



WASTE
REDUCTION
PARTNERS

Beth El Synagogue

ENERGY ASSESSMENT

CONFIDENTIAL REPORT PREPARED BY

Waste Reduction Partners
Triangle J Council of Governments

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Executive Summary

Waste Reductions Partners was contacted to conduct an energy audit and to identify possible energy efficiencies at the Beth El Synagogue, Durham, North Carolina. The Executive Summary includes recommendations for two buildings, the Main Building which contains the sanctuary and social hall and a second building, the Freedman Center, which is used for large meetings and classrooms. Recommendations include replacing incandescent bulbs with compact fluorescent lamps (CFL) and removing lamps from fixtures where lighting is excessive. Retrofitting current T12 fluorescent fixtures to accommodate T8 lamps and ballast should be undertaken to reduce energy consumption. A consultation with a lighting expert for a comprehensive replacement strategy of existing T12 fixtures is suggested (See Appendix B for possible vendors). The installation of programmable thermostats and use of set-back temperatures during times when spaces are not used is also recommended throughout the facilities. Recommended investments in new lamps, light fixtures and AC units may be eligible for rebates from Duke Energy in 2010. For these rebates it is essential to follow the application process and obtain approval prior to making changes (See Appendix B).

Figure 1.

Recommendations for Main Building (containing sanctuary and social hall)

Recommendation	KWh Saved Per Year	Annual Energy Cost savings
Add separate AC unit to office suite area	Not estimated	
Install a weekly timer for control of Sabbath lighting	1970	\$162
Remove lamps from T12 fixtures in hallway, bathrooms and classrooms	3255	\$268
Replace incandescent lamps in sanctuary and social hall	9900	\$812
Replace incandescent exit lights with LED exit lights	567	\$139
Install draperies in east-facing sanctuary windows	Not estimated	
Replace exterior floodlights with CFL	Not estimated	
Replacement of T12 lamps with T8 lamps throughout	Not estimated	
Installation of programmable thermostats	Not estimated	

Estimated annual energy savings and emission reductions from these recommendations can be summarized as follows:

Estimated Annual Energy Savings	
Energy Savings \$/year	\$1,511.00
Energy Savings kWh/year	15,692
Estimated Annual Emissions Reductions	
Carbon Dioxide (CO2)	15,800 lbs
Nitrogen Oxides (NOX)	46 lbs
Sulfur Oxides (SOX)	121 lbs

Figure 2

Recommendations for the Freedman Center

Recommendation	kWh Saved Per Year	Annual Energy Cost savings
Replace halogen bulbs in track lighting (large meeting room)	Not estimated	
Install a weekly timer for control of Sabbath lighting	535	\$54
Remove lamps from T12 fixtures in hallway and classroom	261	\$28
Replace incandescent exit lights with LED exit lights	1708	\$183
Consider SEER13 or higher HVAC replacement	Not estimated	
Replacement of T12 lamps with T8 lamps throughout	Not estimated	
Installation of programmable thermostats	Not estimated	

Estimated annual energy savings and emission reductions from these recommendations can be summarized as follows:

Estimated Annual Energy Savings	
Energy Savings \$/year	\$265.00
Energy Savings kWh/year	2,504
Estimated Annual Emissions Reductions	
Carbon Dioxide (CO ₂)	2,980
Nitrogen Oxides (NO _x)	7
Sulfur Oxides (SO _x)	19

Section 1: Main Building

1.0 Background

The main building contains the sanctuary (~45 x 70'), the social hall (~45 x 54'), a large kitchen (~40 x 18'), storage and utilities room, and an office wing which includes a large anteroom which is used for events along with 3 offices and a library on the ground level. This masonry construction building was built in 1957 and the front office and anteroom areas were renovated in 1998. The office suite, consisting of the Executive Director's office, Rabbi's office, Pre-school Directors office, library and anteroom require comfortable temperatures throughout the week and weekend. The lower level of the main building contains a classroom area of 8 classrooms which is used for daycare, a small sanctuary, a small kitchen, and an office and large room with the boiler and storage. The classroom side of the lower level has access to the outside and receives daylight through windows on the east side of the building. The boiler room, 1 classroom, an office and a kitchen are located under the office wing and do not receive daylight. The natural gas-fired boiler heats water which is distributed to heating coils in the ductwork used for the air-conditioning. The social hall and sanctuary feature large single pane windows of about 4' x 16' at the top of the ~18-20' high walls. In addition there is a large 16' x 16' single pane window on the east side at the rear of the sanctuary. The anteroom has 3 sets of full height windows, however, this area was re-modeled 12 years ago and these windows are double-pane insulated windows. There is baseboard heating in the office areas.

Offices in the main building are used Monday through Thursday from 9:00 AM to 5:00 PM and Friday from 9:00 AM to 12:00 PM. Services are held on Saturdays in both sanctuaries from 9AM until early afternoon and are followed by lunch in the social hall. The kitchen is used on Fridays to prepare the lunch for Saturday and for other occasions, such as weddings. There are additional services and meetings on Saturday afternoons. In addition there is a musical choir practicing on a weekly basis and other services may take place in the morning or evening during the week. Daycare takes place from 9AM to 12:00 PM Monday through Friday for 10 months. Classrooms as well as the sanctuary downstairs are used on the Sabbath. Religious practice dictates that lights and heating or cooling be turned on Fridays before sunset and left on until after sunset on Saturday night.

2.0 Energy Use Analysis, Main Building

A summary of the annual energy consumption is as follows:

Summary of Energy Benchmarks	
Annual Cost of Electricity	\$11,309
kWh's Per Year	139,720
Average Cost \$ Per kWh	\$0.082
Natural Gas Therms Per Year	5,375
Annual Cost of Natural Gas	\$5,933
Yearly Energy Cost	\$17,242
Avg. Daily Energy Cost	\$47.24

2.1 Electricity

From the graph, (Attachment #1) of the Electrical History of the past year May 08 through June 09, the following was noted:

1. The dollar per kWh is averaging \$0.082, over the past year.
2. Usage seems consistent with the time of year. Most of the electricity usage is in the summer for air conditioning.

2.2 Natural Gas

1. Natural gas usage is primarily for heating. A commercial gas stove and ovens are located in the large kitchen near the social hall. Usage seems consistent with the seasonal requirement for heating.

3.0 Recommendations, Main Building

3.1 Observations

1. The social hall and the sanctuary contain about 75 recessed can floodlights, perhaps, about 150 watts each (estimated that ceilings were 18-20 ft. high). Daylight from the large windows is adequate for some activities without addition lighting.
2. The majority of lights in the service areas (kitchen, bathrooms, library, office, hallways downstairs and classrooms) are 4-lamp fluorescent T12 fixtures. Upstairs the main building has a total of 19 4-lamp fixtures and 12 2-lamp fixtures, and on the classroom level there are 74 4-lamp T12 fixtures. Of these 21 4-lamp fixtures are located in classrooms, bathrooms or hallways, which are brighter than necessary.
3. The anteroom has a large number of recessed lights (14 spots, 8 other types) all of which appeared to be CFL bulbs. Outside there are a total of 22 spot lights and flood lights

providing illumination for walkways and for the stained glass windows of the sanctuary. The aesthetic lighting is usually on for evening events. It appears that some of the floodlights under the covered walkways have been changed out for CFL bulbs.

4. Windows on the south side of the library are single pane, but are covered by window blinds.
5. Exterior lighting consisted of 22 floodlights, 8 of which illuminate stained glass windows in the sanctuary. There were several replacements with CFLs. Replacement with outdoor CFLs should be continued for considerable savings.
6. The boiler room has 2 bare incandescent light bulbs and 2 bare 120 W floodlights.
7. The staff observes good conservation measures by keeping lights off in unoccupied spaces.

3.2 Recommended Areas of Savings

AC/ Heat and Hot Water

1. In order to address the extra energy consumption required by the need to turn all lights on for the Sabbath, it is recommended that a weekly timer be installed on the main panel of each building that would turn on the lights Friday evenings prior to sunset and turn them off later in the evening until needed on Saturday morning. With a daily electrical cost of \$30.98 an 8-hour off period for 52 days per year, a savings of \$160 per year for the main building would be achieved, assuming that lighting accounts for 30% of all electrical costs.
2. Since the office suite area can be closed off from the sanctuary and social hall, summer cooling costs could be reduced by installing a 2-ton air-conditioning unit to cool that area comfortably and raising the temperature of the remainder of the building when it is not occupied. Programmable thermostats would be useful for this recommendation.
3. The electric hot water heaters consume energy constantly. When the current units fail, some thought might be given to innovative ways of implementing on-demand water heating that respects religious requirements.
4. The need for duplicate refrigeration and freezer space and the presence of 2 kitchens points out the need to replace these appliances as they age with more energy-efficient models.

Lighting

Recommendations below deal with specific replacement or actions that can be undertaken immediately to reduce energy consumption. Consideration should be given to replacing the T12 lamps with lower watt lamps or replacing the entire fixture with T8 fixtures, lower watt T8 lamps and electronic ballast, which would further reduce the energy requirement. Consultation with a lighting expert would provide the best opportunity for adequate lighting at the most reasonable cost and payback period. Replacement with compact fluorescent lamps (CFL) and T8 lamps is covered under the Duke Energy rebate program. (See "Smart Saver Rebate Program" in the appendix for contact information.)

1. CFL replacement: The social hall and sanctuary contain 75 recessed can lights that may be able to accept CFL. A 52 watt CFL replacement could provide the same light output and would use 98 fewer watts. If lights are assumed to be on for 1352 hrs/year, then the savings per fixture would be $0.098 \text{ kW} \times 1352 \text{ hr/yr} \times \$0.082/\text{kWh} = \$10.86/\text{yr}$ per replacement.

2. Removing lamps from T12 fixtures: Removing 2 lamps from a 4-lamp four-foot T12 fixture will reduce the wattage by 68 watts. In the daycare area light is assumed to be on 2,288 hours/year. The savings per fixture would be $0.068 \text{ kW} \times 2288 \text{ hr/yr} \times \$0.082/\text{kWh} = \$12.76/\text{yr}$ per fixture.

Other conservation measures

The large east-facing window at the rear of the sanctuary is a metal-framed single pane glass. For aesthetic reasons, a Plexiglas insulating layer is not recommended. The payback on replacing this large window is not favorable, either. Therefore, we recommend a heavy drapery, which could be opened for day lighting as desired.

Some savings would be realized by replacing the incandescent bulbs in the boiler room. However, these are bare bulbs and replacement with CFL would constitute a safety hazard (CFL contain small amounts of mercury) if the bulbs were not covered with a safety cage.

Section 2: The Freedman Center

1.0 Background

The Freedman Center also occupies two levels. The upper level has a large open space which is used for a weekly church service and various group activities, 2 meeting rooms and a kitchen. The lower level has 6 classrooms and an office. The office is used during the week for the same hours as the main office. The classrooms are on Monday and Wednesday after school from 3:30-5:30 except in summer.

2.0 Energy Use Analysis, Freedman Center

A summary of the annual energy consumption is as follows:

Summary of Energy Benchmarks	
Annual Electricity Cost	\$3,798
kWh Per Year	37,920
Average Cost \$ Per kWh	\$ 0.108
Natural Gas Therms Per Year	1,773
Annual Natural Gas Cost	\$2,152
Yearly Energy Cost	\$5,950

3.0 Recommendations, Freedman Center

3.1 Observations

1. A lobby area about 8 x 20' has 12 regular spotlights and 4 smaller lights.
2. Large open activity space has about 30 track lights with 3 separate switches. The study rooms at each end have 4 4-lamp T12 fixtures each. The kitchen has 5 2-lamp fixtures. The hall and stairway to the lower level has 3 60W incandescent bulbs and 2 floodlights.
3. The long hall with classrooms to each side has 6 4-lamp T12 fixtures and is brighter than needed. There are 2 exit signs at each end of this hall. One of the classrooms has 4 4-lamp fixtures.
4. A natural gas heater is located in a utility room on the lower level.
5. The aging AC unit on the south side of this building should be replaced with a unit with the highest SEER (Seasonal Energy Efficiency Ratio) over 13 as is practical.

3.2 Recommended Areas of Savings

1. In order to address the extra energy consumption required by the need to turn all lights on for the Sabbath, it is recommended that a weekly timer be installed on the main panel of each building that would turn on the lights Friday evenings prior to sunset and turn them off later in the evening until needed on Saturday morning. With a daily electrical cost of \$10.40 and an 8-hour "off" period and an assumption that 30% of electrical costs are for lighting, a savings of \$54.00 would be realized in one year.
2. If a suitable replacement lamp could be identified for the track lighting in the large meeting room, some energy efficiency would be achieved.
3. The incandescent lighting in the short hall/stairway to the lower level can be replaced with CFLs.
4. At least one classroom is brighter than needed, containing 4 T12 4-lamp fixtures. One entire fixture could be removed or remove 4 lamps. $0.034 \text{ KW/lamp} \times 4 \times 480\text{hr/yr} \times \$0.108 = \$7.05$. Removing 2 lamps from each of 6 fixtures in the hallway would save $0.068 \text{ kW per fixture} \times 480 \text{ hrs/yr} \times \$0.108 = \$3.52 \text{ per fixture/yr}$.
5. Energy saving calculations for LED replacement of exit lights: Replacing a typical incandescent exit light would achieve a reduction of 0.065 KW. If the exit light is always on, then $0.065\text{KW} \times 8760 \text{ hr/yr} \times \$0.108/\text{kWh} = \$61.50$ is saved per year per exit light.
6. Programmable thermostats should be installed so that unoccupied spaces can be temperature-controlled.

Appendices

A. Energy Assessment Follow-Up

Waste Reduction Partners provides energy, solid waste, water, and pollution prevention assessments to institutional and business entities throughout North Carolina. These assessments are confidential, non-regulatory, and provided at no cost to the client. A follow-up contact will be made with clients 6-12 months after this Assessment Report has been delivered to discuss the value of the assessment. The purpose of the follow-up is to evaluate the effectiveness of our reports and consultation and to determine if report recommendations were found to be worthy of implementation. You are encouraged to take the few minutes required to complete the follow-up in order to help Waste Reduction Partners continually improve its services.

B. Duke Energy Smart Saver Rebate Program

Cash incentives are available from Duke Energy for qualified high-efficiency lighting equipment, cooling and water heating equipment. Contact Duke Energy at 866-380-9580 or www.duke-energy.com. Prior approval is required for the incentives program.

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