumatic Leak Survey
  - During the site survey, the air compressors serving the remaining pneumatic controls in both schools were observed to cycle continuously. This is likely due to leaks in the pneumatic systems.
  - A detailed survey for leaks was not performed, but should be implemented as it will save large amounts of energy, at low cost.
  - A sample calculation was done to indicate the typical savings for fixing leaks in a pneumatic system identified by a leak survey.



Controls compressor at Woodcliff Middle School run excessively

ECM #4: Premium Efficient Motor Upgrade

	Dorchester Elementary	Woodcliff Middle School	TOTALS
Estimated Annual Savings:	$180	$530	**$710**
Gross Estimated Implementation Cost:	$3,850	$5,250	**$9,100**
NJ Smart Start Rebate:	$360	$500	**$860**
Avoided Cost (Like and Kind Replacement): [1]	$2,850	$3,890	**$6,740**
Net Estimated Implementation Cost:	$640	$860	**$1,500**
Simple Payback (years): *(With and Without Adjustment For Avoided Cost)*	3.6 (21.4)	1.6 (9.9)	**2.1 (11.6)**
Annual Avoided CO_2 Emissions (tons):	0	1	**1**

[1] *The cost Woodcliff Lake Schools would incur if replacing existing equipment with equivalent standard efficiency equipment; pro-rated by equipment life and ASHRAE expected service life.*

- Pumps at Woodcliff Middle School and Dorchester Elementary School are served with standard efficiency motors. Standard efficiency motors consume more power than their equivalent premium efficiency motors.
- Dome-Tech recommends replacing the recommended regularly operated standard efficiency motors with new premium efficiency motors at their end of life (EOL).
- See the Appendix for a detailed list of motors recommended for replacement by this ECM

ECM #5: Install Duct Insulation

	Dorchester Elementary	Woodcliff Middle School	TOTALS
Estimated Annual Savings:	$105	$450	**$555**
Gross Estimated Implementation Cost:	$590	$590	**$1,180**
NJ Smart Start Rebate:	$0	$0	**$0**
Net Estimated Implementation Cost:	$590	$590	**$1,180**
Simple Payback (years):	5.6	1.3	**2.1**
Annual Avoided CO_2 Emissions (tons):	1	2	**3**

- Several ducts on rooftop units are un-insulated or have damaged insulation. This causes wasted heating and cooling due to thermal losses.
- Sizes and lengths of the ductwork missing insulation is shown below.

School	Description	Size	Length
Woodcliff Middle School	Cafeteria Return Duct	30”x66”	17’
Woodcliff Middle School	Cafeteria Return Duct	38”x38”	20’
Woodcliff Middle School	Cafeteria Supply Duct	24”x66”	10’
Dorchester Elementary School	Library Return Duct	24”x20”	10’
Dorchester Elementary School	Library Supply Duct	36”x16”	10’

ECM #5: Install Duct Insulation (Cont.)

- Insulating the ducts will also protect the ducts from further corrosion. The rusted ductwork on the Library RTU on the roof of Dorchester should be repaired as well (not estimated in this ECM) by removing loose rust, treating, and painting.
- Additionally, the Cafeteria unit on the Middle School has water damaged insulation that is hanging from the ductwork and should be replaced. No energy savings have been calculated for this damaged section, but the cost to repair this insulation was included in the cost estimate.

Woodcliff MS Cafeteria RTU bare ductwork

Dorchester ES Library RTU bare ductwork

Woodcliff MS Cafeteria RTU damaged insulation

ECM #6: Upgrade Pipe Insulation

Dorchester Elementary School	
Estimated Annual Savings:	$120
Gross Estimated Implementation Cost:	$240
NJ Smart Start Rebate:	$0
Net Estimated Implementation Cost:	$240
Simple Payback (years):	2.4
Annual Avoided CO_2 Emissions (tons):	1

Dorchester ES bare heating hot water piping

Dorchester ES refrigerant piping with missing insulation

- Missing or damaged insulation on heating or cooling pipes causes thermal losses and increases the work required by the equipment.
- Both heating hot water pipes and direct expansion (DX) refrigerant piping at Dorchester Elementary are missing insulation.
- Savings for installing insulation on the DX refrigerant piping are negligible; insulation should be installed to improve DX capacity and reduce run time.

ECM #7: Install Drives on Fan Coil Units

	Dorchester Elementary	Woodcliff Middle School	TOTALS
Estimated Annual Savings:	$1,440	$840	**$2,280**
Gross Estimated Implementation Cost:	$4,130	$2,070	**$6,200**
NJ Smart Start Rebate:	$0	$0	**$0**
Net Estimated Implementation Cost:	$4,130	$2,070	**$6,200**
Simple Payback (years):	2.9	2.5	**2.7**
Annual Avoided CO_2 Emissions (tons):	3	2	**5**

- Generally, Fan Coil Units are operated with three pre-set fixed fan speeds or three pre-set airflows are set by a manual control knob at the Fan Coil unit by the user, regardless of the indoor or occupied space climate conditions and needs.
- Adaptive variable speed drive (VSD) technology operates in a manner similar to a variable frequency drive, but in cost effective package designed for smaller, fractional HP motors. Instead of three pre-set fixed airflows, the controller adapts the fan motor's airflow output to match both heating and cooling output.
- These thermostatically controlled VSDs save energy by matching motor speed to the cooling and/or heating output.

School	Unit Type	Quantity
Woodcliff	Airedale	Five (5)
Dorchester	Airedale	Ten (10)

ECM #8: Lighting Upgrade

	Dorchester Elementary	Woodcliff Middle School	TOTALS
Estimated Annual Savings:	$11,440	$10,070	**$21,510**
Gross Estimated Implementation Cost:	$43,480	$48,320	**$91,800**
NJ Smart Start Rebate:	$2,900	$2,550	**$5,450**
Net Estimated Implementation Cost:	$40,580	$45,770	**$86,350**
Simple Payback (years):	3.5	4.5	**4.0**
Annual Avoided CO_2 Emissions (tons):	25	21	**46**

- In general, the schools are outfitted with high efficiency T-5 and T-8 lamps. These lamps and ballasts can be retrofit with low power lamps. This will save energy and reduce the number of types of lamps required to be stocked.
- The Middle School gym is illuminated with older technology Metal halide lighting and should be retrofitted with High Output T5 fluorescent fixtures. Not only do these fixtures consume significantly less energy, they can be turned on instantly with no waiting for warm up.
- In the Middle School basement, older T-12 type lamps are still in use. These lamps should be retrofit with high efficiency T-8 lamps and electronic ballasts. Eight (8) of these fixtures use 8' long lamps and older ballasts that potentially contain PCB's. These fixtures should be re-lamped with T8 bulbs and re-ballasted with energy efficient electronic ballasts.

ECM #8: Lighting Upgrade (Cont.)

- Compact fluorescent “can” type fixtures should be replaced with LED retrofit “can” fixtures.
- Incandescent light bulbs should be replaced with screw-in compact fluorescent lamps (CFLs).
- Lights were observed to be “on” in many areas of both schools, 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%*.
- The appendix provides more information on recommended retrofits for each space.

➢*Source: Turner, Wayne, Energy Management Handbook, 1999.

ECM #9: Computer Power Management System

	Dorchester Elementary	Woodcliff Middle School	TOTALS
Estimated Annual Savings:	$2,380	$2,070	**$4,450**
Gross Estimated Implementation Cost:	$11,830	$7,810	**$19,640**
NJ Smart Start Rebate:	$0	$0	**$0**
Net Estimated Implementation Cost:	$11,830	$7,810	**$19,640**
Simple Payback (years):	5.0	3.8	**4.4**
Annual Avoided CO_2 Emissions (tons):	5	4	**9**

- According to staff, the majority of the school's computers go to standby when not in use. Though it is better than running normally, standby still wastes unnecessary energy.
- Installing a computer power management system will allow IT administrators to reduce per-PC operating cost by reducing energy consumption via shutdown, standby and hibernate for PC's and sleep for monitors.
- Additionally, the software has the capability to set up profiles to optimize time of day schedules as well as enhance network security and improve the success rate of network maintenance task by ensuring that PC's are accessible when IT needs them to be.
- The capability of having an on-demand network-wide shutdown protects against virus outbreak or an imminent power outage. Similarly, shutting down unattended PCs (whether logged onto or not) after operating hours can help protect against unauthorized access to the PCs' data or to network resources.

ECM #10: Upgrade and Expand Controls

- An energy management system (EMS) is a computer controlled system designed specifically for the automated control and monitoring of the heating, ventilation, and lighting needs of a single facility or group of buildings.
- The schools are equipped with Andover and Johnson Controls centralized energy management systems.
- Older sections of the Middle School are served by a Johnson Controls EMS. While this system is functional, it is also antiquated and no longer supported. During Dome-Tech's energy audit, the "front end" PC and software were in the process of being replaced with an up-to-date system. It is assumed that the system is currently functioning.
- Some local controls at Dorchester Elementary School are not correctly set up, are old and not in correct working order, or appear to be abandoned and no longer in use.
  - Local mechanical time clocks controlling units ventilators are disabled; in the past, power outages caused them to go out of synchronization.
  - Local controls serving the gym and locker room units are not synchronized with local time. Staff believe the units never shut off. There was no way to check the functioning of the all pneumatic heating controls for these units during the summer energy audit.
  - Classrooms that are heated with ceiling mounted radiant panels are known to overheat in the "shoulder seasons". Staff indicate that the pneumatic thermostats and heating control valves have been problematic. At times the overheating can be 10 degrees over setpoint, causing the teachers to open windows in an attempt to condition the space.

ECM #10: Upgrade and Expand Controls (Cont.)

- Dome-Tech recommends the following upgrades to the existing Andover *Continuum* energy management system at Dorchester Elementary:
  - Expand EMS to include seventeen (17) unit ventilators. Units vents will be retrofitted with heating valve controls and a new electronic thermostat, and enabled/ disabled using a new local relay.
  - Expand EMS to fully replace old pneumatic controls on gym and locker H&V units. Upgrading controls for these units will require the demolition of the existing pneumatic system. The existing panel may be able to be reused (at the option of the installing contractor), as it has sufficient room for new controllers. Some pneumatic actuators may be able to be reused for valves/dampers (if system pressure is available).
  - Replace antiquated pneumatic valves and thermostats serving radiant ceiling heating systems in classrooms 51 to 60 with electronic equipment and integrate with existing Andover control system.
- This work will save energy and improve comfort by allowing better control and will aid in maintenance and monitoring of the systems.

ECM #10: Upgrade and Expand Controls (Cont.)

Dorchester Elementary School	
Estimated Annual Savings:	$8,890
Gross Estimated Implementation Cost:	$65,130
NJ Smart Start Rebate:	$0
Net Estimated Implementation Cost:	$65,130
Simple Payback (years):	7.3
Annual Avoided CO_2 Emissions (tons):	37

Dorchester ES unit ventilator time clock. Pins are not set.

Dorchester ES Unit Ventilator Pneumatic Thermostat

Dorchester ES gym H&V unit pneumatic control panel. No pressure to panel.

Dorchester ES Gym H&V unit time clock indicates "Sunday 12 AM"

ECM #11: Weatherization- Door Sealing

	Dorchester Elementary	Woodcliff Middle School	TOTALS
Estimated Annual Savings:	$820	$800	**$1,620**
Gross Estimated Implementation Cost:	$6,500	$2,190	**$8,690**
NJ Smart Start Rebate:	$0	$0	**$0**
Net Estimated Implementation Cost:	$6,500	$2,190	**$8,690**
Simple Payback (years):	7.9	2.7	**5.4**
Annual Avoided CO_2 Emissions (tons):	5	5	**10**

Dorchester ES gap in typical double door

Woodcliff MS garage door

- Missing or degraded weather stripping should be replaced on doors at both schools.
- Weather strips on Dorchester entrance doors are in good condition; these can be adjusted instead of being replaced.
- The garage door track at Woodcliff Middle School should be straightened and new seals installed.

	Double Doors	Garage Doors
Dorchester Elementary School	Replace 5/ Adjust 3	0
Woodcliff Middle School	5	1

ECM #12: Weatherization- Window Air Conditioners

	Dorchester Elementary	Woodcliff Middle School	TOTALS
Estimated Annual Savings:	$60	$370	**$430**
Gross Estimated Implementation Cost:	$1,010	$2,210	**$3,220**
NJ Smart Start Rebate:	$0	$0	**$0**
Net Estimated Implementation Cost:	$1,010	$2,210	**$3,220**
Simple Payback (years):	16.8	6.0	**7.5**
Annual Avoided CO_2 Emissions (tons):	0	2	**2**

Window AC unit at Dorchester Elementary installed in uninsulated panel

- Both schools have window air conditioning units installed in windows and through-the-wall. Glass has been removed from some windows and replaced with un-insulated plywood. Window AC units are left in place uncovered year- round.
- Dome-Tech recommends covering window units with insulated fitted covers when not in use, and uncovering for the cooling season.
- Plywood or plastic surrounding the units should be replaced with insulated fiberglass reinforced plastic (FRP) panels. The new panels, AC units, and window frames should be fully caulked.
- This ECM will save energy and reduce drafts by reducing infiltration and thermal envelope losses.

ECM #13: Install Variable Frequency Drives (VFDs) on Rooftop Units

	Dorchester Elementary	Woodcliff Middle School	TOTALS
Estimated Annual Savings:	$360	$550	**$910**
Gross Estimated Implementation Cost:	$8,230	$8,230	**$16,460**
NJ Smart Start Rebate:	$0	$0	**$0**
Net Estimated Implementation Cost:	$8,230	$8,230	**$16,460**
Simple Payback (years):	22.9	15.0	**18.1**
Annual Avoided CO_2 Emissions (tons):	1	1	**2**

- Some of the rooftop units (RTU's) at each school serve systems with variable air volume (VAV) terminal boxes. As the name suggests, VAV boxes vary airflow depending on heating or cooling load.
- The RTU's are equipped with constant speed motors, even though airflow is variable.
- Slowing the fan motors down by installing variable frequency drives can dramatically reduce the fan horsepower during low load periods.
- The power consumed by a fan is proportional to the cube of the pump's speed. In other words, 50% pump speed requires 13% of the power needed at full speed.
- Note that this ECM is mutually exclusive with other RTU-related ECMs.

School	Unit	HP	Area Served
Woodcliff	RTU-4	1.5	Board Conference
Woodcliff	RTU-5	2	Board Offices
Dorchester	RTU-1	1.5	Rooms 15, 16, 18
Dorchester	RTU-4	1.5	Main Office

ECM #14: Variable Frequency Drive on HHW Pumps

Woodcliff Middle School	
Estimated Annual Savings:	$1,220
Gross Estimated Implementation Cost:	$23,180
NJ Smart Start Rebate:	$1,200
Net Estimated Implementation Cost:	$21,980
Simple Payback (years):	18.0
Annual Avoided CO_2 Emissions (tons):	2

- A pair of 10 HP pumps at Woodcliff Middle School provide a constant flow of heating hot water to terminal systems, such as unit ventilators and rooftop units.
- The pumping system could be converted to a variable flow system by installing a variable frequency drive (VFD) on each motor, pressure sensors, and two-way control valves on all end devices.
- With a variable flow system, as heating loads at end devices are satisfied, control valves will close, and the VFD will slow the pump to maintain constant pressure in piping.
- The power consumed by a pump is proportional to the cube of the pump's speed. In other words, 50% pump speed requires 13% of the power needed at full speed.

ECM #15: Rooftop Unit Replacement

	Dorchester Elementary	Woodcliff MS	TOTALS
Estimated Annual Savings:	$220	$1,950	**$2,170**
Gross Estimated Implementation Cost:	$17,070	$110,280	**$127,350**
NJ Smart Start Rebate:	$860	$5,780	**$6,640**
Avoided Cost (Like and Kind Replacement): [1]	$11,050	$64,750	**$75,800**
Net Estimated Implementation Cost:	$5,160	$39,750	**$44,910**
Simple Payback (years): *(With And Without Adjustment For Avoided Costs)*	23.5 (77.6)	20.4 (56.6)	**20.7 (55.6)**
Annual Avoided CO_2 Emissions (tons):	0	1	**1**

Rooftop unit at Woodcliff Middle School

[1] The cost Woodcliff Lake Public Schools would incur if replacing existing equipment with equivalent standard efficiency equipment (pro-rated by equipment life and ASHRAE expected service life).

- The Woodcliff Middle School and Dorchester Elementary School are served by some older rooftop air handling units (RTUs) and direct expansion (DX) cooling units with efficiencies that are lower than are currently available. Some of the units are nearing or have exceeded the estimated end of equipment service life (EESL) per ASHRAE standards (The EESL for package rooftop units is 15 years.)

ECM #15: Rooftop Unit Replacement (Cont.)

- The New Jersey *SmartStart* program offers rebates that help to pay for the incremental cost to upgrade to higher efficient units.
- The large majority of the older RTUs and DX cooling systems are charged with R-22 refrigerant. R-22 is ozone depleting CFC refrigerant, and therefore is currently being phased out. By 2020 it will not be allowed to be manufactured but R-22 that has been recovered and recycled/reclaimed will still be allowed. New units use non- ozone depleting refrigerants, such as R-410a.
- The following units are recommended to be replaced:

DX condensing units located on the roof at Woodcliff Middle School

School	Unit	Age (Years)
Dorchester ES	RTU Room 50 & 52	14
Dorchester ES	York RTU	17
Woodcliff MS	RTU-1 to RTU-6	13
Woodcliff MS	RTU's Media Center (6x)	13
Woodcliff MS	DX Split System: Main Office	22
Woodcliff MS	DX Split System: Nurse's Office	20+

ECM #16: Weatherization- Insulate Above Ceiling

Woodcliff Middle School	
Estimated Annual Savings:	$590
Gross Estimated Implementation Cost:	$15,100
NJ Smart Start Rebate:	$0
Net Estimated Implementation Cost:	$15,100
Simple Payback (years):	25.6
Annual Avoided CO_2 Emissions (tons):	2

Insulation above ceiling

Open seams in lighting fixture

- The ceiling above the Board of Education offices at Woodcliff Lake Middle School is inadequately insulated. Staff indicated there are problems with heating and cooling, with noticeable cold spots in winter.
- There is only about 5” of fiberglass insulation above the dropped ceiling (corresponding to approximately an R-18 rating). There is no insulation above the lighting fixtures. Fixtures are not IC (Insulation Contact) rated. Also, the lighting fixtures have open seams which allow air to leak to the attic.
- Dome- Tech recommends installing an additional 5”-6” of fiberglass insulation to bring the ceiling up to an R-36 rating, installing IC rated light fixtures, and insulating above the lights. While this ECM does not have a good economic payback, it is recommended to improve comfort conditions.

ECM #17: Install Timers on Domestic Hot Water Heaters

	Dorchester Elementary	Woodcliff Middle School	TOTALS
Estimated Annual Savings:	$50	$50	**$100**
Gross Estimated Implementation Cost:	$2,990	$1,490	**$4,480**
NJ Smart Start Rebate:	$0	$0	**$0**
Net Estimated Implementation Cost:	$2,990	$1,490	**$4,480**
Simple Payback (years):	59.8	29.8	**44.8**
Annual Avoided CO_2 Emissions (tons):	0	2	**2**

- Domestic hot water (DHW) heaters are enabled 24/7. There is minimal call for hot water at night and weekends and during vacation periods.
- The gas DHW heaters in both schools have electronic ignitions (no standing pilot lights) and can be enabled or disabled electrically.
- The water heaters should have timers installed on the 110V circuits serving the heaters' igniters.

ECM #18: Weatherization- Window Upgrade

	Dorchester Elementary	Woodcliff Middle School	TOTALS
Estimated Annual Savings:	$1,980	$180	**$2,160**
Gross Estimated Implementation Cost:	$138,580	$6,500	**$145,080**
NJ Smart Start Rebate:	$0	$0	**$0**
Net Estimated Implementation Cost:	$138,580	$6,500	**$145,080**
Simple Payback (years):	70.0	36.1	**67.2**
Annual Avoided CO_2 Emissions (tons):	12	1	**13**

- Windows in both schools are generally in good condition, with the exception of the basement windows at Woodcliff Middle school. These older windows only have single panes of glass and appear to be 'leaky', allowing infiltration.
- Windows in the original section of Dorchester Elementary, while in good condition, are original to the school. They have single panes of glass.
- Replacement of these windows will reduce both envelope and infiltration energy expenditures.

ECM #19: Demand Controlled Ventilation

Dorchester Elementary School	
Estimated Annual Savings:	$80
Gross Estimated Implementation Cost:	$15,750
NJ Smart Start Rebate:	$0
Net Estimated Implementation Cost:	$15,750
Simple Payback (years):	196.9
Annual Avoided CO_2 Emissions (tons):	0

- 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). Since maximum design occupancy is rarely achieved, this results in excessive fresh air volumes which require costly (and unnecessary) conditioning.
- Demand-controlled ventilation (DCV) controls the amount of outside air being supplied based upon the CO_2 levels generated by building occupants. DCV should be added to any space that is ventilated by a large quantity of outdoor air, and where occupancy varies dramatically (auditoriums, lecture halls, theatres).
- Because CO_2 levels correlate directly with the number of people in an occupied zone, CO_2 sensors will be used to control ventilation rate of outside air supplied to each zone. Reducing the amount of outdoor air supplied to a zone reduces the energy required to heat and cool that air, while space conditions are kept in compliance with building codes and standards.
- Demand controlled ventilation systems could be installed at the following locations:

Building	Locations
Woodcliff Middle School	Cafeteria, Band Room, Chorus Room, Chinese Room, Media Center and Board Conference Room
Dorchester Elementary School	Cafeteria, Room 12, Room 27, Gym

ECM #20: Creation of an Energy Awareness & Education Program

Estimated Annual Savings:	$10,000 - $15,000
Gross Estimated Implementation Cost:	$1500 each
Expected Rebate / Energy Efficiency Credit:	None
Net Estimated Implementation Costs:	$1500
Simple Payback (yrs):	Varies
Annual Avoided CO_2 Emissions (tons):	Varies
Cost per Ton CO_2 Reduction ($/ton):	Varies

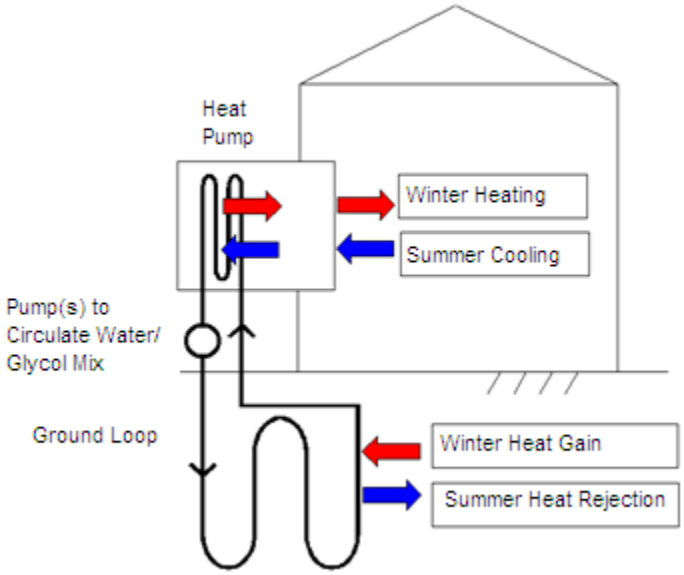
- The Woodcliff schools currently have no observed energy education program in place.
- Educational institutions are where our nation's youth spend a significant portion of their time. As such, educators can have a potentially large impact on promoting an energy conscious and conservation-minded society that starts at their school, leading to energy cost reductions, environmental benefits, and national energy independence.
- In addition, schools can receive recognition for their efforts and possible media coverage, which can contribute to enhanced school spirit, and individual feelings of accomplishment and connection.

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
- Photovoltaics (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.

Renewable Energy Technologies: Ground Source Heat Pumps



Schematic representation of typical ground source heat pump system

Ground source (a.k.a. geothermal) heat pumps heat and cool using the relatively constant temperature of the earth as both a heat source and a heat sink.

These systems heat and cool buildings by adding or removing heat from interior air to a ground loop, using a vapor compression refrigeration cycle within the heat pumps.

The ground loop extracts heat from the earth for winter heating and rejects summer cooling heat back to the ground, using water (mixed with anti freeze) as the working fluid.

Renewable Energy Technologies: Ground Source Heat Pumps (Continued)

Project economics and ground source heat pump pros and cons are presented in the following tables:

GSHP Economics*

	Baseline Systems	GSHP	DX Roof Top
Gross Installation Cost Estimate	$0	$1,570,000	$1,099,000
NJJ SSB Rebate	$0	$188,400	$25,748
Net Installation Cost Estimate	$0	$1,381,600	$1,073,252
Annual Energy Cost	$120,472	$101,690	$111,860
Annual Electric Use, kWh	278,504	643,969	223,972
Annual Natural Gas Use, Therms	80,170	0	80,170
Annual CO2 Emmisions, Tons	561	213	543

*Based upon Woodcliff Lake School District HVAC Systems & Energy Profile

Simple Payback on Net Install Cost GSHP

Net Installation Cost Estimate	$1,381,600
Annual Energy Savings	$18,782
Simple Payback	74

Simple Payback on Incremental Cost of GSHP vs. Typical Roof Top Units

Net Installation Cost Estimate	$308,348
Annual Energy Savings	$10,171
Simple Payback	30.3

Geothermal Pros & Cons

Pros	Cons
➢Annual reduction in heating and cooling-related energy spend and use can be potentially reduced by almost $19,000 (16% reduction). ➢Reduction of annual greenhouse gas emissions by over 210 tons per year. ➢A ground source heat pump project could be incorporated into science and other curriculums to raise student awareness of energy alternatives.	➢Payback period is significant (over 70 years). ➢Complete redesign of many HVAC systems required. ➢The schools do not have balanced HVAC loads (annual heating load is higher than annual cooling load). The temperature of the bore field may decrease over time, leading to diminished heating efficiency and output. ➢Temporary disturbance of most of the green space between schools needed to drill bores for ground loop.

Note that the above analysis assumes:
- *A cooling load of 1 Ton per 500 square feet of building size.*
- *A heating load based on natural gas bills.*
- *Cooling efficiencies of 11.5, 19.2 and 14.3 EER for existing , GSHP and new rooftop equipment, respectively.*
- *Seasonal heating efficiencies of 75% (based on natural gas input) for existing equipment and new rooftop equipment and 3.7 COP (based on electric input) for GSHP.*

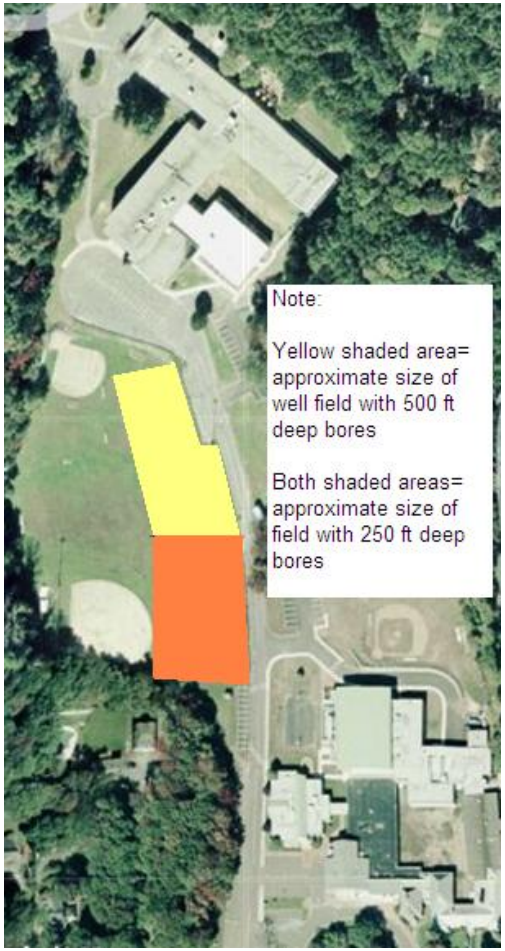
Renewable Energy Technologies: Ground Source Heat Pumps (Continued)

The estimated required ground loop sizing is summarized below:

Well Field Dimension

Estimated System Size, Tons	314
Estimated Well Capacity, ft/ton	250

	250 ft wells	*500 ft wells*
Well Spacing, feet on center	15	15
Number of wells	314	157
Dimension Well Field Foot Print, Sq. Ft	78,849	41,188
Dimension Well Field Foot Print, Acres. Ft	1.8	0.9



The School District should have enough available space for the required vertical well field in the area between the Dorchester and Woodcliff Middle schools.

Note that the table and graph presented on this slide are based on estimated values. The overall configuration and size of the well field- including number, depth, and spacing of bore holes- is highly dependant on local geology, specifically the thermal conductivity of local soil and rock.

Should the District decide to pursue a geothermal project, Dome-Tech recommends commissioning a more detailed study, including drilling a test bore hole and conducting a thermal conductivity test.

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.

Woodcliff Lake Wind Speed

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 Woodcliff Lake area is 5.3 meters per second. Ideal wind speeds for a successful project should average over 6 meters per second.

For Woodcliff Lake 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 (Continued)

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

Wind Turbine Economics: Woodcliff Lake - Dorchester Elementary

	Building Integrated - 1 kW	Ground Mount - 5.2 kW	Ground Mount - 50 kW
Number of Units	11	1	1
Gross Installation Cost Estimate	$71,500	$31,200	$250,000
NJ SSB Rebate	$21,804	$15,929	$87,720
Net Installation Cost Estimate	$49,696	$15,271	$162,280
Annual Energy Savings	$1,042	$761	$13,616
Simple Payback with rebate**	47.7 yrs.	20.1 yrs.	11.9 yrs.
Simple Payback without rebate**	68.6 yrs.	41.0 yrs.	18.4 yrs.
System Capacity	11 kW	5 kW	50 kW
Annual Avoided Energy Use	6,814 kWh	4,978 kWh	89,040 kWh
Annual Avoided CO2 Emmisions, Tons	2	2	31
% of Annual Electric Use*	1.4%	1.0%	17.8%

*Woodcliff Lake - Dorchester Elementary: 500880 kWh/Year.

**The NJ Clean Energy Program temporary hold on all new wind applications (as of 3/8/11) is still in existence at the time of this report

Wind Turbine Pros & Cons

Pros	Cons
➢Annual reduction in energy spend and use can be potentially reduced by almost $13,620 (17% reduction). ➢Typical equipment life span is 15-30 years. ➢Reduction of annual greenhouse gas emissions by 31 tons per year. ➢A wind turbine project could be incorporated into science and other curriculums to raise student awareness of energy alternatives. ➢Highly 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 integrated 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).

The 50 kilowatt ground mounted wind turbine project appears to be the most attractive option. Should the District decide to pursue a wind turbine project, Dome-Tech recommends commissioning a more detailed study.

Renewable Energy Technologies: Wind (Continued)

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

Wind Turbine Economics: Woodcliff Lake - Woodcliff Middle School

	Building Integrated - 1 kW	Ground Mount - 5.2 kW	Ground Mount - 50 kW
Number of Units	14	1	1
Gross Installation Cost Estimate	$91,000	$31,200	$250,000
NJ SSB Rebate	$27,750	$15,929	$87,720
Net Installation Cost Estimate	$63,250	$15,271	$162,280
Annual Energy Savings	$1,399	$803	$14,366
Simple Payback with rebate**	45.2 yrs.	19.0 yrs.	11.3 yrs.
Simple Payback without rebate**	65.0 yrs.	38.8 yrs.	17.4 yrs.
System Capacity	14 kW	5 kW	50 kW
Annual Avoided Energy Use	8,672 kWh	4,978 kWh	89,040 kWh
Annual Avoided CO2 Emmisions, Tons	3	2	31
% of Annual Electric Use*	1.2%	0.7%	12.2%

*Woodcliff Lake - Woodcliff Middle School: 728265 kWh/Year.

**The NJ Clean Energy Program temporary hold on all new wind applications (as of 3/8/11) is still in existence at the time of this report

Wind Turbine Pros & Cons

Pros	Cons
➢Annual reduction in energy spend and use can be potentially reduced by almost $14,460 (12% reduction). ➢Typical equipment life span is 15-30 years. ➢Reduction of annual greenhouse gas emissions by 31 tons per year. ➢A wind turbine project could be incorporated into science and other curriculums to raise student awareness of energy alternatives. ➢Highly 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 integrated 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 the District 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 photovoltaics (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.
- Can be recommended in this application for placement on additional schools / areas.

Renewable Energy Technologies: Solar Photovoltaic

Solar Photovoltaic Systems

Install Roof Mount Solar Photovoltaic System(s)	
Dorchester Elementary School	
Assumptions	
System Capacity, kW-dc (maximum utilization of roof space)	119 kw dc
Estimated Annual AC Energy Produced by Proposed Solar PV System	125,064 kwh
Total Annual Facility Electric Use, kwhrs	1,184,895 kwh
Proposed % of Total Annual kWh supplied by Solar PV	11%
All-In Rate for Electric Year 1	$0.153 / kwh
Year 1 Electric Cost Savings	$19,135
Year 1 Maintenance Costs	$2,373
Estimated Year 1 SREC Value:	$200 / SREC
Estimated Year 1 SREC Revenue:	$24,985
Financial Results	
Actual Payback	**17.7 years**
IRR (25 Years)	**3.0%**
Net Present Value (25 yrs, 8% discount rate)	**($257,555)**
Cost and Rebate	
Cost per kW installed	$6,000
System Installed Cost	$711,942

	System Capacity (kW)	Coverage (Square Feet)	No. of Panels	Annual Output (kWh)
Roof Mount	**119**	**3931**	**516**	**125,064**

Renewable Energy Technologies: Solar Photovoltaic

Solar Photovoltaic Systems

Install Roof Mount Solar Photovoltaic System(s)	
Woodcliff Middle School	
Assumptions	
System Capacity, kw-dc (maximum utilization of roof space)	117 kw dc
Estimated Annual AC Energy Produced by Proposed Solar PV System	123,537 kwh
Total Annual Facility Electric Use, kwhrs	1,184,895 kwh
Proposed % of Total Annual kWh supplied by Solar PV	10%
All-In Rate for Electric Year 1	$0.161 / kwh
Year 1 Electric Cost Savings	$19,889
Year 1 Maintenance Costs	$2,344
Estimated Year 1 SREC Value:	$200 / SREC
Estimated Year 1 SREC Revenue:	$24,680
Financial Results	
Actual Payback	**17.1 years**
IRR (25 Years)	**3.3%**
Net Present Value (25 yrs, 8% discount rate)	**($240,011)**
Cost and Rebate	
Cost per kW installed	$6,000
System Installed Cost	$703,248

	System Capacity (kW)	Coverage (Square Feet)	No. of Panels	Annual Output (kWh)
Roof Mount	**117**	**3931**	**510**	**123,537**

Solar Photo Voltaic System

- Non-Financial Benefits of Solar PV

- The implementation of solar PV projects at Woodcliff Lake Public Schools would place your facilities at the forefront of renewable energy utilization. This allows the District 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 to the younger generations.

Retail Energy Purchasing: Recommendations

Electric

- For the period studied, the Woodcliff Lake School District was utilizing South Jersey Energy as a Third Party Supplier for electricity at a fixed rate of $0.09353 per kWh.

- Dome-Tech recommends the District continue their procurement strategy because there is an opportunity to save money by switching to an electricity supplier versus paying the BGS default rate to the utility. Currently, typical savings are in the 10-15% range.

Natural Gas

- For the period studied, the Woodcliff Lake School District was utilizing Hess Corporation as a Third Party Supplier for natural gas at a floating rate.

- If the District is seeking budget certainty or would like to reduce their market exposure for Natural Gas, the District should consider entering into a fixed price contract with a supplier or joining a purchasing co-operative and developing a procurement strategy.

Energy Purchasing Co-Operatives

Many public entities participate in various energy aggregation buying groups. Sometimes, an entity will have multiple options to choose from. These might include purchasing through a County co-operative, or purchasing through a trade-type association like ACES. Co-operative purchasing may not necessarily get you the lowest rates; however, there is often substantial volume, and it can represent a good alternative for entities with limited energy consumption who can have a difficult time getting energy suppliers to respond to them on a direct, singular basis.

Utility Tariff and Rate Review: Electricity

- **Accounts and Rate Class:** The Woodcliff Lake School District has two facilities with three main electric accounts with service behind Public Service Electric and Gas Company under rate classes General Lighting and Power (GLP) and Large Power and Lighting Service (LPL-S).

- **Electric Consumption and Cost:** Based on the one-year period studied, the total annual electric expenditure for the District is about $194,000 and the total annual consumption is about 1,229,000 kilowatt-hours (kWh).

- **Average/Effective Rate per kWh:** For the one year period studied, the District's average monthly cost per kilowatt-hour ranged from 14.09 ¢/kWh to 20.13 ¢/kWh, inclusive of utility delivery charges. The District's overall, average cost per kilowatt-hour during this period was 15.79 ¢/kWh.
  - Note that these average electric rates are "all–inclusive"; that is, they include all supply service (generation and commodity-related) charges, as well as all delivery service charges. The supply service charges typically represent the majority (60-80%) of the total monthly bill. It is the supply portion of your bill that is deregulated, which is discussed on subsequent slides in this section.

Utility Tariff and Rate Review: Natural Gas

- **Accounts and Rate Class:** The Woodcliff Lakes School District has two facilities with two natural gas accounts with service behind Public Service Electric and Gas Company under rate classes Large Volume Service (LVG) and General Service (GSG).

- **Natural Gas Consumption and Cost:** Based on the one-year period studied, the total annual natural gas expenditure for the District is about $78,205 (note that the annual cost for Dorchester Elementary School is estimated based on Woodcliff Lakes Middle School average rate) and the total annual consumption is about 82,000 therms). Natural gas is used mostly in the winter period for heating purposes.

- **Average/Effective Rate per Therm:** For the one year period studied, the District's overall, average cost per therm during this period was $0.954 per therm.
  - Note that these average natural gas rates are "all–inclusive"; that is, they include all supply service (interstate transportation and commodity-related) charges, as well as all delivery service charges. The supply service charges typically represent the majority (60-80%) of the total monthly bill. It is the supply portion of your bill that is deregulated, which is discussed on subsequent slides in this section.

Utility Deregulation in New Jersey: Background and Retail Energy Purchasing

- In August 2003, per the Electric Discount and Energy Competition Act [N.J.S.A 48:3-49], the State of New Jersey deregulated its electric marketplace thus making it possible for customers to shop for a third-party (someone other than the utility) supplier of retail electricity.
- Per this process, every single electric account for every customer in New Jersey 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 of accounts was based on rate class. The largest electric accounts in the State (those served under a Primary or a Transmission-level rate class) were moved into BGS-CIEP pricing. All other accounts (the vast majority of accounts in the State of New Jersey, including residential) were placed in the BGS-FP category, receiving default electric supply service from the utility.
- The New Jersey Board of Public Utilities (NJBPU) has continued to move new large energy users from the BGS-FP category into the BGS-CIEP category by lowering the demand (kW) threshold for electric accounts receiving Secondary service. Several years ago, this threshold started at 1,500kW; now, it has come down to 1,000 kW. So, if an account's "peak load share" (as assigned by the utility) is less than 1,000 kW, then that facility/account is in the BGS-FP category. If you are unsure, you may contact Dome-tech for assistance.

Utility Deregulation in New Jersey: Background and Retail Energy Purchasing

- There are at least 3 important differentiating factors to note about each rate category:
  1. The rate structure for BGS-FP accounts and for BGS-CIEP accounts varies.
  2. The "do-nothing" option (ie, what happens when you don't shop for retail energy) varies.
  3. The decision about whether, and why, to shop for a retail provider varies.

- **Secondary (small to medium) Electric Accounts**:
  - BGS-FP rate schedules for all utilities are set, and re-set, each year. Per the results of our State's BGS Auction process, held each February, new utility default rates go into effect every year on June 1st. The BGS-FP rates become each customer's default rates, and they dictate a customer's "Price to Compare" (benchmark) for shopping purposes. To learn more about the BGS Auction process, please go to www.bgs-auction.com.
  - A customer's decision about whether to buy energy from a retail energy supplier is, therefore, dependent upon whether a supplier can offer rates that are lower than the utility's (default) Price to Compare. In 2009, and for the first time in several years, many BGS-FP customers have "switched" from the utility to a retail energy supplier because there have been savings. This may be the same case in 2010.

- **Primary (large) Electric Accounts:**
  - The BGS-CIEP category is quite different. There are two main features to note about BGS-CIEP accounts that do not switch to a retail supplier for service. The first is that they pay an hourly market rate for energy; the second is that these accounts also pay a "retail margin adder" of $0.0053/kWh. For these large accounts, this retail adder can amount to tens of thousands of dollars. The adder is eliminated when a customer switches to a retail supplier for service.
  - For BGS-CIEP accounts, the retail adder makes a customer's decision about *whether* to switch relatively simple. However, the process of setting forth a buying strategy can be complex, which is why many public entities seek professional assistance when shopping for energy.
  - For more information concerning hourly electric market prices for our region, please refer to www.pjm.com.

Utility Deregulation in New Jersey: Background and Retail Energy Purchasing

- **Natural Gas Accounts:**

  - The natural gas market in New Jersey is also deregulated. Unlike the electric market, there are no "penalties", or "adders", for not shopping for natural gas. Most customers that remain with the utility for natural gas service pay rates that are market-based and that fluctuate on a monthly basis. While natural gas is a commodity that is exceptionally volatile and that is traded minute-by-minute during open trading sessions, market rates are "settled" each month, 3 business days prior to the subsequent month (this is called the "prompt month"). Customers that do not shop for a natural gas supplier will typically pay this monthly settlement rate to the utility, plus other costs that are necessary to bring gas from Louisiana up to New Jersey and ultimately to your facility.

  - For additional information about natural gas trading and current market futures rates for various commodities, you can refer to www.nymex.com.

  - A customer's decision about whether to buy natural gas from a retail supplier is typically dependent upon whether a customer seeks budget certainty and/or longer-term rate stability. Customers can secure longer-term fixed prices by enlisting a retail natural gas supplier. Many larger natural gas customers also seek the assistance of a professional consultant to assist in their procurement process.

Retail Energy Suppliers

- To learn more about energy deregulation, visit the New Jersey Board of Public Utilities website: www.bpu.state.nj.us
- For more information about the retail energy supply companies that are licensed and registered to serve customers in New Jersey, visit the following website for more information: http://www.bpu.state.nj.us/bpu/commercial/shopping.html
- Provided below is a list of NJ BPU-licensed retail energy suppliers:

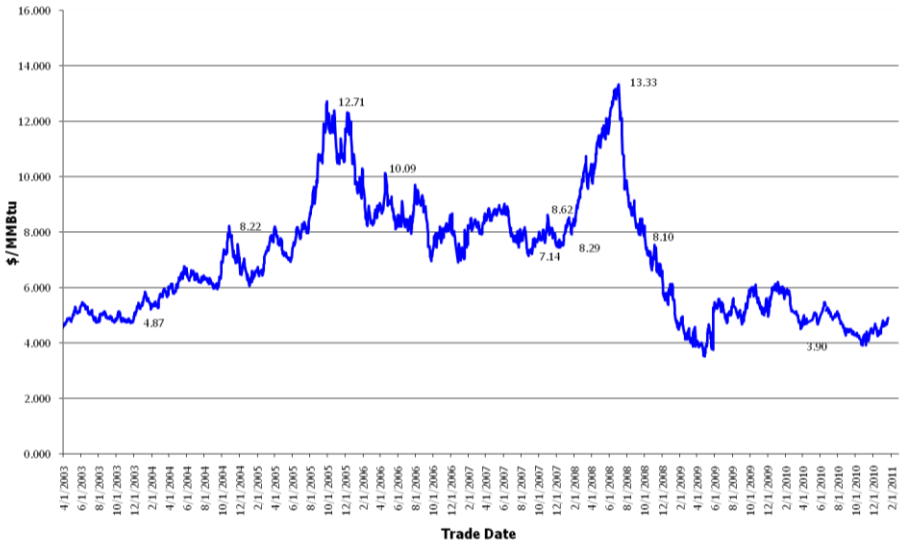
Company	Electricity	Natural Gas	Website
Hess	X	X	hess.com
Sprague	X	X	sprageenergy.com
UGI	X	X	ugienergyservices.com
South Jersey Energy	X	X	southjerseyenergy.com
Direct	X	X	directenergy.com
Global	X	X	globalp.com
Liberty	X		libertpowercorp.com
Reliant	X		reliant.com
First Energy	X		fes.com
ConEd Solutions	X		conedsolutions.com
Constellation	X		newenergy.com
Glacial	X		glacialenergy.com
Integrys	X		integrysenergy.com
Suez	X		suezenergyresources.com
Sempra	X		semprasolutions.com
Woodruff		X	woodruffenergy.com
Mx Energy		X	mxenergy.com
Hudson		X	hudsonenergyservices.com
Great Eastern		X	greateasterngas.com

**Note: Not every Supplier serves customers in all utility territories within New Jersey.*

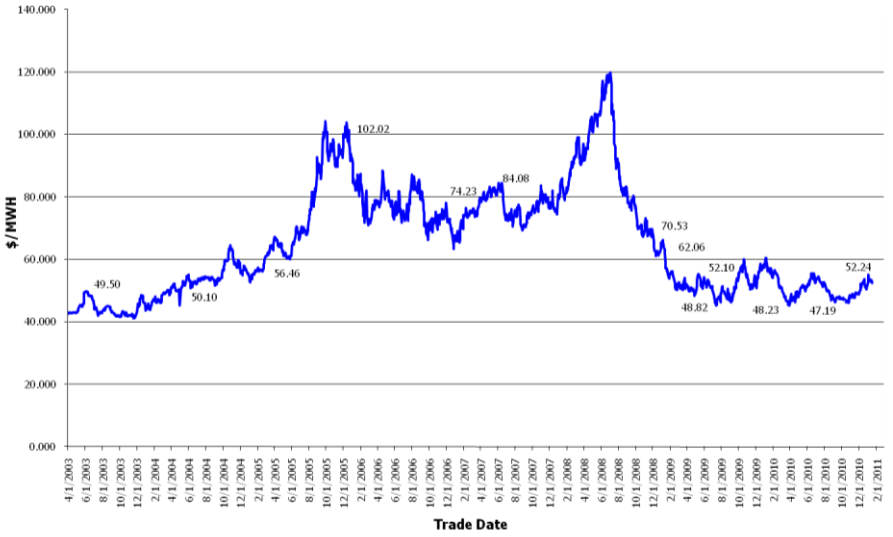
Historical Energy Futures Settlement Prices

- Below please find graphs that show the last several years' worth of market settlement prices for both natural gas and electricity. Each of these graphs shows the average closing prices of a rolling 12-month period of energy futures prices. The graphs are representative of the commodity, alone; they do not include any of the additional components (capacity, transmission, ancillary services, etc.) that comprise a retail energy price. They are meant to provide an indication of the level of pricing that a particular customer might expect to see, but the graphs do not account for the specific load profile of any individual energy user.

Henry Hub 12 month strip



PJM West 12 month strip



Potential Project Funding Sources

Through the NJ Clean Energy program, the New Jersey Board of Public Utilities currently offers a variety of subsidies or rebates for many of the project types outlined in this report. More detailed information can be found at: www.njcleanenergy.com

NJ Smart Start Buildings – Equipment Rebates noted in ECMs where available.
Equipment Rebates - Water Heaters, Lighting, Lighting Controls/Sensors, Chillers, Boilers, Heat pumps, Air conditioners, Energy Mgmt. Systems/Building Controls, Motors, Motor-ASDs/VSDs, Custom/Others http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/nj-smartstart-buildings

Pay for Performance Program – Performance-Based Incentives for installations.
Provides up to 50% of total project costs. ***Based on findings in this study, up to $246,000 in incentives for project implementation could be provided under this program.*** A minimum reduction target of 15% compared to baseline must be achieved. Energy modeling of building and systems and energy reduction plan is required (incentives provided to pay for part of study costs.)

Energy Savings Improvement Program (ESIP) Public entities can contract with energy saving companies in up to 20-year lease purchases enabling public entities to implement energy conservation measures to their facilities and pay for the costs using the value of energy savings that result from the improvements. The Energy Services Companies (ESCO) would assist in bypassing large upfront costs to the entity.
www.**nj**.gov/dca/lgs/lfns/09lfns/2009-11.doc

Potential Project Funding Sources (continued)

Clean Energy Solutions Capital Investment Loan/Grant

The EDA offers up to $5 million in interest-free loans and grants to promote the concept of "going green" in New Jersey. Under this program, scoring criteria based on the project's environmental and economic development impact determines the percentage split of loan and grant awarded. Funding can be used to purchase fixed assets, including real estate and equipment, for an end-use energy efficiency project, combined heat and power (CHP or cogen) production facility, or new state-of-the-art efficient electric generation facility, including Class I and Class II renewable Energy. http://www.njeda.com/web/Aspx_pg/Templates/Npic_Text.aspx?Doc_Id=1078&menuid=1360&topid=722&levelid=6&midid=1357

Clean Renewable Energy Bonds (CREBs) – For Renewable Energy Projects

Federal Loan Program for Solar Thermal Electric, Photovoltaics, Landfill Gas, Wind, Biomass, Hydroelectric, Geothermal Electric, Municipal Solid Waste, Hydrokinetic Power, Anaerobic Digestion, Tidal Energy, Wave Energy, Ocean Thermal

http://www.irs.gov/irb/2007-14_IRB/ar17.html

Renewable funding for PV & wind, plus federal credits currently available:
http://www.njcleanenergy.com/renewable-energy/programs/renewable-energy-incentive-program/applications-and-e-forms-renewable-ener

Potential Project Funding Sources (continued)

Direct Install Program – NJ Clean Energy makes the investment in energy efficiency upgrades by initially covering 60% of the cost to install the recommended energy efficiency measures. If eligible, the entity will pay ONLY 40% of the total cost to install the energy efficiency measures. **http://www.njcleanenergy.com/commercial-industrial/programs/direct-install**

We encourage you to contact the program directly for further information on this particular program for all Buildings.

Steps to Participate for Buildings:

1. CONTACT THE PARTICIPATING CONTRACTOR IN YOUR AREA
Identify the contractor assigned and trained to provide Direct Install services in the county where your project is located. Using the contact information provided, call or email the Participating Contractor to discuss your project. The contractor will schedule an Energy Assessment and work with you to complete the Program Application and Participation Agreement. If you're unable to contact the Participating Contractor or have questions, you may contact us at 866-NJSMART or send an e-mail to DirectInstall@trcsolutions.com..

2. REVIEW RESULTS
After the Energy Assessment, the contractor will review results with you, including what measures qualify and your share of the project cost.

3. DECIDE TO MOVE FORWARD
You will sign a Scope of Work document to proceed with implementation of qualifying measures.

4. ARRANGE INSTALLATION
You and the Participating Contractor will set a convenient start date for the installation.

5. CONFIRM INSTALLATION
Once the Participating Contractor completes the installation, you accept the work by signing a Project Completion Form. A program representative will approve the project as complete.

6. COMPLETE TRANSACTION
You pay the Participating Contractor your share of the project cost and the program pays its share.

Next Steps

- **The following projects should be considered for implementation:**
  - Fix Retro-Commissioning Issues
  - Perform Further Detailed Retro-Commissioning Study
  - Weatherization
    - Permanently Seal and Insulate Exhaust Fans Ducts
    - Weatherize: Window A/C Units, and Exterior Doors
    - Insulate: Bare Ductwork on Roof, Bare Piping, Above Ceiling in Board Office
  - Implement Computer Power Management System
  - Upgrade Control System at Dorchester School
  - Install Drives on Fan Coil Units
  - Lighting Upgrades (In Certain Areas)
  - Start Energy Awareness Program

Note that additional "Phase 2" engineering may be required to further develop these projects, to bring them to bidding and implementation.

- **Consider applying for Pay-For-Performance Program**

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.
- 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 0.66 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.*
- The following utility prices provided were used within this study:

School	Electric $/Kwh	Natural Gas $ / therm
Dorchester Elementary School	$0.153	$0.954
Woodcliff Middle School	$0.161	$0.954

* Note that natural gas energy rate for Dorchester Elementary School is estimated to be equal to that of Woodcliff Middle School. Due to gas meter failure in 2010, natural gas bills from this period are not representative of typical billing rate.