# Faith Community Facilities Manager Workshop
# Buildings and Renovation

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# Buildings

- Buildings are deceptively complex. At their best, they connect us with the past and represent the greatest legacy for the future.
- They provide shelter, encourage productivity, embody our culture, and certainly play an important part in life on the planet.
- Buildings today are life support systems, communication and data terminals, centers of education, justice, and community, and so much more.
- They are incredibly expensive to build and maintain and must constantly be adjusted to function effectively over their life cycle. The economics of building has become as complex as its design.

# Sustainable Design?

- Sustainable architecture is not a question of style; it is about choices made during the design process.
- Sustainable design views the building holistically and observes how it interacts with the environment. This informs decisions about efficient energy, whether to build on a watershed area, or choosing not to disturb a natural prairie environment.
- Additional deliberation can include conserving water, incorporating geothermal heating or gray waste water that reuses water through re-filtering systems, or how to select materials outside and inside the building.
- The planning process for sustainable design can take longer because of the research needed and because we may need to change our thinking process in order to see the bigger picture.

# Trends in Religious Architecture

- Sustainable Design-creating healthier indoor environments, conserving resources, meeting budgets and lowering operating costs
- Daylight Design- worship spaces are better if they have bright and uniform illuminated environments
- Accessibility- physical accessibility or sacramental inclusiveness.
- Worship and Technology-the addition of technology and the opportunities it creates to enhance the worship experience
- Environmental Psychology – expression and understanding of the “sacred place” joining people to their gods – the spirit of a place

# Building Green Efforts

- Invite the building committee to study denominational documents on justice and environmental issues.
- Study the natural setting of your site, the view and also natural heating and cooling options: sun in the winter and cool breezes in the summer.
- Consider LEED certification.
- Consider dedicating space to serve meals to the poor or elderly or to house families in need.
- Provide views of the natural world by incorporating outdoor areas for prayer.

# Building Green Efforts

- Encourage “reversible renovation.” Reversible renovations allow for building changes to be reversed if necessary in the future. Sloping a flat floor may be helpful now, but it may prove to be more costly when adding a later addition to the building.
- Select structural and mechanical systems and materials that are ecologically and environmentally friendly. Cork and linoleum are natural materials, not synthetic ones. High-energy efficient HVAC systems also support a sustainable environment.
- Educate the whole congregation about the values, spirituality, and theology that support sustainable decisions.

# Design Elements to Consider

1. Plant trees to shade buildings
2. Share facilities, including parking areas, buildings, and meeting areas with neighbors
3. Make new construction highly insulated and weatherproofed
4. Use windows and natural “daylighting” to reduce the building’s need for artificial light
5. When artificial lighting is needed, use fluorescent and other energy-efficient lighting
6. Use long-lasting, durable, local and recycled materials in construction
7. Minimize construction waste
8. Design buildings to use natural ventilation to the maximum amount possible
9. Use local native plants to reduce landscape maintenance and water use
10. Provide facilities that will encourage people to walk, ride bikes or transit to church (shaded bike racks, walkways, bus stops, etc.)

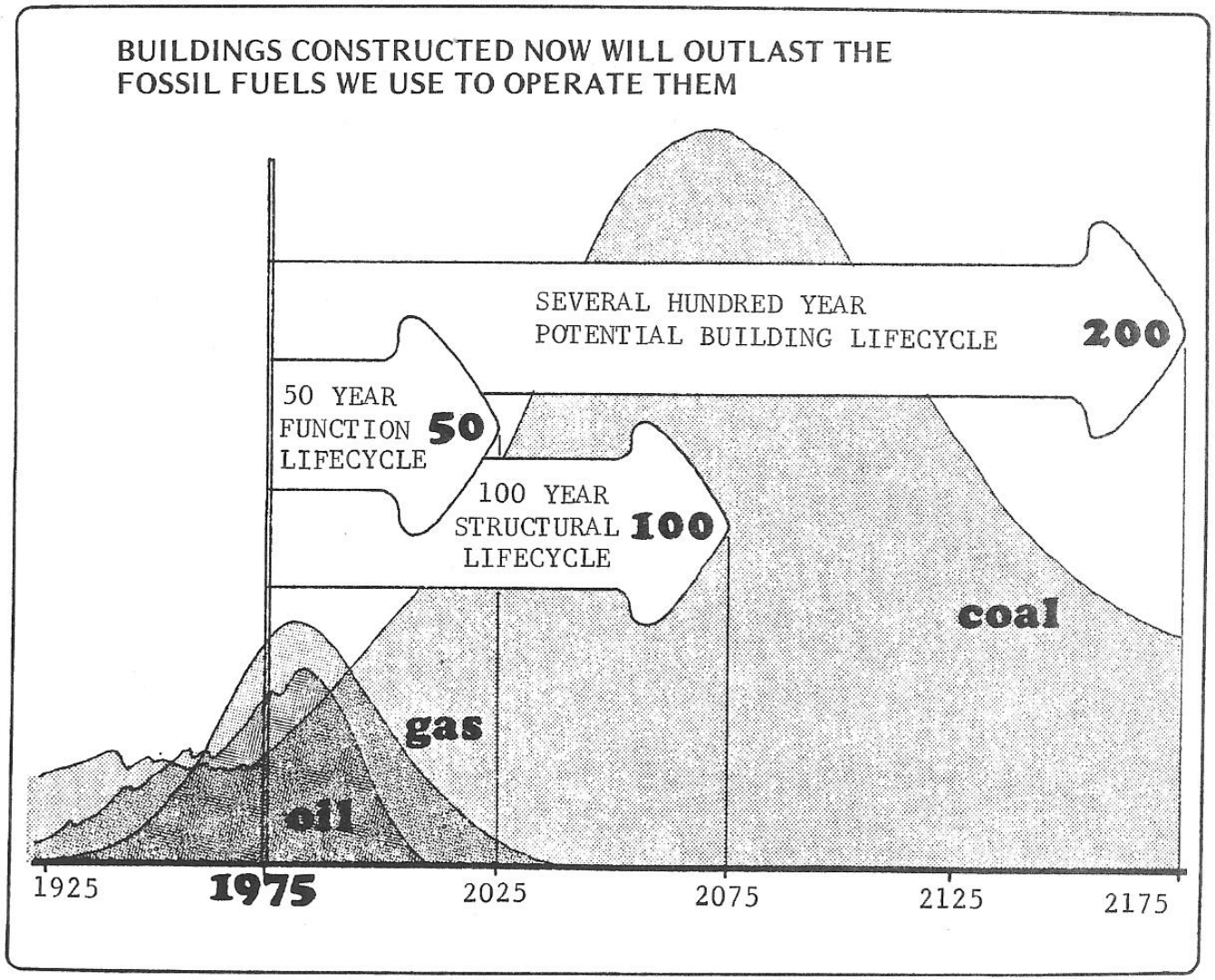
# Buildings and Energy

- “Most people are not used to thinking of large buildings as vast, energy-guzzling machines.  But that is what they are.
- In America, buildings account for 65% of electricity consumption, 36% of total energy use and 30% of greenhouse-gas emissions.”

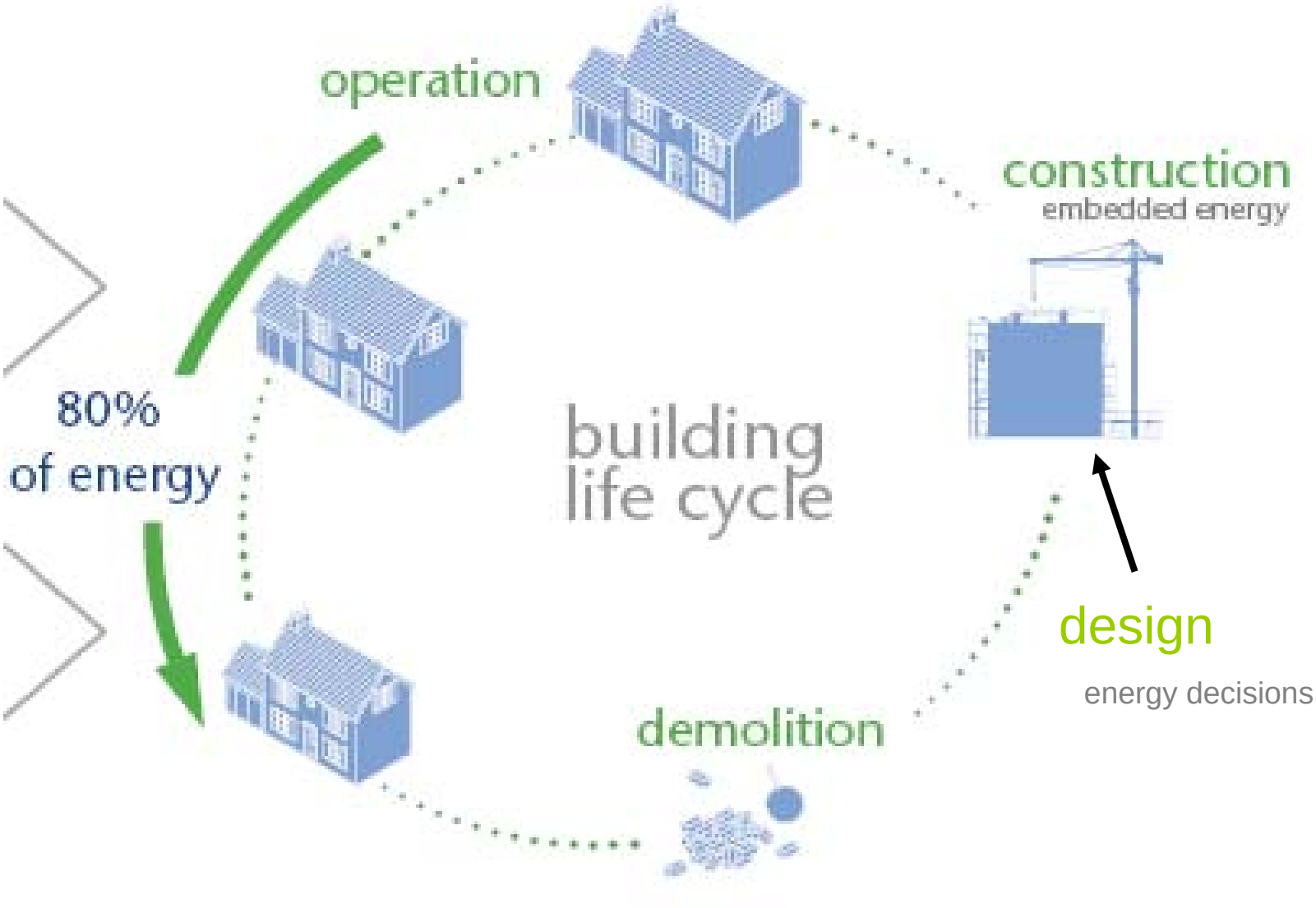
# Building/Energy Use Patterns

- Congregational buildings have unique needs because their energy-use patterns are often very different from other buildings.
- Congregation energy use tends to peak on weekends and lessen during the rest of the week with occasional spikes for special meetings and other functions.
- A large portion of a congregation's energy costs goes toward keeping the facility comfortable during the days when the facility is being used. This includes lighting, heating/cooling rooms and controlling humidity levels.
- Most congregations use the entirety of their facilities only a few days a week, so a congregation that understands this nuance will be better equipped to design or upgrade their facility to reach optimal energy efficiency.

# Energy for Building Lifecycle?



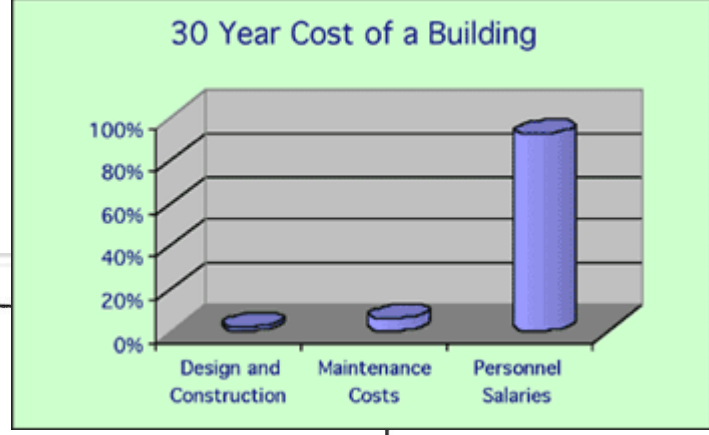
# Building Life Cycle Energy Costs

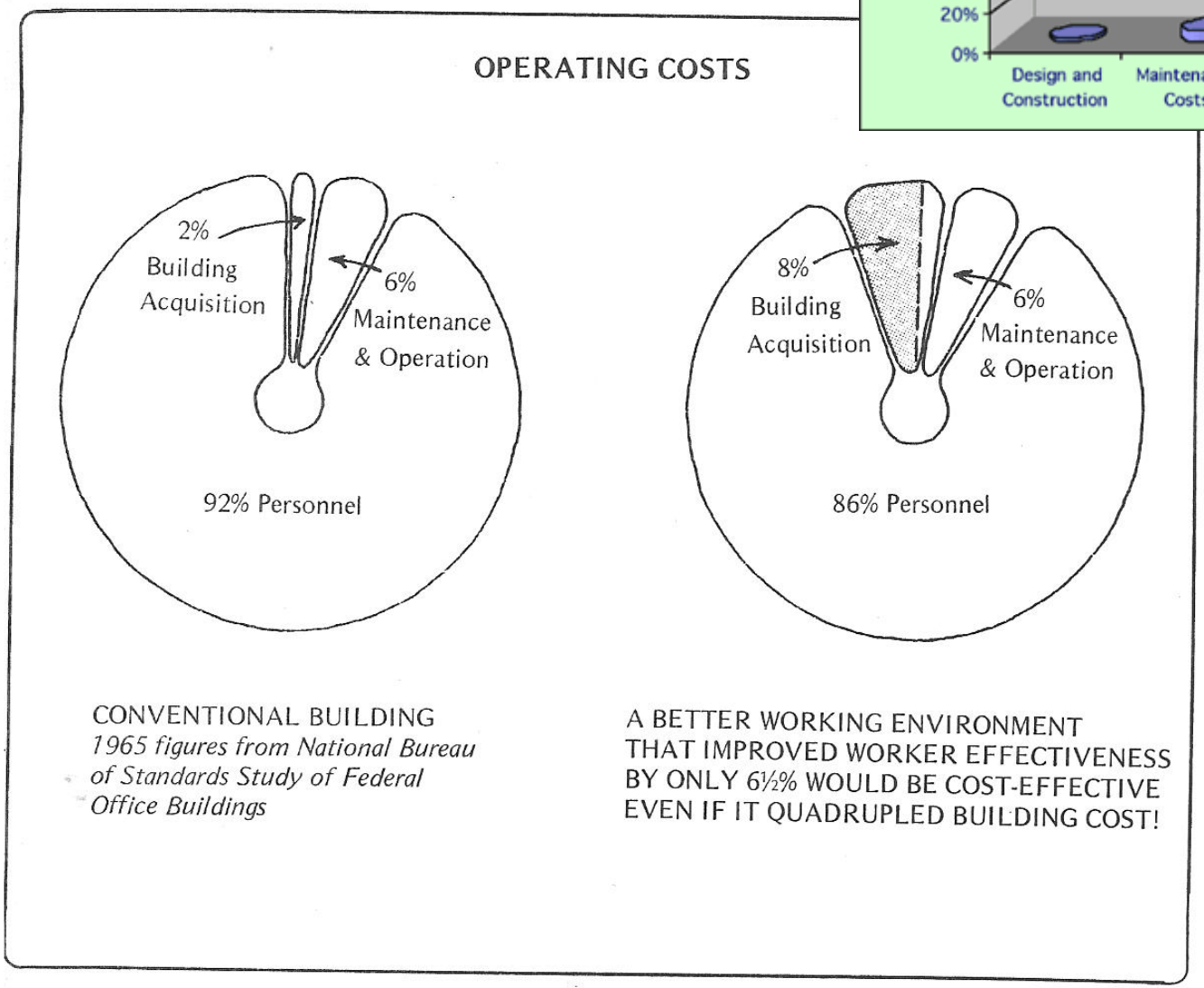


# Embodied Energy

- Building construction involves the use of materials, all of which have used varying amounts of energy in their production.
- Some, like timber, have a low “embodied energy” value, being a natural, renewable resource (if obtained from a sustainable source).
- Others, such as brick and stone, are natural but require the use of more energy to create the final product.
- Yet others, such as PVC, use high levels of energy in their production and are made from non-renewable materials.
- If we consider the “embodied energy” of materials, it makes environmental sense to retain, repair or recycle as much as possible and to minimize the use o materials which use up non-renewable resources.

# Least First Cost Approach?



# Design and Costs

- The intent of energy-efficient design for new construction and/or remodeling is to utilize efficient equipment while optimizing the use of natural energy sources. The ultimate goal is to provide increased comfort with reductions in energy costs and greenhouse gas pollution.
- Energy-efficient design and construction does not need to cost any more than standard design – so get started and realize significant energy and cost savings for your facility.
- ENERGY STAR's Building Design Guidance can help you manage the design and construction process right from the start!

# LEED Rating System

- Currently, the only objective standard to measure the sustainability of new construction projects is through the LEED™ Rating System, from the U.S. Green Building Council.
- LEED is a rating system that evaluates registered projects across a spectrum of issues such as site impacts, energy conservation, water efficiency, greenhouse gas emissions, and indoor air quality.
- Projects can qualify in one of several categories, in increasing order of effectiveness: Certified, Bronze, Silver, Gold or Platinum levels.
- Since its initial released in 2003, less than 3% are churches, synagogues or other places of worship.
- Church construction is not providing many examples of the green building practices common in other types of construction. This may change as more and more congregants make personal lifestyle changes and desire to see the same type of conservation modeled in their places of worship.

# LEED Certification?

- For the most part, churches do not obtain a significant benefit from obtaining the LEED certification.
- Spending the $20,000 +/- to obtain the LEED certification may not have as much “value” to a non-profit entity as a for-profit venture, other than the good will of being an environmentally responsible corporate citizen.

# Energy Efficient Design


- Depending on the facility's size, local climate, use profile, and utility rates, strategies for minimizing energy consumption involve:
  - 1) reducing the load (by integrating the building with the site, optimizing the building envelope [decreasing infiltration, increasing insulation], etc.);
  - 2) correctly sizing the heating, ventilating, and air-conditioning systems; and
  - 3) installing high-efficiency equipment, lighting, and appliances.

# Energy Efficient Design

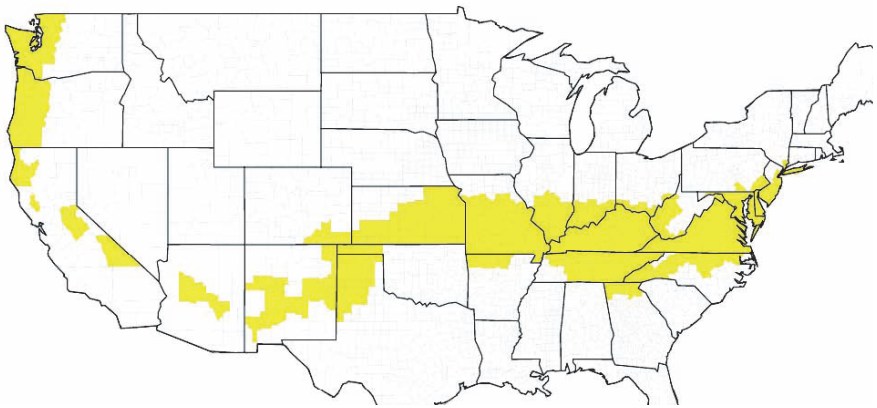

- Consideration should be given to the application of renewable energy systems such as building-integrated photovoltaic systems that generate building electricity, solar thermal systems that produce hot water for domestic hot water (DHW) or space conditioning, or geothermal heat pump systems that draw on the thermal capacitance of the earth to improve HVAC system performance.

# Building Shell

- These elements of the building are a major investment that should be purchased on a "life-cycle costing" or return-on-investment basis, rather than lowest initial cost.
- Plus, in the case of new construction, it will be less costly to "do it right the first time," than to make even more costly upgrades to insulation, windows, walls or roofing material later.

# New Building Design Recommendations

- Each climate zone table includes a set of common items arranged by building subsystem: envelope, lighting, HVAC, and service water heating (SWH).
- Recommendations are included for each item, or subsystem, by component within that subsystem.



Climate Zone 4 Recommendation Table

| | Item | Component | Recommendation | How-To's In Chapter 4 |
|---|---|---|---|---|
| Envelope | Roof | Insulation entirely above deck | R-20 c.i. | EN2, 17, 20-21 |
| | | Metal building | R-13 + R-19 | EN3, 17, 20-21 |
| | | Attic and other | R-38 | EN4, 17-18, 20-21 |
| | | Single rafter | R-38 | EN5, 17, 20-21 |
| | | Surface reflectance/emittance | No recommendation | |
| | Walls | Mass (HC > 7 Btu/ft²) | R-11.4 c.i. | EN6, 17, 20-21 |
| | | Metal building | R-13 | EN7, 17, 20-21 |
| | | Steel framed | R-13 + R-7.5 c.i. | EN8, 17, 20-21 |
| | | Wood framed and other | R-13 | EN9, 17, 20-21 |
| | | Below-grade walls | No recommendation | EN10, 17, 20-21 |
| | Floors | Mass | R-8.3 c.i. | EN11, 17, 20-21 |
| | | Steel framed | R-30 | EN12, 17, 20-21 |
| | | Wood framed and other | R-30 | EN12, 17, 20-21 |
| | Slabs | Unheated | No recommendation | EN17, 19-21 |
| | | Heated | R-7.5 for 24 in. | EN14, 17, 19-21 |
| | Doors | Swinging | U-0.70 | EN15, 20-21 |
| | | Non-swinging | U-0.50 | EN16, 20-21 |
| | Vertical Glazing | Window to wall ratio (WWR) | 20% to 40% maximum | EN23, 36-37 |
| | | Thermal transmittance | U-0.42 | EN25 |
| | | Solar heat gain coefficient (SHGC) | N, S, E, W - 0.46 N only - 0.46 | EN27-28 |
| | | Window orientation | $(A_N * SHGC_N + A_S * SHGC_S) > (A_E * SHGC_E + A_W * SHGC_W)$ | $A_X$–Window area for orientation x EN26-32 |
| | | Exterior sun control (S, E, W only) | Projection factor 0.5 | EN24, 28, 30, 36, 40, 42 DL5-6 |
| | Skylights | Maximum percent of roof area | 3% | DL5-7, DL8, DL13 |
| | | Thermal transmittance | U-0.69 | DL7, DL8, DL13 |
| | | Solar heat gain coefficient (SHGC) | 0.34 | DL8, DL13 |
| Lighting | Interior Lighting | Lighting power density (LPD) | 0.9 W/ft² | EL1-2, 4, 8, 10-16 |
| | | Light source (linear fluorescent) | 90 mean lumens/watt | EL4, 9, 17 |
| | | Ballast | Electronic ballast | EL4 |
| | | Dimming controls for daylight Harvesting for WWR 25% or higher | Dim fixtures within 12 ft of N/S window wall or within 8 ft of skylight edge | DL1, 9-11, EL6-7 |
| | | Occupancy controls | Auto-off all unoccupied rooms | DL2, EL5, 6 |
| | | Interior room surface reflectances | 80%+ on ceilings, 70%+ on walls and vertical partitions | DL3-4, EL3 |
| HVAC | HVAC | Air conditioner (0-65 KBtuh) | 13.0 SEER | HV1- 2, 4, 6, 12, 16-17, 20 |
| | | Air conditioner (>65-135 KBtuh) | 11.0 EER/11.4 IPLV | HV1- 2, 4, 6, 12, 16-17, 20 |
| | | Air conditioner (>135-240 KBtuh) | 10.8 EER/11.2 IPLV | HV1- 2, 4, 6, 12, 16-17, 20 |
| | | Air conditioner (>240 KBtuh) | 10.0 EER/10.4 IPLV | HV1- 2, 4, 6, 12, 16-17, 20 |
| | | Gas furnace (0-225 KBtuh - SP) | 80% AFUE or $E_t$ | HV1- 2, 6, 16, 20 |
| | | Gas furnace (0-225 KBtuh - Split) | 80% AFUE or $E_t$ | HV1- 2, 6, 16, 20 |
| | | Gas furnace (>225 KBtuh) | 80% $E_c$ | HV1- 2, 6, 16, 20 |
| | | Heat pump (0-65 KBtuh) | 13.0 SEER/7.7 HSPF | HV1- 2, 4, 6, 12, 16-17, 20 |
| | | Heat pump (>65-135 KBtuh) | 10.6 EER/11.0 IPLV/3.2 COP | HV1- 2, 4, 6, 12, 16-17, 20 |
| | | Heat pump (>135 KBtuh) | 10.1 EER/11.0 IPLV/3.1 COP | HV1- 2, 4, 6, 12, 16-17, 20 |
| | Economizer | Air conditioners & heat pumps - SP | Cooling capacity > 54 KBtuh | HV23 |
| | Ventilation | Outdoor air damper | Motorized control | HV7-8 |
| | | Demand control | $CO_2$ sensors | HV7, 22 |
| | Ducts | Friction rate | 0.08 in. w.c./100 feet | HV9, 18 |
| | | Sealing | Seal class B | HV11 |
| | | Location | Interior only | HV9 |
| | | Insulation level | R-6 | HV10 |
| SWH | Service Water Heating | Gas storage | 90% $E_t$ | WH1-4 |
| | | Gas instantaneous | 0.81 EF or 81% $E_t$ | WH1-4 |
| | | Electric storage 12 kW | EF > 0.99 – 0.0012xVolume | WH1-4 |
| | | Pipe insulation (d<1½ in./ d≥1½ in.) | 1 in./ 1½ in. | WH8 |

Note: If the table contains "No recommendation" for a component, the user must meet the more stringent of either Standard 90.1 or the local code requirements in order to reach the 30% savings target.

# What You Can Accomplish

- If America's more than 370,000 houses of worship cut energy use by 10 percent…
- **Nearly $315 million would be saved for congregations' missions and other priorities.**
- **More than 1.8 billion kWh of electricity would be available without additional cost and pollution.**
- **More than 1.3 million tons of greenhouse gas emissions would be prevented, equivalent to the emissions of about 240,000 cars, or to planting nearly 300,000 acres of trees.**
- **http://www.energystar.gov/index.cfm?c=small_business.sb_congregations**

# Web Resources

- http://www.energystar.gov/index.cfm?c=small_business.sb_congregations
- http://www.energystar.gov/ia/business/small_business/congregations_guidebook/Cong_Guide.pdf
- http://www.wbdg.org/design/place_worship.php
- http://www.wbdg.org/ccb/DOD/UFC/INACTIVE/ufc_4_730_02n.pdf
- http://www.jameshundt.com/publications/Catholic%20and%20Sustainable.pdf
- http://flourishonline.org/2009/11/flourish-interview-michael-abbate/
- http://www.dpsdesign.org/religious-trends
- http://comperioc3.com/go/the-green-church-initiative/
- http://www.rubiconplanning.com/uploads/UFC-4-730-02-Chapels-and-Religious-Education-Facilities.pdf
- http://interfaithpower.org/wp-content/uploads/2011/08/Solar-Resource-Guide-Final-07.11.11.pdf
- http://issuu.com/nebraskaipl/docs/diy-congregation-energy-audit_kansasipl

# Thank You!

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