Energy

Preparing an Energy Element for the Comprehensive Plan

The South Carolina Energy Office and
The Office of Regional Development

Division of Regional Development
South Carolina Budget and Control Board

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INTRODUCTION

South Carolina and its neighboring states have enjoyed an era of significant growth during the last two decades. While the majority of residents and officials welcome this social and economic transformation, they also recognize the need to plan for the effects of growth on the State and its communities. This unprecedented level of population and economic growth is generating a heightened awareness and providing a forum for debate on sustainable development issues. South Carolinians are increasingly and rightfully concerned about the effects of growth and development and their associated costs on the quality of life in their communities and on the environment. Continued residential, commercial and industrial development raises complex issues regarding the efficient and cost-effective provision of infrastructure, the inclusion of affordable housing, the assurance of long-term economic growth, the appropriate use of land, the formation of orderly development patterns, and the bottom-line realization of fiscal impacts on a community.

The timely integration of sustainable development issues into the comprehensive planning process at the local level is vital to achieving sensible growth in South Carolina. Energy is undeniably a crucial resource in terms of its availability, use and cost. It is a common thread woven throughout the traditional comprehensive plan elements of housing, economic development, environmental resources, community facilities and transportation.

Energy conservation is an integral part of any discussion on sustainable practices and the case for including an energy dimension in the comprehensive planning process is clear and compelling. When households, businesses, institutions and governments cut energy expenses, they have more disposable income to spend on other priorities. Local schools can spend more money on education instead of paying excessive energy costs. Local governments can use funds to improve or increase direct services instead of heating and cooling aging buildings that are not energy-efficient. Reducing energy use and investing in efficiency measures also keeps more dollars circulating in the local economy. Because energy use can adversely affect air quality and other natural resources, energy issues are also environmental quality issues. An effective energy conservation plan can help reduce air pollution, improve water quality, and protect prime agricultural lands and wildlife habitats.

The South Carolina Energy Office (SCEO) has recognized the con-

nection between energy conservation and local comprehensive planning as an opportunity to further the State's energy conservation goals. The mission of the SCEO is to increase the efficient use of energy resources among all consumer sectors, while maximizing environmental quality and minimizing energy costs. Through a combination of technical assistance, information exchange and financial support, the Office continues its commitment to energy conservation programs at the State and local levels that reduce energy consumption, improve energy efficiency, decrease dependence on foreign and non-renewable energy resources, and minimize environmental impacts.

The SCEO recognizes the central role of the State's cities and counties in the formulation, implementation, and ultimate success of energy conservation policies and programs. Amid the growing development pressures and fiscal challenges facing a large number of these jurisdictions, the Office has sought to provide local governments with encouragement and general guidance in improving the efficiency of energy use in their communities.

The Local Planning Guide to Preparing an Energy Conservation Element embodies this commitment by exemplifying how the local planning process can be used as an effective platform to promote conservation strategies. The primary goal of this document is to increase the level of awareness of energy conservation issues and the adoption of replicable practices at the local level. The Guide also provides a framework for communities in the development and integration of an energy conservation element as a viable component of their local comprehensive plan.

Through this planning partnership with cities and counties, the SCEO aspires to improve the quality of life in South Carolina – putting savings into the hands of its residents and local governments, creating jobs and economic sustainability, reducing pollution and conserving non-renewable resources, and supporting the development of affordable, livable and vibrant communities.

USERS GUIDE

The purpose of this document is to equip local governments in South Carolina with comprehensive planning strategies, techniques and approaches for the incorporation of energy conservation practices into local land development policies. The local planning guide is organized into six major sections:

Chapter 1 – The Planning and Energy Conservation Connection *discusses the potential for achieving energy conservation through the local planning process. An overview of the comprehensive planning process in South Carolina begins the discussion, followed by a look at the State's energy "picture" to include its current energy consumption trends within the context of fuel diversity, fuel use and use per economic sector. The conceptual basis for energy conservation planning is presented along with its link to sustainable development efforts. The Chapter concludes with an exploration of local planning processes and regulatory tools as viable vehicles for promoting energy conservation at the local level.*

Chapter 2 – Strategies and Approaches for Energy Conservation *defines the role of local government, and the planning function in particular, in energy conservation efforts. The Chapter suggests opportunities for energy conservation and offers a compilation of implementation models and case studies. This information is presented within the context of diverse, but relevant comprehensive planning categories such as land use, transportation, environmental protection, housing, community facilities and economic development. Implementation opportunities and challenges for energy conservation are summarized at the conclusion of the Chapter.*

Chapter 3 – Preparing the Energy Conservation Element *outlines the basic structure and content of the energy conservation element and the specific linkages between the energy conservation element and the seven required elements of the local comprehensive plan. Methodologies and procedures for conducting a community energy assessment and for setting goals and objectives for the energy conservation element are presented. In addition, the Chapter provides guidance in the development of an implementation plan and discusses effective*

evaluation techniques to monitor plan success and goal attainment.

***Chapter 4 – Glossary of Terms** includes definitions of key terms related to energy use, energy conservation, local planning concepts, and land use regulation.*

*A set of **Appendices** provides detailed worksheets for energy assessments and other resource materials to aid in the preparation of local energy conservation elements.*

*The **Bibliography** includes bibliographic references and a comprehensive listing of resources related to energy conservation, sustainability and sensible growth. In addition to references for printed materials, a listing of pertinent web site addresses is also provided.*

*Companion **Training Materials** to this local planning guide are also available upon request from the Energy Office. The materials provide a framework for presentation to local government planners, elected officials, citizen advisory committees, and other key staff and can be easily adapted for use at the local level.*

CHAPTER 1

THE PLANNING AND ENERGY CONNECTION

Local Comprehensive Planning – Process and Statutory Framework

Within the context of local government the term "planning" is commonly used to describe activities conducted to prepare for and influence the future. An effective planning process includes the following steps:

1. *Identify local problems and needs;*
2. *Collect information and facts necessary to study local problems and needs;*
3. *Develop local goals and objectives;*
4. *Develop plans and programs to achieve goals and objectives;*
5. *Implement plans and programs using available tools and powers;*
6. *Evaluate the results; and*
7. *Update and modify plans as needed.*

The planning process cannot be carried out in a vacuum. Broad-based citizen participation and support are vital to the success of local government planning efforts. The Comprehensive Planning Guide for Local Governments notes that "Direct citizen involvement in the preparation of plans is the best way to accurately assess community problems and needs."[1] The depth and quality of citizen participation are key to the success of local government planning programs.

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The application of the planning process to private and public actions affecting the development and use of land is commonly referred to as "land use planning." While planning initiatives may take many forms, the most effective tool for local governments in land use planning is the comprehensive plan. The comprehensive plan is an official document adopted by the local governing body that outlines general, long-term policies for the physical development of the jurisdiction. It promotes a coordinated, consistent

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approach for addressing land development issues and decisions.

The South Carolina Local Government Comprehensive Planning Enabling Act of 1994 empowers local planning commissions to develop and maintain a planning process that will result in the systematic preparation, continual reevaluation, and periodic update of plan elements considered critical, necessary and desirable to guide the development and redevelopment of their jurisdiction. This planning process results in the development of a comprehensive plan for the community. The comprehensive plan must include, but is not limited to, the following planning elements:

- *Population*
- *Economic Development*
- *Natural Resources*
- *Cultural Resources*
- *Community Facilities*
- *Housing*
- *Land Use*

Each plan element must include an inventory of existing conditions, a statement of needs and goals, and implementation strategies with measurable time frames. In addition to considering the future growth, development and redevelopment of their community, the planning commission must also weigh the most efficient use of public funds and the fiscal impact on property owners when developing the comprehensive plan. Upon completion, the planning commission should recommend the comprehensive plan to the local governing body for adoption. The governing body may adopt the plan as a whole by single ordinance or individual elements of the plan by successive ordinances. Before adoption of an element or the plan as a whole, the governing authority must hold a public hearing to formally solicit citizen comments.

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In addition to the seven required elements, the 1994 Act gives local governments the option of preparing additional comprehensive plan elements. This option enables local governments to address specific issues not included in the required elements or to take a component of particular concern and develop it into a new element. Additional issues of critical importance to South Carolina communities, such as energy conservation, can be addressed in depth through the development of an energy conservation element, rather than as a sub-component of the community facilities element.

The case for including an energy conservation element in the comprehensive plan is compelling. Energy is undeniably a crucial

resource. The system of energy supply, distribution and use is related in significant ways to the spatial organization of society. If land use planning is intended to influence the evolution of spatial structure, then it is legitimate for planners to be concerned with energy supply, demand and conservation.[2] Because energy conservation should only be one of many considerations in local planning, it is best presented within the overall context of a comprehensive plan. Energy conservation weaves a common thread throughout all seven elements of the comprehensive plan and, for many localities, warrants consideration as a separate element.

Energy Consumption in South Carolina

South Carolina ranks among the fastest growing states in the nation, with a population increase of nearly 22% since 1980. If current trends continue, the State will add nearly one million new residents over the next twenty years. It is estimated that more than half a million new housing units (including replacement units) will be needed to accommodate these new residents. In addition, the need for 40 million square feet of new retail space, 40 million square feet of new office space and 30 million square feet of new warehouse space will be generated by the projected population growth.[3] Future growth in the State is expected to be fueled by continued economic success. South Carolina Department of Commerce data reveals that business and industry have invested more than $28 billion in the State since 1995, with a record $6.3 billion in capital investment in 1999.

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Energy plays a primary role in the State's sustained economic success. South Carolinians have long enjoyed energy on demand with some of the lowest prices in the nation. As the State's economy has grown, so too has its energy needs – with South Carolina ranking 18th in total per capita energy consumption nationwide. During the 1990s, statewide energy consumption increased at a much higher rate than the United States average. Specifically, South Carolina experienced a 13.6% increase in per capita energy consumption between 1990 and 1997, while the overall United States per capita rate rose only 7.6%. Its population growth of 8.3% was significantly outpaced by a concurrent rise in energy use of 16.7% during the past decade.

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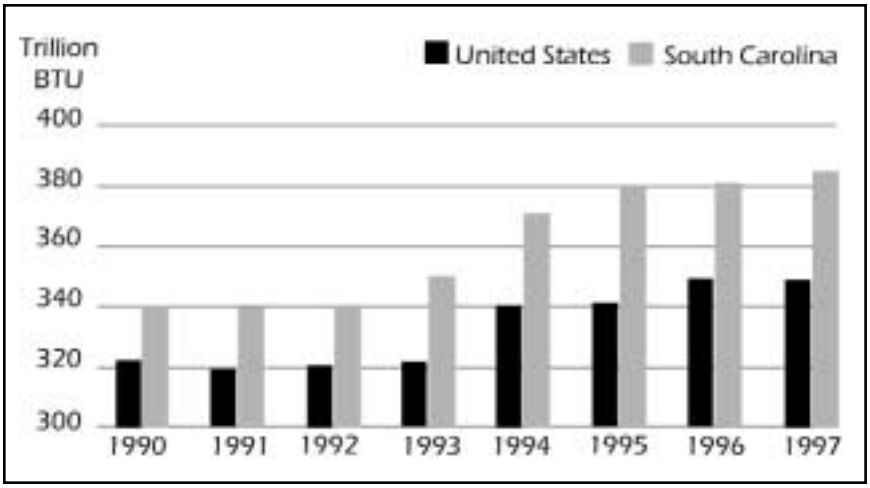
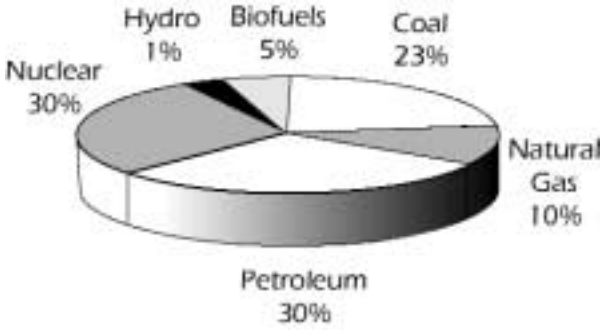
Figure 1. Energy Consumption per Capita, 1990-1997



Source: S.C. Energy Office, 1999 South Carolina Energy Use Profile.

Total statewide energy consumption rose by 101.9% between 1970 and 1997, compared with an increase of only 38.5% nationwide during the same period. Most of the State's increase can be attributed to the nuclear sector, where energy use rose by more than 157% between 1990 and 1997. Nuclear energy accounted for more than 30% of the State's energy consumption in 1997, compared with only 7% on the national level. Petroleum followed closely at nearly 30%, coal at 23% and natural gas at 10% of energy use statewide.

Figure 2. 1997 Energy Consumption by Fuel Source

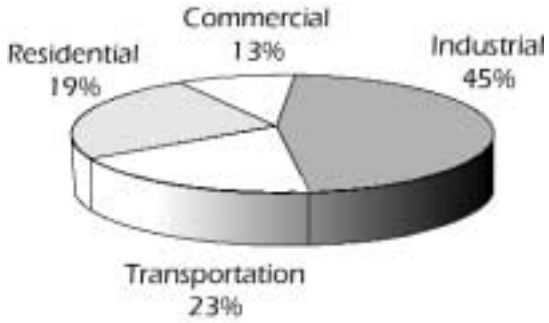


Source: S.C. Energy Office, 1999 South Carolina Energy Use Profile.

The industrial sector accounts for almost one-half of the State's energy consumption. Energy use in the transportation sector comprises more than 23% of statewide consumption while the residential and commercial sectors represent 19% and 13%, respectively. From 1970 to 1997, energy consumption in the State's com-

mercial sector increased by nearly 158%, while industrial energy use rose by more than 125%. Residential energy consumption increased by nearly 97% and transportation use by almost 74% during the same time period.

Figure 3. 1997 Energy Consumption by Economic Sector



Source: S.C. Energy Office, 1999 South Carolina Energy Use Profile.

Energy expenditures statewide have risen by 700% since 1970, while energy consumption increased by more than 100% during this time. South Carolinians spent $7.6 billion on energy in 1995. The transportation sector is responsible for the largest share of energy expenditures at 35%, followed by the residential and industrial sectors at 26% each and the commercial sector at 14%.

Energy expenditures statewide have risen by 700% since 1970, while energy consumption increased by more than 100% during this time.

If current energy consumption trends continue, the State's future will likely be characterized by the following:

- *Continued population and economic growth will place additional demands on energy resources.*
- *Economic growth will result in increased energy consumption in the industrial and commercial sectors.*
- *There will be a continued reliance on nuclear energy sources.*
- *The rate at which energy is consumed in the State will continue to increase.*
- *Reliance on petroleum products will continue, bolstered by the high percentage of energy consumption attributable to the transportation sector.*
- *Energy prices will continue to rise.*

Energy Conservation Concepts

Since the oil embargo and subsequent fuel shortages of the 1970s, state and local governments across the nation have been researching and developing policies, methodologies and procedures that promote energy conservation. With the passage of the Energy Conservation and Efficiency Act of 1992, the South Carolina Energy Office (SCEO) moved to the forefront of such efforts through the integration of energy concerns with environmental responsibility and economic development. The guiding mission of the SCEO remains to increase efficiency in the use of energy resources in all consuming sectors of the State and, to the extent practical, to maximize environmental quality and minimize the cost of energy use.

Energy conservation is defined as "the careful and sparing use of energy with a view to conserving the natural resources from which energy is derived and minimizing environmental pollution."[4] The most effective form of energy conservation is the intelligent and efficient use of nonrenewable energy resources such as coal, oil, natural gas and nuclear fuel (uranium). Energy conservation policies that emphasize this approach and minimize waste are more palatable to the public and have proven much more effective than policies that require personal sacrifice.

An effective energy plan can aid the local economy by keeping more dollars in circulation locally, reducing environmental impacts and providing a focal point for complex local issues such as land use planning and development, transportation system design and affordable housing.

Nationwide, planners at all levels of government are now including energy conservation measures in the plans, policies and regulations of their communities. Such measures run the gamut from educational and promotional programs to community-wide energy plans. Many energy plans are integrated into comprehensive plans, while others are stand-alone documents. An effective energy plan can aid the local economy by keeping more dollars in circulation locally, reducing environmental impacts and providing a focal point for complex local issues such as land use planning and development, transportation system design and affordable housing.

Energy conservation is an integral facet of sustainable development. Whether at the global or community level, the existing patterns and trends of energy consumption are key indicators of sustainability. Energy consumption patterns affect not only the future of energy resources, but also the future of other key elements including economic viability, environmental quality and fiscal stability.

The United Nations' World Commission on Environment and Development (commonly known as the Brundtland Commission) broadly defines sustainable development as "Development which meets the needs of the present without compromising the ability of

future generations to meet their own needs." Conversely, unsustainable development defers costs for later payment, creating an uncertain and diminished outlook for future generations. Planners Peter Berke and Maria Conroy expanded this concept within the context of land use planning by defining sustainable development as "a dynamic process in which communities anticipate and accommodate the needs of current and future generations in ways that reproduce and balance the local social, economic, and ecological systems, and link local actions to global concerns."[5]

The consideration of both present and future needs forms the conceptual core of sustainability. Local governments strive to enhance the quality of life for their residents by providing much-needed and desired services such as transportation systems, fire and emergency services, water, wastewater treatment, and solid waste disposal. In order to provide these services, increased demands are placed on nonrenewable energy resources. With no practical process in place to replenish supplies, these nonrenewable resources are further depleted each year.

The consideration of both present and future needs forms the conceptual core of sustainability.

The concept of sustainable development provides a framework within which communities can promote economic development, use resources efficiently, create cost-efficient infrastructures, and protect and enhance the quality of life. When population growth and accompanying increases in consumption are viewed in light of natural resource limitations, sustainability is recognized as a necessity rather than an option.

State and local governments nationwide have developed guiding principles for sustainable development. While state principles for sustainability are often general in nature, principles for sustainability for local governments are often more specific and are tailored to the specific needs and desires of each community. The following principles were developed by Berke and Conroy within the context of local government planning based on extensive review of sustainable development literature.

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Principles of Sustainable Development

- ***Harmony with Nature.*** *Land use and development activities should reinforce the essential life cycles and support functions of ecosystems. Whenever possible, these activities should mimic ecosystem processes rather than modify them to fit urban forms. These activities must respect and preserve biodiversity, as well as protect and restore essential ecosystem services that maintain water quality, reduce flooding, and enhance sustainable resource development.*

- ***Livable Built Environment.*** *The location, shape, density, mix, proportion and quality of development should: enhance the fit between people and urban form by creating physical spaces adapted to desired activities of inhabitants; encourage community cohesion by fostering access among land uses; and support a sense of place to ensure protection of any special physical characteristics of urban forms that support community identity and attachment.*

- ***Place-based Economy.*** *A local economy should strive to operate within natural system limits. It should not cause deterioration of the natural resource base, which serves as a capital asset for future economic development. Essential products and processes of nature should be used up no more quickly than nature can renew them. Waste discharges should occur no more quickly than nature can assimilate them. The local economy should also produce built environments that meet locally defined needs and aspirations. It should create diverse housing and infrastructure that enhances community livability and the efficiency of local economic activities.*

- ***Equity.*** *Land use patterns should recognize and improve the conditions of low-income populations and not deprive them of basic levels of environmental health and human dignity. Equitable access to social, educational and economic resources is essential for eradicating poverty and accounting for the needs of the least advantaged.*

- ***Polluters Pay.*** *Polluters (or culpable interests) who cause adverse community-wide environmental impacts should be required to bear the associated costs of pollution and other harms, with due regard to the public interest.*

- ***Responsible Regionalism.*** *Communities should not act in their own interests to the detriment of the interests of others, and they should be responsible for the consequences of their actions. Just as individual developers should be subject to the principle that polluters (or culpable interests) pay, a local jurisdiction has the obligation to minimize the harm it imposes on other jurisdictions in the pursuit of its own objectives.*

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Many concepts, plans and policies have been developed that attempt to achieve the ultimate goal of sustainability. Chief among these is the notion that although growth and development are both inevitable and beneficial, the means of achieving growth determines the ultimate cost to the community. Residents and politicians want the jobs, tax revenues, and amenities that come with new development. However, they want these benefits to occur without degrading the environment, depleting natural resources, raising local taxes, or increasing traffic congestion. The

concept of quality, balanced growth recognizes the connection between economic development and quality of life and leverages new growth to improve the community.

The altered patterns of development and associated increased rates of consumption that were a result of the Industrial Revolution have had many positive effects. However these advances have come at a substantial price. The advent of the automobile and improved road systems enabled workers to commute longer distances, making suburban living both possible and attractive. Advances in communications and transport technology made proximity to the city center less critical. As economic investment shifted outward from the central city, existing commercial and industrial enterprises followed, leaving behind abandoned buildings and brownfields. Many residents with the financial means abandoned city life for the suburbs, often resulting in decreased urban property values and a state of disrepair and neglect in many neighborhoods.

While planned growth can bring many benefits to a community, unplanned expansion into suburban and rural areas has often been the experience of most communities. The subsequent development patterns, often called "sprawl," have resulted in increased energy usage, rising housing costs, greater reliance on the car, lost community identity, diminished farmland and open space, and burdensome infrastructure costs. As development reaches even further into traditionally rural areas, older suburbs often suffer the fate of urban areas, over time leaving behind additional abandoned commercial and industrial sites, a deteriorating infrastructure and underdeveloped residential areas. Instead of a natural growth pattern in which an urban area expands to meet the needs of a growing population and economy, such unplanned development "leapfrogs" past existing infrastructure – requiring expensive construction and facility upgrades to accommodate new growth.

If current trends and consumer preferences continue, suburban growth will proceed at a rapid pace. According to a survey conducted by Fannie Mae in the late 1990s, 70% of Americans want to live in either suburbs, small towns far from cities, or rural areas.[6] Ironically, Americans are also becoming increasing dissatisfied with the problems associated with suburban living. Longer commuting distances, traffic congestion, pollution, and the loss of the attributes that once made the suburbs and rural areas so attractive – rural character, natural beauty and a sense of community – have prompted communities around the country to develop initiatives that promote quality, balanced growth and development.

The concept of quality, balanced growth recognizes the connection between economic development and quality of life and leverages new growth to improve the community.

Energy Conservation and Local Government Planning

Through the comprehensive planning process and effective zoning and land development regulations, both citizen planners and professional planners have the opportunity to provide the guidance and direction needed to implement sensible growth strategies.

Planners and officials nationwide are developing sensible growth strategies that balance the need for jobs and economic development with the need to conserve natural resources, preserve the environment and enhance quality of life. While successful energy conservation strategies are largely dependent on the participation of individual citizens, local governments can play a critical role by developing programs and policies that promote the concepts of energy conservation and sustainable development. Through the comprehensive planning process and effective zoning and land development regulations, both citizen planners and professional planners have the opportunity to provide the guidance and direction needed to implement sensible growth strategies. For many communities an important component of this process is the removal of barriers that preclude or inhibit quality, balanced growth. This is often accomplished through the revision of regulatory policies and the streamlining of development procedures, making it easier to pursue projects that incorporate sustainable development characteristics.

Long-term energy conservation is most effectively achieved through sustainable development practices.

Long-term energy conservation is most effectively achieved through sustainable development practices. To achieve sustainability, a community must be as concerned with planning for the future as it is with responding to the present. Because the comprehensive plan represents a "blueprint" for the future development of a community, it can prove an invaluable tool in this effort. The development of an energy element for the comprehensive plan ensures that the goals and implementation strategies for energy conservation and sustainable development will be an integral part of the community's future. The strong connection between energy conservation and land use makes careful consideration of energy-related issues an essential component of the comprehensive plan. The link between the two is mutually dependent, reminiscent of the "chicken and egg" analogy. While the availability and affordability of energy has a significant impact on development, local land use patterns and growth trends also significantly impact energy usage. In addition, it is important that energy-related information contained in the existing conditions section of the energy element be considered when developing the other plan elements, especially the community facilities element and the future land use plan.

Implementation of the comprehensive plan goals is achieved primarily through land use regulations. The most commonly used

form of land use regulation is the zoning ordinance. In South Carolina, zoning can be used to regulate the following:

- *The use of buildings, structures and land;*
- *The size, location, height, bulk, orientation, number of stories, erection, construction, reconstruction, alteration, demolition or removal, in whole or in part, of buildings and other structures, including signage;*
- *The density of development, use or occupancy of buildings, structures or land;*
- *The areas and dimensions of land, water and air space to be occupied by buildings and structures, and the size of yards, courts and other open spaces;*
- *The amount of off-street parking and loading that must be provided, and the restrictions or requirements related to the entry or use of motor vehicles; and*
- *Other aspects of the site plan including, but not limited to, tree preservation, landscaping, buffers, lighting, and curb cuts.*

Zoning regulations can be either an indispensable tool or a great hindrance in the implementation of energy conservation and sustainable development measures. Current Euclidean zoning practices are based upon policies initiated in the late 1920s that required the separation of land uses. Such policies were originally developed to ensure the integrity of uses and to prevent potential nuisances, such as the location of a loud or noxious factory next to residences. Most modern ordinances continue to segregate industrial, commercial and residential land uses, often requiring additional zones for subcategories of these land use types. While such regulations achieve the goal of separating incompatible uses, they generally result in longer travel distances from work to home and to other destinations. Many ordinances include density requirements and minimum lot sizes that preclude compact development and clustering of residential uses. Through the promotion of mixed-use development, compact development, residential clustering, increased densities near activity centers, flexible parking requirements, landscaping for cooling purposes and home-based occupations in appropriate settings, zoning regulations can promote, rather than hinder, sensible growth.

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Land development regulations that encourage interconnected street layouts with reduced road length and width, alternative travel modes such as pedestrian walkways and bikeways, and the full utilization of existing infrastructure hold significant potential as effective tools for achieving sustainable development.

Land development regulations (also called subdivision regulations) are another frequently used form of land use controls, governing the conversion of vacant land into lots and parcels for development purposes. Land development regulations ensure the provision of adequate public facilities through the regulation of site design, street layout, open space, installation of and access to utilities, and other matters related to the conversion of land for development. Like zoning, land development ordinances often include provisions that hinder efforts to conserve energy and promote sustainability. Compact development and residential clustering requires reduced road lengths and widths. By providing less paved area, less energy is used in the construction and maintenance of these developments. Shorter, connected road systems not only reduce travel distances, but the reduction in paved area also results in cooler air temperatures. Unfortunately, many land development ordinances require excessive street widths and encourage lengthy, disconnected street patterns. Relatively few ordinances encourage or require site designs to include alternatives to vehicle travel such as sidewalks or bikeways. Even more rare are ordinances that promote the full utilization of existing infrastructure such as water lines, sewers and roads by encouraging development in areas with established infrastructure. Land development regulations that encourage interconnected street layouts with reduced road length and width, alternative travel modes such as pedestrian walkways and bikeways, and the full utilization of existing infrastructure hold significant potential as effective tools for achieving sustainable development.

Key to energy-efficient building construction is the adoption and enforcement of building codes. Outside the realm of land use regulation, the locally adopted building code can play an important role in energy conservation. Design, construction materials, and orientation all contribute to the energy efficiency of a structure. The South Carolina Code of Laws was amended in 1997 to require that all municipalities and counties in the State adopt and enforce the Standard Building Code, as published by the Southern Building Code Congress, International, Inc. A principal purpose of this amendment was to require energy-efficient construction practices statewide. The 1997 amendment also included specific provisions for energy conservation, including minimum standards for thermal resistance (R) ratings for windows, ceilings, walls, floors and ductwork. Local jurisdictions were granted the authority to adopt additional requirements to further ensure that buildings are energy-efficient.

CHAPTER 2

STRATEGIES AND APPROACHES FOR ENERGY CONSERVATION

Introduction

Energy conservation efforts should be tailored to the unique characteristics and needs of the individual community. Local government, in particular the planning function, can play a key role in the facilitation and implementation of these efforts in the following areas:

Energy conservation efforts should be tailored to the unique characteristics and needs of the individual community.

- *Education and Incentives. The general public is often unaware of the community-wide benefits of incorporating the concepts of energy conservation and sustainability into public policy. Citizens, including local businesses and industries, need to know how such policies can benefit both individuals and the community as a whole. The consequences of not implementing conservation policies should also be publicized. In addition, local governments can provide tangible incentives for citizens, businesses and industries that actively support and participate in initiatives to promote energy conservation.*

- *Leadership. Local governments build and maintain infrastructure; purchase, manage and sell land; set standards, regulations, taxes and fees; procure large amounts of products and services; and provide services such as water, waste management and transportation. By making energy conservation a visible priority in all of their policies and procedures, local governments can lead by example.*

- *Regulation. Local governments can review and revise zoning and land development regulations, building codes and other regulations that hinder energy conservation and sustainable development.*

- *Coalition Building. Local governments can convene development stakeholders to discuss and identify common ground on the issues of energy conservation and sustainable development. Because solutions to these issues rarely follow jurisdictional boundaries, local governments can also seek partnerships in both the public and private sectors that promote regional solutions.*

Due to their diverse training, familiarity with regulatory codes, and close work with the public and elected and appointed officials, planners are well suited to play a pivotal role in promoting and implementing the concepts of energy conservation and sustainability.

Due to their diverse training, familiarity with regulatory codes, and close work with the public and elected and appointed officials, planners are well suited to play a pivotal role in promoting and implementing the concepts of energy conservation and sustainability. Opportunities for energy conservation and sustainability, along with model policies and programs for implementation, are explored in the sections that follow. These case studies are presented within a diverse planning context including land use, transportation, environmental protection, housing, economic development, and community facilities.

None of these opportunities can attain substantial energy savings if implemented in isolation. Instead, they must be included as part of a comprehensive strategy providing a breadth of energy conservation measures. Each community must select the most appropriate policies that speak to their unique conditions and will help them achieve their vision for future growth and development. However, to be truly effective in the long-term, communities must also work in cooperation with neighboring jurisdictions to establish regional approaches to energy conservation.

Land Use Planning Opportunities

Local government land use policies and programs can significantly impact the energy consumption rate of a community. It is estimated that more than half of the energy use of industrialized countries is related to land use distribution – that is, to the spatial relationships of residences to work sites, schools, shopping, and other activities.[7] A variety of land use planning tools and methodologies have proven to be effective energy conservation measures. While some involve the development of new policies or regulations or the provision of incentives, others are accomplished through revisions to existing procedures or regulations.

Mixed-use Development

The location of stores, restaurants, offices, residences, schools, recreation areas and jobs within close proximity lessens reliance on the car and encourages alternative modes of travel. Such "mixed-use" development results in greater independence of movement by non-drivers, such as the young and the elderly, and provides access to support services for the growing number of people who work at home. Mixed-use development can also provide a variety of housing choices for a range of age groups, family types and income levels – contributing to diverse and vibrant communities.

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The case for mixed-use development is best made through close examination of vehicle trip information. Thirty-eight percent of all vehicle trips are for shopping or personal business. Almost 60% of these vehicle trips are between one-half mile and five miles in distance.[8] By planning mixed-use developments that combine residential and commercial uses, bicycle and pedestrian travel could replace 18 to 25% of suburban vehicle trips.[9] Home-to-work trips are the most significant trip type in many areas, representing 20 to 30% of all personal vehicle trips. These trips are usually longer than other types of trips, and most take place during peak traffic periods.[10] With an increasing proportion of new jobs in the service sector, housing and work sites can often co-exist. Advances in technology have resulted in industries that produce no noxious smells or sounds, making them more compatible neighbors to both commercial and residential uses. In addition, an increasing number of people are working from their homes, either telecommuting or operating a home-based business.

The location of shops and services within close proximity to work sites can also produce significant energy savings. With services such as convenience grocery stores, restaurants, dry cleaners,

banks, post offices, childcare centers and pharmacies located near the workplace, commuters can take care of errands without driving elsewhere for these services. It is estimated that if only one in ten of the trips made for shopping and family or personal business was made on foot, energy consumption for personal travel could be reduced by up to 3%.[11]

To encourage mixed-uses and combat the negative effects of sprawl, many communities have adopted ordinances designed to encourage the development of neo-traditional or new urbanism projects. Neo-traditional developments are characterized by walkable neighborhoods oriented around the 5-minute walk, primary orientation around public transit systems, and greater integration of different land uses at the neighborhood level. New Urbanists seek to reintroduce traditional notions of neighborhood design by applying these ideas to new developments in a variety of urban and suburban settings.

Savings of approximately 50% of automobile-related energy can be realized when development consists of multi-family dwellings and higher-density developments such as townhouses or patio homes instead of conventional single-family housing.

Significant savings in energy consumption can be accomplished through the mixing of residential uses as well. Savings of approximately 50% of automobile-related energy can be realized when development consists of multi-family dwellings and higher-density developments such as townhouses or patio homes instead of conventional single-family housing. Substantial energy savings can also be realized for heating and cooling, with from 40 to 56% saved by incorporating a variety of residential uses in new developments.[12]

Zoning, originally a tool to keep noxious uses away from residential areas, has gradually evolved into a system that segregates nearly every aspect of daily life – making mixed-use development difficult, if not impossible. The segregation of work, shopping, education and housing results in longer trips and an increasing reliance on the automobile as the primary mode of travel. Many zoning ordinances so carefully codify segregation by use that mixing of even clearly complementary uses, such as neighborhood retail in or near a residential area, may require controversial amendments. Such cases warrant the careful review of the zoning ordinance and subsequent revision of regulations that prevent or hinder the inclusion of mixed-use developments or buildings in appropriate locations.

The Original Mixed-use Developments

In the 1800s and early 1900s, downtowns generally included a mixture of uses, with housing often located above or behind retail and commercial establishments. Many of these residential uses were phased out over the years for a variety of reasons such as zoning changes, building deterioration, limited parking, traffic congestion, and safety considerations. Ironically, in recent years downtowns of all sizes nationwide have begun to take steps to make downtowns "livable" again. Recognizing the importance of extending the "life" of the downtown beyond the normal 8 a.m. to 5 p.m. workday hours, cities have begun to offer incentives for the redevelopment of previously vacant upper stories of buildings into housing and the construction of infill housing developments, while at the same time addressing the issues of safety, parking and affordability.

The primary challenge in removing the regulatory barriers to mixed-use development lies in identifying specific activities that would complement or enhance each other if zoning did not separate them, while preserving the traditional segregation of genuinely incompatible uses. Considerations such as noise, aesthetics and traffic impact need to be carefully balanced to ensure that increased co-mingling of land uses is indeed beneficial to the community.

The primary challenge in removing the regulatory barriers to mixed-use development lies in identifying specific activities that would complement or enhance each other if zoning did not separate them, while preserving the traditional segregation of genuinely incompatible uses.

The location of stores, restaurants, offices, residences, schools, recreation areas and jobs within close proximity does not inherently ensure energy conservation. Building and site design are critical to the success of mixed-use developments. To encourage walking and biking, residential and commercial developments should include safe, attractive pedestrian and bicycle paths linking areas and activities that connect the site with adjacent locations and paths. Unfortunately, buildings in new office parks and other commercial developments are often set back from the public road by a quarter-mile or more, with on-site sidewalks that do not always connect to public sidewalks. Such office parks may only be a mile or so away from commercial development, but that distance is too long – and the walking environment too unappealing – to encourage lunchtime travel by foot. Likewise, most suburban shopping malls are sited with vast surface parking lots surrounding building entrances, making venturing on foot to another location a daunting and unlikely journey. People are encouraged to leave their cars at home and walk or bike to their destinations through the location of shopping, jobs and other services within walking or biking distances of homes; the provision of attractive, safe pedestrian and bicycle paths; and the encouragement of pedestrian-friendly commercial designs. In the event that driving is necessary, the circulation pattern would allow a person to park once and visit several locations on foot.

In addition to developing supplemental regulations or revising existing regulations, local governments may also offer incentives to encourage the mixing of uses within new developments. Incentives such as density bonuses, tax incentives, and fee reductions can be offered for developments that incorporate housing with large-scale employers or mass transit hubs and neighborhood commercial, as well as a mixture of housing types.

CASE STUDIES

Habersham

Habersham is a 283-acre, 1,100 unit traditional neighborhood development located in Beaufort County, South Carolina. The project includes a town center with up to 80,000 square feet of commercial space, civic buildings, and 350 apartments and townhomes. Developers Robert Turner and Stephen Davis worked with Duany & Plater-Zyberk Architects, Inc. (DPZ) to give Habersham a rural, informal atmosphere reminiscent of a country village. The development includes sidewalks and narrow streets, with mature trees flanking every street. The architecture is informal and most of the single-family homes are smaller-scale cottages.[13]

Cornelius Town Center

Construction has already begun on a 10-acre town center for the Town of Cornelius, North Carolina. Cornelius is a rapidly expanding suburb in northern Mecklenburg County with no true historic center. A cornerstone of the effort is the redevelopment of a former textile mill complex into a main street, offices and a new town hall. A grocery store and other retail outlets totaling 40,000 square feet have already been constructed on the site. Plans include the addition of 50 townhomes and live/work units along the main street, plus a transit-oriented development (TOD) that will include 950 residential units, plus office space, retail and sites for civic buildings. A light rail line will run between the town center and the TOD, terminating in downtown Charlotte.[14]

Celebration

At the other end of the spectrum, Disney's Celebration development includes 5,000 acres (half will be preserved as open space) and will eventually house 20,000 residents. Celebration incorporates the principles of new urbanism, providing a variety of housing types and densities within walking distance of businesses, restaurants and recreation. In a recent survey of Celebration resi-

dents, 63% reported using their cars less than they did in their previous community, while 90% feel that the physical characteristics of Celebration contribute to and improve their overall quality of life.[15]

Harmony

Located on a 776-acre tract along the banks of the Sampit River in Georgetown County, South Carolina, Harmony is the State's newest neotraditional development. The product of urban planners Duany & Plater-Zyberk, this mixed-use development is designed to be pedestrian-friendly and self-contained to include residences, shops, restaurants, medical services, schools, day care centers, churches and neighborhood parks. Walkability is key in the layout and design of Harmony, with development densities and mixed uses promoted to encourage and facilitate walking and biking to work and other services. The development will feature up to four town centers within easy walking distance of residential areas. Commercial structures located in the town centers will include upper-level living quarters. Housing will accommodate a wide range of income levels, including assisted-living facilities for the elderly. The overall design of Harmony is based on interpretations of the coastal Carolina cities of Beaufort, Charleston and Georgetown – the State's three oldest cities. The development will be built-out in four phases, with Phase One currently underway. Upon completion, Harmony will host more than 1,500 housing units with a projected population of more than 5,000 residents.

Infill and Redevelopment

Of all the sensible growth strategies that can be undertaken in a region, strengthening the central city is one of the most critical. Strong central cities experience less abandonment and population loss than weak ones. Successful downtowns offer an attractive pedestrian environment, including a mix of uses that support each other and generate activity throughout the day and into the evening. Although center cities dominated the office, retail, government, cultural, and entertainment landscape during the first half of the Twentieth Century, they now face fierce competition with suburban areas for nearly all of these functions. Rising to the competition is difficult, since public support for investing in and revitalizing urban areas has often exited along with residents and businesses. Revitalization efforts seek to maximize the use of available properties in urban areas, resulting in more productive use of these strategically located centers and reducing the need to convert greenfields into suburbs. However, healthy center cities and suburbs are not mutually exclusive. In fact, a strong central city should

Of all the sensible growth strategies that can be undertaken in a region, strengthening the central city is one of the most critical.

have a positive effect on the whole region. By combining a mixture of uses, higher densities, efficient use of existing infrastructure, and multimodal transportation opportunities, central cities play an important role in reducing per capita energy consumption.

The trend toward developing outward into traditionally rural areas affects older suburbs as well. As growth extends past older suburbs, buildings are abandoned and often left to decay. A current example is the tendency of some "big box" retailers to abandon smaller, relatively new buildings and move to newer, larger facilities located even further from established areas. These abandoned properties can sit vacant and neglected for years, becoming eyesores to the community. A successful revitalization effort should address these older suburbs as well.

Many residential neighborhoods and commercial areas, both old and new, have been under-built, leaving empty, overgrown and unkempt lots that create gaps between buildings. These lots remain vacant in part because local jurisdictions either require overly large setbacks from neighboring property lines or forbid construction on lots under a minimum number of square feet. Stringent regulations, practicality and economic considerations compel developers to place buildings on the most spacious and accessible lots available, frequently passing over buildable lots that are smaller, irregularly shaped or pose topographical challenges.

The promotion of infill development within existing urban areas is an important strategy for accommodating growth and preventing sprawl through greater density and efficiency in land use development.

Though these vacant, abandoned or derelict properties in established residential and commercial areas often appear to be liabilities to the community, they provide excellent opportunities for energy conservation. Infill development makes use of properties within established districts that were initially bypassed or subsequently created by demolition or abandonment for new development. The promotion of infill development within existing urban areas is an important strategy for accommodating growth and preventing sprawl through greater density and efficiency in land use development. Infill developments contribute to energy conservation in many ways. Higher density infill developments promote alternatives to car travel such as walking, bicycling and transit use and help sustain nearby mixed-use development. Infill development also utilizes existing infrastructure, reducing the need to expend additional energy in the expansion or construction of new support facilities.

While people are attracted to the central city for access to major civic and cultural activities, they also value the convenience of being able to accomplish multiple tasks at a single destination. Although many suburbanites identify culturally with cities, they are

frustrated by the daily problems of living in higher densities – i.e., a perceived lack of privacy, security concerns and parking shortages. In order to address these issues and appeal to a broader audience, it is important for developers of infill housing to maximize security and privacy and make creative provisions for automobiles.

Properties that include abandoned or derelict buildings are rarely thought of as desirable sites for new development, since the added demolition and cleanup costs often make redevelopment prohibitive. However, redevelopment of these facilities can also provide excellent opportunities for energy conservation. Redevelopment of such sites, known as brownfields, is often complicated by the existence of real or perceived environmental contamination. Brownfield redevelopment is a strategy for returning such lands to productive use. More than 450,000 brownfield sites have been identified in U.S. cities.[16] The expense of cleaning up these sites is a major reason developers prefer raw land on the suburban fringe over that of the urban core. Brownfield redevelopment results in energy and financial savings as well as improved public and environmental health. Not only will a brownfield redevelopment contribute to the local economy, it may also attract additional development to the area. Moreover, redevelopment can also decrease energy consumption and public cost by utilizing existing infrastructure and preventing further encroachment into greenfields.

Brownfield redevelopment results in energy and financial savings as well as improved public and environmental health.

Redevelopment can also include innovative reuse of existing facilities. For instance, many "dead" retail malls have been converted into schools, churches, government facilities, offices and health care facilities. With predictions of up to 20% of existing malls failing in the next 10 years, some entrepreneurs see adaptive reuse of malls as the most exciting development frontier since the mall itself.[17] In both Aiken and Greenville Counties, former retail malls have been converted into county government complexes. A city block of old retail space in the City of Greenwood was transformed into a successful upscale hotel. In Spartanburg County, the former Sears department store building now houses county government offices.

With predictions of up to 20% of existing malls failing in the next 10 years, some entrepreneurs see adaptive reuse of malls as the most exciting development frontier since the mall itself.

Former schools in the Cities of Columbia and Greenwood have been converted into apartments and a former textile mill in Columbia is being renovated into apartments as well. In Florence, a former elementary school now houses a community-based health center. The center serves as a base for health, social and job training outreach services for a large low-income, predominantly minority community.

Successful infill and redevelopment strategies make such properties

Communities can take a proactive stance for encouraging infill and redevelopment by maintaining a detailed inventory of available sites, including assessments of environmental concerns, and making listings readily available to prospective developers.

more attractive for development through incentives and regulations that promote rather than prohibit appropriate projects. Zoning regulations may prohibit or discourage infill or redevelopment in many localities. Such regulations must be updated to eliminate barriers and provide incentives for infill and redevelopment. Updates can reduce minimum lot size, lot coverage, setbacks and parking requirements; waive prohibitive requirements such as open space; and allow a mix of uses in appropriate areas. Permit approval and review procedures should be reviewed and streamlined to avoid unnecessary delays. Reductions in fees, coupled with tax incentives and low cost loans or subsidies, can be offered to make infill and redevelopment ventures more attractive to developers. Communities can take a proactive stance for encouraging infill and redevelopment by maintaining a detailed inventory of available sites, including assessments of environmental concerns, and making listings readily available to prospective developers.

CASE STUDIES

Cargill Place Redevelopment Project

In the City of Hartsville, South Carolina, the Cargill Place Redevelopment Project has transformed a former eyesore into a catalyst for downtown economic development. The Cargill Place development covers almost two city blocks in the heart of the City, located on the site of the former Cargill Seed Oil Processing Plant that was abandoned in 1981. When cleanup of the site was identified as the City's top priority during a strategic planning effort in the mid-1990s, a community-based task force was appointed to develop a master plan for the redevelopment of the site. Because of its prominent downtown location, the Cargill site was designed to preserve the traditional development patterns of the adjacent downtown business district. The multi-use complex includes a public park site, Applebee's Neighborhood Bar and Grill, and the 74-room Fairfield Inn, with CareSouth (a health provider) occupying the historic Hartsville Oil Mill building. The YMCA occupies part of the restored former J.L. Coker Department Store (a National Register building constructed in 1910), with a recent expansion extending the YMCA from the rear of the Coker Building onto the Cargill property. The other half of the Coker building houses an administrative division of Sonoco. Future plans include the addition of residential units on the property. Pedestrian activities are encouraged by this mixed-use concept, with commercial activities and employment opportunities located within easy walking distance from residential uses and the hotel. The success of the development has generated additional investment in the Greater

Hartsville area, as evidenced by the planned construction of a $25 million downtown campus for the Governor's School for Science and Mathematics and Coker College's recent construction of a $6.5 million performing arts center within three blocks of the Cargill development.[18]

Aiken Redevelopment Incentives

Under a program called Aiken 2000, the Aiken City Council assembled a package of cash and tax incentives aimed at encouraging occupancy of vacant commercial buildings, boosting economic development in the central business district, and reducing development sprawl. The program offers new property owners a way to reduce business overhead costs through reimbursements for City taxes, licenses or utility fees. To qualify, buildings: 1) must be adapted for commercial use; 2) must have been empty or vacant continuously for at least two years; 3) must change ownership; and 4) the proposed use must be a viable commercial venture such as retail, restaurant or warehousing. The cash incentives for using an empty commercial building are based on the number of years the building has been continuously vacant and marketed. If it has been vacant for five or more years, the new property owner could receive an annual reimbursement for all municipal property taxes over the next five years.[19]

Charleston Brownfield Assessment Project

In the City of Charleston, the 3.7-acre former site of Charleston Oil is currently being redeveloped for use by Transworld Electric, an electrical contractor with plans to offer a 4-year electrician apprentice program. Environmental concerns prevented the use of this property for more than two years prior to redevelopment by the current owner. The project is one of the first to be undertaken by the City of Charleston Brownfield Assessment Demonstration Pilot Project with funding provided by the City and the U.S. Environmental Protection Agency. The City's brownfield demonstration project provided an assessment of site conditions and environmental constraints and identified mitigation and development alternatives. The property owner used this information to formulate a detailed mitigation plan and proceed with redevelopment of the site. Not only did the property owner benefit by receiving needed technical assistance in making profitable use of the site, the surrounding community benefited by mitigating a potential health hazard and transforming a former eyesore into a productive property.[20]

Village at Port Royal

Village at Port Royal was constructed on several blocks connected to the Town of Port Royal's previously economically depressed main street. Because it is an infill development, the project was designed to blend in seamlessly with the rest of the Town. The Village includes 45 affordable cottages ranging in price from $78,000 to $145,000. The project has provided a real boost for the historic Town of Port Royal by demonstrating a viable market for homes and serving as a model for new development. The development was made possible through a public/private partnership between the Town and Village Renaissance, Inc.[21]

Broad Street Infill Community

The 11-acre Broad Street infill community is located in an older neighborhood in Beaufort, South Carolina. The development features 56 attached and detached Lowcountry cottages built along two streets sharing a long, central green open space. Homes in the development range in price from $105,000 to $200,000. Broad Street provides linkage to several other neighborhood streets, with a path network that connects to an adjacent elementary school. The streets in the project are 17 to 23 feet wide and include on-street parking. Vince Graham, Merritt Patterson, Paul Trask and Henry Lyon are the developers of the Broad Street community.[22]

Compact Development and Clustering

Clustering is a development design technique that concentrates buildings in specific areas on a site to allow remaining land to be used for recreation, common open space, or the preservation of historic or environmentally sensitive features.

A compact development is one that is built at the optimal density and does not necessarily include the provision of open space.

The introduction and encouragement of compact development and clustering in a community can significantly impact energy usage. While the fundamental concepts of compact development and clustering are similar, they are not interchangeable. Clustering is a development design technique that concentrates buildings in specific areas on a site to allow remaining land to be used for recreation, common open space, or the preservation of historic or environmentally sensitive features. A compact development is one that is built at the optimal density and does not necessarily include the provision of open space. The definition of compact development is context dependent. In rural locations, achieving higher density may mean shrinking large lots slightly to accommodate more housing. In suburbs seeking to maximize land use through small-lot single-family homes, higher density housing could range from 10 to 20 units per acre. In urban infill situations, higher density may mean building at densities that reflect the density of surrounding development.[23] *Compact development concepts are generally used within cluster projects to maximize buildable space*

and ensure the adequate provision of open space.

While the concepts of compact development and clustering can be applied to commercial or industrial projects, they are most often associated with residential development. Compact residential development can be achieved by building homes on smaller lots, incorporating provisions for zero-lot-line design (patio homes), building attached homes (duplexes or townhouses), or building multi-family structures (apartment buildings). Clustering is best suited for suburban or rural areas where there are available properties of adequate size to accommodate the required open space. Compact development is best applied to projects in urban areas where properties are generally too small to include significant amounts of open space.

When compared with conventional subdivisions, compact and cluster developments are more energy-efficient. Compact development shortens trips, lessening dependence on the automobile and thereby reducing levels of fuel consumption and air pollution. Residential clustering can reduce the length of streets and utility line installations. Energy is saved in the construction and later in the maintenance of streets, the transmission of electricity and water, and the provision of services including garbage collection in both compact and cluster developments. In addition, the increased vegetation and open space preserved in cluster developments contribute to a reduction in summer air temperature and cooling needs.

Compact development shortens trips, lessening dependence on the automobile and thereby reducing levels of fuel consumption and air pollution.

The smaller detached single-family, attached single-family and multi-family homes characteristic of compact development use less energy for space heating and cooling than traditional single-family detached homes. Smaller detached and attached dwellings make more efficient use of urban services by accommodating more residents in less space than the typically larger single-family detached homes. Shared walls in attached and multi-family units reduce heating and cooling losses, resulting in even greater energy efficiency.

A study of five San Francisco Bay area neighborhoods found that doubling residential density reduced vehicle miles traveled (VMT) by 25 to 30%. The differences in annual gasoline consumption for the five neighborhoods, assuming an average fuel efficiency of 20 mpg, are presented in Table 1. This reduction in VMT associated with higher densities is most likely due to a reduction in the number of vehicle trips (people shifting to walking, transit, etc.) and the length of vehicle trips (people in higher density areas may not need to travel as far to reach destinations).[24] A similar 1990 study

by Florida traffic specialists compared a conventional subdivision with a more compact, mixed-use development and found that the compact design would generate only 57% of the vehicle miles traveled by residents of the conventional subdivision.[25]

Table 1. The Effect of Housing Density on Gasoline Consumption

Households per Residential Acre	Annual VMT Per Capita	Annual Fuel Consumption Per Capita (gallons)
117.0	2,670	133
32.0	5,090	254
14.0	6,944	347
6.8	7,566	378
3.8	10,216	511

Source: California Energy Commission, Energy Aware Planning Guide.

The market for higher density housing is growing, with smaller families, empty-nesters, an older population, childless married couples and singles seeking convenience, low-maintenance living and more amenities.

As household composition changes, it makes sense for housing to be more flexible. The market for higher density housing is growing, with smaller families, empty-nesters, an older population, childless married couples and singles seeking convenience, low-maintenance living and more amenities. A mix of housing types and densities more accurately reflects the marketplace than standard suburban subdivisions. Evidence suggests that many homebuyers are most concerned with the type of development they move to and care less if the lot is a bit smaller. In a 1997 study focusing on the cost of sprawl, Robert Burchell of Rutgers University found that housing lots could shrink from 20 to 25% before purchasers objected.[26] *Most homebuyers move outward from urban areas because of traffic and noise and the desire for a sense of space, greenery and privacy – all physical attributes that can have design solutions. The successes of a number of master-planned communities around the country offer an important lesson – middle-income and affluent suburbanites will buy higher density housing if it is designed attractively.*

Compact housing can also be more cost-effective for the consumer. Land costs per unit for higher density housing tend to be lower, resulting in housing that is more affordable than homes in conventional subdivisions. In addition, recent tax code revisions allow couples up to $500,000 in tax-free capital gains on home sales. This policy revision gives empty-nesters and others the option to downsize from larger homes to residences that better suit their current lifestyles.

Compact development is a key component of traditional neigh-

borhood development (TND). A traditional neighborhood development is a neighborhood that is walkable from one end to another; has a civic core (a school, church, library, park or similar focal place); includes a variety of housing types and densities; is near to basic goods and services; is designed to keep through traffic down to reasonable levels; and incorporates both public and private individual space. TNDs implement the concepts of new urbanism and are intended to be reminiscent of traditional neighborhood design. While the concept of new urbanism includes mixed-use development, many TNDs do not include a true mix of uses, focusing instead on the provision of a variety of residential options. A 1998 survey of recent homebuyers conducted by the Maine State Planning Office indicated that 37% of homebuyers can be considered good prospects for traditional neighborhood development. Results of the survey indicated that a significant share of homebuyers will choose them if TND alternatives are offered in the marketplace.[27]

Local governments nationwide have begun to develop programs and policies to encourage or require compact development and clustering. However, zoning regulations in many jurisdictions still prohibit or discourage compact development and clustering. Such regulations must be updated to remove these barriers and provide incentives for compact development and residential clustering in appropriate areas. This can be accomplished through reductions in lot size and setback requirements and by allowing zero-lot-line developments (patio homes), attached housing units (townhomes and duplexes) and multi-family units (apartments or condominiums) in appropriate areas. Ordinances may be updated to require compact development or clustering in particular areas. To ease public concern about compact development, communities can develop design guidelines to ensure that new compact developments blend in with surrounding neighborhoods. In addition, the application of minimum density standards in appropriate areas can promote optimal use of properties and discourage low-density and under-built development. Setting a standard for minimum density can be difficult – requirements that are too low may result in undesirably sparse development and those that are too high may deter builders from developing in the area. It is critical that local officials work closely with local developers to set a minimum density standard that is within the range of market demand.

To ease public concern about compact development, communities can develop design guidelines to ensure that new compact developments blend in with surrounding neighborhoods.

Higher densities can also be achieved in established areas by allowing accessory housing units (above garages or in other unobtrusive locations) where appropriate. Berkeley County, South Carolina, has put this concept into place, with "guest houses"

allowed as an accessory use in all residential districts, provided that the structure is no more than 850 square feet in size. In addition, fee reductions and tax incentives can make compact development and clustering more attractive to developers. Density bonuses for projects that incorporate compact development or clustering can be offered as additional incentives to potential developers.

CASE STUDIES

I'on Village

The I'on Village in Mt. Pleasant, South Carolina, is a prominent example of compact development and clustering. I'on is a 243-acre traditional neighborhood development with 760 homes ranging in price from $235,000 to more than $1,000,000. Developers Vince and Tom Graham teamed with designers DPZ and Dover, Kohl & Partners, Inc. to instill the look and feel of old Charleston in the project, incorporating narrow streets, tight building patterns, service lanes behind homes, and attractive public spaces. The pedestrian-oriented community is divided into six smaller neighborhoods (called boroughs) each with between 80 and 150 homes planned around a preserved civic space such as a lake, park or square. A variety of housing types and densities are included, along with a small (30,000 square feet) commercial town center. The natural environment is highlighted throughout the development by views and public access to lakes, marshlands and small pocket parks.[28]

Baxter Village

Baxter Village, located in Fort Mill, South Carolina, within close proximity of Downtown Charlotte, uses compact development and other design features to recreate the feel of a traditional southern neighborhood. Baxter represents the first residential phase of the larger 6,200-acre Clear Springs development that will comprise a series of small residential towns at build-out. Baxter Village will include 1,500 housing units of varying sizes and densities, from townhomes to larger single-family homes, upon completion. The use of residential clustering has resulted in abundant open space connected by an extensive trail system. Office and retail activities are also planned for the 1,033-acre development. The design of the Village is based on traditional upstate South Carolina architecture, with homes ranging in price from $118,000 to $350,000.[29]

Full Utilization of Existing Infrastructure

A sustainable community is one that makes efficient use of public and private infrastructure. Every new building in a community carries an associated cost for supporting public infrastructure – roads and sidewalks for access, water and sewer lines, solid waste disposal, and fire protection and emergency medical services. Sensible development practices encourage people to live where these public services already exist or where extensions have been planned and budgeted, rather than pushing beyond the edges of established areas and creating inefficiencies and/or new demand. Because development that occurs beyond existing service areas requires considerable energy use in the form of construction and extension of infrastructure, provision of emergency services in outlying areas, and increased trip distances for new residents, the potential energy savings associated with encouraging growth in developed areas can be substantial. Due to the accelerating costs of adding additional infrastructure and services, the concept of maximizing existing infrastructure has been embraced by local governments for some time. In recent years, the general public has joined this stance, as illustrated in a 1999 Greenville County survey in which residents ranked the need to encourage growth in developed areas where public sewer and water is already available as one of the most important issues facing the community.[30]

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Sensible development practices encourage people to live where these public services already exist or where extensions have been planned and budgeted, rather than pushing beyond the edges of established areas and creating inefficiencies and/or new demand.

When it comes to sustainable growth strategies, however, one size does not fit all. There are a wide range of incentive, policy and programmatic choices from which to choose. While a certain policy or program may be exactly what one community needs, that same policy or program may not be feasible or desirable to implement in another community. Each community should implement the measures that are most appropriate for its needs after carefully considering the unique economic, geographic and environmental characteristics of the area and its ability to achieve community land use objectives.

Mixed-use development, infill and redevelopment, compact development and clustering are all essential components in a comprehensive energy conservation program. Additional mechanisms have been developed to complement these measures and ensure that the use of existing infrastructure such as water, sewer, roads, emergency services and schools is optimized. Transfer of development rights, development impact fees, and urban service areas represent three emerging tools for local governments.

Transfer of Development Rights

TDR is a market-based technique that encourages the voluntary transfer of growth from places where a community would like to see less development (sending areas) to places where a community would like to see more development (receiving areas).

Although the concept of transfer of development rights (TDR) is most often associated with the preservation of open space, farmland, historic sites and environmentally sensitive areas, it can also be used to encourage development in established areas. TDR is a market-based technique that encourages the voluntary transfer of growth from places where a community would like to see less development (sending areas) to places where a community would like to see more development (receiving areas). TDRs can promote energy conservation by steering development to areas with established infrastructure and away from areas with little or no existing infrastructure. From a local government standpoint, TDRs are very attractive since private funds rather than tax dollars are used to further community goals such as farmland preservation, prevention of development sprawl, and maximization of existing infrastructure.

To understand the TDR concept, it helps to become familiar with the flexible ways in which legal interest in real estate can be divided. Lawyers are trained to view the ownership of real property in America as the ownership of a "bundle of rights." The potential to use this bundle is limited by many factors, including zoning and land use restrictions, building code provisions, environmental laws and other public policy restrictions, as well as the general market forces of supply and demand. Any previous decision of past owners of the same property to sell or give up parts of the bundle while retaining other parts will also affect the rights of the current property owner. A TDR system simply takes some of the content of the bundle of rights for one piece of property and transfers or relocates it to another piece of property. Typically, this is done by shifting the future development potential from one piece of property to another. The transferred development potential may be measured in a number of ways such as floor area, dwelling unit density or number of parking spaces.

When development rights are transferred from a parcel (called the sending parcel), an easement or other notation is recorded in the land records to indicate that the prescribed development rights can no longer be exercised on the sending parcel. The parcel to which the development rights are transferred (called the receiving parcel) is then eligible to exercise additional development rights. Sending site owners are compensated for their reduced development potential by being able to sell their TDRs to the developers of receiving sites. If landowners in the receiving areas choose not to buy TDRs they can still develop their land, however they must strictly adhere to the permitted density and other relevant provi-

sions in the zoning ordinance. Developers who purchase TDRs enjoy additional development rights with economic benefits such as increased density. Property owners are generally not free to transfer development rights among themselves at will. Typically, the transfer of development rights takes place within the context of a formal TDR program or system set up and administered by a local government.

In order for a TDR program to be successful, both the sending and the receiving areas must be carefully described and inventoried. Enough land must be included in the receiving areas to absorb all of the TDRs capable of being produced by the sending areas. Favorable economic and regulatory conditions in the receiving area are also essential. TDRs must add value to the bottom line of development projects in the receiving area or there will be no demand for them. If there is no demand there will be no transfers from the sending area and no easements recorded to permanently protect the land resource.

TDR programs are used to preserve agricultural land and historic landmarks; to achieve efficient, concentrated growth patterns; to protect sensitive natural environments; to protect water quality; or simply to provide a convenience to property owners. For example, if a community is interested in using TDRs to encourage growth in an urban area and discourage growth outside this area, they would designate the land within the urban area as a "receiving" area and land beyond the urban area as a "sending" area. TDR programs offer a streamlined method of increasing density in growth areas as an alternative to lengthy and uncertain rezoning procedures.

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Though several jurisdictions in South Carolina have explored TDR as a mechanism to encourage growth in urban areas and preserve farmland or environmentally sensitive areas, none have active TDR programs. However, a few jurisdictions have undertaken related approaches to address growth pressures. Beaufort County has launched a land preservation program to counter over-development and address unequal development patterns. The program employs two basic approaches – the purchase of development rights (PDR) and the fee-based purchase of properties to maintain open space, preserve valuable forest and farmland, and protect critical and natural resources. The County's PDR program is designed to remove the development potential from important parcels of forest and farmland. Rural landowners are paid not to develop their properties, with the land placed under a conservation easement to protect the area from subdivision and development. The companion critical lands program targets property that possesses unique,

significant or important characteristics which may be purchased in fee, optioned, or the development rights purchased.

CASE STUDIES

Montgomery County TDR Program

With eleven jurisdictions currently incorporating TDR programs, the most extensive use of this technique has been made in the State of Maryland. One of the oldest programs in the State was instituted in Montgomery County, a fast-growing suburb of Washington, D.C. In 1980, the County rezoned a 91,000-acre agricultural reserve from a maximum density of one unit per five acres to one unit per 25 acres. This move was based upon a study indicating that 25 acres was the smallest farm that could function on a cash crop basis in the County. However, property owners in the agricultural reserve who agree to permanently deed restrict their land for agricultural use are allowed to sell their development rights at the rate of one TDR per five acres. The County designates receiving zones based on their proximity to transportation, urban services and existing development. A thriving market for higher density housing, combined with the fact that higher densities are only available for projects that make use of TDRs (with the exclusion of projects providing affordable housing), has resulted in a strong demand for TDRs.[31]

Since the program's inception, TDRs have been used to protect more than 32,000 acres of farmland in Montgomery County – nearly 32% of the County's agricultural land – making it one of the most active TDR programs in the country.[32] *During this time, only 4,000 acres within the Agricultural Reserve have been converted to uses other than farmland.*[33] *Development has instead been directed into areas such as Olney and Potomac, where existing infrastructure is available to accommodate new development. While the Montgomery program does not forbid development in the sending area or require TDR purchase as a condition of development in the receiving area, permitted densities in the sending area are so low that developing a standard subdivision is not economical.*[34] *To further protect the Agricultural Reserve, the County has purchased easements along the eastern edge of the reserve, creating a barrier that discourages extension of water and sewer from the developed area into the reserve area. Detractors of the program note that residents in the receiving areas feel adequate infrastructure has not been provided to serve the increased growth that has resulted from transfers. Annexation is also threatening the viability of the reserve, with developers offering towns*

and villages infrastructure improvements and future tax revenue in exchange for relief from County regulations.[35]

Development Impact Fees

Development impact fees are another potentially effective tool in encouraging growth that makes efficient use of public and private infrastructure. The cost of providing new residential development with new or expanded public facilities including water, sewer, drainage, police, fire and schools has been rising at a pace that often exceeds local government revenue-generating capacity. Local governments have discovered that development impact fees are one way to shift some of the burden of paying for new or expanded facilities to accommodate growth from existing development to new development.[36] *Impact fees are monetary charges imposed on new development to recoup or offset a proportionate share of public capital costs required to accommodate such development. Impact fees grew out of the public realization that growth can significantly drain public coffers. The objective of impact fees is not to raise money, but to ensure adequate capital facilities. Impact fees are assessed and dedicated for the provision of services and facilities such as water and sewer systems, roads, police and fire facilities, emergency medical facilities, hospitals, schools, and solid-waste disposal facilities. However, impact fees cannot be used for operation, maintenance, repair, alteration or replacement of existing capital facilities.*

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...development impact fees are one way to shift some of the burden of paying for new or expanded facilities to accommodate growth from existing development to new development.

When impact fees are charged for infrastructure construction and upgrades to serve new development in rural or outlying areas, infill and redevelopment projects in established areas become more economically attractive to developers. This is especially true when the impact fees are part of an overall program that includes other incentives for developing in established areas and disincentives for developing in rural or outlying areas. When developers choose infill or redevelopment over conventional development in outlying areas, significant energy savings can be realized.

Chapter 6, Article 9 of the *South Carolina Code of Laws* (S.C. Development Impact Fee Act) *stipulates that only local governments that have adopted either a comprehensive plan or a capital improvements plan may charge development impact fees. Under the Act a county or municipality is allowed to impose a development impact fee for the cost of new public facilities or to make system improvements caused by new growth and development. Public facilities are defined as those related to water and wastewater utilities; solid waste and recycling; roads, streets and bridges;*

...all development impact fees levied in South Carolina must be based upon actual improvement costs or reasonable estimates of the costs.

storm water and flood control; public safety; street lighting; parks, open spaces and recreation areas; libraries; and capital equipment and vehicles with an individual unit purchase price of not less than $100,000.[37] In addition, all development impact fees levied in South Carolina must be based upon actual improvement costs or reasonable estimates of the costs. The stringent requirements of the South Carolina regulations related to development impact fees do not preclude their use, but they do require local governments to very carefully document every aspect of their application, particularly acceptable levels of service and project impact costs.

While there are some limitations to the use of development impact fees, solutions have been developed to address these problems. Developers who are asked to pay impact fees at the time of development will naturally pass these costs on to prospective buyers. However, if payment of impact fees is phased over a period of time, developers are given a reasonable chance to meet them without raising prices above competitive levels. Because impact fees tend to be charged at a flat rate, buyers of lower priced properties often end up paying proportionately more for the same services as buyers of higher priced properties. To mitigate this disparity with respect to housing developments, impact fee schedules should be developed that are proportionate to house size, and therefore more aligned with buyer income. Impact fees can also be paid through alternative sources for low and moderate income (LMI) housing and certain economic development opportunities. Another limitation arises when there are vast differences in the costs of achieving similar levels of service among areas within the same jurisdiction. For example, residents of suburban areas may prefer, and be willing to pay, for roads that operate at level of service "C" (free-flowing traffic with some interruption in speed attributable to oncoming or entering traffic), while residents of more urbanized areas may prefer and be willing to pay for only level of service "E" (traffic is dense and speeds are slow, but traffic is moving). Greater equity can be achieved by developing service areas drawn with level of service expectations in mind.[38]

Case Studies

City of Atlanta Transportation Impact Fee Program

The City of Atlanta, Georgia, offers a 50% reduction in transportation impact fees for developments of all types that locate within 1,000 feet of a MARTA transit station. They further stipulate that the 1,000 feet must be measured from property line to property line along a legal and practical pedestrian route – meaning that within

the public domain the distance must be along legitimate walking surfaces such as sidewalks. In measuring the walking distance, the route must utilize pedestrian crosswalks and bridges when crossing roads, railways, water bodies or other potential pedestrian hazards. The rationale for the fee reduction is the idea that close pedestrian access to transit stations will mean fewer cars on the road. Atlanta's transportation impact fees are based upon actual cost recovery or a reasonable estimate of the recovery cost of providing adequate transportation infrastructure to meet the demand generated by the new development. Atlanta officials note that the 50% reduction of transportation impact fees can be substantial, particularly for large projects, offering a strong incentive for developers to consider locating new projects near MARTA stations.[39]

Urban Service Areas

Many jurisdictions have found the delineation of urban service areas to be a controversial but useful tool in maximizing the use of existing infrastructure while minimizing sprawl. An urban service area is an area extending outside an existing urban center within which growth is encouraged, primarily through the provision of government-supplied public facilities and services, and outside of which growth is discouraged. Although development may locate outside of an urban service area, the local government does not subsidize or accommodate it by extending services such as water and sewer. The principal goal of urban service areas is the efficient provision of governmental services to include water, sewer, roads, police, emergency services, recreation, and others. By encouraging the efficient provision of infrastructure and services, urban service areas effectively promote energy conservation.

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Urban service areas are generally designed to encompass an adequate supply of buildable land that can be efficiently provided with infrastructure and support services to accommodate the expected growth during a 20-year period. Many urban service areas include both a primary urban service area, in which services are available now or will be in the near future, and an urban expansion area or urban reserve, where services will be provided within a defined planning period, but generally at a slower pace and beyond the time frame associated with the primary urban service area.

Urban service areas and growth areas should be delineated only after careful consideration and thoughtful analysis of current and future land use conditions. Growth issues should be identified and goals for the service or growth area should be developed through a community-oriented participation process that includes both

Regional cooperation and coordination are essential to the success of an urban service or growth area.

public and private interests. Regional cooperation and coordination are essential to the success of an urban service or growth area. Because the implementation of service areas generally requires a much higher level of intergovernmental cooperation than currently exists, the development of an urban service area must be promoted regionally. Although some urban centers may be located in unincorporated territory, most urban service areas include a central city and surrounding unincorporated lands. Therefore, the first and most essential issue becomes the level of cooperation as two or more local governments (usually a city and county) collaborate on growth and development issues. It is imperative that the participating jurisdictions develop cooperative land use planning, zoning, permitting and codes enforcement, infrastructure and other mechanisms to guide development. Such agreements should be formalized through the adoption of a memorandum of understanding, statement of responsibilities, or interlocal agreement. These documents should include provisions for planning responsibilities, service provision, regulatory requirements, zoning and land development administration, and annexation. In addition, a process for periodic review and adjustment of the urban service areas should be developed to ensure that an adequate supply of developable land is provided within the area and that the goals of the service area are being met.

Relevant Criteria for Establishing Urban Service Areas

1. *Territory outside a city may be included only if it is already characterized by urban growth or is adjacent to territory already characterized by growth.*
2. *Urban growth should be located first in areas that have public facility and service capabilities and second in areas that will be served by planned facilities and services.*
3. *The area is either already developed, firm commitments have been made to develop, or the area is located adjacent to cities or high-intensity population and employment centers.*
4. *Public facilities and services are in place or can be provided at a reasonable cost to accommodate urban growth.*
5. *Natural features and land characteristics are capable of supporting urban development without significant environmental degradation.*
6. *The area does not have high current or future value for agriculture, forestry or mineral production and should be able to develop without having a detrimental impact on nearby resource lands.*

Source: Weitz, Jerry. Sprawl Busting: State Programs to Guide Growth. APA Planners Press, 1999.

Urban service areas are most effective when administered in conjunction with other tools also designed to maximize existing infrastructure and reduce sprawl development. The establishment of minimum density criteria within the service area can ensure that desired density levels are achieved. By designating the urban service area as a receiving area, a transfer of development rights program can be used to encourage development in the service area and steer development away from outlying lands. Many jurisdictions, including all 457 local governments in Florida, allow development to occur only when facilities and services are available to support it – a concept known as concurrency. While traditional land use regulations stipulate what can be developed where, concurrency takes it a step further by specifying when development may occur in an area. In addition, local government can provide incentives such as reductions in taxes, business fees and building fees for new development within the urban service area.

Urban service areas are most effective when administered in conjunction with other tools also designed to maximize existing infrastructure and reduce sprawl development.

While the service area concept encourages optimal use of existing facilities and services and provides stability to the planning process, it can have a number of drawbacks. Adjustments to the urban service area are often problematic, with developers and homebuyers eyeing land just beyond the service area, while those living on the outside of the area resent the potential intrusion of higher density development. Property values inside the service area tend to rise, while those outside fall. The incorporation of a market factor – an amount of developable land beyond what is called for in development and population projections – when determining the original urban service area can help alleviate both of these concerns. A sufficient market factor allows flexibility in the siting of new development and ensures that developers have access to locations favored by the market. In addition, an excess of developable land within an urban service area can have a positive effect on affordability by easing pressure land prices. Another drawback is the possibility that development prohibited in some areas may leapfrog into neighboring areas or jurisdictions where it will be allowed. This often creates a conflict between neighboring local governments and illustrates the need for regional planning and cooperation when developing service areas.

CASE STUDIES

Salisbury Strategic Growth Plan

The 1988 strategic growth plan for the City of Salisbury, North Carolina, identified an urban growth area that includes primary and secondary growth areas. The area outside the urban growth

area is designated as rural. The primary growth area includes land within the City limits and extends beyond to areas that either have city services (water, sewer, etc.) or where these services can be easily provided. In order to encourage development in established areas, Salisbury agrees to provide up to 50% of the cost of extending water and sewer lines within the primary service area and up to 25% within the secondary service area. No incentive is offered for developing in the rural area. The program has been successful. Prior to 1988, the City was experiencing leapfrog development, with subdivisions popping up further and further out in the countryside. From the inception of the incentive program in 1988 to 1997, there were more than 700 new residential lots created and more than 200 properties developed for commercial or industrial purposes within the primary growth area. In 1997, Salisbury added a rebate to developers for each home completed in an ongoing effort to encourage construction and build-out of developments within the urban growth area. The City is also working with developers to encourage compact development and clustering and has revised its zoning ordinance to allow greater density flexibility in appropriate areas.[40]

Tools for Measuring Sustainability

With energy conservation and sustainability fast becoming critical issues for communities nationwide, planners have begun to refine tools to assist in measuring the impact and effectiveness of policies. These computer-based tools enable planners, decision-makers and citizen groups to summarize and analyze multiple influences simultaneously. In addition, these programs allow users to examine both existing conditions and alternative future plans, providing decision-makers with the information needed to make informed decisions for the community well-being.

PLACE³S

*The Center of Excellence for Sustainable Development of the U.S. Department of Energy has developed the computer-based PLACE³S (**PLA**nning for **C**ommunity **E**nergy, **E**conomic and **E**nvironmental **S**ustainability) model to help communities understand how growth and development decisions affect long-term sustainability. PLACE³S uses energy efficiency as a yardstick to measure the sustainability of urban design and growth management plans. By allowing communities to compare the efficiency of various land use alternatives, neighborhood designs, building and infrastructure operations, and transportation management systems, PLACE³S provides a useful tool for gauging the effects of a*

community's land development options. The model integrates public participation, planning, design, and quantitative measurement in a five-step process that evaluates the effects of a plan and its alternatives. When the Eugene-Springfield region of Oregon used PLACE³S to evaluate the region's existing policies on compact growth and transit, the analysis revealed future energy savings of approximately $10 million annually.[41]

Smart Places

Smart Places is a GIS-based (ArcView) software package designed to support communities considering the implications of alternative land use plans. Seven resource features are assessed by the software: land use, energy, transportation, communications, water, wastewater and solid waste. The software can also be modified to include additional resource features. Smart Places enables a community to evaluate key community performance measures and how performance might be impacted depending on the type of development pursued. For example, Smart Places can be used to generate a comparison of the energy requirements for a development of 50 versus 100 single-family homes.[42]

NOTES

NOTES

Transportation Opportunities

During the past century, no single force has had a greater impact on the pattern of land development in American cities than transportation. The development of better roadways resulted in decreased costs of both time and money for transportation within and between urban areas. Improved roadways and affordable cars enabled families to relocate from housing near their workplaces to homes in the suburbs that provided more housing per dollar in the form of larger lots, detached houses, and cleaner environments. In turn, retailers followed their customers to the suburbs. Long-haul trucks freed manufacturing firms from relatively expensive sites near ports and railroad terminals. Service-oriented firms followed the retail and manufacturing firms they served to the suburbs. In short, transportation improvements were a major factor in the exodus of households and businesses from the central cities to the suburbs.[43]

During the past century, no single force has had a greater impact on the pattern of land development in American cities than transportation.

This shift from the central city to the suburbs has resulted in an increasing dependence on the automobile. Between 1969 and 1990, the total number of vehicle trips taken by all Americans increased more than three times as fast as the population.[44] *This dependence on the automobile is mirrored in South Carolina, where more than 92% of residents now travel to work by car – nearly 6% more than the national average. Only 18% of South Carolinians traveling to work by car participate in a carpool – slightly higher than the 15% of Americans that carpool. While more than 5% of the country's population travels to work by public transportation or taxis, only 1% of workers in South Carolina travel to work using these modes of transportation. Only 3% of State residents walk or bike to work compared to slightly more than 4% of American workers who walk or bike.*[45] *Nearly 2% of workers at the State level and 3% at the national level currently work at home.*

Between 1969 and 1990, the total number of vehicle trips taken by all Americans increased more than three times as fast as the population.

There has also been a concurrent increase in the length of vehicle trips. The distance of the average trip increased by 9% from 1969 to 1990 nationwide.[46] *More than 72% of South Carolinians travel less than 30 minutes to work, as compared to 68% of Americans. Only 4% of workers at both the State and national level have a commute of less than 5 minutes. Twenty-six percent of South Carolinians and nearly 30% of Americans travel more than 30 minutes to work, with approximately 4% of workers in the Palmetto State and 6% of workers in the United States commuting more than an hour to work.*[47]

...transportation is a major consumer of energy in the U.S., accounting for more than 40% of total annual energy consumption (both direct and indirect).

With such increases in the number and length of vehicle trips, it is no surprise that transportation is a major consumer of energy in the U.S., accounting for more than 40% of total annual energy consumption (both direct and indirect). Approximately 43% of all oil used in the U.S. each year is refined into gasoline to power automobiles.[48] In South Carolina, nearly 25% of all energy is consumed by the transportation sector.[49] While energy consumed for transportation is generally thought to be used to power vehicles, 40% of the energy consumption attributed to transportation is consumed indirectly, primarily in the production of fuels, construction and maintenance of infrastructure, and manufacture and repair of vehicles.[50]

Automobiles are responsible for a large portion of the total energy used because they are very energy intensive. As shown in Table 2, travel by automobile or light truck consumes more energy per mile than all other modes of ground transportation except light rail systems. Local bus systems and vanpools use less than one-third the energy of automobiles and less than one-fifth the energy of light trucks. Energy savings are even more dramatic when compared to travel on foot or by bicycle. Bicycle travel uses 25 times less energy than automobile travel, while walking uses 9 times less energy. These energy savings are even more significant when you consider that walking and bicycling rely on energy produced by the human body – not fossil fuels. Additional energy savings can be realized per person when the mode of travel is capable of transporting larger numbers of people (buses or rail systems), or even when an automobile or light truck transports more than one person per trip.

Table 2. Transportation Energy Intensity by Mode

Mode	Average Energy Intensity (Btu per mile traveled)
Bicycle	140
Pedestrian	400
Vanpool	600
Bus – Intercity	1,000
Motorcycle	2,300
Rail – Amtrack	2,500
Bus - Transit	3,400
Light Rail/Commuter	3,600
Automobile	3,600
Light Trucks	5,000

Source: Peter Miller and John Moffet, "The Price of Mobility: Uncovering the Hidden Costs of Transportation."

Effective transportation policies, when combined with effective land use policies, can reduce automobile travel by up to 40%.[51] *Options for reducing transportation energy consumption include:*

Effective transportation policies, when combined with effective land use policies, can reduce automobile travel by up to 40%.

- *Shifting traffic to more efficient modes, by lowering the Btu per seat miles (from auto to buses, mass transit and human powered sources);*
- *Increasing load factor, by raising the passenger mile per seat (carpooling and vanpooling);*
- *Reducing demand, by reducing passenger miles (through land use planning, telecommunications and other methods);*
- *Increasing energy conversion efficiency, by lowering the Btu per seat mile (smaller and more efficient vehicles); and*
- *Improving use patterns, by lowering seat miles (traffic design and control).*[52]

Statewide, transportation issues rank as one of the greatest public concerns. A survey conducted by the Institute of Public Affairs at the University of South Carolina in 2000 revealed that in the areas of fastest growth statewide, 25% of the population surveyed ranked traffic/transportation as the most important issue facing their community.[53] *Also, a 1999 survey of more than 7,000 Greenville County residents ranked neighborhood traffic volume as one of the County's most important issues.*[54]

Through transportation policy, governments have the opportunity to greatly affect energy consumption. State, regional and local governments have wide-ranging legal and financial powers to influence transportation. They directly supply or regulate the supply of most transportation infrastructure including roadways, sidewalks, transit, bike paths, and parking.[55] *If improvements and additions to transportation systems are designed with energy conservation in mind, significant energy savings can be realized. Unfortunately, in many cases public policy has been the primary barrier to energy savings. The following sections explore alternatives to many of these transportation policies and practices that fuel excessive and unnecessary energy consumption.*

Street and Parking Design

The evolution of street design in the U.S. has primarily been a product of a growing population's increasing dependence on the

automobile. As traffic volumes increased, road design standards were modified to make auto travel more safe and efficient, often at the expense of the character of residential areas. Standards required streets wide enough to accommodate increased traffic, turning radii large enough for service and emergency vehicles to negotiate cul-de-sacs, and T-configured intersections that minimized traffic conflicts. Traditional grid systems fell out of favor because they allowed through traffic on residential streets, and cul-de-sacs were encouraged because they prevented such through traffic.[56] In addition, parking standards were designed to accommodate the maximum number of automobiles needed for each land use category, with little consideration for shared parking, carpooling or alternative methods of travel, shift changes, or the unique needs of individual businesses or industries.

It has become apparent that many of these practices, while providing solutions to some problems, have created many others. Unnecessarily wide streets encourage faster speeds, discourage walking or biking, increase the percentage of impervious surface, and increase ambient temperatures. Poor connectivity often restricts the viability of other transportation modes, making driving the most attractive travel option. Cul-de-sacs lengthen distances for travelers, discourage pedestrian travel, and make transit service more difficult to operate and use while placing an added financial burden on local governments that must provide emergency, safety and maintenance services. Wide intersections and the placement of sidewalks adjacent to travel lanes make negotiation by pedestrians and cyclists difficult. Expansive parking lots increase impervious surfaces, make walking prohibitive, increase ambient temperatures, and are often underutilized.

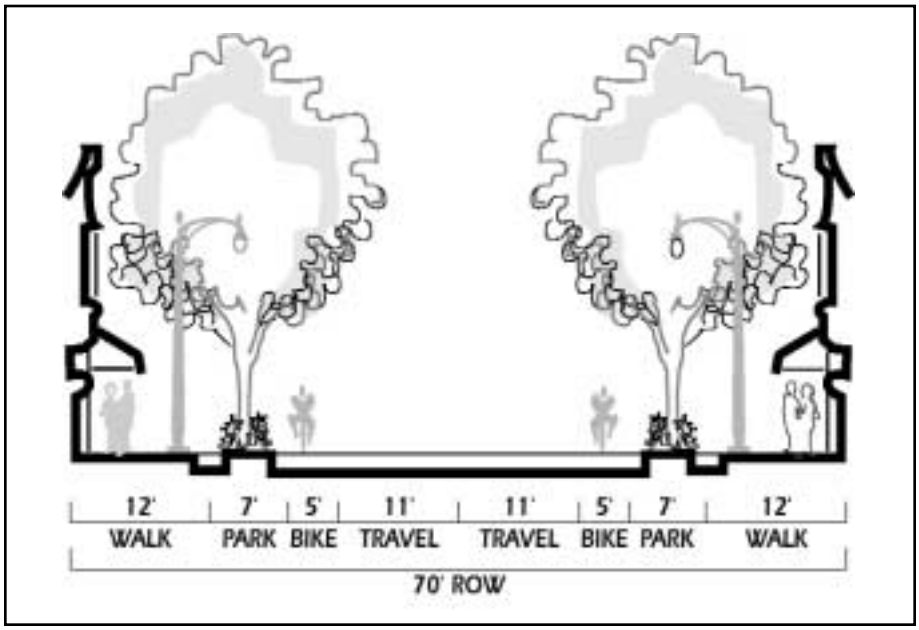
Street design that encourages and enables alternative modes of travel not only saves energy, but can also enhance the overall character and livability of an area.

The problems associated with conventional street and parking design ultimately result in increased energy usage. While it is universally acknowledged that the automobile will continue to be an important factor in land use and transportation planning, communities nationwide are seeking creative alternatives that include energy conservation as a primary criterion. Street design that encourages and enables alternative modes of travel not only saves energy, but can also enhance the overall character and livability of an area.

Alternative means of transportation can be made safer and more attractive by redesigning streets and intersections within intensively developed areas to give equal priority to pedestrians, cyclists, buses and automobiles. Important features of pedestrian and cyclist friendly streets include narrower street widths, on-street parking and less disruptive placement of off-street parking, pedes-

trian protection at intersections, convenient and safe locations for transit stops, and more attractive sidewalk designs and landscaping to include landscape "buffer" areas between streets and sidewalks. In addition, designs that incorporate shorter blocks within perimeters of 1,300 to 1,800 feet encourage pedestrian activity by shrinking the perceived distance between destinations.

Figure 4. Street Design – Cross-section



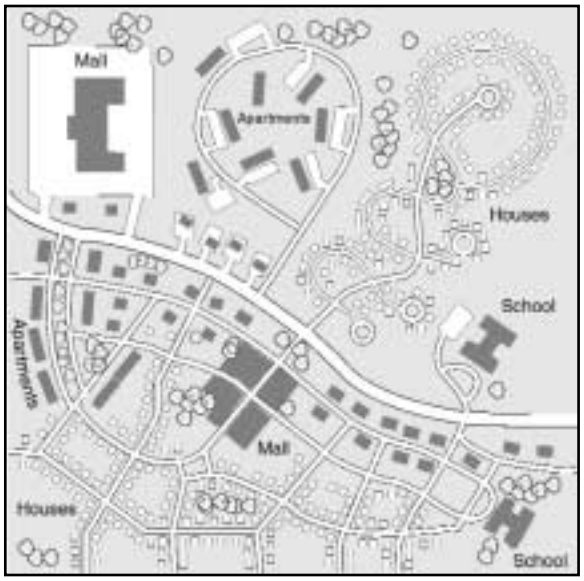
Source: Oregon Transportation and Growth Management Program, The Principles of Smart Development – PAS Report #479.

When switching to alternative modes is not feasible, shortening the length of vehicle trips will reduce gas consumption. The energy required for travel between two points is largely dependent upon the length of the route. Providing a network of fully connected streets allows the use of shorter and more direct routes. Whenever possible, designs for new developments should include connections (ie., streets, bikeways and sidewalks) to existing developments and connections should be added between older developments. When compared to a conventional suburban network of cul-de-sacs and collector streets that funnel all traffic to arterials, a grid street pattern can reduce vehicle miles traveled (VMT) within a development by up to 60%.[57] As shown in Figure 5, travel in a development with poor connectivity requires the use of a collector street, causing congestion and discouraging pedestrians and cyclists, while travel in a development with an interconnected street system allows a variety of transportation options and results

When compared to a conventional suburban network of cul-de-sacs and collector streets that funnel all traffic to arterials, a grid street pattern can reduce vehicle miles traveled (VMT) within a development by up to 60%.

in shorter trips. However, even in a design that includes a combination of cul-de-sacs and through streets, vehicle trips are still more direct than in developments with single access points.

Figure 5. Road Configuration and Connectivity



(Top) Conventional development with poor connectivity
(Bottom) Development with interconnected street system

Source: Oregon Transportation and Growth Management Program, The Principles of Smart Development – PAS Report #479.

...the construction of narrower streets in lower density areas with little through traffic will result in slower traffic, reduced impervious surfaces and, when combined with the addition of shade trees, can result in air conditioning savings of 10 to 30%.

Substantial energy savings can also be realized by sizing streets to accommodate their use. Retaining higher speed street designs and capacities outside intensively developed neighborhoods and developments allows driving speeds to be sustained where they will not endanger or unduly intrude. A system of interconnecting streets of varying designs can provide multiple routes that diffuse traffic congestion by keeping local traffic off regional roads and divert through traffic away from local streets. In addition, the construction of narrower streets in lower density areas with little through traffic will result in slower traffic, reduced impervious surfaces and, when combined with the addition of shade trees, can result in air conditioning savings of 10 to 30%.[58]

Automobiles are most efficient when operated at steady, relatively low speeds (35-45 mph) with no stops. Stop-and-go driving and idling wastes from 30 to 45% of the fuel used while driving on streets with traffic signals. Optimizing the timing of existing signals and installing advanced control equipment can significantly

reduce traffic congestion and fuel use. Conversely, increasing the number of stops and slow-downs or decreasing the average speed below optimal levels will increase energy consumption.[59] Signal optimization is estimated to cost a transportation agency only $0.03 to $0.04 per gallon of gas saved. In other words, each dollar invested in this type of project would result in about 25 gallons of fuel saved.[60] State and local governments can design and maintain traffic signals and other control devices to reduce unnecessary stops and delays while still maintaining safety. Cities participating in a traffic signal management program sponsored by the California Transportation Commission (Caltrans) reduced fuel consumption by an average of 8%, or 4,000 to 6,000 gallons, per intersection per year by optimizing existing signal timing. Stops and delays were reduced by 14% and travel time reduced by 7.5%. Gasoline savings have been raised to 19% above the levels that would have occurred without the improved timing.[61]

Steps can also be taken to make parking areas more energy-efficient. To avoid excessive parking requirements, realistic parking needs can be determined by more closely examining the needs of specific categories of uses. However, a 1986 Urban Land Institute (ULI) survey of nine suburban business parks in Philadelphia and San Francisco found that at 8 of the 9 parks, the peak number of occupied spaces per 1,000 square feet of occupied space was less than 2.0. The survey also revealed that these lower parking needs were not a result of ridesharing or transit use and concluded that a 2.0 parking ratio would be sufficient to take care of the parking needs of most business parks. The conventional requirement for business parks is 4 spaces per 1,000 square feet of occupied space.[62]

To avoid excessive parking requirements, realistic parking needs can be determined by more closely examining the needs of specific categories of uses.

The incorporation of shared parking in mixed-use developments can reduce parking demand by as much as 20 to 30% because parking can be shared among uses with different periods of peak demand.[63] The local use of alternative modes of travel such as public transportation and carpooling should also be taken into account when determining parking requirements. Industries and businesses that actively promote carpooling and the use of public transportation will likely need less parking. Parking design and placement are also critical factors. Lots should be placed and configured to encourage, rather than discourage, pedestrian travel to nearby businesses or residences. The addition of trees and other landscaping features can reduce ambient temperatures in parking lots, in addition to making them more visually appealing for pedestrian use.

CASE STUDY

Newpoint

Newpoint is a 54-acre traditional neighborhood development located in Beaufort, South Carolina, that includes narrow streets in a connected grid pattern. Introduced by Vince Graham and Robert Turner in 1989, the "walkable" neighborhood was one of the first new developments of its kind in South Carolina. Service lanes located at the rear of the lots provide access for automobiles and for service vehicles such as garbage trucks. Front porches and small front-yard setbacks, coupled with sidewalks throughout the project and access to a riverfront park and numerous green spaces, provide an enhanced sense of community. The development includes 126 single-family homes priced from $200,000 to more than $1 million.[64]

Multi-modalism

Before the 1920s, urban areas were characterized by small city blocks connected by a gridded street pattern. The length of streets and size of the blocks were directly related to comfortable walking distances to essential services and public transportation. Most suburbs grew in tandem with the extension of streetcar and railroad lines. Generally, these early subdivisions were compact clusters extending as far as a person could comfortably walk between home and streetcar stop. The advent of affordable car travel after WWII changed the focus of both urban and suburban development from pedestrian and transit-oriented design to street layouts that emphasized safe and efficient automobile movement. Most modern development patterns maximize convenience and safety for the automobile driver, but not for the pedestrian or cyclist. Today's suburban pedestrian must often travel a route five times longer than the direct distance. Each year vehicle accidents involving pedestrians account for approximately one out of every six motor fatalities.[65]

Dependence on the automobile is higher than the national average in the Palmetto State, where more than 92% of residents travel to work by car, compared with only 73% of Americans who drive or ride in a car to work.

Use of alternative modes of travel is especially low in South Carolina, where only 3% of workers walk or bike to work and less than 1% travel to work by public transportation. In comparison, more than 4% of U.S. workers bike or walk to work, while more than 5% commute using public transportation. Dependence on the automobile is higher than the national average in the Palmetto State, where more than 92% of residents travel to work by car, compared with only 73% of Americans who drive or ride in a car to work.[66] *This dependence on the car is attributed in large part to the historically rural nature of the State.*

In recent years multi-modal transportation has been reintroduced in communities across the country through movements such as new urbanism and traditional neighborhood design (TND). Realizing that catering solely to automobile travel at the expense of other transportation modes is costly in numerous ways – excess energy consumption, pollution, and loss of a sense of community, to name a few – communities have begun to encourage or require new developments to include safe pedestrian and bicycle travel in their plans. In many, more urbanized communities, developers are encouraged or required to include transit-oriented development in appropriate areas as well.

Sensible development practices encourage people to use alternative modes of travel – biking, walking or using transit – by providing safe routes to destinations. Interconnected streets reduce distances between points and make destinations easily accessible by multiple methods of travel. Although the option of driving to a destination still exists, better connections make the choice of an alternative mode for shorter trips much more appealing. Poor connectivity often forces people to drive, restricting the viability of other methods of travel. In some commercial areas connections between adjacent buildings can be so poor that patrons are forced to return to their cars, drive back out to an arterial road, travel a few hundred feet to the adjacent parking lot and park again to reach a neighboring building.

Interconnected streets reduce distances between points and make destinations easily accessible by multiple methods of travel.

"Streets are the most prevalent of public spaces, touching virtually every parcel of private land."[67] *For people to choose to walk or bike on neighborhood streets they must feel as welcome and safe as those who choose to drive. Streets designed with many different users in mind encourage non-vehicular travel. Without a comfortable and safe environment for all users, people will continue to rely on the car for trips to and from home. Car-dominated streets can further restrict choices, especially for the 20% of the population who are too old, too young or too poor to drive, by not allowing them the option to safely and conveniently get around independently.* [68]

For people to choose to walk or bike on neighborhood streets they must feel as welcome and safe as those who choose to drive.

Significant energy savings can be realized when vehicle trips are replaced by alternative modes of travel. Nationally, trips of 5 miles or less represent 60% of all vehicle trips and more than 18% of the vehicle miles traveled (VMT). If only 5% of these trips were made by bicycle or on foot, then 3% of all personal vehicle trips would be eliminated and fuel use would drop by more than 1%. Nationwide, 7% of vehicle trips to work and 11% of non-work vehicle trips are less than one-half mile in length each way – a reasonable distance for walking or bicycling if a safe and direct route is

available. If 20 to 50% of these short trips were made on foot or by bicycle instead of driving, total vehicle trips would be reduced by 2 to 5%. Between 5 and 26 gallons of fuel are saved for every 100 of these short trips diverted from a car to walking or bicycling.[69]

There is substantial evidence that if safe and adequate facilities are provided, many people will choose to walk to work, to run errands, and to obtain personal services.

South Carolina's mild winters and moderate temperatures throughout most of the year make walking a popular activity among residents. More than 80% of respondents to a 1994 survey conducted by the S.C. Department of Parks, Recreation and Tourism cited walking as their preferred recreational activity.[70] *While pathways are often provided for recreational walking, these routes do not always directly link essential destinations. There is substantial evidence that if safe and adequate facilities are provided, many people will choose to walk to work, to run errands, and to obtain personal services. A survey of nearly 4,000 residents in five U.S. urban and suburban areas found that 70% would switch from driving to walking or bicycling for shopping and personal business if the trips were reduced to one-half mile in length and bicycle paths and pedestrian walkways were provided. As illustrated in Table 3, the survey also found that improving the design of and access to pedestrian facilities would decrease vehicle trips. Improvements such as the addition of pathways adjacent to major roadways and separated by landscaping (Figure 6), regular sidewalk maintenance, adequate lighting, amenities such as benches and water fountains, and pedestrian-activated traffic signals would result in a decrease of 20% in short trips to work by car and 18% in auto travel for short shopping and personal business trips.*[71]

Table 3. Percentage of Survey Respondents Choosing Walking vs. Driving

Activity	*Existing Participation*	*With Improved Pedestrian Facilities*
Walk to Shop/Personal Business	*18%*	*33%*
Drive to Shop/Personal Business	*69%*	*51%*
Walk to Work	*14%*	*30%*
Drive to Work	*72%*	*52%*

Source: California Energy Commission, Energy Aware Planning Guide.

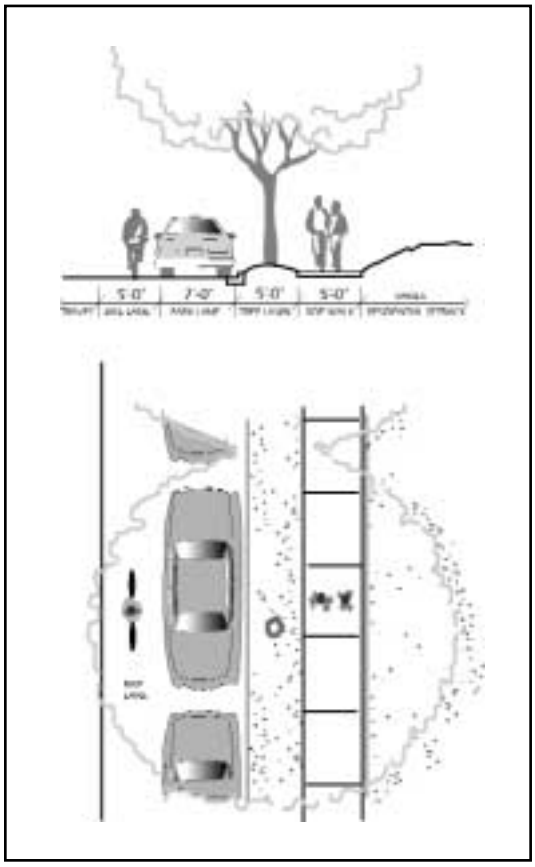
In a separate survey, researchers found that nearly half of suburban office workers left their building during the day to run errands. In an area surveyed that featured a mix of land uses, high-density development and pedestrian facilities, one-fourth of these trips were made on foot. By comparison, in more sprawling, homoge-

neous survey areas, only 6% of such trips were made on foot.[72]

In addition to safety factors, field studies have shown that the level of aesthetic interest is a critical factor in choosing a walking route. People are unwilling to walk farther than 300 feet through a parking lot to reach a desired destination, yet they will walk at least three times that distance along a street of storefronts.[73]

...field studies have shown that the level of aesthetic interest is a critical factor in choosing a walking route.

Figure 6. Pedestrian-Friendly Street Design



Source: Oregon Transportation and Growth Management Program, The Principles of Smart Development – PAS Report #479.

"Pedestrian-Friendly" Design Principles

- ***Provide direct connections.*** *The practical one-way limit for most walking trips is 3,000 feet – about 10 to 12 minutes for the average person.*
- ***Clearly delineate pedestrian paths.***
- ***Provide amenities and make it interesting.*** *Where appropriate, include trash and recycling cans, benches, information kiosks, drinking fountains, decorative landscaping and fountains, and trees.*
- ***Maximize safety.*** *Minimize the number of points where pedestrians and vehicles must cross paths, provide adequate lighting, and provide for police and fire access. Visibility from buildings, parking lots and streets can make paths safer.*
- ***Provide sidewalks.*** *Sidewalks should be provided on both sides of the street. They should be wide enough to minimize congestion and provide separation from cars, but not so wide as to appear empty and desolate. Separate sidewalks from the street with planting strips.*
- ***Install crosswalks at intersections.***
- ***Install and maintain pedestrian signal indicators where appropriate.***
- ***Ensure adequate crossing time at signalized intersections.***
- ***Minimize crossing distances at intersections.*** *Install medians at multi-lane intersections. Reducing street widths and curb radii minimizes distances and slows traffic.*
- ***Minimize curb cuts.***

Source: California Energy Commission, Energy Aware Planning Guide.

The moderate climate in South Carolina is ideal for cycling...

For many people, riding a bicycle is an enjoyable experience. More than 40% of respondents to a 1994 survey of South Carolinians aged 12 and older listed cycling as one of their favorite recreational activities.[74] The moderate climate in South Carolina is ideal for cycling, though periodic rains can be a deterrent. As with walking, though some pathways are provided for recreational bicycling, few connect residences to essential destinations. It is possible to make many types of trips on a bicycle. The types of trips most amenable to cycling are listed in Table 4. The table lists the results of a nationwide survey of personal travel, which revealed that at least half of the trips made in each category were 5 miles or less in length. When combined, these trips of 5 miles or less represent more than 60% of all vehicle trips and more than 18% of the vehicle miles traveled (VMT). If just 5% of these trips were made by bicycle instead

of car, 3% of all personal vehicle trips and nearly 1% of all personal vehicle miles traveled would be eliminated.[75]

Table 4. Percentage of Trips (Nationally) — 5 Miles or Less (One-way)

Destination	Percentage
To/From Work	53%
Work-related Business	53%
Shopping	75%
Other Family/Personal Business	69%
School/Church	69%
Visit Friends	56%
Other Social/Recreational	63%

Source: California Energy Commission, Energy Aware Planning Guide.

Bikeways are most successful in reducing automobile travel in communities where development is compact and a mixture of land uses is encouraged. Although cycling for transportation and recreation is widespread, it is most popular in areas with relatively gentle terrain and in areas with a large student population such as a college or university. The provision of secure bicycle parking at destinations (commercial, recreational and work) is also important. Bicycle paths should be physically separated from roadways whenever possible, and clearly marked by striping and signage when located adjacent to automobile travel lanes. To avoid dangerous collisions with pedestrians, sidewalks should never be designated as bicycle paths. When paths are intended for both bicycle and pedestrian use they should be wide enough to accommodate both without potential conflict. Intersections and bridges should be designed to safely accommodate bicycle access where needed.

Bikeways are most successful in reducing automobile travel in communities where development is compact and a mixture of land uses is encouraged.

Accommodating bikeways in local transportation planning has become a growing priority for many state and local governments. For example, in the neighboring state of North Carolina, the Department of Transportation's (NCDOT) Statewide Planning Branch works closely with municipalities to develop multi-modal transportation options, with an emphasis on bikeways. The Small Urban Unit of NCDOT is responsible for developing long-range thoroughfare plans for municipalities and regions with populations of less than 50,000.[76]

Potential Bicycle Path Hazzards & Solutions

- ***Rumble strips and speed bumps.*** *Eliminate strips and bumps that cross lanes and shoulders.*
- ***Gutter pans and joints.*** *Pans more than 18 inches wide cause problems. Joints should be flush with the pavement.*
- ***Railroad tracks.*** *Rubber padding material can be used. Avoid designing streets that cross tracks diagonally.*
- ***Utility box covers.*** *Should be level with the pavement.*
- ***Storm drains.*** *Should be flush with pavement and designed to avoid entrapping bicycle wheels.*

Source: California Energy Commission, Energy Aware Planning Guide.

Most residents commute by car because it is convenient and provides reliable on-demand, door-to-door service, usually in a timely manner. To be seen as a viable alternative to car travel, transit must provide similar service. Many factors can encourage transit use, including traffic congestion, close proximity to home and work, ease of use, safety, reliability, timely delivery, and affordability. Figure 7 shows how a few key events have significantly affected transit ridership in the U.S. since 1900. Transit use increased dramatically with the fuel shortages caused by the two World Wars, then dipped significantly as the price of automobile travel decreased in the late 1950s. Public concern sparked by the energy crisis of the 1970s resulted in a slight rise in transit ridership, which was bolstered by increased support for transit at all levels of government. Although transit use has leveled off, increased congestion now experienced in many urban areas at peak travel times is likely to make access to transit more attractive.

Transit systems are most convenient and yield the greatest energy and environmental benefits when a rider's origin and destination are located within walking distance of a transit station or stop.

Transit systems are most convenient and yield the greatest energy and environmental benefits when a rider's origin and destination are located within walking distance of a transit station or stop. If rail stations and transit centers are located too far from riders' homes, they will either not use transit or will be forced to drive to the station. By placing more housing near existing and planned transit stations and stops, more people are likely to use transit and will walk to the station, rather than drive. Nationwide in 1983, more than 10% of the people living within one-quarter mile of transit used public transit to get to work. Conversely, only 3.8% of the

people living between one-quarter and two miles from a transit station and less than 1% of the people living more than 2 miles away used transit to get to work. People living close to transit — within one-quarter to one-half mile – are 2 to 4 times more likely than the general population to use this option to commute to work.[77]

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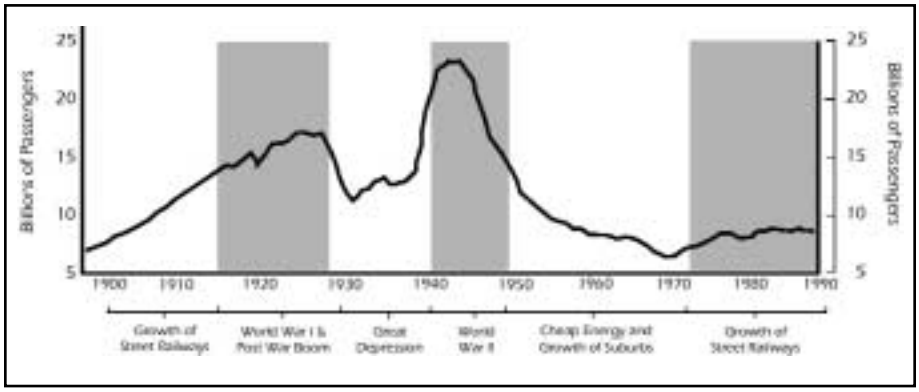
Figure 7. Trends in Transit Ridership



Source: Terry Moore and Paul Thorsnes,
The Transportation/Land Use Connection – PAS Report #448/449.

To encourage and promote transit use, many communities have developed programs that encourage transit-oriented development (TOD) within close proximity of transit stops or stations. Transit-oriented developments include moderate and high-density housing concentrated in mixed-use, walkable developments centered on transit stations or stops. TOD's include higher density at the core but assume low-density development such as single-family detached housing, low-intensity employment uses and large community parks a quarter mile beyond the center. While some cities have established transit overlay zones where densities are required to be higher within a quarter-mile walk from a fixed-route transit stop, others have opted to provide incentives for development of higher density housing near transit stops. For example, the City of Atlanta, Georgia, offers a 50% reduction in transportation impact fees for developments of all types that locate within 1,000 feet of a MARTA transit station.[78]

It is just as critical for efficient provision of transit opportunities that work sites be located within walking distance of transit service. Approximately one-third of all vehicle miles traveled (VMT) are trips to and from work. If a commuter switched from driving to work to using transit just three days a week (about 60% of the time), his overall gasoline consumption would decrease by about 20%, or 160 to 235 gallons each year.[79]

The amount of commercial space, number of employees, and residential density needed to support cost-effective transit and reduce automobile commuting varies greatly between communities. The appropriate density depends on several factors including the type of transit service, the structure of the system, other transportation programs and services, transit fares, and the cost of providing transit service. In addition, factors such as income level and household size influence demand for the higher density housing needed to support transit. The general guidelines suggested by the Institute of Transportation Engineers for the density of residential units and the amount of non-residential floor space that will support various types of transit service are detailed in Table 5.

Table 5. Residential and Non-Residential Units Needed to Support Transit

Transit Type	Non-Residential (million sq. ft.)	Residential (units per acre)
Minimum level of local bus service (one bus per hour)	4 to 5	5 to 8
Intermediate level of local bus service (one bus per half-hour)	7	8 to 20
Frequent level of Local bus service (one bus per 10 minutes)	15	20 to 50
Light rail transit	9 to 12	35 to 50

Source: California Energy Commission, Energy Aware Planning Guide

To encourage transit use, careful attention must be paid to the design of transit stations and stops. Stations and stops should provide shade and protection from inclement weather, be well lighted and fully visible for safety, include comfortable seating, and be fully accessible to handicapped citizens. Placement is also a key issue. Stations and stops should be located away from traffic, with convenient and safe pedestrian access provided. New buildings should be designed and located to encourage transit. If transit riders feel safe and comfortable while waiting for transportation, they will be much more likely to use the facilities on a regular basis.

The true challenge in making streets more genuinely available to everyone is to change the code restrictions and the thought patterns that build streets for cars and then "accommodate" cyclists and pedestrians as an afterthought.

The true challenge in making streets more genuinely available to everyone is to change the code restrictions and the thought patterns that build streets for cars and then "accommodate" cyclists and pedestrians as an afterthought. Community transportation plans should include and address all modes of transportation in an integrated, comprehensive manner. The key principle to follow in designing successful multi-modal road systems is balance – ensur-

ing the safety and quality of the street environment for all users. "Creating sustainable transport systems that meet people's needs equitably and foster a healthy environment requires putting the automobile back into its useful place as a servant. With a shift in priorities, cars can be part of a broad, balanced system in which public transport, cycling and walking are all viable options."[80]

"Creating sustainable transport systems that meet people's needs equitably and foster a healthy environment requires putting the automobile back into its useful place as a servant..."

Ability of Land Uses to Generate Transit Riders

- ***Residential*** *– ridership on public transportation increases as residential density increases. Under good conditions, at 15 dwelling units per net acre (du/acre), there can be a 100% increase in bus usage over that of 5 du/acre; at 30 du/acre bus usage can triple; and at 50 du/acre there can be more bus trips than auto trips.*

- ***Low-density residential areas*** *under 4 du/acre cannot sustain traditional bus services. However, these areas may be served by other types of public transportation such as dial-a-bus, park-and-ride facilities, and van/carpools. The threshold for local bus service to residential areas is approximately 4 to 7 du/acre.*

- ***Medium-density residential areas*** *between 7 to 15 du/acre can generally support local bus service. If these densities are maintained over a large enough area with good access, rail transit may be supported.*

- ***High-density residential areas*** *– the threshold for high capacity transit such as express bus and rail services is approximately 24 du/acre under certain conditions such as the size of the downtown and the distance to the downtown. Multi-family residential of 20 to 25 du/acre can support high capacity transit if location and access are good.*

- ***Employment*** *– public transportation ridership increases as employment density rises. Concentrated employment areas offer the greatest opportunity to generate ridership on public transportation. In most areas, the local bus service threshold for business is approximately 50 to 60 employees per acre. Lower density employment areas may be served by other types of services such as subscription bus and car/vanpools.*

Source: Snohomish County Transportation Authority. A Guide to Land Use and Public Transportation. Snohomish County, Washington, 1989.

Conventional regulations can be revised to encourage, rather than hinder, the development of a multi-modal transportation system. Communities can encourage or require the inclusion of pedestrian and bicycle pathway systems, narrower street widths, on-street parking, pedestrian protections at intersections, advantageous locations for transit stops, and more attractive sidewalk designs and landscaping in new developments. Improving the internal connectivity of residential neighborhoods can dramatically shorten walking distances to transit stops while facilitating convenient foot and bicycle access to neighboring commercial uses and recre-

Incorporating Transit into Building Design

- *Orient new buildings toward the street and locate them close to transit stops. Eliminate or reduce building setbacks near stops. Avoid making pedestrians walk across large parking lots. Most people will not walk more than 1,000 feet to a bus stop – measure actual walking distances.*
- *Cluster buildings near transit stops.*
- *Include and maintain sidewalks and direct paths between transit stops and residences. Provide shade trees along sidewalks.*
- *Avoid walls around subdivisions that limit direct access to transit.*
- *Design building lobbies so employees can wait for transit and still have a view of the street.*
- *Provide transit shelters, eight-foot wide sidewalks, and all-weather pavement at transit stops.*
- *Design streets and intersections on transit routes to accommodate the size and weight of the vehicle. Provide turn-arounds at proper locations to improve on-time performance. Build bus stop pads to reduce wear and tear on the road.*
- *Build "passenger bulbs" – stops where the sidewalk extends to the traffic/bicycle lane. Bulbs allow buses to stop easily and people are prevented from parking at bus stops.*
- *Consider the transit stop an important destination and an important part of the overall design of the project – not an afterthought.*

Source: California Energy Commission, Energy Aware Planning Guide.

To be effective, pedestrian walkways and bike paths should be continuous, linking areas and activities on the site and connecting to locations and paths adjacent to the site.

ational facilities. The use of shorter blocks will encourage pedestrian and bicycle activity by shrinking the perceived distances between destinations and enabling people to take a more direct route. A reasonable, average block perimeter is 1,300 to 1,800 feet – a distance scaled to pedestrians.[81] Cul-de-sacs and other dead-end streets should generally be discouraged. However, when they are allowed, the addition of continuous, non-vehicular connections between streets for pedestrian and bicycle travel should be encouraged. To be effective, pedestrian walkways and bike paths should be continuous, linking areas and activities on the site and connecting to locations and paths adjacent to the site. In addition, locating parking facilities behind or beside commercial buildings – rather than using them to buffer buildings from the fronting street, as is now customary – can dramatically improve access for pedestrians, cyclists and transit riders.

The 1991 Intermodal Surface Transportation Efficiency Act (ISTEA) codified the national movement toward "multi-modalism" by requiring urban areas receiving federal funds to implement planning processes that guaranteed even-handed consideration of alternatives to investment in highways. The Act made federal transportation funding more flexible by declaring investments supporting transit, pedestrian and bicycle travel eligible for funding previously reserved exclusively for highways. The pedestrian and bicycle facilities category requires funded facilities to serve a transportation, rather than a recreational, purpose. The funding was continued in 1998 under the Transportation Equity Act for the 21st Century (TEA-21). Many communities have used this funding source to develop and promote alternative modes of travel.

CASE STUDIES

Bike the Neck

Bike the Neck is a multi-use path designed to provide recreational and alternative transportation access for residents and tourists in the Waccamaw Neck region of coastal South Carolina. Now in its sixth year, the project will eventually connect the coastal communities of Georgetown and Murrells' Inlet in a continuous link for pedestrian and bicycle traffic that parallels the heavily traveled U.S. Highway 17. The pathway will connect numerous residential and tourist developments to allow safe, non-vehicular access to businesses, schools, recreational centers and public and health services. Progress on the pathway has been steady but slow, due in large part to challenges posed by rapid commercial and residential development along the route, the securing of encroachment and easement permits, and design modifications to accommodate the sensitive ecological constraints of the project area. Completed and planned sections of the route feature scenic coastal vistas, along with paths separated from vehicular traffic by buffer strips. The pathway has been recognized as a Millennium Trail, with portions designated as part of the planned Maine-to-Florida East Coast Greenway. The project has been funded to date by a diverse combination of sources that include the S.C. Department of Transportation, Highway Enhancement Funds, Accommodations Tax Revenues, Land Bank funds, and private donations. Active partners in the effort include State and county government, the U.S. Department of Agriculture, community non-profits, developers, public and private utilities, and community organizations.

Cary Greenway System

The Town of Cary, North Carolina, began to assemble its extensive greenway system in the early 1970s. Primary greenways in the system include 10-foot paved pedestrian and bicycle paths. The secondary, more local greenways have 8-foot paths for walking and cycling that can be either paved or unpaved. Developers dedicate .35 acre to the Town for the greenway system for each unit of subdivided land. The greenway system is based upon the Town's Parks, Greenways and Bikeways Master Plan, an element of the Town's comprehensive plan that was adopted in 1998.[82]

Three Rivers Greenway

In the Midlands of South Carolina, the River Alliance is leveraging ISTEA and TEA-21 funds to support the development a regional greenway system. Upon completion the Three Rivers Greenway will run along both sides of the Congaree and Saluda Rivers, with pedestrian bridges spanning the rivers to link Lexington and Richland Counties and the Cities of Cayce, Columbia and West Columbia. As part of the River Alliance's mission to connect people to the Saluda, Broad, and Congaree Rivers, the Greenway provides opportunities for recreation, alternative transportation (walking and biking), and public access to the rivers (including fishing and paddling). At present, the Greenway extends twelve miles and includes a continuous 10-foot wide path, natural areas and green space, picnic areas and public facilities such as restrooms and bike stands.[83]

Travel Alternatives

Telecommuting is a growing practice in which employees work at home and communicate with the office by telephone, computer and fax.

Advances in technology have resulted in new ways to reduce vehicular traffic and conserve energy. While more than 31,000 South Carolinians worked in their homes in 1990, improvements in communications and technology will produce significantly more home-based workers in the future. Many of these workers operate their own businesses from their homes. However, a growing number of companies are instituting telecommuting as an employment option for their employees. Telecommuting is a growing practice in which employees work at home and communicate with the office by telephone, computer and fax. Some telecommuters do all of their work from their home, while others work part of the week at home and part at their place of business. Each day an employee telecommutes or works at home eliminates one round trip. Although such workers may use additional energy at home, researchers estimate that the increase would be no more than one-

third of the energy saved by eliminating the commute trip. Some direct benefits to employers of telecommuters include increased employee effectiveness, decreased turnover, reduced parking requirements, and office space savings.[84] Communities can encourage telecommuting and home-based businesses by developing flexible zoning provisions to allow such uses in residential areas and permit a reduction in the number of parking spaces required if a commitment to telecommuting is demonstrated.

Teleconferencing can also reduce work-related travel by removing the need to travel for meetings and training. Participants use telephone or video technology to hear and view other participants and to view overhead slides or other materials. Computer modems and other technologies enable data and documents to be exchanged. The benefits to employers of teleconferencing include higher meeting attendance and increased participation, elimination of costly trips, less time away from the job for participants, and greater scheduling flexibility. Studies have shown that energy conservation strategies that substitute telecommunications for transportation may lead to a replacement of up to 50% of current face-to-face meetings in the future.[85] These technologies can be utilized by individual companies, businesses or agencies. However, a more cost-effective way to encourage the incorporation of this technology into a wide range of operations is to develop community teleconferencing centers. Such facilities can be developed through public/private partnerships to include local government, universities and community colleges, K-12 schools, government agencies, community-based nonprofits, and private businesses and industries.

...energy conservation strategies that substitute telecommunications for transportation may lead to a replacement of up to 50% of current face-to-face meetings in the future.

Many communities are also encouraging employers to develop work schedule strategies that will help to reduce traffic congestion. Traffic congestion leads to reduced travel speeds, which results in excessive energy consumption. Studies indicate that fuel consumption increases by 30% when average speeds drop from 30 to 20 mph. A drop from 30 to 10 mph results in a 100% increase in fuel use.[86] Alternative work schedules can reduce traffic congestion and energy consumption by shifting commuters out of the peak travel periods and eliminating commute trips. With "compressed work weeks" employees work more than 8 hours a day for 4 days in order to take the fifth day off – resulting in the elimination of one round trip per week. "Flex-time" scheduling allows workers to set their schedules depending upon their needs, with certain core hours when they must be at work. "Staggered work hours" can be used to reduce peak congestion by staggering start times of employees. Both flex-time and staggered work hour pro-

Alternative work schedules can reduce traffic congestion and energy consumption by shifting commuters out of the peak travel periods and eliminating commute trips.

grams can reduce the number of workers commuting during peak travel times, though such programs may interfere with ridesharing opportunities.

CASE STUDY

The Baxter M. Hood Center

Through the individual and combined efforts of higher education, K-12 schools, state agencies, and other public and private entities, a growing telecommunications infrastructure has created new opportunities for residents and businesses in South Carolina to realize cost savings while opening unprecedented access to quality training, meeting and educational resources. With 16 colleges located throughout the State, South Carolina's Technical College System has been a leader in this movement. The Baxter M. Hood Center of York Technical College is one of the most state-of-the-art conference facilities in the Southeast. The 40,000 square foot facility offers on-site videotaping, videoconferencing, and satellite teleconferencing capabilities to public and private organizations in the Rock Hill area.

NOTES

Environmental Opportunities

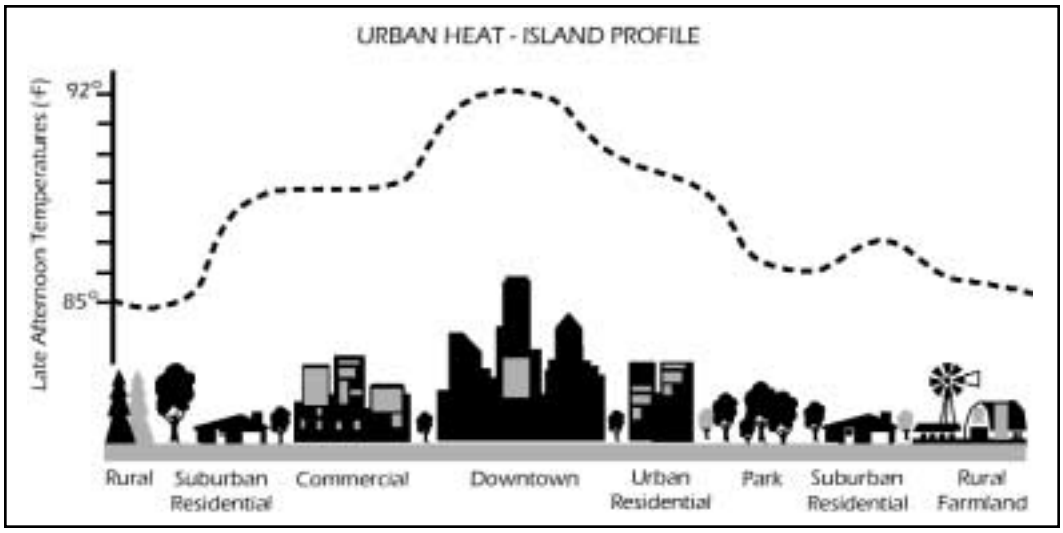
While there are many ways to conserve energy, some of the most effective measures incorporate resources found in nature. Natural resources such as sunlight, wind, vegetation and water can address energy needs and reduce the demand for non-renewable energy sources. The following sections explore ways in which environmentally based approaches can be used to save energy, conserve resources and improve environmental quality.

Urban Forestry and Landscaping

Land use and development density can have an adverse impact on both the local and global environments. As shown in Figure 8, the more densely an area is developed, the higher the temperatures are likely to be. On warm summer days with calm winds, city air can be 2 to 12 degrees Fahrenheit (°F) hotter than the surrounding countryside. Dark roofs and paving materials absorb more of the sun's radiation than vegetation, causing both surface temperature and overall ambient temperature in urban areas to rise. This phenomenon, called the urban heat island effect, has been intensifying throughout the past century, with cities such as Washington, D.C. and Baltimore, Maryland, experiencing temperatures 4 to 5º F hotter on summer afternoons than they did a century ago.[87]

...the more densely an area is developed, the higher the temperatures are likely to be.

Figure 8. Urban Heat Island Profile



Source: California Energy Commission, Energy Aware Planning Guide.

The urban heat island effect significantly affects energy usage in cities. For every 1º F increase in summer temperatures, peak cool-

The air conditioning needed to compensate for the urban heat island effect comprises 3 to 8% of urban electricity use, costing Americans $1 billion annually.

ing loads increase by 1.5 to 2%. The air conditioning needed to compensate for the urban heat island effect comprises 3 to 8% of urban electricity use, costing Americans $1 billion annually.[88] A one degree temperature increase in Los Angeles, California, is estimated to increase demand for cooling power by 2%, or $25 million worth of electricity each year citywide.[89]

Trees and other vegetation block solar radiation, provide shade and help reduce ambient air temperatures through evapotranspiration – the process that occurs when water absorbed by vegetation evaporates from leaves and surrounding soil and naturally cools the surrounding air.[90] This reduction in air temperature is most effective in established areas, where mature trees can transpire up to 100 gallons of water in a single day.[91] As illustrated in Figure 8, when trees and vegetation are displaced by buildings and asphalt, temperatures can increase measurably.

The Urban Heat Island Phenomenon

Cities are "heat islands" – zones of summer air temperatures as much as 12°F higher than surrounding areas.

Cities

- *More engines and building exhaust*
- *Fewer trees*
- *Buildings, sidewalks & streets absorb and hold heat*
- *Dust & other airborne pollutants absorb and trap heat*
- *Concrete & asphalt hasten the drainage of rainfall*

Open Space/Greenways

- *Fewer sources of heat*
- *More trees to provide shade, absorb solar radiation and provide natural air conditioning through transpiration*
- *Cleaner air allows heat to escape into space*
- *Unpaved open areas retain natural moisture longer, helping to cool the air directly and to supply roots with moisture for tree health and transpiration*

Source: National Arbor Day Foundation,
Tree City USA Bulletin No. 21, "How Trees Can Save Money."

Trees have been identified as the "low tech" solution to energy conservation and can save energy by:

- *Reducing the need for air conditioning through shade;*
- *Breaking the force of winter winds and lowering heat costs;*
- *Serving as a renewable source of fuel;*

- *Reducing air temperatures through evapotranspiration;*
- *Sequestering, or "locking up" carbon, an element that is a key factor in atmospheric pollution and the threat of global warming; and*
- *Landscaping with trees to decrease lawn space and reduce areas that need to be mowed using power mowers.*

Urban forests have been shown to lower the ambient temperature of a city's summer "heat islands" by 15º F, if local tree canopies are sufficiently mature.[92] *Planting trees along streets reduces the heat absorbed by asphalt and can reduce the energy used for cooling in adjacent buildings. Evening ambient air temperatures in neighborhoods with well-shaded streets are up to 10º F cooler than areas with less shading. The use of trees and other vegetation to reduce surface temperatures not only saves energy, it can also improve air quality and make urban environments more livable. A healthy urban tree can also absorb 10 to 50 pounds of carbon dioxide (CO_2) per year, making the urban forest a valuable tool in controlling air pollution.*[93]

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Urban and suburban forests are responsible for substantial energy savings. According to the U.S. Department of Agriculture, the average tree cover density in single-family residential areas is approximately 28%. This tree canopy translates into energy savings of almost $2 billion each year, or about 0.5% of all energy use nationwide.[94] *The benefit of tree cover is clearly demonstrated by Atlanta's experience. In Atlanta's metropolitan area, rapid development and urban sprawl have resulted in a loss of 370,000 acres of trees between 1983 and 1992.*[95] *Temperatures in downtown Atlanta have increased by more than 6 degrees since 1972 and sometimes measure up to 12 degrees hotter than surrounding areas. This tree loss translates to an increase in energy use in downtown buildings of 4% over the same period. However, the heat island effect is being counteracted by the dense urban forest in Atlanta's residential areas, where it is responsible for energy savings of $4.6 million annually. For individual homeowners, such energy savings can lower summer cooling bills by $9 to $61.*[96]

Effective selection and placement of trees and shrubs around buildings can reduce air conditioning needs in the summer and heating needs in the winter. Planting trees to shield buildings from the sun's rays can reduce the amount of heat absorbed by these buildings. Well-placed deciduous trees and plants can block 80% of the sun's radiation in summer and shed their leaves in cooler

Well-placed deciduous trees and plants can block 80% of the sun's radiation in summer and shed their leaves in cooler months to permit penetration of needed sunshine.

In areas with warmer climates such as South Carolina, strategically planted trees and shrubs can cut summer cooling needs by 15 to 35% in most cases, and even up to 50% in some cases.

months to permit penetration of needed sunshine.[97] Within 10 to 15 years – the time it takes most trees to grow to significant size – properly placed trees can reduce climate control costs for a typical home or office by an average of 10 to 20%.[98] In areas with warmer climates such as South Carolina, strategically planted trees and shrubs can cut summer cooling needs by 15 to 35% in most cases, and even up to 50% in some cases.[99]

There are many ways that local governments can take an active role in preserving the urban forest and ensuring that adequate trees and vegetation are included in new developments. Jurisdictions can work with local civic and neighborhood groups to plant or replace trees in public areas, maintain existing trees and vegetation, and distribute educational information on how to properly plant and care for trees and other vegetation. Programs that include matching funds, plant maintenance, and other incentives can be developed to encourage tree planting, landscaping and continued maintenance of plants. Jurisdictions can develop new ordinances or revise existing ordinances to require or encourage tree preservation, tree planting, landscaping and maintenance of planted materials. To be effective energy-saving tools, such ordinances should specifically include provisions that require or encourage planting schemes that conserve energy. Depending on the size of the jurisdiction and the extent of their landscaping and tree programs, it is sometimes necessary to hire an urban forester or a landscape architect to oversee local programs, implement tree and landscaping regulations, and ensure proper maintenance of existing trees and landscaping.

Cities with municipally owned power facilities have made increased efforts to use trees to reduce energy use. For example, the City of Rocky Mount, North Carolina, plans to plant 27,000 new trees – one for each of its public power customers. To this end, the City gives away thousands of shade tree seedlings each spring during their annual "Spring Tree Giveaway." They also include educational inserts on the benefits of trees and tree maintenance in their utility bills. The City is counting on the energy conservation benefits from tree shading to forestall the need for new power capacity and reduce the potential for rate increases.[100]

American Forests, an organization devoted to ensuring a sustainable future for the nation's urban and rural forests, has developed the CITYgreen computer program to help local governments, community groups, citizens and developers quantify the benefits of trees. CITYgreen is a Geographic Information System (GIS) software program for mapping urban ecosystems and measuring the

economic and environmental benefits of trees, soils and other natural resources. The program enables users to analyze impacts of storm water runoff, summer energy savings, carbon storage, air quality and urban wildlife. Local governments can use CITYgreen to estimate the effectiveness of tree ordinances, model design standards for subdivisions, and determine potential energy savings derived from additional shade. The program is an application written for use with ArcView, an Environmental Systems Research Institute (ESRI) GIS product. It is offered free of charge to communities by American Forests.[101]

CASE STUDIES

Dekalb County Tree Ordinance

From 1983 to 1992, rapid development and urban sprawl resulted in the loss of about 370,000 acres of trees in the Atlanta metropolitan area. An analysis of the urban ecosystem in Atlanta conducted by American Forests in 1996 found that the undeveloped natural landscape of the City had decreased by 60% since 1972. At that time 87% of the region had a heavy vegetation canopy, but by 1993 this percentage had dropped by more than half.[102] *In an effort to mitigate the loss, neighboring Dekalb County – located in the heart of the metro area – developed and adopted a tree ordinance with the primary objective of preserving existing trees. The ordinance currently requires developers to retain 120 inches of trunk diameter per acre or a flat 25 percent tree coverage per acre, whichever is less. Removal of trees requires substantial replanting. Consequently, it is often more economical for developers to preserve existing trees than to replace them. However, conflicts have arisen when applying the 25% requirement to industrial uses. Although the requirement is compatible with residential uses, industrial uses often plan to develop 80 to 90% of a tract. Such situations often require a developer to either acquire additional property for tree planting or to request a variance from the requirements of the tree ordinance.*[103]

Myrtle Beach Tree Preservation Ordinance

A 1995 community visioning process revealed that citizens of the City of Myrtle Beach, South Carolina, strongly desired more green space and trees in their community. Subsequently, the City convened a Landscape Committee to address these needs through a revision of the existing tree protection ordinance. The Committee included representatives from area retail businesses, Santee Cooper Electric Utility, and the S.C. Forestry Commission, as well as

landscape architects, large developers, residents, code enforcement officers and planning staff. Following a year of research and review the Committee presented a revised tree ordinance for developed and undeveloped land – which included performance standards for the care and maintenance of trees, protection for trees, mitigation requirements, and a listing of landmark trees – to the City Council for approval. The ordinance also provided for the establishment of a tree preservation account. The tree preservation account includes monies from all tree removal fees, penalties and fines collected and is used to fund all tree-related activities. Following the adoption of the revised ordinance in the fall of 1996, the planning staff began the long-range tasks of educating the public on the importance of trees and implementing the community tree planting plan that has and will continue to enhance the "greening of the City." Community education activities included sponsoring a day-long seminar on the value of trees and how to protect them, public service announcements on local cable channels, an educational tree curriculum for area high school students, and sponsorship of local Arbor Day festivities. Since 1996 the City has planted more than 2,500 trees in the public right-of-way and City Council remains openly committed to continuing the effort well into the future.[104]

Open Space

While individual building sites often include landscaping, open spaces offer even greater opportunities for preserving existing vegetation and introducing additional trees into an area.

While individual building sites often include landscaping, open spaces offer even greater opportunities for preserving existing vegetation and introducing additional trees into an area. Open spaces are unimproved parcels or areas of land or water that are set aside, dedicated, designated, or reserved for resource protection and public or private use as active or passive recreation areas. While many jurisdictions require the inclusion of open space in new developments, some communities have developed comprehensive greenway systems that link open spaces – in some cases providing miles of uninterrupted greenways within urban or suburban areas. Greenways link a number of outdoor opportunities in a continuous corridor. A greenway can be a simple path surrounded by just enough natural vegetation to mask the sights and sounds of the city, or it can include linkages to larger open spaces such as a spacious park, wildlife refuge, or historic site.

Statewide, citizens are in favor of preserving open spaces and incorporating greenways into urban and suburban areas. In a 1999 survey, Greenville County residents listed preservation of rural areas, farmland and open space as one of the more important issues facing the County.[105] *Similarly, a survey of more than*

1,000 South Carolina residents conducted in 2000 by the University of South Carolina's Institute of Public Affairs indicated that 75% of the public surveyed would support the creation of greenbelts around cities and towns, while 70% supported the purchase of open spaces to ensure their preservation.[106] *Open spaces and greenways are popular primarily because of the visual beauty and recreational benefits they offer. The significant energy savings and improved air quality these spaces provide are less tangible benefits, often overlooked by advocates. As noted earlier, the trees and vegetation that are an important feature of open spaces and greenways help cool air temperatures in hot weather by providing shade and evapotranspiration and block cold winds in winter months, thereby reducing energy needs for heating and cooling. When greenways are used for travel on foot or by bicycle to primary destinations such as work or school, they can also help reduce vehicle trips.*

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There are several ways local governments can promote the preservation of open space. Jurisdictions can work with local civic and environmental groups to designate potential open space and seek funding for the purchase of these properties. Programs can also be developed to seek conservation easements from private property owners for open space preservation. Provisions requiring or encouraging the designation of open space within all new developments can be added to existing regulations. Land use regulations can be amended to encourage or require cluster development, in which buildings are concentrated in greater densities to allow remaining land to be used as open space and in some cases to protect environmentally sensitive areas such as wetlands. Jurisdictions can develop local or regional greenway plans as part of their comprehensive plans. Most importantly, local parks and recreation commissions or their equivalent agencies should be appropriated the resources needed to properly maintain existing open spaces, to include providing care for trees and other vegetation.

Case Studies

Chattanooga Greenway System

In the early 1980s, residents of Chattanooga, Tennessee, began a mass exodus to the cleaner, greener and safer suburbs. To lure them back, local government, businesses and community groups mobilized to improve Chattanooga's quality of life by cleaning the air, acquiring open space and constructing parks and trails. Today, the City boasts extensive green space interwoven with a bustling commercial and residential district. An eight-mile green-

way is the centerpiece for a planned 75-mile network of greenways and trails. The proposed greenway network extends from Chattanooga's wealthiest to its most distressed neighborhoods, and is designed to ultimately link the Tennessee River Park to the Civil War battlefield on South Chickamauga Creek. Enthusiasm has been so high for the greenway that most funds for land acquisition have come from private donations.[107]

Fort Mill Greenway System

The Town of Fort Mill, South Carolina, is developing an extensive system of greenways and pathways that will ultimately provide connections throughout the municipality. The centerpiece of the system is the 2,300-acre Anne Springs Close Greenway. The Close Greenway includes walking trails, horse paths, several lakes, an outdoor interpretive area and large expanses of forest. Plans include future connections to larger regional and statewide systems such as the proposed Catawba River trails and the Palmetto Trail.[108]

Alternative Fuels

As the nation becomes more dependent on conveniences such as cars, air conditioning and computers, the continued search for alternatives to the nonrenewable fuel sources which we are rapidly depleting becomes more critical.

As the nation becomes more dependent on conveniences such as cars, air conditioning and computers, the continued search for alternatives to the nonrenewable fuel sources which we are rapidly depleting becomes more critical. The energy that powers these conveniences of modern life is generated primarily by coal, oil, natural gas or nuclear energy. As nonrenewable resources, the supplies of coal, oil and natural gas are finite and can be exhausted in the course of time. In addition, the byproducts of these resources, such as carbon dioxide and carbon monoxide, contribute to the degradation of the atmosphere and environment. The use of nuclear energy presents problems as well, in particular the containment of the toxic waste byproducts and the extremely long half-life and costly storage requirements of uranium.

Fortunately, scientists have been working to develop renewable resources that can be used for large-scale applications such as powering cars and heating and cooling buildings. Renewable resources such as sunlight, water and wind will never be depleted, although the cost and the rate at which the resource is used are often crucial factors in their long-term viability. Although there are constraints in the use of these renewable resources as well, they hold the most promise for cleaner, more efficient energy production.

Energy Production from Sunlight

Photovoltaic systems and solar thermal power systems convert sunlight into energy. Photovoltaic (solar) cells absorb sunlight and convert it directly into electricity – without the use of any moving parts. Since individual cells produce only a small amount of electricity, cells are linked together in solar arrays to produce large amounts of electricity. Cells or arrays are mounted on a roof or on platforms to maximize exposure to the sun's rays. Unused electricity is stored in batteries, which is then used to provide power after sunset or during overcast days. While we are familiar with small scale common uses for solar cells, such as powering hand-held calculators and watches, solar arrays have been used on a larger scale to operate space satellites, the Natatorium at the Atlanta Olympics, and the picnic area at the Harbison State Forest in Columbia, S.C. Some western states have constructed large electrical generation plants that utilize solar arrays to help offset peak demand on the utility grid. Although installation of a photovoltaic system is relatively simple, the current cost of converting a home or business can be prohibitively high.

Photovoltaic (solar) cells absorb sunlight and convert it directly into electricity – without the use of any moving parts.

There are three types of proven solar thermal power systems on the market but in limited use: the central receiver solar collector (also called a power tower), the parabolic reflector and the parabolic trough system. The power tower is a central receiver flanked by numerous mirrors. With hundreds of mirrors reflecting the sun's light onto the receiver, the heat generated causes the fluid circulating through the tower to boil and turn to steam. The steam is then used to turn a turbine to produce electricity. A parabolic reflector features a central focal point for the sun's rays, while a parabolic trough uses multiple trough reflectors to focus sunlight onto a central pipe running the length of each trough segment. The heated fluid in the pipes turns to steam, operating a small steam turbine to produce electricity. While the parabolic reflector is currently in the experimental stages, power towers are in use throughout France and an electric generating plant in California has been utilizing a parabolic trough system for a number of years to produce on-peak power.

Energy Production from Biomass

Biomass fuels are energy sources from recent-term organic (plant and animal) matter. Examples of biomass sources are trees, farm crops (such as ethanol from corn), manure, plants and landfill gas. While wood is one of the most plentiful forms of biomass energy, trees can take from 10 to 20 years to become large enough to use

Biomass fuels are energy sources from recent-term organic (plant and animal) matter.

– making sound forestry management essential to the viability of this resource. Wood waste can also be used to make electricity. For example, most of the pulp and paper industries across the state and the nation utilize their wood residues (sawdust, shavings, bark and black liquor), as a fuel source to produce process heat or steam. The Trigen Biopower-Greenwood Plant in Ware Shoals, S.C., uses mountains of wood residue and fuel derived from tires to produce steam daily. The plant sells the steam to the neighboring National Textile facility. On average, the Trigen Plant burns 9 tons of wood chips and 0.18 tons of tire chips per hour, thus diverting it from the local landfill.

Grain crops such as corn and wheat can be processed into alcohol fuels such as ethanol.

Grain crops such as corn and wheat can be processed into alcohol fuels such as ethanol. Ethanol is made from corn and is a proven gasoline additive already in use in this country. The Ford Motor Company manufactures models of the Ford Ranger and Taurus that run on 85 percent ethanol and 15 percent gasoline. However, the high price of ethanol compared to crude oil has inhibited its widespread use to date.

Methane gas can be used either in an internal combustion engine to produce electricity or to assist in co-firing a boiler or heat exchanger system.

The methane gas derived from animal and human waste using an anaerobic digester is an attractive fuel source. Methane gas can be used either in an internal combustion engine to produce electricity or to assist in co-firing a boiler or heat exchanger system. In some instances the gas is bottled and used to fuel farm equipment. The conversion of landfill gases to methane has significant potential for energy production, since landfill gas emitted by the nation's 750 landfills has the potential to power three million homes if captured and converted. Beginning in 1989, the Foster Wheeler Plant in Charleston, S.C., has used methane gas to incinerate municipal solid waste, providing the former Charleston Naval Shipyard with a majority of its process steam until the shipyard closed.

<u>Hydroelectric Power</u>

Hydroelectricity is created when water from a river or stream flows through a turbine, which in turn operates an electric generator. Hydroelectric power plants have been in use in the U.S. since the late 1800s. Once a major power source, comprising 57% of electricity generated in the U.S. in 1900, hydroelectricity now accounts for only 11% of electricity produced nationwide and only 3% of energy produced in South Carolina. Rivers or large streams are often dammed to build up the water supply, enabling the power plant to generate larger volumes of electricity. There are many hydroelectric plants in operation in South Carolina, including the

J. Strom Thurmond Power Plant located near McCormick and the Lockhart Power Plant located near Union.

Geothermal Energy

Due to the close proximity of magma (superheated, liquid rock from beneath the Earth) to the Earth's surface in the western U.S., these areas are able to harness this heat and convert it into energy. To harness this energy, heated water (existing or pumped down to the magma) is pumped from the geothermal well and its heat used directly for manufacturing purposes or converted into steam for electricity production. In South Carolina, geothermal heat pumps that require only moderate ground temperatures use the Earth's moderate, relatively constant temperature to provide heating and cooling year round. Geothermal heat pumps are among the most efficient and comfortable heating and cooling technologies available, requiring no supplemental heat source because of the moderate temperature of the ground even in winter.

Wind Power

Windmills have historically been used to pump water from wells. However, in recent decades they have been employed in areas with constant winds to produce electricity. In California, windfarms consisting of thousands of windmills are generating large amounts of electricity. Because windmills are only feasible in selected areas that have sustained wind speeds of 12.5 miles per hour, windpower is not considered a feasible energy source in South Carolina.

Local Government Role

The most visible way local governments can promote the use of alternative fuels is by seeking innovative ways to incorporate the use of these fuels in their operations. Jurisdictions can develop partnerships with federal, state, community and private organizations to obtain funding for programs that will promote the use of alternative fuels and to educate the public on the benefits of their use. To promote and protect the use of solar energy, local governments can prevent new construction from obstructing the solar access of existing buildings and other land uses. Communities can also work closely with businesses, industries, service providers and farmers to encourage the use of alternative fuels in their operations.

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PROGRAMS AND CASE STUDIES

The S.C. Energy Office (SCEO) is participating with the U.S. Environmental Protection Agency and the U.S. Department of Energy in several projects designed to promote the use of alternative fuels, as reflected in the case studies that follow.

Clean Cities

The Clean Cities program is a locally based, voluntary public/private partnership coordinated by the U.S. Department of Energy (DOE) that encourages the use of alternative fuel vehicles (AFVs) and their supporting infrastructure throughout the nation. The U.S. Department of Energy developed this program to promote energy use in the transportation sector that is clean, safe, less dependent upon foreign sources, and sustainable. The Clean Cities program takes a voluntary approach to AFV development, working with coalitions of local stakeholders to help develop the AFV industry and integrate this development into larger planning processes.

The South Carolina Energy Office (SCEO) is partnering with two regional councils of government to develop Clean Cities Coalitions in South Carolina. The Catawba/Centralina Clean Fuels Coalition (CCCFC) is a joint effort between the Catawba COG in Rock Hill, S.C., and the Centralina COG in Charlotte, N.C. The group came together in early 1999 to take advantage of the environmental, public health, energy security, and economic benefits and the financial incentives associated with the Clean Cities program. The CCCFC seeks to improve the quality of life in the twelve-county, bi-state region by creating public/private partnerships to enhance the development of an alternative fuel marketplace and supporting infrastructure. Through monies received as part of a national settlement against a local manufacturer, the CCCFC is developing ethanol refueling stations throughout a four-county region that will be available to federal, state and local fleets, private fleets and individual citizens. The Coalition has already identified more than 600 E-85 vehicles (capable of using a mixture of 85% ethanol and 15% gasoline) in use in various fleets within the region.

The Central Midlands Council of Governments is spearheading the effort to bring clean fuels to the Columbia area. The Central Midlands Clean Cities Coalition (CMCCC) was formed in early 1999 and has worked with a number of entities including SCEO, the Sierra Club, the Chamber of Commerce, USC, SCDHEC, SCDOT, the American Lung Association, SCE&G, and local governments in Richland, Lexington, Newberry and Fairfield counties to determine

the number of alternative fueled vehicles (AFVs) in the area, the level of interest in purchasing AFVs, and the total number of fleets that will be affected by the Energy Policy Act of 1992 (EPAct92). As a result of consultation with the CMCCC, the Central Midlands Board of Directors decided to purchase seven new compressed natural gas (CNG) transit buses when they replaced SCE&G's aging bus fleet in the spring of 2000. Together these buses are expected to reduce nitrogen dioxide and hydrocarbon emissions by 6,296 pounds per year over a ten-year period, which will result in a cleaner downtown area. The CMCCC is also working to expand the capacity of Columbia's only CNG refueling station and to encourage other agencies to purchase CNG vehicles.

Geothermal Heat Pump Project

Since 1997, the S.C. Energy Office has participated in a special project with a grant from the U.S. Department of Energy (DOE) and in collaboration with Berkeley Electric Cooperative, Palmetto Electric Cooperative, and the South Carolina Energy Research and Development Center. The SCEO has used funding from DOE to accelerate the installation and use of geothermal heat pumps (GHPs) in South Carolina by providing demonstration units at several locations throughout the State.

Through a utility partnership with Berkeley Electric Cooperative (BEC), three sites were chosen to install GHP systems. Mepkin Abbey in Moncks Corner, S.C., installed a system for its Senior Wing – a 12-room assisted living facility designed for the care of the community's elder monks. A hazard mitigation demonstration home located on Calhoun Street in Charleston, S.C., also had a GHP system installed. The third installation was a residence at Hope Plantation on John's Island, S.C., which will be used to train architects, builders and other professionals. BEC also plans to use these facilities to showcase the technology for realtors and others interested in a hands-on experience.

The Palmetto Electric Cooperative organized the installation of a GHP system at the Hilton Head Island Visitor and Welcome Center. More than 125,000 people visit the Center annually, making it an ideal location to showcase the technology. A display at the museum promotes the benefits of the system to visitors.

Both the S.C. Botanical Gardens Visitor Center and the Geology Museum on the Clemson University campus employ geothermal heat pump systems. The Visitor Center is served by two GHP sys-

tems providing a total of eleven tons of cooling capacity. The Geology Museum is served by two horizontal-loop systems, totaling approximately ten tons of cooling capacity.

In addition, geothermal heat pumps provide temperature control for two Habitat for Humanity homes that were constructed by the Pickens County Habitat for Humanity organization. Each of the Habitat houses is served by a two-ton horizontal loop GHP.

Landfill Methane Outreach Program

SCEO signed on as a State Ally in EPA's Landfill Methane Outreach Program (LMOP) in order to promote the development of landfill gas-to-energy (LFGTE) projects in the State. The LMOP is a voluntary initiative designed to facilitate landfill gas-to-energy project development nationally. The LMOP accomplishes this by providing hands-on technical assistance, information, software tools, and networking opportunities. In its role as a State Ally, the Energy Office organized a task force made up of public sector representatives – from the S.C. Public Service Commission, the S.C. Department of Health and Environmental Control, Greenville County, Georgetown County and Lexington County – to address LFGTE issues and projects. The task force has developed a primer on landfill gas-to-energy projects, and sponsored a one-day workshop to educate local leaders and professionals on the use of methane gas in December of 1999.

In a survey conducted for EPA's LMOP, thirty South Carolina landfills were identified as potential LFGTE project sites. The total potential output of these projects is equivalent to 81 megawatt equivalents (Mwe). If harnessed into usable energy, this would be enough energy to power 60,000 homes for a year. The environmental equivalent would be the same as removing 1.4 million cars from the road for one year and planting 1 million acres of trees.

There are many landfill methane conversion projects currently under development throughout the State. These initiatives have in common the view that methane gas is an asset to be harnessed and sold, rather than a liability that must be disposed of. At present, most landfills flare off the highly combustible gas, instead of opting for conversion to a renewable energy source. Two projects, one in Spartanburg County at the Palmetto Landfill and another in Richland County at the Screaming Eagle Landfill, involve piping the methane gas to nearby industrial users for use in boilers. In Georgetown County and at Hickory Hill Landfill in Jasper County, the use of methane gas from the landfills to heat

commercial greenhouses is being explored. Not only will this provide a needed outlet for the methane, the greenhouses will also provide local jobs. Horry County is working with Santee Cooper – the state-owned electric and water utility and the nation's fourth largest public-power system – on a project to convert the methane from the county landfill into electricity.

The Center for Alternative Energy Transportation

York Technical College in Rock Hill, South Carolina, hosts a Center for Alternative Energy Transportation. The College serves as a center for excellence in alternative fuel vehicle (AFV) technical training, providing educational opportunities to individuals, industries and government agencies to support the introduction and growth of AFVs as a viable mode of transportation. York Tech is the only two-year institution with this designation by the U.S. Department of Energy to develop and demonstrate electric vehicle technology. The College has partnered with the City of Rock Hill, the City of Charlotte, Duke Power, the Town of Hilton Head Island, the Discovery Place science museum and the South Carolina Governor's Office to integrate electric vehicle use into operations. The Center has also expanded its program to include development and educational programs for liquefied petroleum gas, compressed natural gas, propane and hydrogen. The program currently operates and supports a diverse fleet of 21 electric vehicles.

Recycling

Though most of us recognize that recycling is driven by environmental concerns, it can also yield significant energy savings. Less energy is used to produce products from recycled material than from virgin material. For example, producing aluminum cans from recycled materials uses 90% less energy than manufacturing cans from new materials. Savings for other metals range from about 50 to 90%. Producing recycled paper uses from 23 to 70% less energy, depending on the grade of paper.[109]

Less energy is used to produce products from recycled material than from virgin material.

Table 6. Energy Savings from the Recycling of Selected Waste Materials

Material	Million Btu per Ton Saved	Percent Energy Saved
Aluminum	168.5 – 281.0	92 - 96%
Steel	7.8 – 19.0	47 – 74%
Steel and Iron	9.2 – 15.5	63 – 74%
Lead	5.5 – 17.4	56 – 65%
Copper	40.3 – 94.7	84 – 95%
Glass (20% recycled)	0.59	4%
Glass (50% recycled)	1.47	11%
Glass (100% recycled)	2.95	22%
Plastic – polyethylene	96.0	97%
Plastic – polymer	—	90 – 95%
Rubber	22.0 – 22.1	70 – 71%
Newspaper (33% recycled)	1.23	23%
Newspaper (100% recycled)	2.42	53%
Paper	14.0 – 35.5	60 – 70%
Low-grade Paper	12.0	70%
High-grade Paper	—	60%
Writing & Printing Paper	16.4	33%
Corrugated Cardboard	6.3 – 12.2	24%
Paperboard	—	10 – 20%

Source: California Energy Commission, Energy Aware Planning Guide.

To be effective, recycling programs should have a recycling coordinator and include penalties and incentives for public compliance.

Recycling has become a higher priority in South Carolina in recent years. The *South Carolina Code of Laws* requires most counties to develop solid waste management plans that include an extensive recycling component. Instead of developing an individual plan, counties also have the option of participating in a regional solid waste management program. Whether the plan is for the county or the region, all local governments within the service area must participate in the planning process. Solid waste management plans must include a recycling or resource recovery program, unless the county or region proves that such a program is economically infeasible, impracticable, or unnecessary to meet the State's waste recycling goals. The community facilities element of the local comprehensive plan should reflect the goals of the county waste management plan to ensure consistency of local government planning priorities. To be effective, recycling programs should have a recycling coordinator and include penalties and incentives for public compliance. Recycling programs should also include a public education program on the benefits of recycling and the local recycling program. Counties or regions that have a

solid waste management plan must provide citizens the opportunity to recycle through curbside collection systems, drop-off centers, collection centers, or collection systems for multi-family residences as appropriate.

Though recycling requires extra individual effort, the public is increasingly supportive of recycling programs. For instance, residents responding to the 1999 Greenville County Community Survey indicated that conservation, nonprofit recycling, and curbside recycling are all very important to their community.[110] *Such grassroots support is vital to local recycling programs, which depend upon the active participation of individuals for their overall success. Support from the business community is also key. Local government recycling focuses primarily on residential recycling and it is generally up to individual businesses and industries to incorporate recycling into their internal operations.*

To encourage recycling, jurisdictions should provide clean, efficient and accessible recycling facilities.

The success of local recycling programs is highly dependent on the role of local government. To encourage recycling, jurisdictions should provide clean, efficient and accessible recycling facilities. Educational programs on the benefits of recycling and the use of local recycling facilities should target a wide range of users – including children. Jurisdictions can partner with local community groups to seek funding for improvements and education and to develop programs aimed at increasing participation in recycling efforts. Partnerships can also be developed with local businesses and industries to encourage recycling in the commercial and manufacturing sectors. Local zoning ordinances and building codes can be amended to allow for and/or require adequate space for recycling and access to pickup for recyclables in new commercial buildings. In multi-family developments space should be included for recycling containers near trash bins or enclosures for residents to deposit recyclables. Requirements for commercial and industrial developments depend on the specific land use and the anticipated waste stream. Whether reviewed on a case-by-case basis or required to meet minimum standards for categories of use, requirements for businesses and industries should be flexible to accommodate changing equipment and collection practices and to encourage creativity. Land should also be made available in appropriate locations for recycling activities. Zoning ordinances and maps can be amended to include areas that permit various types of recycling facilities, from local collection stations to full-scale, staffed operations.

CASE STUDY

Lexington County Recycling Centers

Lexington County, South Carolina, has developed a comprehensive recycling program anchored by twelve manned convenience stations located throughout the County. Residents are able to drop off their pre-sorted household trash at the stations for recycling by the County. At the stations, recyclables are sorted by categories such as newspaper, office paper, magazines, plastic, aluminum, foam rubber, cardboard and metals. Oil, oil filters and oil containers are also accepted for recycling. Larger items such as appliances and tires are collected for recycling at the County landfill. The County collects more than 5,900 tons of recyclable materials each year including approximately 120 tons of mixed plastics, 30 tons of aluminum, 1,800 tons of newspaper, 650 tons of cardboard, 300 tons of tires, 2,000 tons of metals (including household appliances) and more than 90,000 gallons of oil. The convenience stations have been very successful and enjoy tremendous citizen support, primarily because the stations are clean and efficient. An additional benefit is that the County has hired special needs clients from nearby Babcock Center as attendants for the stations, providing them with needed work experience and additional onsite help for convenience station customers.[111]

NOTES

Housing Opportunities

Nearly one-fifth of the energy consumed in South Carolina is attributed to residential use. The State has experienced a 97% increase in residential energy use since 1970, more than twice the national increase.[112] As residential energy consumption continues to rise, its impact on overall energy consumption becomes more significant. Consequently, in order to substantially reduce overall energy use at the local level it is important to include policies and programs that target reductions in residential energy use.

The Berkeley Electric Cooperative (BEC) estimates that 46% of the total energy used by a typical new home in their service area (portions of Berkeley, Charleston and Dorchester Counties) is for heating and cooling. Energy needed individually for heating and for cooling is nearly equal, with 25% of total energy used for heating and 21% used for air conditioning. BEC estimates that another 23% of total energy is used for water heating, with the remaining 31% used for lighting, refrigeration, cooking and other activities.[113] The BEC service area is located in the S.C. Lowcountry where temperatures are slightly warmer than in more northern areas of the State. Even with a small variance in temperature depending on location within the State, the BEC figures provide a good representation of residential energy usage in South Carolina. With nearly half of residential energy consumption in the State devoted to indoor temperature control, energy conservation efforts must include measures designed to reduce heating and cooling needs. Since heating and cooling are closely tied to factors such as outside air temperature and wind, it is possible to implement residential construction and development design measures that will result in significant energy savings.

With nearly half of residential energy consumption in the State devoted to indoor temperature control, energy conservation efforts must include measures designed to reduce heating and cooling needs.

As discussed in previous sections, development design characteristics such as density and housing type are significant factors in residential energy use. Multi-family and other attached housing unit types incorporating shared walls require less energy for heating and cooling. Smaller detached single-family, attached single-family and multi-family homes use less energy for space heating and cooling than larger, more traditional single-family detached homes. In addition, the shorter streets included in compact (higher density) housing developments help reduce vehicle trips and require less energy to construct and maintain.

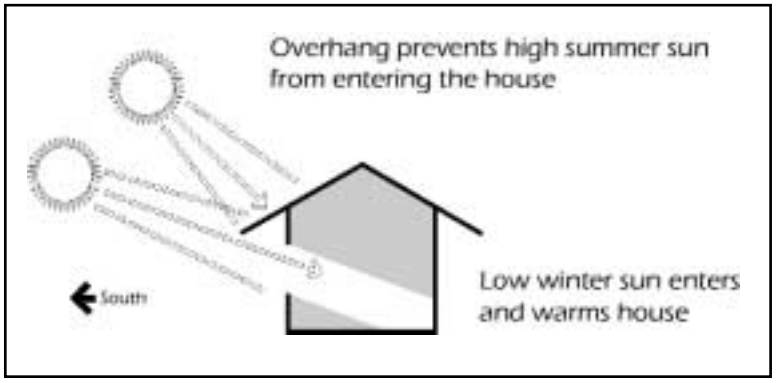
Proper siting of individual housing units can also yield energy savings. The site orientation of a building has a significant effect on

heating and cooling needs. In hot, humid areas such as South Carolina, protecting homes from the hot summer sun and assuring good air movement in and through the site are important design considerations. Homes should be sited to maximize shade and wind flow. When possible, residences should be positioned high on a slope near the crest of a hill where wind velocities are highest. Primary outdoor living areas should also be oriented to take advantage of prevailing breezes.

If possible, homes in South Carolina should be oriented to face south or southeast, with an ideal orientation of 5 degrees south-southeast.

There is a great difference in the amount of solar energy that falls on each wall of a building, depending on the season and the direction the building faces. As shown in Figure 9, buildings that face south receive the maximum possible sunlight in winter, when it is most needed to reduce heating needs. If possible, homes in South Carolina should be oriented to face south or southeast, with an ideal orientation of 5 degrees south-southeast.[114] However, building orientation in residential developments is often dependent on the street layout, since houses generally face the street. If street orientation is primarily from east to west, either the front or back walls of the homes (the largest sides with the most windows) should face south.[115]

Figure 9. Summer and Winter Solar Angles



Source: Erley, Duncan, David Mosena, and Efraim Gil, Energy-efficient Land Use – PAS Report 341.

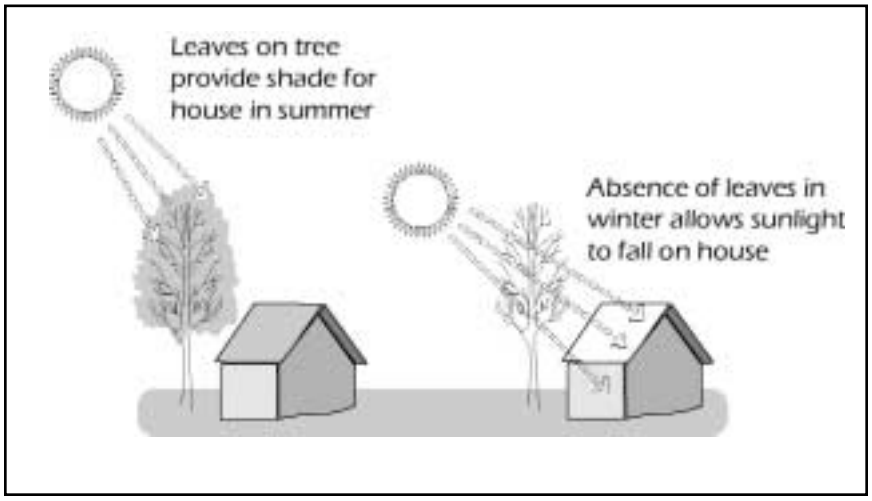
Simply orienting well-insulated buildings to maximize southern window exposure and minimizing windows on the east and west can reduce heating and cooling needs by 20 to 50%.

Within the home, living areas should be located on the south and west sides, leaving the northeast portion for inactive areas like garages or storage rooms. North-facing exterior walls should be well insulated and have few, if any, windows. Windows on the east and west sides of the home should be minimal as well. Simply orienting well-insulated buildings to maximize southern window exposure and minimizing windows on the east and west can reduce heating and cooling needs by 20 to 50%.[116] Overhangs,

awnings and vegetation should be added on the south, east and west sides of the home to provide shade to the building and the surrounding ground. Exterior shading is critical, since it is seven times more effective to cool a building by shading the exterior rather than by interior shading such as blinds or draperies. Trees are one of the most effective ways to keep the sun's rays from entering a building. Through proper placement of a few mature trees, a building can be shaded for most of the daytime hours. Deciduous trees can block about 80% of summer radiation.[117] In winter, when the sunlight is welcome, deciduous trees permit solar energy to warm buildings and the surrounding ground (see Figure 10). A single tree 8 inches in diameter can pay for itself in six years by shading a medium-sized house and lowering air conditioning costs during the summer.[118]

A single tree 8 inches in diameter can pay for itself in six years by shading a medium-sized house and lowering air conditioning costs during the summer.

Figure 10. Microclimatic Effect of Deciduous Trees



Source: Erley, Duncan, David Mosena, and Efraim Gil, Energy-efficient Land Use – PAS Report 341.

If buildings are located to take advantage of them, water bodies can also have a moderating effect on climate, providing cross breezes for natural cooling. The daily differences between land and water temperatures can produce constant breezes in many areas. While people often want to live near water for the recreation opportunities and views, the cooling effects of water are an important and often overlooked benefit.[119]

Building construction and materials also play an important role in energy consumption. The use of light-colored and reflective materials, particularly on the roof, can result in lower temperatures, reducing cooling energy needs by up to 20%.[120] Air-tight con-

Studies of energy retrofits (primarily insulation improvements) on older single-family homes nationwide indicate overall energy savings of 20 to 25%

struction that includes proper insulation, thermal windows and adequate weatherproofing will also reduce heating and cooling needs. Studies of energy retrofits (primarily insulation improvements) on older single-family homes nationwide indicate overall energy savings of 20 to 25%. Simply installing ceiling insulation in older homes reduced space heating energy use by 13 to 21%. Likewise, energy savings of 14 to 16% were accomplished when older multi-family residential buildings were retrofitted to save energy.[121] In Portland, Oregon, a weatherization program targeting low-income single and multi-family housing is saving more than 44 million kilowatt hours per year. The City has weatherized 2,600 single-family homes and 21,000 multi-family housing units in the 14 years since the program was initiated, resulting in yearly monetary savings to residents of more than $2.5 million.[122]

South Carolina has recently taken steps to ensure the incorporation of energy saving measures into all residential construction. In 1997, the General Assembly adopted a mandatory statewide building code that included the Council of American Building Officials' Model Energy Code as the official state energy code. Prior to the 1997 legislation less than 40% of South Carolina's counties had adopted building codes and even fewer had building code enforcement. The legislation allowed up to three and a half years for counties and municipalities to adopt building codes and set up an enforcement agency. Since the legislation was adopted, 95% of the jurisdictions in the State have adopted the building code and the accompanying energy code. The energy code requires new buildings to have insulation with a minimum rating of R-30 for ceilings, R-13 for exterior walls and R-19 for floors (with crawl space). Double-pane windows or single-pane with storm windows are also required.[123]

Though more expensive, solar heating or water heating systems and geothermal heat pumps are much more energy-efficient than conventional heat pumps and water heaters and actually pay for themselves through energy cost savings over time.

Additional residential energy savings can be realized through the incorporation of relatively inexpensive measures such as programmable thermostats, energy-efficient lights and water heaters, and air-tight, well insulated doors. Though more expensive, solar heating or water heating systems and geothermal heat pumps are much more energy-efficient than conventional heat pumps and water heaters and actually pay for themselves through energy cost savings over time. On average, the investment for a residential geothermal heat pump can be recouped in 2 to 10 years and recoupment for a well-designed and properly installed solar water heater can be realized in 4 to 8 years.

Energy-efficient housing equates to more affordable housing. Development and construction costs for compact residential devel-

opments are generally less expensive because each unit requires less land, site preparation and infrastructure, and typically less floor and wall area. When these savings are passed on to the home-buyer or renter, housing costs become affordable to a broader range of income levels. However, the direct cost of renting or buying a home is not the only barrier to affordability. Accessibility issues such as alternatives to car ownership, proximity of necessary services such as childcare and retail, and proximity to work also affect housing affordability. In addition to saving energy, the provision of transportation alternatives and a mixture of uses that include convenience shopping, childcare and nearby workplaces also make neighborhoods more affordable for residents.

Another aspect of affordability is housing upkeep and maintenance. Homes that are built to be energy-efficient are also less expensive to maintain. Reductions in heating and cooling needs can equate to significant savings on utility bills. The addition of energy-efficient lights, refrigeration, water heating and appliances can also lower overall housing costs.

Homes that are built to be energy-efficient are also less expensive to maintain. Reductions in heating and cooling needs can equate to significant savings on utility bills.

There are a number of ways in which local governments can influence the incorporation of energy conservation practices into building and development in their communities. Along with adopting and enforcing State building and energy codes, jurisdictions can develop local requirements to ensure energy-efficient construction and site development. One way to accomplish this is to amend land use regulations to require solar access for buildings and to encourage or require energy-efficient site design. Requirements more stringent than those in the State code can also be added to local building codes to strengthen energy conservation practices. Partnerships can be forged with civic groups and local utility providers to educate the public on the benefits of energy-efficient construction and site design and to promote the use of energy-efficient appliances. These partnerships could also seek funding for programs such as weatherization, upgrade opportunities to energy-efficient heating and cooling units and appliances, and other energy conservation measures.

PROGRAMS AND CASE STUDIES

S.C. Manufactured Housing Energy Efficiency Certification

In an effort to promote energy-efficient construction in manufactured housing, the S.C. Energy Office provides certification through a program launched in 1998. Through this program, the SCEO distributes S.C. Manufactured Housing Energy Efficiency

Labels to qualified manufacturers. The S.C. Manufactured Housing Energy Efficiency Label certifies that the manufactured home meets or exceeds the energy efficiency levels provided for in the South Carolina Code of Laws. By law, energy labels may only be placed on homes that meet or exceed the minimum requirements for energy efficiency. To meet energy efficiency standards, the home must have storm or double-pane glass windows, insulated or storm doors, and a minimum insulation thermal resistance rating of R-11 for walls, R-19 for floors and R-30 for ceilings, or equivalent allowances. More than 10,000 labels were distributed in both 1998 and 1999. The impact of the program on overall energy efficiency in the manufactured housing sector has been tremendous, with nearly 75% of manufactured homes sold in the State today certified as energy-efficient – a major increase from the 4% of manufactured homes sold in 1992 that met energy efficiency standards.

NOTES

Community Facilities Opportunities

Community facilities include projects and activities essential to a community's sustained growth and development. Utilities, infrastructure, governmental and educational functions are addressed under the vast community facilities umbrella. These functions include water and sewer service, electric and natural gas, telecommunications access, stormwater management, transportation, solid waste collection and disposal, police and fire protection, health care, emergency medical services, governmental facilities, emergency preparedness, educational facilities, parks and recreation, libraries and other institutional uses. Community facilities have substantial influence on energy usage patterns in a community and provide an effective arena for the introduction and implementation of energy conservation measures.

While community facilities are provided and maintained primarily by local government and by institutions within the community, some facilities such as roads and educational centers are built and maintained by the state or federal government. Institutional facilities also include hospitals, health clinics, private schools and colleges and other public, non-governmental facilities.

Local governments and institutions are among the leading consumers of energy within a community. This is due in large part to the size of public buildings and facilities, coupled with the fact that such facilities are often older and less energy-efficient. Institutions such as hospitals, police stations and prisons are in operation 24 hours a day and rely on equipment that requires substantial amounts of energy around the clock. Schools and other public buildings have a great deal of traffic in and out of the buildings, which significantly increases the heating and cooling needs of such facilities.

As high-profile energy consumers, local governments and institutions have a tremendous opportunity and responsibility to promote energy conservation through the efficient use of energy within their operations. In addition to the significant energy cost savings that can be realized through energy conservation within public institutions, successful programs can also encourage private entities and citizens to conserve energy. Local government conservation efforts typically fall into one of several categories: administration, policies and employee education; community facility site selection; building efficiency and site design; facility management; and fleet efficiency.

As high-profile energy consumers, local governments and institutions have a tremendous opportunity and responsibility to promote energy conservation through the efficient use of energy within their operations.

Administration, Policies and Education

Faced with tightening fiscal conditions and a growing public demand for efficiency and accountability, local governments and public institutions nationwide have begun to incorporate energy conservation measures into their policies and procedures.

Energy costs represent top budget expenditure categories for most local governments. Faced with tightening fiscal conditions and a growing public demand for efficiency and accountability, local governments and public institutions nationwide have begun to incorporate energy conservation measures into their policies and procedures. Some have started on a smaller scale by targeting readily attainable energy conservation goals within relatively short time frames, while others have adopted a more holistic, long-term approach that integrates the principles of energy conservation into all aspects of their operations. The following suggestions for developing and implementing an effective energy conservation program within a local government or institution have been developed based upon the experiences of a number of successful energy conservation programs that represent both approaches:

- *Designate a lead office for the energy planning effort. The lead office can be housed as part of an existing function such as the planning department or can be established as a separate energy office.*

- *Conduct an energy assessment. The assessment step is essential in identifying opportunities and barriers and matching available resources with appropriate technologies.*

- *Identify major institutional goals and issues. It is important to make a clear connection between energy conservation efforts and existing organizational goals.*

- *Build support from all departments and coordinate activities. Provide departments with incentives to institute energy conservation into their operations. Also, regular meetings with staff and management from each department can enhance activity coordination efforts, provide for early problem identification and resolution, establish high program visibility, reinforce and sustain organizational commitment to energy conservation programs, and institutionalize conservation initiatives.*

- *Identify and analyze energy plan options. Options should be evaluated based on associated costs, benefits, environmental impacts, technological feasibility and political acceptance. First, list all tasks that should be accomplished to improve energy efficiency. Then screen tasks according*

to how well they address community needs. Next, prioritize tasks based on ability to produce the greatest benefit.

- *Write and adopt an energy-efficiency plan. The plan should include clear goals and issues and should be based on the previously identified energy options. Once developed, the plan should be widely distributed with training provided to all employees on implementation strategies and anticipated benefits.*

- *Establish a fund for efficiency improvements. Efficiency improvements often require up-front capital expenses. If effective, proposed expenditures can eventually be recovered through lower utility bills, sometimes within a few years. A fund can be established (initially through general funds or other budget sources) to provide seed funding for efficiency projects. Any utility rebates and all or part of the utility bill savings yielded by the programs can be reinvested into the fund to support future efforts.*

- *Implement the plan. Start with attainable and easily measurable goals that can be launched with available resources, but avoid short-term thinking. Concentrate on projects that will produce the greatest impact. Look for alternative funding sources such as grants and establish partnerships to implement the goals of the plan.*

- *Monitor progress, evaluate programs and update strategies. After efficiency measures are implemented, energy consumption should be monitored to track benefits. Results should be posted and communicated regularly to maintain awareness and interest at the departmental level. Also, keep elected officials and institutional administrators informed of progress and benefits, including actual cost savings.*

Local governments and institutions can realize significant energy savings by revising policies and operational procedures to make energy conservation a high priority. Data from the National Science Foundation asserts that municipalities can reduce energy costs by as much as 15% without affecting the level of public services.[124] There are many ways in which policies and procedures can be revised to promote energy efficiency. In the area of procurement, policies can require that energy efficiency be considered as an evaluation criteria for new equipment purchases. Purchases should be made based on a fair return-on-investment, using ener-

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While more inefficient equipment may initially be less expensive to purchase, the utility costs over the lifetime of the item may be significantly higher.

gy savings estimates as one basis for procurement decisions. While more inefficient equipment may initially be less expensive to purchase, the utility costs over the lifetime of the item may be significantly higher. Information on equipment costs for energy-efficient versus less efficient equipment is developed through life-cycle costing analyses to make informed purchasing decisions. This analysis can be applied to purchases ranging from items as small and inexpensive as a light bulb to those as expensive as an emergency response vehicle.

Life-Cycle Costing Analysis

Life-cycle costing analysis for purchasing decisions involves calculating capital cost, estimated energy costs, and estimated life of equipment.

For example, two different types of light bulbs are compared in the example below – a 17-watt compact fluorescent lamp (CFL) and a 60-watt incandescent lamp (IL):

Costs	CFL	IL
Capital Cost	$17.99	$ 8.20*
Energy Cost	$20.40**	$72.00**
Total Cost	**$38.39**	**$80.20**

* CFL = 10 IL = 10,000 hours of lighting

** 17-watts = 170 kWh versus 60-watt = 600 kWh (energy cost for a home and business at 12 cents per kWh)

Over the life of the two light bulbs there is a savings of $41.81 with the CFL option.

Source: Energy Element, Santa Barbara County Comprehensive Plan.

Local governments and institutions can also foster an environment conducive to energy conservation by educating employees on the role and impact of energy conservation in their day-to-day activities. It is important to train personnel to incorporate energy conservation into daily operations. For example, staff should be trained to turn off equipment that is not in use and lighting that is unnecessary.

Changes to personnel policies can also save energy. In an effort

to reduce the number of commutes, maximize office space, lower utility costs, and increase productivity, many local governments and institutions have instituted telecommuting programs for their employees. As previously discussed, many jobs are well suited for working from the home, with employees communicating with their employer by telephone, fax and computer technology. For example, building inspectors could be allowed to go directly to their inspections from home, rather than driving to the office first. The energy saved through telecommuting can be significant. For each day that an employee telecommutes from home, one round trip is eliminated. Studies of telecommuting programs reveal that the increase in residential energy used by home-based workers adds up to no more than one-third of the total energy savings that result from eliminating commuter trips.

Teleconferencing can also reduce work-related travel for local governments and institutions by reducing travel to attend meetings and training. Participants use telecommunications technology to hear and view trainers and participants from other sites and to view overhead slides and related materials. Fiber-optic, satellite and digital technologies enable voice and video presentations and documents to be exchanged in real time, transcending the traditional barriers of time, place and distance. A cost-effective way to encourage the incorporation of this technological alternative to travel into a wide range of operations is to develop community teleconferencing centers. Telecommunications facilities are becoming more widespread and accessible throughout the State, with various technologies currently in extensive use by K-12 schools, the State Technical College System, South Carolina Educational Television, and the State's senior research universities. As highlighted in a previous section, the Baxter M. Hood Conferencing Center at York Technical College is a prominent example – providing affordable access to on-site videotaping, videoconferencing, and satellite teleconferencing capabilities to a myriad of public and private organizations in the Rock Hill area.

Fiber optic, satellite and digital technologies enable voice and video presentations and documents to be exchanged in real time, transcending the traditional barriers of time, place and distance.

In addition to the use of telecommunications for education and training purposes, the doors have been opened for innovative use by health and human service providers. Many social services and job assistance programs are now available on-line and accessible through community libraries and other neighborhood access points. Health care providers, such as the Medical University of South Carolina, have undertaken pilot programs to reach under-served and hard to reach populations through telemedicine projects.

Many local governments and institutions are instituting alternative

work schedules in an effort to reduce traffic congestion and energy consumption by shifting commuters out of peak travel periods and eliminating commute trips. As discussed previously, a compressed workweek typically allows an employee to work more than eight hours a day for four consecutive days in order to take the fifth day off. This method results in the elimination of one round trip per week and a sustained reduction in energy use when the fifth day is scheduled in conjunction with the weekend. Flexible scheduling allows workers to set their schedules depending upon their needs, with certain core hours when they must be at work. Staggered work hours with varied employee starting times can also be used to reduce peak traffic congestion.

Local governments and institutions can lead the way in promoting the use of alternative means of transportation by encouraging their employees to carpool or rideshare, use public transit, and walk or bike to work.

Local governments and institutions can lead the way in promoting the use of alternative means of transportation by encouraging their employees to carpool or rideshare, use public transit, and walk or bike to work. This can be done through the distribution of information on transit, organizing carpools and ridesharing, providing bicycle racks and lockers, and incorporating pedestrian and bicycle-friendly design into the building grounds. Employers can also offer incentives for carpooling, walking or bicycling such as extra leave time or gift certificates. Promotion of alternative modes of travel should be geared toward local conditions. If most employees live within one to ten miles of work, ridesharing may not be as effective as the promotion of local transit, walking and biking options. Conversely, if transit service is poor or nonexistent, then the employer should promote and help organize carpool and vanpool efforts.

CASE STUDIES

Wake County, North Carolina

In an effort to promote energy conservation, Wake County, North Carolina, instituted flexible work policies in the early 1980s that continue today. Many of the 18 employees within the County Planning Department are on flexible schedules. Two employees telecommute on a regular schedule – one on Mondays and the other on Tuesdays and Fridays of each week. Both telecommuters hold technical positions that have proven to be considerably more productive in an environment where interruptions are eliminated. Each of the telecommuters communicates with the planning office via computer while working from their homes. Two other employees work nine 8-hour days and take every other Friday off; another works 10-hour days with every Friday off. Other employees avoid rush hour traffic by coming in before 8 a.m. and leaving

before 5 p.m. Wake County's experience has been very positive and touts the added benefit of allowing employees to tailor their schedules to fit their personal work styles and needs.[125]

Sustainable Universities Initiative

The State's three major research universities – Clemson University, the Medical University of South Carolina and the University of South Carolina – have joined together in the Sustainable Universities Initiative designed to incorporate the principles of sustainability into the curriculum, reduce the "ecological footprint" of each school, and develop productive linkages with the surrounding community. Efforts are currently underway to include all of South Carolina's institutions of higher education in the Sustainable Universities Initiative, including the State's 16 technical colleges. An important component of this initiative is to lead by example in the areas of sustainability and energy conservation and provide models for sustainable design and operation for other universities and large institutions. The Sustainable Universities Initiative sponsored a "Green Building" conference in October 2000, targeting architectural students and faculty, campus facilities managers and construction managers. Presenters addressed planning, executing, trouble-shooting and funding alternatives for campus construction and renovation that emphasize energy conservation in design and materials selection.

The Sustainable Universities Initiative also provides funding for research on issues of sustainability and energy conservation. In one funded study, Clemson University planning students researched and documented alternatives to auto transportation in the City of Greenville, South Carolina. Another funded effort linked professors and students in landscape architecture, forestry, and horticulture at Clemson with the South Carolina Energy Office to develop a guide for achieving energy efficiency through landscape design. At the University of South Carolina, students are in the process of researching, developing and ultimately implementing an environmental management system (EMS) that will be tailored to the needs of higher education. The system is modeled after the ISO 14000 designation standard adopted by industries worldwide and will focus on institutional administration as it addresses the immediate and long-term impact of institutional products, services and processes on the environment. The EMS model will provide colleges and universities with a framework for order and consistency in environmental management through the allocation of resources, assignment of responsibilities and ongoing evaluation of practices, procedures and processes.

City of Phoenix, Arizona

The City of Phoenix's energy management program has saved millions of tax dollars since its inception in the late 1970s and has been recognized as one of the most effective energy programs in the country. Phoenix started small, focusing on low-cost projects such as energy audits and the installation of equipment controls in its buildings. The City spent $50,000 in 1980 to implement the energy audit recommendations. In 1984, Phoenix established the Energy Conservation Savings Reinvestment Plan with seed money from state funds. Under the Plan, the City reinvests half of all documented energy savings (up to a limit of $750,000) into a fund that finances energy-efficiency capital projects for the coming year. Energy savings are established by comparing energy consumption data before and after a retrofit for the first year the improvement is in place. For the ten years that follow, half of this baseline amount is committed to the Plan. The remainder is directed into the City's general fund. By 1986, annual energy savings were greater than $1 million and the fund had reached its initial ceiling of $500,000 a year. The ceiling was subsequently raised to $750,000 to compensate for inflation.

Phoenix also uses fund resources to help municipal departments pay for new energy-efficient equipment. For example, the fund will pay the difference between the price of a more expensive, energy-efficient piece of equipment over a standard, less efficient version. Many of the funded measures are considered low technology, such as improved lighting and motors. However, the fund has proven critical in financing a district cooling system and a thermal storage system for the new Phoenix City Hall, as well as small-scale cogeneration, solar, air volume, and wastewater systems. Through the Reinvestment Plan, Phoenix is projected to save $42.6 million in energy costs from 1978 to 2002.

There are several keys to the success of the Phoenix energy program. First, the City established an in-house capability to plan and monitor its actions and calculate energy costs and savings. An Energy Conservation Team was also created that included representatives from all municipal departments. Buy-in from department managers was assured by pledging support for their budgets through participation in the program, both in current operations and for future projects. In addition, 8 to 15% of all energy-efficiency project costs were reserved for maintenance and operator training.[126]

Phoenix has demonstrated that energy-efficiency efforts can start small and achieve impressive results. With only a minimal first year

appropriation, subsequent savings can be reinvested in additional energy-efficiency measures to create a sustainable energy conservation program for local governments of all sizes.

Portland's City Energy Challenge

In looking for ways to cut energy use and save energy dollars, Portland, Oregon, has developed a program that is one of the nation's leading examples of how energy planning can become an integral part of the comprehensive planning process. Under its 1990 Portland Energy Policy, the City has targeted energy-efficiency improvements for municipal buildings, residential buildings, commercial and industrial facilities, transportation and energy supply. The policy also requires increased recycling, decreased waste and the development of telecommunications as an energy-efficiency strategy. Portland's Energy Policy has been quite effective, with more than 90% of the Policy's 89 objectives accomplished within the decade following its adoption.

The five-year goal of the City Energy Challenge launched in 1992 was to increase energy efficiency in city-owned facilities and save $1 million in annual energy bills to include electricity, natural gas and gasoline. This goal represented a 10% reduction in municipal energy bills. To achieve this goal, the City imposed a 1% fee on all City government energy bills. Totaling about $70,000 per year, this fee income was used to hire an energy management coordinator. By the end of 1992, Portland had already identified opportunities and implemented measures to save more than $775,000 annually. Five years later, at the end of fiscal year 1997-98, Portland's efforts had resulted in more than $1.7 million in annual energy savings for City government facilities.

The success of Portland's energy policy can be attributed to several factors. First, the policy has clear, achievable goals coupled with well-defined authority. The Portland Energy Office manages the day-to-day implementation of the program and credits the policy with affording them credibility and a conduit to merge energy with other community issues. The Energy Policy was adopted as official City policy and incorporated into the City's general plan. The Portland Energy Commission, made up of citizen volunteers appointed by the Mayor and City Council, actively oversees policy implementation and updates. [127]

Pee Dee JUSTICE Project

The Pee Dee JUSTICE Project represents a six-county partnership in

the predominantly rural Pee Dee region of South Carolina. The project is driven by a collaborative effort among law enforcement, correctional facilities, the courts, and legal services providers to use telecommunications to improve the responsiveness of the criminal justice and public safety systems at the regional and local level. The effort is designed to generate substantial cost savings related to travel and staff time and to ultimately redirect scarce resources to more proactive crime prevention activities. The partner organizations are engaging video-conferencing technology to reduce excessive travel times for law enforcement and other personnel by linking up to 40 different sites throughout the region for access to training programs; video arraignment; legal consultation; witness, victim and child testimony; telemedicine consultation between health care providers and corrections facilities; and other related uses. The project will impact local energy consumption by expediting and reducing the backlog of court cases and thereby alleviating jail overcrowding and the need for facility expansion and new construction. Another key benefit is a decrease in the number of vehicle trips by law enforcement to transport prisoners to and from court hearings over long distances throughout the region, resulting in measurable savings in fuel costs.

Southwest Virginia Alliance for Telemedicine

The University of Virginia is spearheading a telemedicine and distance learning partnership, the Southwest Virginia Alliance for Telemedicine. The partnership will use teleconferencing and the Internet to reach four remote, mountainous communities in Lee, Buchanan, Russell and Wise Counties in southwestern Virginia. The project is intended to enhance the quality and cost-effectiveness of repeated health clinic visits through remote consultation and patient education. Health care facilities in this remote rural region consist only of small (approximate 100-bed) community hospitals, rural primary care medical practices and clinics. Chronic health problems among the population account for large numbers of clinic visits. The project will use PC-based clinical workstations via a high-speed network. In addition to videoconferencing capabilities, the system will capture voice, video, data, and high resolution still imagery and will create an electronic medical record transportable between sites. The system will be placed at the University of Virginia and four rural locations. Telemedicine clinical consultative services will also be phased in to make health professional and patient education services available to the region's residents. The project will impact energy conservation by reducing the need for frequent medical-related trips outside the region and curtailing the need for costly hospital expansions and equipment upgrades for outlying, rural facilities.[128]

Site Location

Facilities planning for governmental and institutional uses should incorporate sound energy conservation principles not only in building design, but in site selection processes as well. Because of the physical nature of community facilities, such planning has substantial influence on the type and direction of growth as well as the potential for redevelopment of an area. Locating new buildings or facilities near transit, bicycle and pedestrian facilities will encourage the use of alternative modes of travel. Close proximity of facilities to other related uses, along with adequate pathways, will decrease vehicular travel between facilities. For example, location of the county fueling station(s) near vehicle intensive departments such as public works or the sheriff's department will reduce travel. Also, many local governments and institutions are major employment centers. When they are located near essential services such as retail, restaurants, childcare and other necessary destinations, employees are more likely to use alternative modes of transportation.

Governmental and quasi-governmental organizations – federal, state, regional and local – can have considerable influence on a community's long-term energy efficiency through site selection decisions for public facilities. The location of federal post offices, federal and state courthouses, state health and social services offices, regional transportation centers and routes, federal and state corrections facilities, post-secondary institutions, and other essential facilities can either complement or derail community development plans.

Governmental and quasi-governmental organizations – federal, state, regional and local – can have considerable influence on a community's long-term energy efficiency through site selection decisions for public facilities.

Perhaps the most significant, but often overlooked, example of the importance of site selection is the location of new schools. A 1999 study on Lowcountry school site selection and design practices in South Carolina coastal counties revealed eye-opening data on the strong link between school location decisions and urban sprawl. Authored by Christopher Kouri on behalf of the South Carolina Coastal Conservation League, "Wait for the Bus" is a thought-provoking report that quantifies the land use implications of school site selection and design in South Carolina. The report demonstrates how newer schools built on outlying, larger sites in typically rural areas contribute to sprawling development patterns and impose barriers to traditional alternative transportation modes such as biking and walking for students. Specifically, the report notes that: students are four times more likely to walk to schools built prior to 1983 than those constructed later; newer school sites are an average of 41% larger than those built in 1983 or earlier; and these newer school sites average 60% larger in total acreage

than State standards require.[129] Recommendations on improving the site selection and design process at the local level to mitigate such impacts emphasize:

- *Including local jurisdiction planners in meetings with school facility planners and developers to ensure compliance with local comprehensive plans;*
- *Initiating a formal review and comment process for local jurisdictions on proposed school sites and designs;*
- *Ensuring coordination between local planners and school district officials on school site design and linkages to existing transportation networks to encourage walking and biking opportunities; and*
- *Preparing transportation cost-benefit analyses of proposed school sites to strengthen the decision-making process.*

Schools built within close proximity of existing residential areas encourage alternative modes of travel such as biking or walking and require shorter vehicular trips.

It is clear that the construction of schools is a catalyst for growth. Unfortunately, school location decisions in many South Carolina districts are characterized by a lack of consideration of local land use plans and, in many cases, work against the community's comprehensive plan goals. As a result, new schools are frequently located on large tracts of cheaper, undeveloped land beyond the boundaries of current development, requiring costly investments in extension of water and sewer lines, transportation improvements, and emergency and public safety services. Such schools also attract residential and commercial growth to previously undeveloped areas and open the door for annexation. However, when carried out in coordination with the community land use plan, school siting can strengthen local development and energy conservation goals. Schools built within close proximity of existing residential areas encourage alternative modes of travel such as biking or walking and require shorter vehicular trips. When schools are located near essential commercial services such as dry cleaners, day care centers, and health providers such as dentists and doctors, fewer trip miles are needed to reach multiple destinations.

Coordination and collaboration in local school and recreation planning efforts can also yield sizable savings in the energy used for construction and maintenance, reduce land acquisition costs and maximize the use of such facilities. In most communities, school districts have made significant investments of tax revenues in indoor and outdoor recreational facilities such as gyms, tracks, ball fields and tennis courts. Joint use of such facilities by the surrounding

community in times of non-educational use can reduce the costly duplication of construction and maintenance of such facilities.

CASE STUDIES

City of Sumter Public Works Facility

In response to the need for more space to consolidate and expand its public services departments, the City of Sumter, South Carolina, purchased an old steel mill located three blocks from Main Street. The purchase of 20 acres of land and more than 260,000 square feet of previously vacant building space has allowed the public services departments to consolidate and provide room for future growth. Formerly a deteriorating eyesore in the downtown district, the abandoned mill is being transformed into a productive resource for the City by complementing the City's downtown revitalization efforts through infill and redevelopment. The $1.5 million purchase of the property was financed through a general obligation bond, with the costs offset by the sale and lease of the existing Public Works and City Shop facilities. The renovated facility will house the administrative and engineering offices of Public Works and will free up much-needed office space in City Hall. The City's Material Recovery Facility will be housed under warehouse cover at the new complex and will have room to expand as needed for Sumter's growing recycling program. The new facility is large enough to house City equipment to protect it from the weather, which will extend its life expectancy. A Central Store is also housed in the complex to increase the City's purchasing efficiency. Ultimately, the consolidation of departments in the facility will reduce municipal costs through shared equipment, manpower and resources. The City's decision to locate the consolidated operations in the downtown area instead of on larger, undeveloped tracts on the City's periphery provides an example for the private sector and strengthens downtown redevelopment efforts.[130]

State of Florida School Siting Criteria

Florida is among several states that have recognized the disconnect between local planning and school siting processes and has passed legislative mandates that require coordination with local development goals. The State's Comprehensive Planning Legislation requires localities to identify future sites for educational facilities in their land use plans and to seek opportunities for co-location of public and school facilities such as parks, ball fields, libraries and community centers. Florida School Law statutes also require that school boards work with local planning officials and

that new school sites be developed in concurrency with, and not preceding, other development, including infrastructure. Acreage requirements and other siting criteria are flexible and based on local considerations and needs. School boards and planning agencies must follow a prescribed process that includes written notification and comment on the siting and development of school properties.[131]

Site Design and Building Efficiency

Site design and building orientation also influence energy use. Buildings should be oriented to take advantage of solar heating in the winter, while maximizing prevailing breezes to reduce air temperatures in warm-weather months. Landscaping should be incorporated to provide shading and reduce ambient air temperatures in the summer. During colder months, landscaping can also divert winter winds by acting as wind breaks.

The potential for energy savings in local government and institutional facilities is significant. Energy savings of 10% to 35% are feasible in many buildings.

The potential for energy savings in local government and institutional facilities is significant. Energy savings of 10% to 35% are feasible in many buildings.[132] *Such energy savings can be realized through either retrofitting existing facilities with energy-efficient technologies and designs or by encouraging energy-efficient design and the use of energy-efficient technologies in new buildings. It is important to include energy savings as a factor when considering return-on-investment for either retrofits or new construction. Determining potential energy savings for the retrofit of existing buildings requires a comprehensive energy audit of all facilities operated by the local government or institution.*

Of the energy used in buildings, more than one-half is directed to heating and cooling needs.[133] *It is therefore important to weatherproof buildings, provide for solar heating when possible, incorporate natural ventilation and shading, and install energy-efficient heating and air conditioning units. Table 7 lists a number of ways in which buildings can be designed or retrofitted to promote energy conservation.*

Table 7. Energy Conservation Principles for Building Systems

Item	Action for Energy Management
Site	• Take advantage of microclimate conditions • Orient building for most favorable sun and wind conditions • Take advantage of shading provided by plants or topographical features • Use plants or topography for wind breaks • Use vegetation to influence microclimate (reduce heat absorption, provide evaporative cooling) • Use bodies of water (natural or artificial) to influence microclimate • Select a site that minimizes transportation energy
Building Envelope	• Provide shading to reduce solar heat gain and protect against wind losses • Optimize building volume, area and layout for energy efficiency • Maximize use of daylighting • Tighten building envelope – minimize infiltration and exfiltration • Insulate building envelope heavily to minimize conduction losses • Improve glazing to reduce window losses • Provide thermal energy storage capability, either passive or active • Incorporate solar heating collectors as structural elements in building envelope • Ensure proper design of entrances (include vestibules)
Systems	• Design lighting and heating systems to make use of daylight and solar heat gain • Optimize lighting and HVAC systems to deliver lighting and comfort conditions only to occupied areas; use unoccupied areas as buffers against unwanted heat gains and losses • Provide automatic controls for lighting and HVAC with local override capability, including the use of computers • Optimize use of summer or winter outside air • Employ heat recovery from lights, equipment and environment • Group systems so heat producing and heat using activities are adjacent to facilitate heat recovery • Provide for co-generation of heat and power when feasible

Source: ASCE, Urban Planning Guide, Revised Edition.

The potential dollar savings that can be realized through energy conservation in public facilities are significant. Moreover, energy savings can be redirected to meet the pressing fiscal requirements of other administrative, operational, programmatic and facilities infrastructure needs. The SCEO works with targeted public institutions to address energy use problems and provide technical assistance through programs such as Rebuild South Carolina and the ConserFund loan program. Through the Rebuild South Carolina program, energy technicians perform energy audits of public facilities to locate problems and propose solutions. If an institution needs financial assistance, the SCEO's ConserFund loan program

can provide funding for needed energy-efficiency measures. Institutions repay the loans from the cost savings achieved through the implementation of recommended energy-efficiency measures.

Case Studies

Chattanooga Trade Center

The City of Chattanooga, Tennessee, is featured in the President's Council on Sustainable Development report, Sustainable America: A New Consensus, as one of the nation's leading environmental success stories. Through public-private partnerships the City has undertaken a wide range of programs aimed at improving air quality, saving energy, and preserving natural resources. One of the featured projects is the expansion of the Chattanooga Trade Center, which will be a model for energy-efficient design when completed. The building will be illuminated primarily by sunlight and natural ventilation will be utilized throughout. Skylights will employ screening devices to deflect the sun during summer months. The grass roof will absorb ultraviolet rays, provide insulation and collect storm water. A solar aquatics system will treat sewage waste on site through a series of biological filters, eventually reusing the resultant "gray water" for rooftop grasses and landscaping. At street level, thirty-foot tall trees will be planted along both sides of the street, producing shade and reducing the building's summer cooling load.[134]

Guide to Energy Performance Contracting

The South Carolina Energy Office (SCEO) has developed a Guide to Energy Performance Contracting for school districts and local governments. This guide seeks to help school districts and governments understand the methodology, as well as the potential costs and benefits, of Energy Performance Contracting. Energy Performance Contracting is a financing method that allows institutions to use the money saved through reduced utility expenditures to pay for more efficient building equipment, controls and maintenance. The guide provides an introduction to Energy Performance Contracting and serve as a practical reference manual to help school districts and governments through the process.

Rebuild America

The South Carolina Energy Office has developed the Rebuild South Carolina Partnership (RBSC) to bring the benefits of energy efficiency to public agencies and school districts in South Carolina.

The partnership is designed to address the specific needs of agencies and school districts. Any public agency or school district with facilities that use energy at higher than normal rates is eligible to participate in the program. Being part of RBSC is not a one-time deal; it is an ongoing, interactive relationship. The program provides the following services:

- *Energy Use Audits - The Energy Office provides a walk-through energy use audit to assess the building's energy costs and efficiency by analyzing energy bills and conducting a brief survey of the structure. This audit identifies and provides savings and cost analysis of all practical measures that meet the owner's needs and economic criteria. It also discusses any operation and maintenance needs. Should the Energy Office and the client agree that a more thorough analysis is needed, a technical analysis audit is conducted.*

- *Plan Development - From the information gathered in the audit phase, the Energy Office assists the client in developing an implementation plan. This plan prioritizes retrofit activity based on the unique needs of the client.*

- *Financing - If the agency or school district does not have adequate funding for its project, RBSC offers financing options through the Energy Office's ConserFund Loan Program, the State Treasurer's Office, local banks or other lenders. The goal is to arrange financing that is covered by payments from energy savings, so borrowers can repay the loans without the need for additional revenue.*

- *Project Coordination - Once the audits have been completed, the scope of the project defined, and financing options selected, the Energy Office assists the client in ensuring the smooth implementation of the project.*

- *Energy Consumption Monitoring - The Energy Office assists the client in monitoring and verifying the estimated energy and cost savings for each project. When variations in actual savings are discovered, the Energy Office does the necessary research to determine problems and to recommend possible solutions. The Energy Office also provides a discount on the purchase of approved energy accounting software and data set development.*

- *Training - The Energy Office provides any energy management training needed by the client's staff.*

ConserFund Loan Program

ConserFund Loans are available from the S.C. Energy Office for energy efficiency improvements in state and local governments, schools and colleges, hospitals and other not-for-profit organizations. Energy efficiency improvements can make a difference in reducing utility expenses, replacing unreliable, unsafe equipment, and increasing productivity and comfort of the work environment. Eligible projects include:

- *Lighting systems;*
- *Heating, ventilation, and air conditioning systems;*
- *Energy Management Systems;*
- *Building envelope modifications such as doors, windows, insulation and roofs;*
- *Fuel conversion projects; and*
- *Water conservation.*

Facilities Management

Energy use by community facilities varies widely and is dependent on factors such as the number and age of buildings and facilities, the climate, and the types of activities conducted. Although it is difficult to develop an overall picture of energy use by local government and institutional facilities such as hospitals, energy consumption and cost data is available for school districts, state agencies and public institutions of higher education in South Carolina. The South Carolina Energy Office (SCEO) compiles this energy data on an annual basis, focusing exclusively on energy use by buildings and fixed facilities. Transportation-related energy use and costs are not included in the annual report. In addition to the categorical profiles outlined in the SCEO report, each institution, district and agency receives a customized report from the Office that details energy costs and usage per square foot and provides comparisons to the facility averages in each category. The data also enables the SCEO to identify institutions and individual structures with unusually high energy usage and/or expenditures. This data can then be referenced against the detailed, building-by-building data provided by each institution to locate specific problems.

Energy data for the State's public schools and post-secondary institutions offers comparative insight on the magnitude of energy usage in public facilities, in terms of both quantity consumed and cost to taxpayers.

Energy data for the State's public schools and post-secondary institutions offers comparative insight on the magnitude of energy usage in public facilities, in terms of both quantity consumed and cost to taxpayers. The 1999 Energy Use in South Carolina's Public Facilities report reveals that South Carolina school districts consume an average of 44 kBtu per square foot at a present cost of

$0.82 per square foot. Colleges and universities consume an average of nearly 128 kBtu per square foot at a cost of $1.21 per square foot. Most of the difference in energy usage between K-12 and colleges can be attributed to campus housing, which is in operation around the clock and is often older and less energy-efficient. Many post-secondary institutions are also open for longer periods each day to accommodate the schedules of adult learners and continue operation of support facilities on weekends and during the summer months. Average combined energy use for both K-12 schools and institutions of higher education is nearly 67 kBtu per square foot at a cost of $0.92 per square foot. Statewide efforts to reduce energy use in school districts have been successful, resulting in an overall reduction in energy consumption of nearly 7% since 1996.

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Table 8. 1999 Energy Statistics for S.C. Schools and Colleges/Universities

Institutions	Total Sq. Ft. (in millions)	Total Energy Cost (in millions)	Average $/Sq. Ft.	Total kBtu (in millions)	Average kBtu/Sq. Ft.
School Districts	91.9	$ 75.2	$0.82	4,081.3	44.41
Colleges & Univ.	33.9	$ 41.1	$1.21	4,333.1	127.82
Totals	**125.8**	**$116.3**	**$0.92**	**8,414.4**	**66.89**

Source: S.C. Energy Office, Energy Use in South Carolina's Public Facilities – Fiscal Year 1999.

Both K-12 and institutions of higher education rely most heavily upon electricity for their energy needs. More than 91% of the energy used by school districts and 83% of energy consumed by colleges is derived from electricity. Natural gas provides 8% and 16% of the energy consumed by school districts and colleges, respectively.

Table 9. 1999 Energy Expenditures by Fuel Source for S.C. Schools and Colleges/Universities (in millions of dollars)

Fuel Source	School Districts	% of Total	Colleges & Univ.	% of Total	TOTALS	% of TOTALS
Electricity	$68.723	91.3%	$33.936	82.5%	$102.659	88.2%
Natural Gas	$ 5.901	7.8%	$ 6.718	16.3% $	12.619	10.8%
Fuel Oil	$ 0.214	0.3%	$ 0.033	0.1% $	0.247	0.2%
Propane	$ 0.394	0.5%	$ 0.019	0.0% $	0.413	0.4%
Coal	$ 0.000	0.0%	$ 0.447	1.1% $	0.447	0.4%
Total Expenditures	**$75.232**		**$41.153**		**$116.385**	

Source: S.C. Energy Office, Energy Use in South Carolina's Public Facilities – Fiscal Year 1999.

An assessment of energy usage is an essential tool in the effort to reduce energy use. Periodic energy use assessments of equipment, systems and maintenance practices will uncover inefficiencies and provide the data necessary to recommend and evaluate needed upgrades and retrofits. These assessments should include larger systems and facilities such as water and wastewater facilities, HVAC and computer systems, and road maintenance and landfill equipment. Energy use by smaller systems such as lighting systems for individual buildings and landscaping equipment should also be included.

Water distribution can be the largest single component of energy use by local governments.

Water distribution can be the largest single component of energy use by local governments. Across the United States, energy consumption accounts for an average of 50% to 75% of the cost of operating local water systems. Of this total, water pumping can consume 80% or more of the electricity used in water distribution and treatment and represents a prime opportunity for local government to save energy and dollars. However, a growing number of cities are cutting the energy consumption of their water departments by using computers to communicate with water system control points such as pumps, reservoirs, and metering stations. Fresno, California, is one such city using a computerized water distribution system to save energy and money. The City currently pays about $5 million per year in water distribution utility bills, which is $725,000 less than it would likely pay without the system. Completed in 1988 at a cost of $3.2 million, Fresno's system is based on a VAX computer system that communicates by radio with the 200 wells that supply the City's water.[135]

To encourage staff participation and interest, rewards or recognition can be used to recognize those employees who go the extra mile in conserving energy.

Routine maintenance of most mechanical and electronic equipment can save energy. Staff should be trained in proper maintenance techniques and methods, with on-going updates on new technologies and procedures. To encourage staff participation and interest, rewards or recognition can be used to recognize those employees who go the extra mile in conserving energy. A standard methodology for tracking energy use and comparing actual performance with conservation goals should be developed early on to both inform and motivate employees.

Through the adoption of policies such as office recycling, local governments and institutions can save energy, reduce costs, and serve as examples to the community. Efforts can range from the recycling of common office waste such as paper and plastic to the production of energy from landfill gases.

CASE STUDIES

Swansea High School

Lexington School District Four is working to improve the learning environment and comfort level for faculty and students while improving the energy-efficiency of their facilities. Working in partnership with the Rebuild South Carolina program, the District conducted an energy audit of the 20-year old Swansea High School. The audit identified several potential energy reduction activities that were implemented using District funds. An old chiller was replaced with a newer one that uses environmentally-friendly refrigerant and operates more efficiently, resulting in a 29% reduction in energy use. The energy management system was upgraded to a more accurate and reliable direct digital control system. In addition, 1,800 older lighting fixtures were replaced with energy-efficient fixtures, reducing energy consumption by another 43%. The first-year savings at Swansea High School totaled nearly $21,000. Based upon the success of the energy upgrades at Swansea High School, the District has also upgraded lighting systems at both Swansea and Frances Mack Elementary Schools.[136]

Memphis/Shelby County Energy Management Program

The joint City of Memphis/Shelby County government created an internal Energy Management program that has generated a positive return on a number of energy projects. The Energy Management's (EM) mission is to stimulate the efficient use of energy within local government. EM performs this mission by providing various forms of engineering assistance ranging from monthly monitoring of utility bills to detailed facility audits to energy audits and engineering assistance in preparing drawings and specifications for renovations and new construction. Since 1989, the City of Memphis has completed a number of successful energy projects. The Public Works Division reduced the annual energy cost of the two wastewater treatment plants by more than $1 million by switching utility rate structures and reducing energy consumption through treatment process changes. Lighting and HVAC system modifications in City Hall have reduced its annual utility bill by more than $100,000. In addition, the General Services Division has identified or completed additional energy conservation projects estimated to save another $150,000. All energy modification projects, with the exception of the upgrades to the wastewater treatment plants, have a simple payback of less than five years.[137]

Fleet Efficiency

Local governments and institutions can save significant amounts of energy and money by increasing the fuel efficiency of individual vehicles, operating vehicles more efficiently, and improving overall fleet management practices.

Many local governments and institutions operate and maintain a fleet of vehicles. Although these fleets vary greatly in size and composition, they present a prime opportunity to institute energy saving measures. Local governments and institutions can save significant amounts of energy and money by increasing the fuel efficiency of individual vehicles, operating vehicles more efficiently, and improving overall fleet management practices. Regular maintenance alone, including minor tune-up adjustments and adding air to tires, can improve fuel economy an average of 1 to 5%. For example, fuel consumption increases 0.4% for every pound per square inch below proper tire inflation.[138]

Improved vehicle operations can also save energy. For each mile in excess of 55 miles per hour, the average vehicle loses nearly 2% in fuel economy.[139] *Avoiding stops and extra travel miles by planning routes before getting into the vehicle also improves efficiency.*

...replacing 20% of a fleet with vehicles that average 30 miles per gallon instead of 25 would reduce overall fuel consumption by 4%.

Gradually replacing older, less fuel-efficient vehicles can result in significant energy savings over time. The amount of energy saved from fleet upgrades depends on the efficiency of the existing fleet and the replacement rate. For example, replacing 20% of a fleet with vehicles that average 30 miles per gallon instead of 25 would reduce overall fuel consumption by 4%.[140] *When replacing and assigning vehicles, it is important to match the vehicle type with its proposed use. Smaller, more energy-efficient vehicles should be used whenever possible, leaving larger utility vehicles for jobs that require hauling or towing.*

There are numerous opportunities for local governments and institutions to make fleet operations more energy efficient. Some ideas for implementation include:

- *Implement a management information system. By closely tracking maintenance schedules, fuel consumption, mileage, fuel costs and other related information, the fleet manager can identify potential problems at an early stage and develop timely solutions to reduce costs and fuel consumption.*

- *Assign vehicles appropriate to the task. Smaller, more efficient vehicles should be used whenever possible, reserving larger, more powerful vehicles for more appropriate uses.*

- *Purchase fuel-efficient and appropriately-sized vehicles. By*

carefully analyzing vehicle needs, fleet managers can "down-size" the fleet – substituting smaller and often less expensive, but more energy-efficient, vehicles for less energy-efficient vehicles when making new purchases.

- *Practice preventative maintenance. Routine practices such as keeping tires properly inflated and providing regular tune-ups will measurably improve fuel efficiency.*

- *Train maintenance staff. Staff should be well trained in maintenance practices that improve fuel economy.*

- *Train drivers in fuel-efficient driving techniques. Excessive idling and speeding, as well as poorly planned trips, increases gas consumption.*

- *Centralize fleet operations. It is sometimes possible to achieve an economy of scale, improve maintenance efficiency, and more effectively implement fuel efficiency programs by centralizing fleet operations.*

- *Automate fueling stations. Automated fueling stations accurately track fuel use per vehicle. This information can be used to track fuel efficiency, schedule preventative maintenance, and discourage excessive personal use of fleet vehicles.*

- *Explore use of alternative fuel vehicles. Through the use of alternative fuels, local governments and institutions can reduce non-renewable fuel use within their own fleets and can help to promote awareness of alternative fuel use within the greater community.*

CASE STUDIES

Chattanooga Electric Bus System

The City of Chattanooga, Tennessee, has been a pioneer in the use of electric transit vehicles. The system was created in 1993 as a public-private venture linking all levels of government, the Chattanooga Area Regional Transportation Authority (CARTA), and local manufacturers of electric transit vehicles. The 17-vehicle electric shuttle bus system is a vital part of the City's downtown redevelopment effort, providing free transportation to commuters and area residents. Not only has the system reduced vehicle trips, it has helped to improve air quality and has provided a boost to the

local economy. Locally-based Advanced Vehicle Systems (AVS) provides the electric buses for the Chattanooga system and since has expanded its market – now exporting similar shuttle buses to eleven other U.S. cities and to international customers such as Costa Rica.[141]

Alternative Fuel Vehicle Program

As discussed in an earlier section, York Technical College hosts the Center for Alternative Energy Transportation. The mission of the Center's Alternative Fuel Vehicle program is to provide educational opportunities to individuals, industries and government agencies to support the introduction and growth of alternative fuel vehicles (AFVs) as a viable mode of transportation. The Center maintains and manages a fleet of 21 AFVs, which are used by the College, the City of Rock Hill, the City of Charlotte, Discovery Place, Duke Power, Palmetto Electric Cooperative on Hilton Head Island, and the S.C. Governor's Office.

NOTES

Economic Development Opportunities

The State's economic health influences virtually every aspect of life for South Carolinians, from jobs and taxes to education and quality of life. Paralleling the expansion of state economies throughout the South, South Carolina has experienced heightened social and economic growth during the past two decades. Emerging from an agrarian tradition, the State has successfully launched the transformation of its economy into a diversified base of manufacturing, trade, services, health care, and tourism activity. For many communities across the State, this increase in economic activity has been a primary catalyst in the push for local comprehensive planning and land use regulation. By integrating economic development processes with other local planning responsibilities, local governments can diminish the myriad of uncertainties and concerns posed by growth.

A community's economic development strategy has clear implications for land use, transportation, energy conservation and other local planning issues. Although some degree of economic development can, and probably will, happen by default in any community, only a carefully planned program will advance the type of growth and quality of life specifically desired by residents. Such a comprehensive approach lays the foundation for quality economic development that is balanced with local environmental concerns, renewable and reliable energy sources, cost-effective infrastructure utilization, and community fiscal capacity. Conversely, a lack of planning can be detrimental to a community in the long run, deterring the development and recruitment of cleaner, resource-efficient and sustainable industries.

A community's economic development strategy has clear implications for land use, transportation, energy conservation and other local planning issues.

Energy efficiency influences all aspects of the local economy and any balanced discussion of energy use and attempts at energy conservation must include the economic sector, especially industrial and commercial interests. Together, the industrial and commercial sectors represent 58% of South Carolina's annual energy consumption at 45% and 13%, respectively. Although dominated by manufacturing industries, the industrial sector also includes mining, construction, forestry, and commercial agriculture and fisheries. The commercial sector consists of wholesale and retail operations, hospitality and tourism businesses, and other services. Both direct and indirect impacts of energy investments affect a community's economic health. Direct costs are easily quantifiable as revealed in actual energy expenditures by individual businesses and industries in the form of utility bill payments, equipment purchases and new construction. The indirect investments in energy efficiency, howev-

...the industrial and commercial sectors represent 58% of South Carolina's annual energy consumption at 45% and 13%, respectively.

er, are more far-reaching, stimulating multiple spin-off benefits in the form of jobs, services and equipment purchases.

The economic vitality of a community is a cornerstone of its sustainability.

Local economic policy should focus the local government's administrative, regulatory and financial resources in an integrated framework with the common goal of developing and maintaining a sustainable economic base for the community. A proactive economic development program and sustainable development efforts are not mutually exclusive. The economic vitality of a community is a cornerstone of its sustainability. Likewise, consideration of sustainability principles in economic development strategies can be the most influential contributor to sustainability goals and will measurably advance sensible growth objectives.

Business and Industry Recruitment and Retention

Located in the heart of the nation's sunbelt with abundant access to five Interstate highways and three ports on the Atlantic Ocean, South Carolina is strategically poised to continue to attract new business and industry. The economic development strategies of the past two decades have accomplished the initial goal of guiding the State's successful transition to a manufacturing and service based economy. Given the success of these efforts, future economic growth offers an opportunity to refine these development strategies as a primary vehicle to build a sustainable economy for South Carolina.

Strategies aimed at building sustainable economies must cultivate a diverse employment base that includes both large and small employers, as well as manufacturing, service and retail sector employment opportunities. At present, manufacturing production constitutes nearly 27% of the Gross State Product (GSP). This contribution translates into more than $23 billion annually. Another key impact of the emergence of the manufacturing sector in recent decades is that for every 100 manufacturing jobs added in the State, an additional 60 non-manufacturing jobs are created. A concurrent rise in non-manufacturing employment has been highlighted by new growth in the trade, services, and construction sectors. Of State residents employed in non-agricultural jobs, 22% are in manufacturing, 4% in transportation and public utilities, 24% in wholesale and retail trade, and 22% in the service sector.

Although large manufacturing firms have captured the headlines, small businesses continue to contribute significantly to the economic growth of the State. Investment by companies employing 50 or fewer people comprises more than 27% of the total capital

investment in the State. These smaller companies also create nearly one-half of all new jobs in South Carolina. Another advantage of smaller firms is that they are usually locally-owned and typically employ residents within the local community, do business with other community-based firms, and reinvest profits within the community. Such firms also tend to locate in existing facilities and utilize existing infrastructure, resulting in less capital investment on behalf of the local government to accommodate new business.

Thus, for a growing number of cities and counties throughout the State, the local and regional economic development strategy that has proven effective in the past is now at a crucial crossroads. Communities are looking beyond a mere influx of new jobs in search of a sustainable economic growth strategy that will address other local concerns such as brownfield redevelopment, education and training, job and wage security, cultural resources enhancement, traffic congestion, pollution prevention, natural resources conservation and infrastructure development. Local industrial recruitment and retention efforts should work in concert with local planning strategies to preserve and improve the quality of life in South Carolina communities.

Communities are looking beyond a mere influx of new jobs in search of a sustainable economic growth strategy...

In light of this shifting emphasis from quantity to quality in economic development, many localities are recognizing new economic growth opportunities by encouraging businesses in energy efficiency, materials recycling, environmental technologies and brownfield redevelopment. An increasing number of local governments are developing specific sustainable economic development strategies that focus on advancing their community's long-range development vision. These sustainable strategies often include one or more of the following: the development of eco-industrial parks; the encouragement of infill development and revitalization of downtowns; the facilitation of waste recycling and renewable energy use among business and industry; the efficient design and operation of industrial and commercial facilities and production processes; the development of financial incentives for sustainable practices; and the adoption of regulatory streamlining and reform measures by local governments.

...many localities are recognizing new economic growth opportunities by encouraging businesses in energy efficiency, materials recycling, environmental technologies and brownfield redevelopment.

Based on carefully defined community growth objectives, jurisdictions are equipped to conduct target industry analyses to identify desirable and realistic business prospect categories and specific companies for focused recruitment efforts. Also increasingly apparent for many communities are the benefits of forging cooperative, rather than competitive, economic development programs at the regional level. Programs that are regional in scope offer

additional opportunities to recruit and retain energy-efficient and environmentally-friendly employers, while minimizing development conflicts among neighboring jurisdictions.

CASE STUDIES

Sustainable Economic Development Action Strategy, Northampton County, Virginia

Northampton County, Virginia, has established a County Department of Sustainable Economic Development that is tasked with pursuing economic development within the community's overall sustainable development strategy. Prospective businesses and industries are evaluated against a series of social, environmental and energy conservation criteria as defined in the community's Sustainable Economic Development Action Strategy. The recruitment process considers criteria such as:

- *Percentage of employees who are community residents*
- *Industry's system for the categorization and separation of wastes*
- *Percentage of recycled products or materials used in the firm's day-to-day business operations*
- *Firm's involvement in research and development of new technologies in energy efficiency, pollution prevention and other key concepts*
- *Percentage of employees who commute to work via alternative transportation*
- *Percentage of by-products from other park occupants that firm will re-use in its operations*
- *Percentage of firm's by-product used by other industries*
- *Ratio of unrecyclable to recyclable materials generated by industry*
- *Percentage of scarce resources used by industry in its processes*[142]

The Charleston Downtown Plan

In 1999, the City of Charleston, South Carolina, completed an extensive planning process that culminated in the development of The Charleston Downtown Plan: Achieving Balance Through Strategic Growth. The Plan focuses on real estate and economic growth and the need to find a balance between economic growth and the elements that constitute the City's unique quality of life. A detailed market analysis provides a foundation for the Plan and identifies development potential by economic sector. The Plan takes this market analysis a step further, addressing the specific types of economic growth that will benefit the City the most. The resulting strategies advocate certain types of new commercial, retail and services employment growth – as long as it is compatible with the City's long-range development goals that center on smart growth practices. Among the nine principles that anchor the Plan are: the pursuit of economic diversity; the fostering of sustainability; and the strategic use of growth to strengthen the City's social, cultural and environmental amenities.[143]

Revitalization and Infill

...revitalization of existing built properties and the infill of new development on vacant lands within developed areas also produces significant energy conservation benefits.

Smart growth initiatives encourage the development of land closer to existing urban development, provide incentives for infill and the redevelopment of previously developed areas, and avoid encroachment of new development into areas that lack the necessary public facilities, services and infrastructure. This strategy facilitates the revitalization of urban centers and contributes to the retention of existing infrastructure investments. The revitalization of existing built properties and the infill of new development on vacant lands within developed areas also produces significant energy conservation benefits. Commercial and employment centers sited in developed areas offer more convenient access to retail stores, governmental services, health care, cultural venues and other amenities – reducing the need for lengthy commutes and encouraging the use of public and alternative transportation.

Localities can use economic development as an effective tool for achieving the revitalization and infill of developed areas. Industrial, retail and service sector development that contributes to the long-term health of central business districts and other underdeveloped or declining areas should be encouraged. Capital improvement programs for redevelopment districts can be designed that not only foster infill projects, but also encourage restoration and reuse of properties and buildings of historical significance. Such efforts can be augmented by the location of jobs near existing workforce hous-

ing, the development of shared parking facilities and alternative transportation systems, and the linkage of job sites with convenient, affordable transit service. For instance, in response to the Atlanta region's growing traffic congestion, BellSouth Corporation has announced plans to consolidate all of its suburban office locations into three centralized facilities that are closely tied to the City's mass transit system. Through this move, BellSouth will replace 2 million square feet of office space in the suburban fringe with 3 million square feet of new infill development in the downtown area. Meanwhile, in Charlotte, North Carolina, the Bank of America is investing more than $350 million in redevelopment and infill projects. This effort includes Gateway Village, a downtown community characterized by mixed-uses that blend housing with commercial and retail opportunities in an effort to spark further redevelopment in the core business district.[144]

...redevelopment of existing facilities and build-out of vacant properties within developed areas alleviates growth pressures on community infrastructure.

Jurisdictions can delineate special districts to assist in achieving economic development and land use goals and develop marketing plans and targeted economic incentives to encourage private investment in designated redevelopment areas. The redevelopment of existing facilities and build-out of vacant properties within developed areas alleviates growth pressures on community infrastructure. Detailed land inventories can be conducted in key areas to identify vacant, under-utilized and available commercial and industrial properties and facilities including brownfield sites. Once completed, the data can be compiled and maintained as a directory of lands and existing buildings suitable for business use, including a profile of available public facilities and services for each site. Local governments can use these databases to identify partnerships with the private sector to redevelop brownfield sites and transform them from community liabilities into significant revenue and job-generating centers.

For areas beyond the central business district, planners and local officials can evaluate and pursue appropriate commercial and/or industrial projects within master planned communities. This mixed-use strategy encourages compact development and creates employment opportunities within close proximity to housing, again facilitating alternative transportation and reducing reliance on cars. Local ordinances can also be amended as needed to provide for home-based businesses, while protecting and complementing existing communities and neighborhoods.

Case Studies

Spartanburg Business Corridor Redevelopment Incentive Program

The City of Spartanburg, South Carolina, has initiated a strategy to encourage private developers to revitalize vacant commercial properties within the City called the Business Corridor Redevelopment Incentive Program. The program allows property owners to recapture 20% of their investment using the Multi-County Industrial Park (MCIP) designation, which allows for a fee-in-lieu of property taxes. The fee collected equals the amount that would have been paid in property taxes and allows the City to rebate a portion of the fee. Thirty percent of the tax increment increase will be credited back to the property owner for 15 years or until the total equals 20% of the redevelopment costs. Response by the development community has been positive with four key developments using the program to date.[145]

Cowpens Brownfield Redevelopment Project

In 1997, the Town of Cowpens, South Carolina, became the first South Carolina jurisdiction to win EPA Brownfield Assessment Pilot designation. Partnering with the Center for Manufacturing and Technology (CMAT) and the University of South Carolina at Spartanburg, the Town is converting a brownfield site that consists of a 228,000 square foot facility and 90 acres into an eco-industrial park. As the smallest jurisdiction in the nation to participate in the Brownfield Assessment program, Cowpens faces unique challenges in its effort. The guiding objectives of the project include the establishment of an incubator for sustainable business, the creation of a Center for Urban and Industrial Ecology, and the development of an eco-industrial economic base. The Center for Manufacturing and Technology, with assistance from the S.C. Department of Commerce and the S.C. Department of Health and Environmental Control, has recently concluded a feasibility study on industrial waste exchange opportunities within a 100-mile radius of the Town to guide tenant recruitment. The redevelopment effort will ultimately return the site to a needed revenue-generating property for the community and enhance public awareness and enthusiasm for sustainable growth. The Town of less than 2,200 residents has two additional brownfield sites, including a vacant textile mill in the heart of downtown, and it is anticipated that the successful reclamation of the pilot site will spark expanded redevelopment efforts.[146]

Industrial Ecology

Industrial park development is a tried-and-true tool for economic development. By providing a designated focal point for manufacturing and other related facilities, such parks inherently contribute to the efficient distribution of energy resources. Water and sewer, natural gas, telecommunications, and electrical transmission lines, along with railways and roads, can be extended to serve a centralized cluster of industries in a single park instead of scattered individual facilities.

However, in most industrial parks, a common utilities and infrastructure access is typically the only thing shared by park occupants. The traditional industrial park concept has evolved during recent decades to encompass a more holistic view in which companies are part of a shared industrial ecosystem. This new breed of industrial park is promoted as an approach to reduce waste, improve efficiency, reduce environmental impacts and, ultimately, boost a company's bottom line. Such parks emphasize a bond between manufacturers as part of a common industrial ecosystem for business and environmental excellence with an integrated and sometimes shared network, or ecology, of suppliers, customers, geography and markets.

Eco-industrial development...centers on the production of economically valuable goods and services while reducing the ecological impacts of production.

Eco-industrial development, also known as green industry, offers a practical strategy to implementing sustainable economic development. The concept centers on the production of economically valuable goods and services while reducing the ecological impacts of production.[147] *Seven basic criteria for eco-efficient industrial operations have been outlined by the World Business Council for Sustainable Development:*

- *Reduction of the material intensity of goods and services*
- *Reduction of the energy intensity of goods and services*
- *Reduction of toxic dispersion*
- *Enhancement of material recyclability*
- *Maximization of sustainable use of resources*
- *Reduction of material durability*
- *Enhanced service intensity of goods and services*

Local governments and planners can foster eco-industrial development at the local level by reviewing economic development practices and amending them to include policies that encourage eco-industrial development approaches. Eco-industrial development strategies should be considered for brownfield redevelopment projects and as the job creation component in new urban-

ism projects. The location of eco-industrial operations within a mixed-use development offers an energy-efficient, environmentally-sensitive employment option that contributes to a diverse but compatible economic mix.

Case Studies

Port of Cape Charles Sustainable Technologies Industrial Park

The Port of Cape Charles Sustainable Technologies Industrial Park in Eastville, Virginia, has been designed as part of the community's comprehensive Sustainable Economic Development Action Strategy. In keeping with community goals, the park is host to mixed uses and a nature preserve. Other key sustainable economic aspects include the creation of jobs for local residents and the cultivation of locally-owned and employee-owned companies. The recycling of water resources constitutes a major design element within the park through a used water collection system, a water recovery facility, and a recycled water distribution system. In addition, a local technical advisory panel analyzes the waste by-products of both existing and proposed industries for potential re-use by other industries. The park is the product of a diverse partnership among local, regional, state and federal organizations under the management of the County Department of Sustainable Economic Development. The joint effort included support from Northampton County and the historic Town of Cape Charles, the Virginia Departments of Transportation, Conservation and Recreation, and Housing and Community Development; and the U.S. Department of Agriculture, the U.S. Fish and Wildlife Service and the Environmental Protection Agency.[148]

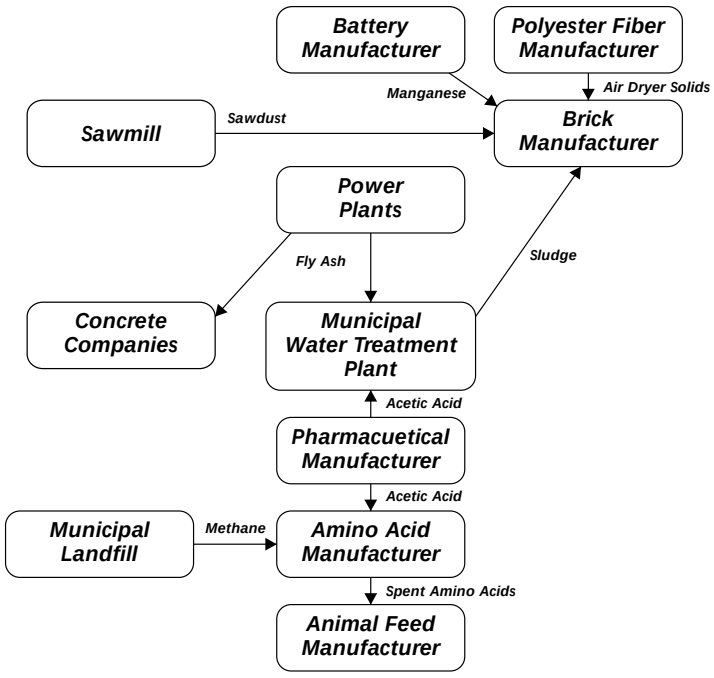
Industrial Ecosystem Development Project, Triangle J Council of Governments

The Triangle J Industrial Ecosystem Development Project was launched to address the needs of businesses in search of new ways to reduce costs and minimize the use and disposal of resource materials. The project seeks to identify alternatives for converting industrial and agricultural wastes into useful products and energy sources. The Industrial Ecosystem Development initiative has centered on the development of a regional forum for the promotion and development of mutually-beneficial partnerships between local business and industry for the reuse of natural resources, materials and energy. The project staff conducted a survey of 182 industries and institutions within a six-county region in North Carolina to identify facility by-products and waste streams.

Survey data was linked to a geographic information system to reveal potential matches between producers of waste materials and possible users of the waste products. Within one year, potentially feasible partnerships had been identified for 48% of the participating businesses. One such relationship under consideration would bring annual savings of $100,000 per year for one industry and $70,000 for the other.

Current industrial partnerships include a pharmaceutical manufacturer that supplies discarded acetic acid to an amino acid manufacturer and a municipal water treatment plant. In turn, the amino acid manufacturer derives its energy supply from a municipal landfill and routes its spent amino acids to an animal feed manufacturer. A local brick manufacturer now utilizes waste by-products of four producers – air dryer solids from a polyester fiber manufacturer, manganese from a battery manufacturer, sawdust from a sawmill, and sludge from the same municipal water treatment plant that uses acetic acid from the pharmaceutical industry. The symbiotic relationships established under the Triangle J project significantly advance the near-term cost cutting goals of business, while moving the region toward its long-term vision of sustainable development.[149]

Figure 11. Sample Triangle J Industrial Ecosystem Partnerships



Source: Triangle J Council of Governments.

Renewable Energy and Recycling

Approximately $8 billion was spent in South Carolina on energy last year, with 98% of this energy supplied by sources external to the State. Data from the U.S. Department of Energy suggests that as much as $0.80 of each dollar spent on energy exits the State immediately. This overwhelming dependence on outside energy sources translates into lost wages for South Carolinians, lost profits for community businesses, lost revenues for local governments, and lost markets for the State's industries. This economic drain must be addressed if sustainability goals are to be attained by South Carolina communities.

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In South Carolina, as in the nation, the industrial sector is by far the largest consumer of energy. The exponential manufacturing growth that has characterized the State's economy has been accompanied by a doubling of total electrical power generation, with the State's industrial sector now representing 46% of electricity consumed. Industrial use also comprises 65% of total statewide natural gas consumption. Of typical industrial energy use nationwide, 45% is used to produce steam, 29% to generate heat for manufacturing processes and buildings, and 25% to run motors, lighting systems and electrolytic processes.[150] The development and use of locally renewable energy resources, particularly by the industrial sector, is requisite to curbing the adverse economic and environmental effects of the State's current energy use and consumption patterns.

Both businesses and local governments are now recognizing the benefits of capturing the economic and energy-generating potential of waste streams. Many counties, municipalities and regions across the nation are actively assessing the potential of their local waste streams and recruiting employers who can not only create much needed jobs, but can also incorporate what would normally be considered unwanted waste and pollutant by-products into viable components of their production processes and end products.

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The creation of local and regional recycling and resource recovery programs, with an emphasis on resource recycling supports job creation in both the public and private sectors. For example, biomass energy production currently supports nearly 70,000 jobs nationwide and, given present growth trends, biomass power could provide more than 280,000 jobs within the next decade.[151] A 1995 study by the North Carolina Office of Waste Reduction documented more than 8,000 private sector and 1,000 public sector jobs

In Wisconsin, data collected by the State's Energy Bureau reveals that using renewable energy generates an overall economic benefit that is three times greater than investment in non-renewable fossil fuel costs.

attributed to recycling activity in North Carolina.[152] Between 1988 and 1992 alone, the State of Massachusetts reported a 257% growth rate in energy efficiency related firms. In Wisconsin, data collected by the State's Energy Bureau reveals that using renewable energy generates an overall economic benefit that is three times greater than investment in non-renewable fossil fuel costs.[153]

South Carolina has also recognized the virtually untapped economic potential embodied by recycling-related industries. Created in 1991, the South Carolina Recycling Market Development Advisory Council (RMDAC) is comprised of recycling industry representatives. The Council's mission is to assist in the development of markets in South Carolina for recovered materials and products with recycled content. The main objectives of the RMDAC include improved solid waste management, resource conservation, and economic development. The 14-member Council conducts an annual assessment of the recycling industry status in South Carolina, identifies new and continued barriers affecting recycling, and makes recommendations to facilitate market development. RMDAC efforts are coordinated within the State's Department of Commerce to foster the integration of economic development and recycling programs into a unified market development effort.

The newest tool of the Council, an economic model developed by the Center for Environmental Policy at the University of South Carolina, is designed to assist cities and counties in improving the effectiveness of solid waste recycling programs. The economic model forecasts changes in waste reduction and recycling rates once a local community adopts new incentives for recycling such as pricing systems. The model uses local community demographic data, coupled with waste stream data, for comparative analysis with other community profiles to yield quantitative estimates of proposed program impacts on waste reduction and recycling increases.[154]

CASE STUDIES

Georgetown County Carbon Recycling Plant

Georgetown County, South Carolina, is the recently announced location for a state-of-the-art carbon recycling plant that will process and convert nearly one-half million tons of fly ash each year from waste material into a prime ingredient for construction. The facility for Southeastern Fly Ash Company is slated for completion in the summer of 2001 near the Santee Cooper Winyah Electric Generating Station. The industry represents a $13.5 million economic investment and the initial creation of 22 new jobs.

The carbon ash is a by-product of the coal-fired generating station and is created when coal is burned to generate electricity. Normally, this waste material containing silica, aluminum and iron is sluiced away to an ash-collection pond for storage. Transport and storage of the waste ash has historically been a costly endeavor for the utility, with recent retrofitting of new equipment to improve environmental performance resulting in even greater amounts of the by-product. The new recycling facility will employ a fluid-bed combustion process that will yield a product that will be ready for use as a partial replacement for cement in ready-mixed concrete. Fly ash increases the durability and strength of concrete when incorporated into cement paste. The co-location of the new industry with the generating station will ultimately reduce the Station's operational and maintenance costs for handling and disposing the fly ash, while also reducing the amount of coal consumed to generate electricity. The heat from the new carbon recycling industry will be returned to the neighboring Winyah generating station and used to generate steam. In short, the partnership will transform what had previously been a costly liability in the form of fly ash into a valuable asset with economic, environmental and energy conservation benefits for the region.[155]

Paper Recovery and Recycling Plant, Pontotox County, Mississippi

The Three Rivers Solid Waste Management Authority oversees a regional landfill that serves seven counties and seven cities in northeastern Mississippi. Following landfill construction in 1995, an industry expressed interest in co-locating a $130 million paper recovery and recycling plant to divert paper waste from the landfill and convert it to pulp for re-use. The recycling activities of the industry remove enough waste from the landfill stream to extend its life by more than fifty percent and have lowered waste disposal fees for local residents and businesses. The local jobs and payroll created by the new industry bring substantial economic benefits to the region by taking a local waste product and turning it into an asset.[156]

Center for Environmental Policy, The University of South Carolina

The Center for Environmental Policy at the University of South Carolina's Institute of Public Affairs provides technical assistance, education, and policy-related research on emerging environmental issues in South Carolina. In addition to work on the economic aspects of recycling, the Center coordinates a statewide program providing technical assistance on pollution prevention in private industry.

Southeastern Regional Biomass Energy Project (SERBEP)

The SCEO and the Southeastern Regional Biomass Energy Project partner with business and industry each year to identify and participate in projects that introduce and utilize biomass power technologies and biomass energy feedstocks. The SERBEP provides funding for transportation, biopower and related projects that promote biomass. Transportation projects focus on ethanol production from cellulosic resources and ethanol production from food and beverage wastes. Biopower projects utilize animal waste through anaerobic digestion, thermochemical conversion, or other technologies that have a strong biopower component. Demonstration projects must have replication potential and can include: new waste treatment technologies with conventional energy conversion technologies; conventional waste treatment technologies with new energy conversion technologies; and a combination of new waste treatment and new energy conversion technologies. Other projects that are beneficial to promoting biomass in the region are also considered.

For example, the SCEO, in conjunction with the SERBEP and Clemson University, has launched a project to encourage the use of on-farm biogas production technology in South Carolina. Manure has value as a prime resource for both plant nutrients and as a fuel source that can help reduce the operational costs associated with modern agricultural facilities. Because animal waste systems are often viewed as a cost that holds no financial return potential to the producer, the project will attempt to determine the most cost-effective method to implement an on-farm biogas system. The project will also develop workshops to educate the agricultural community throughout the State on the multiple benefits of utilizing animal waste as an energy source.

Facilities, Production and Technologies

Community concern over industrial and commercial energy savings is warranted, because each dollar that is saved on energy bills can instead be reinvested into the business and thus, the local economy.

Although not as clearly within the parameters of local planning, local governments can influence energy efficiency in the areas of industrial and commercial facility construction and site design, facilities management, production processes, and the development and application of new technologies in the workplace. Community concern over industrial and commercial energy savings is warranted, because each dollar that is saved on energy bills can instead be reinvested into the business and thus, the local economy.

Research has shown that investment in energy efficiency measures yields greater local economic benefits than mere energy bill expen-

ditures. The economic contrast between utility costs and efficiency investments can be quantified by the use of economic multipliers to define energy investments in terms of dollar impact. For instance, the economic multiplier for payment of an electric bill is only $1.75, compared to a multiplier of $2.32 generated by purchasing energy efficiency measures. In short, the energy efficiency option translates into an additional local economic benefit of $0.57 more per $1.00 spent than with the traditional utility bill expenditure. Although actual economic multipliers differ among regions, energy efficiency investments will outpace traditional utility bill expenditures in overall economic impact. The typical utility bill payment will exit the local economy, leaving minimal lingering impact. Investments in energy conservation measures can leverage community economic growth – when local construction firms are used for facility modification and equipment installation and upgrades; when new, energy-efficient equipment is purchased from local vendors; and when energy savings increase a company's productivity and profitability, resulting in business expansion and the addition of new jobs for local residents.

Communities can encourage high quality design and energy-efficient building materials through a cooperative effort involving industry, government and utility providers. Industrial facilities and commercial buildings should be designed for energy efficiency and environmental performance. The use of energy and water efficient technologies in new building design and the retrofit of commercial and industrial facilities can yield significant savings and environmental benefits. For instance, the retrofit of a 100,000 square foot commercial building can potentially decrease carbon dioxide emissions by more than 60,000 pounds. A nationwide study of 1,700 commercial facilities that had undergone energy retrofits revealed a median savings of 18% in overall building energy use and a median cost recovery period of approximately three years.[157] Retrofits can take the form of lighting upgrades; heating, ventilation and air conditioning (HVAC) system improvements; water and waste water system modifications; and computerized management and control system installation.

Communities can encourage high quality design and energy-efficient building materials through a cooperative effort involving industry, government and utility providers.

Energy savings can also be realized with the adoption of more resource efficient production processes. Traditional industry relies on a linear production process in which raw materials and energy resources are extracted and processed, with waste materials generated being essentially dumped back into the environment. Industries should examine their production processes for energy efficiency opportunities, including how their products are designed, packaged and transported. Industrial processes can be evaluated to decrease

both the amount of materials used and energy consumed in the production process. Industries can realize measurable increases in productivity that stem from equipment and technology improvements in production process design and monitoring. Newer, more efficient equipment not only yields energy savings, but decreases manufacturing down time due to machinery and equipment failure. Such improvements strengthen an employer's competitiveness in the marketplace, often leading to not only job retention, but also new job creation for community residents.

...communities can mobilize technical assistance, financial incentives, and new technologies to enhance the energy efficiency and in effect, the economic competitiveness, of business and industry.

Working in partnership with local employers, communities can mobilize technical assistance, financial incentives, and new technologies to enhance the energy efficiency and in effect, the economic competitiveness, of business and industry. Specific activities by local governments that can encourage efficiency investments by businesses include:

- *Establishing partnerships with local utilities and industries to develop energy efficiency and conservation programs that generate cost savings for local businesses;*
- *Making energy conservation information available through the business licensing and building permit processes;*
- *Sponsoring workshops on energy conservation practices;*
- *Conducting energy audits for commercial and industrial facilities;*
- *Partnering with employers and utility providers to construct demonstration facilities where energy-efficient design principles are put into practice and showcased;*
- *Assisting local employers with applications for grant and loan programs that help cover the costs of retrofits and the development and implementation of new technologies in the work environment; and*
- *Facilitating local and regional eco-industrial recycling partnerships for waste by-product incorporation into industrial production processes and energy generation.*

CASE STUDIES

National Industrial Competitiveness through Energy, Environment and Economics (NICE³)

The SCEO works within South Carolina to fund the commercial demonstration of innovative industrial technologies that reduce energy consumption, waste production and operating costs. The program is designed to ready such technologies for commercialization. The funded projects focus on the following industries: agriculture, chemicals, forest products, glass, metalcasting, mining, petroleum and steel. Projects are also considered in the building, transportation, and power sectors. NICE³ project proposals are evaluated on the basis of commercialization and technology transfer prospects, innovation, energy savings, greenhouse gas emission savings, other waste savings, and economic competitiveness.

Motor Challenge

The Motor Challenge program is designed to reduce energy waste in the pulp and paper industry and among water and wastewater providers. Nearly 70% of electricity used in industry is consumed by some type of motor-driven system and 24% of all electricity purchased in the nation is consumed by industrial motor systems. The program promotes awareness of the economic benefits of energy-efficient drives and motors and provides information to businesses on creating productive motor-driven systems. The SCEO estimates that the use of energy-efficient motors in the targeted industries would save South Carolina businesses more than $1 million annually.

EnerFund Loan Program

EnerFund provides South Carolina businesses with an opportunity to promote manufacturing with recycled materials, reduce the State's dependency on imported energy and lower utility bills. Through the EnerFund program, the SCEO provides business loans for energy efficiency improvements and recyclable material conversion. *EnerFund Category A* loans focus on installation of energy-efficient equipment or technology designed to reduce energy consumption, peak demand or utility costs. Eligible improvements include lighting systems; HVAC systems; energy management systems; alternative or renewable energy systems; building envelope modifications; fuel conversion projects; water conservation; and alternative transportation fuel equipment. *EnerFund Category B* loans support projects that involve the installation of equipment or technology designed for the final process-

ing or conversion of materials in industrial feedstock. Eligible activities include: use of waste material as an energy source; manufacture of new products from recycled materials; and processing of recyclable materials for specified end users.

Energy Efficiency Guide for Businesses, Industry, Government and Institutions

The SCEO distributes the Energy Efficiency Guide to encourage energy management in commercial and industrial facilities. The Guide details six important steps to realize energy savings and discusses savings opportunities for lighting, building envelope, heating, ventilation and air conditioning, hot water, and machinery.

Animal Manure and Related Feedstock Study

Energy and steam requirements are a significant component of manufacturing costs. With natural gas prices rising steadily, finding an economically justifiable alternative fuel source is of key interest to manufacturers. Animal manure and waste is an issue of national concern as an environmental risk and an energy-intensive waste disposal problem. Biopower projects based on animal manure and related feedstock can provide a proactive resolution with energy-efficient results. A feasibility study is being conducted to address the requirements for potential installation of the industry-proven Biotechnische Abfallverwertung GmbH (BTA) technology in the Biomass/Cogeneration facility for the Linpac Paper Mill in Cowpens, South Carolina. The stream of organic material from the Linpac facility, along with the volume of local and regional animal manure, can provide the raw material for an anaerobic digestion system. The anaerobic digestion system will enable the local production of high-grade methane fuel for process heat (steam) or power production (electricity).

Regulations and Incentives

...cumbersome and prolonged review processes and antiquated regulations can impede the recruitment and cultivation of energy-friendly businesses.

Regulation of land use, design, construction and environmental practices is considered integral to ensuring community safety and quality of life. However, cumbersome and prolonged review processes and antiquated regulations can impede the recruitment and cultivation of energy-friendly businesses. Local governments and designated economic development authorities can take the following regulatory and policy steps to stimulate energy-efficient and environmentally sound economic development:

- *Conduct surveys and compile a database of existing industrial waste streams and potential users to serve as a basis for focused economic marketing and recruitment;*

- *Streamline regulations and approval processes, allowing flexibility to accommodate new manufacturing technologies, emerging markets for recycled goods, and the innovative re-use of waste by-products in production processes;*

- *Pursue federal and state funding opportunities for public and private sector led pilot energy efficiency projects and the development and testing of new conservation technologies and products;*

- *Involve local business and industry representatives on local energy advisory committees and in the energy conservation planning process;*

- *Facilitate and foster partnerships among existing and potential industries for waste stream recycling and by-product re-use;*

- *Work with State officials to identify and secure tax breaks, loans, financing, infrastructure grants and other incentives and work to eliminate existing financial disincentives for desirable industries; and*

- *Minimize the uncertainties faced by the private sector by clearly linking economic development decisions with the land use planning, zoning, permitting, codes enforcement and inspections functions.*

Local governments must undertake economic development decisions within the overall context of other planning functions, including planning, zoning, permit approvals, inspections, housing development, community revitalization, capital improvements and transportation. The community's support for economic development must be reflected in a decision-making process that is clear and consistent. By integrating economic development decisions with their other responsibilities, South Carolina communities can reduce the regulatory and procedural barriers that often impede the realization of sustainable development objectives.

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CASE STUDIES

Hydra-Co Wood Waste Fuel Power Plant

Nearly a decade ago, Craven County, North Carolina, was faced with a regulatory dilemma. Changes in landfill requirements threatened the County with two choices it could hardly afford – either the loss of a major employer, the Hydra-Co wood waste fuel power plant, or an additional $500,000 in annual waste disposal costs. In a creative response, the County teamed with Hydra-Co, the County Extension Service and local farmers to evaluate the wood ash by-product from the power plant as an agricultural soil additive in an effort to divert it from the landfill stream. Further cooperation between the local and state government resulted in the successful reclassification of the ash by-product from "waste" to "soil additive" by the North Carolina Division of Solid Waste Management. Following the revised designation and educational programs for area farmers on the availability of and uses for the new product, demand for the wood ash additive grew to utilize all the ash produced by the company within just one year of the program's inception. The County's creative effort resulted in the preservation of an existing employer, cost savings for waste disposal, the dramatic reduction of landfill waste and extension of the life of the landfill, and a local market for agricultural soil nutrients.[158]

NOTES

Table 10. Summary of Strategies and Approaches for Energy Conservation

OPPORTUNITIES	OBSTACLES	STRATEGIES
Land Use		
Mixed-Use Development	• Single-use zoning • Separation of uses • Development designs that discourage alternative modes of travel • Home occupations discouraged or not allowed • Accessory housing units discourage or not allowed • Time-intensive review or variance procedures required	• Revise ZO to allow mixed-use development in appropriate areas • Develop incentives for mixed-use development • Allow home occupations • Allow accessory housing units • Encourage housing in/near large-scale commercial developments • Encourage affordable housing near large employers • Streamline review and variance procedures
Infill and Redevelopment	• Prohibitive zoning regulations • Time-intensive review or variance procedures required • Prospective sites are often contaminated • Developers view infill and redevelopment as more costly	• Revise ZO to allow infill and redevelopment - as a permitted use whenever possible • Streamline review and variance procedures • Develop brownfields policies and procedures • Provide tax incentives and fee reductions to developers for infill and redevelopment projects
Compact Development and Clustering	• Prohibitive zoning regulations • Areas do not reach planned densities • Public perception of higher density developments is sometimes negative • Developers view compact or cluster development as more risky	• Revise ZO to allow compact development and clustering where appropriate - as a permitted use whenever possible • Apply minimum density standards where appropriate • Allow accessory housing units • Provide incentives for TDR developments • Work with realtors and development community to educate the public on the advantages of higher density developments • Develop design guidelines • Provide tax incentives and fee reductions to developers of compact or cluster development projects
Full Utilization of Existing Infrastructure	TDRs • Receiving areas not capable of absorbing all TDRs from sending areas • Inadequate development demand in receiving areas • Infrastructure in receiving area not capable of serving all of the potential growth	TDRs • Design receiving areas to include enough land to absorb all TDRs from sending areas • Design receiving areas to include land that is in demand for development • Provide tax incentives and fee reductions for development in receiving areas

Table 10. Summary of Strategies and Approaches for Energy Conservation

OPPORTUNITIES	OBSTACLES	STRATEGIES
Land Use		
Full Utilization of Existing Infrastructure (Continued)	TDRs Continued • Non-participating nearby jurisdictions annex land within the sending areas Impact Fees • Development impact fees programs can be difficult to design and administer • Impact fee cost is passed on to consumers • Lower priced properties tend to pay proportionately more for the same service • There may be vast differences in the costs of achieving the same level of service everywhere within a jurisdiction Urban Service Areas • Adjustments of the service area can be difficult • Property values inside the service area may rise, while values outside the service area may fall • Development may leapfrog into neighboring jurisdictions where it is allowed	TDRs Continued • Provide adequate infrastructure in receiving area to serve new growth • Develop sending and receiving areas on a regional basis Impact Fees • Develop and maintain an up-to-date comprehensive plan and capital improvements plan • Phase impact fees over a period of time • Develop an impact fee schedule that is proportionate to house size and nearly proportionate to income • Develop alternative sources to pay for impact fees on LMI housing or certain economic development opportunities • Develop service areas drawn with level of service expectations in mind Urban Service Areas • Incorporate a market factor when designing the original service area • Seek regional support and cooperation in the design and implementation of urban service areas
Transportation		
Street and Parking Design	• Subdivision regulations require wide streets and large turn-around radii • Regulations do not encourage connected street systems • Regulations encourage use of cul-de-sacs • Regulations have excessive parking requirements • Streets and parking areas are not required to accommodate pedestrians and cyclists • Traffic congestion	• Revise regulations to size street widths relative to their use and to allow smaller turn-around radii • Encourage or require connected street systems • Discourage use of cul-de-sacs • Develop parking standards that address the realistic needs of different land uses and incorporate shared parking • Include provisions for safe and convenient pedestrian and bicycle travel in street and parking design standards • Incorporate traffic signal optimization measures

Table 10. Summary of Strategies and Approaches for Energy Conservation

OPPORTUNITIES	OBSTACLES	STRATEGIES
Transportation		
Multi-modalism	• *Alternatives to car travel are not provided* • *Regulations do not encourage integration of alternative modes of transportation* • *Pedestrian and bicycle pathways are often not convenient, safe or inviting* • *Streets are primarily designed for vehicular travel and do not adequately accommodate alternative modes of travel* • *Little or no connectivity of pedestrian and bicycle pathways* • *Transit supportive development is not addressed* • *Access to transit is often difficult and dangerous*	• *Encourage or require integration of alternative modes of transportation in new developments* • *Include provisions for safe, convenient and attractive pedestrian and bicycle paths in all new developments* • *Encourage or require new developments to include pedestrian and bicycle paths that connect to existing developments* • *Encourage or require transit-oriented development near transit stops and stations* • *Encourage or require new developments to provide safe and convenient access to transit where needed*
Travel Alternatives	• *Zoning prevents or discourages home occupations or telecommuting* • *Lack of teleconferencing facilities* • *Traffic congestion at peak travel times*	• *Revise regulations to encourage telecommuting and home occupations* • *Develop partnerships to build teleconferencing facilities available for use by public and private entities* • *Encourage employers to initiate work schedules that will help alleviate congestion at peak hours*
Environmental		
Urban Forestry and Landscaping	• *Ordinances do not encourage or require tree preservation* • *Ordinances do not encourage or require trees in new developments* • *Ordinances do not encourage or require landscaping for energy conservation* • *Ordinances do not require or enforce proper maintenance of trees and landscaping* • *Planning staffs do not have expertise in landscaping and urban forestry* • *Developed areas do not include trees and landscaping*	• *Amend current regulations or develop new regulations to encourage or require tree preservation where appropriate* • *Revise regulations to encourage or require landscaping for energy conservation, to include trees* • *Revise regulations to encourage or require proper maintenance for landscaping and trees* • *Work with civic groups to educate the public on the benefits of adding trees and landscaping and proper landscaping maintenance* • *Obtain the service of an urban forester or landscape architect* • *Work with civic groups to plant trees and other vegetation in developed areas*

Table 10. Summary of Strategies and Approaches for Energy Conservation

OPPORTUNITIES	OBSTACLES	STRATEGIES
Environmental		
Open Space	• *Ordinances do not encourage or require open space in new developments* • *Ordinance do not encourage or require the linking of designated greenways in new developments* • *Existing open spaces and greenways are not linked* • *Developed areas do not include open space* • *Landscaping in existing open spaces is not maintained* • *Existing open spaces are unsafe*	• *Revise regulations to encourage or require the provision of open space in new developments* • *Revise regulations to encourage or require developers to link new open spaces and greenways to existing greenways* • *Develop a community greenway plan* • *Develop programs to fund land purchases for greenways and to solicit conservation easements from property owners* • *Develop an open space plan (can be part of the greenway plan)* • *Designate potential open spaces in developed areas and seek funding for their purchase* • *Seek funding for the proper maintenance of open spaces and greenways* • *Seek support and funding for safety measures such as safe equipment, adequate lighting, and increased law enforcement presence*
Alternative Fuels	• *Alternative fuel sources are not well known* • *No incentives exist to use alternative fuels* • *Alternative fuels are sometimes more expensive than conventional fuels* • *The use of solar energy is sometimes hampered by blocked access to solar energy*	• *Work with civic groups and other levels of government to promote the use of alternative fuels and to educate the public on the availability and benefits of alternative fuels* • *Incorporate the use of alternative fuels into local government and institutional operations* • *Work with civic groups and other levels of government to seek funding for incentive programs to include grant and loan programs* • *Revise regulations to prevent solar access obstruction for existing buildings and other land uses*
Recycling	• *The importance of recycling is not understood* • *Recycling is not always required* • *Recycling is not strictly enforced* • *Commercial and industrial recycling is generally voluntary* • *Recycling centers are often not user friendly or conveniently located*	• *Work with civic groups to educate the public on the benefits of recycling* • *Revise regulations to require recycling and implement adequate enforcement at recycling centers* • *Work with local businesses and industries to encourage recycling in that sector*

Table 10. Summary of Strategies and Approaches for Energy Conservation

OPPORTUNITIES	OBSTACLES	STRATEGIES
Environmental		
Recycling (Continued)	• Ordinances do not require proper space for recycling in new developments	• Develop recycling centers that are convenient, clean and safe, and that make recycling relatively easy • Revise zoning maps to include conveniently located sites for recycling centers • Revise regulations to require new developments to include proper space for and access to recycling areas
Housing		
	• Ordinances do not encourage or require energy-efficient development • Ordinances do not encourage or require siting of residential buildings for energy conservation • Older homes are under-insulated and are not weatherproof • Many in the building industry and the general public are unaware of the benefits of energy-efficient development and construction • The general public is often unaware of the availability and benefits of energy-efficient heating and cooling units, water heaters, and other appliances	• Revise regulations to encourage compact development and mixed-use development • Revise ordinances to encourage or require buildings to be sited for maximum energy efficiency where possible • Work with local civic groups and utilities to seek funding for weatherization programs and to educate the public on the benefits of making buildings more energy-efficient • Work with the building industry to educate their members about the benefits of energy-efficient development and construction • Work with local civic groups and utilities to educate the public on the benefits of energy-efficient heating and cooling units, water heaters, and other appliances
Community Facilities		
Administration, Policies and Education	• Local governments and institutions do not have energy conservation programs • Procurement policies do not require energy efficiency as an evaluation criterion • Teleconferencing is not available or not encouraged • Personnel policies do not allow telecommuting or alternative work schedules • Policies do not promote energy conservation by employees	• Develop and implement a comprehensive energy conservation program • Incorporate life cycle costing into procurement evaluation • Seek partnerships to develop teleconferencing facilities and encourage teleconferencing by employees and the community • Revise personnel policies to allow and/or encourage telecommuting and alternative work schedules • Promote the use of alternative modes of travel by employees

Table 10. Summary of Strategies and Approaches for Energy Conservation

OPPORTUNITIES	OBSTACLES	STRATEGIES
Community Facilities		
Site Location	• Potential impact on energy use is not considered in site selection • State and federal facilities are not required to comply with local land use requirements • Impact on energy use is not considered when locating new schools and other state and federal facilities	• When possible, locate new facilities near transit, bicycle and pedestrian facilities • When possible, locate new facilities near related uses • When possible, locate new facilities near essential services such as childcare, restaurants, etc. • Work with school districts and other state and federal organizations to encourage compliance with local requirements • Work with school districts and other state and federal organizations to encourage consideration of energy use impacts when siting new facilities
Site Design and Building Efficiency	• Energy usage in buildings is not known • Existing buildings are not energy-efficient • Energy efficiency is often not a priority in new construction • Energy conservation is not considered when siting new buildings • Existing and new buildings often do not use landscaping to help control heating and cooling needs	• Conduct an energy audit of all buildings • Retrofit existing buildings with energy-efficient technologies • Weatherize existing buildings • Incorporate energy-efficient design and technologies into new buildings • Orient new buildings to take advantage of solar heating and cooling breezes • Use landscaping to provide shade and to act as windbreaks
Facilities Management	• Limited understanding of current energy usage for equipment and systems • Frequent maintenance is not required for equipment and systems • Employees are not aware of the benefits of energy conservation • Employees are not trained to incorporate energy conservation measures in day-to-day activities • Basic internal energy conservation systems are not in place	• Conduct an energy use audit and track progress • Institute regular maintenance on all equipment and systems • Train employees to incorporate energy conservation into all facets of their activities • Train employees on the benefits of energy conservation • Post results of energy use tracking • Provide incentives to employees who successfully reduce energy use • Develop and implement recycling and other internal energy conservation programs

Table 10. Summary of Strategies and Approaches for Energy Conservation

OPPORTUNITIES	OBSTACLES	STRATEGIES
Community Facilities		
Fleet Efficiency	• Lack of data on fleet energy use • Fleet energy use is not monitored • Many fleet vehicles are not energy-efficient • No regular fleet maintenance schedule • Vehicles are often not selected for use based upon energy efficiency • Fleet maintenance staff is not trained in energy conservation procedures • Employees are not trained in energy-efficient vehicles operation • Alternative fuels are not used	• Implement a fleet management information system • Automate fueling stations • Centralize fleet operations • Replace older vehicles with more energy-efficient models • Provide regular maintenance for vehicles • Assign vehicles appropriate to the task • Train maintenance staff in procedures that will save energy • Train personnel in fuel efficient driving techniques • Incorporate the use of alternative fuels with the fleet when feasible
Economic Development		
Business and Industry Recruitment and Retention	• No direct link between the comprehensive plan and economic development efforts • Sole emphasis in recruitment and retention is placed on job creation • Focus of recruitment and retention programs is on larger businesses and industries	• Work with local economic developers to link the comprehensive plan and economic development goals and objectives • Consider contribution to local sustainability when evaluating industrial and business prospects • Develop strategies for recruiting industries that contribute to local energy conservation efforts • Develop strategies for recruiting and retaining small businesses and industries
Revitalization and Infill	• Economic development efforts do not advocate infill properties or existing facilities to industrial or business prospects • No inventory of available existing facilities or infill properties • Industries and businesses are reluctant to locate in existing facilities or on infill properties	• Focus economic development efforts on the reuse of existing properties and the use of infill properties • Develop detailed inventories of vacant, underutilized and available commercial and industrial properties • Develop incentives to locating in existing facilities or infill properties such as tax or fee reductions or zoning incentives • Work with local developers, realtors and economic developers to develop promotional materials for revitalization areas

Table 10. Summary of Strategies and Approaches for Energy Conservation

OPPORTUNITIES	OBSTACLES	STRATEGIES
Economic Development		
Revitalization and Infill (Continued)	• Properties containing brownfields are not economically attractive to prospective businesses or industries due to liabilities and regulatory hurdles	• Seek funding for brownfield reclamation. Work with economic developers to develop promotional materials on successful brownfield redevelopments • Facilitate regulatory flexibility in redevelopment
Industrial Ecology	• Industrial parks place primary emphasis on access to infrastructure • Manufacturers operating in relative isolation	• Amend economic development policies to encourage industrial parks that reduce waste, promote recycling and energy efficiency, and have minimal impact on the environment • Increase industry awareness of their role in community and regional industrial ecosystem
Renewable Energy and Recycling	• Few businesses and industries recycle waste products • Extent of recycling by business and industry is often unknown • Businesses and industries are primarily dependent on non-renewable energy sources • Waste disposal is a costly and energy-intensive process	• Work with local businesses and industries, the chamber of commerce and local solid waste managers to develop recycling incentives and reliable reporting mechanisms for recycling • Develop partnerships to encourage the use of renewable energy sources and to seek funding for the implementation of renewable resource programs • Facilitate local and regional eco-industrial recycling partnerships for waste by-product incorporation into industrial production processes and energy generation
Facilities, Technology and Processes	• Traditional production processes are linear, and resource- and energy-intensive • Reluctance to invest in what are perceived as costly measures	• Assist business and industry with identification of funding assistance for upgrades, retrofits, and new technology demonstration • Educate employers on long-term savings from energy efficiency investments • Establish partnerships with local utilities to develop energy efficiency and conservation programs • Sponsor workshops on energy conservation practices and conduct energy audits for commercial and industrial facilities • Partner with employers and utility providers to build demonstration facilities to showcase energy-efficient design principles

Table 10. Summary of Strategies and Approaches for Energy Conservation

OPPORTUNITIES	OBSTACLES	STRATEGIES
Economic Development		
Regulations and Incentives	• Regulations often impede the recruitment and cultivation of energy-friendly businesses • Economic development efforts are often in conflict with local planning and development programs and vice versa	• Streamline regulations and approval processes and allow flexibility for new technologies and innovations • Link economic development efforts with the comprehensive plan • Coordinate closely with economic developers in planning and development matters • Pursue federal and state funding opportunities for pilot projects and development of new energy technologies and products • Involve local business and industry representatives in the energy conservation planning process • Eliminate existing financial disincentives for desirable industries • Identify and secure tax breaks, loans, financing, infrastructure grants and other incentives

NOTES

CHAPTER 3

PREPARING THE ENERGY CONSERVATION ELEMENT

The Energy Conservation Element

As an optional element of the comprehensive plan, the energy conservation component should be similar in format to the other elements of the plan. As prescribed by the 1994 Comprehensive Planning Enabling Act, all plan elements must include an inventory of existing conditions, a statement of needs and goals, and implementation strategies with measurable time frames. The scope of the energy conservation element should be extensive enough to convey a clear understanding of energy – how energy is used locally, the benefits of conservation, local opportunities for energy conservation, and proposed actions to save energy. Most importantly, the energy conservation element should make the connection between energy conservation and the other seven elements of local government planning. Inclusion of energy conservation within the comprehensive planning process will reshape planning and regulatory policy and identify potential conflicts between energy conservation goals and existing plans and strategies.

The scope of the energy conservation element should be extensive enough to convey a clear understanding of energy – how energy is used locally, the benefits of conservation, local opportunities for energy conservation, and proposed actions to save energy.

As with all elements of the comprehensive plan, the energy conservation element is developed under the oversight of the planning commission. When drafting the energy element, those involved should look at least ten years into the future. An advisory committee appointed by the commission and composed of citizens knowledgeable in energy-related issues and dedicated to including energy conservation in the planning process can provide valuable insight and build community support. Committee members should represent a wide range of energy interests including the planning commission, neighborhood and community-based organizations, utilities, business and industry, developers, school districts, environmental groups and interested citizens.

The potential for coordination of energy conservation measures on a regional basis should also be explored as part of the planning process. Energy conservation programs and strategies are most effective when implemented in cooperation with neighboring municipalities and counties. In some cases, regional areas of coordination can be organized to include the service areas of the utility providers – which generally do not coincide with political boundaries – or could encompass a council of governments

Energy conservation programs and strategies are most effective when implemented in cooperation with neighboring municipalities and counties.

(COG) region which adheres to political boundaries. If opportunities exist for regional coordination, representatives from neighboring jurisdictions should be included on the advisory committee.

After completion of the energy conservation element, the planning commission will recommend it to the elected body for adoption. As a part of the comprehensive plan, the energy element must be reviewed by the planning commission at least every five years to ensure relevance. An update of the comprehensive plan, including all of its elements, is required a minimum of once every ten years. The 10-year update is a substantial undertaking in which the planning commission prepares and recommends a new plan to the local council for adoption.

Relationship to Other Plan Elements

The energy conservation element should be developed within the context of the entire comprehensive plan.

The energy conservation element should be developed within the context of the entire comprehensive plan. As the energy conservation element is developed, a review of each of the other plan elements is necessary to identify opportunities to include energy conservation related issues and information. If such opportunities exist, portions of those elements may require amendment in order to compliment or include the goals and objectives of the energy conservation element. By the same token, the energy element must also speak to issues and information related to the other elements of the plan. For instance, many aspects of energy conservation are directly related to transportation issues presented in the community facilities element. Table 11 includes examples of common linkages between the energy element and other plan elements. Likewise, if the energy conservation element is being developed as part of a new comprehensive plan or a major update to an existing plan, it should be considered an integral part of the plan with equal standing.

Table 11. Energy Element Linkages - Examples

Element	Opportunities to Include Energy Issues	Factors Affecting Energy Conservation
Population	• *Population distribution*	• *Population growth impacts energy use* • *Population distribution impacts energy use*
Economic	• *Recruitment of clean industries* • *Industrial and business recycling* • *Brownfield redevelopment* • *Green industrial parks* • *Siting and design issues* • *Telecommuting* • *Infill development* • *Adaptive reuse of existing facilities*	• *As the largest user of energy, industry presents the potential for significant energy conservation impacts* • *Proximity of employers to residential areas impacts transportation energy use*
Natural Resources	• *Air and water quality* • *Forest management* • *Open space and greenway preservation* • *Urban forestry programs*	• *Trees and other vegetation impact air temperature*
Cultural Resources	• *Energy-efficient facilities* • *Alternative transportation access* • *Reuse and preservation of historic facilities*	• *Proximity of entertainment and religious facilities to residential areas impacts energy used in transportation*
Community Facilities	• *Energy-efficient facilities* • *Community and institutional recycling programs* • *Multi-modalism* • *Street and parking design* • *Travel alternatives* • *Traffic signal optimization* • *Alternative fuels programs* • *Site selection and design* • *Telecommunications infrastructure*	• *Proximity of recreation, education, and other community facilities to residential areas impacts energy used in transportation* • *Existing road system and planned road additions or improvements impact energy use* • *Street and parking design requirements impact energy use* • *Requirements and plans for sidewalks, greenways, and bike paths impact energy use* • *Existing transit and future transit plans impact energy use*
Housing	• *Housing density* • *Energy-efficient construction* • *Housing types* • *Affordability* • *Infill development*	• *Existing and planned housing densities impact energy use* • *Existing and planned housing types impact energy use*
Land Use	• *Compact Development* • *Mixed-use development* • *Multi-modalism* • *Redevelopment* • *Zoning and land development regulations*	• *Proximity of recreation, education, and other community facilities to residential areas impacts energy consumption* • *Higher densities reduce energy use* • *Redevelopment of existing sites and facilities reduces energy consumption*

The land use element integrates the goals and objectives of the other plan elements into a cohesive and "comprehensive" plan for the future of the community. Accompanied by the implementation strategies for the plan, the land use element provides the primary implementation platform for the comprehensive plan. Therefore it becomes even more important that the goals and objectives of the energy conservation element be well represented in both the land use element and the implementation strategies.

Background Information

The background section describes the community's energy supply, energy usage, compatibility of energy use with other local goals, and opportunities for energy conservation.

The background section – also known as the inventory of existing conditions – describes the community's energy supply, energy usage, compatibility of energy use with other local goals, and opportunities for energy conservation. This information enables local governments to identify significant community issues associated with energy conservation, which will in turn facilitate the development of goals and objectives for the energy element. The preparation of this background information comprises an energy assessment and is critical to the energy conservation planning process.

Much of the data and information needed for an energy assessment is complex, derived from a variety of technical disciplines and organizations. Local governments need to work closely with local utilities and other data sources to compile and interpret the information and to identify local energy conservation issues. The South Carolina Energy Office (SCEO) is also a reliable resource for energy-related information. Each year the SCEO produces the South Carolina Energy Use Profile, an annual statewide energy assessment that provides a comprehensive picture of energy use by sector.

Energy Measurement

To assess energy use, it is important to understand how energy is measured. Electricity is commonly measured in watts and watt-hours. While watts describe the rate at which energy is being consumed or produced at a given moment, watt-hours measure the total amount of energy consumed or produced over time. A kilowatt is equal to 1,000 watts and is used to describe the power use of appliances such as refrigerators and water heaters. One kilowatt hour (kWh) is 1,000 watts consumed or produced in one hour. Measuring the output of power plants requires larger measuring units such as the megawatt (equal to one million watts) and the gigawatt (equal to 1,000 megawatts).

Natural gas is measured either by volume (cubic feet) or by heat

content (therms). When measured in terms of cubic feet, larger volumes of natural gas are measured in hundreds of cubic feet (Ccf) or thousands of cubic feet (Mcf). In recent years gas companies have begun to switch to therms as the standard measurement because heat content is a more accurate way of quantifying amounts of natural gas. A therm is defined as 100,000 British thermal units (Btu). One hundred cubic feet of natural gas is roughly equivalent to one therm.

To compare or add the energy consumed or produced by different energy sources, it is useful to convert to the energy industry's common unit, the Btu. One Btu represents the amount of energy required to increase the temperature of one pound of water (one pint) by one degree Fahrenheit. The following table includes conversion factors for translating various measurements of energy into Btu.

To compare or add the energy consumed or produced by different energy sources, it is useful to convert to the energy industry's common unit, the Btu.

Table 12. Converting Energy Measurements to Btu

To Convert to Btu	Multiply by
kWh of electricity	3,413
Mcf of natural gas	1,030,000
Therm of natural gas	100,000
Gallon of gasoline	125,000
Cord of wood	14,000,000
Gallon of propane	91,000

Source: Alice Hubbard and Clay Fong, Community Energy Workbook – A Guide to Building a Sustainable Economy.

Energy Assessment Methodology

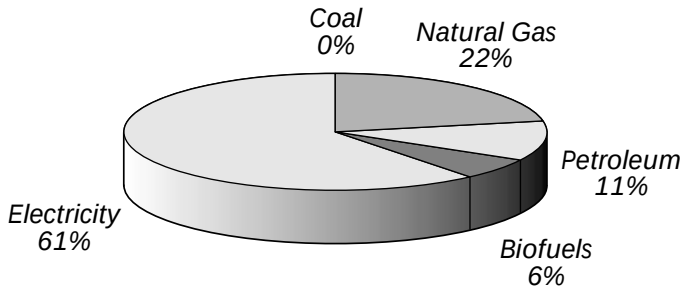
Several organizations have developed methodologies for conducting an energy assessment at the local level. These methodologies share the same goal – to formulate a picture of energy consumption and costs and to identify opportunities for energy conservation within the community. The following section includes a methodology for assessing energy use that is suited to energy practices and fuels typical to South Carolina communities. Completion of the following assessment steps can provide most of the information needed by local governments to develop goals, objectives and strategies for energy conservation.

Step 1. Inventory of local energy sources and costs. *The sources of a community's energy supplies are an important baseline for energy planning. This inventory should include an assess-*

ment of the diversity, availability, reliability and affordability of energy sources; local dependence on these sources; and the economic and environmental consequences of dependence. Descriptive data for each energy source including the means of production and distribution, quantities supplied annually, and current customer rates are also important considerations. An understanding of energy sources available to the community can be reached by answering the following questions:

- *How diverse is the mix of energy supplies and is there an over-reliance on any particular source?*
- *Are the supplies derived from renewable or nonrenewable sources?*
- *What is the breakdown of energy source use by sector (residential, industrial, commercial, transportation)? For example, what is the percentage of residential energy provided by electricity? Figure 12 includes a breakdown of South Carolina residential fuel sources.*
- *Are there adverse environmental impacts associated with the use of some energy sources?*

Figure 12. 1997 S.C. Residential Energy Consumption



Source: S.C. Energy Office, 1999 South Carolina Energy Use Profile.

Appendix A includes an "Energy Sources Worksheet" that lists several key energy source supply questions and provides sources of information and technical assistance for completing the local supply inventory.

Step 2. Inventory of Current Usage and Projected Future Needs. *Once energy sources and related costs have been identified, the next step is to determine how that energy is being used. In this step, the community is classified by major end-use sectors*

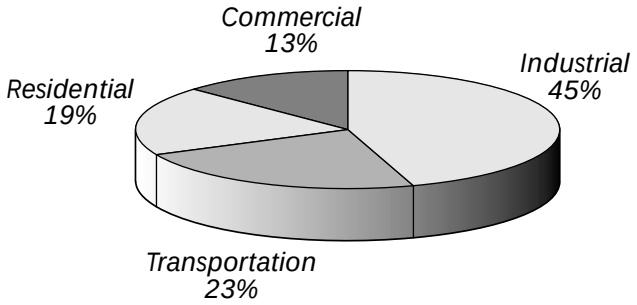
and consumption characteristics are surveyed within each sector. The South Carolina Energy Office divides energy use into residential, commercial, industrial and transportation sectors. Additional sectors such as institutional and agricultural can also be added based on local conditions. Key energy use questions to be addressed when determining local energy use include:

- *Which local sectors are the largest consumers of energy at this time and what are the emerging trends for the future?*

- *How do local consumption patterns compare with usage in the State and in similar communities? Figure 13 illustrates energy consumption by sector statewide.*

- *What are the costs of energy use and how do these costs impact the local economy?*

Figure 13. 1997 S.C. Energy Consumption by Economic Sector



Source: S.C. Energy Office, 1999 South Carolina Energy Use Profile.

Surveys of each end-user sector should include characteristics and needs that influence energy consumption (ie., age and condition of housing) fuels and types of heating and cooling equipment that are prevalent in each sector, and estimates of total energy use and energy costs by sector.

To compile a comprehensive picture of energy use within a community it is essential to develop forecasts of future energy use. This can be accomplished by using existing energy use data and current population figures to calculate current per capita energy consumption, then applying population growth projections to arrive at an estimate of future energy needs.

Appendix B includes an "Energy Use Composite Worksheet" that lists some of the principal energy use questions and provides

sources of information and assistance for developing a composite picture of local energy demand for the community. Additional forms in Appendix B entitled "Energy Use Calculation Worksheets" contain instructions for determining approximate energy use per sector and the types and percentages of various fuels used annually in each energy sector in the community. The information gathered on the "Energy Use Calculation Worksheets" can be used to summarize energy use, impact and cost by sector.

Step 3. Assessing Energy Conservation Opportunities. *Once the energy sources, costs and usage, and future use projections have been identified for a community, the next step is to assess specific opportunities for saving energy. An evaluation of energy use sectors can reveal opportunities for cost-effective conservation measures. Appendix C includes "Opportunities for Energy Conservation & Efficiency Worksheets" that help identify opportunities for energy conservation and efficiency. Estimates of potential energy savings for these opportunities should be included in this assessment as well.*

Once opportunities for energy conservation and efficiency have been identified, the community can design strategies for their implementation. Chapter 2 of this document provides a variety of opportunities and strategies for implementing energy conservation measures and examples of communities which have successfully incorporated similar measures. These opportunities and strategies are summarized in Table 10. Not all of the strategies described in Chapter 2 are applicable or feasible for all communities. Each community must develop a comprehensive energy conservation plan that addresses its particular situation and needs, including local level policies as well as participation in regional measures when possible.

Step 4. Assessing Local Renewable Resource Potential. *After plans are developed to maximize energy conservation efforts within the community, the next step is to assess its ability to develop local renewable resources. Developing local renewable energy resources will reduce the need to import non-renewable supplies, thus increasing the diversity of energy supplies while at the same time strengthening the local economy. It will also lessen the community's vulnerability to outside supply disruptions and price fluctuations.*

Governments and businesses in South Carolina have already begun to successfully employ renewable energy sources in a variety of ways. A list of alternative fuels and energy sources is included in Chapter 2 of this document, under the Alternative Fuels section. This

section also includes programs available to assist local governments and others in developing local renewable energy sources and lists localities that have successfully implemented such programs.

Appendix D includes a "Renewable Resource Worksheet" that can be used to assess renewable resource opportunities within the community. Assessment data to be collected on solar, biomass and geothermal resources includes availability, feasibility of use, available technologies, and environmental issues associated with their use.

Step 5. Summarizing Findings. *The final step in the energy assessment process is the summation of findings from the previous steps. This will provide local officials with the information they need to establish realistic goals and objectives and make informed policy choices. A summary should be based on the following key considerations:*

Energy Supplies

- *Are energy supplies produced from renewable or non-renewable sources?*
- *How diverse is the energy supply and is there an over-reliance on any particular source? How vulnerable is the community to supply interruptions and is there a contingency plan for interruptions?*
- *Are there significant local environmental impacts associated with the production or distribution of any particular energy source?*
- *How much of the local economy is dedicated to importing energy supplies? What are the overall costs of energy supplies for the community and for typical households and businesses?*

Energy Use

- *Who are the largest consumers of energy in the community and which sectors are experiencing the fastest growth in energy consumption?*
- *How do local consumption patterns compare with State averages and those of similar communities?*

- *Are there any significant negative impacts to the environment associated with particular energy uses?*

- *What assessment tools are available for ongoing measurement of local energy use and future changes in energy use?*

Energy Conservation Opportunities

- *Which energy use sectors have the greatest potential for energy conservation and what are the required investments and paybacks to implement these opportunities?*

- *What, if any, existing programs are in place?*

- *Which environmental problems can be addressed through energy conservation measures?*

- *Which energy conservation opportunities have the greatest potential for benefiting the local economy?*

- *What are the key organizations, public and private, with authority and capacity to undertake energy conservation projects and what types of technical and financial assistance are available to implement such projects?*

Renewable Resource Opportunities

- *Which local and regional renewable resources have the greatest potential for producing energy and which can be feasibly developed in order to displace imported supplies and/or create supply exports?*

- *What would be the major environmental impacts of developing local renewable resources? What would be the economic effects?*

- *Will development of local renewable resources also require new or expanded energy transmission facilities and, if so, what would be the impacts?*

- *What organizations, public and private, are key players in the sponsorship and regulation of renewable resource projects and what types of technical and financial assistance are available for implementing renewable energy projects?*

With this information in hand, community officials can craft goals and objectives for energy based on a clear understanding of current energy circumstances and the problems and opportunities that must be addressed to ensure a locally reliable, affordable, and environmentally-friendly energy approach for the future.

The "Energy Summary Worksheet" included in Appendix E helps summarize the information developed in the previous five steps. When completed, it should present a clear picture of the community's current and projected energy use by sector and type.

Goals, Objectives and Strategies

Perhaps the most important and time-consuming phase of the energy conservation planning process is the development of local detailed goals, objectives and strategies for energy conservation. The first step in this process is to develop a vision statement that defines the overall intent of the energy conservation element. Once the vision statement is crafted, it is used to guide development of the goals and objectives, along with detailed strategies that will implement the goals and objectives. Goals are a general expression of an ideal future result or condition, while objectives are more detailed, time-specific and measurable. Objectives may be long-term or short-term and represent tasks to be accomplished in the process of attaining a stated goal. Once goals and objectives are established, strategies are developed to facilitate their implementation. For example, a vision statement could read "The City/County of XYZ will build a sustainable future by infusing energy conservation principles into all aspects of community planning, strengthening our long-term viability and quality of life through a decreased reliance on non-renewable energy sources, increased economic productivity and enhanced community identity and livability." A goal under this vision may be "to decrease dependence on the automobile." A companion objective could be "to increase availability of travel alternatives including pedestrian, public transit and bike options." A strategy that would implement that objective might be to amend the zoning and land development regulations to require sidewalks and greenway connections in all new developments. Just as each goal will generally have multiple objectives, each objective will be implemented through a series of strategies.

Perhaps the most important and time-consuming phase of the energy conservation planning process is the development of local detailed goals, objectives and strategies for energy conservation.

It is important to involve the community in all aspects of the planning process – from formulating the vision statement to developing strategies for implementation. The most effective way to involve members of the community in the development of the energy conservation element is to establish an advisory committee

It is important to involve the community in all aspects of the planning process – from formulating the vision statement to developing strategies for implementation.

as described earlier. Once formed, subcommittees can be established to focus on particular tasks or issues. Not only will the advisory committee be invaluable in gathering the data needed to develop realistic goals, objectives and strategies for energy conservation, the members will also provide valuable insight into community needs and priorities. In addition, the committee can help broaden community support for the energy conservation element.

When developing the goals and objectives for the energy conservation element it is important to remedy any conflicts with the goals and objectives of the other plan elements.

The *1994 Comprehensive Planning Enabling Act* requires that goals and objectives be established for all elements of the comprehensive plan. When developing the goals and objectives for the energy conservation element it is important to remedy any conflicts with the goals and objectives of the other plan elements. The goals and objectives of the energy conservation element must be consistent with those of the other elements and with the comprehensive plan as a whole. Likewise, the goals and objectives of the other plan elements should not conflict with the energy conservation element.

The goals and objectives of the energy conservation element will aid decision-making, not only for issues directly related to energy conservation, but also for issues that may have less obvious relationships to energy use.

As an element of the comprehensive plan, the energy conservation element serves as a guide to the planning commission and the elected body as they consider issues related to land use and the built environment. The goals and objectives of the energy conservation element will aid decision-making, not only for issues directly related to energy conservation, but also for issues that may have less obvious relationships to energy use. In this way energy conservation becomes a consideration in all aspects of land use planning and regulation in a community.

Table 13 includes examples of a vision statement, goals, objectives and strategies for the energy conservation element. The example is not intended to represent a full array of goals, objectives and strategies, but to illustrate one of many formatting and content options. Each jurisdiction must develop goals and objectives for energy conservation that are relevant to their particular situation and needs, only after careful consideration of the role of energy in their community.

Table 13. Sample Goals, Objectives and Strategies

VISION	
The city/county of XYZ will build a sustainable future by infusing energy conservation principles into all aspects of community planning, strengthening our long-term viability and quality of life through a decreased reliance on non-renewable energy sources, increased economic productivity and enhanced community identity and livability.	
Goal 1. Conserve energy through land use planning	
Objective 1.1. Encourage mixed-use development	Strategy 1.1.1. Develop an incentive program for developers Strategy 1.1.2. Develop promotional/educational materials for developers and the public Strategy 1.1.3. Amend zoning and land development regulations to allow and encourage mixed-use and compact development
Objective 1.2. Encourage infill and redevelopment	Strategy 1.2.1. Develop an incentive program for developers Strategy 1.2.2. Develop promotional/education materials for developers and the public Strategy 1.2.3. Amend zoning and land development regulations to allow and encourage infill and redevelopment Strategy 1.2.4 Seek partnerships and funding to develop a brownfield reclamation program Strategy 1.2.5 Develop an inventory database of developable properties
Goal 2. Reduce energy used for transportation	
Objective 2.1. Reduce energy use through street and parking design	Strategy 2.1.1. Amend zoning and land development regulations to allow reduced road widths and turn-arounds Strategy 2.1.2. Amend zoning regulations to adjust parking requirements to be more use specific and more accurately reflect current trends Strategy 2.1.3. Provide incentives to developers to construct narrower streets Strategy 2.1.4. Amend zoning and land development regulations to require connected street patterns within new developments whenever feasible
Objective 2.2. Provide a multi-modal transportation system	Strategy 2.2.1. Amend zoning and land development regulations to require the inclusion of sidewalks and greenway connections within new developments Strategy 2.2.2. Seek partnerships and funding to develop an inter-connected greenway system throughout the community and the region Strategy 2.2.3. Amend zoning and land development regulations to remove requirements that make walking, biking or transit use difficult Strategy 2.2.4. Seek partnerships to promote walking and biking for transportation purposes Strategy 2.2.5. Amend zoning and land development regulations to allow and encourage mixed-use and compact development

Implementation and Evaluation Techniques

The implementation strategies reflect the actions necessary to achieve the goals and objectives of the energy conservation element.

As part of the comprehensive plan, the energy conservation element must include implementation steps and time frames for completion. The implementation strategies reflect the actions necessary to achieve the goals and objectives of the energy conservation element. The implementation plan should also include time frames for completion of each strategy and a listing of the individuals, jurisdictions or agencies that will participate in the implementation process.

Implementation of goals and objectives of the energy conservation element may require revisions to existing plans and programs, as well as modifications to ordinances and regulations such as the zoning ordinance and land development regulations. Chapter 2 provides information and guidance on opportunities and strategies for implementing energy conservation measures. These opportunities and strategies are further summarized in Table 10.

Table 14 illustrates an implementation plan. The example presented does not represent a complete set of strategies, time frames and participants and is shown for reference purposes only.

Table 14. Implementation Plan - Example

Goals/Objectives		Participants	Time Frame for Completion
Objective 1.1.	*Encourage mixed-use development*		
Strategy 1.1.1.	*Develop an incentive program for Developers in targeted areas*	*Planning commission City/County council Energy advisory committee Planning staff Economic development staff*	*Jan. 1, 2001 to Mar. 31, 2001*
Strategy 1.1.2.	*Develop promotional/educational materials for developers and the public*	*Planning commission Energy advisory committee Planning Staff*	*Mar. 1, 2001 to May 31, 2001*
Strategy 1.1.3.	*Amend zoning and land development regulations to allow and encourage mixed-use development*	*Planning commission City/County council Planning staff Utility providers Economic development staff*	*Jan. 1, 2001 to June 30, 2001*
Objective 1.2.	*Encourage infill and redevelopment*		
Strategy 1.2.1.	*Develop an incentive program for developers*	*Planning commission City/County council Energy advisory committee Planning staff*	*Jan. 1, 2001 to Mar. 31, 2001*
Strategy 1.2.2.	*Develop promotional/education materials for developers and the public*	*Planning commission Energy advisory committee Planning Staff*	*Mar. 1, 2001 to May 31, 2001*
Strategy 1.2.3.	*Amend zoning and land development regulations to allow and encourage infill and redevelopment*	*Planning commission City/County council Planning staff*	*Jan. 1, 2001 to June 30, 2001*
Strategy 1.2.4	*Seek partnerships and funding to develop a brownfield reclamation program*	*City/County council Planning staff Economic development staff Energy advisory committee*	*Jan. 1, 2001 to Dec. 31, 2001*
Objective 2.1.	*Reduce energy use through street and parking design*		
Strategy 2.1.1.	*Amend zoning and land development regulations to allow reduced required road widths and turn-arounds*	*Planning commission City/County council Planning staff*	*Jan. 1, 2001 to June 30, 2001*
Strategy 2.1.2.	*Amend zoning regulations to adjust parking requirements to be more realistic and specific to particular land uses*	*Planning commission City/County council Planning staff*	*Jan. 1, 2001 to June 30, 2001*
Strategy 2.1.3.	*Provide incentives to developers to construct narrower streets*	*Planning commission City/County council Energy advisory committee Planning staff*	*Jan. 1, 2001 to June 30, 2001*
Strategy 2.1.4.	*Amend zoning and land development regulations to require connected street patterns within new developments whenever feasible*	*Planning commission City/County council Planning staff*	*Jan. 1, 2001 to Dec. 31, 2001*

Table 14. Implementation Plan - Example (Continued)

Goals/Objectives		Participants	Time Frame for Completion
Objective 2.2.	*Provide a multi-modal transportation system*		
Strategy 2.2.1.	*Amend zoning and land development regulations to require the inclusion of sidewalks and greenway connections within new developments*	*Planning commission City/County council Planning staff*	*Jan. 1, 2001 to Dec. 31, 2001*
Strategy 2.2.2.	*Seek partnerships and funding to develop an inter-connected greenway system throughout the community*	*City/County council Planning staff City/County recreation department or commission Developers Energy advisory committee Neighborhood associations*	*Jan. 1, 2001 to Dec. 31, 2001*
Strategy 2.2.3.	*Amend zoning and land development regulations to remove requirements that make walking, biking or transit use difficult*	*Planning commission City/County council Planning staff*	*Jan. 1, 2001 to June 30, 2001*
Strategy 2.2.4.	*Seek partnerships to promote walking and biking for transportation purposes*	*Planning commission Energy advisory committee Planning staff Neighborhood associations*	*Jan. 1, 2001 to Dec. 31, 2001*
Strategy 2.2.5.	*Amend zoning and land development regulations to allow and encourage mixed-use and compact development*	*Planning commission City/County council Planning staff*	*Jan. 1, 2001 to Dec. 31, 2001*

Once the energy conservation element has been adopted and its goals and objectives become policy, periodic evaluation is necessary to ensure that measurable impacts are being realized and to determine where modifications are needed.

Once the energy conservation element has been adopted and its goals and objectives become policy, periodic evaluation is necessary to ensure that measurable impacts are being realized and to determine where modifications are needed. Because the primary goal of an energy conservation element is to conserve energy, the most important measure of success would be an overall reduction in energy use. This can be determined by subtracting the energy saved by the implementation of each objective from the local and state baseline energy use data gathered in the initial planning process.

The process of calculating energy savings differs with each type of energy conservation measure. While some measures such as vehicle trips are more easily determined through traffic counts taken before and after the implementation of a strategy such as the provision of a multi-modal transportation system, the success of other types of strategies is more difficult to quantify.

The evaluation process for any plan element should be designed to

produce a valid assessment of the progress of implementation strategies and quantifiable evidence of the attainment of objectives for each activity. To be successful, the evaluation component of the energy conservation element must be a priority consideration from the initial planning stage onward. The resulting assessment process must be thorough, feasible and appropriate to the goals, objectives and outcomes of the plan. An effective process will be characterized by: the use of quantitative and qualitative data; a focus on results defined by concrete objectives; an open, participatory climate; a ongoing process for plan modification and improvement; and the continuation or refinement of plan activities. Clearly defined data elements and collection procedures will accurately measure the attainment of individual objectives and the collective success of conservation efforts in addressing the plan goals.

Objective performance measures that are directly linked to the intended conservation outcomes of the plan will yield both quantitative and qualitative data. Quantitative data should include, but not be limited to, energy expenditures, utility savings, traffic counts, housing density increases, alternative fuel usage, air quality data, transit ridership, and governmental appropriations for conservation activities. Qualitative indicators can be used to track changes in attitude and increased awareness and support for energy conservation initiatives. Formal and informal input can reveal significant obstacles and opportunities for energy conservation that may not be as evident in hard data. Qualitative data will encompass observation, surveys, interviews, focus groups, perceptions, and satisfaction levels among the development community, building and permitting staff, business and industry, local utility providers, and the general public relative to energy issues.

An ongoing evaluation process will ensure that energy plan goals and strategies are not only based on accurate data and assumptions, but accommodate unanticipated changes in the community's social, economic and physical fabric.

An ongoing evaluation process will ensure that energy plan goals and strategies are not only based on accurate data and assumptions, but accommodate unanticipated changes in the community's social, economic and physical fabric.

A sound evaluation process will ultimately:

- *Establish clearly defined goals, objectives and strategies that ensure consistency with the overall comprehensive plan;*
- *Retrieve sound data, conduct quantitative and qualitative analyses, and yield timely reports on progress and successes in carrying out the energy conservation plan;*

- *Promote the long-term institutionalization of energy conservation activities within all facets of the community, both public and private, within the community;*

- *Identify problems and barriers to success and offer alternative solutions and actions to achieving energy conservation goals;*

- *Ensure the cost-effective and efficient allocation and expenditure of local public and private resources to support energy conservation goals; and*

- *Facilitate a climate of open communication and awareness of energy conservation activities in all levels of the community and throughout the region.*

NOTES

CHAPTER 4
GLOSSARY OF TERMS

Affordable Housing: *Housing available for rental or purchase to low- or moderate-income families at 30% of their income. Low-income families are defined as those earning 50% of area median income (AMI), while moderate-income families are classified as those earning less than 100 percent of AMI.*

Alternative Fuels: *"Alternative fuel" is a government designation describing any fuel that can be substituted for traditional gasoline or diesel fuels. There are several different types of alternate fuels, and many projects still in development, but EPAct 92 only recognizes seven: compressed natural gas (CNG), methanol, ethanol, propane, electricity, soy diesel (or biodiesel) and hydrogen. These fuels are used either in place or in conjunction with gasoline.*

Biomass (Biofuels): *Energy sources from recent-term organic (plant and animal) matter. Nonfossil biomass energy sources are essentially unprocessed; they are burned or gassified, as received, to produce thermal energy or electricity. Examples include fuelwood, wastewood, garbage, and crop waste.*

Brownfields: *Abandoned, idled, or under-used industrial and commercial facilities where expansion or redevelopment is hindered by real or perceived environmental contamination.*

Cluster Development: *A development design technique that concentrates buildings in specific areas on a site to allow remaining land to be used for recreation, common open space, or the preservation of historically or environmentally sensitive features. Cluster development is designed to minimize infrastructure and development costs while achieving the allowable density.*

Commercial Sector: *The commercial sector as defined by the South Carolina Energy Office includes non-manufacturing business establishments such as hotels, motels, restaurants, churches, wholesale businesses, retail stores, and health, social and educational institutions.*

Community Facilities: *Facilities essential to the community's growth, development or redevelopment, including facilities related to water, sewer, electric and natural gas service, telecommunications access, stormwater management, transportation, solid waste collection and disposal, police and fire protection, health care, emergency medical services, governmental facilities, emergency preparedness, educational facilities, parks and recreation, libraries and other institutional uses.*

Compact Development: *Also known as high or higher density development. Developments built at optimal density. The definition of compact development is context dependent. In rural locations, achieving higher density may mean shrinking large lots slightly to accommodate more housing. In suburbs seeking to maximize land use through small-lot single-family homes, higher density housing could range from 10 to 20 units per acre. In urban infill situations, building at higher density may mean building at densities that reflect the density of surrounding development.*

Comprehensive Plan: *An official document adopted by the local governing body that outlines general, long-term policies for the physical development of the jurisdiction.*

Concurrency: *A technique in which the facilities and services necessary to meet the demands of new development are put in place concurrently with the development. Use of this technique is meant to ensure development will locate where services are available within the urban service area. The State of Florida requires that all 457 local governments implement concurrency for water and sewer systems, stormwater management, solid waste collection and disposal, parks and recreation, and transportation.*

Conservation Easement: *The grant of a property right stipulating that the described land will remain in its natural state and precluding future or additional development. Conservation easements are usually used for the preservation of open space, environmentally sensitive areas, scenic views, or wetland buffers.*

Development Impact Fee: *Monetary charges imposed on new development to recoup or offset a proportionate share of public capital costs, primarily for services and infrastructure, required to accommodate such development.*

Economic Multiplier: *A measure of the economic activity generated by different types of investments within a geographic area.*

Energy: *The capacity for doing work as measured by the capability of doing work (potential energy) or the conversion of this capability to motion (kinetic energy). Energy has several forms, some of which are easily convertible and can be changed to another form useful for work. Most of the world's convertible energy comes from fossil fuels that are burned to produce heat, which is then used as a transfer medium to mechanical or other means in order to accomplish tasks. Electrical energy is usually measured in kilowatthours, while heat energy is usually measured in Btus.*

Energy Assessment: *A comprehensive assessment of energy use describing energy supply, consumption and cost; barriers to energy conservation; and opportunities for energy conservation. Such an assessment can be conducted for a community; a local government, institution or business; or a sub-component such as an individual department within a local government.*

Energy Use Audit: *The evaluation of the efficiency of building and process systems that use energy. Within the audit, energy sources are identified, information on the amount of energy used for specific functions is gathered, the efficiency of energy use for each function is evaluated, and energy and cost saving opportunities are identified.*

Energy Conservation: *The careful and sparing use of energy with a view to minimizing environmental pollution and conserving the natural resources from which energy is derived (especially fossil hydrocarbons).*

Energy Consumption: *The use of energy, including non-renewable natural resources such as oil, coal, natural gas and peat, as well as renewable energy sources such as biomass (including wood), solar, water (hydro) and wind power.*

Energy-efficient: *Using less energy to perform the same activity or function.*

Evaluation: *A process to determine whether a project or strategy is meeting intended goals and an assessment of the results achieved.*

Fossil Fuel: *Any naturally occurring organic fuel, such as petroleum, coal, and natural gas, which is derived from the remains of ancient plants and animals. Fossil fuels are sometimes referred to as conventional fuels or conventional energy sources (as compared with renewable energy sources such as solar power, biomass, and wind energy) because the bulk of today's energy generation is derived from them and most of the industrial economy is based upon them.*

Geothermal Energy: *Energy produced by the internal heat of the Earth.*

Greenfields: *Previously undeveloped properties or farmland located in rural or suburban areas. When considered in relation to the definition of "brownfields," greenfields are defined as farmland or open areas where there has been no prior industrial or commercial activity, and therefore where the threat of contamination is much lower than in urbanized areas.*

Greenway: *A linear open space; a corridor composed of natural vegetation. Greenways can be used to create connected networks of open space that include traditional parks and natural areas.*

Hydroelectric Power: *Electricity produced by water power using turbine generators.*

Industrial Ecology: *The production of economically valuable goods and services while increasingly reducing the ecological impacts of production. Eco-efficient production requires a close look at the raw materials, energy, fuels and utilities consumed during the entire production cycle.*

Industrial Sector: *The industrial sector as defined by the South Carolina Energy Office is that sector of the economy that includes manufacturing, construction, mining, agriculture, fishing, and forestry establishments.*

Infill Development: *The development of new housing or other buildings on vacant lots and in areas within established neighborhoods and commercial districts that were bypassed or created by demolition or abandonment for new development.*

Infrastructure: *Public facilities and services, including transportation, water and sewer, telecommunications, recycling and solid waste disposal, parks and other public spaces, schools, police and fire protection, and health and welfare services.*

Institutional Use: *A nonprofit use, whether public or private, such as a church, library, school, hospital, or government owned or operated building, structure or land used for public purpose.*

ISTEA: *The 1991 Intermodal Surface Transportation Efficiency Act (ISTEA) is widely recognized as pivotal legislation that set a new direction for federally supported transportation activities in the United States. ISTEA declared the Interstate highway system complete; shifted attention from new facility construction towards efficient management, operation and maintenance of the existing system; and focused resources and processes on creation of a "seamless" intermodal transportation system. In addition, ISTEA allocated significant funds to development of intelligent transportation systems that apply computer-based information and sending technologies to solving problems of coordination, system capacity and safety.*

Land Development Regulations: *Land development regulations govern the conversion of raw land into subdivided lots for the construction of buildings and other structures. These regulations are used to control site design, street layout, provisions for water and sewer service, and other matters related to the conversion of land for development.*

Leapfrog Development: *New development that is not contiguous with existing development and that leaves substantial vacant land in between.*

Life-Cycle Costing: *Life cycle costing is a method of analyzing purchasing decisions through comparisons of calculated capital cost, estimated energy costs, and estimated life of equipment. The methodology can be applied to purchases ranging from small, inexpensive items such as light bulbs to larger, more expensive items such as HVAC systems.*

Planning: *Within the context of local government, planning is commonly referred to as activities conducted to prepare and organize the future.*

Mixed-use Development: *A building or tract of land developed for two or more different uses such as, but not limited to, residential, office, manufacturing, retail, public services or entertainment.*

Multi-modalism: *The holistic view of transportation in which individual modes work together or within their own niches to provide the user with the best choices of service and in which the consequences of the policies for a single mode on all other modes are considered. Multi-modal transportation refers to any mode of transportation including travel by mass transit, vehicle, rail, bicycle, boat, air or pedestrian travel. An alternative definition refers to the connections between different modes such as adequate highway to port or bus service to rail transit.*

Neo-traditional Development: *An approach to land use planning and urban design that promotes the building of neighborhoods with a mix of uses and housing types, architectural variety, a central public gathering place, interconnecting streets and alleys, and edges defined by greenbelts or boulevards. The basic goal is integration of the activities of potential residents with work, shopping, recreation and transit all within walking distance.*

New Urbanism: *A term used to describe development which focuses on the restoration of urban centers and towns within coherent metropolitan regions, the reconfiguration of sprawling suburbs into communities of neighborhoods and diverse districts, the conservation of natural environments, and the preservation of our built legacy.*

Nonrenewable Energy Resource: *A source of energy that cannot be replenished naturally or takes millions of years to produce. Nonrenewable energy resources include fossil fuels such as coal, oil, natural gas and nuclear fuel (uranium).*

Open Space: *Any parcel or area of land or water essentially unimproved and set aside, dedicated, designated, or reserved for public or private use as active or passive recreation areas or for resource protection.*

Overlay Districts: *Zoning districts in which additional or alternative regulatory standards are superimposed on existing zoning. Overlay districts provide a method of placing special restrictions in addition to or in place of those required by basic zoning ordinances.*

Planned Unit Development (PUD) Zoning: *Planned unit development provisions allow land to be developed in a manner that does not fit into all the use, bulk, and open space requirements of any of the standard zoning districts. The PUD allows greater flexibility and innovation than conventional standards because a planned unit is regulated as one unit instead of each lot being regulated separately.*

Recycling: *The process of converting materials that are no longer useful as designed or intended into a new product.*

Redevelopment: *Replacement, renovation or reuse of existing structures to accommodate new development.*

Renewable Energy Resource: *A natural, but flow-limited, resource that can be replenished. Such resources are virtually inexhaustible in duration, but limited in the amount of energy that is available per unit of time. Some (such as geothermal and biomass) may be stock-limited in that stocks are depleted by use, but on a time scale of decades, or perhaps centuries, they can probably be replenished. Renewable energy resources include: biomass, hydro, geothermal, solar and wind.*

Residential Sector: *The residential sector is defined by the South Carolina Energy Office as private household establishments which consume energy primarily for space heating, water heating, air conditioning, lighting, refrigeration, cooking and clothes drying.*

Solar Energy: *Electromagnetic energy transmitted from the sun, also known as solar radiation.*

Solar Power: *Electricity generated from solar radiation.*

South Carolina Local Government Comprehensive Planning Enabling Act of 1994: *The legislation that grants South Carolina local governments the authority to create and maintain a comprehensive planning process. This Act consolidated existing planning legislation into one location and updated existing law to include current practices and new methods, tools and procedures for local government planning.*

South Carolina Model Energy Code of 1995*: The legislation that specifies the minimum energy efficiency requirements for single and two family dwellings of three stories or less to help curb energy usage and lower monthly or annual utility bills.*

Sprawl: *The expansion of unplanned, primarily low-density development beyond established areas into historically rural areas.*

Sustainability: *The ability of a society, ecosystem, or any such ongoing system to continue functioning into the indefinite future without being forced into decline through exhaustion of key resources.*

Sustainable Development: *Development which meets the needs of the present without compromising the ability of future generations to meet their own needs.*

TEA-21: *The Transportation Equity Act for the 21st Century (TEA-21) replaced ISTEA in 1998. TEA-21 builds on the initiatives established in the ISTEA. The new Act combines the continuation and improvement of current programs with new initiatives to meet the challenges of improving safety as traffic continues to increase at record levels, protecting and enhancing communities and the natural environment as transportation needs are met, and advancing America's economic growth and competitiveness domestically and internationally through efficient and flexible transportation.*

Telecommuting: *A work arrangement for performing work electronically (via fax, email, etc.), where employees work at a location other than the primary work location, such as at home or in a subordinate office.*

Traditional Neighborhood Development (TND): *A neighborhood that is walkable from one end to another; that has a civic core (school, church, library, park or similar place); that is near to basic goods and services; that is designed to limit through traffic to reasonable levels; and that incorporates both important public space and, for each resident, private space.*

Transfer of Development Rights (TDR): *A market-based technique that encourages the voluntary transfer of growth from places where a community would like to see less development (sending areas) to places where a community would like to see more development (receiving areas). Such conveyance of development rights is accomplished by deed, easement or other legal instrument authorized by local law.*

Transit-Oriented Development (TOD): *Moderate and high-density housing concentrated in mixed-use developments located along transit routes. The location, design and mix of uses in a TOD emphasize pedestrian-oriented environments and encourage the use of public transportation.*

Urban: *Of, relating to, characteristic of, or constituting a city. Urban areas are generally characterized by moderate and higher density residential, commercial and industrial development, as well as the availability of public services required for that development, such as water, sewer and an extensive road network.*

Urban Forestry: *Urban forestry is the comprehensive management of forests and related natural resources in urbanized areas, including inner cities, developing fringe of cities and towns, and communities of various sizes. The process integrates natural, social and economic systems as they affect and are affected by human activity into a comprehensive management plan for the forest.*

Urban Services: *Utilities (such as water, gas, electricity and sewer) and public services (such as police, fire, schools, parks and recreation) provided in an urbanized or urbanizing area.*

Urban Service Area: *An area extending outside of an existing urban area within which growth is encouraged, primarily through the provision of government-supplied public facilities and services, and outside of which growth is discouraged. Urban service areas are based on the population forecast and should include areas and densities sufficient to permit the urban growth that is projected to occur during a specified period.*

Zoning: *The delineation of districts and the establishment of regulations governing the use, density, placement, spacing and size of land and structures, and other aspects of the development and use of land or structures.*

NOTES

NOTES

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ENERGY SOURCES WORKSHEET

Energy Source	Information Needed	Data Sources
Electricity	• *Generating plant locations* • *Fuels or renewable resources used* • *Classification of energy sources as renewable or nonrenewable* • *Annual quantity distributed per sector* • *Current customer rates*	• *Local energy utilities* • *SCEO* • *SC Public Service Commission (SCPSC)*
Natural Gas	• *Production area locations* • *Annual quantity distributed per sector* • *Current customer rates*	• *Local natural gas distributors* • *SCPSC*
Fuel Oil and Propane	• *Refinery locations* • *Annual quantity distributed per sector* • *Current customer prices*	• *Local fuel oil and propane distributors*
Transportation Fuels	• *Production and refinery locations* • *Annual quantities of each type (gasoline, diesel, alternative fuels) distributed per sector* • *Current customer prices*	• *Local transportation fuel distributors and retailers* • *SC Department of Revenue* • *Federal Highway Administration*
Renewable Direct Uses (Solar, Geo-thermal, Biomass)	• *Number, type and size of installations* • *Total estimated annual output per sector*	• *Local equipment vendors and installers* • *Local utilities* • *SCEO*

ENERGY USE COMPOSITE WORKSHEET

Sector	Information Needed	Data Sources
CURRENT ENERGY USE		
Residential	Dwelling numbers and characteristics	• Housing Element • Local building official • US Census Bureau
	Prevalent fuels and equipment types (heat pump, etc.)	
	Annual energy usage (typical dwellings and sector total)	
	Annual energy cost (typical dwellings and sector total)	
Commercial	Building numbers and characteristics	• Local building official • US Census Bureau • Economic Element
	Prevalent fuels and equipment types	• Local energy utilities • US Energy Information Administration
	Annual energy usage (typical buildings and sector total)	
	Annual energy cost (typical buildings and sector total)	
Institutional	Building numbers and characteristics	• Local agency facility managers • SCEO • Community Facility and Cultural Resources Elements
	Prevalent fuels and equipment types	
	Annual energy usage (typical buildings and sector total)	
	Annual energy cost (typical buildings and sector total)	
Industrial	Company numbers and types	• Economic Element • Local economic development agency
	Prevalent fuels and equipment types	• Local energy utilities • Industry representatives
	Annual energy usage (typical companies and sector total)	
	Annual energy cost (typical companies and sector total)	
Agricultural	Farm numbers and characteristics	• SC Dept. of Agriculture • Clemson Extension Service • Natural Resources and Land Use Elements • US Census Bureau
	Prevalent fuels and equipment types	• Local energy utilities • SC Public Service Commission
	Annual energy usage (typical farms and sector total)	
	Annual energy cost (typical farms and sector total)	
Transportation	Vehicle numbers and types	• SC Dept. of Transportation (SCDOT) • SC Dept. of Revenue • Community Facilities Element
	Annual vehicle miles traveled and fuel efficiencies	• SCDOT • SCEO
	Total annual vehicle fuel consumption	
	Total annual vehicle fuel cost	
	Public transit operating characteristics	• Local transit agencies
	Total annual public transit fuel consumption	
FUTURE ENERGY USE		
Electricity and Non-transportation Fuels used per Sector	Population projections for 5, 10 and 20 years in the future	• SC Office of Research and Statistics (SCOIR) • Population Element
	Price forecasts	• Local energy utilities • SCEO
Transportation Fuels used per Sector	Population projections and per capita driving coefficients	• SCOIR • Population Element • SCDOT
	Price forecasts	• Local transportation fuel distributors and retailers • SCEO

ENERGY USE CALCULATION WORKSHEETS

These worksheets are designed to help planners gather energy use information and calculate totals for energy use and energy sources (fuels) used per sector. Once completed, the worksheets can provide an estimate of annual community energy consumption. This data can be used to develop a summary of community energy supply and demand. For consistency, researchers should obtain all data for the most recent year available (study year) and ensure that all data gathered coincides with the same study area (municipality, county, etc.).

Step 1. Identify local energy providers and obtain the following information from each for the residential, commercial and industrial sectors:

- *How much energy was distributed to each sector for the study year? Request the information in both millions of Btus (Mbtu) and the energy unit normally used by the provider. If Btu information is not available, use the conversion chart found in Table 12 of Chapter 3.*

- *What was the total dollar amount of sales made to each sector during the study year?*

The following form can be used to gather information from local energy providers on energy distributed to residential, commercial and industrial sectors. This information can be added and entered into the "Energy Use Sector Totals" and "Energy Use Type Totals" tables shown on the following pages to generate a profile of community energy consumption.

Sample Energy Distribution Form

Study year _____ *Study Area* _____

Type of Energy Supplied _____

Sector	Amount Distributed per Sector		
	kWh, therms, gallons, cords, etc.	MBtu	Cost ($)
Residential			
Commercial			
Industrial			
Other			

Energy Supplier _____ *Contact Person* _____

Phone _____ *Contact Date* _____

ENERGY USE CALCULATION WORKSHEETS (continued)

Energy Use Sector Totals

RESIDENTIAL			
Energy Type	**Amount**	**MBtu**	**Cost ($)**
KWh - electricity			
Mcf / therms - natural gas			
Other (specify)			
Residential Totals			

COMMERCIAL			
Energy Type	**Amount**	**MBtu**	**Cost ($)**
KWh - electricity			
Mcf / therms - natural gas			
Other (specify)			
Commercial Totals			

INDUSTRIAL			
Energy Type	**Amount**	**MBtu**	**Cost ($)**
KWh - electricity			
Mcf / therms - natural gas			
Other (specify)			
Industrial Totals			

OTHER SECTOR			
Energy Type	**Amount**	**MBtu**	**Cost ($)**
KWh - electricity			
Mcf / therms - natural gas			
Other (specify)			
Other Totals			

OTHER SECTOR			
Energy Type	**Amount**	**MBtu**	**Cost ($)**
KWh - electricity			
Mcf / therms - natural gas			
Other (specify)			
Other Totals			

ENERGY USE CALCULATION WORKSHEETS (continued)

Energy Use Type Totals

ELECTRICITY				
Sector	**kWh**	**Btu**	**Cost ($)**	**% of total kWh**
Residential				
Commercial				
Industrial				
Totals				100%

NATURAL GAS				
Sector	**Mcf**	**Btu**	**Cost ($)**	**% of total Mcf**
Residential				
Commercial				
Industrial				
Totals				100%

OTHER ENERGY TYPE				
Sector		**Btu**	**Cost ($)**	**% of total other**
Residential				
Commercial				
Industrial				
Totals				100%

OTHER ENERGY TYPE				
Sector		**Btu**	**Cost ($)**	**% of total other**
Residential				
Commercial				
Industrial				
Totals				100%

ENERGY USE CALCULATION WORKSHEETS (continued)

Step 2. Develop an estimate for transportation fuel use.

To develop an estimate for transportation fuel use, the following information must be gathered:

- *An estimate of the number of vehicles in the study area. This information is available from the Auditor for each county in the State, and from the SC Department of Transportation.*

- *The average annual gallons of fuel consumed per vehicle. If more current information is not available, the Rocky Mountain Institute estimated in 1992 that an average of 842 gallons of fuel per vehicle is used annually in South Carolina.*

- *The average price of a gallon of fuel during the study year. This information may be obtained by surveying local gas stations and distributors or auto clubs such as AAA.*

- *Transportation fuel costs for vehicle fleets. Local governments, school districts, and other organizations that operate vehicle fleets keep detailed records and may be willing to share some of this information. Ask for the number of vehicles, total gallons of fuel consumed and average cost per gallon during the study year.*

- *Information on use of alternative fuels. Contact local governments, institutions of higher education, school districts, utilities, transit providers, local fuel suppliers, and the SCEO to find out what kinds of alternative fuels are used in the study area.*

The "Transportation Energy Use Summary" table on the following page can be used to summarize this information.

ENERGY USE CALCULATION WORKSHEETS (continued)

Transportation Energy Use Summary Table

Study year _____ *Study Area* _____

_____ *Estimated number of local vehicles*	x	_____ *Average annual gallons per vehicle*	=	_____ ***Total gallons consumed***
_____ ***Total gallons consumed***	x	_____ *Average local price per gallon*	=	_____ ***Annual transportation fuel bill***
_____ ***Total gallons consumed***	÷	*42 (number of gallons in 1 barrel)*	=	_____ ***Barrels of oil***
_____ ***Total gallons consumed***	x	*125,000 Btu/gallon of gasoline (138,700 Btu/gallon of diesel)*	=	_____ ***Transportation Btu***

Sampling of Transportation Fleet Fuel Costs

Fleet type	***# of Vehicles***	***Total Gallons of Fuel Consumed***	***Price per Gallon***	***Annual Transportation Fuel Bill***
School Districts				
County Vehicles				
Other				
Other				
Other				

ENERGY USE CALCULATION WORKSHEETS (continued)

Step 3. Summarize total energy use within each energy sector.

Using the information collected in Steps 1 and 2, calculate the total energy use. The following table will enable you to calculate total community energy use and determine the percentage of total energy use for each energy sector.

Total Community Energy Use

Energy Sector	Cost ($)	% of Total Cost	Btu	% of Total Btu
Residential				
Commercial				
Industrial				
Transportation				
Other				
Total Energy Cost		**Total Btu**		

OPPORTUNITIES FOR ENERGY CONSERVATION AND EFFICIENCY WORKSHEET

End Use	Efficiency Opportunities	Data and Assistance Sources
***Buildings* - Residential, Commercial and Institutional**	*Percent of buildings pre-dating SC Energy Code building standards*	• *Housing Element* • *Local building official*
	Percent of older buildings audited for efficiency improvements	• *Local energy utilities* • *Local building official*
	Number of older buildings retrofitted with high efficiency lights or space conditioning systems	• *Facility managers*
	Use of home energy rating system during sales of older residences	• *Local building official* • *Facility managers*
	Enforcement level of SC energy code standards	• *Realtors*
	Percent of new construction exceeding SC Energy Code standards	
	Percent of existing housing (including manufactured homes) not subject to SC Energy Code	• *Housing Element* • *Local building official*
	Percent of manufactured homes with SC Manufactured Housing Energy Efficiency Labels	• *SCEO*
	Participation levels in utility efficiency incentive and energy education programs	• *Local energy utilities* • *SCEO*
	Availability of technical training in energy efficiency techniques and technologies	• *Local vocational schools and technical colleges* • *SCEO* • *Building Officials Association of South Carolina* • *Clemson Extension Service*
Industry	*Thermal and/or mechanical processes suitable for updating*	• *Local industries* • *SCEO*
	Waste products not currently being recycled	• *Local utilities*
	Waste heat suitable for co-generating electricity and process heat	• *SC Dept. of Health and Environmental Control (SCDHEC)*
	Participation levels in utility efficiency incentive programs	• *Local energy utilities* • *SCEO*
Agriculture	*Fuel requirements for mechanized farming*	• *US Census Bureau* • *US Department of Agriculture* • *SC Department of Agriculture*
	Number of irrigation pumps retrofitted with high efficiency motors	• *Local energy utilities*
	Local participation levels in energy conservation/ efficiency programs	• *Local energy utilities* • *Clemson Extension Service*
Land Use and Transportation	*Average local vehicle fuel efficiency levels*	• *Local vehicle dealers* • *SCDOT* • *Local vehicle dealers*
	Purchases of new high fuel efficiency vehicles	• *SCDOT*
	Vehicle miles traveled annually	• *Local Metropolitan Transportation Organization (MPO)*

OPPORTUNITIES FOR ENERGY CONSERVATION AND EFFICIENCY WORKSHEET (continued)

End Use	Efficiency Opportunities	Data and Assistance Sources
Land Use and Transportation *(Continued)*	*Average local commute distances and times*	• *SCDOT* • *Local MPO* • *US Census* • *Community Facilities Element*
	Amount of productive time lost in local traffic congestion	
	Availability and use of vehicle occupancy measures such as ridesharing	
	Availability and use of vehicular alternatives such as mass transit and telecommuting	
	Availability and use of bicycle lanes and related facilities	
	Use of parking measures to influence vehicle usage	• *Local MPO* • *Planning Staff*
	Presence of land use plans encouraging high-density, mixed uses	• *Housing Element* • *Land Use Element* • *Community Facilities Element* • *Economic Element* • *Planning Staff* • *Council of Governments*
	Land use plans designating housing and employment areas near transit facilities	
	Amount of new development incorporating transit access features	
Public Infrastructure	*Participation levels in water conservation programs*	• *SC Dept. of Natural Resources (SCDNR)* • *Local water providers*
	Number of water supply systems audited and retrofitted with efficiency pumps and controls	• *Local water providers* • *Local energy utilities* • *SCDHEC*
	Number of wastewater treatment systems audited and retrofitted with high efficiency pumps, treatment processes and controls	• *Local wastewater treatment providers* • *Local energy utilities*
	Level of training of plant operators on energy-efficient operation and water conservation	• *SCDNR* • *Local water and wastewater* • *treatment providers* • *SCDHEC*
	Number of streetlights retrofitted with high efficiency lamps	• *Local public works department* • *Local energy utilities*

RENEWABLE RESOURCES WORKSHEET

Resource	Resource Characteristics	Data and Sources
Solar	Local levels of solar radiation	• Local solar designers, equipment vendors and installers • SCEO • SCDHEC • Local utility providers
	Direct thermal application technologies and environmental issues	
	Electric generation technologies and environmental issues	
Biomass	Location, quantity and quality of biomass supplies: wood, agricultural wastes, and municipal/county solid wastes	• SCDNR • Local waste management agencies • SC Dept. of Agriculture • Clemson Extension Service • US Forest Service • Local industries
	Direct thermal application technologies and environmental issues	• Local designers, equipment vendors and installers • US Environmental Protection Agency (EPA) • SCEO
	Electric generation technologies and environmental issues	• Local electric utilities • EPA • SCEO
Geothermal	Location and quality of resource types: low-temperature groundwater, moderate-temperature groundwater, etc.	• US Geological Survey • US Dept. of Energy • SCDNR • SCEO • Equipment vendors and installers • Local utilities
	Direct thermal application technologies and environmental issues	

ENERGY SUMMARY WORKSHEET

These worksheets summarize the energy information gathered in previous worksheets. To complete the worksheets, researchers must first obtain the total population of the study area for the appropriate study year. Population data can be obtained from the population element of the local comprehensive plan or from the SC Office of Research and Statistics. If a population total is not available for the study year, it may be necessary to develop an estimate based upon the most recent information. Using the information in this table, it is possible to calculate per capita energy use in terms of millions of Btu and in dollars.

ENERGY USED BY SECTOR AND ENERGY TYPE

Use the information gathered in the "Energy Use Calculation Worksheets" in Appendix B to complete this worksheet.

Study year _____ *Study Area* _____ *Population* _____

Energy Used by Sector and Energy Type in Millions of Btu

Sector	Electricity	Natural Gas	Petroleum	Other	Sector Total	Sector % of Total
Residential						
Commercial						
Industrial						
Transportation						
Energy Type Total						
Energy Type % of Total						
Total Energy Use by All Sectors in MBtu:						

Energy Used by Sector and Energy Type in Dollars

Sector	Electricity	Natural Gas	Petroleum	Other	Sector Total	Sector % of Total
Residential						
Commercial						
Industrial						
Transportation						
Energy Type Total						
Energy Type % of Total						
Total Energy Use by All Sectors in Dollars:						

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