

Energy Workbook

Walkthrough Survey

&

Solutions

This Energy Workbook is based on KAIROS' **Energy Workbook for Religious Buildings**.

We have revised the workbook to facilitate the use of this resource by residents of the U.S. We have changed the units of measurement to those used in the U.S.

### **Helpful Hint for Churches**

Many churches will find it beneficial for the committee responsible for caring for the building and grounds and the committee concerned with social justice and environmental ministries to work together with the pastor, custodial staff and volunteers. KAIROS recommends that each congregation assembles an energy management team responsible for tracking energy use, formulating and coordinating an energy conservation program, documenting savings achieved, and educating the congregation about energy efficiency at church and at home.



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# ENERGY WORKBOOK: Walkthrough Survey

## Preliminary Assessment

An initial walk through assessment will help identify energy losses that can often be corrected by maintenance or operational actions. You will be amazed at how much can be done at little or no cost.

## Checklist

To complete the checklist, please read the detailed descriptions (see page 4). These provide you with technical descriptions and information, along with hints and options for increasing energy savings.

## Initial Energy Retrofits

Correct the obvious energy waste found in your walkthrough survey immediately. Appreciable savings can be realized from simple, minimal, or no-cost steps such as lowering the thermostat settings and turning off lights and fans in unoccupied areas. You can improve energy efficiency by changing operational and maintenance procedures, requiring little capital investment.

After you have evaluated the findings in your own assessment and find that a more detailed analysis of your energy consumption is necessary, contract a professional energy-management specialist to conduct an energy assessment and assist you in identifying additional improvements. Your assessment information will provide important preliminary data required for an in-depth analysis.

### 1. Building Envelope (Insulation, Sealing and Vapor Barrier)

1.1 Is weatherstripping in good condition?	Yes	No
1.2 Are cracks well sealed around windows, doors, wall sidings, block foundations?	Yes	No
1.3 Is the building well insulated? Areas that are poorly insulated or uninsulated are: _____	Yes	No

### 2. Equipment

2.1 Is equipment shut down when not in use?	Yes	No
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### 3. Greenspace

3.1 Are deciduous or broad leaf trees or shrubs planted strategically around the building to reduce heating and cooling demands?	Yes	No
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#### 4. HVAC (Heating, Ventilation and Air-conditioning)

4.1 A Temperature settings during occupied hours in the Summer: 4.1 B Temperature settings during occupied hours in the Winter:		
4.2 Temperature settings during unoccupied hours:		
4.3 Are building temperatures set back during non-use periods?	Yes	No
4.4 Is the boiler operating efficiently?	Yes	No
4.5 Is the furnace filter clean?	Yes	No
4.6 Does the area need to be this hot in the winter?	Yes	No
4.7 In the summer, does the air-conditioner need to be set so low? Type of air-conditioner used (window, split-system central, packaged central): _____	Yes	No

#### 5. Lighting

5.1 Record lighting information on Worksheet A "Lighting Record"		
5.2 Are lights turned off when space is unoccupied?	Yes	No
5.3 Are lights turned off in areas where daylight is available?	Yes	No
5.4 Are you using efficient types of lighting?	Yes	No
5.5 Is the light level appropriate for the purpose of the area?	Yes	No
5.6 Are you making the most of available natural light?	Yes	No

#### 6. Refrigerators

6.1 Have all unnecessary refrigerators and freezers been unplugged?	Yes	No
6.2 Are all water coolers unplugged?	Yes	No
6.3 Are the freezer coils cleaned twice a year?	Yes	No
6.4 Is the refrigerator at least 3 inches from the wall?	Yes	No
6.5 Is the refrigerator door well sealed when shut?	Yes	No

## 7. Waste

7.1 Do you have a scrap paper box?	Yes	No
7.2 Are both sides of paper used for photocopying or for notes?	Yes	No
7.3 Are organic wastes composted?	Yes	No
7.4 Are materials recycled whenever possible?	Yes	No

## 8. Water

8.1 Are all faucets, toilets and water pipes regularly checked for drips and leaks?	Yes	No
8.2 Are all water drips and leaks fixed?	Yes	No
8.3 Do you have ultra-low flow toilets in place?	Yes	No
8.4 Are the hot water tank and pipes insulated?	Yes	No
8.5 Is the hot water tank set between 110-120 °F?	Yes	No
8.6 Do you avoid watering the lawn/gardens in the heat of the day?	Yes	No

## 9. Basic Information

9.1 Collect anything relevant to energy use within your office for future references.		
9.2 Does the office/organization have an energy policy?	Yes	No
9.3 Has the office/organization established energy reduction targets? If yes, what are they?	Yes	No
9.4 Record information about the building on Worksheet B -"Building Characteristics."		
9.5 Record information about office/building usage/occupancy on Worksheet C -"Weekly Occupancy."		
9.6 Does the office regularly track its energy consumption?	Yes	No
9.7 Record information from monthly utility bills for the past year (12 months) on Worksheet D - "Energy Consumption Record."		
9.8 Calculate the Energy Consumption per square foot.		

## **Detailed Descriptions**

### **1. Building Envelope (Insulation, Sealing and Vapor Barrier)**

- 1.1 Examine weatherstripping. Replace weatherstripping that pulls away easily from the wall or is broken.
- 1.2 Cracks in the foundation and wall structure and gaps between bricks can result in significant heat loss as well as incoming drafts. Fixing these will make the building more comfortable as well as reduce the overall energy consumption.
- 1.3 Note the rating of the insulation if available. A rating of R20 would indicate a well-insulated wall space. A well-insulated attic/ceiling, basement would have a higher R-value. Are there specific areas that are poorly insulated or uninsulated (e.g., basement, attic, walls)? Basements and attics in particular are often a significant source of heat loss.
- 1.4 SOLUTIONS:
  - Repoint brick or stone work to minimize drafts.
  - Caulk and weatherstrip the inside and outside of all doors and windows.
  - Close shades at night in the winter and during day in the summer.
  - Add insulation where needed (particularly in the attic and basement).
  - Install storm windows or upgrade windows to dual or triple pane glass.
  - Use reflective film on windows to block out solar heat and direct sun glare.
  - Rent or lease space in your building (does not directly reduce energy use, but allows for a better use of resources).

### **2. Equipment**

- 2.1 Energy saving features and shutting down equipment when not in use will help reduce energy consumption.
- 2.2. SOLUTIONS:
  - Auto shut off.
  - Use energy saving features.
  - Purchase high energy-efficient equipment (Energy Star).

### **3. Greenspace**

- 3.1 Planting trees and shrubs in strategic locations can help minimize heating and cooling demands. In the summer, strategically located trees/shrubs provide shade. In the winter, they allow light in as well as provide a wind break.
- 3.2 SOLUTIONS:
  - Plant coniferous varieties to the North and North-west of the structure and deciduous in the South and South-west of the structure.

### **4. HVAC (Heating, Ventilation and Air-conditioning)**

- 4.1 By knowing your setback temperatures, you can look at whether your office/building is making the most efficient use of heating and cooling systems.
- 4.2 Consider the length of time required to return to operating conditions from the setback temperatures.
- 4.3 Maintaining optimal occupied temperatures during non-use times is both demanding on your system and a significant factor for heating and cooling costs
- 4.4 Talk to maintenance and your boiler inspector to determine whether your boiler is operating at its optimum. If it is not operating at its best, find out what changes could be made to improve its efficiency.

- 4.5 A clean furnace filter will help keep your furnace operating efficiently and reduce energy demand.
- 4.6 Consider the purpose of each area in making this decision. What are most people saying about the temperature? Temperature is different from an area being drafty. Often, the thermostat can be lowered during winter once drafts are eliminated.
- 4.7 During summer, a building can get too cold because of air-conditioning. Consider the purpose and frequency of use of each area. Are there some areas you may wish to have cooler than others. Are most people comfortable?
- 4.8 SOLUTIONS:
- Install an energy-efficient furnace or boiler -- one that is adequate for the size and operation of the building.
  - Inspect and tune-up furnace or boiler each fall.
  - Change furnace filter every other month during heating season.
  - Install a 7-day Programmable setback thermostat.
  - During winter, when the office/building is not in use, set back thermostat to 55°F (12°C).
  - During summer, when the office/building is not in use, set back thermostat to 80°F (25°C).
  - Install in-floor heating coils in large meeting areas.
  - Keep air grills, registers, and space heaters clear.

## 5. Lighting

- 5.1 Record the location, type of light, wattage of bulb, number of bulbs, hours used/year, cost of bulb, life expectancy of bulb, and comments. This information can be used to calculate payback periods and help determine the feasibility of replacing current bulbs with more efficient bulbs.
- 5.2 Lights left on during unoccupied periods waste energy.
- 5.3 Making the most of available light can reduce energy and heating costs.
- 5.4 Consider the amount of light you get from the type of bulb being used and compare to other possible alternatives.
- 5.5 Different purposes require different light levels and light quality.
- 5.6 Natural light can be used to reduce lighting and heating costs.
- 5.7. Notes:
- Motion sensors work well in small areas with irregular occupancy patterns. Timer switches can be used in areas such as washrooms, where the use is infrequent and lights (and fans) tend to be forgotten.
  - LED lamps offer the same function in exit signs at a fraction of the energy cost (10-15%) and have a life expectancy of 25 years.
- 5.8 SOLUTIONS:
- Use high-efficiency lighting (replace incandescent lighting with CFL bulbs).
  - Use natural light whenever possible.
  - Install dimmers.
  - Use computerized controls (timers, motion and light level sensors).
  - Replace bulbs with a lower watt bulb for over lit areas or remove some fixtures.
  - Use LED lamps in exit signs.
  - Use task lighting for specific jobs rather than overhead lighting.
  - Use silver or aluminum reflectors in fixtures (reflectors maximize light output as they direct the light down and reduce glare by minimizing reflected light off of walls).

## **6. Refrigeration**

- 6.1 The efficiency of refrigerators correlates closely with age. Prior to federal standards, refrigerators were relatively inefficient. The newest models use about half the energy of those made about 15 years ago. For estimating the efficiency of your current unit, use the following guidelines:
- Low: Units more than 10 years old.
  - Medium: Units less than 10 years old but made before 1993.
  - High: Units made in 1993 or later.
- 6.2 Instead of water coolers, consider storing cool water in a refrigerator. Water coolers are often inefficient and not well used.
- 6.3 Built up ice can reduce available space and efficiency of freezers.
- 6.4 A space between the back of the refrigerator and the wall prevents coils from heating up and allows the fridge to run more efficiently.
- 6.5 If a dollar bill can easily slip out from a closed door, the door is not sealing properly.
- 6.6 SOLUTIONS
- Consolidate contents and unplug unnecessary refrigerators and freezers.
  - Move the refrigerator 3 inches from wall.
  - Unplug all water coolers.
  - Clean the freezer coils twice per year.
  - Replace seal on refrigerator door.
  - Make sure refrigerator is level (door may not seal properly if not).

## **7. Waste**

- 7.1 A scrap paper box indicates an effort to conserve resources.
- 7.2 New products consume energy. By using both sides we can cut in half the cost of producing new materials, transporting, packaging. We also reduce the cost of supplies.
- 7.3 Organic materials can be used to minimize the use of fertilizers. In the landfill, organic material is compressed and will produce methane gas as it biodegrades since there is little or no oxygen available. Methane is one of the primary greenhouse gases.
- 7.4 If a product can not be reused, recycling will help minimize the energy costs of extracting new resources from mining, logging, etc..
- 7.5 SOLUTIONS:
- Use both sides of paper (photocopying, notes, etc.).
  - Compost organic wastes.
  - Recycle materials whenever possible.

## **8. Water**

- 8.1 Regularly checking for leaking faucets or dripping taps will help prevent more serious problems from developing.
- 8.2 Ongoing drips and leaks are a source of regular energy consumption that can be easily fixed.
- 8.3 Pumping water into a building requires energy. So does the treatment of water.
- 8.4 Insulation, or even a blanket, can be wrapped around the hot water tank to help reduce heat loss.

8.5 Less energy is required to maintain a lower temperature on a hot water heater.

8.6 Much of the water is lost to evaporation.

8.7 SOLUTIONS:

- Insulate hot water tank and hot pipes.
- Turn hot water tank down to 110-120°F (40-45°C).
- Install a timer on electric hot water tanks.
- Install tankless hot water tanks.
- Fix all leaking faucets and toilets.
- Replace conventional toilet with ultra-low flow one.
- Avoid watering gardens and lawn in the heat of the day.

**9. Basic Information**

9.1 Relevant materials may include thermostat operation manual, energy bills, energy policy, blue prints, etc..

9.2 An energy policy will help: establish energy efficiency as a priority; remind staff/employees about energy management; and involve everyone.

9.3 Reduction targets can be used to help prioritize actions that will meet goals. Having a reduction target is an essential first step to reducing energy consumption. Choose a target, which is challenging, but obtainable.

9.4 Record building and occupancy information. Use blueprints for floor plans (if available). Otherwise, make basic sketches. Age: Make note of the age of renovations if they affect the exterior building envelope. Otherwise, use the age of the main building structure. Optional: Climate information such as heating degree days, cooling degree days, etc. can be obtained from Energy Information Administration. ( See <http://www.eia.doe.gov/emeu/mer/overview.html> for current data. See <http://www.eia.doe.gov/emeu/aer/overview.html> for historical data.) This information would be useful if you want to compare your data. Solar radiation, wind speed and direction data should be recorded if available to you.

9.5 If building usage/occupancy varies greatly during the summer season, use an additional table to show the weekly occupancy during that time period. Record the average weekly occupancy during the regular and Summer seasons, with a breakdown by day, hours, purpose, room, and number of occupants.

9.6 Monitoring your energy consumption will help point the way to potential cost-effective energy saving measures. If you have set a reduction target, it is important to record this information to verify whether you have met the goal.

9.7 If you use other energy sources not listed in the “Energy Consumption Record,” record these in the additional columns with the type, unit, monthly consumption and cost. Calculate the actual energy consumption in \*Btus using: Heating Oil/Diesel fuel = 139,000 Btu/gallon, Natural Gas=100,000 Btu/Therm, Electricity = 3,412 Btu/KWh, Propane = 91,000 Btu/gallon

9.8 Calculate the total energy consumption per square foot of gross floor area. Use the gross floor area in square feet from Worksheet B. Use the total of all sources of energy consumption (Btu) from Worksheet D. This will give you an overall idea of your office's/building's energy consumption and energy efficiency. You will also be able to compare your office/building with other offices/buildings in your area.

9.9 SOLUTIONS:

- Develop an energy policy for your office/organization.
- Ask utility company for ‘green power.’
- Increase use of renewable energy.

\*The Btu is the measure of thermal energy used most frequently in the United States.

**Table: Color Quality vs. Efficiency (Lumens/Watt)**

Color Rendering Index (CRI): The ability to distinguish between different colors and how close the color viewed under a particular light source is to that color under natural light. While incandescent lighting has the lowest color distortion, it provides the least amount of light (brightness) per kilowatt.

Efficiency: A description of the efficiency of a light source, as measured in light produced (lumens) per unit of power consumed (watts). ENERGY STAR efficacy requirements vary with the style of CFL (bare spiral, covered reflector, etc.) and wattage, but are generally 3-4 times higher than comparable incandescent light bulbs

Lumens: Standard measure of the brightness of light.

Light Source	CRI	Color	Lumens/Watt
Incandescent lamps	97	Excellent	10-18
Fluorescent, full spectrum 7500	94	Excellent	40-90
Fluorescent, cool white deluxe	87	Excellent	40-90
Compact fluorescent	82	Excellent	40-90
Fluorescent, warm white deluxe	73	Good	40-90
Metal halide (400 W clear)	65	Good	60-90
High pressure sodium (250 W)	65	Good	60-120
Fluorescent, cool white	62	Good	40-90
Fluorescent, warm white	52	Fair	40-90
Mercury	43	Poor	20-50
High pressure sodium (400 W)	32	Poor	60-120
Mercury vapour (clear)	22	Poor	20-50
Low pressure sodium	-	Undefined	90-200

Degree-days: are relative measurements of outdoor air temperature used as an index for heating and cooling energy requirements. Heating degree-days are the number of degrees that the daily average temperature falls below 65° F. Cooling degree-days are the number of degrees that the daily average temperature rises above 65° F. The daily average temperature is the mean of the maximum and minimum temperatures in a 24-hour period. For example, a weather station recording an average daily temperature of 40° F would report 25 heating degree-days for that day (and 0 cooling degree-days). If a weather station recorded an average daily temperature of 78° F, cooling degree-days for that station would be 13 (and 0 heating degree days).

Web Pages: • See <http://www.eia.doe.gov/emeu/mer/overview.html> for current data. • See <http://www.eia.doe.gov/emeu/aer/overview.html> for historical data.



## Worksheet B: Building Characteristics

Office: \_\_\_\_\_

Address: \_\_\_\_\_

Prepared by: \_\_\_\_\_ Date: \_\_\_\_\_

### Building Physical Data

Age: \_\_\_\_\_

No. of floors: \_\_\_\_\_

Total floor area (square feet): \_\_\_\_\_

Net floor area air conditioned: \_\_\_\_\_

#### Construction type:

##### Walls:

Exposure (N, E, S, W)

Type: (stone, brick, etc): \_\_\_\_\_

##### Roof:

Type: Flat \_\_\_\_\_

Color: Light \_\_\_\_\_

Pitched \_\_\_\_\_

Dark \_\_\_\_\_

##### Window Glazing:

Exposure (N, E, S, W)

Type (single, double, insulating, reflective, etc.) % glass/external wall area

##### Doors:

Exposure (N, E, S, W)

Type: \_\_\_\_\_

Level of insulation on: all exterior walls \_\_\_\_\_

roof: \_\_\_\_\_

Draw or attach basic floor plans, which show the location and size of all rooms, doors, windows and basic layout.



**Worksheet D: Energy Consumption Record (1 of 3)**

	Electricity Consumption			Electricity Demand	
Meter No.					
Meter Location					
	KWh	\$	Btu	KW	\$
January					
February					
March					
April					
May					
June					
July					
August					
September					
October					
November					
December					
Total					

Notes:

Calculate the actual energy consumption in Btus using: Electricity = 3,412 Btu/KWh

Adjust Amount to reflect the average consumption over the # of days in the month, since reading dates vary.

Total Energy Consumed/Gross Floor Area (Btu/ft3) \_\_\_\_\_

**Worksheet D: Energy Consumption Record (2 of 3)**

	Heating Oil/Diesel Fuel			Natural Gas		
Meter No.						
Meter Location						
	Gallons	\$	Btu	Therm	\$	Btu
January						
February						
March						
April						
May						
June						
July						
August						
September						
October						
November						
December						
Total						

Notes:

Calculate energy consumption in Btus using: Heating Oil/Diesel fuel = 139,000 Btu/gallon, Natural Gas=100,000 Btu/Therm

Adjust Amount to reflect the average consumption over the # of days in the month, since reading dates vary.

Total Energy Consumed/Gross Floor Area (Btu/ft3) \_\_\_\_\_

**Worksheet D: Energy Consumption Record (3 of 3)**

	Propane					
Meter No.						
Meter Location						
	Gallons	\$	Btu		\$	Btu
January						
February						
March						
April						
May						
June						
July						
August						
September						
October						
November						
December						
Total						

Notes:

Calculate the actual energy consumption in Btus using: Propane = 91,000 Btu/gallon

Adjust Amount to reflect the average consumption over the # of days in the month, since reading dates vary.

Total Energy Consumed/Gross Floor Area (Btu/ft<sup>3</sup>) \_\_\_\_\_