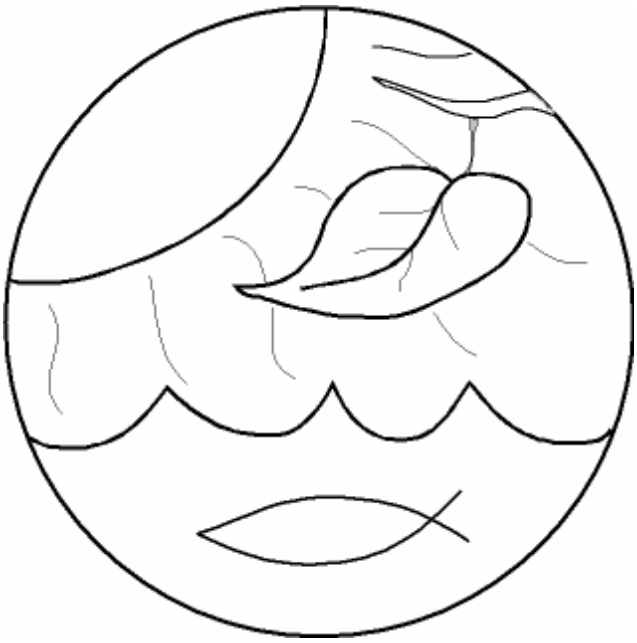
Guidelines for Environmentally Friendly Structures



a checklist for rural churches & related buildings

Compiled by Stephens Architecture,
a member of the U.S. Green Building Council,
for the North Carolina Annual Conference and the
Western North Carolina Conference of the United Methodist Church.
Funded by the Rural Church Division of the Duke Endowment

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Disclaimer

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Reminder

The technology that touches the ideas presented in these guidelines is changing daily. We therefore strongly recommend that you and your architect procure up-to-date information on any of these suggestions before considering them for inclusion in your building project.

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Foreword

Even prior to the establishment of The Duke Endowment in 1924, the Duke family was assisting rural United Methodist churches with building projects. The Duke interest often meant that a rural church received technical assistance from an architect and, that the new building or addition was well designed and fit aptly in its surroundings. The Duke family and The Duke Endowment have long cared for rural churches, their buildings, communities, and natural settings.

More recently attention has been given not only to the ways that buildings are sensitive to their surroundings, but also to how we need to be conscious of how we construct these buildings. Architects and congregations are making the connection between their faith and their care for the environment, especially in their building programs. With the urging of students and faculty at Duke Divinity School, The Duke Endowment sponsored a conference on environmentally friendly structures, "Holy and Beautiful," at Duke Divinity School in the winter of 2005. The conference attracted architects, clergy, lay members of church building committees, and liturgical designers. Dr. Ellen Davis, Professor of Bible and Practical Theology at Duke, challenged the conference participants to consider the theological foundation for the "holy work of constructing sacred space—that is, doing it in a way that glorifies God and at the same time edifies, builds up the people of God." At the conference The Duke Endowment's Rural Church Division announced a challenge to eligible rural United Methodist churches in North Carolina – they would assist with any additional costs for building in a sustainable fashion.

Michael Talton and Paul Stephens were deeply affected by this conference. These North Carolina architects quickly indicated an interest in working with The Duke Endowment and a rural United Methodist church on a building project that sought to be environmentally friendly. The three of us talked about lots of details of such work, and we determined that rural churches, architects, and builders needed some very practical assistance with this work - some general concepts and practical ways to build, while being good stewards of God's creation.

The Duke Endowment commissioned Michael and Paul to pull together such a guide book. I thank them for this hard and important work. We all hope it will assist all houses of worship and congregations as they plan to build. Michael Crosbie, editor of *Faith and Form* Magazine, argues that "almost any strategy to make buildings greener and more efficient will pay off for a forward looking congregation." And Dr. Davis states the sacredness of such work: "Through stone, brick, wood, glass, space, religious architecture articulates a holy knowledge of the world that is properly speaking, ecological." These guidelines are intended to help all of us build to the glory of God.

The Reverend W. Joseph Mann
Director, Rural Church Division of the Duke Endowment

Preface

Paul Stephens and I feel extremely fortunate to have an opportunity to combine several of our own personal interests that, heretofore, have remained distinct and separate. The spiritual, outdoor, and architectural aspects of our lives have all played a part in the production of this document. It is our hope that these guidelines will help every congregation take steps to produce a more sustainable building, and that even if the steps are modest at first, the impact on the environment that the hundred or so churches the Rural Church Division of the Duke Endowment works with each year will be significant. We would like to thank all who supported this endeavor, especially those listed below.

Michael W. O'Neal Talton
New Bern, North Carolina
March 7, 2006

in alphabetical order:

Broad Creek United Methodist Church
Newport, North Carolina

Frank A. DePasquale, AIA Emeritus

David Hatcher
Senior Editor, LANDABOOKS
Washington, D.C.

The Reverend W. Joseph Mann
Director, Rural Church Division of the Duke Endowment

Dennis O. Talton, R.A.
LEED Accredited Professional
Special Assistant for Architecture and Accessibility
Sustainable Development Program Manager
Naval Facilities Engineering Command

U. S. Green Building Council
Washington, D.C.
(who quite literally "wrote the book" on green building guides)

Introduction – The Value of Good Stewardship

It is common practice for many families, as they sit down to a meal, to give thanks for their food. What about water? And clean air? And all the other natural resources? Let us now, as we construct the sacred spaces from which we go forth to do God's work, teach by example and demonstrate the respect that is due the gifts that have been placed in our care. Let the church be a role model in the community. Let us practice loving our neighbors, and be sensitive to the effects our actions have on them. And as good stewards, let us conserve our resources, as their abundance or scarcity will have a direct impact on those with whom we share this planet.

Please set aside some time to look over these guidelines with your building committee and your architect. In fact, the sooner anyone involved in the design or construction of the project (builder, mechanical engineer, etc.) is brought into the process, the better. Consider the building as a whole, with all of its constituent parts integrated, rather than as several separate systems operating as if they were independent of, and ignorant of, of each other. This may be a slightly different way of approaching the building process, but in order to achieve a better, more sustainable, and environmentally friendly product, a new way of thinking is in order.

This list is by no means exhaustive, and not all of the suggestions will be relevant to your project. It is, however, a collection of sustainable* practices that might be used in lieu of more traditional methods that will likely come up for a church, fellowship hall, church office, or Sunday-school classroom. Remember to be creative – innovation, as you move through the design process, will help unite the wants and needs of your congregation into an environmentally friendly package.

The opening lines of the Hebrew Scriptures, commonly called the Old Testament, boldly proclaim that in the beginning, God created the heavens and the earth ~ let's try to keep them healthy.

**When the word* sustainable *is used in this guide, it refers not only to environmental sustainability, but social and economic sustainability as well.*

How to Use These Guidelines

There are many ways to approach the building process. At some point, however, the church ~ probably through a building committee and in conversation with an architect ~ will establish a list of wants or needs. As this "program" is developed, sustainable solutions found in these guidelines should be considered and opportunities created to take advantage of any that may pertain to your building project. Remember, many topics in these guidelines overlap, and the sooner ideas described here are considered, the easier and less expensive it will be to incorporate them into the design process. You may already be under consideration for a grant from the Duke Endowment based on the location of your church. Additional funding may also be available from them if you take steps to build a structure that is more environmentally friendly – check with the Rural Church Division of The Duke Endowment for availability.

As schematic drawings are prepared, your architect should be including the environmentally friendly solutions as alternates in your preliminary cost estimate, with the more traditional solutions as part of your base cost or base bid. What you are trying to establish is the initial cost difference, if any, between the two solutions, and the benefits ~ both short term and long term ~ of the more environmentally friendly solution. This information will be evaluated as your additional funding from the Duke Endowment Rural Church Division is considered.

When your schematic drawings are submitted to the Duke Endowment, a copy of the PRELIMINARY ESTIMATE must be included for review and comment. When actual prices have been established, through a successful bidding process or negotiation, the FINAL SUMMARY will need to be sent to the Duke Endowment. Blank copies of the Preliminary Estimate and the Final Summary can be found in the Appendix, reproduced as needed, and filled out by hand. If it would be more convenient, electronic files containing those forms, with the formulas in place, can be obtained by contacting Stephens Architecture (www.stephensarchitecture.com) by telephone at (252) 637-3301 or by contacting me by e-mail (michael@stephensarchitecture.com).

Finally, as the project is completed, your architect will need to send a letter to the Duke Endowment confirming that each of the environmentally friendly solutions you planned to use was actually implemented, or if not, which were omitted.

In short:

- while developing the building "program," consider environmentally friendly options
- submit PRELIMINARY ESTIMATE with schematic drawings to the Duke Endowment, listing your environmentally friendly solutions as alternates.
- submit FINAL SUMMARY (after actual prices are determined) to the Duke Endowment
- submit letter from your architect confirming implementation of alternatives, after construction is complete

YOUR SITE

Choosing your Site

You may have some choices when you are deciding where to put your building on your site. Quite simply, try to locate your building so that it has the least impact on the environment. A survey or site plan that shows trees, major vegetation, wetlands, waterways, and other site features may be helpful during the planning stages.

What you can do:

- Work around significant trees.
- Do not disturb creeks and streams that are on your site.
- Protect wildlife habitat that is present.
- Use land that has been previously cleared or developed.

Benefits:

- Reduced impact on wildlife habitat, trees, vegetation, and local waterways.
- Aesthetic appeal ~ a building that takes advantage of natural landscape features such as trees and streams will have a much more pleasant and welcoming appearance than one dropped in the middle of a clear-cut site without regard to the surrounding environment.
- Outward display of good stewardship.

Soil Erosion

Soil erosion can occur during and after construction, when wind and water carry soil off your site and deposit it in nearby creeks and streams or local stormwater systems. It is usually the result of changing the natural land contours and the destruction of existing vegetation when clearing the site, leaving the soil exposed and vulnerable to the forces of nature.

What you can do:

- Minimize disturbance to natural drainage, land contours, and vegetation during construction.
- Put down mulch where soil is exposed. Not only will it slow down soil erosion, but it will also help reduce moisture loss due to evaporation.
- Use quick-growing grasses as a temporary means of slowing down soil erosion.
- Use mulch around trees, shrubs, and planting beds as part of a long-term plan.
- For permanent landscaping, use native plants, trees, and shrubs to help your soil resist erosion over time.
- Erect fabric fences during construction to filter sediment and keep silt out of stormwater systems and local waterways.

Benefits:

- Reduced burden on your local stormwater system.
- Reduced amount of silt and sediment that would contaminate creeks, streams, and other bodies of water.
- Reduced risk that soil erosion may expose the building foundations, which could compromise the structural system.

Applications:

- Any time your site is disturbed, consider steps to prevent soil erosion.
- Many of the actions to reduce erosion can be taken by members of the church.
- Your local Cooperative Extension Service may be able to help you determine what types of mulch (hay, pine straw, etc.) and grasses may be appropriate for temporary control, and will also be able to assist in the selection of permanent plants, trees, and shrubs for your area.

Sources:

- **"Mulching Trees and Shrubs"**
  Erv Evans, Consumer Horticulturist
  North Carolina State University
- **North Carolina Cooperative Extension Service**
  www.ces.ncsu.edu

Easy as Riding a Bike

That's right. One way to reduce the negative effects that automobile use has on our environment is to take advantage of alternative forms of transportation.

What you can do:

- Encourage churchgoers to take advantage of nice weather by walking or riding bicycles.
- Provide secure bike racks. Covered racks are especially nice. Check with your local building official to see if they would consider a reduction in your parking space requirements in return for providing facilities for a certain number of bicycles. This would reduce the quantity of paved surface and stormwater runoff, plus initial paving costs.
- Make some space available to change clothes, either by adding some square footage to the toilets, choir robing room, etc., or providing separate changing rooms that could accommodate a bench or chairs, lockers, or a shower stall.

Benefits:

- Saves energy and dollars by reducing automobile fuel consumption.

- Reduces air and water pollution associated with automobile exhausts.
- Increases exercise – most of us could probably use a little more anyway.

Cost ($):

- The initial cost of accommodating bicycle use varies greatly. For example:
  a) Racks – a simple, galvanized rack for a half dozen bicycles may cost $150-$200, or up to $350-$400 for one that would secure 20 bikes. More elaborate racks may be twice that.
  b) (6) 12”x12”x60” typical metal school lockers may cost $ 300-$900 new. Used lockers may also be an option.
  c) A basic one-piece shower enclosure can probably be found in the $100 - $500 price range.

Sources:

- **Dero Bike Rack Company**
  2627 32nd Avenue S
  Minneapolis, MN 55406
  www.dero.com
- **Locker Solutions**
  www.lockersolutions.com

Carpools

It’s an old concept – individuals heading in the same direction at the same time sharing one vehicle. Minimizing the total number of vehicles that come to your church on a Sunday morning is another good way to use less fuel, save money, and reduce automobile exhaust pollution.

What you can do:

- Encourage churchgoers to ride together when possible.
- Offer an incentive – cars filled to capacity or carpooling get to park in those spaces right up front.

Benefits:

- Saves energy and dollars by reducing automobile fuel consumption.
- Reduces air and water pollution associated with automobile exhausts.

Stormwater Runoff

When rain or snow falls on an undeveloped site, some is absorbed by the ground, and some travels over the surface to awaiting creeks, rivers, ponds, lakes, etc. When a site is developed, and hard, impervious surfaces replace vegetation, more water is diverted from the site, via natural waterways or your local stormwater system. This additional water may also contain sediment and pollutants (stormwater that runs off parking areas carries oil and gasoline residue, etc.), which will either end up in our waterways or require treatment.

What you can do:

- Minimize the amount of hard, impervious surfaces on your site. For example:
  a) Build only what you need. This is not as easy as it sounds, and may require your church to spend some time in thoughtful prayer in an effort to determine what your needs *really* are.
  b) Use paving systems that allow water to reach the soil, in lieu of traditional asphalt or concrete. Historically, these systems work best in areas with lower traffic volumes such as parking spaces (especially "overflow" parking) and service roads. These systems are composed of plastic or concrete grids, or interlocking pavers, so you can place gravel in the voids or allow grass to grow through. Your could also use porous paving, which allows water to seep through the actual paving to the soil below. There are maintenance issues with both methods – one may require the grass to be mowed, and the other requires occasional vacuuming or sweeping as the air spaces in the concrete fill with surface dirt.
  c) Plan parking areas efficiently, with the aim of reducing the amount of paving used for automobile circulation.
  d) Minimize sidewalk areas where possible.
  e) Turn your roof into a prayer garden. Otherwise known as garden roofs, green roofs, and vegetated roofs, these can significantly reduce the amount of hard surface included in your project AND provide an opportunity to create additional, usable space. A vegetated roof is considered to have a longer life and to require less maintenance than a traditional roofing system, especially when native plants and grasses are used. It will generally consist of three parts:
     1) plants and soil,
     2) a layer that temporarily retains the rain water,
     3) and a synthetic liner which keeps water from penetrating the building.
- Re-use the stormwater runoff that you *do* generate. For example:
  a) Collect the water that comes off your roof for non-potable purposes such as flushing toilets or landscape irrigation. Systems for doing this consist of three parts:
     1) a water-collection system to gather the water and transport it to the storage cistern,
     2) a cistern, to store the water,
     3) and a water-distribution system, usually including a pump, to move the stored water to where it is needed.
- Treat the runoff that you don't re-use. For example:

a) To assist in filtration, divert stormwater from roofs and parking areas to vegetated swales instead of concrete culverts.

b) Construct a pond (or series of ponds) to allow pollutants to settle and biodegrade.

- Share parking areas with neighboring businesses, schools, etc. You and your architect can check with your local zoning officials about sharing parking and thereby reducing both your paving cost and the amount of impervious surface imposed on the landscape, which will benefit your local water treatment facility.

Benefits:

- Reduced volume of water sent to your municipal treatment facility, which will have a positive effect on the size of the treatment system (less water to move and treat) and maintenance of the facility.
- Improved quality of the water that is diverted from your site to receiving waters ~ reducing the burden on both the environment and your local water- treatment facility by keeping sediment and pollutants out of the "system."
- Decreased chance of depleting your regional aquifer. By diverting less water from your site, you stay closer to the natural cycle of replenishing your groundwater.
- Reduced impervious surface and lower cost will result from planning parking areas efficiently and minimizing sidewalks where possible.
- Increased thermal insulation, decreased stormwater runoff, and an opportunity for a prayer garden or intimate outdoor chapel in a natural setting that is removed from the street level and its associated noise and distractions.

Applications:

- The many ideas discussed in this section can be applied to parking areas, service roads, walks, and rooftops. Worthy of special mention would be the use of paver blocks or grids for overflow parking ~ a phenomenon common to most churches, especially at Christmas and Easter ~ and making an opportunity for a rooftop prayer garden or chapel. A vegetated roof is a much more involved roof than a traditional roofing system at this point in time, but is becoming more common every day.

Cost ($):

- Reducing the area of your building to exactly what you need, minimizing walkways, and designing your parking area efficiently ~ or arranging to share parking with another facility ~ will reduce initial costs.
- Currently, pervious paving systems are a little more expensive than a traditional pavement such as asphalt. This additional cost, however, may be offset by the reduction in curbs and gutters, plus reduced infrastructure for transporting stormwater runoff.
- The costs associated with vegetated swales and ponds used for bioretention vary with the complexity of the system. Simple swales can be considered part of the overall lancscaping, whereas more-involved systems of ponds may be relatively expensive compared to an area with minimal landscaping.

- At this time, the initial cost of a modest green roof (1-5 inches of soil depth, planted with ground cover and grasses, approximately 12-15 pounds per square foot, with a simple irrigation and drainage system) is about $8 per square foot, installed. In contrast, a traditional built-up roof may run between $1.25 and $1.50 per square foot, installed. Part of the additional cost should decrease as roofing contractors become more familiar with the process, and as the demand for green roofs increases, spawning an increase in the number of green-roof installers. Reduced stormwater infrastructure, increased insulation to reduce the amount of heating and cooling costs, and the longer life of a vegetated roof (the vegetation reduces the amount of damage from UV radiation to the roof substrate) over a traditional roofing system, will also help offset the higher initial costs.
- Costs for rainwater-harvesting systems (collection, storage, and re-distribution) vary from $1,300.00 to $4,500.00, depending on the size and complexity of the system installed. They are currently more costly than hooking up to a municipal water system, but some of the difference in cost may be offset over time by reduced utility bills.

Sources:

- **Advanced Buildings Technologies & Practices**
  www.advancedbuildings.org
- *New Jersey Stormwater Best Management Practices Manual*
  Chapter 9.7, February 2004
  "Standard for Pervious Paving Systems"
  www.state.nj.us/dep/stormwater
- *Tennessee Valley Authority Economic Development*
  "Sustainable Development Guide"
  www.tvaed.com/sustainable/index.htm
- *The Texas Manual on Rainwater Harvesting*
  Texas Water Development Board
  Third Edition, 2005
  www.twdb.state.tx.us/ home/index.asp
- **U. S. Department of Transportation**
  Federal Highway Administration
  "Planning, Environment, and Realty (HEP)"
  www.fhwa.dot.gov/environment
- **U. S. Environmental Protection Agency**
  "Polluted Runoff (Nonpoint Source Pollution)"
  www.epa.gov/owow/nps/whatis.html
- **"Heat Island Effect (Green Roofs)"**
  www.epa.gov/hiri/strategies/greenroofs.html

What's a "Heat Island"?

"Heat Island" is the term used to describe the higher temperature near a developed area that has traded trees and vegetation for buildings and roads. According to the EPA, the temperature difference between the developed area and a nearby rural area can be as

much as 10°F. The EPA also estimates that the U. S. currently spends about $40 BILLION to air-condition buildings.

What you can do:

- Keep existing trees.
- Plant trees to shade buildings, usually on the south, southeast, and southwest exposures. To take advantage of the warming sun when you need it, use native, deciduous trees that will provide shade during the summer, and drop their leaves in the winter. If trees are not practical, a trellis with vines will create shading for walls, walks, and drives, plus provide an enormous aesthetic value. Imagine driving (or biking or walking) up to your church on a hot Sunday morning under a canopy of shade trees or through the cool, green light of a trellis adorned with ivy. In addition to helping to reduce soil erosion, plants, shrubs and trees allow evaporation to help cool the landscape. One thing to keep in mind is that shading a building must be coordinated with other parts of the overall design, such as using the sun for solar collectors, passive solar gain, and daylighting. And while you are planting trees, remember that evergreens between your building and the prevailing winter winds will assist in keeping your heating costs down. NOTE: be sure to balance your need to reduce heating costs by blocking winter winds (in cooler climates) with the need to use summer breezes to cool and ventilate (in warmer climates).
- Putting plants (grasses, shrubs, etc.) outside windows can reduce glare and the amount of heat that is absorbed through windows that could be reflected by paving surfaces.
- Use paving that is light in color and reflects sunlight instead of absorbing the sun's heat, or a pervious paving that allows water to infiltrate the soil below and cool the paving through evaporation. Using concrete made with a white cement rather than a grey cement makes a huge difference, and either of these reflect much more light than asphalt. Care should be taken, however, in placement of light-colored, reflective surfaces where they could pose a hazard to driving, an annoyance to building occupants due to excessive glare, or contribute to "light pollution."
- Choose a roofing material that reflects sunlight (a high *albedo*) and the ability to release the heat that it does absorb (a high *emittance*). For flat or low-sloped roofs, the EPA recommends that the roofing material have a reflectance of 65% or more, and that sloped roofs have a reflectance of at least 25%. We suggest that you and your architect research roofing materials on the EPA's Energy Star website (www.energystar.gov) for assistance. Another alternative to choosing a roofing material that reflects solar energy is the roof garden, discussed in the previous section, that keeps the roof cool through evaporation. Please note that in cold climates (where the largest concern is keeping a building warm rather than cool), the benefits would be much smaller.

Benefits:

- Trees, shrubs, and other vegetation that shade buildings, parking areas, and walks can reduce energy and costs consumed for cooling by 25%.
- A roofing material that reflects over 65% of the solar energy that would have been absorbed by traditional asphalt roofing can reduce the roof temperature by approximately 70°F, which translates into reduced utility costs during the air-conditioning season.
- A roof garden may cut the traditional asphalt summertime roof temperature of 190°F by more than half.

- Reducing the "Heat Island" effect lowers the impact on nearby plants and animals that may be more sensitive to local climate changes.
- As most real estate professionals will attest, trees and landscaping will add to the property value of your facility.

Applications:

- Trees and landscaping can have a profound impact on the outward appearance of your church, presenting a welcoming and inviting feel for new-comers and old-timers alike.
- A roof garden presents opportunities already discussed in the previous section.

Cost ($):

- The higher costs associated with vegetated roofs is discussed in a previous section, and may be largely offset over time because of lower utility bills, especially during the cooling season.
- Using lighter colored cement usually costs more than traditional asphalt. One consideration is that a solution such as pervious pavement or paver blocks that allow grass to grow through may provide additional advantages, such as helping to reduce the stormwater runoff.
- The cost of planting trees and other vegetation would be similar to any other landscaping expenses, especially if native plants are used.
- The higher initial costs of a more-reflective roof will be partially offset over time by lower utility bills during the cooling season.

Sources:

- **Energy Star Program**
  www.energystar.gov
- **U. S. Environmental Protection Agency**
  www.epa.gov

Light "Pollution"

When areas are lighted without regard to where the light is actually going, several things occur. One, it can shine onto adjacent properties, whose owners may or may not desire it. Two, unnecessary lighting comes at no small cost in energy and dollars. Also, light that is unneccessary contributes to a phenomenon called "light pollution" that is cutting us off from one of God's most spectacular aspects of creation – the stars in the night sky.

What you can do:

- If outdoor lighting is required, use fixtures that shield the light from shining in undesired directions, such as up into the night sky, and onto neighboring properties. The International Dark-Sky Association publishes a list of shielded fixtures - see "Sources" below.

- Keep exterior lighting set back from the property line, since light that bleeds over the line could have been used for your lighting needs.
- Keep the wattage of the lighting as low as possible and still maintain a safe environment.
- Reduce the level of light shining on the outside of your building(s).
- Work closely with your architect's electrical consultant or other lighting expert to help navigate the ins and outs of putting light only where you need it, and at an appropriate level. Remember – it is the *quality* of the lighting that is used rather than the *quantitiy* that determines a safe outdoor environment.

Benefits:

- The church becomes a better neighbor by not allowing the light it generates to "trespass" on adjacent properties.
- Saves energy and money by not lighting unneccessarily.
- Helps congregation and other community members gain access to the night sky and all its splendors.
- Reduces impact on nocturnal wildlife.

Source:

- **International Dark-Sky Association**
  www.darksky.org/keyword

Landscape Irrigation

Water is one of our most valuable natural resources, and a complex, costly infrastructure is required to bring potable water to our buildings, then carry it away again to be treated after use. Reducing or eliminating the use of potable water for irrigation is one way we can help conserve one of our most precious gifts.

What you can do:

- Use native plants and trees for landscaping – they tend to have lower irrigation requirements than non-native species.
- Collect rainwater to re-use for irrigation.

Benefits:

- Conserves one of our natural resources.
- Reduces impact on municipal water and sewer infrastructure.
- Reduces utility costs.
- Reduces need for maintenance, chemicals and fertilizers (native plant species require less of all three).

Cost ($):

- Selecting native plants for landscaping should add no additional cost to your project.
- Using some of your collected water for irrigation would be an added benefit if you are considering a water-collection system for other purposes, such as reducing stormwater runoff.

Source:

- **Advanced Buildings Technologies & Practices**
  www.advancedbuildings.org

Waste Water and Reducing Your Water Use

As stated in the previous section, water is one of our most valuable natural resources. Using potable water, which has been treated, to transport sewer wastes to the treatment facility, only to be treated again, is a costly and inefficient use of a precious resource.

In his article Frequently Asked Questions About Septic Systems (May/June 2002), Dr. Ted Loudon, of the Agricultural Engineering Department of Michigan State University, has this to offer about septic systems, which churches in many rural areas will be using: "The environmental impact of a septic system depends upon the environment in which it functions. A septic system in very sandy soils with a shallow water table and no clay soil between the bottom of the septic system soil absorption trenches and the water table will contribute nitrate to the groundwater. If there is a clay layer protecting the groundwater, it is likely that very little nitrate will reach the groundwater. Also, septic systems in very permeable soils can result in pathogenic bacteria and viruses reaching the groundwater. However, after a system has been in use for a while and a "biomat" or soil-clogging layer is formed in the soil absorption system, the removal of bacteria and viruses in the soil is very efficient. This is because the biomat slows the rate of water entry into the natural soil and produces slow, unsaturated flow through the natural soil. This greatly enhances the ability of the soil to remove pathogens.

Failing systems that result in water coming to the surface are a public health hazard and can cause surface water contamination by nutrients and pathogens. If a system is functioning hydraulically (i.e. accepting the water) in a slowly permeable soil there will be very little environmental impact."

"We thank you, Almighty God, for the gift of water.
Over it the Holy Spirit moved in the beginning of creation.
Through it you led the children of Israel out of their bondage
in Egypt into the land of promise. In it your Son Jesus
received the baptism of John and was anointed by the Holy
Spirit as the Messiah, the Christ, to lead us, through his death
and resurrection, from the bondage of sin into everlasting life."

- from the Sacrament of Holy Baptism,
  found in the 1979 U.S. *Book of Common Prayer*,
  as used by The Episcopal Church

What you can do:

- Use water collected from roof runoff rather than potable water to flush toilets and urinals.
- Use low-flow toilet fixtures or waterless urinals.
- Specify aerators for all faucets to restrict water flow.

Benefits:

- Reduced consumption of potable water, conserving a natural resource and reducing utility costs.
- Reduced impact on municipal water-treatment systems.

Cost ($):

- Almost all toilet fixtures are now low-flow models, and should not require any additional costs.
- Waterless urinals cost less than traditional fixtures with flush valves, and are not plumbed with a water-supply line, increasing the cost savings.
- Collecting rain water would add expense – see Costs under **Stormwater Runoff**.

Source:

- **Advanced Buildings Technologies & Practices**
  www.advancedbuildings.org

REDUCING YOUR ENERGY NEEDS

Building Size

One way to reduce the amount of energy your building consumes is to refrain from building any more than you need. Generally, the larger the building, the more air that needs to be conditioned, the more space that needs to be heated, and the more material that will be needed to construct it.

What you can do:

- Take the time during the beginning of the project to carefully program your needs with your building committee and your architect.
- Decide whether some finishes are really necessary. For example, carpet or tile may not be needed in mechanical rooms, or finished concrete may be perfectly acceptable in toilets, corridors, kitchens, or fellowship halls.
- Organize your building so that you have the ability to share parts of your facility – libraries, multi-purpose rooms, classrooms, etc. - with other groups in your community.

Benefits:

- Reduced material and utility costs.
- Reduced size and cost of your heating and cooling system.

Automatic Sensors

Lighting requires a large portion of a building's energy needs, so keeping the lights off when an area is not in use usually saves energy and money.

What you can do:

- Install sensors that will automatically turn off lights when room is not occupied. There are two main types of sensors available: Passive Infra-red (PIR) sensors that detect heat, and Ultrasonic sensors that detect motion. For individual offices, a lower cost, wall-mounted PIR sensor is probably sufficient. In larger open offices or classrooms, a ceiling-mounted PIR sensor might be a better choice. For areas with obstructions, an ultrasonic sensor is recommended.

Benefit:

- Saves energy and money ~ a sensor can reduce a room's energy use by 30% - 60%.

Applications:

- Automatic sensors would work well in any room without a lot of partitions, such as classrooms and offices. The sensors are also equipped with a manual switch in the event that the room is occupied and needs the lights off.

Cost ($):

- Currently, sensors cost between $65 and $175, which should be offset by energy savings in about two years.

Source:

- **Advanced Buildings Technologies & Practices**
  www.advancedbuildings.org

Lighting

About 1/3 of the energy consumed in the United States goes to buildings. Almost 40% of *THAT* energy is dedicated to keeping the lights on.

> "The two main determinants of excellence in church architecture are the quality of its enclosed space and of its natural light. It cannot be emphasized strongly enough that the sources and flow of daylight are among the most important factors in the success or failure of a church."
>
> - G. E. Kidder Smith, FAIA
> *The New Churches of Europe*
> Holt, Rinehart & Winston, Inc., 1964

What you can do:

- Light only what you need. Rather than indiscriminately filling a room with light fixtures, take time with your architect to decide exactly where light is required, and light only for those specific needs.
- Use high-efficiency bulbs. Inside, use compact fluorescent lamps instead of incandescent where possible – they use about 75% less energy, and last 10 times longer. Even exit signs, which stay on all the time, can become more efficient by using a compact fluorescent or LED. Outside, metal halide lamps and low-temperature fluorescents generally use less energy than other types.
- Use daylighting to bring more natural light into your building with:
  a) open planning where possible, with fewer partitions to obstruct the daylight,
  b) light shelves to both block the direct summer sun and bounce light indirectly onto the ceiling,
  c) slope ceilings to let more indirect light in,
  d) use light colors on ceilings and walls to increase the amount of reflected light,
  e) use vertical clerestory windows and "light tubes" to let daylight penetrate the interior of the building.

Benefits:

- Reduced energy consumption that will save money, resources, and lessen the world's dependence on fossil fuels.
- Reduced energy expended for lighting also reduces the heating load on your cooling system.
- Vastly improved quality of the interior space from bringing natural light into your building.

Cost ($):

- Daylight is readily available at no cost.
- The initial cost difference between compact fluorescents and incandescent bulbs is offset by longer life, lower heat output, and reduced wattage, which will be reflected in lower utility and maintenance costs for your church.

Sources:

- **Union of Concerned Scientists**
  Citizens and Scientists for Environmental Solutions
  www.ucsusa.org

- **U.S. Department of Energy**
  www.eere.energy.gov/buildings/info/design/integratedbuilding/passivedaylighting.html#window

USING FREE AND RENEWABLE ENERGY

Nighttime Air and Natural Ventilation

Prevailing breezes, cool nighttime air, and the fact that hot air rises all provide opportunities to use natural ventilation to help cool your building. Air movement enhances heat transfer between the air and the human body, accelerating the cooling process through evaporation. This lowers the "apparent" temperature by a few degrees, extending the season when no air-conditioning is needed.

What you can do:

- Provide operable windows that will gather in the prevailing breezes and allow a draft. The humidity in your area may be a factor in how far into the cooling season natural ventilation is viable.
- Since heat rises, provide openings up high to allow the hot air to escape. This same principle, coupled with openings low in the building, will allow the warm air that is exiting in the upper part of the building to draw in the cooler nighttime air.
- Use ceiling fans to supplement natural air movement and get the most out of your air conditioning system.
- Use open planning where possible to assist in natural ventilation.

Benefit:

- Reduces burden on heating and cooling system. In some cases, a smaller system may be feasible, increasing your cost savings.

Cost ($):

- There may be a slight initial cost difference between operable and inoperable windows.

Source:

- **Union of Concerned Scientists**
  Citizens and Scientists for Environmental Solutions
  www.ucsusa.org

The Constant Temperature of the Earth (geothermal energy)

"The geothermal heat pump, also known as the ground source heat pump, is a highly efficient renewable energy technology that is gaining wide acceptance for both residential and commercial buildings. Geothermal heat pumps are used for space heating and cooling, as well as water heating. Its great advantage is that it works by concentrating naturally existing heat, rather than by producing heat through combustion of fossil fuels.

The technology relies on the fact that the Earth (beneath the surface) remains at a relatively constant temperature throughout the year, warmer than the air above it during the winter and cooler in the summer, very much like a cave. The geothermal heat pump takes

advantage of this by transferring heat stored in the Earth or in ground water into a building during the winter, and transferring it out of the building and back into the ground during the summer. The ground, in other words, acts as a heat source in winter and a heat sink in summer."

- U.S. Department of Energy
  Energy Efficiency and Renewable Energy
  www1.eere.gov/geothermal/heatpumps.html

What you can do:

- Install a ground-source heat pump, that uses the constant temperature of the earth and groundwater to heat and cool a building in a closed loop system.

Benefits:

- Ground-source heat pumps can reduce energy consumption by 50% or more. The largest benefit, however, will be for buildings that require heating and cooling for extended periods of time.
- Surface area is required for wells (under parking areas is acceptable), but there are no outdoor units to screen. This is especially helpful if there is no "back" to your building.

Cost ($):

- Ground source heat pumps currently have a higher initial cost than a traditional heat pump, but realize lower utility costs over time.

Sources:

- **Advanced Buildings Technologies & Practices**
  www.advancedbuildings.org
- **International Ground Source Heat Pump Association**
  www.igshpa.okstate.edu

The Sun (passive solar energy)

The sun is a source of free energy that can be passively collected, stored, and distributed to assist in heating your building. There are volumes and volumes written on this subject, so the following should be considered the tip of the proverbial iceberg.

What you can do:

- Orient the building along an east–west axis, so that the longer side faces within 15 degrees of due south. Within 30 degrees is acceptable, but within 15 degrees is best.
- Provide windows on the south side of your building to let the sun's warming rays in during the winter. The "south facing window" to "total wall" ratio should stay below 25% to 35%, or there is a chance of overheating the building. The type of glass in

your windows also plays an important role in energy efficiency of your building – please see **Insulated and Low "E" Glass**.

- Place windows on the north side of your building judiciously, according to your location. They will be on the "cold" side of the building, which will be a disadvantage in cooler climates, but can be useful for letting in "cooler" light and ventilating breezes in warmer climates. They will also admit the indirect, non-glaring north light favored by artists, which is useful to light parts of the sanctuary without getting glare from direct sunlight.
- Don't forget (see **What's a "Heat Island?"**) to use native deciduous trees or ample roof overhangs to shield the building interior from the sun in the summer months. Interior "light shelves" and blinds can also be employed to help control the summer sun. A "light shelf" can perform the same shading function as a roof overhang by blocking the high summer sun and letting the low winter sun in. It also provides a convenient location for an operable window up high in a room for ventilation, and helps reflect indirect light up to the ceiling and farther into a room.
- Place materials such as concrete or brick where they can absorb and store the sun's heat coming through your south windows on the winter days, to be released later in the evening.
- Depending on your location, put the rooms that are occupied more regularly on the south side of the building, keeping the storage, mechanical rooms, etc., on the north side to act as buffers. If cooling your building consumes more of your annual budget than heating, you might need to do just the opposite.

Benefit:

- Passive solar energy can provide up to 50% or more of a small building's heating energy needs.

Cost ($):

- If the site allows, the cost for orienting a building on an east–west axis adds little or nothing to the cost.

Sources:

- **Advanced Buildings Technologies & Practices**
  www.advancedbuildings.org

- **Union of Concerned Scientists**
  Citizens and Scientists for Environmental Solutions
  www.ucsusa.org

The Sun (solar collectors and photovoltaics)

Photovoltaic cells convert free sunlight directly into electricity. The photovoltaic system may be tied directly into the local utility grid. When the system produces more electricity than the building is using, that electricity flows back into the utility's wires, and can be purchased by the utility company at a competitive rate. When the building requires more electricity than the photovoltaics can provide, it is purchased from the utility company in the

traditional method. Solar collectors have been around for a long time, are always being improved, and as with passive solar energy, there are numerous books and manuals relating to them.

What you can do:

- Discuss with your architect, utility company, and local building officials the feasibility of incorporating solar collectors in your project.

Benefits:

- Reduced consumption of resources, especially fossil fuels.
- Lower monthly utility costs for your church.

Cost ($):

- Initial costs are still currently high, but will be partially offset by lower utility costs over time.

Sources:

- **Advanced Buildings Technologies & Practices**
  www.advancedbuildings.org
- **Union of Concerned Scientists**
  Citizens and Scientists for Environmental Solutions
  www.ucsusa.org

INCREASING YOUR ENERGY EFFICIENCY

Insulation

This section concerns the *quantity* of insulation, which directly affects the transfer of heat and cold through your building "envelope," and therefore how energy efficient your building is. Some *types* of insulation are discussed in the **Materials** section.

What you can do:

- Install insulation in your roof and walls to achieve a higher R-value than what the building code considers a minimum standard. The R-value is a measure of the thermal *resistance* – the higher the R-value, the better the product insulates.

Benefits:

- Conserves energy and money with reduced utility bills.

Cost ($):

- The initial cost of additional building insulation is a tiny fraction of the overall building cost, and will be offset by lower utility bills.

Earth Berms

An earth berm is simply a mound of dirt near or against an exterior wall, that can act as a wind break or provide thermal insulation.

What you can do:

- Construct an earth berm, normally on the north side of your building.

Benefits:

- When placed against the wall, it will act as insulation.
- Set back from the building, it will help to deflect winds around, or up and over, your building. The decision to use an earth berm to create a wind break will need to be evaluated taking into consideration your local weather patterns and region, and whether it is more beneficial to maintain air movement around your building for cooling and natural ventilation during the cooling season, or to protect your building from winter winds during the heating season.

Cost ($):

- Generally, the cost of dirt is minimal, and you may have surplus fill available from excavations for footings, etc. already on your site.

Source:

- **U. S. Department of Energy**
  www.eere.energy.gov

Insulated and Low "E" Glass

Insulated glass is one way to "insulate" your window openings. Instead of a single piece of glass standing as the barrier between hot and cold, insulated glass is a sealed unit made up of two pieces of glass with an air space between, usually filled with argon gas. Additionally, each piece of glass can be made or coated to vary its color, tint, or reflectivity, which will have an effect on how the sun's energy and visible light enter your building, plus how much heat escapes from the inside to the outside through conductivity.

What you can do:

- Use insulated glass.
- Where you have glass, determine how you want to handle the sunlight and the transfer of heat through that glass. Some of the major concerns ~ which should be discussed with your architect ~ are as follows:

  a) How much of the sun's energy (heat) enters your building? Half of this energy is visible light, most of which you will want to let in. The other half of the heat is not visible, and blocking that will reduce the amount of heat gain without changing the quality of the light or the view to the outside. This is important during the cooling season to reduce the need for air conditioning, and can be dealt with by using a reflective glass that actually reflects some of the sun's energy, or a "low-e" coating that absorbs the energy and pushes it back outside. The downside of this is that, during the heating season, it would be good to allow that heat to enter and help heat your space. As mentioned in another section, other ways to solve this riddle are by using building overhangs, light shelves, and blinds. The way the glass industry measures how much heat your glass lets in is called the Solar Heat Gain Coefficient, a number between 0 and 1. The lower the number, the less the heat gain.

  b) Energy (heat) is also transferred through glass (and curiously, this can happen at the same time that heat in the form of sunlight is coming from the outside INTO your building) when heat moves from the warm inside to the colder outside through conductivity. The conductivity of glass is indicated by its U-factor. The lower the U-factor, the more it will resist heat flow, and the greater its insulating value.

Benefit:

- The right glazing in the right situation can reduce the amount of energy needed to heat or cool the building.

Applications:

- The benefits of different types of glass in different situations will have to be analyzed carefully with your architect to see which gives the greatest benefit, and achieves the best balance between letting heat in to warm the building in winter and keeping heat out to reduce the cooling requirements during the summer.
- PLEASE NOTE: Special care should be taken when working with existing stained glass. For example, applying a clear window on the outside of existing stained glass (without proper ventilation) to protect it from vandalism, for example, may actually damage the older glass because of stresses created by a layer of trapped air that heats up.

Cost ($):

- Insulated glass is the standard. Adding reflective or low-E coatings increases the initial cost of windows slightly, and may be offset by reduced utility bills over time.

Source:

- **Pilkington North America (glass)**
  www.pilkington.com
  Chris Barry, technical services
  (419) 247-4203

Roof Color

Something as simple as the color of your roof has an impact on the amount of energy your church consumes, and the amount of your monthly utility bill. A roof that is light in color or somewhat reflective will reduce the amount of heat that it absorbs.

What you can do:

- Use roofing materials that are light in color or reflective in nature.

Benefits:

- Reduced energy consumption.
- Lower utility costs.

Cost ($):

- There may not necessarily be any initial cost difference between similar materials in different colors.

Source:

- **Union of Concerned Scientists**
  Citizens and Scientists for Environmental Solutions
  www.ucsusa.org

Size of Heating / Cooling System

Efficient, well insulated buildings that take advantage of some of the ideas put forth in these guidelines and other places may require a smaller heating and cooling system than a building that depends solely on some of the more-traditional building methods.

What you can do:

- Make sure that the architect's mechanical consultant takes into account all of the energy-saving ideas you have incorporated into your building when sizing the heating/cooling system.

Benefit:

- A smaller system costs less to begin with, and requires less to operate over time.

Size and Shape of Ducts

The size and shape of the ductwork that makes up your heating and cooling system will have an impact on how easily, and therefore how efficiently, the air moves through the system.

Shape: all else being equal, a round duct will create less friction as the air moves through it than a rectangular duct with the same cross-sectional area. For example, in order for a rectangular duct to move air at the same efficiency as a round duct with a cross sectional area of 3.14 square feet (a 30 inch diameter), it would have to have an area of 5.67 square feet, almost twice that of the round duct, say 16"x51".

Size: a duct that is sized too small will force the air out at an excessive volume, which is inefficient and noisy. One that is sized too large may not push the air out at a high enough volume, causing the air in a room to stratify, forcing the user to try to correct the problem with the thermostat. This too reduces the efficiency of the system.

What you can do:

- Consider using round ductwork.

Benefit:

- More efficient heating and cooling system.

Cost ($):

- Round ducts currently have a slightly higher initial cost than rectangular ducts; this would eventually be offset by reduced utility costs.

Sources:

- **"Reduce System Costs with Right-Sized Ducts"**
  www.energystar.gov/ia/partners/bldrs_lenders_raters/downloads/BuilderGuide3C.pdf
- **"The Great Duct Debate: Another View on Equivalent Sizing"**
  John Gierzak
  www.mcgillairflow.com/newsDocs/newsPDFS/techTips.pdf

Multiple Units for Heating / Cooling Systems

Of particular interest to a church facility, with building-use fluctuating substantially from day to day, is the possibility of multiple, smaller HVAC units in lieu of one big one. This would allow a more efficient operation, since the operating size at any given time could be more accurately matched to the changing occupant load.

What you can do:

- Use multiple, smaller units rather than one large unit.
- Organize your building(s) so that different zones can be heated and cooled independently.

Benefit:

- Conserves energy by running equipment that is sized appropriately for the job.

Cost ($):

- Initial cost of multiple, smaller units may be higher than a single one of equal capacity, but costs may be offset by energy savings, and increased life of equipment.

Tankless Water Heaters

A tankless, or instantaneous, water heater, heats water on demand, as the water passes through it on the way to the user. It does not heat water and store it, as with a traditional tank-type water heater, so there is no energy lost to heated water standing idle in a storage tank.

What you can do:

- Install a tankless water heater in lieu of a traditional tank-type water heater.
- NOTE: if you install a tank-type water heater, be sure to insulate it properly.

Benefits:

- Conserves energy since there is no energy lost to heated water standing idle for most of the week.
- Saves space, because most tankless water heaters take up less room than a small briefcase.
- Reduces landfill burden, since a tankless water heater is a fraction of the size of a tank-type.

Application:

- Most church facilities require the bulk of their heated water during one specific time of the week, with greatly reduced hot-water needs during the rest of the week. To meet this type of demand more efficiently, a tankless water heater could be used.

Cost ($):

- Currently, the initial cost of a tankless water heater is higher than a tank-type, but the difference will be offset by energy savings over time.

Source:

- **PATH (The Partnership for Advancement of Technology in Housing)**
  Technology Inventory
  www.toolbase.org

MATERIALS

Re-using Existing Buildings

We have all seen this symbol:  . It reminds us to REDUCE, RE-USE, & RECYCLE. Re-using and recycling are good, but the most-effective way to handle our waste is to avoid producing it in the first place. Using a building that already exists may be a means of keeping large amounts of demolition waste, as well as new-construction waste, out of landfills and recycling centers too. It can also reduce the resources consumed to mine, produce, transport, and install new-construction materials.

What you can do:

- Look carefully with your building committee and architect at any buildings you currently have, or other existing buildings in your area that may fit your needs.

Benefits:

- Keeps large amounts of waste from entering the landfill.
- Renovation costs are generally lower than new-construction costs.
- Conserves green space by using land that is already developed.
- Provides an opportunity to breathe new life into an existing historic structure, helping to preserve part of the fabric of a town or neighborhood.
- Extends the useful life of the original building materials and the energy that was expended to build the building in the first place.

Re-using Existing Materials

Cabinets, pews, chairs, office furniture, altars, rails, windows and doors – just a few of the things that might be re-used in a new facility.

What you can do:

- Salvage and re-use materials from other buildings, items donated by members of the congregation, and discounted materials from a Habitat for Humanity store. Note: this will require some creativity in the design by your architect, and coordination with the builder.
- When new materials are needed, use them in their modular sizes to reduce waste.

Benefits:

- Extends the useful life of existing products and materials, as well as the landfill.

- Saves money.
- Reduces burden on “virgin” resources.

Cost ($):

- Even after taking into account modification costs, “used” usually costs less than “new.” Not always, but usually.

The Landfill

Using products that can be re-used or recycled at the end of their useful life can lessen the impact on our landfills. For example:

Carpets

Benefits:

- There are carpet tiles available that the manufacturer guarantees to pick up at the end of their useful life - at no additional transportation or recycling cost to the consumer. Manufacturers separate the backing from the fiber, and re-process each to make more backing and more fiber for new carpet tiles. This recovery-and-recycle process forms a continuous loop, potentially keeping tons of carpet out of the landfill each year.
- Some carpet tiles also use recovered coal fly ash in lieu of limestone as an inert filler in their backing, reducing the need for mining limestone and utilizing a “waste” product from burning coal.
- Colors in carpets can also be achieved by a process known as solution dyeing, or thermal pigmentation, where the pigment is added to the molten nylon before it is extruded into fibers, reducing water use and the resultant chemical-laden effluent that would have been generated.

Concern:

- The Volatile Organic Compounds (VOC’s) contained in and emitted by carpets and their adhesives will be discussed in the section **Indoor Air Quality**.

Application:

- Any place one would ordinarily use carpet, especially where carpet could provide a means of sound-absorbtion to improve acoustics.

Cost ($):

- There is a wide range in the cost per square yard of carpet, and an environmentally friendly carpet tile is neither at the top nor the bottom of that range, providing a decent quality floor covering with no significant initial cost difference between it and a more traditional carpet similar in quality in other respects.

- When the time comes to remove the carpet, one that is reclaimed and recycled will save the consumer dumping or tipping fees normally charged for using a landfill.

Sources and Partial List of Manufacturers:

- **Shaw Contract Group**
  380 S. Industrial Blvd.
  Calhoun, Georgia 30701
  www.shawcontractgroup.com

  Mike Nuckolls
  Institutional Specialist
  Eastern North Carolina
  Mike.Nuckolls@shawinc.com

Materials with Recycled Content

Products that incorporate post-consumer and post-industrial recycled materials help reduce the demand for "virgin" materials, and the energy and resources needed to process them.

What you can do:

- Be a wise consumer ~ carefully compare products for the type and amount of recycled content.

Benefits:

- Helps create a market for recycled products.
- Reduces demand for "virgin" materials.

Materials Available Locally

Occasionally, products and materials that can be incorporated into your project are available in your area. Also, if identified early enough in the process, the project may be designed to exploit local products and materials.

What you can do:

- Landscape with native plants, trees, and shrubs.
- Research materials being used in your building, and determine whether similar products are available in your region.
- Some municipalities collect yard waste and redistribute it later as mulch, at no charge to residents. Be sure and check before purchasing something shipped in from who-knows-where.

Benefits:

- Using products that are available locally reduces transportation costs and negative environmental impact.
- Generally, native plants require less maintenance than non-native species, and keep site compatible with local surroundings.
- Supports local and regional economy.

Renewable Materials

Using materials that are quickly and easily renewable reduces the strain on "virgin" resources. For example:

Linoleum

Benefits:

- Linoleum is made from materials that are biodegradable, and rapidly renewable for the most part. The recipe includes linseed oil (obtained by pressing the seeds of the flax plant), pine rosin, wood flour, organic pigments (without heavy metals), and jute.
- The useful life of linoleum is approximately 40 years, an anomaly in today's "disposable" culture, and longer than a more traditional sheet vinyl or vinyl composition tile flooring.
- When used with a low VOC (volatile organic compound ~ see **Indoor Air Quality**) adhesive, linoleum emits fewer VOCs than traditional vinyl flooring.
- Linoleum is naturally anti-bacterial, resists building up a static electrical charge, and the majority of maintenance can be done by sweeping, vacuuming, or using a dust mop, resulting in fewer chemicals and reduced labor.

Concerns:

- One of the ingredients of linoleum is limestone. Limestone is a natural, biodegradable material, apparently plentiful, is not renewable and may require mining to be obtained from the earth.
- Linoleum is a hard surface, as is vinyl flooring, and therefore has little sound absorption. This should be taken into consideration when the acoustics of a particular room are being studied.

Applications:

- Linoleum is available in a wide variety of rich patterns and colors, appropriate for formal areas such as the sanctuary, and durable enough to be suitable for high traffic areas such as fellowship halls, classrooms, corridors, and multi-purpose rooms. It has been successfully used on floors, table tops and countertops, and on walls to make a durable and attractive wainscot. Due to the ability to "cut in" designs, linoleum can also be applied to a multi-purpose room floor, with lines for a basketball court integrated into the flooring out of the same material in different colors.

Cost ($):

- Recently, the initial cost of linoleum has been close to twice the cost of traditional vinyl composition tile flooring, but appears to be a much more versatile and sustainable material, with almost twice the useful life span.

Sources and Partial List of Manufacturers:

- **Forbo Linoleum, Inc.**
  P. O. Box 667, Humboldt Industrial Park
  Hazelton, PA 18201
  www.forboflooringna.com

  Pat Blide
  Forbo Flooring Inc
  pblide@fL-NA.com

- **Advanced Buildings Technologies & Practices**
  www.advancedbuildings.org

Cotton Batt or Sheep's Wool Insulation

Cotton-batt insulation is made from post-industrial cotton fibers such as denim, and comes in 3 ½" (R-13) or 5 ½" (R-19) thicknesses. Sheep's wool insulation comes in a similar batt form, and both are borate treated for pest and fire resistance.

Benefits:

- Cotton batts are 75% post-industrial recycled material ("waste" from blue jean manufacturing), AND are recyclable at the end of their useful life.
- Cotton batts contain no formaldehyde or other chemical irritants.
- Sheep's wool is a sustainable, natural product.

Cost ($):

- Currently, to achieve an R value of R-19, fiberglas batt insulation will cost under $0.50/sf, cotton approximately $1.20/sf, and sheep's wool about $2.40/sf.

Sources:

- **PATH (The Partnership for Advancement of Technology in Housing)**
  Technology Inventory
  www.toolbase.org

- **U. S. Department of Energy**
  Energy Efficiency and Renewable Energy
  www.eere.energy.gov

Bamboo Flooring

Bamboo is botanically classified as a grass, and reaches maturity much faster than most trees – 3 to 5 years, compared to 50 or 100 years for most hardwood species. If harvested after 3 years, the cutting process does not adversely affect the plant. After they are cut, the stems are sliced into strips, boiled in water with a preservative, pressed flat, and processed into laminated boards.

Benefits:

- Due to its rapid growth rate, and the fact that the plant is not damaged after harvest, bamboo is a good example of a readily renewable resource.
- Bamboo is similar to oak in dent-resistance, and more dimensionally stable than most common wood-flooring species.

Concern:

- The adhesive currently used to laminate the bamboo flooring contains urea formaldehyde resins, which will "off-gas" formaldehyde when exposed to heat and humidity, although not to the extent that particleboard does.

Application:

- Bamboo flooring is suitable for foot traffic, just as oak flooring would be.

Cost ($):

- At this time, pre-finished bamboo flooring costs between $4 and $8 per square foot, not including installation.

Source:

- **PATH (The Partnership for Advancement of Technology in Housing)**
  Technology Inventory
  www.toolbase.org

Wool Carpet

Sheep's wool is a natural material that is suitable for carpet fiber.

Benefits:

- The wool sheared from sheep is readily renewable, easing the burden on other "virgin" resources.
- A natural fiber, wool contains no chemicals to "off-gas."
- Wool is biodegradable, and has a relatively long useful life as a carpet.

Concerns:

- As with any carpet, care must be taken to use an adhesive low in VOC emissions.
- A wool carpet that has been bleached would normally involve using dioxins, which have historically been a source of pollution. So, specify a carpet that has not been bleached before dyeing.

Cost ($):

- Environmentally friendly wool fiber carpets will probably fall into the mid- to high-end price category of carpets.

Source:

- **Natural Home Design Center**

  www.naturalhomeproducts.com

Wood and Responsible Forestry

"In many forests around the world, logging still contributes to habitat destruction, water pollution, displacement of indigenous peoples, and violence against people who work in the forest and the wildlife that dwells there. Many consumers of wood and paper, and many forest products companies believe that the link between logging and these negative impacts can be broken, and that forests can be managed and protected at the same time. Forest Stewardship Council certification is one way to improve the practice of forestry."

- Forest Stewardship Council

What you can do:

- Use wood and wood products that are certified in accordance with the Forest Stewardship Council's Principles and Criteria, and display their logo.

Benefit:

- Supports "responsible" forestry and rewards good stewardship in others.

Source:

- **Forest Stewardship Council**
  www.fscus.org

MISCELLANEOUS

Indoor Air Quality

Chemicals in building components, such as carpet, furniture, plywood, paints and adhesives can have an adverse effect on building occupants when they *off-gas* these chemicals (e.g., new carpet smell) or produce mold as a result of moisture. The results can be anything from mild allergy symptoms to lung cancer. This is a sobering thought when we realize that most Americans spend between 75-90% of their time indoors. Granted, I am expanding the definition of "environmentally friendly" to include the indoor environment, and the "resources" that are being conserved are the men, women, and children of your congregation.

What you can do:

- Require builders to seal all duct openings during construction and/or demolition, and if possible limit use of the heating/cooling system to times when there is no major construction or demolition in progress. If this is unavoidable, deligent filtering should be required.
- Require builders to keep materials dry at all times.
- Choose materials that emit low or no quantities of contaminants such as Volatile Organic Compounds (VOCs) - including materials used during construction, as well as products used during the life of the building for cleaning and maintenance. There are various industry standards in place that set requirements for low-emitting materials.
- Perform a building "flush-out" before occupying it, using only outside air and special filters for at least two weeks.
- Discuss with your architect and mechanical consultant your concern for indoor air quality and maintaining a relatively high ratio of filtered, fresh air in the heating / cooling system.

Benefit:

- A higher quality of indoor air, resulting in healthier, happier building occupants.

Sources:

- **Union of Concerned Scientists**
  Citizens and Scientists for Environmental Solutions
  www.ucsusa.org

- **U. S. Environmental Protection Agency**
  Sources of Indoor Air Pollution - Organic Gases (Volatile Organic Compounds - VOCs)
  www.epa.gov/iaq/voc.html

Your Recycling Plan (this one is easy)

Good stewardship of God's gifts doesn't end when the building is finished. The plan is fairly simple. Materials that have not been re-used and can be recycled (such as glass, paper, cardboard, aluminum and steel cans, and some plastics), are separated from the "garbage" that goes to the landfill, and are collected for re-introduction to the manufacturing process to be processed into new products. Examples of new products that include recycled materials are newspapers; paper towels and toilet tissue; aluminum, plastic, and glass soft drink containers; steel cans; and plastic laundry detergent bottles. Recovered plastics are also used in carpeting, and in the "lumber" used for park benches, decks, and pedestrian bridges. You are responsible for the separation, and the collection can occur several ways, including curbside pick-up, drop-off centers, buy-back centers, and deposit/refund programs.

Some yard and kitchen waste can also be recycled, using a simple compost pile.

What you can do:

- Make recycling easy and convenient. Dedicate a few bins (located strategically in the kitchen, fellowship hall, classrooms, etc.) for cans, bottles, and other recyclables. Set a box next to the copier and in each office and classroom to collect paper. Someone, such as janitorial staff or maybe the youth of the church, will need to be responsible for consolidating the contents of these bins and boxes and either setting them out at the curb on the appropriate day, if curbside pick-up is available, or transporting them to your local drop-off center.
- Start a compost pile, as simple or complex as you want to make it. Leaves, grass clippings, and some kitchen scraps can easily be recycled and re-used to provide a healthy additive for your planting beds, or let the kids fill pots with the finished product and give out flowers on Mother's (or Father's) Day.

Benefits:

- Reduced demand on "virgin" natural resources.
- Ease the burden on already overcrowded landfills.
- Save money and resources by using fewer plastic bags for yard "waste."

Source:

- **U. S. Environmental Protection Agency**
  www.epa.gov

North Carolina State University "Solar House"

To view first hand some methods that are used to conserve energy in buildings, you can visit the Solar House on the campus of North Carolina State University in Raleigh.

> "Dedicated and opened to the public in 1981, the Solar House at North Carolina State University is one of the most visible and visited solar buildings in the United States. Over the last two decades, more than 250,000 people from around the world have toured the facility.
>
> First and foremost, the Solar House is a resource to help meet your solar energy needs. Since the NC Solar Center was founded in 1988, the Solar House has served as its educational and demonstration showcase for solar and energy-efficient technologies. Specialists and graduate students are available to answer visitors' questions and help them get the information they need. A reference library and media center, the latter including more than 100 videotapes available for viewing or loan, are provided for public use. A multi-media station provides access to renewable energy Internet sites, a CD-ROM encyclopedia, and a variety of computer programs.
>
> Beyond the educational value of the Solar House, the building, together with an adjacent research annex, is a living laboratory for solar research. Numerous graduate student theses and dissertations have focused on the House. By monitoring, metering and compiling data, we have determined how well the Solar House works, under what weather conditions, and what it costs to operate. The total heating bill per winter for the Solar House averages less than $70."
>
> - NCSU Solar House website

The key features of the Solar House are as follows:

- A centrally located SUNSPACE that collects, stores, and distributes solar heat for space heating.
- Two THERMAL STORAGE WALLS that collect, store, and transfer solar heat for space heating.
- An active SOLAR HOT WATER SYSTEM that heats domestic hot water.
- A PHOTOVOLTAIC SYSTEM that generates 3.2 kilowatts of electricity.
- SOLARTUBES to provide natural daylighting.
- A WATER SOURCE, GEO-THERMAL HEAT PUMP coupled to a horizontal, closed-loop heat exchanger that provides backup heating and cooling.
- EARTH BERMING for first-story north and west walls that reduces winter heat loss and summer heat gain.
- NATURAL ARCHITECTURAL devices that provide summer shading on the south side of the house.

You can find out more about the Solar House on the NCSU Solar Center website by visiting www.ncsc.ncsu.edu, then selecting the "Solar House" tab. You can also visit the Solar House – the telephone number is (919) 515-3799, or 1 (800) 33-NCSUN (toll-free in NC).

APPENDIX

PRELIMINARY ESTIMATE

Job Name: _____ Date: _____

				Material		Labor		
	Description (sustainable / traditional)	Qty	Units	$	Sub-Total	$	Sub-Total	Total
Sust.								
Trad.								
							Initial Cost Difference:	
Sust.								
Trad.								
							Initial Cost Difference:	
Sust.								
Trad.								
							Initial Cost Difference:	
Sust.								
Trad.								
							Initial Cost Difference:	

PRELIMINARY ESTIMATE - SAMPLE Job Name: _____ Date: _____

				Material		Labor		
	Description (sustainable / traditional)	Qty	Units	$	Sub-Total	$	Sub-Total	Total
Sust.	tankless water heater	1	EA	$834.00	$834.00	$300.00	$300.00	$1,134.00
Trad.	30-gallon water heater	1	EA	$450.00	$450.00	$300.00	$300.00	$750.00
							Initial Cost Difference:	$384.00
Sust.								
Trad.								
							Initial Cost Difference:	
Sust.								
Trad.								
							Initial Cost Difference:	
Sust.								
Trad.								
							Initial Cost Difference:	

FINAL SUMMARY

Job Name: _____ Date: _____

	Description (sustainable / traditional)	$
Sust.		
Trad.		
	Initial Cost Difference:	

Sust.		
Trad.		
	Initial Cost Difference:	

Sust.		
Trad.		
	Initial Cost Difference:	

Sust.		
Trad.		
	Initial Cost Difference:	

Sust.		
Trad.		
	Initial Cost Difference:	

Sust.		
Trad.		
	Initial Cost Difference:	

FINAL SUMMARY - SAMPLE

Job Name: _____ Date: _____

	Description (sustainable / traditional)	$
Sust.	tankless water heater	$1,134.00
Trad.	30-gallon water heater	$750.00
	Initial Cost Difference:	$384.00
Sust.		
Trad.		
	Initial Cost Difference:	
Sust.		
Trad.		
	Initial Cost Difference:	
Sust.		
Trad.		
	Initial Cost Difference:	
Sust.		
Trad.		
	Initial Cost Difference:	
Sust.		
Trad.		
	Initial Cost Difference:	