PALISADES PARK SCHOOL DISTRICT

Energy Audit

Prepared For:
Palisades Park Board of Education

Contact :
Dr. Charles Smith
Superintendent

Prepared By:
Dome – Tech, Inc.

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

July 2011

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July 28, 2011

Dr. Charles Smith
Superintendent
Palisades Park Board of Education
410 Second Street
Palisades Park, NJ 07650

**Re: EXECUTIVE SUMMARY FOR PALISADES PARK BOARD OF EDUCATION
STATE OF NEW JERSEY LOCAL GOVERNMENT ENERGY AUDIT**

Dear Dr. Smith:

Dome-Tech was retained by Palisades Park Board of Education, as a pre-qualified participant in the Local Government Energy Audit Program, to perform an energy audit. The objective of the energy audit was to evaluate the District's 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 twelve (12) month period January 2010 – December 2010, for the facilities included in this study, the District had an annual expenditure of:

- Electricity: 1,511,425 kWh at a total cost of $ 245,394.34
- Natural Gas: 149,292 therms at a total cost of $ 170,377.80

The following three (3) buildings were evaluated under this study:

- Charles Smith School 33,484 SF
- Lindbergh School 87,365 SF
- Palisades Park High School 106,626 SF

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, etc.

If all identified ECMs were to be implemented, they would provide the following estimated benefits to the District:

- Total annual electrical savings: 410,500 kilowatt-hours; 27%
- Total annual natural gas savings: 51,535 therms of natural gas usage; 35%
- Total annual cost savings: $110,535; 27%
- Total annual CO_2 emissions reduction: 437 tons
- Total net estimated implementation cost: $1,283,870
- Total average simple payback: 11.6 years

A summary of the projects that are recommended for implementation (at all facilities) includes: installing new building management system. Installing new boilers; installing vending machine power management; installing premium efficiency motors; upgrading piping insulation; upgrading lighting; and implementing an energy awareness program. Please see the report for a full list of recommended ECM's.

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

- Dome-Tech considered three different types of wind turbine technologies that consisted of both building-mounted and traditional ground-mounted variety. Ground-Mounted is not possible for these buildings due to space constraints and the surrounding buildings. The Building-mounted wind turbine project appears to be the only technically viable option but we would not recommend it due to payback and high noise concerns. Should the District decide to pursue a wind turbine project, Dome-Tech recommends commissioning a more detailed study.
- Roof-mounted photovoltaic system ranging in size from 5 - 145 kW dc, could provide approximately 11 - 24% per building of the District's annual energy usage was assessed for implementation at each site.
- CHP (Combined Heat and Power), Fuel Cells, and Micro-turbines were also considered and not recommended for any of the buildings, due to unfavorable energy rates (spark spread).

The District's data was entered into the US EPA ENERGY STAR's Portfolio Manager database program. Buildings with scores of 75 or higher may qualify for the ENERGY STAR Building Label. In order to receive an Energy Star rating, more than 50% of a building must be defined by one of the following space types: Bank/Financial Institution, Courthouse, Hospital (Acute Care and Children's), Hotel, K-12 School, Medical Office, Office, Residence Hall/Dormitory, Retail Store, Supermarket, Warehouse (Refrigerated and Non-refrigerated), Wastewater Treatment Plant, or Data Center. Energy Star scores range between 39 -78. Please see the report for individual facility information.

Regarding the procurement of utilities, Dome-Tech understands that the Palisades Park Board of Education is currently not under contract with a retail energy supplier for electricity or natural gas. Dome-Tech can assist the District with securing a retail electricity and natural gas provider, which can generate annual savings of approximately $24,500 - $36,800, with no out-of-pocket costs.

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,

Alex Hild
Senior Energy Engineer

Prepared by Dome-Tech, Inc.

PALISADES PARK TOWNSHIP BOE- ECMs Sorted by Payback

	Energy Conservation Measures (ECM)	Buildings	Energy Savings			Gross Installation Costs*	Rebates/ Incentive	Avoided Cost	Net Implementation Costs	Annual Energy Cost Savings	Annual Oper. Cost Savings	Total Annual Cost Savings	Simple Pay Back	Internal Rate of Return (IRR)	Measure Life	Lifecycle Savings	CO2 Savings (lbs)
			kWh	kW	Therms								Years				
1.1	BMS UVs Time of Day Optimization	Lindbergh School	53,560	0.00	7,820	$161,250	$0	0	$161,250	$17,120	$0	$17,120	9.4	6.5%	15	$43,127	63
1.1	BMS UVs Time of Day Optimization	Palisades Park High School	40,560	0.00	9,380	$207,805	$0	0	$207,805	$17,480	$0	$17,480	11.9	3.1%	15	$870	68
1.2	BMS Holiday Schedule Time of Day	Palisades Park High School	3,630	0.00	550	$1,270	$0	0	$1,270	$1,230	$0	$1,230	1.0	96.8%	15	$13,414	4
1.2	BMS Holiday Schedule Time of Day	Lindbergh School	3,910	0.00	535	$1,270	$0	0	$1,270	$1,210	$0	$1,210	1.0	95.3%	15	$13,175	4
1.3	Exhaust Fan Time of Day	Palisades Park High School	10,280	0.00	2,010	$2,715	$0	0	$2,715	$4,005	$0	$4,005	0.7	147.5%	15	$45,096	15
1.4	Setpoint Optimization	Lindbergh School	990	0.00	70	$0	$0	0	$0	$240	$0	$240	0.0	#DIV/0!	15	$2,865	1
1.4	Setpoint Optimization	Charles Smith School	6,620	0.00	400	$110	$0	0	$110	$1,580	$0	$1,580	0.1	1436.4%	15	$18,752	5
1.4	Setpoint Optimization	Palisades Park High School	670	0.00	375	$0	$0	0	$0	$835	$0	$835	0.0	#DIV/0!	15	$9,973	2
Sorted by Payback																	
2	Unit Heater Optimization	Charles Smith School	30	0.00	190	$0	$0	0	$0	$220	$0	$220	0.0	#DIV/0!	15	$2,626	1
3	Kitchen Cooling Counter Time of Day	Lindbergh School	4,660	0.00	0	$0	$0	0	$0	$430	$0	$430	0.0	#DIV/0!	15	$5,133	2
4	Weatherstripping	Lindbergh School	0	0.00	425	$470	$0	0	$470	$480	$0	$480	1.0	102.1%	15	$5,260	2
4	Weatherstripping	Palisades Park High School		0.00	360	$470	$0	0	$470	$410	$0	$410	1.1	87.2%	15	$4,425	2
4	Weatherstripping	Charles Smith School	160	0.00	160	$320	$0	0	$320	$210	$0	$210	1.5	65.6%	15	$2,187	1
5	Vending Machine Management System	Palisades Park High School	4,840	0.00	0	$1,000	$0	0	$1,000	$800	$0	$800	1.3	80.0%	15	$8,550	2
5	Vending Machine Management System	Lindbergh School	4,840	0.00	0	$1,000	$0	0	$1,000	$745	$0	$745	1.3	74.5%	15	$7,890	2
6	Premium Efficient Motors	Palisades Park High School	1,960	0.80	0	$2,540	$320	1,600	$620	$330	$0	$330	1.9	53.1%	15	$3,320	1
6	Premium Efficient Motors	Lindbergh School	1,210	0.43	0	$2,030	$270	1,200	$560	$190	$0	$190	2.9	33.5%	15	$1,708	0.4
7	Winterization of Window AC Units	Palisades Park High School	0	0.00	250	$1,020	$0	0	$1,020	$285	$0	$285	3.6	27.1%	15	$2,376	1
7	Winterization of Window AC Units	Lindbergh School	0	0.00	190	$390	$0	0	$390	$220	$0	$220	1.8	56.3%	15	$2,236	1
8	Install Insulation on Condenstate Tank	Palisades Park High School	0	0.00	250	$950	$0	0	$950	$290	$0	$290	3.3	29.9%	15	$2,512	1
8	Install Insulation on Condenstate Tank	Lindbergh School	0	0.00	220	$920	$0	0	$920	$250	$0	$250	3.7	26.4%	15	$2,064	1
9	Kitchen Exhaust Fan VFDs	Palisades Park High School	2,815	0.00	0	$2,930	$900	0	$2,030	$470	$0	$470	4.3	22.0%	15	$3,581	1
9	Kitchen Exhaust Fan VFDs	Charles Smith School	1,880	0.00	0	$2,460	$775	0	$1,685	$320	$0	$320	5.3	17.2%	15	$2,135	1
9	Kitchen Exhaust Fan VFDs	Lindbergh School	1,880	0.00	0	$2,460	$775	0	$1,685	$290	$0	$290	5.8	15.1%	15	$1,777	1
10	Install Insulation on Hot Water Piping	Palisades Park High School	0	0.00	300	$2,200	$0	0	$2,200	$340	$0	$340	6.5	13.0%	15	$1,859	2
10	Install Insulation on Hot Water Piping	Lindbergh School	0	0.00	100	$1,225	$0	0	$1,225	$110	$0	$110	11.1	4.0%	15	$89	1

Prepared by Dome-Tech, Inc.

PALISADES PARK TOWNSHIP BOE- ECMs Sorted by Payback

	Energy Conservation Measures (ECM)	Buildings	Energy Savings			Gross Installation Costs*	Rebates/ Incentive	Avoided Cost	Net Implementation Costs	Annual Energy Cost Savings	Annual Oper. Cost Savings	Total Annual Cost Savings	Simple Pay Back	Internal Rate of Return (IRR)	Measure Life	Lifecycle Savings	CO2 Savings (lbs)
			kWh	kW	Therms								Years				
11	Walk-in Freezer & Cooler Fan Controls	Palisades Park High School	870	0.00	0	$760	$0	0	$760	$140	$0	$140	5.4	16.6%	15	$911	0
11	Walk-in Freezer & Cooler Fan Controls	Charles Smith School	600	0.05	0	$920	$0	0	$920	$110	$0	$110	8.4	8.4%	15	$393	0
11	Walk-in Freezer & Cooler Fan Controls	Lindbergh School	300	0.00	0	$680	$0	0	$680	$50	$0	$50	13.6	1.3%	15	-$83	0
12	Lighting Upgrades	Lindbergh School	80,990	26.40	0	$111,800	$1,520	0	$110,280	$12,960	$0	$12,960	8.5	-1.4%	8	-$19,305	27
12	Lighting Upgrades	Palisades Park High School	92,175	29.32	0	$107,670	$1,130	0	$106,540	$14,750	$0	$14,750	7.2	2.3%	8	-$3,000	30
12	Lighting Upgrades	Charles Smith School	51,170	15.87	0	$66,980	$630	0	$66,350	$8,190	$0	$8,190	8.1	-0.3%	8	-$8,859	17
13	Install Univent VFDs on Blower Fans	Lindbergh School	20,610	0.00	0	$23,100	$0	0	$23,100	$3,170	$0	$3,170	7.3	10.8%	15	$14,743	7
13	Install Univent VFDs on Blower Fans	Charles Smith School	5,200	0.00	0	$8,750	$0	0	$8,750	$880	$0	$880	9.9	5.6%	15	$1,755	2
13	Install Univent VFDs on Blower Fans	Palisades Park High School	9,370	0.00	0	$15,750	$0	0	$15,750	$1,555	$0	$1,555	10.1	5.4%	15	$2,813	3
14	Upgrade RTU efficiency at End of Life	Palisades Park High School	2,510	1.67	0	$6,745	$370	0	$6,375	$420	$0	$420	15.2	-0.1%	15	-$1,361	1
15	Replace Window AC units	Lindbergh School	230	0.00	0	$660	$0	0	$660	$40	$0	$40	16.5	-1.2%	15	-$182	0
15	Replace Window AC units	Palisades Park High School	1,980	0.00	0	$9,570	$0	0	$9,570	$330	$0	$330	29.0	-7.3%	15	-$5,630	1
16	Replace Boilers	Lindbergh School	0	0.00	15,220	$405,190	$13,260	137,000	$254,930	$6,510	$0	$6,510	39.2	-10.1%	15	-$177,214	89
16	Replace Boilers	Palisades Park High School	0	0.00	12,730	$536,090	$20,920	226,930	$288,240	$11,340	$0	$11,340	25.4	-6.0%	15	-$152,864	74
	Totals	**TOTALS**	**410,500**	**74.54**	**51,535**	**$1,691,470**	**$40,870**	**$366,730**	**$1,283,870**	**$110,535**	**$0**	**$110,535**	**11.6**	**3%**	**14**	**-$1,301**	**437**

Notes:

1. KW - Where Zero (0) values are shown in the table there is no demand reduction for this measure.
2. Rebates- Where Zero (0) values are shown in the table we could not find any rebates of other financial incentives that are currently available for this measure.

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: Jan. 2010 – Dec. 2010

Buildings	Electric - PSE&G				Natural Gas - PSE&G			
	Account Meter	Annual Consumption kWh	Annual Cost	$ / kWh	Account Meter	Annual Consumption Therms	Annual Cost	$ / Therms
Lindbergh School	726023123	26,124	$4,066.04	$0.156	1660091	4,830	$5,176.06	$1.072
	778010982	544,585	$83,953.58	$0.154	3499623	46,442	$52,677.71	$1.134
Charles Smith School	728011741	256,880	$43,557.57	$0.170	3275479	8,104	$9,234.64	$1.140
Palisades Park High School	626030129	1,116	$346.36	$0.310	2859612	501	$678.97	$1.355
	778010981	682,720	$113,470.79	$0.166	2807080 / 1785526	86,939	$99,620.03	$1.146
					2639708	2,476	$2,990.39	$1.208
TOTAL / AVERAGE		**1,511,425**	**$245,394.34**	**$0.162**	**TOTAL**	**149,292**	**$170,377.80**	**$1.141**

Please see Appendix for full utility data and consumption profiles for each building.

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.
- Due to inefficient HVAC design of the high school, (and older outdated HVAC units) at Lindbergh elementary school, it will be difficult for these buildings to achieve the energy star label. After implementing some energy conservation measures listed in this this report, the school's energy star score should improve.

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)
Charles Smith School	33,484	78	Yes	50.3	112.5
Lindbergh School	87,365	58	NA	73	127
Palisades Park High School	106,626	39	NA	112	166.8

Historic Energy Consumption (continued)

Portfolio Manager Sign - In

- An account has been created for Palisades Park BOE 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:	***PalisadesParkBOE***
➢Password:	***DTPalisadesParkBOE***
➢Email for account:	***csmith@palpkschools.org***

Facility Information

➢ Building Name: Lindbergh School

Address:	401 Glen Avenue Palisades Park, NJ 07650
Gross Floor Area:	87,365 sf
Year Built:	1929; renovations 1968 and 1990
# Occupants:	725
Use:	The facility is an elementary school serving grades 2-7. The classrooms are utilized from 7am until 3:30pm M-F; closed Saturdays and Sundays with the exception of the auditorium and stage, which is used on Saturdays from 5-7 pm and Sundays from 8am until 3pm.

➢ Construction Features:

Facade:	Three story, brick and stone façade with a separate modular building made of stucco-covered rigid foam board, in good condition
Roof Type:	Flat, dark colored, metal deck, built-up/rubberized, in good condition
Windows:	Covering approximately 40% of façade, metal frame, double hung, 80% with shades/blinds, in good condition
Exterior Doors:	Approximately 15, metal frame, entrance doors are metal and glass, in fair condition (many exterior doors do not have weather stripping or do not close properly, allowing outside air to enter the building through the gaps)

Facility Information

Major Mechanical Systems – Lindbergh School

Air Handlers / AC Systems / Ventilation Systems

HVAC at Lindbergh School is handled primarily by unit ventilators, with additional air handlers and portable AC units serving some spaces. Classrooms and hallways are served by heating-only hot water (HW) unit ventilators (or “univents”). Univents also provide perimeter heating for areas that are served by other equipment. The gym and cafeteria are each served by a McQuay heating-only HW rooftop unit. The music rooms, some offices, and locker rooms are each served by heating-only HW air handler unit (AHU). The library is cooled by a Carrier split DX heat pump. Cooling in most other spaces is provided by window AC units. However, three (3) 5-ton portable units are available for space cooling as necessary in larger areas, such as the auditorium. Approximately 15 exhaust fans provide exhaust for corridors, mechanical rooms, and restrooms, as well as the kitchen, auditorium, and gym areas.

Boilers

There are two (2) cast iron, natural gas fired HB Smith sectional (or “pork chop”) steam boilers, each with a maximum output of 4,177 MBH. These boilers operate in a lead lag sequence. There is a steam to hot water shell and tube heat exchanger that supplies hot water to the building. Hot water is circulated by two sets of lead-lag pumps that each serve a different part of the building: two (2) 3-HP heating hot water pumps that supply the newer section of the school and two (2) 7.5-HP heating hot water pumps that supply the older section of the school.

Domestic Hot Water

Domestic hot water (DHW) is provided by a natural gas fired Lochinvar hot water heater. The heater can provide 633 gph at a 100 F temperature rise. The unit is equipped with a circulator pump.

Major Mechanical Systems – Lindbergh School (continued)

Controls

The hot water (HW) distribution loop is controlled by a pneumatic controls system. Each of the two main loops has its own control panel that allows for some energy-saving controls strategies, such as hot water reset based on outside air temperature and night time hot water temperature setback. However, the night time setback capability is not being utilized currently because certain spaces in the building are occupied after school hours. Without local controls overrides, going into setback mode would result in under-heated occupied spaces.

Approximately 12 exhaust fans within the building are controlled with local time clocks. Also, the boiler is controlled by steam pressure at the heat exchanger. A control valve maintains the steam setpoint pressure.

Facility Information

- **Building Name:** **Palisades Park High School**

Address:	1 Veterans Plaza Palisades Park, NJ 07650
Gross Floor Area:	106,626 sf
Year Built:	1968; renovations in 1990
# Occupants:	600
Use:	The building is a school serving students in Junior and Senior High School; the classrooms are occupied from 7am-3pm M-F and closed Saturdays and Sundays, with the exception of the gym, which is utilized Mondays through Saturdays between 6am until 10pm.

- **Construction Features:**

Facade:	Three story, brick façade, in good condition
Roof Type:	Flat, dark colored, metal deck, built-up/rubberized, in good condition
Windows:	Covering approximately 30% of façade, metal frame, double hung, 80% of windows have shades/blinds, in good condition
Exterior Doors:	Approximately 25 in total, 15 are glass pane and metal, 10 are solid metal, in fair condition (many exterior doors do not have weather stripping or do not close properly, allowing outside air to enter the building through the gaps)

Facility Information

➢ Major Mechanical Systems – Palisades Park High School

Air Handlers / AC Systems / Ventilation Systems

HVAC at Palisades Park High School is handled primarily by unit ventilators, with larger air handlers and portable AC units serving some spaces. Classrooms and hallways are served by heating-only hot water (HW) unit ventilators (or “univents”). Several AHUs serve various areas of the building. The gym is heated by two (2) HW heating AHUs. Additionally, the gym locker rooms are heated by two (2) HW heating AHUs. The auditorium is conditioned by two (2) AHUs equipped with 15-ton split DX cooling coils and HW heating coils. The administrative office area is served by a cooling-only 4-ton DX rooftop unit. Four (4) Carrier rooftop units equipped with DX cooling coils and natural gas heat serve two classrooms and two computer lab in the academic wing. A 5-ton portable AC unit serves the cafeteria when needed. Cooling in most other spaces is provided by window AC units. Approximately 35 exhaust fans provide exhaust for corridors, mechanical rooms, and restrooms, as well as the kitchen, auditorium, and gym areas.

Boilers

There are two (2) cast iron, natural gas fired Cleaver Brooks steam boilers, each with a maximum input of 10,461 MBH. These boilers operate in a lead lag sequence. There is a steam to hot water shell and tube heat exchanger that supplies hot water (HW) to the building. Two (2) 7.5 hp HW return pumps push return water through the heat exchanger. Four (4) approximately 3 hp HW supply pumps serve four secondary HW loops throughout the building.

Domestic Hot Water

Domestic hot water (DHW) is provided by a natural gas fired Lochinvar hot water heater. The heater can provide 633 gph at a 100 F temperature rise. The unit is equipped with a circulator pump.

Facility Information

Major Mechanical Systems – Palisades Park High School (continued)

Controls

The hot water (HW) distribution loop is controlled by a pneumatic controls system. Each of the two main loops has its own control panel that allows for some energy-saving controls strategies, such as hot water reset based on outside air temperature and night time hot water temperature setback. However, the night time setback capability is not being utilized currently because certain spaces in the building are occupied after school hours. Without local controls overrides, going into setback mode would result in under-heated occupied spaces.

A majority of the exhaust fans within the building are controlled with manual on/off switches and operate continuously. Also, the boiler is controlled by steam pressure at the heat exchanger. A control valve maintains the steam setpoint pressure.

Facility Information

➢ Building Name: Charles R. Smith

Address:	270 First Street Palisades Park, NJ 07650
Gross Floor Area:	33,484 sf
Year Built:	2005
# Occupants:	275
Use:	The building is a school serving grades K-1; the building is operated M-F from 8am until 6pm, closed weekends and holidays

➢ Construction Features:

Facade:	Two story, stucco sided with brick/block façade, in new condition
Roof Type:	Flat, dark colored, metal deck, appeared to be rubberized (large amount of snow at time of field visit), in new condition
Windows:	Covering approximately 30% of façade, metal frame, double hung, 80% of windows have shades/blinds, in new condition
Exterior Doors:	Approximately 9, 6 solid metal and 3 glass pane double doors, in fair condition (most exterior doors do not have weather stripping or do not close properly, allowing outside air to enter the building through the gaps)

Facility Information

➢ Major Mechanical Systems – Charles R Smith School

Air Handlers / AC Systems / Ventilation Systems

HVAC at Charles R Smith School is handled primarily by unit ventilators, with rooftop and fan coil units serving some spaces. Classrooms and hallways are served by heating-only hot water (HW) unit ventilators (or "univents"). The administrative offices, cafeteria and gym, and upstairs corridor are each served by three (3) Trane roof top units equipped with DX cooling coils and natural gas burners. The teachers' lounge and basement server room are served by two small, cooling only split DX units. Several exhaust fans provide exhaust for corridors, mechanical rooms, and restrooms, as well as the kitchen, cafeteria, and gym areas.

Boilers

There are four (4) condensing hot water LAARS boilers, each with a maximum output of 420 MBH. These boilers operate in a lead lag sequence. Each boiler is equipped with a mounted circulator pump. Two (2) 7.5 hp HW supply pumps provide heating water to the building. The pumps operate in a lead/lag configuration.

Domestic Hot Water

The majority of the domestic hot water (DHW) is provided by a natural gas fired AO Smith storage heater, with an 85 gallon storage capacity and maximum rated 500 MBH input. A 4500 W electric Rheem 40 gallon storage heater provides additional DHW to two first floor classrooms.

Facility Information

- **Major Mechanical Systems – Charles R Smith School**

Controls

Boilers are controlled by a Tekman Boiler Control 264 controller. The controller stages the boilers and maintains HW supply temperature. Energy-saving controls sequences, such as HW temperature reset based on outside air temperature and unoccupied HW temperature setback, are implemented using the controller.

In general, the space HVAC equipment is controlled by digital programmable thermostats. The univents are controlled by a digital programmable thermostat and a digital time clock at each unit. The programmable thermostat modulates a HW control valve to maintain space temperature and the time clock shuts off the univent fan during unoccupied hours.

Greenhouse Gas Emission Reduction

Implementation of all identified ECMs will yield:

- 410,500 kilowatt-hours of annual avoided electric usage.
- 51,535 therms of annual avoided natural gas usage.
- This equates to the following ***annual*** reductions:

  - 437 tons of CO_2;

    -OR-

  - 76 Cars removed from road;

    -OR-

  - 119 Acres of trees planted annually

The Energy Information Administration (EIA) estimates that power plants in the state of New Jersey emit 0.666 lbs CO_2 per kWh generated.

The Environmental Protection Agency (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: Building Management System

	High School*	Lindbergh *	TOTAL*
Estimated Annual Savings:	$23,550	$18,570	**$42,120**
Gross Estimated Implementation Cost:	$211,790	$162,520	**$374,310**
NJ Smart Start Rebate:	$0	$0	**$0**
Net Estimated Implementation Cost:	$211,790	$162,520	**$374,310**
Simple Payback (years):	9.0	8.8	**8.9**
Annual Avoided CO_2 Emissions (tons):	90	68	**158**

* The BMS savings, cost and payback represent the total of ECMs 1.1, 1.2, 1.3 and 1.4.

- The High School and Lindbergh school currently utilize an antiquated pneumatic controls system to operate most of its HVAC equipment. The system is designed with a manual Day/Night switch to operate the units in an occupied mode and an unoccupied mode (which sets back the space temperatures).
  - The following areas can operate on the 'night' schedule: High School: Classroom, Auditorium, Administration, Gym Zone Lindberg: Classroom, Gym, Gym Lockers, Kitchen

- Building maintenance staff indicated that all the units run in the 'Day' or occupied mode 24/7.
  - They indicated that each area is an "all or nothing" system and it is difficult to utilize due to varying occupancy through out the building after classes are complete.

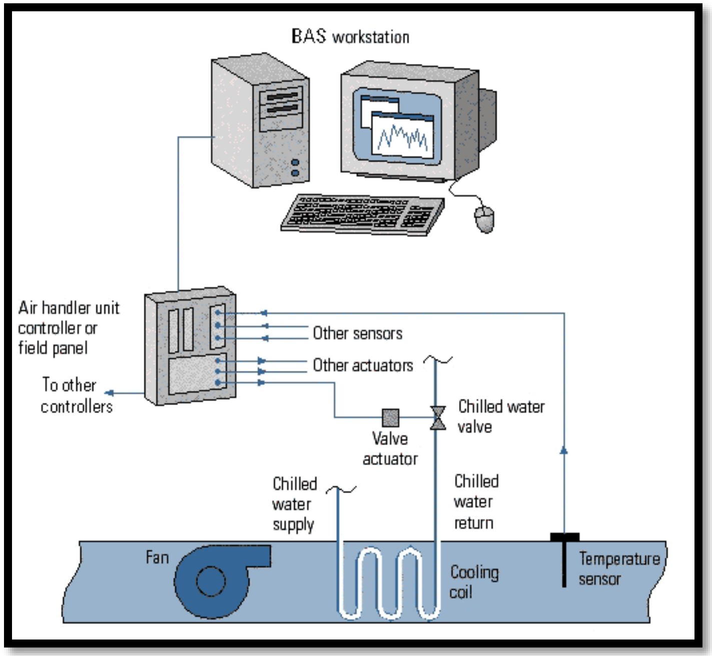
Pneumatic control panel at Lindbergh Elementary

ECM #1: Building Management System (continued)

- A building management system (BMS) is a computerized electronic controls system that could replace the existing pneumatic system. Each HVAC unit is connected to the main computer on site. This computer allows the user to program each units time of day schedule (on/off operation), occupied and unoccupied temperature setpoints for the entire year.
  - Depending on the level of complexity, it can monitor and control many other features such as boiler and pump operation, lighting and CO2 levels.
  - This allows the user to easily monitor and reduce energy usage directly from the computer.

- The BMS electronic controls will drastically increase controllability and easily allow the user to turn off units that previously couldn't be turned off.
  - Other hidden savings not included in this analysis are the elimination of compressed air leaks that typically plague old pneumatic systems.

- The annual BMS savings in the previous slide represents the sum of ECMs 1.1, 1.2, 1.3 and 1.4, all of which will be operated by the BMS.
  - Note: ECM 1.3 & 1.4 can be implemented without the BMS, which is described in each slide.



Example of a BMS

ECM #1.1: Time of Day and Setpoint Optimization

	High School	Lindbergh	TOTAL
Estimated Annual Savings:	$17,480	$17,120	**$34,600**
Gross Estimated Implementation Cost:	$207,805	$161,250	**$369,055**
NJ Smart Start Rebate:	$0	$0	**$0**
Net Estimated Implementation Cost:	$207,805	$161,250	**$369,055**
Simple Payback (years):	11.9	9.4	**10.7**
Annual Avoided CO_2 Emissions (tons):	68	63	**131**

- Dome-Tech recommends first attempting to utilize the pneumatic ‘Night’ controls to setback the space temperatures when the areas are unoccupied since a substantial portion of the savings would be realized at no cost.
  - However, the existing pneumatic system has not been utilized in approximately 15 years and some pneumatic controls may need to be replaced and/or calibrated.
  - Also, maintenance staff would need to be present before and after occupancy to manually operate the controls due to varying zone occupancy throughout the day.
- To fully optimize the building HVAC system and realize the entire savings, Dome-Tech recommends installing a BMS. The user could preprogram each individual unit’s time of day schedule and setpoint for the entire year as well as modify them if occupancy changes.
  - This would eliminate the ‘all or nothing’ operation and allow an entire zone to shut down with the exception of any individually selected room within that zone.

ECM #1.2: Holiday Time of Day Optimization

	High School	Lindbergh	TOTAL
Estimated Annual Savings:	$1,230	$1,210	**$2,440**
Gross Estimated Implementation Cost:	$1,270	$1,270	**$2,540**
NJ Smart Start Rebate:	$0	$0	**$0**
Net Estimated Implementation Cost:	$1,270	$1,270	**$2,540**
Simple Payback (years):	1.0	1.0	**1.0**
Annual Avoided CO_2 Emissions (tons):	4	4	**4**

- Currently, Lindbergh and the High School utilize their HVAC equipment to fully condition the air in the building during school holidays when the building is not occupied. This unnecessarily increases HVAC conditioning and electrical costs.

- Dome-Tech recommends first attempting to utilize the manual pneumatic ‘night’ switch to put the building into unoccupied mode. However, if implementing the building management system ECM then it is recommended to program the holiday schedules into the BMS. The user could preprogram the holidays into the system, ensuring the systems will automatically turn to unoccupied mode.

- The implementation cost above represents the labor hours for a controls technician to program the holiday schedules.

ECM #1.3: Optimize Exhaust Fan Time of Day Schedules

High School	
Estimated Annual Savings:	**$4,005**
Gross Estimated Implementation Cost:	**$2,715**
NJ Smart Start Rebate:	**$0**
Net Estimated Implementation Cost:	**$2,715**
Simple Payback (years):	**0.7**
Annual Avoided CO_2 Emissions (tons):	**15**

- Approximately 24 exhaust fans in the High School are controlled by a manual on/off switch that is left on 24/7.
- Operating these fans during unoccupied building hours unnecessarily increases motor electrical consumption as well as increases conditioning costs due to the fans exhausting already conditioned air from the building.
- Dome-Tech recommends installing a 7-Day time clock to turn off the exhaust fans during building unoccupied hours, similar to the time clocks that control the exhaust fans at Lindbergh Elementary. The cost above represents material and labor costs associated with installing the time clocks.
- If the building management system ECM is implemented, it is recommended that the time of day schedules be programmed into and controlled by the BMS.

Exhaust fan manual switches left on 24/7

ECM #1.4: Optimize and Standardize the Space Temperature Setpoints

	High School	Lindbergh	Charles Smith	Total
Estimated Annual Savings:	$835	$240	$1,580	**$2,655**
Gross Estimated Implementation Cost:	$0	$0	$110	**$110**
NJ Smart Start Rebate:	$0	$0	$0	**$0**
Net Estimated Implementation Cost:	$0	$0	$110	**$110**
Simple Payback (years):	0.0	0.0	0.1	**0.1**
Annual Avoided CO_2 Emissions (tons):	2	1	5	**8**

- A review of the local digital thermostats controlling the rooftops units (RTU) revealed limited or no unoccupied setback temperatures.
  - Many of the unoccupied setpoints are heating and/or cooling their zone to the same setting when the building is occupied.
  - Setting back the temperatures when the zone is unoccupied will reduce heating and cooling costs and have no impact on comfort during occupied building hours.
- Dome-Tech recommends the following:
- 1) Setting back the unoccupied heating and cooling setpoints at the digital thermostat to 60°F and 80°F, respectively.
  - For units that do not operate on the weekend, Dome-Tech recommends programming the unoccupied setpoints for the entire weekend.
- 2) Adjusting the occupied cooling setpoints at the digital thermostat to 74°F (the cooling setpoints are currently set between 70°F and 73°F.
  - The current occupied heating setpoints are at an acceptable level (range between 68°F and 70°F).
- It is also recommended to install protective covers over the digital thermostats that do not have covers to ensure students and staff do not adjust the setpoints (implementation cost represented above).

ECM #2: Optimize Unit Heater Temperature Setpoints

Charles Smith	
Estimated Annual Savings:	**$220**
Gross Estimated Implementation Cost:	**$0**
NJ Smart Start Rebate:	**$0**
Net Estimated Implementation Cost:	**$0**
Simple Payback (years):	**0.0**
Annual Avoided CO_2 Emissions (tons):	**1**

- In Charles Smith Elementary, a hot water unit heater is located near the boiler make-up air unit with a temperature setpoint of 74°F. Any time the make-up air unit operates it blows cold air at the unit heater causing it to going into heating mode.
- Dome-Tech recommends turning off the unit heater or lowering the setpoint down to approximately 50°F so that it cycles on less often.
- The radiant heat from the boilers should provide sufficient heat to the room.
- Also, it was noticed that in other areas of the basement some unit heaters had setpoints as low a 50°F and the space temperature was comfortable. This indicates that that space temperature should be comfortable with the unit heater off in the boiler room.

Unit Heater at Charles Smith that cycles on excessively

ECM #3: Kitchen Cooling Counter Time of Day Optimization

Charles Smith	
Estimated Annual Savings:	**$430**
Gross Estimated Implementation Cost:	**$0**
NJ Smart Start Rebate:	**$0**
Net Estimated Implementation Cost:	**$0**
Simple Payback (years):	**0.0**
Annual Avoided CO_2 Emissions (tons):	**2**

- Dome-Tech observed the cooling unit for the kitchen server counter remained on during building unoccupied hours.
  - Turning the cooling unit off when it's not in use will reduce electrical energy consumption.
- Dome-Tech recommends asking the staff to turn off the unit at the completion of the last lunch period to reduce its operating cost. They can then turn it back on in the morning.
- To ensure that they are diligent about manually turning off the unit they could perform a daily walk through at the end of the day to ensure they are turning off/unplugging all equipment that can be turned off (i.e. food display heaters and milk cases that do not have any contents inside).

Kitchen cooling counter left on during building unoccupied hours

ECM #4: Upgrade Door Weather Stripping

	High School	Lindbergh	Charles Smith	TOTAL
Estimated Annual Savings:	$410	$480	$210	**$1,100**
Gross Estimated Implementation Cost:	$470	$470	$320	**$1,260**
NJ Smart Start Rebate:	$0	$0	$0	**$0**
Net Estimated Implementation Cost:	$470	$470	$320	**$1,260**
Simple Payback (years):	1.1	1.0	1.5	**1.2**
Annual Avoided CO_2 Emissions (tons):	2	2	1	**5**

- Missing or degraded weather stripping was present on many exterior doors at each school.
- These doors allow outside air to infiltrate the building, increasing heating and cooling conditioning costs.
- Dome-Tech recommends installing new weather stripping on all exterior doors that allow outside air to enter the space.
- The approximate number of doors identified with air leakage are:
  - High School & Lindbergh: 10, Charles Smith: 5

Close up of an exterior door with no weather stripping in a science room at Lindbergh Elementary School

Dome-Tech, Inc.

ECM #5: Vending Machine Power Management

	High School	Lindbergh	Total
Estimated Annual Savings:	$800	$745	**$1,545**
Gross Estimated Implementation Cost:	$1,000	$1,000	**$2,000**
NJ Smart Start Rebate:	$0	$0	**$0**
Net Estimated Implementation Cost:	$1,000	$1,000	**$2,000**
Simple Payback (years):	1.3	1.3	**1.3**
Annual Avoided CO_2 Emissions (tons):	2	2	**4**

- Dome-Tech recommends installing a vending machine power management device on all vending machines.

- This 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 #6: Replace Existing Motors with Premium Efficiency

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	High School	Lindbergh	Total
Estimated Annual Savings:	$330	$190	**$520**
Gross Estimated Implementation Cost:	$2,540	$2,030	**$4,570**
NJ Smart Start Rebate:	$320	$270	**$590**
Avoided Cost (Like and Kind Replacement): [1]	$1,600	$1,200	**$2,800**
Estimated Incremental Implementation Cost:	$620	$560	**$1,180**
Simple Payback (years): *(Incremental and without Avoided Costs)*	1.9 (6.7)	2.9 (9.3)	**2.3 (7.7)**
Annual Avoided CO_2 Emissions (tons):	1	.4	**1.4**

[1] The cost Palisades Park BOE would incur if replacing existing equipment with equivalent standard efficiency equipment.

- Dome-Tech identified several standard efficiency motors in Lindbergh and the High School.
  - These motors consume more power than their equivalent premium efficiency motors.
- The standard efficiency motors identified are listed below:
  - High School: Two (2) 7.5HP motors on the gym air handlers and two (2) 7.5HP motors on the hot water pumps.
  - Lindbergh: Two (2) 7.5HP motors and two (2) 3HP motors on the hot water pumps.
- Dome-Tech recommends replacing the regularly operated standard efficiency motors with new premium efficiency motors.
- NJ Smart Start rebates are available for this ECM.

ECM #7: Winterize Window Air Conditioning Units

	High School	Lindbergh	Total
Estimated Annual Savings:	$285	$220	**$505**
Gross Estimated Implementation Cost:	$1,020	$390	**$1,410**
NJ Smart Start Rebate:	$0	$0	**$0**
Net Estimated Implementation Cost:	$1,020	$390	**$1,410**
Simple Payback (years):	3.6	1.8	**2.8**
Annual Avoided CO_2 Emissions (tons):	1	1	**2**

- A number of schools have window air conditioning units in windows and through-the-wall installations. The units are left in place uncovered year round, which allows outside air to enter the space during the winter, increasing heating costs.
- Window units should be covered with insulated fitted covers when not in use and uncovered for the cooling season.
- Also, it is recommended that any gaps between the walls and window ACs be sealed up to reduce outside air infiltration. This will further reduce conditioning costs (see picture to the right).
- There were approximately 8 and 21 window air conditioners located at Lindbergh and the High School, respectively.

Window AC with outside air leakage in the library at the High School

ECM #8: Install Insulation on Condensate Return Tanks

	High School	Lindbergh	Total
Estimated Annual Savings:	$290	$250	**$540**
Gross Estimated Implementation Cost:	$950	$920	**$1,870**
NJ Smart Start Rebate:	$0	$0	**$0**
Net Estimated Implementation Cost:	$950	$920	**$1,870**
Simple Payback (years):	3.3	3.7	**3.5**
Annual Avoided CO_2 Emissions (tons):	1	1	**2**

- The condensate return tank at the High School and Lindbergh are not insulated.
- Insulating the tank reduces heat loss due to convection and radiation.
- Furthermore, reducing radiant heat losses will reduce boiler natural gas consumption due to higher temperature condensate returning to the boiler.

Uninsulated condensate return tank in Lindbergh Elementary School

ECM #9: VFD Controls on Kitchen Exhaust

	High School	Lindbergh	Charles Smith	Total
Estimated Annual Savings:	$470	$290	$320	**$1,080**
Gross Estimated Implementation Cost:	$2,930	$2,460	$2,460	**$7,850**
NJ Smart Start Rebate:	$900	$775	$775	**$2,450**
Net Estimated Implementation Cost:	$2,030	$1,685	$1,685	**$5,400**
Simple Payback (years):	4.3	5.8	5.1	**5.0**
Annual Avoided CO_2 Emissions (tons):	1	1	1	**3**

- The kitchen exhaust fans currently operate fully loaded during all kitchen hours regardless of actual temperature and exhaust demand.
- Placing variable frequency drives controlled by temperature and opacity (smoke) sensors will reduce fan speeds according to actual exhaust demand.
- Thus, the VFD’s will significantly reduce exhaust fan and make up air conditioning energy usage.
- Note: Dome-Tech recommends checking local fire/building codes prior to implementation.

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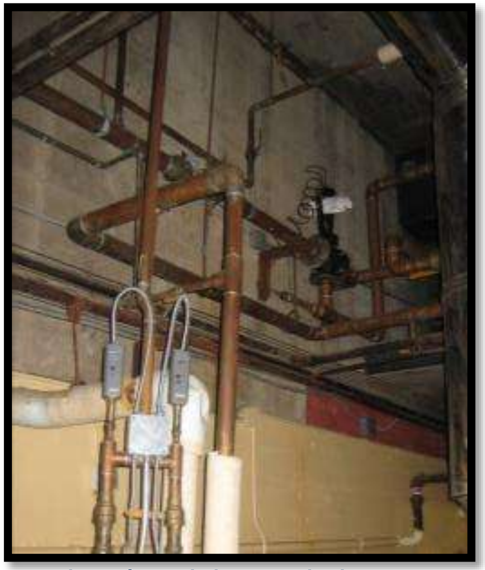
ECM #10: Insulate Hot Water Pipes

	High School	Lindbergh	Total
Estimated Annual Savings:	$340	$110	**$450**
Gross Estimated Implementation Cost:	$2,200	$1,225	**$3,425**
NJ Smart Start Rebate:	$0	$0	**$0**
Net Estimated Implementation Cost:	$2,200	$1,225	**$3,425**
Simple Payback (years):	6.5	11.1	**7.6**
Annual Avoided CO_2 Emissions (tons):	2	1	**3**

- The domestic hot water and condensate return pipes at the High School and Lindbergh are not insulated.
- Insulating the hot water pipes reduces heat loss due to convection and radiation.
- Furthermore, reducing radiant heat losses will reduce boiler and domestic water heater natural gas consumption.



Un-insulated domestic hot water pipes at Lindbergh

ECM #11: Walk-In Cooler Controllers

	High School	Lindbergh	Charles Smith	Total
Estimated Annual Savings:	$140	$50	$110	**$300**
Gross Estimated Implementation Cost:	$760	$680	$920	**$2,360**
NJ Smart Start Rebate:	$0	$0	$0	**$0**
Net Estimated Implementation Cost:	$760	$680	$920	**$2,360**
Simple Payback (years):	5.4	13.6	8.4	**7.9**
Annual Avoided CO_2 Emissions (tons):	0	0	0	**0**

- Typically the walk-in cooler evaporator fans run continuously. However, full airflow is only required approximately 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 electrical energy consumption of the fan. In addition, the motor produces less heat at slower speeds, which means that the compressor has less heat to remove from the refrigerated compartment.

ECM #12: Lighting Upgrade

	High School	Lindbergh	Charles Smith	Total
Estimated Annual Savings:	$14,750	$12,960	$8,190	**$35,900**
Gross Estimated Implementation Cost:	$107,670	$111,800	$66,980	**$286,450**
NJ Smart Start Rebate:	$1,130	$1,520	$630	**$3,280**
Net Estimated Implementation Cost:	$106,540	$110,280	$66,350	**$283,170**
Simple Payback (years):	7.2	8.5	8.1	**7.9**
Annual Avoided CO_2 Emissions (tons):	30	27	17	**74**

- Most of the building utilizes standard T-8 fluorescent lamps. There are currently higher efficiency T-8 fluorescent lamps and ballasts available. The upgraded light fixtures will reduce electrical consumption and cost while maintaining the minimum lighting output as per state codes.

- Many areas such as bathrooms 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.

ECM # 13: Install Univent Variable Frequency Drives (VFDs) on Blower Fans

	High School	Lindbergh	Charles Smith	Total
Estimated Annual Savings:	$1,555	$3,170	$880	**$5,605**
Gross Estimated Implementation Cost:	$15,750	$23,100	$8,750	**$47,600**
NJ Smart Start Rebate:	$0	$0	$0	**$0**
Net Estimated Implementation Cost:	$15,750	$23,100	$8,750	**$47,600**
Simple Payback (years):	10.1	7.3	9.9	**8.5**
Annual Avoided CO_2 Emissions (tons):	3	7	2	**12**

- The unit ventilators serving each classroom at Charles Smith, Lindbergh and the High School utilize fractional horsepower (1/6 – 1/4 HP) motors that operate at constant volume.
- Dome-Tech recommends installing fractional horsepower VFDs on all classroom unit ventilator.
  - The VFDs will operate as a stand alone device at the unit ventilator and can be installed with the existing pneumatics.
  - The VFDs will modulate the motor speed based on the return air temperature. During mild conditions the VFDs will reduce the speed of the motors, which yields electrical energy savings.
- Savings calculation assumed:
  - VFD installed on 136 units (sum of all three schools) at $350/unit (equipment and labor).

ECM #14: Rooftop Unit Replacement

Palisades Park High School	
Estimated Annual Energy Cost Savings:	**$420**
Gross Estimated Implementation Costs:	**$6,745**
NJ Smart Start Rebate:	**$370**
Estimated Incremental Implementation Cost:	**$6,375**
Estimated Simple Payback (years):	**15.2**
Annual Avoided CO2 Emissions (tons):	**1**

- The High School utilizes a 4 ton cooling only rooftop units (RTU) that is approximately 30 years old. The unit is well passed its 15 year estimated end of equipment service life (EESL) per ASHRAE guidelines.
  - Maintenance staff indicated that they perform typical maintenance on the unit yearly, such as refilling the system with refrigerant.
  - Maintenance costs are not included in the savings.
- Replacing this RTU with a new higher efficiency unit will reduce annual energy and maintenance costs.
- New Jersey SmartStart offers rebates that pay for some of the incremental cost to upgrade to higher efficient units.

Seasonal Energy Efficiency Ratios[1]

School	Unit Capacity (tons)	Existing SEER[2]	Proposed SEER
High School	4	9.7	14.0

[1]Seasonal energy-efficiency ratio (SEER) describes the seasonally adjusted efficiency rating - cooling output (Btu) divided by the electrical energy input (watts). The higher the SEER, the more efficient the unit.

[2] ASHRAE 90.1-1989 Referenced for existing SEER (9.7).

ECM #15: Upgrade / Replace Window AC Units

	High School	Lindbergh	Total
Estimated Annual Savings:	$330	$40	**$370**
Gross Estimated Implementation Cost:	$9,570	$660	**$10,230**
NJ Smart Start Rebate:	$0	$0	**$0**
Net Estimated Implementation Cost:	$9,570	$660	**$10,230**
Simple Payback (years):	29.0	16.5	**27.7**
Annual Avoided CO_2 Emissions (tons):	1	0	**1**

- Window air conditioning units at Lindbergh and the High School provide localized cooling for offices and other small areas.
- Approximately 10 units in the High School and 1 unit at Lindbergh are in fair/average physical condition, yet inefficient compared to today's standards.
  - The one unit at Lindbergh is approximately 30 years old and many of the units in the high school have a 9.0 EER.
- Dome-Tech recommends replacing these units with new higher efficiency units. New 10.8 SEER (Seasonal Energy Efficiency Rating) units are estimated to be at least 14% more energy efficient at full and part loads than the existing equipment.

30 year old unit at Lindbergh

ECM #16: Replace Boilers with High Efficiency Boilers

- The High School is equipped with two natural gas fire tube steam boilers. Lindbergh Elementary School is equipped with two natural gas cast iron sectional steam boilers.
- The boilers at the High School are 43 years old and past the ASHRAE service life of 25 years. The boilers at Lindbergh are 25 years old and approaching its ASHRAE service life of 30 years.
- The age and boiler system configuration does not lend itself to an efficient operation. They produce steam (which is not used at either facility) and then convert it to hot water through a heater exchanger.
- Also, as boilers approach the end of their service life, the efficiency degrades and the boiler must consume more fuel in order to produce the same rated output. In addition, there is a direct correlation between risk of equipment failure (tube breaks & meltdown, shell cracks, furnace surface area failure) and equipment age.
- Dome-Tech recommends replacing the existing steam boilers with hot water condensing modular boilers, which are utilized at Charles Smith Elementary School.
  - Natural gas consumption would be reduced due to increasing combustion efficiency from an estimated 80% up to 88%.
- While replacement of the existing steam boilers will be cost extensive, the building heating distribution system is already fitted with hot water piping, which would not need to be replaced.

ECM #16: Replace Boilers with High Efficiency Boilers (continued)

- The high first cost of a new boiler system may preclude this ECM from being justified by economics alone. However, reliability issues warrant consideration of these projects as part of a long-term capital improvement plan. The ECM table details the economics at each site:

Building	High School	Lindbergh	TOTAL
Estimated Annual Savings:	$11,340	$6,510	**$17,850**
Gross Estimated Implementation Cost:	$536,090	$405,190	**$941,280**
NJ Smart Start Rebate:	$20,920	$13,260	**$34,180**
Avoided Cost (Like and Kind Replacement): [1]	$226,930	$137,000	**$363,930**
Estimated Incremental Implementation Cost:	$228,240	$254,930	**$543,170**
Estimated Simple Payback (years): *(Incremental and without Avoided Costs)*	25.4(45.4)	39.2(60.2)	**30.4 (50.8)**
Annual Avoided CO_2 Emissions (tons):	74	89	**163**

[1] The cost Palisades Park BOE would incur if replacing existing equipment with equivalent standard efficiency equipment, pro-rated by equipment life and ASHRAE expected service life .

.

Lindbergh Steam Boiler

High School Steam Boilers

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: 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.

Palisades Park 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 Palisades Park area is 6.2 meters per second. Ideal wind speeds for a successful project should average over 6 meters per second.

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

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

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

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

Renewable Energy Technologies: Wind

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

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	$35,858	$28,735	$82,384
Net Installation Cost Estimate	$94,142	$33,665	$167,616
Annual Energy Savings	$1,860	$1,491	$13,009
Simple Payback	50.6 yrs.	22.6 yrs.	12.9 yrs.
System Capacity	20 kW	10 kW	50 kW
Annual Avoided Energy Use	11,206 kWh	8,980 kWh	78,369 kWh
Annual CO2 Emmisions, Therms	4	3	27
% of Annual Electric Use*	1.6%	1.3%	11.5%
Palisades Park High School: 683836 kWh/Year.			

Wind Turbine Pros & Cons

Pros	Cons
➢Annual reduction in energy spend and use can be potentially reduced by almost $13,000 (80% reduction). ➢Typical equipment life span is 15-30 years. ➢Reduction of annual greenhouse gas emissions by 27 tons per year. ➢A wind turbine project could be incorporated into science and other curriculums to raise student awareness of energy alternatives. ➢High visible “green” project.	➢Payback period is significant (over 10 years). ➢Average area wind speed is not ideal and impacts performance. ➢Prone to lighting strikes. ➢Bird collisions are likely, but may be reduced with avian guard (building integrate only). ➢Zoning may be an issue. Check with local zoning regulations. ➢Wind turbines do create noise, although below 50 dB (a typical car ride is over 80 dB).

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

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.

Solar Photovoltaic Systems

Install Roof Mount Solar Photovoltaic System(s)	
Palisades Park Board of Education - Palisades Park High School	
Assumptions	
System Capacity, kw-dc (maximum utilization of roof space)	145 kw dc
Estimated Annual AC Energy Produced by Proposed Solar PV System	153,064 kwh
Total Annual Facility Electric Use, kwhrs	683,836 kwh
Proposed % of Total Annual kWh supplied by Solar PV	22%
All-In Rate for Electric Year 1	$0.166 / kwh
Year 1 Electric Cost Savings	$25,409
Year 1 Maintenance Costs	$2,904
Estimated Year 1 SREC Value:	$640 / SREC
Estimated Year 1 SREC Revenue:	$97,910
Actual Payback	**8.0 years**
IRR (25 Years)	**10.3%**
Net Present Value (25 yrs, 8% discount rate)	**$138,399**
Cost and Rebate / Tax Incentives	
Cost per kW installed	$6,000
System Installed Cost (does not include value of tax credits)	$871,332

Solar Photovoltaic Systems

Install Roof Mount Solar Photovoltaic System(s)	
Palisades Park Board of Education - Lindbergh Elem. School	
Assumptions	
System Capacity, kw-dc (maximum utilization of roof space)	98 kw dc
Estimated Annual AC Energy Produced by Proposed Solar PV System	103,004 kwh
Total Annual Facility Electric Use, kwhrs	570,709 kwh
Proposed % of Total Annual kWh supplied by Solar PV	18%
All-In Rate for Electric Year 1	$0.154 / kwh
Year 1 Electric Cost Savings	$15,863
Year 1 Maintenance Costs	$1,955
Estimated Year 1 SREC Value:	$640 / SREC
Estimated Year 1 SREC Revenue:	$65,889
Actual Payback	**8.2 years**
IRR (25 Years)	**9.9%**
Net Present Value (25 yrs, 8% discount rate)	**$75,128**
Cost and Rebate / Tax Incentives	
Cost per kW installed	$6,000
System Installed Cost (does not include value of tax credits)	$586,362

Solar Photovoltaic Systems

Install Roof Mount Solar Photovoltaic System(s)	
Palisades Park Board of Education - Charles Smith School	
Assumptions	
System Capacity, kw-dc (maximum utilization of roof space)	31 kw dc
Estimated Annual AC Energy Produced by Proposed Solar PV System	32,921 kwh
Total Annual Facility Electric Use, kwhrs	256,880 kwh
Proposed % of Total Annual kWh supplied by Solar PV	13%
All-In Rate for Electric Year 1	$0.170 / kwh
Year 1 Electric Cost Savings	$5,582
Year 1 Maintenance Costs	$625
Estimated Year 1 SREC Value:	$640 / SREC
Estimated Year 1 SREC Revenue:	$21,058
Actual Payback	**6.6 years**
IRR (25 Years)	**13.4%**
Net Present Value (25 yrs, 8% discount rate)	**$60,396**
Cost and Rebate / Tax Incentives	
Cost per kW installed	$6,000
System Installed Cost (does not include value of tax credits)	$156,170

Solar Photo Voltaic System

Non-Financial Benefits of Solar PV

- The implementation of solar PV projects at Palisades Park 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.

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 facilites with year-round thermal and/or cooling loads.
- ***Not recommended for Palisades Park schools due to the lack of thermal requirements in the summertime.***

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Retail Energy Purchasing: Recommendations

Electric

- For the period studied, Palisades Park BOE was not utilizing a Third Party Supplier for the supply of electricity.
- Dome-Tech recommends Palisades Park BOE to establish a 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. Typical savings are in the 10-15% range. This could represent an annual savings of $24,500 - $36,800 for the BOE's electric accounts.

Natural Gas

- For the period studied, the Palisades Park BOE was not utilizing a Third Party Supplier for the supply of natural gas.
- If the BOE is seeking budget certainty or would like to reduce their market exposure for Natural Gas, the District should consider entering into a contract for retail supplier or joining a purchasing co-operative and developing a procurement strategy.

Retail Energy Purchasing: Recommendations and Resources

- **Electric**
  - Based on current and recent market conditions, and actual bid processes run by Dome-Tech for various clients, we have seen customers with BGS-FP accounts save approximately 10-15% in projected energy costs by switching to retail energy supplier. It is important to note that actual rates and potential savings will be dependent on several factors, including market conditions, account usage characteristics/load profile (load factor), volume, and contract term.

- **Natural Gas**
  - Based on current and recent market conditions, and actual bid processes run by Dome-Tech clients, we have seen many customers entering into longer-term contracts for fixed natural gas rates. These rates vary substantially based on load type, volume, and term.

- **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.

- To determine whether a savings opportunity currently exists for your District or for guidance on how to get started, you may contact Dome-Tech to discuss. There is also additional information provided below.

Utility Tariff and Rate Review: Electricity

- **Accounts and Rate Class:** Palisades Park BOE has three facilities with five 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 BOE is about $245,000 and the total annual consumption is about 1,511,000 kilowatt-hours (kWh).

- **Average/Effective Rate per kWh:** For the one year period studied, the BOE's average monthly cost per kilowatt-hour ranged from 15.42 ¢/kWh to 31.04 ¢/kWh, inclusive of utility delivery charges. The BOE's overall, average cost per kilowatt-hour during this period was 16.24 ¢/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:** Palisades Park BOE has three facilities with six 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 BOE is about $170,000 and the total annual consumption is about 149,000 therms (th). Natural gas is used predominantly throughout the winter period for heating purposes.

- **Average/Effective Rate per Therm:** For the one year period studied, the BOE's overall, average cost per therm during this period was $1.141 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 (cont.)

- 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 (cont.)

- **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 Purchasing:

- 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	spragueenergy.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 $145,000 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 services 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)

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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. There is a $50,000 incentive cap on each project. The 100 kW peak demand threshold has been waived for local government entities who receive and utilize their Energy Efficiency and Conservation Block Grant in conjunction with Direct Install.
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

- **<u>The following projects should be considered for implementation:</u>**

  - All ECMs with a 5 year payback or less
  - Lighting upgrades
  - Energy Procurement (Electricity & Gas)
  - Start Energy Awareness Program
  - Install Building Management System
  - Boiler Replacements

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

  - **<u>Consider applying for Pay-For-Performance Program</u>**

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.
- Some ECM's proposed in this report are mutually exclusive (e.g. Building Management Systems). ECM savings are not cumulative.
- Interactive effects between ECM's have not been accounted for in all cases.
- 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
Lindbergh School	$0.154	$1.134
Charles Smith School	$0.170	$1.140
Palisades Park High School	$0.166	$1.146