Kittatinny Regional High School

A Nationally Recognized School Of Excellence

Energy Audit

Prepared For:

Kittatinny Regional High School

Margaret Conroy
Business Administrator

Prepared By:

Dome – Tech, Inc.

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

August 2009

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July 13, 2009

Ms. Margaret Conroy, Business Administrator
Kittatinny Regional High School Board of Education
77 Halsey Road
Newton, NJ 07860

Re: EXECUTIVE SUMMARY FOR KITTATINNY REGIONAL HIGH SCHOOL BOARD OF EDUCATION STATE OF NEW JERSEY LOCAL GOVERNMENT ENERGY AUDIT

Dear Ms. Conroy:

Dome-Tech was retained by Kittatinny Regional High School Board of Education, as a prequalified participant in the Local Government Energy Audit Program, to perform an energy audit. The objective of the energy audit was to evaluate the schools' energy consumption, establish baselines for energy efficiency and identify opportunities to reduce the amount of energy used and/or its cost.

The scope of the audit is standardized under the Program, and consisted of the following:

- Benchmarking historic energy consumption utilizing EPA Energy Star's Portfolio Manager
- Characterizing building use, occupancy, size, and construction
- Providing a detailed equipment list including estimated service life and efficiency
- Identifying and quantifying energy conservation measures (ECMs)
- Evaluating the economic viability of various renewable/distributed energy technologies
- Performing a utility tariff analysis and assessing savings potential from energy procurement strategies
- Providing the method of analyses

Based upon data received for the period Feb 2008 – Jan 2009, Kittatinny Regional High School had an annual expenditure of:

- Electricity: 2,250,937 kWh at a total cost of $373,999
- Fuel Oil: 55,512 gallons at a total cost of $123,210

Please refer to Section 2 of this report for a detailed list of identified Energy Conservation Measures (ECMs), along with a summary of their preliminary economics (estimated project cost, estimated annual energy savings, applicable rebate(s), etc.) In this report, all identified ECMs are ranked and presented according to their simple payback; however, please note that the master ECM table can also be sorted by building, by measure type, cost, etc.

If all identified ECMs were to be implemented, they would provide the following estimated benefits to Kittatinny Regional High School Board of Education:

- Total annual electrical savings: 497,410 kilowatt-hours; 22%
- Total annual cost savings: $83,410; 16.8%
- Total annual CO_2 emissions reduction: 164 tons
- Total estimated implementation cost: $402,460
- Total average simple payback: 4 yrs

The projects that are recommended for implementation (at all facilities) include: upgrading the lighting, installing vending machine power management systems on vending machines, installing a variable frequency drive (VFD) on the cooling tower fan, installing a roof-mounted photovoltaic system, optimizing exhaust fan time of day schedules, and implementing an energy awareness program.

The Kittatinny Regional High School data was entered into the US EPA ENERGY STAR's Portfolio Manager database program. The school attained a score of 13. Buildings with scores of 75 or higher may qualify for the ENERGY STAR Building Label.

Distributed/Renewable Energy Systems were reviewed for the school with the following conclusions:

- A Ground Source Heat Pump (GSHP) installation is not recommended as an immediate retrofit project. However, a detailed life cycle analysis of a GSHP system versus a traditional HVAC system is recommended once the existing equipment exceeds the estimated equipment service life.
- Dome-Tech considered three different types of wind turbine technologies that consisted of both building-mounted and traditional ground-mounted variety. 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 Kittatinny Regional High School BOE decide to pursue a wind turbine project, Dome-Tech recommends commissioning a more detailed study.
- A roof-mounted 684 kw dc photovoltaic system that could provide 32% of the school's annual energy usage was assessed for implementation.
- CHP, Fuel Cells, and Micro-turbines were also researched, but are not recommended due to the lack of thermal requirements in the summertime.

Regarding the procurement of utilities, Dome-Tech understands that Kittatinny Regional High School BOE is served by two electric accounts behind Jersey Central Power & Light, under General Service rate class. Dome-Tech understands that Kittatiny Regional High School BOE has Basic Generation Service Fixed Price accounts that are currently not contracted with a retail energy supplier. The district also uses #2 fuel oil for winter heating. Now is an ideal time to seek longer-term rate stability through a fixed price arrangement through a retail supplier.

During the development of this audit, Dome-Tech was assisted by facility personnel, who were both knowledgeable and very helpful to our efforts. We would like to acknowledge and thank those individuals.

Sincerely,

Michael Bosco
Energy Engineer

Kittatinny High School ECO/ECM Summary

ECO/ECM Summary

	Energy Conservation Measures (ECM)	Energy Savings kWh	Energy Savings Therms	Gross Installation Costs*	Rebates/ Incentives	Avoided Cost	Net Implementation Costs	Total Annual Cost Savings*	Simple Pay Back*	Annual Avoided CO2 Emissions	Return on Investment (ROI)	Lifecycle Cost Savings*
1	Vending Machine Power Management	8,240	0	$ 1,250	$ -	$ -	$ 1,250	$ 1,400	0.9	3	112%	n/a
2	VFD on Cooling tower fans	13,500	0	$ 4,000	$ -	$ -	$ 4,000	$ 2,300	1.7	4	58%	n/a
3	Upgrade to Premium Efficiency Motors	32,500	0	$ 29,400	$ 2,880	$ 18,900	$ 7,670	$ 4,400	1.7	11	57%	$ 79,200
4	Walk-in Freezer fan control	2,400	0	$ 920	$ -	$ -	$ 920	$ 310	2.9	1	34%	n/a
5	Lighting	434,400	0	$ 407,100	$ 28,330	$ -	$ 378,800	$73,900	5.1	143	20%	n/a
6	Exhaust fan Operation Optimization	6,370	0	$ 9,820	$ -	$ -	$ 9,820	$ 1,100	9.1	2	11%	n/a
Totals		497,410	0	$ 452,490	$31,210	$ 18,900	$402,460	$83,410	3.6	164	49%	$ 79,200
									cars	42.72616		
									trees	109.6263		

Energy Audit Purpose & Scope

Purpose:

- The objectives of the energy audit are to evaluate the 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.

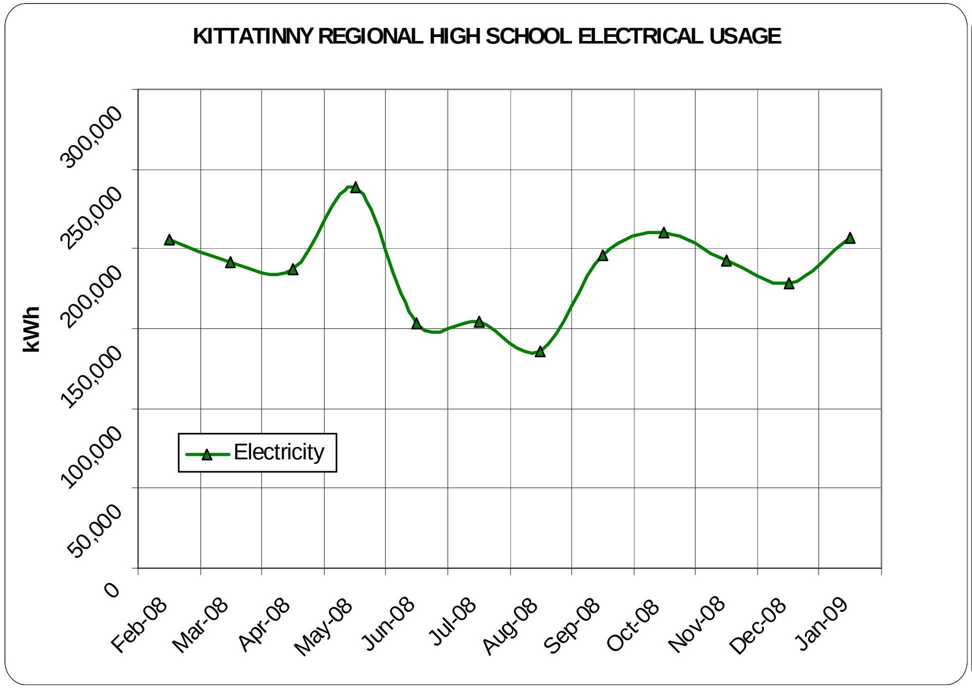
VI. Energy Purchasing and Procurement Strategies: Perform utility tariff analysis and assess potential for savings from energy procurement strategies.

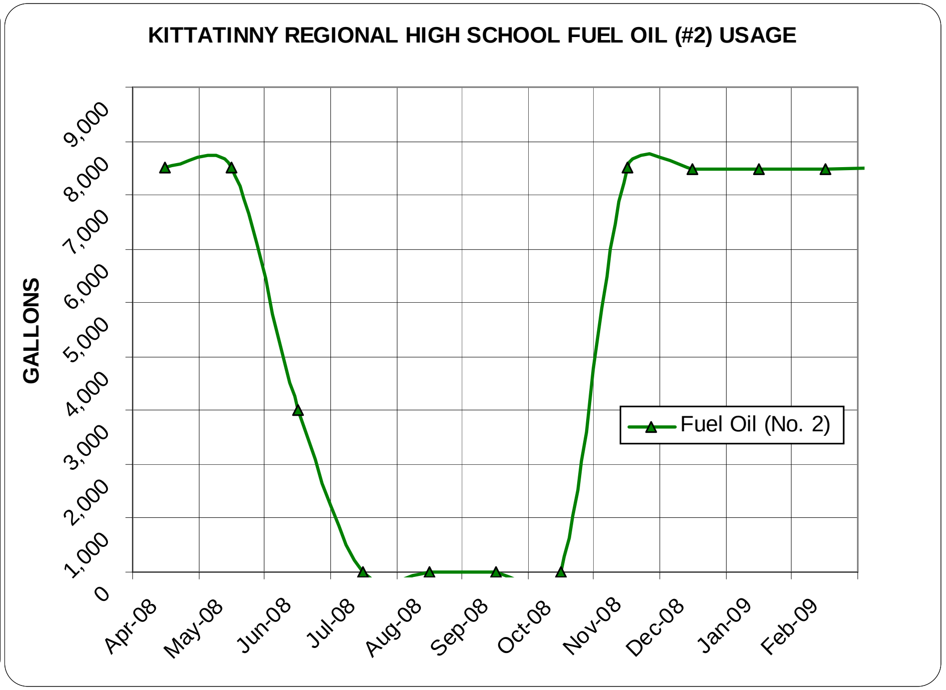
VII. Method of Analysis: Appendices

Historic Energy Consumption

Utility Usage and Costs Summary **Time-period: Feb. 2008 – Jan. 2009**

SCHOOL	Electric			Fuel Oil		
	Annual kWh	Annual Cost	$ / kWh	Annual Gallons	Annual Cost	$ / Gallon
Kittatinny Regional High School	2,250,937	$ 373,999.43	$ 0.17	55,512	$ 123,210.07	$ 2.22





Please See Appendices for full Portfolio Manager and Utility Data for the School

Historic Energy Consumption (continued)

Facility Name	Total Floor Area (S.F.)	Energy Star Score	Eligible to Apply for ENERGY STAR	Current Site Energy Intensity (kBtu/SF)	Current Source Energy Intensity (kBtu/SF)
Kittatinny High School	210,503	33	NA	76	161.8

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: office buildings, banks & K-12 schools), therefore the Score column is marked NA where the facility is a different building type.

Historic Energy Consumption (continued)

Portfolio Manager Sign - In

- An account has been created for Kittatinny Regional High School in Portfolio Manager. You should 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 building's 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 building'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:	KittatinnyHS
Password:	DTKittatinnyHS
Email for account:	mconroy@krhs.net

Facility Information

- ## <u>Building Name:</u> **Kittatinny Regional High School**

Address:	77 Halsey Road, Newton, NJ 07860
Gross Floor Area:	210, 503 S.F.
Year Built:	1975
Grades:	7-12
# Students/ # Staff:	1,300 / 200

- ## <u>Construction Features:</u>

Facade:	Brick; concrete block
Roof Type:	Metal deck; rubber membrane; in good condition
Windows:	Aluminum frame; operable (dual pane to be installed Summer 2009); blinds
Exterior Doors:	Aluminum frame (10% glass); in good condition

- ## <u>Major Mechanical Systems</u>
  - **Air Handlers / AC Systems / Ventilation Systems**
    - One (1) US Electric Chiller; Nine (9) Carrier Roof Top Units (RTUs); Twenty (20) American Air Filter HVAC units; Twenty-eight (28) GE SC Univents; Fourteen (14) AO Smith ceiling univents; Three (3) air compressors
  - **Boilers/ Heating Systems**
    - Three (3) Cleaver-Brooks boilers; Two (2) Peerless boilers; One (1) Smith boiler; One (1) Bock water heater
  - **Controls**
    - Siemens-Apogee HVAC Controls Automation with night and weekend set back
    - Power Control Systems Pneumatic 7-day timer

Greenhouse Gas Emission Reduction

Implementation of all the ECMs will yield:

- 497,410 kilowatt-hours of annual avoided electric usage.
- This equates to the following ***annual*** reductions:

- 164 tons of CO_2;

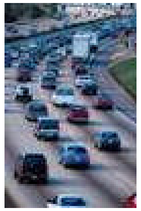
  -OR-

- 42.7 Cars removed from road;

  -OR-

- 109.6 Acres of trees planted annually

The Energy Information Administration (EIA) estimates that power plants in the state of New Jersey emit 1.096 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.

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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 following utility prices provided were used within this study:
  - Electricity Cost ($/kWh): $ 0.17
  - Fuel Oil Cost ($/gal): $ 2.22

- 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 CO_2 per kWh generated.

- The EPA estimates that burning one therm of natural gas emits 11.708 lbs CO_2.

- The EPA estimates that one car emits 11,560 lbs CO_2 per year.

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

Energy Conservation Measures ECM #1: Vending Machine Power Management

Estimated Annual Energy Savings:	$1,400
Gross Estimated Implementation Cost:	$1,250
NJ Smart Start Rebate:	$0
Net Estimated Implementation Cost:	$1,250
Simple Payback (years):	0.9
Annual Avoided CO_2 Emissions (tons):	3

- Dome-Tech recommends installing a VendMiser vending machine power management device on all seven (7) 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).

ECM #2: Cooling Tower Fan VFD

Estimated Annual Energy Savings:	$2,300
Gross Estimated Implementation Cost:	$4,000
NJ Smart Start Rebate:	0
Net Estimated Implementation Cost:	$4,000
Simple Payback (years):	1.7
Annual Avoided CO_2 Emissions (tons):	4

- The cooling tower is equipped with one (1) 15 HP fan.
- The system is designed to have one fan in operation when the condenser water temperature rises over 80 deg F. If the condenser water temperature falls below set point, the bypass valve recirculates the water, and the fan will stop (known as “On/Off” control).
- Dome-Tech recommends installing variable frequency drives (VFD’s) on the fan motors, and controlling the fan speeds based upon condenser water temperature. The fan speed is proportional to the cubed root of the required power. In other words, 50% fan speed will require 13% of the full load power.

ECM #3: Premium Efficiency Motors

Estimated Annual Energy Savings:	$4,400
Gross Estimated Implementation Cost:	$29,400
Like In-Kind Replacement (Avoided Costs):	$18,900
NJ Smart Start Rebate:	$2,880
Net Estimated Implementation Cost:	$7,620
Simple Payback (years):	1.7
Annual Avoided CO_2 Emissions (tons):	11

- 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.

Typical Efficiencies for Standard & Premium Motors (1800 RPM Open Drip-Proof Motors)

Motor Size (HP)	Standard Efficiency	Premium Efficiency	# Motors
5	85.5-87.5%	89.5%	13
7.5	89.5%	91.7%	1
10	87.5-89.5%	91.7%	5
15	87.5-89.5%	93.0%	6
20	89.5%	93.0%	2
25	87.5%	93.6%	1

- 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. The new motors would reduce electrical consumption.

ECM #4 - Walk-In Freezer Fan Controllers

Estimated Annual Energy Savings:	$310
Gross Estimated Implementation Cost:	$920
Simple Payback (years):	2.9
Annual Avoided CO_2 Emissions (tons):	1

- In virtually all walk-in freezers, air is cooled by forced-circulation evaporators containing propeller fans powered by fractional-horsepower motors.
- Typically these 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.

Note: Proceed with this ECM after verifying the following:

Applicable if: The compressor does not run all the time; the evaporator fan runs at full speed all the time: the evaporator fan motor in single-phase applications is of shaded-pole or permanent-split-capacitor design.

Do not use controller if: the compressor runs all the time; the evaporator fan does not run at full speed all the time (for example, it turns off with the compressor or it switches between full speed and half speed); or the evaporator fan motor in single-phase applications is any type other than shaded pole or permanent-split capacitor design.

ECM #5: Lighting Upgrade

Estimated Annual Energy Cost Savings:	$73,900
Gross Estimated Implementation Cost:	$407,100
NJ Smart Start Rebate:	$28,300
Net Estimated Implementation Costs:	$378,800
Simple Payback (yrs): (with rebate)	5.1
Annual Avoided CO_2 Emissions (tons):	143

- The existing lighting consists of older, less efficient T-12 fluorescent lamps, newer T-8 fluorescent lamps, metal halide lamps, incandescent lamps and compact fluorescents.

- Dome-Tech recommends the following lighting upgrades:
  - T-12 fluorescent light fixtures to new, high efficiency T-8 lamps and electronic ballasts;
  - incandescent lights to high efficiency compact fluorescent lamps;
  - Metal halide lamps (gym) to high bay T-8 fluorescent lamps with aluminum reflectors.

- Many areas 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).

Please see the Appendix for detailed line-by-line lighting upgrades.

ECM #6: Optimize Exhaust Fan Time of Day Schedule

Estimated Annual Energy Savings:	$1,100
Gross Estimated Implementation Cost:	$9,820
NJ Smart Start Rebate:	$0
Net Estimated Implementation Cost:	$9,820
Simple Payback (years):	9.1
Annual Avoided CO_2 Emissions (tons):	2

- A review of the schedules in the programmable thermostats revealed an opportunity to optimize the time of day schedules.
- Optimizing the schedules to better reflect actual building occupancy will reduce heating and cooling costs.
- For example, programming the bathroom exhaust fans to turn off during unoccupied hours will reduce HVAC costs.

EF Operation	Quantity	Existing Schedule (Hrs/day)	Revised Schedule (Hrs/day)
Online 24/7	17	24	16
Bathroom	27	17	14

ECM #7: Creation of an Energy Awareness & Education Program

Estimated Annual Savings:	2-3%*
Gross Estimated Implementation Cost:	$1500 each
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

- Kittatinny Regional High School currently has no observed 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.

* 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
- 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.
- Geothermal applications are used widely in western U.S. (most prominent in the Yellowstone basin and in northern California)

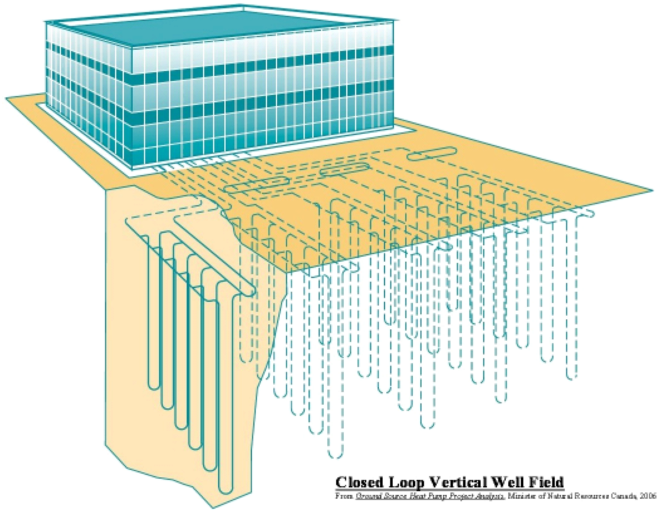
Renewable Energy Technologies: Geothermal

Geothermal ground source heat pump (GSHP) systems are HVAC systems that use the earth's relatively constant temperature to provide heating or cooling to a system. In doing so, GSHP systems move 3 to 5 times more energy between the building and the ground than is actually consumed by the system components. In comparison, this represents a 30% decrease in energy consumption when compared to conventional HVAC systems that required chillers or refrigeration coils for cooling and boilers or electric resistance coils for heating.

A GSHP system consists of three major components: the heat pump, the well field, and the heating/cooling distribution system.

Heat Pump

The heat pump is the driving force behind a GSHP system. A typical heat pump is an "air-to-water" unit, meaning the fluid carries heat to and from the earth (via the earth connection) is a water or water/antifreeze mixture, and the HVAC distribution system in the building distributes hot or cold air. Heat pumps are self-contained in a single enclosure and consist of a refrigerant compressor, earth heat sink heat exchanger, and an air distribution system (fan, refrigerant-to-air heat exchanger, and condensate removal). Heat pumps range in size between 1 to 30 tons. For larger facilities (such as schools and office buildings), several heat pump units are required.



Closed Loop Vertical Well Field
From *Ground Source Heat Pump Project Analysis*, Minister of Natural Resources Canada, 2006

Well Field

The well field provides the heat exchanging mechanism between the GSHP system water side and the earth. Well fields are either open or closed system. Open systems directly draw from an adjacent water source such as a lake or aquifer. Closed systems are typically polyurethane tubing buried in horizontal trenches or boreholes. The system selected for this analysis is a closed loop, horizontal well field. Wells are typically 250 to 500 feet deep each, and provide 1 ton of cooling for every 250 linear feet. Wells are spaced at 15 to 20 feet on center, and larger systems can have a significant footprint. In addition, the well boring portion of the project is capital intensive and usually accounts for over 50% of the total GSHP system cost. Once installed, and well field has a estimated equipment service life of over 50 years.

Heating/Cooling Distribution System

The heating/cooling distribution system consists of the ductwork used to supply conditioned air the building. As previously stated, larger facilities often require multiple heat pumps connected to a common building loop. Buildings equipped with GSHP's may also require make-up air units to provide fresh air to the spaces, as well as an auxiliary heat source (such as a boiler or steam heat exchanger) to supplement heating during high heating degree days.

Renewable Energy Technologies: Geothermal

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The project economics and GSHP pro's and cons are presented in the following tables:

GSHP Economics*

	GSHP	DX Roof Top
Gross Installation Cost Estimate	$2,975,000	$1,487,500
NJJ SSB Rebate	$157,250	$33,575
Net Installation Cost Estimate	$2,817,750	$1,453,925
Annual Energy Cost	$210,760	$313,722
Annual Electric Use, kWh	1,239,765	1,192,997
Annual Natural Gas Use, Therms	0	49,961
Annual CO2 Emmisions, Therms	434	710

*Based upon Kittatinny Regional High School HVAC Systems & Energy Profile

Simple Payback on Net Install Cost GSHP

Net Installation Cost Estimate	$2,817,750
Annual Energy Savings	$102,962
Simple Payback	27.4

Simple Payback on Incremental Cost of GSHP

Net Installation Cost Estimate	
Annual Energy Savings	$102,962
Simple Payback	13.2

GSHP Pros & Cons

Pros	Cons
➢Annual HVAC energy reduction of over 30% and energy spend by over $100,000. ➢Well fields installations typically last over 50 years. ➢Reduction of annual greenhouse gas emissions by 185 tons per year. ➢Potential for removal of boiler and chiller / low efficiency DX refrigeration system. ➢Potential for reduced maintenance costs if the GSHP system replaces a cooling tower or other equipment.	➢Payback period is longer than expected life of heat pump equipment (exclusive of well field). ➢Ground conditions are not always conducive to a well field installation. Conditions unknown until drilling is complete. ➢The well field requires a significant amount of real estate. In this case, well over an acre of land may be required depending on depth of well field.

A GSHP installation is not recommended as an immediate retrofit project. However, a detailed life cycle analysis of a GSHP system versus a traditional HVAC system is recommended once the existing equipment exceeds the estimated equipment service life.

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.

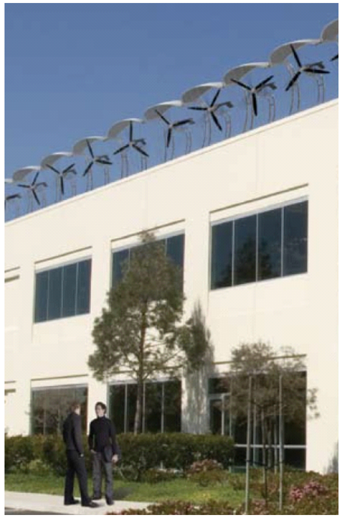
Newton Area Wind Speed

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 Kittatinny RHS area is 4.6 meters per second. Ideal wind speeds for a successful project should average over 6 meters per second.

For the Kittatinny RHS, 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

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

Wind Turbine Economics

	Building Integrated	Ground Mount 5 kW	Ground Mount 50 kW
Gross Installation Cost Estimate	$130,000	$62,400	$250,000
NJJ SSB Rebate	$45,278	$35,994	$95,720
Net Installation Cost Estimate	$84,722	$26,406	$154,280
Annual Energy Savings	$2,405	$1,912	$17,857
Simple Payback	35.2 yrs.	13.8 yrs.	8.6 yrs.
System Capacity	20 kW	10 kW	50 kW
Annual Avoided Energy Use	14,149 kWh	11,248 kWh	105,041 kWh
Annual CO2 Emmisions, Therms	5	4	37
% of Annual Electric Use*	0.6%	0.5%	4.7%

Kittatinny Regional High School: 2250937 kWh/Year.

Wind Turbine Pros & Cons

Pros	Cons
➢Annual reduction in energy spend and use can be potentially reduced by almost $23,000 (1% 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).

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

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.

Renewable Energy Technologies: Solar Photovoltaic

System Capacity, kw-dc (maximum utilization of roof space)	684 kw dc
Annual Electric Generation, kwhrs of AC electricity produced	721,054 kwh
Total Annual Facility Electric Use, kwhrs	2,250,937 kwh
% of Total Annual Usage	32%
All-In Cost of Electric Year 1	$0.170 / kwh
Annual Electric Cost Savings	$122,579
Estimated SREC Value (Year 1):	$640 / SREC
Estimated Year 1 SREC Revenue:	$461,237
Equivalent Annual CO2 Emission Reduction (tons per year)[1]	395 tons/yr
Equivalent Cars Removed From Road Annually[2]	68
Equivalent Acres of Trees Planted Annually[3]	108
System Installed Cost (does not include value of tax credits)	$4,788,784
Simple Payback (includes tax incentives)	9.6
IRR (25 Years)	7%

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

Non-Financial Benefits of Solar PV

- The implementation of this solar PV project would place Kittatinny Regional High School at the forefront of renewable energy utilization. This would allow the district the opportunity to not only gain experience with this new energy technology, but also to win recognition as an environmentally sensitive, socially conscience institution. Additionally, this project could be incorporated into science and other curriculums to raise awareness of energy alternatives to the younger generations.

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 Kittatinny High School due to the lack of thermal requirements in the summertime.

Kittatinny Regional High School Energy Bill and Purchasing Review: <u>Electricity</u>

- <u>Accounts and Rate Class:</u> Kittatinny Regional High School is served by two electric accounts behind Jersey Central Power & Light under General Service (GS) rate classes.

- <u>Electric Consumption and Cost:</u> The total annual electric expenditure for the District is about <u>$374,000</u> and the total annual consumption is about <u>2,250,000 kilowatt-hours (kWh</u>).

- <u>Average/Effective Rate per kWh:</u> In 2008, the District's average cost per kilowatt-hour ranged from 14 ¢/kWh to 20 ¢/kWh, inclusive of delivery charges. The District's overall, average cost per kilowatt-hour during this period was almost 17¢/kWh.

Energy Bill and Purchasing Review: Electricity (cont.)

Dome-Tech, Inc.

- **Deregulation 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.**
  - **Dome-Tech understands that the District has BGS-FP accounts that are currently not contracted with a retail energy supplier.**

Energy Bill and Purchasing Review: Electricity (cont.) – PJM West – 12 Month Strip

Energy Bill and Purchasing Review: Fuel Oil

- **<u>Fuel Oil Accounts:</u> The District is served by one Fuel Oil No. 2 account, and is currently supplied by JW Pierson Co. Fuel Oil.**

- **<u>Fuel Oil Consumption and Cost:</u> Fuel Oil is used primarily for winter heating purposes at the school; total annual usage for the period studied was about 55,000 gallons at an expenditure of approximately $123,000. The District paid on average $2.22 per gallon.**

- **<u>Current Heating Oil Market Futures Pricing</u>: Heating oil commodity futures prices at the time of this report are at about $1.50 per gallon for August 2009, and are approximately $2.00 per gallon for the winter of 2009/2010. These are levels that have not been seen in more than 3 years. 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.**

Next Steps

The following projects may be considered for implementation:

- Lighting upgrade
- Install vending machine power management systems on vending machines
- Install VFD on cooling tower fan
- Install roof-mounted photovoltaic system
- Optimize exhaust fan time of day schedules
- Start an Energy Awareness and Education Program

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