

# Smart Energy Audit: Library

Ramapo Energy Project

*A Project of Ramapo College of New Jersey  
and the New Jersey Board of Public Utilities*



# Library Basics

- **Libraries are a good place to save energy, money and reduce negative impacts on the environment.**
  - They require extensive lighting for good visibility.
  - They often have large open floor plans which require a lot of energy to keep at controlled temperatures.
  - Computers are becoming abundant in libraries because they provide information quickly and easily. Computers use substantial amounts of electricity, but options exist to reduce and manage the energy they use.
  - There are libraries located in every municipality across the country. Even small changes could produce huge results on a national level.

# Building Basics

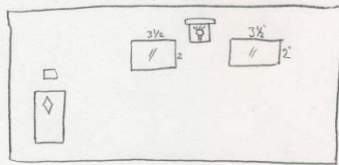
- Building built in approx. 1966
- Two-story building with basement
- 5600 sq. ft., with 2800 sq. ft. roof
- Yearly energy Consumption:
  - Electricity: 57,440 kWh per year
  - Natural Gas: 2078.8 therms

# Building Basics

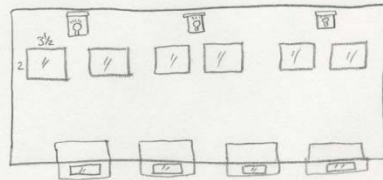
- Front of building/main door face approx. SE
- Hours of Operation:
  - Monday –Thursday: 10 AM – 9 PM
  - Friday: 10 AM – 5PM
  - Sat: 10 AM -2 PM
  - Sunday: Closed
- *The building is closed on Saturdays during July and August*
- *Maintenance personnel use building M – F, 7 – 10 AM*

# Façade Sketches

North View of Building:  
North East



East View of Building:  
Northwest



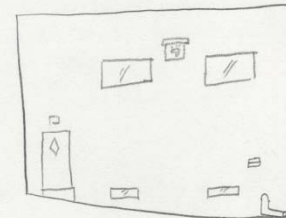
South View of Building (Pay particular attention to potential south facing roof space, tilt angle, shading, type of roofing, uninterrupted space on walls, places for attached sunspace or GH):

South East



West View of Building:

South West



# More on the South Face/Entrance...

- The main entrance has a large overhang that protects from rain and snow, but also shades the entry door from the sun through most of the year.
- The building has a vestibule, but the inside door is always left open because it is heavy, and it is more difficult for patrons to open two doors.  
***Installing a lighter-weight inner door with weather-stripping will allow the inner door to be closed and the vestibule to provide energy savings.***
- Windows on the SE and SW side are not shaded, and library staff complained that the rooms on those sides were too warm (uncomfortable) when the sun was out. These windows have potential for energy savings through shading.
- SE windows also have white vertical shades on the inside. If they were more reflective on one side, they might better reflect the heat gain in the summer, but they probably work to some degree now.

# The Roof

- 2800 sq. ft. roof is flat,, with rolled tar roofing
- 2 natural gas/electric Carrier HVAC units on the roof, and a roof ventilation fan.
- Uninsulated Bilco steel door entry to the roof , but with weather-stripping.



# The Roof

- Entire roof has good access to the sun. The Carrier units are on the NW side of the roof.
- There is a maple tree on the SE side, but it will be many years before it will shade the roof at all.



# HVAC Info

- The downstairs floor has a roof-mounted Carrier natural gas HVAC unit with an electric input around 12,000 watts. It supplies both heating and cooling.
- The upstairs floor has a roof-mounted Carrier natural gas HVAC unit with an electric input about 13,200 watts. It supplies both heating and cooling.
- Ventilation fan on roof. It likely connects to all bathrooms (one upstairs and three downstairs).

# HVAC Info

- 30 gallon electric hot water heater connects to bathrooms and kitchen. Model #: 81D30DB. The upper and lower resistance heaters are both 4500 watts. The hot and cold pipes that come out of the top of the water heater do not have insulation for the first few feet.
- The tank is not wrapped.



# HVAC Info

- Hot and cold air are distributed through air handling ductwork from the Carrier units on the roof. The ductwork is wrapped with insulation.
- Both HVAC units are controlled by programmable thermostats. There is a separate thermostat for each floor.



# Building Envelope

- Windows appeared to be in good condition. They were replaced in 1999. The weather stripping was also in good condition. Windows were double glazed with steel framing. Larger windows were of the double hung type. Smaller windows up and downstairs in the rear and side of the building were hinged to open inward from the top.
- There appeared to be no insulation in the walls. Concrete block with brick facing had a thin strip board mounted on the inside block and was covered with sheetrock. The ceiling was a suspended drop ceiling with white fiberglass panels. The roof has approximately 1-1 ½ inches of a brown fibrous material (presumably with some insulating ability but not much) underneath the tar roofing.
- Because of the brick exterior, the sealed tar roof and the relatively new windows, infiltration is likely to come from only a few places. One large source consists of two vents through the brick wall above the upper floor ceiling on the two sides of the building.



# Lighting



Type of Light		Operating Hours
2 incandescent	100 W	On and off depending on use
4 fluorescent fixtures w/2 bulbs each	40 W	Lunch Hour
15 fluorescent fixtures w/2 bulbs each	40 W	On and off all day
95 fluorescent fixtures w/2 u-shaped bulbs each	34 W	On all day
1 fluorescent fixture with 2 bulbs	34 W	Light was off at the time
1 fluorescent fixture with 2 bulbs (short lights)		Light was off at the time
3 fluorescent fixtures w/2 bulbs each	34 W	Lights were on at the time
3 lights (not sure what type)		On all day
4 square lights		On all day
3 high pressure sodium lights	70W	On motion sensors
2 small fluorescent lights		On when being used
5 high pressure sodium lights	70 W	On timer at night

# Appliances/Electronics

Appliance		Hours of Operation
Gas Stove (Hotpoint)		Hardly ever used
Fridge/Freezer (Hotpoint) Model #: HTR15BBMBRWW Approx 15 cubic ft.	780 W	Continuously on Temp set to 7.5 out of 9 options
Sharp Microwave	108 W	Used for lunch daily
Sony Clock Radio Model #: ICF-CD513 Dream Machine		
Emerson T.V.	90 W	Not plugged in
Clock radio	8 W	
Large T.V.		Used for approx. 1 hour per week
3 water chillers	444 W	
1 typewriter		
2 bathroom fans		Fan goes on when the light is turned on
12 computers		On all day
7 printers		On all day
1 fax machine 1 <sup>st</sup> Office		On all day
1 scanner 2 <sup>nd</sup> Office		On all day
2 electric typewriters		On all day
1 copy machine		On all day
1 microfilm reader	180 W	Once every 3 months
1 electric dumbwaiter		Used frequently
Fire door alarms		Run off of a battery
2 routers		On all day
7 exit signs		Turn on when lights go off

# Audit Results – Likely Energy Savings!

## *Thermostats*

- The programmable thermostats should be set during the heating season to drop to 60 degrees F when the library is closed, and to 68 degrees F during hours of operation.
- In warm weather, the thermostat should be set to 78 degrees F during library occupied hours. HVAC units should be set to go on about 2 hours before the library opens, and to go off an hour before it closes. These times can be adjusted if needed.
- Compared to a constant 72 degrees (current operation), the above action can save around 8-10% of the heating and cooling energy.
- This is a no-cost option since the programmable thermostats are already installed.

# Audit Results – Likely Energy Savings!

## *Insulation*

- A major problem for the building is that ***it has in essence no insulation***. The walls have sheetrock over a one-inch furring strip. If the walls are ever replaced, 2" x 4" studs can be added with foam insulation. However, the walls are presently in good condition so this is not an immediate recommendation. The roof has only has a one and a half inch brown fibrous material under the rolled tar roof, with minimal insulation value. ***The bulk of the heating and cooling energy used for the building is lost through the roof.***
- Foamed-in-place insulation could likely be installed under the roof, with considerable energy savings for both heating and cooling. We suggest getting contractor estimates of costs and savings for this action.
- The Bilco roof-access door also should be foamed with insulation.
- The contractor should also decide whether the vent openings in the walls above the ceiling should be sealed at this same time. Because of air gaps around light fixtures and ceiling tiles, warm air (or cool air in summer) from the building can easily escape through these vents.
- If the roof is foamed, the old Carrier HVAC units can be replaced with much smaller units -- perhaps both old units can be replaced with just one new efficient unit to supply heating and cooling to both upstairs and downstairs.

# Audit Results – Likely Energy Savings!

## *Lighting*

- The lighting in the room older than the rest of the 2-inch U tube lighting in could also be more



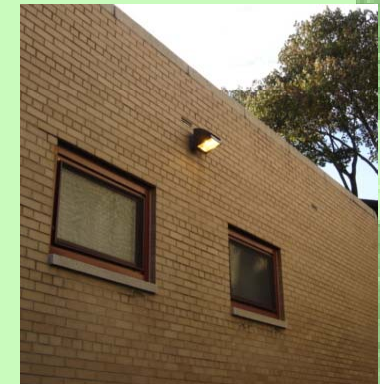
outside the kitchen is much lighting in the building. The the rest of the building efficient if replaced by

T8 or T5 fluorescent lights.

- We suggest getting an estimate from a lighting contractor that would include:

- measuring existing foot candle levels on working surfaces to see if intensities could be lowered somewhat, and
- providing estimates of cost and payback times for replacing existing fixtures with T8 and/or T5 fluorescent bulbs.

- Outside lighting can be put on a light sensor control rather than a timer, and the most efficient bulbs can be installed.
- Inefficient lighting not only increases power usage, but the waste heat generated increases air conditioning loads in the warmer weather. This usually makes lighting upgrades a smart choice for energy upgrades.



# Audit Results – Likely Energy Savings!

## *Electric Hot Water Heater*

- The electric hot water heater can be put on a timer to provide service only during the library's hours of operation (provide a two hour lead time to make sure it's hot when the library opens).
- The hot and cold pipes on the tank should be insulated. The electric tank should be wrapped with additional insulation.
- Thermostat setting should be no higher than 120 degrees F.
- Insulation savings for tank and pipes should be about 10%. Timer will provide additional savings. These are relatively low-cost one-time actions.



# Audit Results – Likely Energy Savings!

## *Exit Signs*

- The exit signs should be replaced with LED lights and fixtures.
- Typical paybacks for this are 1-2 years depending on whether you are currently using incandescent or fluorescent lights.

- EPA Fact Sheet:

[http://www.energystar.gov/ia/business/small\\_business/LED\\_exit\\_sign\\_tech.doc](http://www.energystar.gov/ia/business/small_business/LED_exit_sign_tech.doc)



# Audit Results – Likely Energy Savings!

## *Computers*

- Computers should be shut down fully when the library is closed. This can simply be done by putting them on power strips which are turned off when the library closes.
- To reduce power use, computers can also be put in a “sleep” mode when not in use. Simple options in the computer’s Control Panel activate this feature.
- Isolated printers can be put on a separate power strip and turned on only when used.
- Computers not only consume electricity, but they also increase the air conditioning loads in warm weather. Thus, savings are substantial when computer power reduced.



# Audit Results – Likely Energy Savings!

## *Refrigerator/Freezer*

- The refrigerator is likely on too high a setting.
- Also, based on its size (15 cubic feet) and wattage (760 watts), it is an inefficient model, and should likely be replaced at the first opportunity with an Energy Star rated refrigerator.



# Audit Results – Likely Energy Savings!

## *Shade Awnings for Southeast Windows*

- For the offices on the southeast side of the building, you could consider adding a shade awning that would reduce most of the excess solar gain through the windows during the warm part of the season. An extension of two or three feet would not interfere with sunlight and solar gains in the cooler weather.



# Audit Results – Likely Energy Savings!

## *Roof*

- The existing tar roof is in good condition. If that were to be replaced sometime in the future, you might consider adding insulation to the top of the existing roof, and then covering it with the new roof.
- At that time other options could be considered, including adding PV on top of the new roof or adding a white reflecting material that would reduce heat gain from the sun during the warm weather.



# Audit Results – Likely Energy Savings!

## *Photovoltaics*

- The flat roof has good solar access, and photovoltaic solar panels for electricity could be installed on part of the roof, either in flat configuration or in a tilted configuration. However, most other recommendations in this list should be implemented before this one since their payback times are likely to be a lot shorter.
- The roof has good solar access for solar hot water. However, given the minimal use of hot water in the library, this is not recommended at the present time.
- ***A detailed PV analysis follows...***



# Audit Results – Likely Energy Savings!

## PV Analysis -- Site Information:

Site Inspection: December 2007

Roof Pitch: Flat

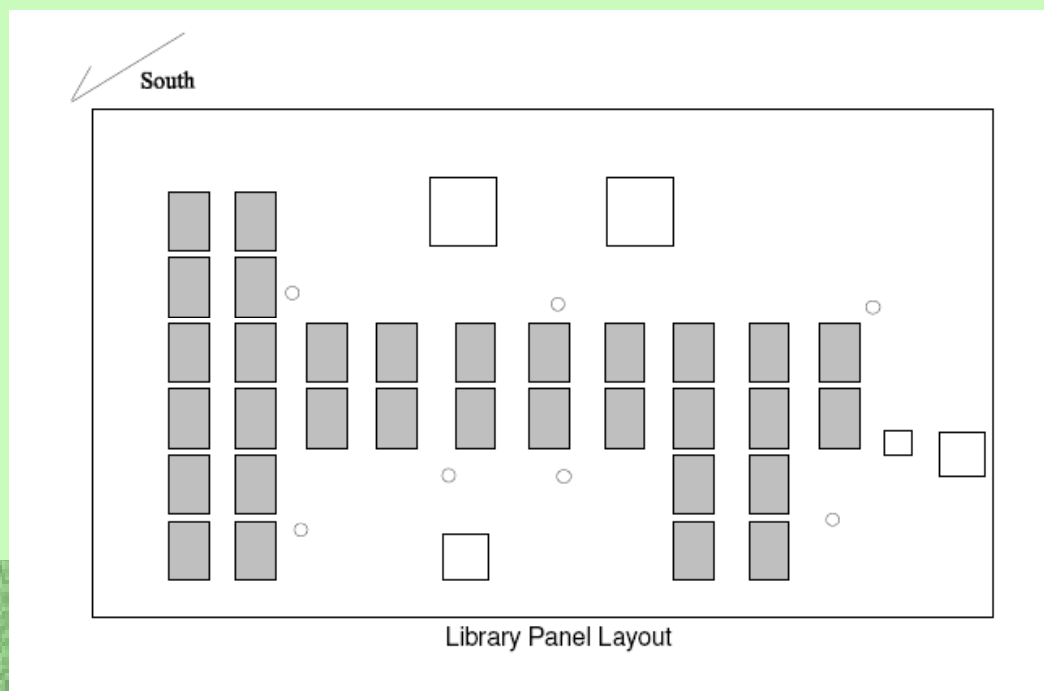
Roof Obstacles: various

Array Shading Analysis: With the array shape as designed, shading will be at a minimum

Usable Array Size: About 650 sq. ft.

Array Direction: South West

## Library Panel Layout



# Audit Results – Likely Energy Savings!

## PV Analysis -- Proposed System Information

Panel Recommendation:

Sanyo 205 watt panels: Width: 36", Height: 52"

System Size/Configuration:

- 10 degree tilt
- mounting system:
- no penetrations into roof
- 32 panels, totaling 6560 watts (205 watts \* 32 panels)
- panels in landscape mode
- low profile rack with ballast
- assumes roof can handle up to 10 lbs per sq. foot

Estimated output: 7072 kWh/year

Estimated Carbon Dioxide Reduction: 10,143 lbs in first year

Estimated Electric Rate (kWh): \$0.14

Estimated Electric Savings (per year): \$990.08

Estimated SRECs (per year):\* 7

Estimated SREC Value:\* \$500 (Solar Renewable Energy Credits)

Estimated SREC Income (per year):\* \$3,500

Estimated First Year Savings: \$4,490.08

Estimated System Cost (per watt): \$10.00

Estimated Total System Cost: \$65,600

*\* SREC values and length of time that systems may accrue SRECs are subject to the New Jersey Board of Public Utilities and the NJ Clean Energy Program  
See <http://www.NJCEP.com>*

# Audit Results – Likely Energy Savings!

## ***Photovoltaic Analysis – Financial Incentives and Benefits***

- New Jersey Clean Energy Program Website: <http://www.NJCEP.com>. Offers detailed information on incentives, rebates and financial benefits that New Jersey's Clean Energy Program offers to New Jersey residents for purchasing renewable energy. Detailed and up-to-date information is available on Solar Renewable Energy Credits, a major financial asset for producers of solar energy.
- Federal Tax Incentives: The Energy Act of 2005 includes tax incentives for PV systems. Photovoltaic systems may be eligible for a federal tax credit of up to 30%. Please contact your tax professional to determine your eligibility for this credit. A detailed document, titled, "Guide to Federal Tax Incentives for Solar Energy" has been compiled by the Solar Energy Industries Association (SEIA). This guide can be obtained at <http://www.seia.org/manualdownload.php>.
- Our Smart Energy Audit website offers detailed resources on both renewable energy and energy efficiency.

# The End...

- The Smart Energy Audit team hopes you found this detailed audit helpful!
- If viewing this on the Smart Energy Audit Website, please use the links at left to obtain more information.
- Detailed Photovoltaic Audit performed by SEA Audit team member:
  - Charles Virga
  - *Choose Green Energy LLC*
  - 100 Manhattan Ave #611
  - Union City, NJ 07087
- Detailed audit performed by SEA audit team members Danielle Ersalesi, Nicholas DeCristofaro, and William Makofske, Ph. D.