THE GREEN COMMUNITIES STUDY COMMITTEE REPORT
July 22, 2011

1. INTRODUCTION

Massachusetts is not an energy-producing state. As a result, virtually all of the energy spending by residents and businesses in the Commonwealth leaves the region, providing little or no local economic benefit. Massachusetts imported $22 billion of energy in 2008, representing a net outflow of $5,000 per household. Increasing energy efficiency and developing local sources of renewable energy will retain more of those dollars here, generating jobs and net economic benefit.

To advance those goals, the Green Communities Act of 2008 established far-reaching changes in how Massachusetts gets and uses energy. Combined with actions of the Massachusetts Department of Public Utilities, it established a business and economic environment that promotes the use of renewable energy and allows energy efficiency to compete with the generation of new energy to cost-effectively meet our energy needs.

These changes have so far resulted in:

- An initial three-year State-wide energy efficiency program that will invest $2 billion in energy efficiency upgrades and deliver $6 billion of savings to customers.
- Doubling of employment in energy efficiency services since 2007.
- A twenty-fold increase in Solar PV installation.
- Quadrupling of the number of solar installation firms and doubling of employment in solar manufacturing and installation.

The Legislature and the Administration recognized in drafting and implementing the Green Communities Act that a significant proportion of energy use is in municipalities. The Green Communities program aims to unlock the potential benefits of these changes for municipalities by providing targets, support, and incentives to municipalities to reduce energy use, increase renewable energy, and grow the Massachusetts green economy.

The Green Communities Division of the Commonwealth's Department of Energy Resources oversees the program's implementation. The Division has made clear that the program, and the Division's role in implementing it, is neither punitive nor regulatory. The aim is to help communities set and achieve the program's goals through support, collaboration and incentives.

The Green Communities Division is funded by statute to a maximum of $10 million per year. The funding, which is not subject to further appropriation, is largely derived from the proceeds of the RGGI (Regional Greenhouse Gas Initiative) auctions of emission allowances. This regional cap and trade system to reduce pollution from electricity generation has been in operation since the fall of 2008, generating almost $136 million to support Massachusetts energy efficiency programs.

2. REQUIREMENTS OF BECOMING A GREEN COMMUNITY AND HOW NEEDHAM MIGHT MEET THEM

2.1 Adopt local zoning bylaw or ordinance that allows as-of-right siting of renewable and/or alternative energy R & D facilities, manufacturing facilities or generation units.

Needham's Solution: Needham has zoning in place in the New England Business Center that would allow renewable and other alternative energy research.

2.2 Adopt an expedited application and permitting process that would allow whichever as-of-right siting the town adopts to complete the permitting process within one year.

Needham's Solution: Needham has taken and continues to take steps to expedite the permitting process. With the changes that have been made we believe the Town can meet this requirement.

2.3 Green Communities must establish an energy baseline from no earlier than 2008 for municipal buildings, vehicles and street lighting and traffic signals. An energy baseline is a measurement of the amount of energy that was consumed by the Town in the base year. From the baseline, a plan must be developed to reduce energy use by 20% within five (5) years. The sources of 15% of the 20% have to be clearly described. Some buildings have already been renovated, and while there are no guarantees, representatives from the State have indicated that they will likely accept the inclusion of energy improvements in those buildings as part of the reduction plan. If conditions prevent full implementation of the plan or the plan does not result in the desired savings, the Town's existing base grants are not jeopardized. However depending on the reason that a plan was not implemented, the Town's Green Communities designation might be re-evaluated.

Needham's Solution: Town Meeting approved funds for an energy efficiency upgrade study. We believe that we can meet this requirement with consideration of some past work. The Town has been assured that past work (such as the geothermal heating and cooling system at PSAB) will be included in the 20% reduction requirement.

2.4 Adopt a plan to purchase fuel efficient vehicles when they are available and practicable. The standards for each type of vehicle are only in effect if there are at least two commercially available models that meet the standard. Examples of what vehicles must have in a combined city and highway MPG rating include the following:

2 wheel drive car	29 MPG
4 wheel drive car	24 MPG
4 wheel drive small pick-up truck	19 MPG
4 wheel drive sport utility vehicle	18 MPG
4 wheel drive standard pickup truck	16 MPG

Heavy duty vehicles with a weight rating of 8,500 pounds or more, such as busses, fire-trucks, ambulances and dump trucks are exempt. Police cruisers are exempt until fuel efficient cruisers that meet law enforcement needs become commercially available. Hybrids are not required.

Needham's Solution: Needham already includes fuel efficiency in its purchase standards. We believe that the adoption of a policy to meet this standard will not be a detriment to the Town.

2.5 Minimize lifecycle energy costs.

Needham's Solution: This requirement can be met by the adoption of the energy-saving building "stretch code" which will be examined in detail in a later section.

3. BENEFITS OF JOINING THE GREEN COMMUNITIES PROGRAM

While there are never guarantees, Green Communities are eligible for an initial cash grant to fund energy-saving projects in the community. The amount is determined by a formula which includes:

- A $125,000 minimum base grant with additional funds based on per capita income and population.
- Additional funds for communities who meet the as-of-right requirement by enabling renewable energy generation.
- A cap of $1,000,000 - based on Needham's population and per capita income, a Green Communities Program representative estimated that Needham's grant would be in the range of $150,000.
- According to the program representative, sufficient funds are available to cover all towns that join the program over the next few years.

All 53 Green Communities have received an initial grant, for example:

Acton	$150,794	for energy conservation measures at the public library, an HVAC analysis of town hall, tankless hot water heaters and an energy education and outreach program
Andover	$160,329	for a municipal lighting retrofit project
Arlington	$200,188	to improve energy efficiency of lighting and steam traps, and for an energy management system at the Hardy School
Dedham	$179,800	toward a 128.5 kW Solar PV system at the Dedham High School as part of an energy savings performance contract
Hopkinton	$137,502	for various municipal building energy efficiency measures
Lexington	$158,083	to buy down the cost of a solar PV project for multiple municipal buildings
Lincoln	$140,294	for school and other town building energy efficiency measures
Natick	$173,526	for a solar PV power purchase agreement at the middle school, for the incremental cost of hybrid vehicles, and for carbon dioxide sensors at town hall

The State plans to establish a competitive program for additional grants to Green Communities who have successfully completed the projects funded with the initial grants. Programs aimed at helping communities meet the requirements to become a Green Community, but available to all Massachusetts communities, have so far included making energy management software available at no cost to municipalities, and providing education to local code officials and building professionals on the stretch code. Additionally, Green Communities are given preference for access to and funding from innovative energy-related programs. Examples include a pilot program for electric vehicle recharging stations in 2010, and a planned program to provide streamlined installation and funding for residential solar PV by consolidating multiple interested residents into a single acquisition.

4. STRETCH ENERGY CODE SUMMARY

What is the Stretch Energy Code?

The Stretch Energy Code was developed in response to the call for improved building energy efficiency in Massachusetts and has been adopted by many communities as part of their decision to join the growing list of towns that have qualified as "Green Communities". It offers a streamlined and cost-effective route to achieving approximately 20% better energy efficiency than the base building code. The recommended way for towns to meet this requirement is by adopting the Mass. Board of Building Regulations and Standard's Stretch Code (BBRS), an appendix (Appendix 120.AA) to the 7th edition of the MA State Building Code 780 CMR.

Who is Impacted?

The stretch code applies to all residential buildings, new construction as well as additions and renovations, and to new commercial/municipal buildings or new additions to existing commercial/municipal buildings over 5,000 sf.

Who is not impacted?

- Residential renovations that do not impact the building envelope (e.g. an external wall or the roof).
- Renovations to existing commercial/municipal buildings and specialized facilities with unusual energy use requirements such as supermarkets, laboratories, and warehouses up to 40,000 sf.
- Commercial/municipal buildings under 5,000 sf.

What are the Stretch Code Requirements for Residential Buildings?

All new homes require a performance-based code approach. Renovations and additions to existing homes may choose between a performance-based code approach or a prescriptive code approach as outlined below:

<u>Performance-based Code Approach for Residential Buildings</u>

New home construction requires a Home Energy Rating System (HERS) index score*, performed by a certified HERS rater**, as follows:

- HERS index of 65 or less - New homes above 3,000 sf.
- HERS index of 70 or less - New homes below 3,000 sf (includes multi-family buildings of 3 stories or less).
- HERS index of 80 or less - Major renovations to homes above 2,000 sf.
- HERS index of 85 or less - Major renovations to homes below 2,000 sf. This typically includes exterior building envelope additions or changes.

* A HERS index of 65 indicates that the home is estimated to use 65% as much energy as the same size and type of home built according to the standards of the 2006 Mass. energy code (which has a HERS index of 100), or a 35% annual energy savings.

** HERS raters work with the residential building/developer/design team, and should be included in the team from the outset. HERS ratings require testing of the air leakage rate of residential units and help builders to identify possible problems before a home is completed. HERS raters are typically experienced building professionals who take a training course in residential energy efficiency, learn how to use the HERS software, are required to pass a certification test, and keep their certification through continuous code education. Costs for HERS ratings currently range from $600-$1,200 and may be subsidized by the utility-sponsored Energy Star for Homes program.

Prescriptive-based Code Approach for Residential Buildings

All renovations and additions may use a prescriptive approach where specific efficiency measures are required in lieu of a HERS index number. This utilizes the Energy Star for Homes prescriptive requirements, and insulation equal to IECC 2009 for climate zone 5.

What are the Stretch Code Requirements for Commercial/Municipal Buildings?

All large commercial/municipal buildings over 100,000 sf require a performance-based code approach. New commercial buildings or additions between 5,000 and 100,000 sf have the option of meeting a performance-based code approach or a prescriptive code approach as outlined below:

Performance-based Code Approach for Commercial/Municipal Buildings

All large commercial/municipal buildings over 100,000 sf require a performance-based code approach set at 20% below the energy usage in the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) 901 2007 code, demonstrated through computer modeling by methods and software approved by BBRS.

Prescriptive-based Code Approach for Commercial/Municipal Buildings

New commercial buildings or additions between 5,000 and 100,000 sf have the option of meeting a performance-based code approach or a prescriptive code approach as an alternative to Chapter 13 in the current Energy Code 780 CMR. The prescriptive code is based on Chapter 5 of the IECC 2009 Energy Code.

5. STRETCH ENERGY CODE - HOW IT WILL IMPACT NEEDHAM

The Stretch Energy Code will benefit Needham and its residents in the following ways:

- Reduce energy consumption and utility costs for residents, businesses and the town.
- Reduce emissions of Greenhouse gases.
- Reduce reliance on imported energy sources (economic and national security implications).
- Require higher standards of quality in the building construction industry.
- Level the playing field in home construction by ensuring high quality energy efficient construction. Contractors who already provide high quality, energy efficient construction will no longer be at a competitive disadvantage.
- HERS raters can lower the enforcement burden on the Town's Building Department by providing an independent, certified review of the construction as it relates to the energy code.
- The stretch Energy Code will have minimal impact on municipal building construction and costs as most Town projects already meet or exceed the Stretch Code requirements.

- Adoption of the Stretch Code / Green Communities will make Needham eligible for state funding ($100,000 - $200,000) for additional energy efficiency projects in the Town.

Adoption of the Stretch Energy Code brings with it some limited burdens, including:

Needham Inspectional Services
Enforcement of the Stretch Energy code will increase the regulatory enforcement workload on the Town's Building Department. The Town Manager and her staff are currently calculating what will be the cost to the Building Department for enforcement.

Utilize Independent HERS Certifiers
The burden on the Inspectional Services (above) can be offset partially by requiring that builders/owners utilize the services of certified HERS inspectors. However, the mandatory use of HERS inspectors is subject to challenge by builders/owners when required by the local government, but not where mandated in the stretch code or in some other way by the state.

Increased Construction Costs for Residential Buildings-New Homes - Major Renovations
It is anticipated that the average cost to a homebuilder/owner will increase by 2 - 4%. Some of these costs may be reduced by rebates from the local utility company.

Increased Construction Costs for Residential Buildings - Minor Renovations
It is anticipated that the average cost to a homebuilder/owner will increase by 0-$500, depending on how much of the building "envelope" is affected. Some of these costs may be reduced by rebates from the local utility company.

Increased Construction Costs for Commercial
It is anticipated that the average cost will increase by no more than 2%. Some of these costs may be reduced by rebates from the local utility company.

Municipal Buildings
The cost for Needham’s municipal buildings is not expected to increase since the Town is already incorporating green building designs and is likely to be already meeting the requirements of the stretch code.

Scheduling Delays
Builders who are unaware of the Stretch Code requirements could experience delays when trying to obtain permits or inspection approvals. It is important that the Town provide information to the builders about Stretch Code enforcement when they obtain building permits so as to avoid costly delays or unanticipated construction costs near the end of a project.

Professional Services
Design professionals (architects/engineers) are affected as well. They must ensure that their designs comply with Stretch Code requirements. The cost of professional services may increase slightly until the stretch code requirements become a routine part of their professional practice.

6. NEEDHAM'S PROCESS FOR BECOMING A GREEN COMMUNITY

- The Green Communities Study Committee will complete its fact finding and determine whether to recommend the Stretch Code to the Board of Selectmen. IF Yes then:
- The Board of Selectmen will receive the report, discuss as a Board, hold a hearing and do any other necessary fact finding before deciding whether to bring to Town Meeting. If Yes then:
- The November Town Meeting will decide whether to approve the Stretch Code.
- Regardless of the above: The Town Manager and staff will, with the aid of an approved consultant, develop a plan for the buildings to further reduce energy usage. (An RFP has been issued and a contract will be awarded shortly).
- A plan to further increase fuel efficiency of Town vehicles will be adopted by the Town including the Schools.
- If needed, Town Counsel will issue letters certifying that the required as of right siting is in compliance and that the permitting process can meet the one year requirement.
- If all of the above occurs, then Needham will apply to be a Green Community and will likely be accepted.

7. RECOMMENDATIONS

The Green Communities Study voted to approve the following recommendations:

- That the Needham Board of Selectmen and Town Meeting should vote to adopt the stretch energy code.

- That the Town should join the Green Communities Program provided that:

  a. The Selectmen and Town Meeting adopt the Stretch Code;
  b. The Town can develop a viable plan to lower energy usage in its buildings by 20% or some lesser amount acceptable to the Green Communities Program.

8. EXHIBITS

1. Information about residential energy savings related to adoption of the Stretch Energy Code
2. Stretch Energy Code Case Studies: Approximate additional construction costs
3. Building Permit Activity calendar year 2010 – Major Categories
4. Information about energy and recent green design aspects of municipal building

GREEN COMMUNITIES STUDY COMMITTEE MEMBERS

Joe Carroll	Michael Greis	Steve Popper
Romeo D'Agostino	Susan McGarvey	Ed Quinlan
Bill Dermody	Michael McKay	Dan Walsh
Robert Ernst	Jeanne McKnight	Jerry Wasserman
Natasha Espada	Gary McNeill	Rick Zimbone

EXHIBIT 1

RESIDENTIAL ENERGY SAVINGS

Adding energy saving provisions to building codes began with the energy shortages in the 1970's. Each iteration of the code, up to and including the stretch energy code, has specified a greater level of energy savings. Reducing air leakage, increasing insulation, improving windows and specifying higher efficiency heating & cooling systems all contribute to reducing the energy use of homes and saving money for homeowners.

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Achieving those savings is highly dependent on how the work is done. Small air gaps caused by faulty installation of insulation can reduce its R-value by 50%. The stretch energy code is the first to address those issues through performance testing (HERS rating) and/or checklists (using the prescriptive approach).that ensures that homeowners will actually get the energy savings that energy codes are intended to produce. The net result delivers about a 30% reduction in energy costs.

For homeowners doing renovation in a town like Needham, the benefit of that performance guarantee is magnified. Since two-thirds of the homes in Needham are over 50 years old, homeowners will likely capture energy savings greater than 30% when doing a significant renovation.

Energy use depends on house size, style and construction. It is also significantly affected by behavioral considerations – thermostat settings, differing perceptions of comfort, life style, and occupancy patterns. So it is challenging to provide a single base figure from which to calculate the value of the savings.

The US Energy Information Agency provides a starting point with survey data compiled in 2005 on total energy consumption in US households. At that time, energy expenditures in New England were estimated at $0.98 per square foot, and energy use was estimated at 52.3 thousand BTU's per square foot. Data on the actual cost of energy in New England is available up to 2009, and shows about a 24% increase from the 2004-05 period represented in the EIA surveys. Using a conservative 4% inflation factor to bring that to the present provides a 2011 estimate of **$1.34 per square foot for household energy expenditures**. That represents **$3,350 a year for a 2,500 square foot house** or **$4,020 a year for a 3,000 square foot house**.

Using those estimates**, a 30% savings** (corresponding to a HERS rating of 70) **would represent $1,005 per year** for the owner of a 2,500 square foot house. For homes 3,000 square feet and larger, the HERS target is 65, representing at **35% savings,** or a savings of **$1,407 per year.** Over 10 years, assuming that energy costs rise 4% a year, the owner of the 2,500 square foot house would save **$12,066** and the owner of the 3,000 square foot house would save **$16,893**.

EXHIBIT 2

Case 800 sq. ft. Addition Energy Budgets 4/26/11

	Building Envelope Improvement	Approximate Additional Construction Costs: Lumber Material Cost	Adhesives, Fillers and foam, Etc. Material Costs	Insulation SubcontractorMaterial & Labor Cost	Framing Cost (approx.)	Other Costs	Incremental Cost over Baseline Fiberglass	Incremental Cost over Baseline Foam	Incremental Cost over Baseline Hybrid
Wall	2x6 wall w/fiberglass r-19 **baseline**	$ -	$ -	$ -	$ -	$ -	n/a	n/a	n/a
	2x6 wall w/fiberglass r-19 and technique **for stretch ACH**	$ 50.00	$ 100.00	$ 450.00	$ 350.00		$ 950.00		$ 950.00
	2x6 wall w/open cell spray foam			$ 3,200.00				$ 3,200.00	
							$ -	$ -	$ -
Roof	2x10 roof w/fiberglass (R-38) **baseline**	$ -	Incl . Above	$ -	$ -	$ -	n/a	n/a	n/a
	2x10 roof w/fiberglass (R-38) and technique **for stretch ACH**	$ 75.00	$ 85.00	$ 350.00	$ 250.00		$ 760.00		
	2x10 roof w/open cell spray foam		$ -	$ 2,500.00				$ 2,500.00	$ 2,500.00
	HERS RATER						$ 800.00	$ 800.00	$ 800.00
	Additional administration and supervision					$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00
	Contractors O and P						$ 601.50	$ 1,200.00	$ 862.50
							$ -	$ -	$ -
							$ 4,611.50	$ 9,200.00	$ 6,612.50
							2.3%	4.6%	3.3%

Case 2600 sq. ft. House Energy Budgets 4/26/11

	Building Envelope Improvement	Approximate Additional Construction Costs: Lumber Material Cost	Adhesives, Fillers and foam, Etc. Material Costs	Insulation SubcontractorMaterial & Labor Cost	Framing Cost (approx.)	Other Costs	Incremental Cost over Baseline Fiberglass	Incremental Cost over Baseline Foam	Incremental Cost over Baseline Hybrid
Wall	2x6 wall w/fiberglass r-19 **baseline**	$ -	$ -	$ -	$ -	$ -	n/a	n/a	n/a
	2x6 wall w/fiberglass r-19 and technique **for stretch ACH**	$ 100.00	$ 500.00	$ 1,100.00	$ 2,500.00		$ 4,200.00		$ 4,200.00
	2x6 wall w/open cell spray foam			$ 8,200.00				$ 8,200.00	
							$ -	$ -	$ -
Roof	2x10 roof w/fiberglass (R-38) **baseline**	$ -	Incl . Above	$ -	$ -	$ -	n/a	n/a	n/a
	2x10 roof w/fiberglass (R-38) and technique **for stretch ACH**	$ 75.00	$ 500.00	$ 950.00	$ 1,500.00		$ 3,025.00		
	2x10 roof w/open cell spray foam		$ -	$ 7,350.00				$ 7,350.00	$ 7,350.00
	HERS RATER					$ 1,100.00	$ 1,100.00	$ 1,100.00	$ 1,100.00
	Equipment upgrades HVAC					$ 3,500.00	$ 3,500.00	$ 3,500.00	$ 3,500.00
	Additional administration and supervision					$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 2,250.00
	Contractors O and P						$ 1,998.75	$ 3,247.50	$ 2,760.00
							$ 15,323.75	$ 24,897.50	$ 21,160.00
							2.9%	4.8%	4.1%

EXHIBIT 3

Building Permit Activity Calendar Year 2010 - Major Categories

Type of Permit	Number of Permits	HERS Requirement 65 for 3000sq. ft. or more	HERS Requirement 70 for less than 3000sq. ft.	Prescriptive Option	Registered Professional Commercial Property
New residential one and two family dwelling permits	80	72	6		
Amendments to one and two family dwelling permits^	89	89			
Residential one and two family dwelling addition permits *	185	2	183	185	
Residential one and two family dwelling alteration permits**	369			317	
Percent of Projects Requiring HERS Rating	**12.62%**				
New construction commercial permits	7				7
Commercial addition permits	7				7
Commercial alteration permits	73				

Notes

^ These amendments are to the 80 original permits and are considered one project

* Project may use ether HERS or prescriptive option

** 317 of the permits are estimated to require compliance with the prescriptive path - 52 permits were issued for fewer than 10 square feet

EXHIBIT 4

High Rock School

This schools design was extensively modeled in 2008 with results identified in the attachment. Comparison to base cost was not available however modeling predicted usage in the order of 415,000 kWh and 15,300 therms ($1.71/sf) which is tracking at approximately 81% and 74% respectively to actual usage during the period of March ’10 thru Feb ’11 with an annual cost of $2.14/sf for this 62,000sf facility.

I have also included a summary of energy saving design elements that were considered and those included in the actual design. The cost for the modeling was $15,000 by an independent consultant.

Needham Public Library

Data from the designer indicated roughly 50% in gas consumption savings and 40% electricity savings from “base” case under the 2001 energy code.
Savings largely due to high efficiency boilers, energy recovery unit (ERU) included in HVAC system, and certain administrative assumptions (opening windows) made during shoulder seasons on running of A/C. This facility is operating 6-7 days/week from 9AM to 9PM M-Th.

Actual FY 2010 energy consumption tracked fairly closely with reported consumption expectations of 449,000kWh (vs. 602,000 kWh actual) and 11,570 therms (vs. 8,973 therms actual) and $2.80/sf actual cost vs. $2.33/sf expected cost for this 48,000sf facility. Detailed back-up is not available.

EXECUTIVE SUMMARY

DiNisco Designers Partnership secured the services of Andelman and Lelek Engineering, Inc. to perform services related to computer building energy consumption simulation to evaluate several energy conservation measures (ECMs) considered for the New High Rock School in Needham, MA. The main objective of the study was to estimate the impact these measures may have on reducing the building annual energy use and cost. An eQUEST energy consumption model of the *as designed* building that was created in the course of a "companion study" of the overall future annual energy consumption of the building[1] was used to estimate energy savings for each measure.

The evaluated measures, along with a brief description are listed below. The annual energy savings summary is provided in Table 1 below.

ECM #1 – Glazing upgrade option 1 – this measure would upgrade currently specified glass for the windows to 1½" Heat Mirror Quad glass. This glass consists of two main glass panes and two layers of Heat Mirror low-e suspended film.

ECM #2 - Glazing upgrade option 2 – this measure would upgrade currently specified glass to 1½" Heat Mirror glass. This glass consists of two main glass panes and one layer of Heat Mirror low-e suspended film.

ECM #3 – Increase of roof insulation – this measure would provide additional 1½" of roof insulation.

ECM #4 – Increase of wall insulation – this measure would add 1½" of sprayed-in insulation between metal studs for all new construction walls.

Table 1 - Energy Intensity Comparison

% difference is defined as: (Energy cost for Actual Design- Energy cost for Option)/Energy cost for Actual Design

Option	Energy consumption					Energy savings					
	Electricity	Gas	Cost-Electr.	Cost-Gas	Cost-Total	Electricity		Gas		Total Savings	% below
	kWh	therm	$	$	$	kWh	$	therm	$	$	design
Actual Design	414,105	15,307	$84,422	$ 21,491	105,913						
Option 1: Glazing 2 layers of Heat Mirror	409,954	15,178	$83,187	$ 21,308	104,495	4,151	$ 1,235	129	$183	$ 1,418	1.34%
Option 2: Glazing 1 layer of Heat Mirror	412,487	15174	$84,143	$ 21,304	105,447	1,618	$ 279	133	$187	$ 466	0.44%
Option 3: Increase Roof Insulation	413,406	15036	$84,413	$ 21,117	105,530	699	$ 9	270	$374	$ 383	0.36%
Option 4:Increase Wall Insulation	414,701	15168	$84,600	$ 21,298	105,898	(596)	$ (178)	139	$193	$ 15	0.01%

More information on the proposed measures is provided in the *Evaluated Energy Conservation Measures* section of this report on page 6. For information on the facility description and the analysis methodology please refer to the subsequent sections of this report. Supplemental information, including selected energy model output reports is provided in the *Appendix* section.

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[1] That study was undertaken to help the town assess their future operating costs of the subject school building based on its current design and current utility rates. The draft report for that study was dated April 22nd, 2008. The report was titled *Energy Performance Report.*

Potential Energy Upgrades
Needham High Rock
13 May 2008

DiNisco Design Partnership Limited
architects and planners
87 Summer Street Boston, MA 02110

Item	Benefits	Estimated Construction Cost	Estimated Design Fee	Comments
Glazing Upgrade #1 Upgrade glazing to 1 1/2" "double" Heat Mirror (U=0.16) (Quad Glazing)	• Reduced Energy Costs • Increased comfort	$215,000	TBD	• Save $1,418 / Year • 152 Year Payback
Glazing Upgrade #2 Upgrade glazing to 1 1/2" Heat Mirror (U=0.21) (Triple Glazing)	• Reduced Energy Costs • Increased comfort	$125,000	TBD	• Save $466 / Year • 268 Year Payback
Increase Roof Insulation Add additional 1.5" of insulation	• Reduced Energy Costs	$75,000 - $125,000	TBD	• Save 383 / Year • 196 Year Payback
Increase Wall Insulation Add 2" spray-in insulation in metal stud backup wall at new construction	• Reduced Energy Costs	$35,000	TBD	• Save $193 / Year • 181 Year Payback

06494.0 CorConsEnrgyModel/!!FinalReport/06494.0 PotentialEnergyUpgrades.xls

ORIGINAL

EXECUTIVE SUMMARY

DiNisco Designers Patnership secured the services of Andelman and Lelek Engineering, Inc. to perform services related to computer building energy consumption simulation to evaluate energy performance of the New High Rock School in Needham, MA. The main objective of the study was to create an eQUEST model of the *as designed* building and to estimate the future annual energy consumption of the building. This task was undertaken to help the town assess their future operating costs of the subject school building based on its current design and current utility rates.

The analysis indicates that the annual energy consumption of the *as designed* school building will amount to approximately $105,913 per year. Please see *Note 1* below for additional qualification of these results. More detailed breakdown of the estimated energy use of the building is provided below:

Electricity consumption	414,105 kWh/year
Natural gas consumption	15,307 therm/year
Cost of electricity	$84,422 /year
Cost of gas	$21,491 /year

When presented on "per square foot" bases the annual values amount to the following based on the building area of 62,000 sf.:

Electricity consumption	6.68 kWh/ft^2 per year
Natural gas consumption	0.25 therm/ ft^2 per year
Cost of electricity	$1.36 /ft^2 per year
Cost of gas	$0.35 /ft^2 per year
Total energy cost	$1.71/ ft^2 per year

The breakdown of the energy cost by the building end use, as determined using the *as designed* building model, is shown at the end of this section. Monthly electric and natural gas use profiles are also provided. Additional information on the energy use breakdown by the building end use and by the fuel type (electricity and natural gas) is shown in Figure 6 and 7 in the *Appendix* section. Copies of several eQUEST output reports are also included in the *Appendix*.

For information on the facility description, the analysis methodology, and the design features that were incorporated into the current building design and that contribute to energy conservation please refer to the subsequent sections of this report. Supplemental information is provided in the *Appendix* section.

Note 1:
It should be understood that while the energy modeling can be used with high level of confidence to estimate the relative savings values (difference between "baseline" and "as designed" models) the absolute energy estimates depend heavily on certain assumptions that are mode during modeling process that can have a very significantly impact on the total estimated energy use. Such factors include:

1. Schedules of building operation. This factor alone can make the margin of error very high. For example, during the modeling process we may be advised that most of the building will not be used in the evening or during the summer break. However, as the building starts to operate the town may decide to increase the spaces utilization (building is new, pleasant, well conditioned, etc so it is used more than originally expected for after school or community programs). This could easily result in the energy consumption increase by 30% or more as compared to the original estimates.

2. The model also assumes that the building operates "as design". That is so often not a case, especially during the final stages of construction, or building start up; when systems are left on over night, are not properly controlled, etc. Sometimes building systems do not operate "as designed" even after the construction is presumably 100% complete and the building is turned over to the owner.
3. Not all energy consuming devices may be included in the building model. This especially applies to small and irregular loads that are not a part of the building "typical" operation. For example the model developed for this study does not account for the operation of the school emergency generator.
4. There are also other items that have impact on the energy use and may be difficult to estimate precisely. For example air infiltration (depends heavily on the overall quality of construction, may also be impacted by open windows, etc). The air infiltration that the building will eventually experience may be higher or lower that the values assumed in the model.

We typically suggest that for budgeting purposes of future utility costs the estimated "as designed" energy consumption (or costs) is multiplied by a factor of 1.25 to 1.5. This should give some "wiggle room" within the energy cost budget and also allow for energy cost increases (utility rates increase) between now and the time when the building is turned over to the owner.

HIGH ROCK SCHOOL

09 July 2007
Rev 11 March 2008

Needham, MA

"GREEN DESIGN" FEATURES INCORPORATED INTO THE HIGH ROCK DESIGN

- Overall, project is approximately 25% more energy effective than "code".
- Site is centrally located and near public transportation.
- School facilities and recreation fields jointly used by the community and school.
- No development within flood plans.
- Building footprint has been minimized through construction of a multi story addition "bridging" the existing administrative wing.
- All of the existing building area is being reused - no demolition.
- Construction waste will be managed and recycled.
- Indoor air quality for occupants will be protected during construction (Cover ductwork during construction, "air out" period before occupancy) and by pre-occupancy indoor air quality testing.
- Innovative storm water management through use of water quality swales.
- Water conservation through use of low flush/duel flush toilets and waterless urinals.
- High efficiency condensing (90%) boilers, variable air volume boxes and motors are part of HVAC system.
- HVAC controls will include tie in to lighting occupancy controls, providing low-cost "demand ventilation".
- Multiple HVAC zones allow unoccupied portions of building to be shut down during off hour use and the summer.
- Highly efficient lighting design incorporates daylighting (including sunscreens and light shelves on south facing windows) Hi-efficiency T5 lamps, occupancy and daylighting controls, all of which will reduce lighting loads by more than 35% of code requirements (0.94 watts/SF as designed vs. 1.5 watts/SF per code).
- Thermally broken aluminum windows with hi-performance Low E glass "tuned" to each solar exposure. Operable windows provided in all classrooms. Windows in south exposure are shaded with an integral sunscreen.
- Acoustic Ceilings in classrooms with high NRC (Noise Reduction Co-efficient), and the ability to provide "assisted listening" via the LCD projector sound system in each classroom.

"GREEN" ELEMENTS NOT INCLUDED AT THIS TIME DUE TO "VALUE ENGINEERING"

- Specific overall recycled content requirements for new materials.
- Highly renewable materials (bamboo, linoleum).
- Highly reflective roofing (town standard built-up roofing system not highly reflective).
- Specific overall low V.O.C. requirements for construction materials (other than paint).