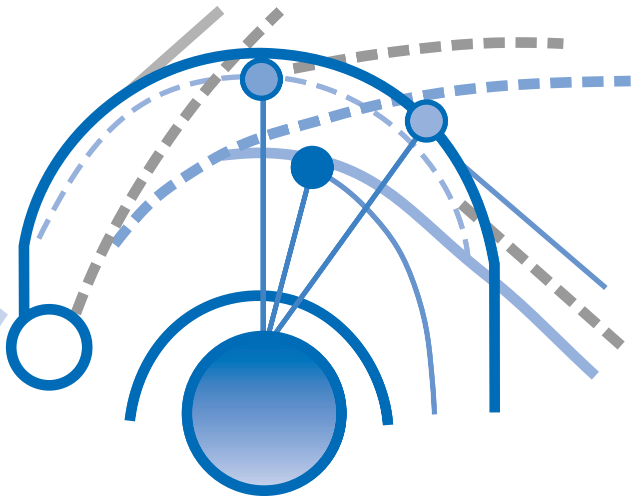
THE ENERGY YARDSTICK:

Using PLACE^{3}S to Create More Sustainable Communities



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PLACE^{3}S is an acronym that stands for **PLA**nning for **C**ommunity **E**nergy, **E**conomic and **E**nvironmental **S**ustainability. It is the name of a *method* of planning developed cooperatively by the state energy offices in California, Oregon and Washington and consultants Criterion, Inc. and McKeever/Morris, Inc., both of Portland, Oregon. The PLACE^{3}S method is in the public domain. To avoid confusion, the name PLACE^{3}S should not be used directly or in hyphenated form to name proprietary computer models or planning tools developed to help implement the PLACE^{3}S method. Please direct questions about using the PLACE^{3}S name to Nancy Hanson, California Energy Commission, 916-654-3948.

ACKNOWLEDGMENTS

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The concept for the PLACE^{3}S method was introduced in 1991. Between that year and the present, many local and regional governments participated in developmental demonstrations of the method. The authors thank the local and regional governments mentioned in this document for their assistance and insights.

The U.S. Department of Energy provides communities current and accessible economic and environmental information through its Center of Excellence for Sustainable Development. The authors of this report thank **Mr. William S. Becker,** Director of the Denver Regional Support Office and the Center of Excellence for Sustainable Development, for supporting the preparation of this guidebook and for including it on the Center's website at http://www.sustainable.doe.gov/.

Many persons contributed to the preparation of this document. These people are:

From state energy offices—

California Energy Commission
Nancy Hanson, Program Manager
Jacque Gilbreath, Graphic Artist and Cartographer
Eric Knight, Energy Analyst
Cathy Siebensohn, Text and Layout Coordinator

Oregon Department of Energy
Sam Sadler, Energy Analyst

Washington State Energy Office
R. Gordon Bloomquist, Geologist

Technical consultants and primary authors—

Criterion, Inc, Portland, Oregon
Eliot Allen, AICP, Principal

McKeever/Morris, Inc, Portland, Oregon
Michael McKeever, President
Jeff Mitchum, Urban Designer

Reviewers -

Susan Anderson, Portland City Energy Office
Jeff Brookby, National Center for Appropriate Technology
Pekka Lahti, Technical Research Centre of Finland
Kari Rauhala, Technical Research Centre of Finland
David Skiles, Denver Smart Places Project
Ken Snyder, US DOE, Denver Regional Support Office

ABSTRACT

The capacity of local government action to enhance the sustainability of this nation is immense. Within city, county and regional governments resides the lion's share of authority over how land is used, buildings are constructed, transportation systems designed and operated, and population growth managed. Wise use of these authorities is vitally important to achieving sustainability.

PLACE^{3}S, an acronym for **PLA**nning for **C**ommunity **E**nergy, **E**conomic and **E**nvironmental **S**ustainability, is a land use and urban design method created specifically to help communities understand how their growth and development decisions can contribute to improved sustainability. PLACE^{3}S can help communities assemble the data and perform the analysis needed to find and to maintain the complex balance that will lead to sustainability. In essence, PLACE^{3}S enables communities to use energy as a yardstick to measure the sustainability of their urban design and growth management plans.

The PLACE^{3}S approach to urban planning uses energy accounting to evaluate the efficiency with which we use our land, design our neighborhoods to provide housing and jobs, manage our transportation systems, operate our buildings and public infrastructures, site energy facilities, and use other resources. PLACE^{3}S uses energy accounting as a uniform language to bring together a diverse set of stakeholders. It provides maps and focused data to educate the public and decision makers about the effects of their choices on their community. The outcome is a well-informed, inclusionary public process that balances community values and integrates environmental, economic and social goals.

Chapter 1 explains the highly-integrated role of energy in a community and the value of an energy-focused approach to community design and growth management. Chapter 2 provides an overview of how PLACE^{3}S works. Chapters 3 and 4 go into detail about applying PLACE^{3}S at the regional and neighborhood levels, respectively. Chapter 5 briefly discusses some special uses for the PLACE^{3}S method. Both regional and neighborhood-level case studies of PLACE^{3}S assessments are in Chapter 6. A glossary and extensive listing of sources of information and bibliography are in Chapters 7 and 8.

> "A key role for planners in the development of integrated policy is to make the complexity of the interactions intelligible to decision makers and their constituents so that decisions are better informed."
>
> **Terry Moore and Paul Thorsnes,**
> *The Transportation/ Land Use Connection*

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THE PLACE³S PLANNING METHOD

Chapter 1

THE VALUE OF ENERGY EFFICIENT COMMUNITIES

American cities and towns account for over 80 percent of national energy use. Land use planning and urban design affect about 70 percent of that, or 56 percent of the nation's total energy use (Anderson, 1993). For example, the density, mix, and spatial arrangement of land uses in a community heavily influence the amount and mode of travel and, therefore, transportation energy use. These same urban characteristics also affect the amount of energy needed to heat and cool buildings and build and operate community infrastructure.

Because of energy's pervasive influence in a community, creating a plan for its efficient use is a good strategy for simultaneously accomplishing other community goals, including:

- ***Affordable Housing.*** Lower energy bills for housing and commuting can mean better eligibility for home financing or renting.
- ***Greater mobility options and reduced traffic congestion.*** Energy efficient travel options such as walking, biking, and transit can reduce auto dependence. Improved land-use patterns can reduce the number and length of auto trips. Strategies to increase auto occupancy can further reduce congestion.
- ***Improved air quality and reduced greenhouse gas emissions.*** Fewer automobile trips and more efficient houses and businesses result in significantly lower air pollutant and greenhouse gas emissions, especially carbon dioxide (CO_2).
- ***Reduced cost to provide public services.*** Compact development with a mix of uses reduces the length of water, sewer, natural gas, and electric lines needed to serve a community. There is a potential of significant savings in the construction, operation and maintenance of the lines, booster pumps and labor.
- ***Open space and agricultural land preservation.*** Efficient development of compact regions and cities reduces overall urban land consumption.
- ***Increased personal and business income.*** Energy savings translate into more disposable income for individuals and more working capital for businesses. These dollars tend to recirculate in the local economy, creating more economic benefit than dollars used to purchase energy.
- ***Job retention and creation.*** Reduced commercial and industrial energy costs and reinvestment of savings can mean better protection of existing jobs and greater potential for new jobs.

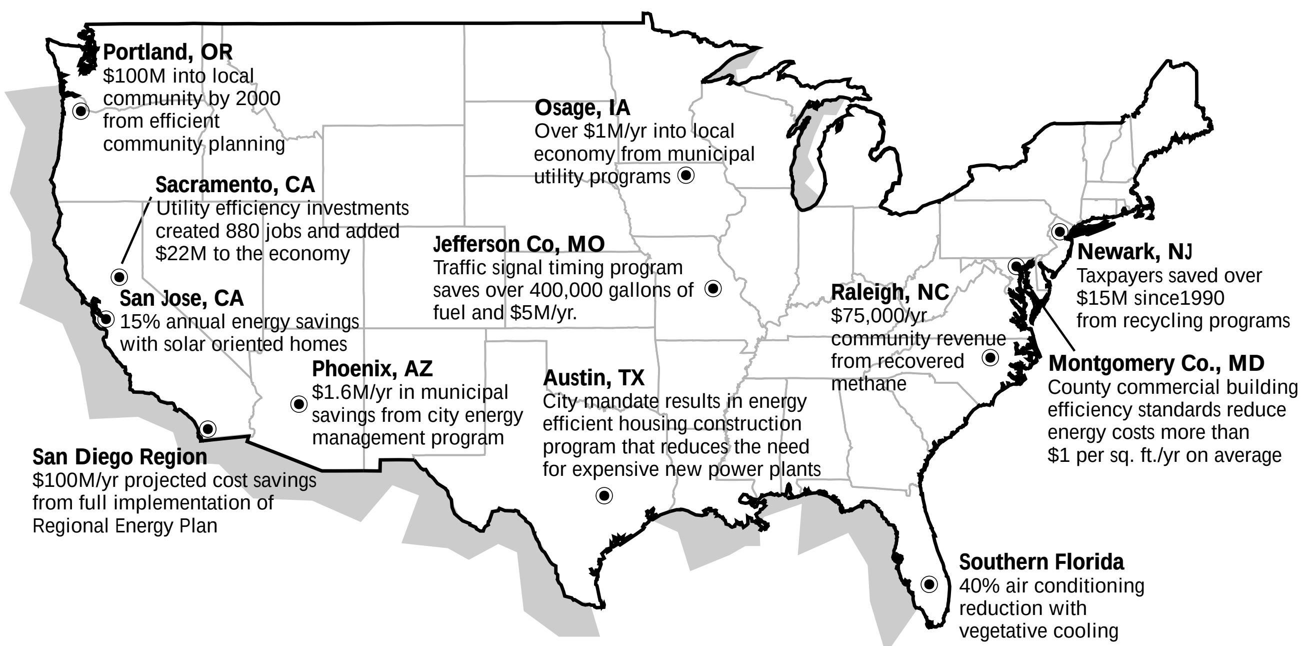
By carefully integrating energy use and generation policies into long-term growth and development planning, a community can promote local sustainable development. Sustainable development is the deliberate effort to ensure that community development not only enhances the local economy, but also the local environment and quality of life. For example, energy efficiency means lower utility bills for homes and businesses, which will improve business competitiveness, retain jobs, reduce air pollution and environmental compliance costs, and conserve local government budgets.

> "The case for including an energy dimension in the urban development process is compelling. Not only is energy a crucial resource, but it is associated with serious environmental effects at all scales."
>
> **Susan Owens,**
> Cambridge University

As Figure 1.1 shows, communities are reaping the economic and environmental benefits of using energy conserving strategies as part of their comprehensive planning. Portland, Oregon, for example, is planning a 10 percent increase in citywide efficiency by the year 2000. It expects this increase in energy efficiency to yield $100 million in annual savings for the local economy. To realize these savings, Portland is supporting "neotraditional urban village" designs as part of the regional growth strategy, which the Portland-area metropolitan government is developing. The City of Portland is also working to reduce greenhouse gas emissions through use of renewable power for municipal facilities and helping small businesses to reduce energy and water use and to recycle and reduce wastes.

FIGURE 1.1

NATIONAL EXAMPLES OF COMMUNITY ENERGY EFFICIENCY BENEFITS



The National Renewable Energy Laboratory's Cities and Counties Program provides excellent summaries of community energy programs. Contact NREL at (303)275-4285, Fax (303) 275-4053 or E-mail at brownrh@tcpplink.nrel.gov.

Similar efforts are under way throughout the country. Miami, San Francisco, Chicago, Denver, and Seattle are just a few of the cities discovering the power of integrated resource planning to improve both their livability and economic competitiveness. Chapter 8 lists additional sources of information on resource-efficient planning and designs.

In the context of this discussion, community refers to not only to a single jurisdiction or neighborhood, but also to the metropolitan region. In addition to the local benefits, making communities more efficient also helps achieve state and national goals for sustainable communities. The reduction in greenhouse gases that result from more efficient communities help meet international commitments to mitigate climate change.

Common community planning issues today are population growth, competition for business, limited infrastructure, and declining quality of life. How a community responds to these issues will determine if it becomes more or less sustainable in the future. (Adapting a community planning process to employ the PLACE³S (**PLA**nning for **C**ommunity **E**nergy, **E**conomic and **E**nvironmental **S**ustainability) method will provide information about the long-term energy, environmental, and economic implications of plans to help communities discover ways to increase sustainability. Using energy as a yardstick of urban sustainability, the PLACE³S planning method helps a community make better informed land use and development decisions by addressing three key questions:

- How energy efficient is the community today?
- How much more or less energy efficient will the community become in the future?
- How much can energy efficiency contribute to the community's economy, environment and sustainability?

> If the energy efficiency policies in the recently adopted San Diego Regional Energy Plan are fully implemented, about $100 million will be retained in the local economy each year.

PLACE³S answers these questions to show whether a community is moving toward or away from sustainability. In one sense, PLACE³S simply adds an energy dimension to existing community planning goals; however, the impact of PLACE³S on community planning can be far reaching and transforming. It makes clearer the trade-offs a community must make among its various goals by providing a common yardstick for measuring them. The outcome of using the PLACE³S method is a more thorough integration of community goals, economic efficiency and environmental improvements.

CREATING EFFICIENT COMMUNITIES WITH PLACE³S

The premise of PLACE³S is that urban planning and design can shape communities for efficient energy production, distribution and use. By intentionally conserving all forms of energy and promoting reliance on renewable resources in planning and design choices, cities can simultaneously improve their economies, environments, and quality of life. These widespread benefits are due to the integral nature of energy in communities, where efficiency gains in one sector lead to related improvements in other sectors.

Throughout history, the cost, form, and availability of energy have significantly influenced the location and shape of cities and towns. Early dependence on rivers for travel and power generation is an historic example. During the 20th Century, falling real energy prices in the developed world have influenced the increasing distance between activities and urban sprawl. Comparing the density and land area between cities in the northeastern United States that grew to maturity in the late 19th and early 20th Centuries using streetcar transit and cities in southern California that experienced very rapid post-World War II growth, which developed by relying on the car, provides a stark illustration of this fact.

Figure 1.2 lists land-use and design variables that can significantly effect community energy efficiency. The objective of PLACE³S is to identify and describe these potential efficiency gains for community planning participants and to help them select the best combination of efficiency strategies for their local circumstances. The PLACE³S approach does this by comparing energy use under existing conditions (how efficient the community is today) with future conditions under a range of planning alternatives (how much more or less efficient the community could become).

FIGURE 1.2
INFLUENCE OF URBAN PLANNING ON ENERGY DEMAND

Planning Variables	Energy Link	Effect on Energy Demand
Shape of urban boundaries	Travel requirements	Energy use variation of up to 20%
Shapes and sizes of land-use designations	Travel requirements (especially trip length and frequency)	Variation of up to 150%
Mix of activities	Travel requirements (especially trip length)	Variation of up to 130%
Density/clustering of trip ends	Transit feasibility	Energy savings of up to 20%
Density and mix	Space conditioning needs and district heating/ cooling/cogeneration feasibility	Savings of up to 15%. Efficiency of primary energy use improved up to 30% with district heating and cooling
Site layout/orientation/ design	Solar use feasibility	Energy savings of up to 20%
Siting/landscaping/ exterior materials	Microclimate improvements	Energy savings of at least 5%; more in exposed areas

Adapted from Owens, 1986.

There are three main components to the PLACE³S approach:

- ***Public participation:*** a fully engaged, comprehensive group of stakeholders committed to the principles of sustainability and collaborative planning;
- ***Planning and design:*** a clear set of planning and design principles that embody a community's values and vision of what greater resource efficiency and sustainability mean to their future; and
- ***Measurement:*** quantitative documentation of energy, economic, and environmental impacts to support informed planning choices and monitor plans as they are implemented.

This guidebook reviews each of these components and suggests procedures for using them in community planning processes. It is very important to keep in mind that is a *suggested* method of community planning. It is designed to be flexible. The details of each local planning process must come from local stakeholders addressing their own set of issues and concerns. In many cases, communities will already have adopted some or all of the components and can use this guidebook for fine-tuning or making adjustments to their processes.

Public Participation

The first component of the PLACE³S approach is public participation. A primary purpose for using the PLACE³S approach is to inform the public and decision makers about quantitative differences among alternative development proposals. Because PLACE³S applies the same assumptions to each calculation, it compares alternatives fairly, promoting greater public understanding and reducing conflict. Figure 1.3 describes the characteristics of communities that are successfully engaging their stakeholders in the challenges of sustainability. Figure 1.4 lists guides to effective public participation.

FIGURE 1.3
HOW TO SUCCESSFULLY ENGAGE STAKEHOLDERS

- **Create widespread awareness of issues and opportunities.** In many communities, residents seldom think of energy issues, much less see improved energy use as a means to a stronger economy and better environment. In communities that are making progress, awareness of energy efficiency is becoming common place as people incorporate efficiency features into everyday practices.

- **Create incentives for change.** Community members see that it is in their best interest to take advantage of energy effficiency for economic, environmental or other reasons. Rather than an issue that only a few citizen activists care about, improving energy use becomes a community priority directly tied to important local goals and concerns.

- **Generate community and political support.** Good ideas without community and political backing often go nowhere. Strong and enthusiastic support from elected officials, civic leaders, and the community at large plays a critical role in turning good ideas into lasting local change.

- **Secure strong local leadership.** Someone in the community, or some organization, has a vision of how local energy use and the economy could be improved. They have taken an active, persistent role in turning community potential into reality.

- **Mobilize resources.** Education and the resulting awareness of energy alternatives are not enough. Successful energy-efficient communties have made the most of available resources to help residents and businesses overcome barriers such as a lack of up-front financing or technical expertise.

- **Create an effective organization to carry on the effort, year after year.** This organization might be a community development corporation, local government, a nonprofit energy center, or a variety of organizations working together. While individual actions are critical to success, institutions and organizations create a reliable base to mobilize resources needed to keep energy effficiency a community priority.

Adapted from Hubbard, 1995.

PLACE³S can be valuable to a variety of stakeholders working on many different projects. For example:

- **Citizens** evaluating whether a proposed development will protect the environment and promote efficient resource use.
- **Neighborhood associations** working with their local government to develop a community plan that meets their objectives, including efficiency.
- **Developers and consultants** designing projects to meet local government standards for minimizing automobile travel and promoting density in urban areas.
- **Developers and consultants** quantifying the cost savings per household attributable to good design as a marketing tool for promoting their project.
- **Local government staff and decision-making bodies** evaluating development applications to ensure they meet efficiency and sustainability standards.
- **Councils of governments** preparing regional growth management plans to conserve farm land and open space, support transit and reduce air pollution.
- **Transportation agencies** promoting land-use patterns that encourage transit use, bicycling, walking, and other alternatives to driving alone.
- **Energy utilities** trying to match existing transmission and distribution capacity with community growth to minimize the need for additional substations and related facilities and to promote the use of local energy supply resources.
- **Military bases** facing expansion, redevelopment or reuse.

Sustainability is achieved when the needs of the present are met without compromising the ability of future generations to meet their needs.

FIGURE 1.4

STAKEHOLDER INVOLVEMENT GUIDES

- ***Pulling Together: A Planning and Development Consensus-Building Manual,*** by David Godschalk, et.al., 1994. A manual that combines ideas and techniques from the fields of dispute resolution, citizen participation, and meeting management with community development processes. Supplemented by case studies of successful consensus based decision making. Published by the Urban Land Institute, Washington, DC

- ***Community Energy Workbook: A Guide to Building a Sustainable Economy,*** by Alice Hubbard and Clay Fong, 1995. Public education and involvement guidelines for identifying community energy use, costs, and environmental impacts; and describing how to promote the reinvestment of efficiency gains in a sustainable local economy. Available from the Rocky Mountain Institute, Snowmass, CO.

- ***Taking Charge: How Communities Are Planning Their Futures,*** by Ronald Thomas, 1988. A guide to community planning practices that is broadly inclusionary of stakeholders, built on visioning and consensus. Published by the International City Management Association, Washington, DC.

- ***Sustainable Energy: A Local Government Planning Guide for a Sustainable Future,*** by the Urban Consortium Energy Task Force, 1992. A step-by-step guide for preparing a sustainable energy plan, including useful workbook sheets and public involvement instruction. Available from Public Technology Incorporated, Washington, DC.

Planning and Design Principles

The second component of the PLACE^{3}S method is the development of a clear set of planning and design principles that describe a community's values related to sustainability. These principles focus the planning process on locally important resource efficiency issues. PLACE^{3}S does not presume to specify the exact principles that lead to optimum efficiency for all communities. Instead, it offers a flexible method for evaluating a variety of principles and finding the most satisfactory combination for local circumstances. Figure 1.5 lists urban planning and design guides that embody the general principles promoted by PLACE^{3}S, which a community can use as a starting point for drafting its own principles.

> PLACE^{3}S does not presume to specify the exact principles that lead to optimum efficiency for all communities. Instead, it offers a method for evaluating a variety of principles and finding the most satisfactory combination for local circumstances.

FIGURE 1.5
COMMUNITY PLANNING & DESIGN GUIDES

- ***Planning and Design for Transit Handbook,*** by Tri-County Metropolitan Transportation District of Oregon, 1996. Guidelines for implementing transit-supportive land uses and transportation plans, development projects, and street improvement projects. Available from Tri-Met, Portland, OR.
- ***Regenerative Design for Sustainable Development,*** by John T. Lyle, 1994. Sustainable development principles with an energy efficiency focus, including design techniques and case examples. Published by John Wiley & Sons, New York, NY.
- ***The Next American Metropolis: Ecology, Community, and the American Dream,*** by Peter Calthorpe, 1994. Traditional neighborhood design principles, guidelines and case examples, with emphasis on transit-oriented development. Published by Princeton Architectural Press, Princeton, NJ.
- ***The Transportation/Land-Use Connection,*** by Terry Moore and Paul Thorsnes, 1994. Fundamentals of urban growth and market forces impacting land-use and transportation conditions, with policies for improving land-use/travel efficiency and coordination. Published by APA Planning Advisory Service, Chicago, IL.
- ***Visions for a New American Dream,*** by Anton C. Nelessen, 1993. Urban design principles, process and standards for efficient neighborhoods, towns and small communities. Published by APA Planners Press, Chicago, IL.
- ***Transportation Related Land Use Strategies to Minimize Emissions,*** by Deborah Dagang and Terry Parker,1995. Comprehensive survey of land-use strategies for minimizing auto travel and proposed land-use performance standards for nine types of communities. Published by the California Air Resources Board, Sacramento, CA.
- ***City Comforts: How to Build An Urban Village,*** *by* David Sucher, 1995. A unique compilation of micro design features that can invigorate urban space and create both micro and macro efficiencies. Published by City Comforts Press, Seattle, WA.
- ***A Guide to Land-Use and Public Transportation: Applying the Concepts,*** by the Snohomish County, Washington Transportation Authority, 1993. Policies and design guidelines for transit-friendly community development. Available from the Puget Sound Council of Governments, Seattle, WA.

Energy Measurements

The third component of the PLACE^{3}S method is measuring the energy impacts of community plans and monitoring energy indicators to see whether the community is becoming more or less sustainable over time. The objective is to give decision-makers quantitative information that strengthens the argument for resource-efficient choices. Figure 1.6 lists several energy planning guides that explain how cities use energy, how they can tabulate that use, and how they can prepare strategies for improving their efficiency. The following subsection, Measuring Energy, discusses typical PLACE^{3}S energy measurements. Figure 1.7 shows the projects to date that have used PLACE^{3}S

FIGURE 1.6
ENERGY PLANNING GUIDES

- ***Cities and Counties Resource Guide: Meeting Today's Energy Needs Without Sacrificing Tomorrow's Resources,*** by USDOE, 1994. Background information and case studies on a wide variety of community efficiency strategies. Available from the National Renewable Energy Laboratory, Golden, CO.

- ***Energy-Aware Planning Guide,*** by the California Energy Commission, 1993. A compendium of energy-efficient planning techniques and case examples covering land-use, transportation, buildings, water use, and solid waste reduction/recycling. Available from the California Energy Commission, Sacramento, CA.

- ***A Primer on Sustainable Building,*** by Dianna Barnet, 1995. A comprehensive guide to the fundamentals of efficient community planning and design, from transportation to landscaping. Published by the Rocky Mountain Institute, Snomass, CO.

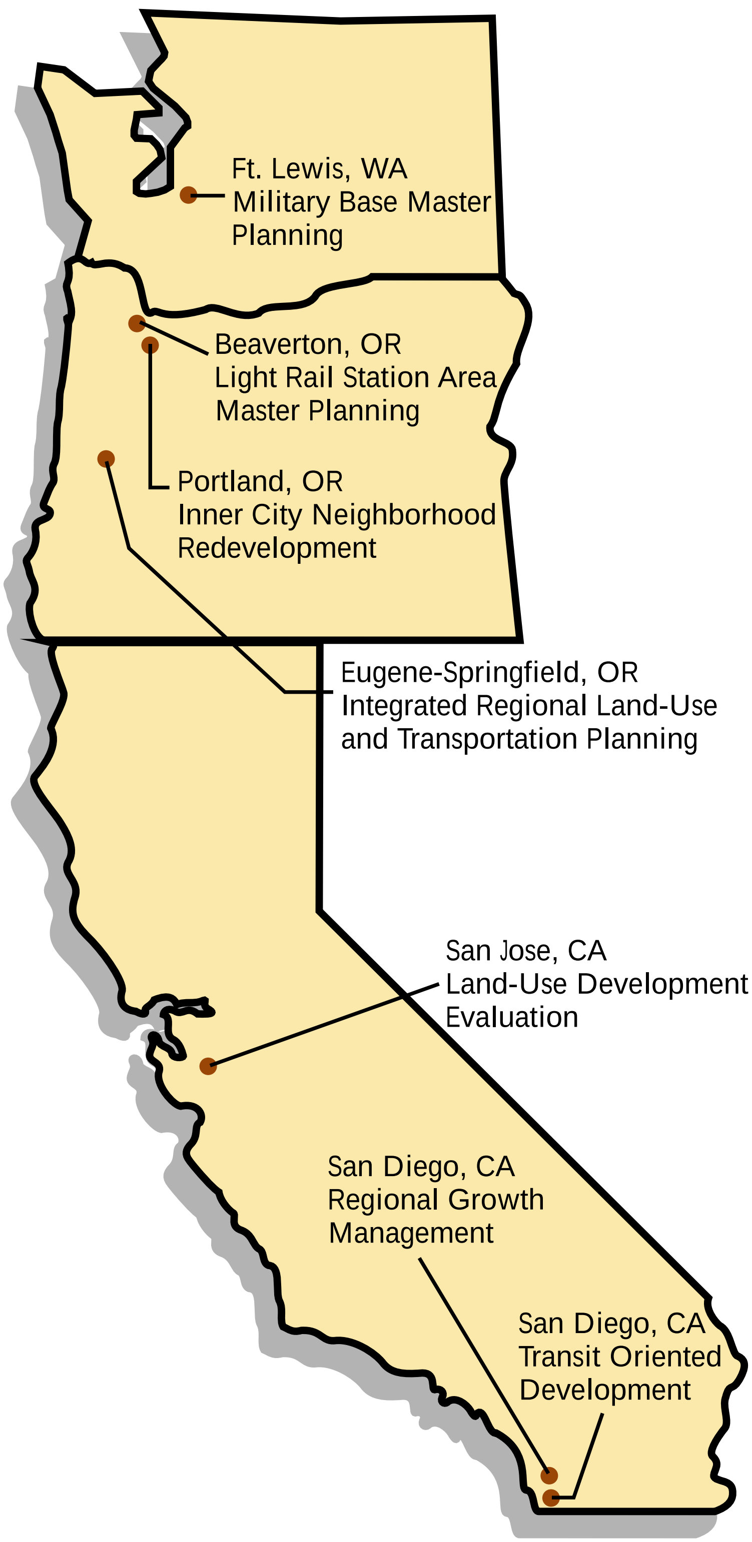
- ***Land-Use Planning, Siting and Building Regulations: Setting the Right Directions for Efficient Urban Structures in the Long Term,*** by Susan Owens, 1991. Describes the linkages between energy and urban development, and proposes criteria and methods for integrated urban energy planning. Published by the Organization for Economic Cooperation and Development, Paris, France.

- ***Energy Technology Status Report,*** by the California Energy Commission, 1992. Comprehensive technical, economic and environmental data on hundreds of energy production and end-use technologies, including renewables and high-efficiency equipment. Available from the California Energy Commission, Sacramento, CA.

- ***Urban Form, Energy and the Environment,*** by William Anderson and Pavios Kanaroglou, 1993. A thorough review of issues, evidence and analytical approaches to the linkages between urban. Published by the McMaster University Institute for Energy Studies, Hamilton, Ontario, Canada.

- ***Urban Form and Energy Use for Transport. A Nordic Experience,*** by Petter Næss, 1955. A doctoral thesis documenting the influence of several urban form variables on the amount of transportation, on the modal split between different means of transportation, and on energy use for transportation. Dr. Ing. Thesis, Norwegian Institute of Technology, Trondheim, Norway.

FIGURE 1.7
PLACE³S PROJECTS TO DATE



to improve the energy efficiency of community plans. These projects range from regional studies that identified efficiency improvements of as much as 12 percent over business-as-usual conditions to neighborhood projects that show gains of as much as 50 percent in dense city centers compared to conventional suburban development. Case study summaries for some of these projects are found in Chapter 6.

PLACE³S uses measurements of energy use, energy cost, and energy related air pollutant and CO_2 emissions to document existing conditions and compare alternatives.

MEASURING ENERGY

Creating energy efficient community plans requires measuring energy demands and supplies for housing, employment, transportation, and infrastructure. These measurements are similar to other calculations that tabulate dwellings, residents, workers, traffic, and other variables in city planning. The PLACE³S method simply adds an "energy column" to these measurements. The energy sectors that PLACE³S measures include:

- ***Transportation.*** How much gasoline, diesel, and alternative fuels do cars, trucks, and transit vehicles use? Transportation energy is usually the largest end-use sector in a community, often accounting for 40 to 50 percent of total energy use annually.
- ***Residential/Commercial/Industrial.*** How much electricity, natural gas, and other fuels do heating and cooling, lighting, and appliances and equipment in buildings use? PLACE³S also tabulates the energy embodied in the manufacturing and transport of construction materials. The residential sector is normally 20 to 30 percent of total community energy use, with the commercial and industrial sectors often accounting for another 20 to 25 percent.
- ***Infrastructure.*** How much electricity do streets lights, traffic signals, and water and sewer systems use? PLACE³S also measures energy embodied in the construction of streets and utility systems. Community infrastructure normally amounts to 5 to 10 percent of total community energy use.
- ***Energy production.*** In contrast to the consumption measurements described above, this category measures energy output for local renewable energy resources such as solar, wind, and geothermal and for high-efficiency technologies such as cogeneration and district heating and cooling. These types of production resources can make communities more self-sufficient and can extend the life and efficiency of existing electric and natural gas distribution grids.

All of these measurements involve a variety of energy types and fuels that are described in unique units. Electricity use, for example, is normally expressed in kilowatt/hours, while gasoline consumption is measured in gallons. To simplify tabulations, the PLACE³S method directs planners to convert all energy values into a common expression of British thermal units (Btu). One Btu is the amount of thermal energy required to raise the temperature of one pound (one pint) of water 1°F at sea level. Because a single Btu is a small amount, PLACE³S uses one million Btu (MMBtu) as its standard unit of energy measurement. Figure 1.8 presents conversions of various fuels into Btu equivalents according to energy content, typical cost, and carbon monoxide (CO) and CO_2 emissions. PLACE³S uses quantifications of energy use, energy cost, and energy-related air pollutant and CO_2 emissions to document existing conditions and compare alternatives.

PLACE³S measures energy in conjunction with the standard components of community planning: persons, households, major land-use types, and travel modes. Figures 1.9 through 1.13 provide average U.S. energy use for these components. Be aware that emissions associated with electricity use vary widely according to the mix of generating plants supplying an area. Figures 1.10 through 1.12 also illustrate the significant impact that land-use choices can have on energy use, costs, and pollutant and CO_2 emissions. Suburban households, for example, require as much as 40 percent more energy than urban households. The mix of jobs and housing in an area can vary the amount of energy needed by as much as 100 percent.

It is not necessary to be an expert in energy measurement to use the PLACE³S planning approach, but a familiarity with the concepts and relative differences described here is important for collecting data and interpreting results. Stakeholders unfamiliar with energy measurements can obtain information and help with calculations from local energy utilities and agencies, universities, and consultants. Chapters 3 and 4 give detailed descriptions of required measurements for regions and neighborhoods, respectively.

FIGURE 1.8
ENERGY CONVERSION VALUES

	Btu Equivalent	Million Btu (MMBtu) Equivalent	National Average Cost ($/MMBtu)	National Average Emissions (Lbs/MMBtu)	
				CO	CO_2
1 kilowatt of electricity	3,412	0.003412	20.10	0.153	537.74
1 therm of natural gas	100,000	0.100000	3.90	0.021	115.80
1 gallon of gasoline	125,071	0.125071	9.10	2.221	155.40
1 gallon of diesel	138,690	0.138690	7.00	0.850	159.70

Source: USEPA, 1995

FIGURE 1.9
TYPICAL COMMUNITY ENERGY USES

	Energy Use (MMBtu/yr)	Energy Cost ($/yr)	(CO_2 tons/yr)
Single-family home (2.5 persons)	110	1,280	13
10,000 sq. ft. store	850	10,240	129
20,000 sq. ft. office	2,080	25,180	317
Auto (avg. 1.1 occupants)	80	740	6
Bus (avg. 10 occupants)	1,300	10,380	103
Total per capita	150	1,650	17

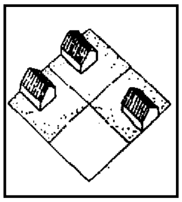
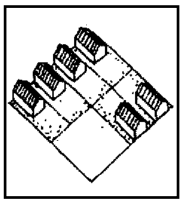
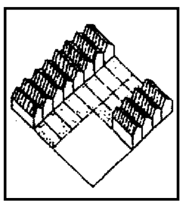
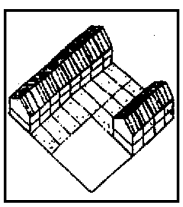
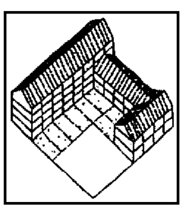
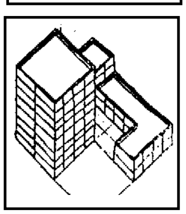
Source: See Figure 1.13.

FIGURE 1.10
URBAN vs. SUBURBAN ENERGY USE PER HOUSEHOLD

		Urban Families			Suburban Families		
		Energy (MMBtu/yr	Cost ($/yr)	CO_2 (tons/yr)	Energy (MMBtu/yr	Cost ($/yr)	CO_2 (tons/yr)
Household (2.5 persons)	Travel	80	910	6	140	1,670	11
	Home	100	1,220	12	110	1,340	14
	Community fraction*	140	1,650	21	190	2,280	29
		320	3,780	39	440	5,290	54

* Community fraction includes household share of all non-residential energy use and community infrastructure energy use.
Source: See Figure 1.13.

FIGURE 1.11
ENERGY EFFECTS OF RESIDENTIAL DENSITY

		Total Operating Energy Use Per Household		
		Energy (MMBtu/yr)	Cost ($/yr)	CO_2 (tons/yr)
	3 Units/Acre Single-family subdivision on 10,000 sq. ft. lot, auto dependent.	440	4,800	50
	6 Units/Acre Detached housing on 5,000 sq. ft. lot, commuter oriented transit service.	410	4,600	49
	12 Units/Acre Townhouse on 2,500 sq. ft. lot, high level of transit service to employment centers; attached walls reduce building energy use.	380	4,300	47
	24 Units/Acre Low rise apartments, walking and transit trips equal to auto use; bldg. energy use lower per apt.	360	4,100	47
	48 Units/Acre Mid rise apartments, transit and pedestrian trips exceed auto use; per apartment energy reduced further.	340	3,900	45
	96 Units/Acre High rise, very high transit and pedestrian activity; very low building energy use per apartment	310	3,700	42

Total operating energy use includes building, travel, and community fraction. Acres are net.
Source: See Figure 1.13.

FIGURE 1.12
ENERGY EFFECTS OF LAND-USE MIX

	Energy (MMBtu/yr)	Cost ($/yr)	CO_2 (tons/yr)
1 Acre Retail	61,100	566,400	5,020
1 Acre Office	17,000	168,300	1,660
1 Acre Jobs/Housing **Ratio 4:1**	8,200	83,800	860
1 Acre Jobs/Housing **Ratio 1:4**	4,600	48,500	530
1 Acre Jobs/Housing **Ratio 1:1**	5,500	57,700	620

Energy use includes buildings and travel only; excludes community fraction. Jobs are office only.
Source: See Figure 1.13.

FIGURE 1.13
DATA SOURCES AND ASSUMPTIONS FOR FIGURES 1.9-1.12

1. Energy consumption of buildings is from USDOE Annual Energy Outlook, 1994.
2. National average office is 20,000 sq. ft. and retail is 10,000 sq. ft. (USDOE Commercial Buildings Survey, 1993).
3. Annual auto vehicle miles traveled (VMT) is 12,500 per vehicle (USDOE Transportation Energy Data Book, 1994).
4. Auto miles per gallon is 19.1 (USDOE Transportation Energy Data Book, 1994).
5. Annual bus VMT is 35,000 (American Public Transit Association, Transit Fact Book, 1993).
6. Urban and suburban categories are set at Level 2 of CARB typology (Dagang and Parker,1995).
7. An urban home is assumed to consume 5% less energy than the national average, and a suburban home is assumed to consume 5% more energy than the national average.
8. For calculating household VMT based on residential density, Holtzclaw curve was used (NRDC, 1994).
9. For calculating nonresidential floor areas a floor area ratio (FAR) of 1.0 was used.
10. Jobs to housing mix was obtained by maintaining a FAR of 1.0 and 25 DU/acre and varying the area of land-use.
11. In the jobs/housing mix, only office space was used to obtain the required number of jobs, and 200 sq. ft./office employee was assumed.
12. Average vehicle trips/VMT ratio for retail and office uses was assumed to be 0.16 based on CARB data (Dagang and Parker, 1995).
13. Trip generation rates were obtained from the Institute for Transportation Engineers, Trip Generation, 5th ed., 1996.
14. Light rail travel includes 27,126 miles/yr per car and 10.01 kWh/mile (APTA Transit Fact Book, 1993) and an electric rate of 90% of the national commercial average rate (USDOE, 1994).
15. Table 1-8 shows representative CO_2 conversion coefficients, based on the *States Workbook: Methodologies for Calculating Greenhouse Gas Emissions* (Second Edition, US EPA, 1995). CO_2 emissions represent 99% combustion.

DATA AND COMPUTER NEEDS

PLACE³S can be a data-intensive planning method. In large communities or regions, the method's reliance on energy measurements means that participants must use computers to assemble and interpret large amounts of data, especially when evaluating multiple planning alternatives. In small community or neighborhood settings, however, a modest amount of data and hand calculations may support a PLACE³S study. Either way, the objective of PLACE³S is not elaborate "number crunching" for its own sake, but rather the reasonable use of data to inform decision-makers of the implications of their choices. Local priorities and resources will determine how many data are enough and how to compute them. PLACE³S is flexible enough for users to adapt the methodology to function with their databases.

Many of the data needed for PLACE³S will already be available from other planning processes. Local data bases almost always document the number, size, and location of dwelling units, for example. The PLACE³S method simply takes those existing data and adds another set of coefficients to estimate the energy needs of dwelling units and their emissions. PLACE³S estimates energy used by businesses, transportation and infrastructure, which local data bases also normally document, in a similar manner. Figure 1.14 lists sources of basic energy data that can be modified or expanded upon at the local level with the help of energy utilities, government agencies, universities, and consultants.

FIGURE 1.14
ENERGY DATA SOURCES

These are national databases with breakdowns by multi-state regions. Chapter 3 and 4 describe additional data sources and Chapter 8 provides an extensive bibliography.

Annual Energy Outlook with Projections. Existing conditions and 20-year forecasts of energy supplies and demands by fuel type and end-use.

Household Energy Consumption and Expenditures. Survey of consumption and expenditure patterns for all residential energy use, except household transportation.

Household Vehicles Energy Consumption. This is a companion residential survey devoted to household transportation, including vehicle types, miles traveled, and fuel efficiency.

Commercial Buildings Energy Consumption and Expenditures. Survey of commercial building energy consumption by building type, energy end-use, and fuel type nationally.

For information about ordering the above documents contact the National Energy Information Center, EI-231, Energy Information Administration, Forrestal Building, Room 1F-048, Washington, DC 20585, (202) 586-8800, E-mail: infoctr@eia.doe.gov, World Wide Web Site: http://www.eia.doe.gov

National Personal Transportation Survey. Comprehensive survey of all forms of personal travel, including non-motorized and transit modes. Available from the Office of Highway Information Management, Federal Highway Administration, HPM-40, Washington, DC 20590, (202) 366-0160.

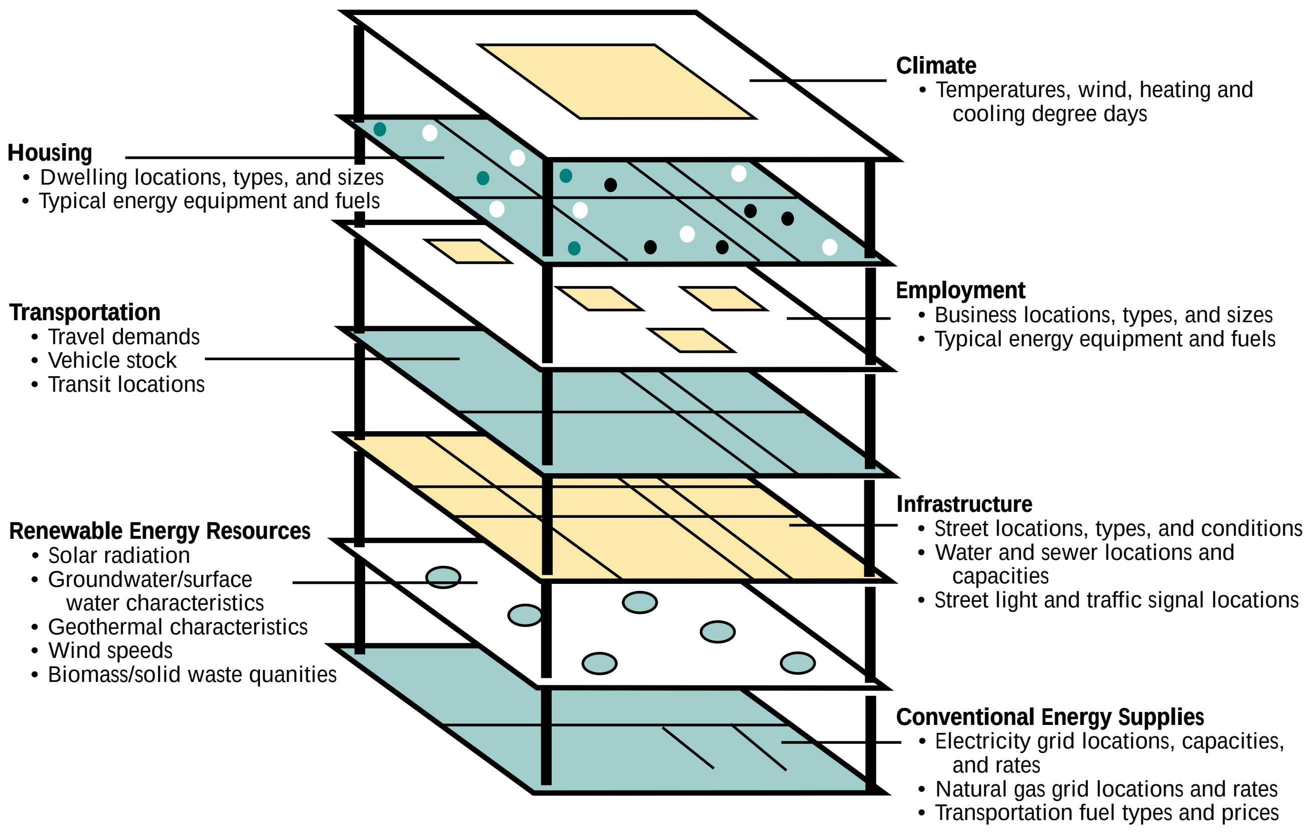
Transportation Energy Data Book. Detailed national breakdown of energy consumption, costs, and air pollutant emissions for all motorized travel modes. Available from the National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, VA 2216, (703) 487-4600.

Figure 1.15 summarizes the major types of information needed for the PLACE³S approach as layers in a geographic information system (GIS) to emphasize the relationship between urban geography and energy efficiency. Use of a GIS for PLACE³S-focused planning makes the process more efficient and strengthens its ability to communicate results to the public and decision-makers. Use of a GIS can also be coordinated with the computer-aided design (CAD) work of land developers and engineers, who are often preparing the growth proposals that PLACE³S can evaluate. In fact, one way of promoting stakeholder collaboration in a PLACE³S project is to establish the joint use of common computer data files and equipment.

In projects in which computer help is appropriate, hardware and software requirements are not extensive. If a community or region already operates a GIS, it already possesses a system it can adapt to make PLACE³S calculations. In locations without a GIS, a personal computer and spreadsheet software can tabulate data, which are then transferred to drawings. A CAD system can also automate this approach.

FIGURE 1.15

INFORMATION NEEDED FOR PLACE³S STUDY
(Details in Chapters 3 and 4)



Criterion, Inc. of Portland, Oregon, has developed proprietary software to assist communities in applying the PLACE³S method. The current version of this software, called INDEX®, requires ArcView™ from ESRI Inc. and a 486 PC (or MAC) with 16 MB of RAM. Operation may require up to 100 MB of hard drive space depending on the study size. INDEX is not plug and play software. It may need to be customized to answer unique questions. Also, data describing the study area must be entered into the program before operation. Contact Eliot Allen, Principal, Criterion, Inc., for details about INDEX. [eliot @ crit.com or (503) 224-8606].

Software to help implement the PLACE³S method also is being developed as part of the redesign of Denver's abandoned Stapelton Airport property. This software, called Denver Smart Places, is a decision support system for sustainable land use and development. Like INDEX®, it is built to function with ESRI's ARCView™ geographic information system software. The Denver Smart Places system software is designed to be flexible, allowing modifications to fit community project needs. Denver Smart

WHAT ARE GIS AND CAD?

GIS = Geographic Information System. GIS is a computer technology that combines a computer's capability to print maps with its capability to organize and retain large amounts of data and quickly perform complex calculations. By efficiently integrating mapping with location-specific data, GIS users are able to generate maps and reports that use a community's own data to answer specific questions such as "Where are the undeveloped parcels that are within one-tenth mile of existing water supply and sewer lines, each with at least 10 percent excess capacity?" In this way GIS is a powerful tool for bringing information to decision makers in a format that answers the questions at hand. GIS also provides a central site for collecting and managing location-based information, reducing information redundancy among city departments and helping to ensure everyone is working with the most current data.

A GIS promises greater productivity and effective use of information in return for a significant investment of time, money and personnel to get and keep the system up and running. A GIS can be a large-scale (mainframe-based) or small-scale (PC-based or workstation-based), operated by one department or shared in a regional planning environment. Virtually any GIS can be adapted to provide the maps and data needed to conduct regional and neighborhood-level PLACE³S studies.

A GIS system may already exist in your community. Often the Public Works or the Planning Department are first to use GIS technology. However, in some communities a GIS may be found in the Property Assessment Office, the Fire Department or the 911 service center. Also, state and federal agencies and private sector users may have GIS systems and formatted data that can be acquired via partnership agreements.

CAD = Computer Aided Design. CAD systems were developed primarily for architects and engineers who need to create and analyze two and three dimensional designs, keep track of a large volume of design-related data and understand how a change to one part of the design will affect the whole. CAD systems also can be run on either a mainframe or a PC. They cannot, however, relate multiple facts with multiple sites to answer complex questions like the proximity to excess water and sewer capacity. CAD systems exist in many communities and can be adapted for neighborhood-level PLACE³S analyses.

The Local Government Guide to Geographic Information Systems: Planning and Implementation is an excellent introduction to GIS and CAD technology. This Guide provides technical and administrative information and six case studies of communities using GIS technology. It is available from Public Technology, Inc., 1300 Pennsylvania Ave., NW, Washington, DC 20004, (202) 626-2400.

Places is public domain software developed by a public-private partnership in collaboration with the Electric Power Research Institute. The software will be available with full documentation in late 1996. For information contact the Denver Smart Places Project by E-mail at Denversp@aol.com.

KEEPING PERSPECTIVE

The reality of gradual physical changes in cities should be acknowledged. However, it should not be a reason for inaction or business-as-usual indefinitely.

In their critique of planning methods that rely on quantitative modeling, Moore and Thorsnes (1995) warn that it is possible to describe generally the forces that shape cities, but it is not possible to "describe with quantitative rigor the *optimal* size or configuration of a real urban area" (emphasis added). This is a reasonable warning. PLACE³S is not a method that produces an optimum plan that is necessarily the most efficient for a community. Instead, it uses a relatively simple, consistent quantitative approach to illustrate order-of-magnitude differences between planning alternatives. With PLACE³S, for example, measuring a region's greenhouse gas emissions in absolute terms is not as important as discovering that an alternative land use plan could cut those emissions significantly.

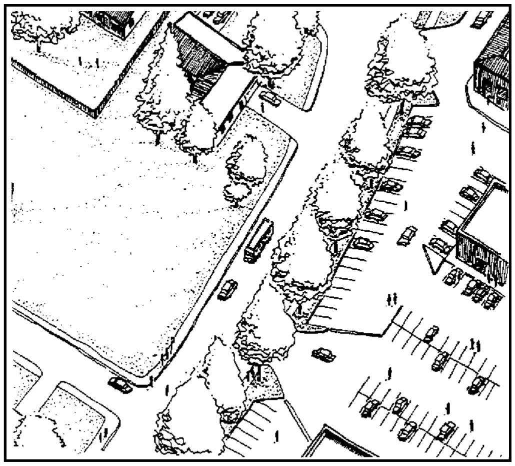
Some observers also legitimately question how much difference urban planning can make in community efficiency given the relatively slow rate of physical change in the built environment. These analysts correctly point to the sizable existing investment in auto-oriented infrastructure that will exert enormous influence on cities for decades to come, reducing potential gains from land-use techniques to potentially small near-term improvements in efficiency. This cautionary perspective deserves consideration when using the PLACE³S method. The reality of gradual physical changes in cities should be acknowledged, but balanced with knowledge of the large amount of growth projected to occur in the United States. For example, the U.S. Department of Energy's Office of Building Technology, Statistics and Community Programs finds that, between 1995 and 2015, an additional 25 million households and 17 billion square feet of commercial floor space will be built in the United States. This new development could increase energy use by 5.7 quadrillion Btus, an amount equal to the combined annual energy use of the states of Virginia and Ohio. They also estimate that if energy efficiency measures were fully implemented in these new structures, efficiency could be improved about 30 percent over standard construction, saving about $100 billion annually in energy costs. Therefore, as Figure 1.16 shows, the gradual nature of change is a reason to begin, not delay, planning a more sustainable future.

Another legitimate concern is the difficulty of proving cause and effect relationships among the dozens of design variables that comprise a community's built environment and its inhabitants' behaviors. For example, many of the savings that the PLACE³S methodology identifies are from reduced transportation fuel use accomplished by substituting car trips with walking, bicycling and transit. However, some authors have raised questions about whether a neo-traditional neighborhood or compact region will actually see those savings.

Crane, in a working paper for the University of California Transportation Center, (Crane, 1995), questions the theoretical basis for stating that the new urbanism, or neo-traditional development, will unambiguously reduce car travel. He finds ambiguity in how mixing and intensifying uses will affect car trips, although he assumes such measures will probably reduce trip demand and vehicle miles travelled. He concludes that neo-traditional designs are attractive and probably have the claimed transportation

FIGURE 1.16
THE GRADUAL NATURE OF EFFICIENCY IMPROVEMENTS

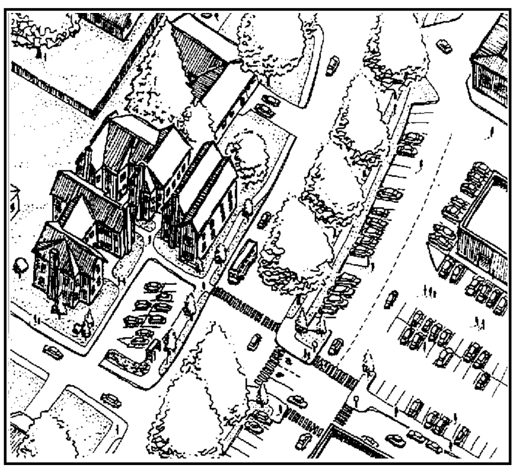
Existing Development



Per Capita/Year

- 175 MMBtu energy use
- $2,100 energy cost
- 22 tons CO_2 emissions

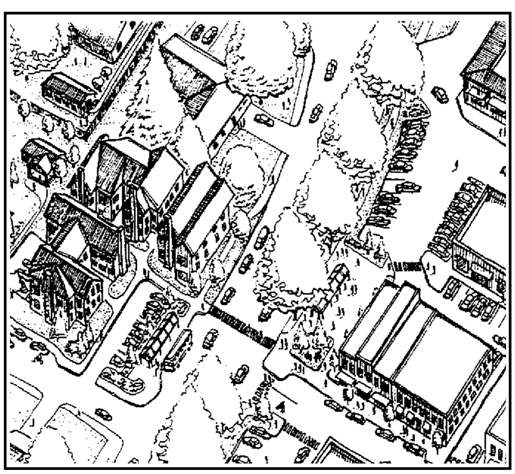
After 5 Years



Per Capita/Year

- 150 MMBtu energy use
- $1,800 energy cost
- 19 tons CO_2 emissions

After 10 Years



Per Capita/Year

- 125 MMBtu energy use
- $1,500 energy cost
- 16 tons CO_2 emissions

Adapted from Lane Council of Governments, 1995.

"There is a good marriage between PLACE³S and GIS. PLACE³S adds value to our existing geographic information, enabling us to use data to answer a broader variety of questions such as estimating the energy effects of growth and transportation plans."

Bob Parrott,
Director of Research
San Diego Association of Governments

benefits in some instances. However, he cautions that designers and planners need to more fully understand how the price, cost and quality of a design feature contributes to the reduction in car travel.

Until more empirical data are collected and studied, many uncertainties will remain. Notwithstanding these reservations, the applications of the PLACE³S methodology rely on the best available estimates of influence of land use on transportation. To date, PLACE³S applications have focused primarily on the technical feasibility of the methodology. In the near future, tests will begin that include full-scale public involvement. Only after a few such comprehensive tests have finished will it be possible to judge the rate of community acceptance of PLACE³S and its ability to create measurably more efficient communities.

HOW PLACE³S WORKS

Chapter 2

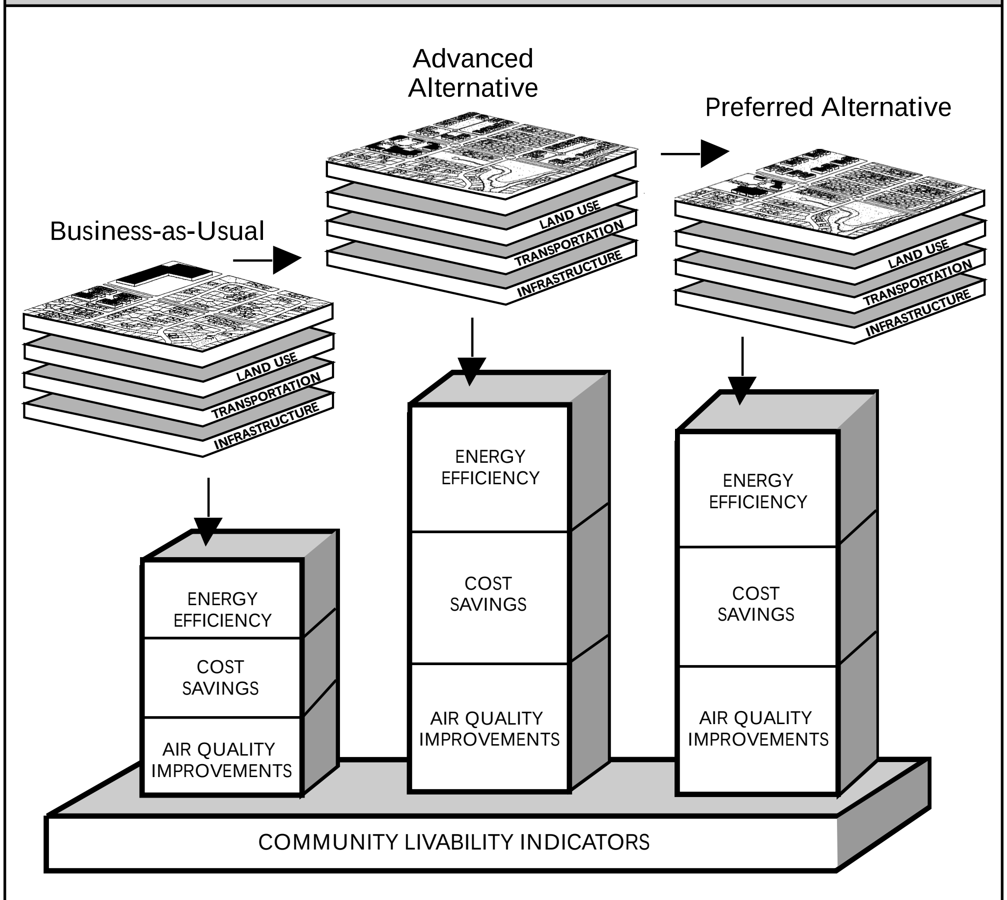
THE METHOD

PLACE³S differs from other methods of community planning by its unique combination of:

- Well-informed stakeholder involvement
- Adherence to a comprehensive set of energy-efficient urban planning and design principles
- Quantification of the energy, economic, and environmental effects of a plan and its alternatives

As Figure 2.1 shows, the PLACE³S method measures and compares a set of plans that stakeholders create. The method concludes with the creation of a preferred plan, which should be significantly more efficient than a business-as-usual plan.

FIGURE 2.1
THE PLACE³S PLANNING METHOD



> "You are right on track when your solution for one problem...solves several others. You decide to minimize automobile use to conserve fossil fuels, for example, and realize that this will reduce noise, conserve land by minimizing streets and parking, multiply opportunities for social contact, beautify the neighborhood, and make it safer for children."
>
> **Michael Corbett,**
> Davis, CA
> Developer

This chapter provides a general description of the PLACE^{3}S method and the recommended planning process for using it. Chapters 3 and 4 provide details to apply PLACE^{3}S to regional and neighborhood projects, respectively.

Several questions must be addressed when first employing the PLACE^{3}S method:

- ***Integrating the PLACE^{3}S method into established procedures.*** How can PLACE^{3}S energy, economic and environmental data and decision-making maps best be integrated into established procedures?
- ***Geographic scope.*** Will the PLACE^{3}S approach be applied at a regional or neighborhood level, or both?
- ***Energy efficiency.*** Which urban planning and design strategies will be most effective in reducing energy demands and increasing the use of renewables and high-efficiency supply technologies?
- ***Measuring energy use, cost and emissions.*** What data and calculations will be needed to estimate energy use, costs, and air pollutant and CO_2 emissions?

Just as planning commissions expect to receive traffic impact estimates for new development proposals, over time they should be able to expect comparable estimates of energy efficiency and other indicators of sustainability.

The remainder of this chapter addresses these four questions and describes the recommended planning process for using PLACE^{3}S. The chapter concludes with a fictional account of a citizen whose neighborhood has been through a PLACE^{3}S process. This account should give the reader an overview of how the PLACE^{3}S approach works.

Integrating the PLACE^{3}S Method into Established Procedures

In many situations, community planners can integrate the PLACE^{3}S approach into their established planning procedures. They can use PLACE^{3}S to judge the sustainability of their current policies and identify ways to include energy efficiency in their policies. For example, by revealing the per household cost savings and community-wide economic stimulation and air quality benefits, PLACE^{3}S can help determine the extent to which an affordable housing plan contributes to community sustainability. After a community becomes familiar with the data and mapping the PLACE^{3}S approach can provide, decision-makers will begin to look for the energy differences among the policy choices they are making.

The PLACE^{3}S approach can strengthen an established public involvement process by providing better information to all stakeholders as they evaluate alternatives. The PLACE^{3}S approach also can be a stand-alone process whose primary objective is improving energy efficiency and related economic and environmental conditions. A regional energy plan that projects demands for all sectors and recommends options for meeting those demands is an example of this type of application.

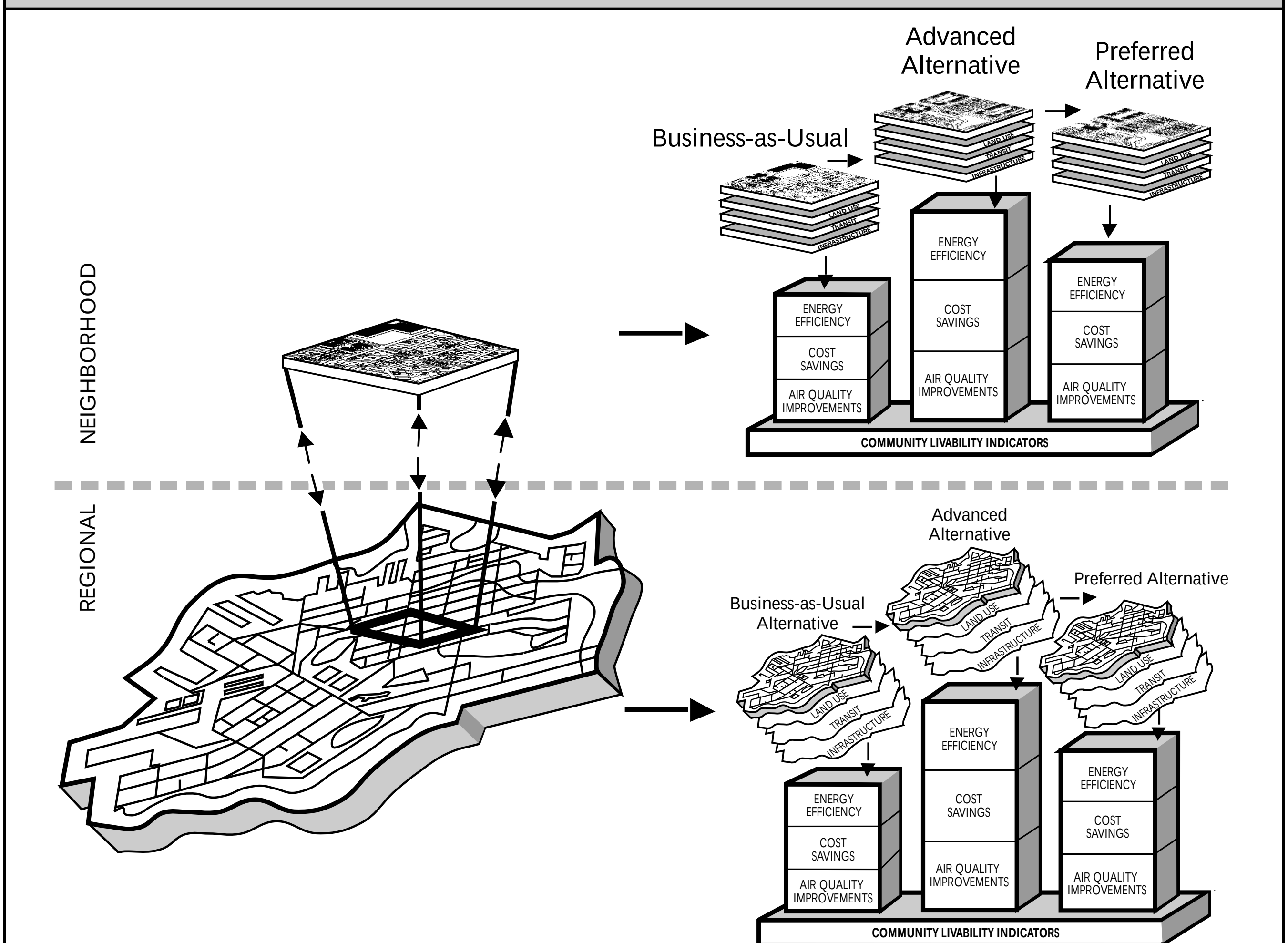
Regardless of how a community initially uses it, eventually the PLACE^{3}S approach can become an integral part of the community development process. Just as planning commissions expect to receive traffic impact estimates for new development proposals, over time they should be able to expect comparable estimates of energy efficiency and other indicators of sustainability.

Geographic Scope

The PLACE³S approach is geographically flexible, as Figure 2.2 shows. It can evaluate an area as small as a single neighborhood or as large as an entire region. For PLACE³S assessments, a region is defined as the cities and counties that generally comprise a single metropolitan area. A region can include large amounts of open space, but is predominantly urbanized or urbanizable. A city or small town can be considered a "mini-region." Neighborhoods typically are a subarea of a city. Exactly what constitutes a neighborhood varies widely among communities, but most applications at this level will be 100 to 300 acres in size, although some projects may be considerably larger.

If possible, first complete a region-level PLACE³S analysis to establish areawide benchmarks of energy use, costs, and air pollutant and CO_2 emissions. A unique feature of PLACE³S is its ability to identify subareas of unexpected inefficiency. These often warrant neighborhood-level evaluation to determine what actions can make the subarea as efficient as, or more efficient than, the surrounding subareas.

FIGURE 2.2
GEOGRAPHIC FLEXIBILITY OF THE PLACE³S METHOD

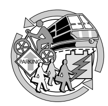


Energy Efficiency

There is a wide variety of planning and design techniques to reduce energy demand or increase reliance upon renewable sources of energy. Figure 2.3 provides a list of the efficiency techniques used by the PLACE^{3}S method. The greatest net energy, economic and environmental benefits are realized when an urban plan addresses the full list of measures. To get the most out of your PLACE^{3}S assessment, use as many of the measures as feasible and use each measure as extensively as possible as Figure 2.4 shows.

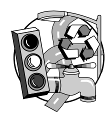
FIGURE 2.3
MENU OF PLACE^{3}S EFFICIENCY MEASURES

Landform/Microclimate
- Topography
- Light-colored surfacing
- Vegetative cooling
- Wind buffering/channeling
- Evaporative cooling

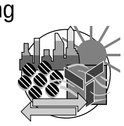


Transportation
- Integrated, multimodal street network
  - Pedestrian
  - Bicycle
  - Transit
  - High-occupancy vehicles
- Pavement minimization
- Parking minimization/siting

Land-Use/Site Design
- Use density
- Use mix
- Activity concentration
- Solar orientation
- Pedestrian orientation
- Transit orientation
- Micro-climatic building siting

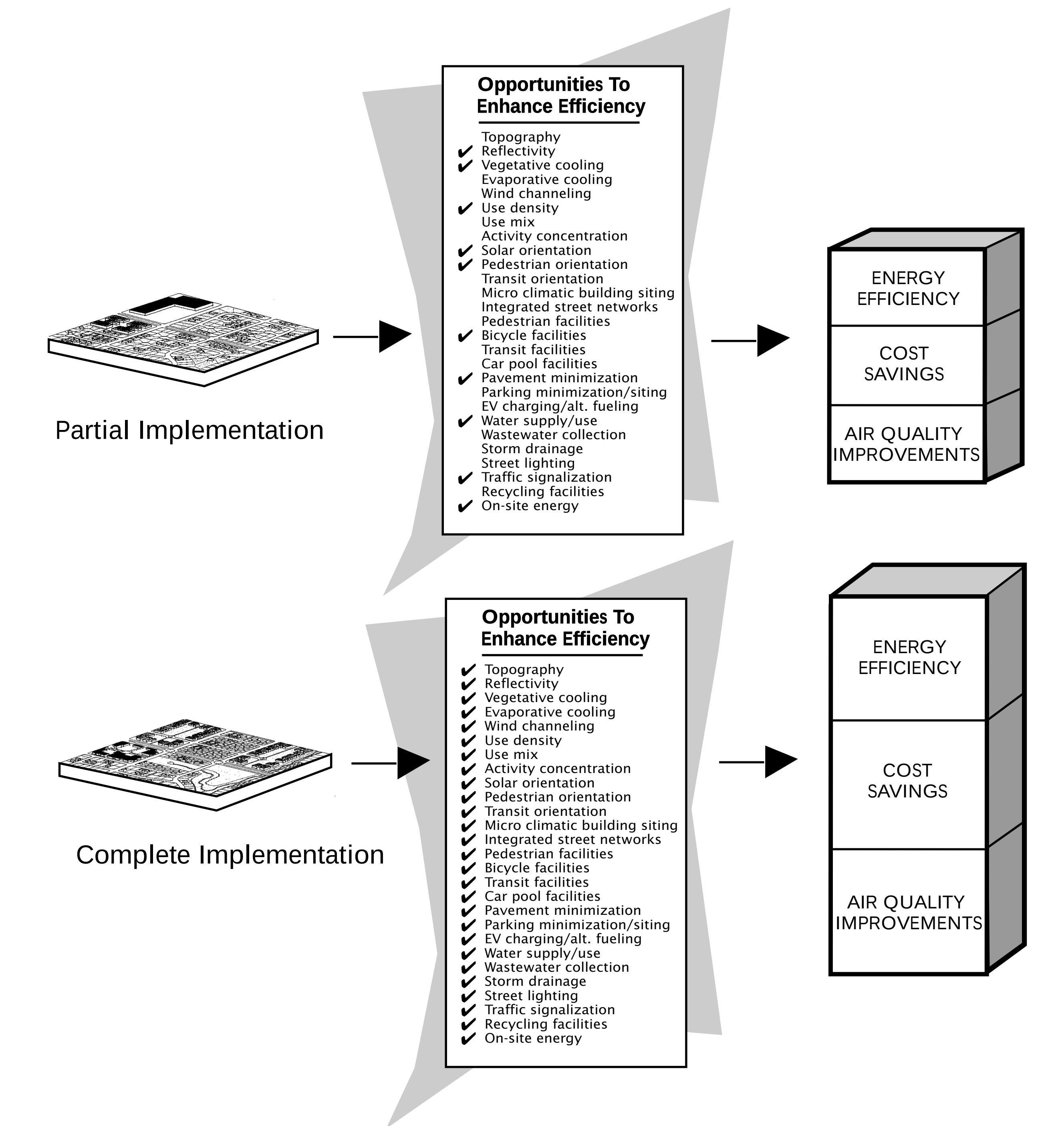


Infrastructure Efficiency
- Water supply and use
- Wastewater collection
- Storm drainage
- Street lighting
- Traffic signalization
- Recycling facilities



On-Site Energy Resources
- Geothermal/groundwater
- Surface water
- Wind
- Solar thermal/Photovoltaic
- Biomass
- District heating/cooling
- Cogeneration
- Thermal storage
- Fuel cell power

FIGURE 2.4
COMPREHENSIVE IMPLEMENTATION REAPS LARGER BENEFITS



Measuring Energy Use, Cost and Emissions

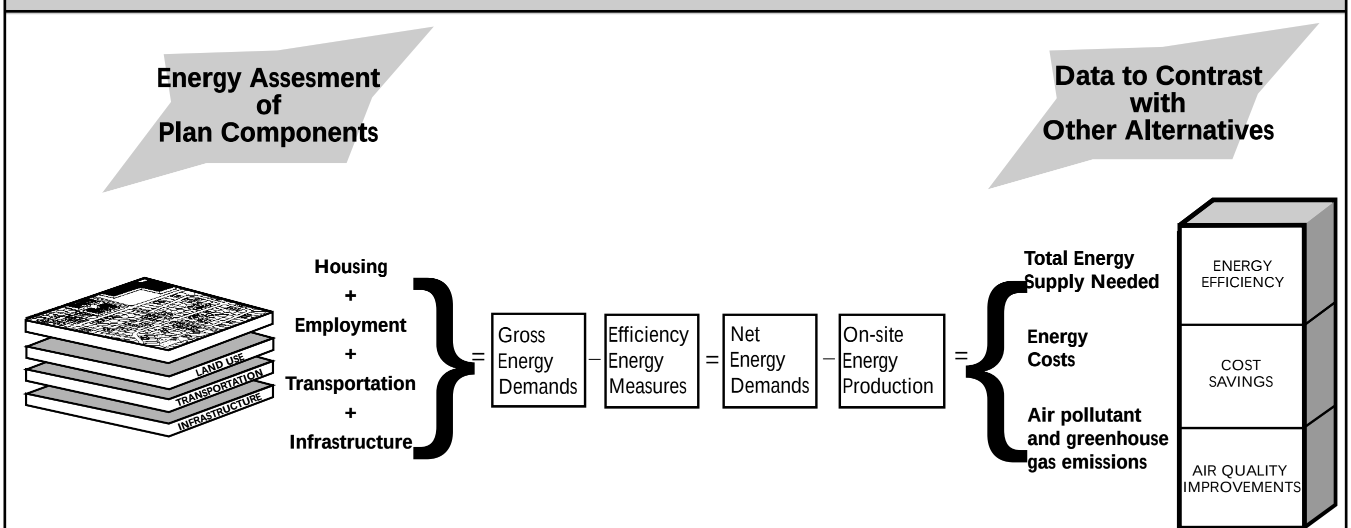
The PLACE³S method requires data to estimate energy use, costs and emissions for current and projected conditions and proposed alternatives. Figure 2.5 explains how the PLACE³S method calculates the energy performance of each alternative.

Use a consistent approach to analyzing alternatives, whether applying the PLACE³S method at the neighborhood or regional level. A consistent approach will most clearly portray the actions needed to capture the economic and environmental benefits of sustainability. The objective is to create and evaluate a range of feasible alternatives, and to select the one, or combination of several, that best meets stakeholders' planning criteria.

A standard PLACE³S approach should include the following alternatives:

- **Existing Conditions** - Existing conditions include a description of the current development and level of efficiency.
- **Business-as-Usual Alternative** - This alternative describes future conditions if no policy changes are made (how efficient the community will be at the end of its planning horizon, often 20 years). Quantification of the Existing Conditions and Business-as-Usual alternatives provide the baseline against which the stakeholders compare alternatives.
- **Planning Alternatives** - These alternatives reflect different stakeholder visions for the future. There can be any number of planning alternatives. At least one of these alternatives should contain as many of the energy efficiency measures Figure 2.3 lists as practical. This PLACE³S-focused alternative, referred to throughout this document as the Advanced Alternative, will show how optimizing efficiency can provide economic and environmental benefits. This alternative will also establish a theoretical level of efficiency, economic and environmental benefit that can be achieved by fully implementing established urban design practices.

FIGURE 2.5
MEASURING THE ENERGY EFFECT OF A PLANNING ALTERNATIVE



- **Preferred Alternative** - This preferred plan is the outcome of employing the PLACE³S method in a public decision-making process. It represents the stakeholders' balancing of the costs, benefits and impacts of each alternative in a trade-off process. The Preferred Alternative should incorporate greater efficiency than the Business-as-Usual Alternative and most of the efficiency measures used in the Advanced Alternative. Exposure to and appreciation of the economic and environmental benefits of the Advanced Alternative can lead stakeholders to chose an efficient Preferred Alternative.

> "The problem is that some communities are using their capital assets as if they were income which is like dairy farmers' selling their cows to buy feed. When we deplete our resources, we're treating our community as if it's a business liquidation. We spend the income, then bequeath the mess to our children."
>
> **Michael Kinsley & Hunter Lovins,**
> *Paying for Growth, Prospering from Development*

A Simple Example

Figure 2.6 shows a simple application of the PLACE³S method. This example is a fictional 100-acre "greenfield" parcel being developed around a new light rail station. Three alternative scenarios vary the density and land-use mix to produce considerably different results. Each plan has different implications for community sustainability.

THE PLACE³S PLANNING PROCESS

There are five basic steps to applying the PLACE³S method. The five steps, as illustrated in Figure 2.7, are general enough to fit most local circumstances, but adjustments and fine tuning will likely occur when applying them. Broadly, the steps follow:

Step 1: Start-Up

Establish the geographic scope of the PLACE³S project, along with its relationship to other planning projects affecting the study area. Begin stakeholder participation, including formulating criteria for evaluating planning alternatives. Collect data and document existing conditions.

Step 2: Establish Business-as-Usual Alternative

Measure the energy efficiency of the Business-as-Usual Alternative to set a baseline for comparing alternatives. Project the Business-as-Usual conditions or an adopted plan to the end of the planning horizon. The objective is to simulate current policies and market trends if they continue without change. This will show how efficient a Business-as-Usual plan will be.

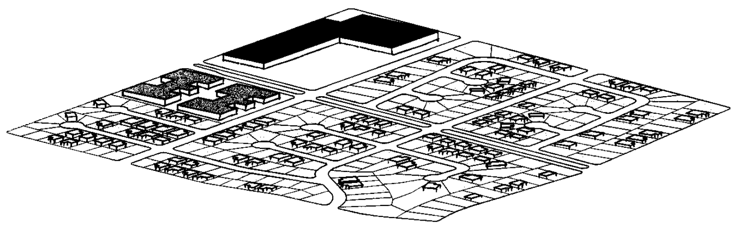
Step 3: Analyze Alternatives

Develop and evaluate alternatives that improve upon the Business-as-Usual plan. These alternatives will address major planning issues such as redirecting growth and new transportation programs. One alternative, the Advanced Alternative, should focus on optimizing efficiency. Figure 2.3 provides the design menu for constructing the Advanced Alternative. Compare energy use, costs and air pollutant and CO_2 emissions of each alternative against the other alternatives to determine how much more or less efficient the community could become under each alternative.

FIGURE 2.6
A SIMPLE PLACE^{3}S APPLICATION

1. **BUSINESS-AS-USUAL:** Developer proposes to build on a 100-acre parcel at four units to the acre. The PLACE^{3}S profile reveals the following:

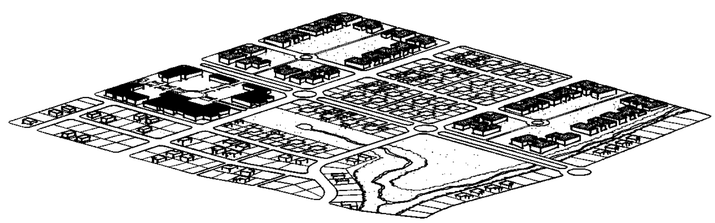
- Total development requirement: 100 acres
- 0 acres reserved open space
- 348 homeseekers served
- Transit feasibility: Poor, too few (47%) residents are within walking distance of transit- will not support good transit service.
- Local Street Connectivity: Poor, few streets provide direct access to transit.



- 175 MMBtu/person/yr
- $2100/person/yr
- 22 tons CO_2 /person/yr

2. **ADVANCED ALTERNATIVE:** Community develops an alternative that doubles housing to meet projected need and doubles density to conserve resources, lower prices and preserve the environment. The PLACE^{3}S profile reveals the following:

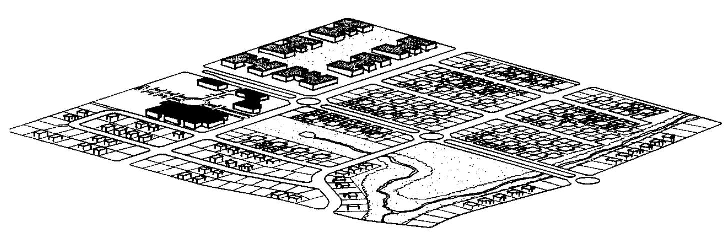
- Total development requirement: 82 acres
- 18 acres reserved open space
- 770 homeseekers served
- Transit feasibility: Excellent, 95% of residents are within walking distance of transit
- Verticle mixed uses in Activity Center.
- Local Street Connectivity: Excellent, streets provide direct access to transit, shopping and employment
- Pavement minimization: skinny streets.



- 125 MMBtu/person/yr
- $1500/person/yr
- 16 tons CO_2 /person/yr

3. **PREFERRED ALTERNATIVE:** After assessing all alternatives in public meetings and negotiating trade-offs, the community removes some multi-family homes and open space, but agrees to a plan that is an improvement over the Business-As-Usual Alternative. The PLACE^{3}S profile reveals the following:

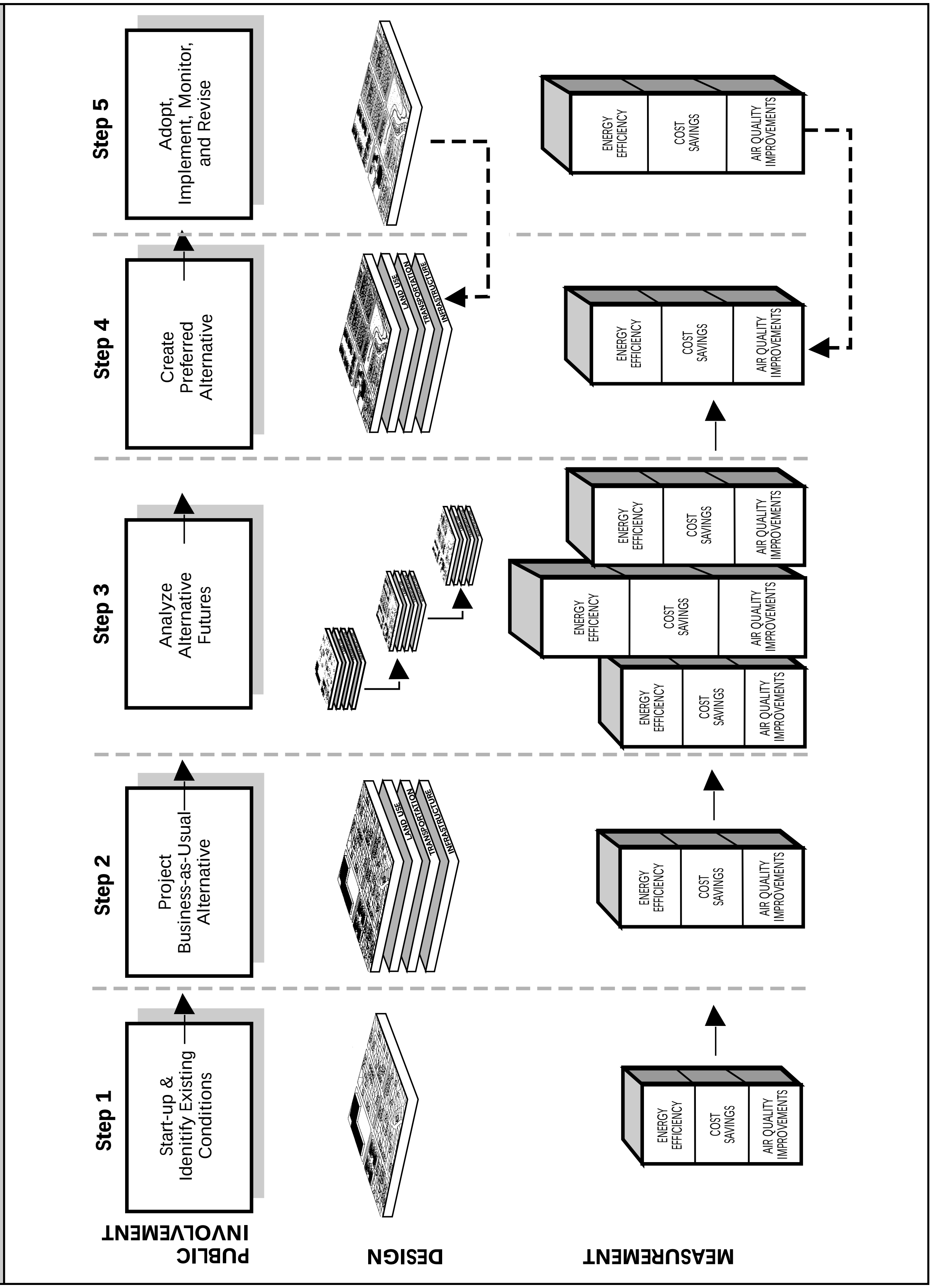
- Total development requirement: 85 acres
- 15 acres reserved open space
- 452 homeseekers served
- Transit feasibility: Good, density partially supports transit.
- Horizontal mixed uses in Activity Center
- Local Street Connectivity: Good, most streets provide direct access to transit and shopping



- 140 MMBtu/person/yr;
- $1900/person/yr
- 19 tons CO_2 /person/yr

Adated from Burchell, 1988.

FIGURE 2.7
THE PLACE³S PROCESS



Step 4: Create Preferred Alternative

Create the Preferred Alternative by selecting the strongest alternative or constructing a hybrid composed of elements from the multiple alternatives assessed in Step 3. Use the public process to construct the Preferred Alternative to achieve the best balance of energy efficiency and other community values. Document the expected level of energy efficiency, cost savings, and air quality and CO_2 emission improvements for use in Step 5.

Use the public process to construct the Preferred Alternative to achieve the best balance of energy efficiency and other community values.

Step 5: Adopt, Implement, Monitor, and Revise

Adopt the Preferred Alternative and use its energy, costs, and air pollutant and CO_2 emission levels for measuring success in achieving its goals. Evaluate intervening short-range development proposals and plans against these goals to ensure that incremental efficiency improvements are occurring.

Implementation should include monitoring and evaluation of expected energy efficiencies. Agree on benchmarks and periodically collect data to compare them against predictions. Make amendments as needed to ensure that efficiency goals are realistic and are being met.

MEASURES OF SUCCESS

Elements of the Planning Process

It is important to establish measures of success for a PLACE³S project at its outset. Such measures will help in designing the project and evaluating its performance. If all elements of the planning process are followed, the likelihood of achieving exemplary results will be significantly increased. If any of the following elements are eliminated or only partially met, the chances of achieving significant results will be reduced accordingly:

1. Were key stakeholders (agencies, citizens, businesses) fully involved in all phases of the planning process?
2. Did the alternatives comprehensively assess the energy efficiency improvement potential in transportation, building and infrastructure sectors and use of local renewable energy resources and high-efficiency technologies?
3. Did the process use reliable data to estimate the impacts of planning and design options?
4. Did the process analyze impacts over the long-term as well as short-term?
5. Did the process address all issues important to stakeholders, including those not directly related to energy efficiency or sustainability?
6. Did the process present information in a clear, graphic, and accurate manner?

Results of the Planning Process

It is equally important at the outset of a project to agree on how to judge the results. The following benchmarks could be starting points:

1. The preferred future is measurably more efficient than the Business-as-Usual case. Ranges of reasonably achievable efficiency gains and on-site output include:

	Percent Improvement
Buildings efficiency	5 - 15
Transportation efficiency	10 - 40
Infrastructure efficiency	5 - 15
On-site production	10 - 100

2. Project results are implemented.
3. Monitoring over time shows that predicted energy efficiencies are achieved, along with expected economic and environmental benefits.

A STAKEHOLDER'S PERSPECTIVE

To explain the PLACE³S methodology better and to show the critical aspect of public involvement, the following fictional account gives the perspective of a citizen whose neighborhood has used the PLACE³S approach to assess growth plans. Receiving a real account like this from a stakeholder would be a significant measure of success in its own right.

Start-up

The city planners visited my neighborhood association to start the process of developing a community plan for our neighborhood. They said they would use a new process called PLACE³S. They said PLACE³S would put us in charge of the planning process through an open, bottoms-up planning process. It would provide us with good data and information. We could see the impacts the different ideas we had for our future would have both in our neighborhood and the entire region. Finally, it would give us lots of graphic images to help us visualize the "feel" of different plans and how they would work on the ground.

We were skeptical, but we agreed to participate. We knew the city was trying to promote more development in neighborhoods such as ours, but we felt that the city had a poor track record listening to neighborhood concerns. We worried that this was just a plot to let developers ruin our neighborhood so the city could collect more property taxes and keep the developers happy. But, we decided it was best to participate , and the PLACE³S process actually sounded kind of interesting.

First, we formed a committee. We started talking about our general concerns for the neighborhood and our dreams for the future. Our neighborhood consists of about 1,000 families in an older area of the city. It is almost entirely residential, with a few vacant lots and several houses in need of repair or replacement. Most houses are single family; several are rented. Some are vacant and boarded up. The nearest *grocery and other stores are nearly a mile away. Crime has increased over the last decade. Cars along our streets have also increased because of people who do not live here traveling through our neighborhood. A big change coming in three years is a new light rail line along one edge of the neighborhood.*

We reviewed a great deal of information, maps, and pictures that described existing conditions in our neighborhood, what the planners called Business-as-Usual. This information helped us to understand how our land was currently being used. It showed what was happening with our streets and where traffic accidents and crime occur most often. It also showed where we traveled to work, shop and have fun. It showed how we used energy in every thing we did. This was all very interesting.

I was surprised at two new pieces of information: how so much of the way our neighborhood functions can be understood by how we use energy, and how what happens in our neighborhood relates to the whole metropolitan area. I had never really thought about how driving everywhere uses a lot of energy and increases air pollution. I only thought of it as a cheap way to get where I wanted to go if I don't count car or insurance payments.

I had no idea that I spent $2,000 a year on energy when it was all added up, or that our neighborhood's energy bill is $2 million a year. I certainly did not know our area was contributing 1,000 tons of carbon monoxide and 20,000 tons of carbon dioxide to the atmosphere each year. When you think about all of the other neighborhoods like ours, no wonder people are concerned about air quality and climate change. I also had never thought about how much I was helping by choosing to live close to town instead of on the edge of our region. We learned that our neighborhood has a residential density of about six homes per acre, and that our homes sit on lots that average about 6,000 square feet. The charts and maps also showed how much capacity for water, sewer, roads, electricity, and natural gas we had in our neighborhood. A lot of that was not being used while subdivisions on the edge of the region have to build all this capacity. I had not thought about how I pay for this new capacity. This made me think in a new way about the vacant lots in the neighborhood. These lots are a valuable resource for future housing or shops that otherwise might be built in the suburbs. Still, I worried what it would mean to the livability of our neighborhood if too much development started coming in.

All of this information was thought provoking. It was very powerful to have all the information on a computer that was hooked up to a big screen to show maps and images. We could switch from topic to topic as we pleased. The colored maps and images helped us understand what all the numbers really meant.

We discussed all of this and then started talking about our goals for the neighborhood. They centered on things like crime prevention, safe streets, a better look and feel to the neighborhood, holding down our cost of living, and generally making our area a healthy, sustainable community in every sense of the word. The planners helped us write down these goals in the form of evaluation criteria and explained that these would help us evaluate the good and bad points of different plans for our future.

Business-as-Usual Plan for the Future

At the next few meetings, we worked on something called the Business-as-Usual plan for the future. This turned out to be what was most likely in our neighborhood over the next 20 years if things kept going pretty much as they had been, that is, if the city's plan for the area did not change, the transportation system stayed the same except for the new light rail line, and real estate market conditions controlled development and redevelopment in the neighborhood.

The planners came back to us with a number of questions to check whether their information and assumptions were correct. It seemed like we had to change quite a bit of their information. For experts they sure needed a lot of help. I think they started to figure out that we were really the ones who knew more about our neighborhood than anyone. We appreciated the fact that they asked us and that they responded to the suggestions we made.

After a lot of work, we had another meeting with a whole new set of figures, maps, and pictures. So this is what things will be like in 20 years! I had never really thought about it before. It was not a very pretty picture. Still no stores within walking distance. Our streets twice as congested as today. More traffic accidents, higher energy costs, and even more air pollution. Not much happening to redevelop the area. This was particularly disturbing when we looked at what would be happening in the rest of the region under this future base case. There would be lots of new development in the suburbs, which we would help pay for.

The planners asked us what we thought about this future. They helped us to describe our opinions using the evaluation criteria we had developed earlier. On most of the criteria we decided things would be worse, in some cases by quite a bit. We decided this was not acceptable, that we wanted to find a way to do better.

Alternative Plans

This was the most fun part of the project. The planners told us to be creative and dream about what we would like our future to be. We worked in something called "charrettes" (turned out be a pretty fun way to spend a couple Saturdays) to design three alternative futures for the neighborhood. One of them was called an "Advanced Alternative." It was based on the goal of making the neighborhood as energy efficient and sustainable as possible.

The planners gave us a lot of help with this one, explaining the different ways we could do this. We figured out how to lay out lots so that nearly every house in the neighborhood gets warming sunlight in the winter and daylight bright enough to cut down on electricity lighting, how to change the streets to make them safe for bicyclists and walkers, how to slow down traffic, and how to reduce the amount of asphalt. We designed a landscaping plan to help keep us stay cool in the summer and beautify the area. We found a way to add stores so we could walk to shop. We changed all of the vacant lots to either housing, shops, or small parks. We designed streets, sidewalks, and pathways to make it easy to get to transit stops. We changed some of the zoning to allow rowhouses and to allow people to convert parts of homes to apartments or to add them over their garages.

We had to look at a lot of pictures and designs before we were convinced these levels of development could be added without ruining the area—or making it seem like we were living in the middle of New York City! Again, the drawings and other graphics really helped this process. We were able to see how different densities, types of development, and street systems would look in the neighborhood. This changed a lot of minds. I know I was a lot more open to some of the ideas after I saw they could be built to look nice and actually improve the overall quality of the neighborhood. I found I really had no idea of what "units per acre" and density meant until I saw some of the photographs of housing at different densities.

One of the other alternatives we created kept the neighborhood almost entirely residential and stressed creating public places, especially parks and open spaces. Another alternative added a commercial and small light industrial district, which took out a lot of housing. The planners made sure we kept the three alternatives quite different from one another and that we pushed ourselves to be creative, maybe even with extreme ideas. This was hard, because we wanted to get down to designing the neighborhood we wanted. They claimed that if we got ahead of ourselves, we might not think of all of the best ideas. We were not too sure about this at first, but it was fun to be a little wild, and it turned out we really did come across some pretty exciting new ideas.

After we created the three alternatives, the planners brought back another set of figures, maps, and pictures. They organized all this in the same way we saw it in the Business-as-Usual plan. This made it easy for us to compare the three alternative plans to each other and to the Business-as-Usual plan to see if we liked them any better. It was remarkable how much projected energy use and cost, traffic, water use, and air pollution varied among the alternatives. Because the information was provided in a per capita format, we could see the economic and environmental effect caused by each person, over a range of life styles. The planners also brought along figures, maps and pictures describing alternatives describing the entire metropolitan region of about one million people. One of them was a regional "Advanced Alternative" that used concepts similar to our neighborhood's maximum energy efficiency case. We carefully examined the alternatives and asked questions about all the information. Then we rated each of the neighborhood alternative plans using our evaluation criteria.

Each of the three alternatives for our neighborhood had different strengths and weaknesses. The Advanced Alternative certainly did what it was supposed to: energy use, costs, and air pollution all went down a lot. Compared to Business-as-Usual, household energy costs were 10 percent lower in the Advanced Alternative, which means $200 a year in savings to my family. Again, I was surprised at how much energy costs when you add it all up. The savings from the regional Advanced Alternative were even more impressive.

Looking at the region made our neighborhood seem pretty insignificant at first, but then we saw how plans like ours in many other neighborhoods could add up to a big difference for the region. For example, a new family moving into the region could reduce its annual energy costs by as much as 40 to 50 percent if it had the option to choose a home in central neighborhoods like mine instead of the suburbs. The planners also showed us that accommodating new families in central neighborhoods could save about 4,000 acres of farm land that would otherwise have become new subdivisions. This type of compact regional growth would also allow us to get our *money's worth out of those under-used utilities we learned about at the beginning. In fact, it turned out that letting most growth happen in the suburbs would cost **all** taxpayers 15 to 20 percent more in infrastructure costs than using the systems we already have in older neighborhoods. This certainly made me think in a different way about what effect development on the vacant lot next to me might have— not just on me, but on my neighborhood and the entire region.*

Preferred Alternative

This was the hardest part of the project, but also the most rewarding. We had to agree on what we wanted our future to be. We came to another Saturday charrette and worked in small groups pouring over the maps, data, pictures, and criteria evaluations from the Business-as-Usual plan and three alternative plans. Naturally, we were looking for a way to have everything and make everyone happy; and, of course, we could not figure out how to do that.

The planners kept telling us to focus on the evaluation criteria. Those criteria already reflected our agreement about what was important to us. And the scoring we had already done on each of the alternative plans reflected our agreement about how each of the plans fared. All we really had to do was pick the best parts of each plan and put them together in a way that made sense.

Well, it was not quite that easy. But, it worked. We decided that we liked a lot of the elements in the Advanced Alternative. We ended up using that as the foundation to develop our Preferred Alternative, and then changing it to bring in elements we liked from other alternatives. The main changes we made were adding more parks and open space, reducing the housing densities a little bit in a few places to match better the overall character of the neighborhood, and adding a little more convenient commercial development to expand our local shopping options.

The hardest issues to get final agreement on were housing densities and what effect the light rail stop should have on the neighborhood. All of us started the project believing that more density was bad for us. But, the information presented to us clearly showed the overall benefit to us and the region from more development in our neighborhood and neighborhoods like ours. This made us think more carefully about the issue. But, we still had to be convinced. The Advanced Alternative had more than doubled our existing density to 14 homes per acre. The other alternatives had levels in between.

The planners kept stressing how careful attention to design could keep the look and feel, and privacy, of our traditional neighborhood vision and still allow for a substantial density increase. They had quite a few photographs, and even some videos, of neighborhoods around the country that have found a successful balance between compact development and livability.

We finally found that common ground, at around 10 homes per acre, but it was not easy. I think it really took all of the information and pictures—for the region and the neighborhood—to crack the issue. Now we understand that the increased density will actually help our neighborhoods to thrive instead of deteriorate.

The transit stop issue was similar. Through the process we came to understand how important a healthy light rail system is to the livability of our entire region. But we had initially viewed the introduction of transit to our neighborhood as a negative. It would make it more difficult to cross that street and probably bring more people we did not know into our neighborhood.

We eventually figured out how to use the light rail stop as a major focal point for the neighborhood. We also saw how other transit stops could become focal points and began to appreciate how we could use the system to accomplish things that now required our cars. We saw how we could convert some older buildings around the transit station to job sites and help get that walkable shopping that we were also looking for. We actually reached the point where we felt fortunate that we lived in an area that would be so close to transit.

The planners then produced a final set of maps, figures, and pictures to show us what our preferred plan would look like and how it would work. We scored it using the evaluation criteria one last time. We did lose just a little bit of energy efficiency compared to the Advanced Alternative, but not much. We certainly had a plan that was much more energy efficient than it would have been if we had not had the PLACE^{3}S information.

Implementation and Monitoring

The City Council adopted our Preferred Alternative, largely as a result of our strong turnout in support of it. It has asked our committee to meet annually to judge how well it is being implemented. This will give us a way to make sure the plan does not sit on a shelf at the planning department; and it will allow us to fine tune and modify it as things change. I understand that the city will also give us data to show whether all the predicted energy savings from the plan are actually occurring. In closing, these are the observations I have about the PLACE^{3}S process. Overall, I thought it was a positive experience. The things I liked best were:

- *We were fully involved from the first to the last day. We truly owned the final product when it was taken to the city council for adoption.*
- *The planners gave us useful information about what impacts various plans would have. The specific nature, reliability and amount of information were impressive. It helped to give us confidence that we were making truly informed choices, not just guessing.*
- *Using energy use as a key organizing principle and predictor of other impacts worked. No one thought energy was that big of a deal when the project started, but it turned out to be woven into just about every part of our lives. The direct and indirect impacts of energy use clearly have an important effect on my own quality of life, as well as that of my neighborhood and the region. And because energy is less controversial than some other topics, I think it helped to convince everyone to participate at the outset. It also gives us a simple, effective way to track how well we are doing as we move into the future.*
- *We used a lot of creativity in the process. The PLACE^{3}S design menu of options gave us choices that we would not have considered on our own. And it set a pattern of thinking that led to us creating many ideas of our own.*

- *The numerous graphic images were essential. We could never have visualized the impacts of different planning and design options without them. We saw that development we thought would be ugly and negative could be attractive and positive if done in certain ways.*
- *The regional information raised our whole thinking process to a higher plateau. We understood that our choices would not just affect us, but every one else as well. You might think that would make the process harder, but it gave it a sense of purpose that helped make us determined to succeed.*
- *The structure of the process was simple and helped us reach agreement. Using the evaluation criteria as an important part of the whole project helped to assure that our own values were driving the process and that we had an orderly way to discuss information and resolve disagreements.*

REGIONAL PLANNING

CREATING EFFICIENT REGIONS

Chapter 3

For the last half of the 20th century, the dominant pattern of metropolitan growth in the U.S. has been unlimited, low-density sprawl. This pattern of urban growth creates auto-dependent suburbs surrounding weakened central cities and threatens the long-term sustainability of metropolitan regions. Traffic congestion, air pollution, lack of affordable housing, loss of open space, and expensive new infrastructure are just a few of the results of sprawl that many metropolitan regions share.

Most metropolitan areas now have agencies that address these regional issues. Planning at the regional level includes growth management, transportation, air quality, open space, and economic development. In general, these plans strive to make regions more efficient, either directly or indirectly, through more rational use of land and economic and environmental resources. Regional transportation plans are most common because they are prerequisites for receiving federal transportation funds. Most of these efforts have processes for involving stakeholders and share the following general planning principles (Moore, 1994):

- Minimize the spread of urban expansion.
- Control more directly the design of new development.
- Encourage or require higher densities in suburban development.
- Create clusters of high-intensity development.
- Improve the system that serves pedestrians, bicyclists, transit, and other high-occupancy vehicles.

Seattle is evolving an interesting approach to regional planning. In the Seattle process, as shown in Figure 3.1, the region developed a hierarchy of six regional centers as part of its growth plan. Each center has a land-use density, mix of uses, and transportation strategy to match its scale and to relate efficiently to other centers in the hierarchy. This kind of framework for planned growth can reverse the negative impacts of uncontrolled growth. By channeling development and redevelopment toward coordinated locations and scales, for example, regions can cut infrastructure costs substantially, as Figure 3.2 describes.

PLACE³S uses a similar framework for regional planning. By employing an energy accounting system, PLACE³S reveals and quantifies components of sustainability. It makes explicit the relative differences in the degree of sustainability among regional alternatives. PLACE³S does this by carefully evaluating the following two basic linkages between energy and regional development (adapted from Owens, 1991):

- **PLACE³S quantifies the energy demands that the arrangement of land-uses throughout the region create**. For example, low-density development creates a need for greater travel between uses than compact development. A mixture of land-uses makes it easier to walk to work and shopping or to take shorter auto trips.

> "From an ecological planning perspective, the amount of growth is less important than the pattern of growth in determining the level of environmental impact and the efficiency of resource use."
>
> **Mark Roseland,**
> *Ecological Planning for Sustainable Communities*

FIGURE 3.1
SEATTLE'S HIERARCHY OF EFFICIENT REGIONAL CENTERS

Type of Center	Growth	Land-Use	Transportation	Residential Density (DU/Net Acre)	Employment Density (Employee/ Net Acre)	Total Employment	Ratio of New Jobs to New Households
Regional Employment Center	- Focus of regional growth	- Mixed-use - Employment center - Pedestrian/transit center	- All modes (especially fixed-route rapid transit/pedestrian-only ferries) - Parking restrictions - Served by major highways	(Dwelling Units/Net Acre) 20 (or mixed-use)	500	N/A	1.5 - 2.5
Metropolitan Centers	- Focus of regional growth	- Mixed-use - Employment center - Pedestrian/transit center	- All modes (especially fixed-route rapid transit/pedestrian-only ferries) - Parking restrictions - Served by major highways	20 (or mixed-use)	100	40,000	0.75 - 1.5
Subregional Centers	- Focus of regional growth - Strong existing market	- Mixed-use - Employment center - Pedestrian/transit center	- On fixed-route rapid transit line by 2020 (except Kitsap, which requires passenger-only ferry) - Parking restrictions - Significant connections to highways	20	50	40,000	0.75 - 1.5
Activity Clusters	- Not focus of regional growth, but still grows	- Some areas of mixed-use - Employment to serve residences - Pedestrian facilities	- Bus connects to fixed-route rapid transit - Express service to above centers - Commuter parking	12	Minimize employment growth to serve population needs		N/A
Small Towns	- Deliberately small - Tightly defined growth boundary	- Employment to serve surrounding area - Main street pedestrian improvements	- Local transit to nearest subregional center and/or to commuter parking for fixed-route rapid transit	4	Minimize employment growth to serve population needs		N/A
Pedestrian Pockets	- Predominately all new growth but small - Tightly defined growth boundary	- Mixed-use - Employment center - Residential center - Pedestrian/transit center	- At fixed-route rapid transit station or at passenger-only ferry terminal by 2020	20	500	2,000	N/A

Source: PSCOG, 1991

Source: Puget Sound Council of Governments, 1991

FIGURE 3.2
RELATIVE INFRASTRUCTURE COSTS FOR BUSINESS-AS-USUAL VERSUS MANAGED GROWTH

Infrastructure	Trend Development Costs (%)	Planned Development Costs (% relative to trend)			Planned Development Cost Synthesis (% relative to trend)
		Duncan Study	Frank Study	Burchell Study	
Roads	100	40	73	76	75
Schools	100	93	99	97	95
Utilities	100	60	66	92	85

Adapted from Anderson, 1993.

> The objective of using PLACE³S for regional assessments is to identify the region's efficient locations and to ensure that land-use, transportation, and infrastructure plans capture the efficiencies that are inherent in those locations.

- **PLACE³S matches energy production and distribution systems to the land-uses and transportation systems they will serve.** For example, district heating and cooling is most feasible in high-density, mixed-use areas, in contrast to passive solar use, which is most easily used in lower density areas where buildings can be oriented to best solar exposure. Regional assessments of energy generation and distribution will reveal ways to direct growth to reduce costs and pollution.

Figure 3.3 is a list of landmark regional studies from the 1970s that measured the effects of alternative regional plans on transportation and total energy use. Of the studies listed, the 1977 Roberts work is one of the more extensive. In regional applications to date, PLACE³S results are tending to agree with Roberts. In the San Diego region, for example, a transit-oriented PLACE³S scenario estimated transportation and total energy use reductions of 11 percent and 6 percent, respectively. These estimates are close to Roberts' results for a similar scenario in Washington D.C. The PLACE³S assessment in San Diego further calculated that the 6 percent total energy savings would result in nearly $1.5 billion retained in the regional economy by 2010. It would also result in more than 5,000 new jobs in energy efficiency services and the elimination of about one-half million tons of air pollution.

PLACE³S uses conventional benchmarks of energy efficiency, such as total energy use or per capita use. It rates the geographic efficiency of regional land-use and transportation plans two ways:

- **Location Criteria**: PLACE³S uses location criteria to group regional subareas into categories of similar distance to key features (distance to jobs, transit, and shopping) and ability for the subarea to provide efficient urban services (presence of infrastructure)
- **Planning Criteria:** PLACE³S uses planning criteria to estimate the level of consistency of a land-use designation with its assigned location criteria (if a subarea is close to transit and jobs, it should be zoned for high-density uses).

The objective of using PLACE³S for regional assessments is to identify the region's efficient locations and to ensure that land-use, transportation and infrastructure plans capture the efficiencies that are inherent in those locations.

In summary, a regional application of PLACE³S will:

- Establish quantified benchmarks of how energy-efficient the region is and how efficient it will likely be in the future under various planning alternatives.
- Identify areas where land-use changes can improve efficiencies.
- Estimate and contrast the economic development value of efficiency for current and alternative development conditions.
- Estimate air pollution and CO_2 emissions from each regional planning alternative.

In this way, stakeholders can use PLACE³S to understand better the implications of alternative regional plans and to understand the patterns and levels of efficiency those plans would create.

FIGURE 3.3
IMPACTS OF REGIONAL PLANNING ON ENERGY CONSUMPTION

Author	Regional Study Area	Time Horizon	Regional Scenarios	% Reduction: Transportation Energy	% Reduction: Total Energy
Council of Environmental Quality (1975)	Hypothetical region	Static comparison	Low density sprawl High density planned Combination	0 53.9 29.4	0 46.3 26.8
Roberts (1977)	Washington D.C.	1973-1992	Sprawl Sectoral Beltway oriented Transit oriented Dense center	0 5.4 9.0 18.4 17.4	0 2.8 3.4 7.6 7.9
Carrol (1977)	Nassau and Suffolk counties, Long Island	1972-2000	Sprawl Clustered	0 51.9*	0 19.0* *reduction in incremental energy use
Edwards (1977)	Sioux Falls, S.D.	Static comparison	Least efficient Most efficient	0.0 80.+	N/A N/A
Næss, (1995)	Norwegian and Sweedish towns	Static comparison	Low density, decentralized High density, centralized	0 60	N/A N/A

Adapted from Anderson, 1993, and Næss, 1995.

REGIONAL PLANNING STEPS

Figure 3.4 summarizes the five-step PLACE³S regional planning process.

Step 1: Start-Up

1.1 Establish relationship of PLACE³S to the regional planning process.

PLACE³S works at the regional scale in a variety of ways. The tools available to affect regional growth patterns vary significantly from region to region. The regional governance structure, if one exists, is often a council of governments (COG). COGs are voluntary associations whose effectiveness depends on the willing participation of their member cities and counties. Transportation planning is the most common topic that regional organizations address. Federal funding for transportation projects is tied to creating regional transportation plans through regional agencies called metropolitan planning organizations (MPOs). In some states, special agencies such as air districts or congestion management districts have regulatory powers over certain matters within a metropolitan area or region.

"PLACE³S has been an invaluable tool for making the benefits of coordinated land use and transportation planning strategies come alive to local officials and citizens throughout the region. It has also been very helpful in furthering the implementation of these components of the Regional Growth Management Strategy."

Steve Sachs,
Senior Planner,
San Diego Association of Governments

FIGURE 3.4
PLACE³S REGIONAL PLANNING PROCESS

STEP 1: START-UP

1.1 Establish relationship of PLACE³S to regional planning processes.
1.2 Initiate public involvement.
1.3 Assemble regional and subarea data on existing conditions.
1.4 Estimate existing energy use, costs, and air pollutant and CO_2 emissions.
1.5 Establish and apply subarea rating criteria.
1.6 Formulate regional plan evaluation criteria.

STEP 2: CREATE BUSINESS-AS-USUAL ALTERNATIVE

2.1 Project land-use and travel conditions.
2.2 Estimate energy use, costs, and air pollutant and CO_2 emissions.
2.3 Establish and apply efficiency rating criteria.
2.4 Conduct public review of Business-as-Usual Alternative.

STEP 3: CREATE AND ANALYZE PLANNING ALTERNATIVES

3.1 Create alternative plans.
3.2 Adjust database to simulate alternatives.
3.3 Estimate energy use, costs, and air pollutant and CO_2 emissions of each Planning Alternative.
3.4 Apply efficiency rating criteria and compare alternatives.
3.5 Conduct public review of Planning Alternatives.

STEP 4: CREATE PREFERRED ALTERNATIVE

4.1 Conduct stakeholder selection of Preferred Alternative.
4.2 Adjust database to simulate Preferred Alternative.
4.3 Prepare energy use estimate and efficiency ratings.
4.4 Conduct public review of Preferred Alternative.

STEP 5: ADOPT, IMPLEMENT AND MONITOR

5.1 Adopt the Preferred Alternative.
5.2 Select monitoring benchmarks.
5.3 Periodically collect and report performance data.

Some of the common regional planning efforts include:

- Establishing urban limit lines, or urban growth boundaries, to separate urban from rural development.
- Preparing and implementing air quality plans.
- Creating housing strategies to ensure that all local governments do their fair share to provide a range of affordable housing.
- Creating open space plans.
- Establishing standards for siting major facilities, such as regional shopping centers or solid waste stations.

A fundamental decision is how to integrate the PLACE^{3}S method into existing regional plans and planning efforts. PLACE^{3}S can contribute to updating or creating regional plans or it can be used to create a stand-alone regional energy plan. Ideally, a regional application of the PLACE^{3}S method will be coordinated with any relevant community-level or neighborhood-level projects that are going on at the same time. The PLACE^{3}S approach can coordinate planning horizons, share data and equipment, and conduct joint public events to fit with related planning activities. Also, it helps to include some amount of neighborhood analysis in a regional project to strengthen confidence that regional assumptions and recommendations are appropriate when applied at the local level.

1.2 Initiate public involvement.

Identify stakeholders who will be affected by the planning process and document their interests and values. Address both regional and local stakeholders. Target substantial public involvement resources on stakeholders with regional interests. These are typically local governments, certain state agencies, and regional businesses such as utilities and the building industry. Assist local governments so they can and do provide a meaningful connection to the local stakeholders in the region.

Establish a stakeholder committee for the project and appoint members. The committee should provide input and guidance throughout the project, including developing the final recommendations that form the Preferred Alternative. The appropriate committee structure will vary for each project. Try to pattern the committee after existing successful regional planning projects as long as those structures represent a range of stakeholders. Establish a regular briefing schedule with appropriate regional committees, local governments, and state agencies to help build their understanding and support throughout the project.

1.3 Assemble regional and subarea data on existing conditions.

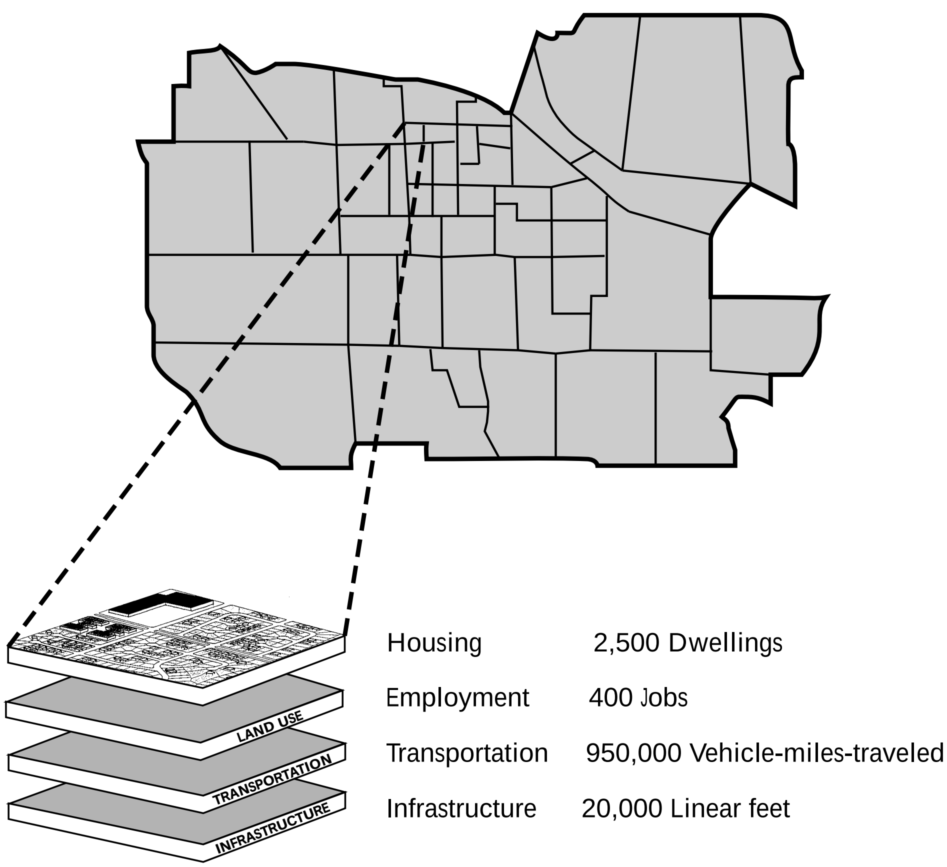
Establish study area boundaries for the region and subareas. The regional boundary should coincide with other metropolitan designations such as urban growth boundaries or regional transportation modeling boundaries.

Break the region down into subareas to tabulate energy demands and analyze geographic efficiencies as shown in Figure 3.5. Traffic analysis zones (TAZs), which most regions already use in their transportation models, are convenient subareas. TAZ databases usually contain many of the land-use and travel data needed for PLACE^{3}S calculations. In the absence of TAZ data, alternative subareas could be neighborhood boundaries or census tracts.

Use the most recent year for which complete data are available to describe existing conditions. For each subarea, the PLACE[3]S method needs the following land-use and travel data:

- ***Dwelling units (DU) by type.*** At a minimum, distinguish dwelling types between single-family and multi-family. Use additional housing types if they are available in the regional database, since they can support greater accuracy in energy consumption estimates.
- ***Employment by standard industrial classification (SIC).*** Employment is usually expressed by number of employees in a subarea. These data generally are organized by SIC type. Alternatively, some databases contain square footage of employment facilities, which can also be used to support energy consumption estimates.
- ***Vehicle miles traveled (VMT) per year.*** This includes all motorized vehicle types, except transit. It includes all trips produced by, and attracted to, each subarea.
- ***Transit passenger miles traveled (TPMT) per year.*** This includes all transit trips produced by, and attracted to, each subarea.

FIGURE 3.5
EXISTING CONDITIONS DATABASE BY SUBAREA



1.4 Estimate existing energy use, costs, and air pollutant and CO_2 emissions.

Develop coefficients to measure energy use, costs, and air pollutant and CO_2 emissions for each of the four land-use and travel components described above. For example, each housing type needs a coefficient that expresses the average amount of electricity used annually per house. For non-residential land-uses, develop coefficients using SIC codes on a per employee or square foot basis. Express the energy co-efficients in a common unit such as million Btu (MMBtu). Figure 3.6 illustrates a partial coefficient matrix.

- ***Energy use coefficients.*** This is the amount of electricity, natural gas, and transportation fuels that housing, employment and travel use annually. These coefficients will be unique to each region, reflecting climatic conditions that affect the amount of electricity and natural gas needed primarily for heating and cooling and the fuel efficiency of the local vehicle stock. Local electricity and natural gas pricing also affects energy use coefficients. Furthermore, not all areas will have natural gas service.

FIGURE 3.6
SAMPLE COEFFICIENT DEVELOPMENT

SINGLE-FAMILY RESIDENCE →	Electric lights & appliances	+	Natural gas space & water heating	=	Annual Single-Family Housing Coefficients
Energy use/yr	13,804 kWh (or 47 MMBtu)	+	590 therms (or 59 MMBtu)	=	106 MMBtu
Energy cost/yr	7¢/kWh (or $944)	+	57¢/therm (or $335)	=	$1,219
Pollutant emissions/yr	0.13 lbs/CO/MMBtu (or 6 lbs.)	+	0.02 lbs./CO/MMBtu (or 1 lb.)	=	7 lbs. CO
Greenhouse gas emissions/yr	412 lbs./CO_2/MMBtu (or 19,427 lbs.)	+	116 lbs./CO_2/MMBtu (or 6,774 lbs.)	=	26,201 lbs. CO_2

AUTOMOBILE →	Gasoline	=	Annual Auto Travel Coefficients
Energy use/Yr	650 gallons (or 81 MMBtu)	=	81 MMBtu
Energy cost/yr	$1.13/gallon (or $737)	=	$737
Pollutant emissions/yr	2.2 lbs./CO/MMBtu (or 180 lbs.)	=	180 lbs. CO
Greenhouse gas emissions/yr	155.4 lbs./CO_2/MMBtu (or 12,956 lbs.)	=	12,956 lbs. CO_2

Local electric and natural gas utilities and/or state energy agencies can usually provide the coefficients needed for housing and employment. State energy and/or transportation agencies have transportation fuel coefficients. In the absence of utility or agency assistance, derive the coefficients from the data sources listed in Figure 2.8 or model them using local university or consultant help.

- ***Energy costs.*** Determine these coefficients by first converting the standard unit cost of each fuel into cost per MMBtu and then multiplying that value by the applicable energy use coefficient. State energy offices, local utilities or fuel suppliers can provide this information.
- ***Energy related air pollutants and CO_2 emissions.*** These are criteria pollutants and CO_2 emitted per unit of energy consumed in homes, businesses, and vehicles. Obtain these coefficients from the same organizations cited above or from your local air quality agency. In the absence of organization assistance, local universities or consultants can help prepare air pollution coefficients. The US Environmental Protection Agency's *State Workbook: Methodologies for Calculating Greenhouse Gas Emissions,* Second Edition (1995), is a useful guide for calculating CO_2 emissions.

Early involvement of utility system planners in regional PLACE³S assessments can improve coordination between land use and utility planning, ultimately reducing the cost to live and do business in a region.

Figure 3.7 illustrates a set of coefficients for a hypothetical region. These coefficients reflect the local market share of each fuel type. Multiply land-use and travel data (similar to Figure 3.5) by the energy coefficients (similar to Figure 3.7) to tabulate each subarea's annual energy use, costs, and pollutant emissions. In addition to tabular reports such as spreadsheets, GIS mapping is an effective way to depict geographic patterns of energy use.

Figure 3.8 compares two versions of total energy use:

- **Energy use per person** (residents plus workers), which is high in outlying auto-dependent suburbs and low in the denser, transit-oriented core; and
- **Total energy use per acre,** which will likely show higher energy use in core areas.

If PLACE³S data are held in a GIS, electric and natural gas utilities can coordinate their distribution grids with regional growth. With electric utility help, it may be possible to develop peak demand coefficients in addition to the annual values described above. Peak demand estimates aid in electric system planning by revealing how well each planning alternative fits within the existing capacity of the electric transmission system. Having this knowledge early in a regional planning process is especially relevant to utility planners. They will be better able to participate in the development of a preferred alternative so that costly expansions of the electric transmission system can be minimized. Early involvement of utility system planners in regional PLACE³S assessments can improve coordination between land use and utility planning, ultimately reducing the cost to live and do business in a region.

1.5 Establish and apply subarea rating criteria.

In this step, rate subareas according to the efficiency of their location in the region and the compatibility of their land-use designations with their location. A GIS is necessary for this step in order to measure distances between subareas and key regional features electronically. If a GIS is not available, this step can be eliminated from the process without detracting from the energy consumption benchmarks set in earlier steps.

Rating the efficiency of subareas is a two-part process, as Figure 3.9 shows. Part One rates subareas according to the efficiency of their location, e.g., a subarea near jobs and transit is generally more efficient for urban development than a subarea far away from such features. Part Two then rates subareas according to their "planned efficiency" or the consistency of their land-use designations with their location qualities, e.g., subareas near transit and jobs are generally more efficient if planned (and then developed) in high-density uses rather than low-density uses.

FIGURE 3.7
SAMPLE REGIONAL ENERGY COEFFICIENTS*

	Energy (MMBtu)	Cost ($)	CO (lbs)	CO_2 (lbs)	Units
Housing - Electric					
Single-family stock	45.5	690.0	2.3	8,388.5	unit/yr
Multi-family stock	34.9	530.5	1.7	6,449.3	unit/yr
Mobile home stock	53.4	810.8	2.7	9,857.3	unit/yr
Housing - Natural Gas					
Single-family stock	21.6	189.9	0.4	2,591.2	unit/yr
Multi-family stock	16.6	146.0	0.3	1,992.2	unit/yr
Mobile home stock	25.4	223.1	0.5	3,044.9	unit/yr
Employment - Electric					
Lumber & wood employees	1.774E+02	1,975.7	8.9	32,728.6	emp/yr
Other durable employees	1.033E+02	1,150.3	5.2	19,054.8	emp/yr
Food products employees	1.530E+02	1,704.2	7.6	28,230.3	emp/yr
Other nondurable employees	1.224E+02	1,363.7	6.1	22,589.9	emp/yr
Construction employees	1.064E+01	118.5	0.5	1,963.1	emp/yr
Transportation employees	1.559E+02	1,736.4	7.8	28,765.2	emp/yr
Wholesale trade employees	2.699E+01	300.7	1.3	4,981.6	emp/yr
Retail trade employees	6.141E+01	684.1	3.1	11,322.1	emp/yr
Employment - Natural Gas					
Lumber & wood employees	1.633E+02	1,549.5	3.3	19,609.7	emp/yr
Other durable employees	7.308E+01	693.5	1.5	8,776.9	emp/yr
Food products employees	4.667E+02	4,429.1	9.3	56,052.5	emp/yr
Other nondurable employees	3.263E+02	3,096.9	6.5	39,192.6	emp/yr
Construction employees	3.623E+00	34.4	0.1	435.1	emp/yr
Transportation employees	3.905E+02	3,705.4	7.8	46,893.2	emp/yr
Wholesale trade employees	5.722E+00	54.3	0.1	687.2	emp/yr
Retail trade employees	1.786E+01	169.5	0.4	2,145.5	emp/yr
Transportation					
Vehicle miles traveled/yr	5.739E-03	0.0793	0.0092	0.8062	VMT
Transit passenger miles traveled/yr	1.023E-03	0.0106	0.0014	0.1739	TPMT

* Coefficients are based on local market share of each fuel type

FIGURE 3.8
TOTAL REGIONAL ENERGY USE

TOTAL REGIONAL ENERGY USE

Housing:	90,000 Billion Btu
Employment:	95,000 Billion Btu
Transportation:	280,000 Billion Btu
Infrastructure:	5,000 Billion Btu

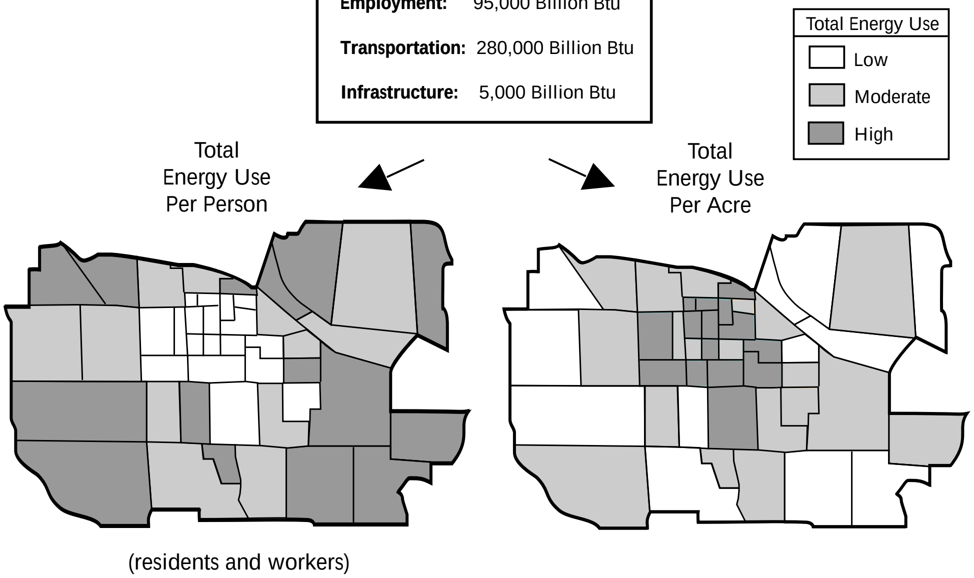


FIGURE 3.9
SUBAREA EFFICIENCY RATING CATEGORIES

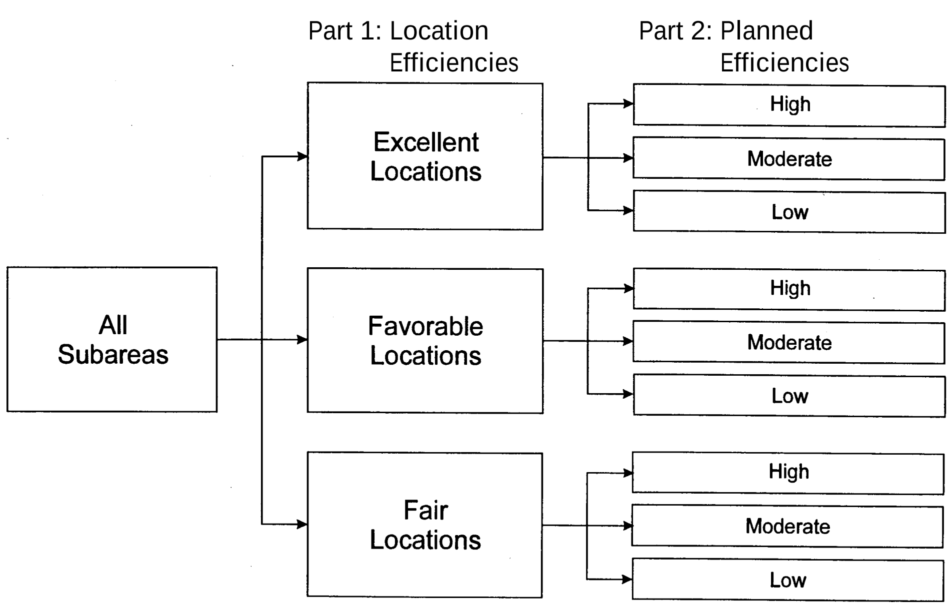


FIGURE 3.10
SUBAREA EFFICIENCY RATING PROCEDURE

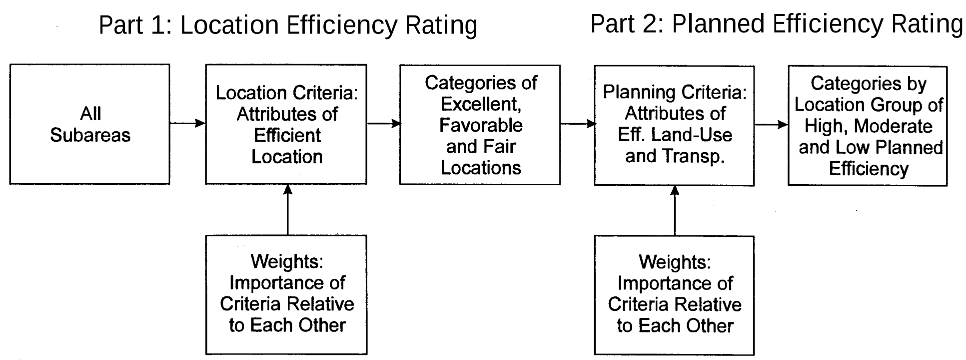


FIGURE 3.11
SAMPLE: LOCATION CRITERIA AND WEIGHTS

Variable	Measurement Unit	Proximity (miles)			Weight
		Excellent	Favorable	Fair	
Employment	Major employment centers (250 or more employees)	0 - 2.50	2.51 - 10.00	10.01 or more	0.15
Transportation	Transit/mixed-use center	0 - 1.00	1.01 - 2.00	2.01 or more	0.30
	Bike route	0 - 0.25	0.26 - 1.00	1.01 or more	0.05
	Bus stop	0 - 0.25	0.26 - 1.00	1.01 or more	0.20
Water & Wastewater	Urban development	0 - 0.25	0.26 - 2.00	2.01 or more	0.05
Urban Amenities	School	0 - 0.25	0.26 - 1.00	1.01 or more	0.05
	Park	0 - 0.25	0.26 - 1.00	1.01 or more	0.02
	Minor retail (20 or fewer employees)	0 - 0.25	0.26 - 2.00	2.01 or more	0.02
	Intermediate retail (21-49 employees)	0 - 1.00	1.01 - 5.00	5.01 or more	0.03
	Major retail (50 or more employees)	0 - 2.50	2.51 - 5.00	5.01 or more	0.05
Electricity	Feeder circuit	0 - 0.25	0.26 - 1.00	1.01 or more	0.03
	Substation	0 - 2.00	2.01 - 4.00	4.01 or more	0.02
Natural gas	Service line	0 - 0.25	0.26 - 1.00	1.01 or more	0.03
					1.00

Unweighted proximity values

Excellent = 3
Favorable = 2
Fair = 1

FIGURE 3.12
SAMPLE: PLANNING CRITERIA AND WEIGHTS

Variable	Measurement Unit	Planned Efficiency			Weight
		High	Moderate	Low	
Land-use	1. Mix (number of uses)	4 or more	2-3	1	0.20
Housing	2. Density (units/residential ac)	30 or more	10 - 29	9 or less	0.25
Employment	3. On-site presence (jobs/acre)	60 or more	20 - 59	19 or less	0.10
Transportation	4. % of tot. trips that are 1-person vehicle	59 or less	60 - 89	90 or more	0.05
	5. % of tot. trips that are transit	14 or more	1 - 13	1 or less	0.30
	6. % of tot. trips that are walk/bike	14 or more	1 - 13	1 or less	0.10
					1.00

Unweighted efficiency values

High = 3
Moderate = 2
Low = 1

Both Parts One and Two require evaluation criteria and criteria weights. Stakeholders use these to “score” subareas, as Figure 3.10 shows. Figure 3.11 and 3.12 provide examples of location and planning criteria and weights. Using the stakeholder committee, develop the criteria and weights as follows:

Part 1: Location efficiency

- ***Location criteria:*** List the community features to which people travel frequently and the features that subareas need to function efficiently, such as infrastructure. Figure 3.11 provides an example. For each of these features, develop a high to low point scale that corresponds to the implied energy relationship between the subarea and the feature, e.g., distance to a bus stop is scored excellent (3 points) if it is less than one-quarter mile, favorable (2 points) if it is between one-quarter and one mile, and fair (1 point) if more than one mile.
- **Criteria weights:** Assign weights to the location criteria according to their importance relative to one another. The last column of Figure 3.11 provides an example. Assigning weights enables the PLACE^{3}S method to reflect local policies and priorities. For example, this sample region has transportation-related air quality problems; therefore, it gave more than half of the total weighting (0.30 + 0.05 + 0.25) to transit and bicycle criteria.

Part 2: Planned efficiency rating

- ***Planning criteria:*** List the characteristics for judging a subarea’s land-use and travel efficiency. For example, Figure 3.12 shows sample planning criteria, including the number of land uses, number of residential units per acre, jobs per acre, and percent of trips made with only one person per vehicle. Develop a second high to low point scale that corresponds to the implied efficiency of the criterion, e.g., density is scored high (3 points) if more than 30 dwellings per acre, moderate (2 points) if 10-29 dwelling units per acre, or low (1 point) if fewer than 10 dwellings per acre.
- ***Criteria weights:*** Assign weights to the planning criteria according to their relative importance to one another in terms of capturing the efficiencies available at a location. In this example, a community gave *density* a higher weight (0.25) than *use mix* (0.20) in a transit-oriented plan because empirical evidence suggests that density has a greater effect than mix on increasing transit ridership. The last column of Figure 3.12 shows this example of weighting. Each community must develop its own weighting criteria.

The examples provided in Figures 3.11 and 3.12 describe a region where stakeholders have focused on employment and transit proximity as the primary indicators of an efficient location. It has land-use mix and density as the primary indicators of planned efficiency. Figure 3.13 shows a simplified example of computing some of these criteria.

Apply the full set of criteria and weights to produce the results that Figure 3.14 shows. The GIS mapping shows the location categories and the planned efficiency ratings of each subarea within the two categories: Step 1) *location efficiency,* and Step 2) *planned efficiency*.

FIGURE 3.13
SAMPLE PLACE^{3}S RATING CALCULATION FOR SINGLE SUBAREA

This is an example of GIS scoring of a mid-city residential neighborhood which has some mixed uses and moderate transit access. Major employment centers and retail shopping are within biking distance, but the nearest bike route is more than one mile away, as noted by the bolded circles on the upper table. It is therefore not surprising that few people in the subarea travel by bicycle, as noted in the lower table. The conflict between bicyling potential and lack of bike route access results in decreased efficiency. Total weighted scores summarize the efficiency of the subarea's location (1.91) and the coordination of the subarea's planning designations with location attributes (1.80). Mismatches such as the bicycle issue are reflected in the moderate total scores.

It is important to remember that the variables and measurement units in these tables are developed by PLACE^{3}S stakeholders to tailor the PLACE^{3}S quantitative process to local issues and priorities.

1. Calculate Location Efficiency

Variable	Measurement Unit	Unweighted Proximity (miles)			Weight	Unweighted Score Value X Weight
		Excellent	Favorable	Fair		
Employment	Major employment centers (250 or more employees)	0 - 2.50	2.51 - 10.00	10.01 or more	0.15	0.30
Transportation	Bus transit focus area	0 - 1.00	1.01 - 2.00	2.01 or more	0.30	0.60
	Bike route	0 - 0.25	0.26 - 1.00	1.01 or more	0.05	0.05
	Bus stop	0 - 0.25	0.26 - 1.00	1.01 or more	0.20	0.40
Water & Wastewater	Urban development	0 - 0.25	0.26 - 2.00	2.01 or more	0.05	0.15
Urban Amenities	School	0 - 0.25	0.26 - 1.00	1.01 or more	0.05	0.05
	Park	0 - 0.25	0.26 - 1.00	1.01 or more	0.02	0.02
	Minor retail (20 or fewer employees)	0 - 0.25	0.26 - 2.00	2.01 or more	0.02	0.04
	Intermediate retail (21-49 employees)	0 - 1.00	1.01 - 5.00	5.01 or more	0.03	0.03
	Major retail (50 or more employees)	0 - 2.50	2.51 - 5.00	5.01 or more	0.05	0.10
Electricity	Feeder circuit	0 - 0.25	0.26 - 1.00	1.01 or more	0.03	0.09
	Substation	0 - 2.00	2.01 - 4.00	4.01 or more	0.02	0.02
Natural gas	Service line	0 - 0.25	0.26 - 1.00	1.01 or more	0.03	0.06

Unweighted Scoring Values
Excellent = 3
Favorable = 2
Fair = 1

Total weighted score = 1.91

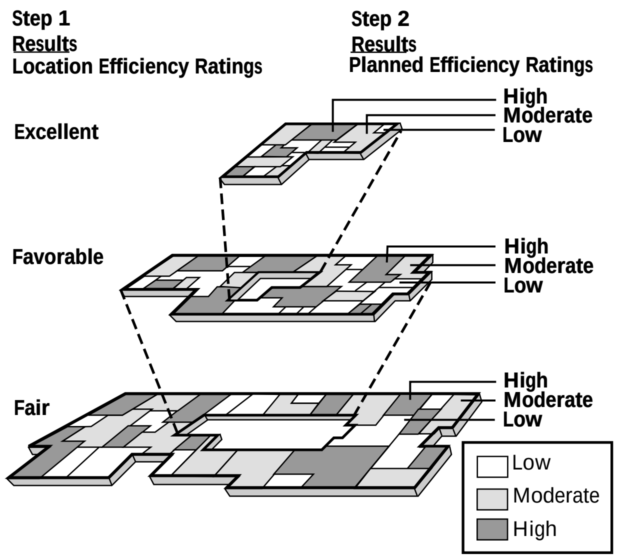
2. Calculate Planned Efficiency

Variable	Measurement Unit	Unweighted Planned Efficiency			Weight	Unweighted Score Value X Weight
		High	Moderate	Low		
Land-use	1. Mix (number of uses)	4 or more	2-3	1	0.20	0.40
Housing	2. Density (units/residential ac)	30 or more	10 - 29	9 or less	0.25	0.50
Employment	3. On-site presence (jobs/acre)	60 or more	20 - 59	19 or less	0.10	0.10
Transportation	4. % of tot. trips that are 1-person vehicle	59 or less	60 - 89	90 or more	0.05	0.10
	5. % of tot. trips that are transit	14 or more	1 - 13	1 or less	0.30	0.60
	6. % of tot. trips that are walk/bike	14 or more	1 - 13	1 or less	0.10	0.10

Unweighted Scoring Values
High = 3
Moderate = 2
Low = 1

Total weighted score = 1.80

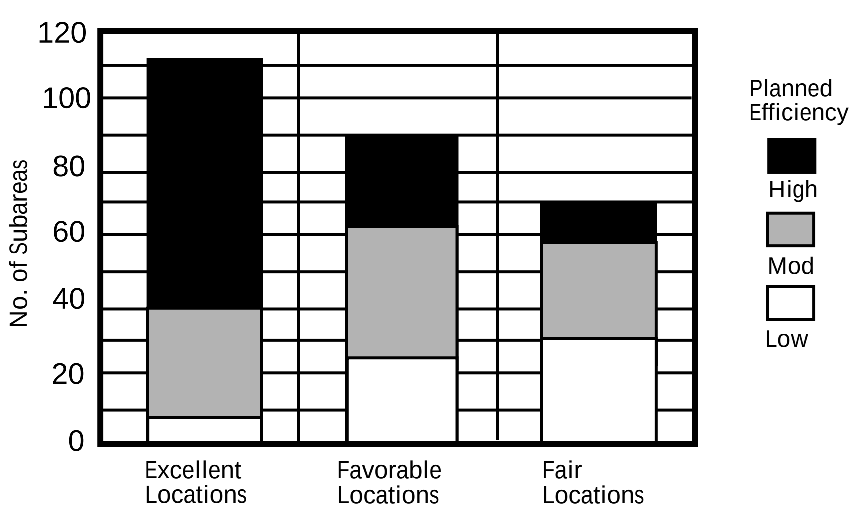
FIGURE 3.14
RATING RESULTS BY SUBAREA GEOGRAPHY



In effect, the methodology subdivides the region into locations based on proximity and infrastructure factors that cannot be readily changed (location efficiency). It then subdivides the region again into groups of land-use plan designations that take efficient advantage of a location and those land use designations that are inconsistent with their location (planned efficiency).

Figure 3.15 sums the planned efficiency ratings and compares them among location groups. In this example, the excellent locations have a relatively high level of planned efficiency versus the favorable and fair locations, where land-use planning is less consistent with subarea location.

FIGURE 3.15
PLACE³S RATING RESULTS BY SUBAREA CATEGORY



Rating results for a relatively efficient land-use plan are shown here. More than 40% of the subareas are excellently located. More than half of the excellently located subareas take advantage of their location to reduce energy use and promote sustainability, therefore receiving a high planned efficiency rating. This analysis also identifies those subareas in all location categories with low planned efficiencies. These are the areas where land-use planning can be better coordinated with subarea attributes.

1.6 Formulate regional plan evaluation criteria.

Develop PLACE^{3}S evaluation criteria to measure the strengths and weaknesses of the Business-as-Usual Alternative and each Planning Alternative. There are many issues to address in the evaluation criteria. It is important not to limit the criteria to those issues that the plan addresses directly. For example, if PLACE^{3}S is being used to analyze a regional transportation plan, the criteria should address transportation and related values the stakeholders believe are important. For example, transportation planning effects the cost of housing, public safety, jobs, and environmental quality. Criteria should be constructed to address these related issues.

> "A repeated theme in the literature on urban environmental problems is the need for a more integrated approach to planning."
>
> **William Anderson,** *Urban Form, Energy and the Environment*

Be sure to identify and include all fundamental interests. If you leave out key stakeholder concerns in the beginning, you limit the ability of the plan to address those concerns successfully later. It does not take advantage of the ability of the PLACE^{3}S method to integrate multiple stakeholder interests, and it will reduce the chances of support and implementation in the end. Figure 3.16 lists evaluation criteria that are illustrative of regional planning projects.

FIGURE 3.16
SAMPLE: REGIONAL PLANNING EVALUATION CRITERIA

Public Value	Evaluation Criteria
Green space/open space	Number of acres of protected green and open space per capita in urban areas.
Farmland	Number of acres of farmland converted to non-farm uses.
Clean air	Number of days in compliance with clean air regulations.
Mobility	Average number of minutes to travel between home and work.
Travel choice	Per capita miles of bike routes and sidewalks, hours of transit service, and number of bus stops.
Affordable housing	Percent of households that can qualify to purchase a house.
Efficient resource use	Total energy use and cost per capita.

Step 2: Create the Business-as-Usual Alternative

This step projects Business-as-Usual conditions to the planning horizon year, such as 2015, to estimate what the region would be like if current policies and market trends continue unchanged.

2.1 Project land-use and travel conditions.

Repeat the procedure described in Step 1.3 to forecast land-use and travel conditions in the horizon year (and any interval years if desired). Use existing regional plans, as appropriate, to develop these projections.

2.2 Estimate energy use, costs, and air pollutant and CO_2 emissions.

Repeat the procedure described in Step 1.4 to estimate energy use, costs, and air pollutant and CO_2 emissions in the horizon year. In this instance, modify the energy coefficients to account for increases in efficiency resulting from new technologies, changes in energy costs, and changes in the mix of electricity generating plants. Assemble these coefficient modifications from the data sources cited in Figure 2.8 with the assistance of local energy utilities, agencies, universities, and consultants.

2.3 Establish and apply efficiency rating criteria.

Repeat the procedure described in Step 1.5 for rating subarea efficiency.

2.4 Conduct the public review of Business-as-Usual Alternative.

Assemble summary information on findings thus far. Review findings with the oversight committee, appropriate regional and local bodies, and the public at large. Supplement tabular results and GIS maps with photographs and drawings of representative regional locations. Use the project's regional plan evaluation criteria from Step 1.6 to assess the strengths and weaknesses of the Business-as-Usual Alternative.

It is important to develop understanding and consensus about what the future will bring if no changes are made. Conduct a thorough public review of the Business-as-Usual Alternative to create an awareness of how efficient the region is now and how much more or less efficient it will become without major policy changes. This understanding will be captured in the data, maps and visual images used throughout the PLACE³S process to document net change from current policy.

Step 3: Create and Analyze Planning Alternatives

3.1 Create alternative plans.

Most planning processes develop a set of alternatives to enable stakeholders to assess several visions of the future. PLACE³S will enhance this process by comprehensively addressing and integrating efficiency. One planning alternative in a PLACE³S study should strive for optimum efficiency. Refer to the menu of PLACE³S efficiency measures (Figure 2.3) and create an Advanced Alternative devoted to optimum energy efficiency. Quantification of the Advanced Alternative is very important to the

PLACE³S method. This alternative will reveal the full theoretical economic and environmental benefits of efficiency policies that are comprehensively integrated into a plan. Although it may be unlikely that *all* measures will be part of the adopted plan, presentation of the benefits will educate the stakeholders about the value of efficiency in their community, thereby improving the sustainability of the plan that is adopted.

Although it may be unlikely that *all* measures will be part of the adopted plan, presentation of the benefits will educate the stakeholders about the value of efficiency in their community, thereby improving the sustainability of the plan that is adopted.

3.2 Adjust the database to simulate alternatives.

Modify the database used in Step 2 to simulate each Planning Alternative. Housing density, for example, may change from the Business-as-Usual Alternative. If so, make corresponding corrections in dwelling unit size and energy demand.

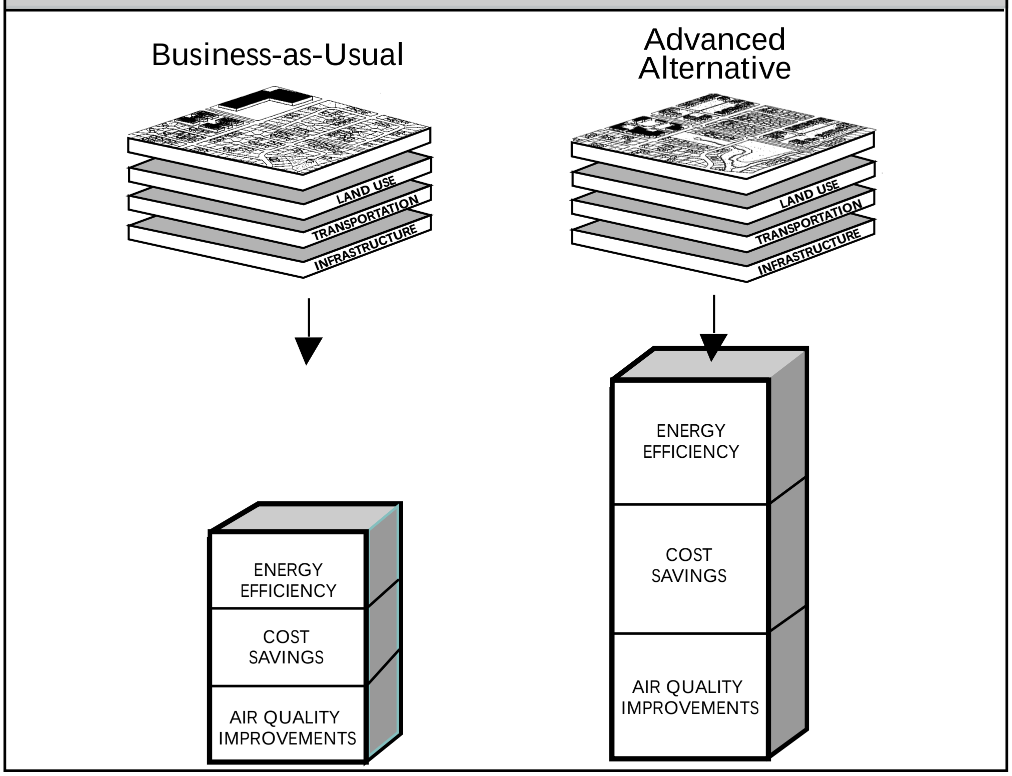
3.3 Estimate energy use, costs, and air pollutant and CO_2 emissions of each Planning Alternative.

Repeat Step 2.2 for each of the alternatives.

3.4 Apply efficiency rating criteria and compare alternatives.

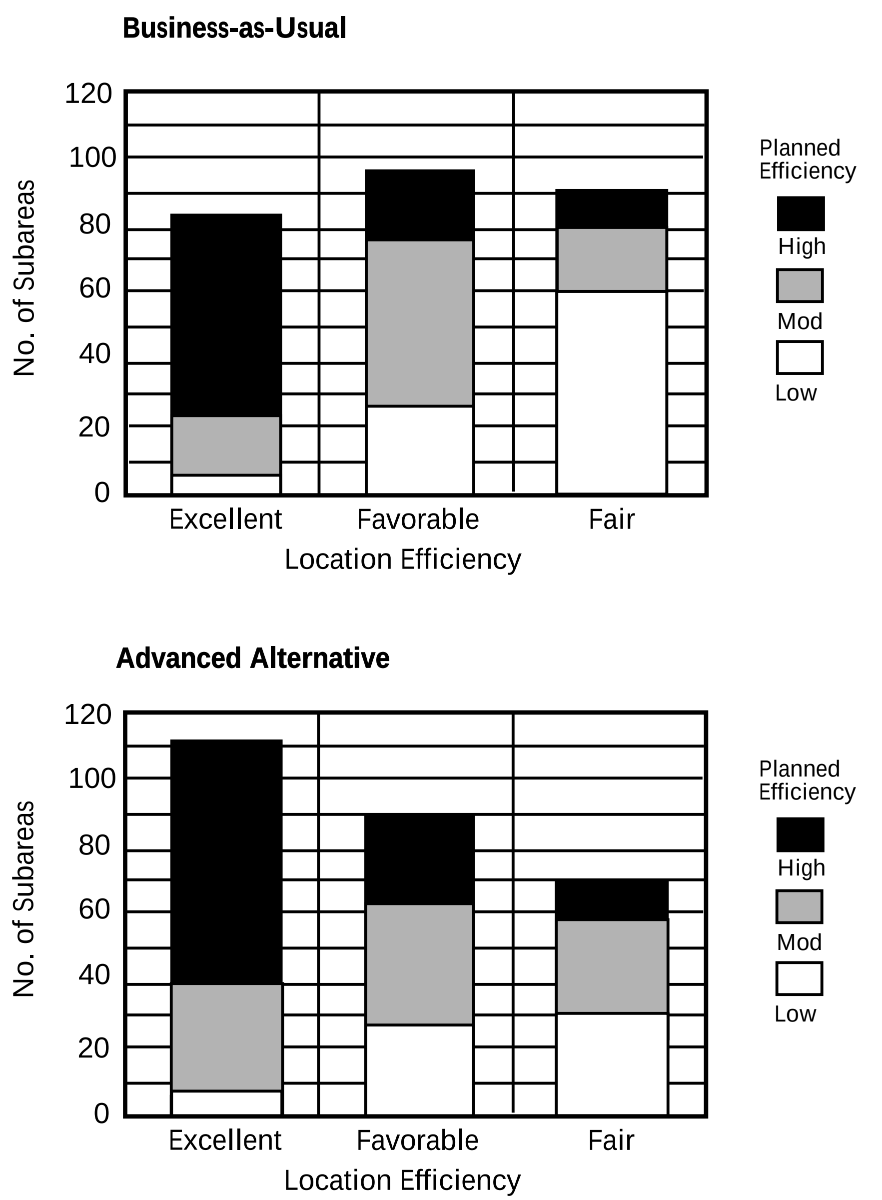
Use the same set of efficiency rating criteria from Step 2.3 to rate each of the Planning Alternatives. Compare the alternatives against each other and the Business-as-Usual Alternative to reveal total and percent differences in:

FIGURE 3.17
COMPARISON OF ENERGY EFFICIENCY BENEFITS OF PLANNING ALTERNATIVES



- Total energy use, costs, and air pollutant and CO_2 emissions as Figure 3.17 shows.
- Per capita energy use, costs, and air pollutant and CO_2 emissions.
- Energy use per unit of land area.
- Number of subareas that are well located and that have land use designations that will take advantage of the efficient location, as Figure 3.18 shows.

FIGURE 3.18
COMPARISON OF EFFICIENCY RATINGS OF ALTERNATIVES



3.5 Conduct public review of the Planning Alternatives.

Assemble the results of Step 3 and review them with the stakeholder committee, other appropriate bodies, and the public. It is again important to supplement PLACE^{3}S results with visual illustrations of the alternatives being considered, particularly design features relevant to citizens at the neighborhood level. The major objective of this task is to compare each alternative against the evaluation criteria from Step 1.6 and inform stakeholders about the types and extent of differences among the Planning Alternatives.

Step 4: Create the Preferred Alternative

4.1 Conduct stakeholder selection of Preferred Alternative.

Present data and maps describing the energy, economic and environmental conditions expected to occur under Business-as-Usual (Step 2) and under each Planning Alternative, including the Advanced Alternative (Step 3) to stakeholders and public. Use the evaluation criteria in a stakeholder discussion of community tradeoffs. Construct a Preferred Alternative from the components of the Business-as-Usual and Planning Alternatives. Use techniques such as design charrettes to assist in selecting preferred features from the alternatives. The Preferred Alternative should eventually become the adopted plan.

4.2 Adjust database to simulate the Preferred Alternative.

Repeat the Step 3.2 database adjustment to ensure accurate measurement of the Preferred Alternative.

WHAT IS A CHARRETTE?

A charrette is an interactive, concentrated period of creative thinking. Charrettes are used to create and illustrate a *collective* vision for the future of a region or a neighborhood. Components of the vision can be just about anything, but often include location of public facilities, business and residential development; architectural style; landscaping; transportation infrastructure, including bicycle and pedestrian needs; and amount, rate and placement of growth. Participants in a charrette should include anyone who lives, works, plays, or has some interest in the well being of the area affected by the design project. Typically, participants are stakeholders such as residents, merchants, property owners, elected and appointed officials, financiers, and service providers (e.g., utilities).

A charrette can last for a few hours, several days, or take place over many weeks. The duration is a function of the complexity of the task, degree of public activism, visibility of the project, and quality and public support for past design work governing the project site. Charrettes generally are facilitated by urban design or architecture professionals capable of spontaneously illustrating participants' vision and assembling the information into a final vision upon which the participants agree.

4.3 Prepare energy use estimates and efficiency ratings.

Repeat the energy estimation and efficiency rating steps for the Preferred Alternative. These results will be used as benchmarks for monitoring and evaluation in Step 5.

4.4 Conduct public review of Preferred Alternative.

Assemble summary information describing the Preferred Alternative and disseminate it to appropriate regional and local bodies and the public at large. Use the regional evaluation criteria from Step 1.6 to describe the benefits of the Preferred Alternative. The objective is to communicate the character of the Preferred Alternative, the reasons that led the stakeholders to support it, and the benefits that the region should expect from its implementation.

Step 5: Adopt, Implement and Monitor

5.1 Adopt the Preferred Alternative

If the process concludes successfully, the local planning commission or elected officials will adopt the Preferred Alternative as the final plan. Following plan adoption, modify public information materials to reflect final changes to the plan. Disseminate this information regionally to appropriate stakeholder audiences and official bodies. Begin the regional adoption procedure and encourage local-level adoption and implementation.

5.2 Select monitoring benchmarks.

Use results from Step 4.3 to select key indicators of regional efficiency. Then, use these indicators to monitor the plan's implementation. Appropriate benchmarks include:

- Per capita use of energy;
- Percent of per capita personal income spent on energy;
- Per capita air pollutant and CO_2 emissions from energy consumption;
- Energy use per unit of land area;
- Number of subareas scoring in the high planned efficiency categories of the three location groups; and
- Ratio of total regional energy expenses to total number of regional energy jobs.

5.3 Periodically collect and report performance data.

Use stakeholder assistance to assemble benchmark data every two to five years to determine whether the plan's implementation is providing savings. Disseminate information from this periodic monitoring and evaluation to regional stakeholders on how effective the plan is and whether stronger or modified measures are needed.

NEIGHBORHOOD PLANNING

Chapter 4

CREATING EFFICIENT NEIGHBORHOODS

The PLACE3S method can help communities plan and design sustainable neighborhoods by employing urban design principles reminiscent of traditional community land-use patterns. These traditional communities, built before every family owned one or more automobiles, tend to be compact and inherently energy efficient.

Neighborhoods designed using the PLACE3S method will be compact with a mix of housing, shops, offices, schools, parks, and other recreation easily available by walking, bicycling, and using transit, as well as by using a car. People are seeing the benefits of having a mix of housing, stores and services in a neighborhood. These neighborhoods are energy efficient and cost residents less. They have good access to local and regional transportation networks and are connected to community water, sewer, and energy infrastructure. Some use local sources of energy.

Figure 4.1 is a sampling of the principles that planners, developers, and neighbors are increasingly using. Planning opportunities for using these ideas at the neighborhood level include:

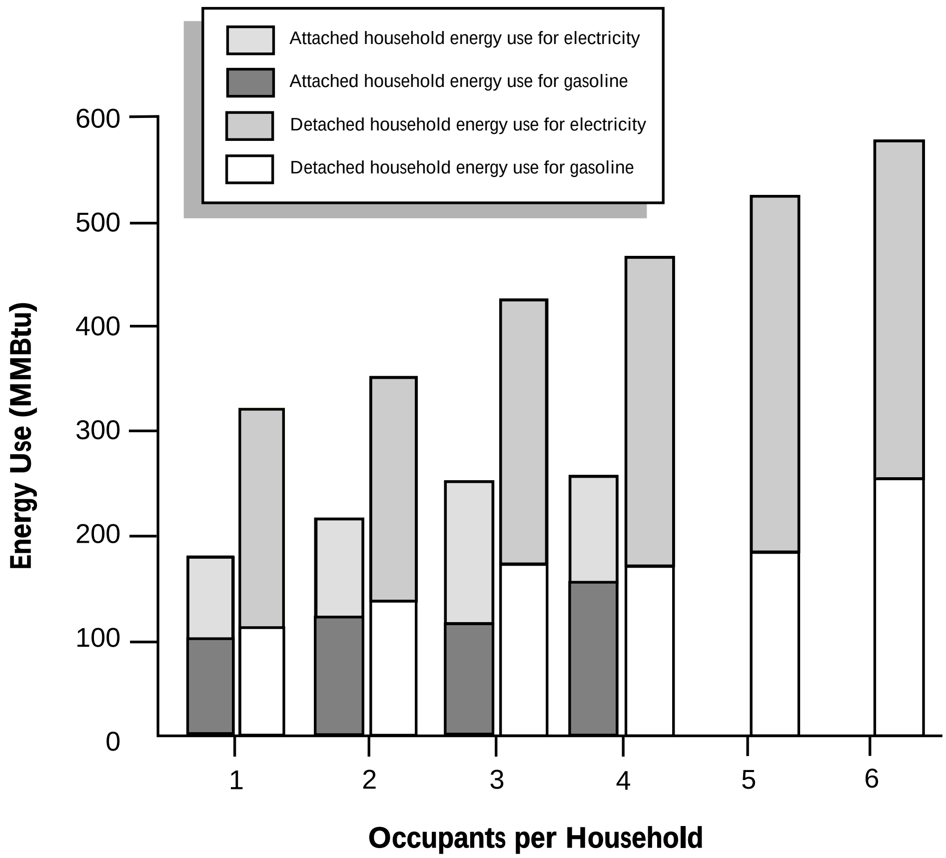
> "The issues raised by land use conflicts are symptomatic of a failure critically to analyze the implications of environmental sustainability, in all its dimensions, for economic activity."
>
> **Susan Owens,**
> Land Use as an Instrument of Sustainable Development

FIGURE 4.1
A DOZEN DESIGN IDEAS FOR EFFICIENT NEIGHBORHOODS

1. Reduce and/or relocate yards to allow for increased densities.
2. Mix housing types—single family, town homes, apartments, co-housing.
3. Hide the garage in an alley or side yard and emphasize front porches.
4. Make the streets narrow and the sidewalks wide to slow traffic and encourage walking and interaction with neighbors.
5. Reduce the number of cul-de-sacs, and connect streets so that pedestrians, bikes, and autos can travel in short, convenient routes.
6. Improve connections to transit to encourage its use.
7. Bring back the corner store and other neighborhood shops so that people can shop without driving.
8. Shrink parking lots to save land and pavement and discourage dependence on the automobile.
9. Work at home to reduce the number and length of work trips.
10. Use the sun for heating and lighting to reduce energy costs and air pollution.
11. Use trees and community gardens for cooling to reduce energy costs and improve the pedestrian environment.
12. Use shared energy production systems at the neighborhood center for economies of scale and better efficiencies.

Adapted from Felsenthal, 1995.

FIGURE 4.2
COMPARATIVE NEIGHBORHOOD EFFICIENCIES BY HOUSING TYPE



In 1990, the Florida Solar Energy Center surveyed 10 neighborhoods totaling approximately 300 households to determine relationships between land-use, density, dwelling types, travel behavior, and energy use. Major findings included:

- Detached households consumed 85 to 99% more energy than attached households of equal size.
- Detached households consume more gasoline than attached households of equal occupancy.
- Forty-seven percent of attached households reported that someone walked or biked to a store or park as opposed to just 17% of detached households.
- Detached households consume substantially more electricity than attached households of equal occupancy.
- Distances to work, schools, and most errand trips were shorter for attached households.
- Food store was easily accessible by walking or bicycling according to 42% of attached households as compared to only 4% of detached households.

- Neighborhood-specific planning done as a part of citywide comprehensive planning
- Planning for a major “greenfield” project that will create all or part of a new neighborhood
- Neighborhood infill planning where one or more large, vacant sites are being developed or redeveloped
- Urban renewal planning in under-used or blighted areas
- Transit station area and corridor planning where new or expanded transit service is integrated into a neighborhood

Energy relationships are numerous and complex within neighborhoods. Housing, employment, recreation, travel, infrastructure, and use of local renewable energy resources all affect energy use or supply. Figure 4.2 shows a good example of the relationship between neighborhood development and energy use. Taken from a Florida Solar Energy Center survey, it illustrates the lower housing and transportation energy demands of higher-density residential areas.

Applying energy data at the neighborhood level is similar to the regional PLACE^{3}S procedure. In fact, many data from a regional PLACE^{3}S analysis apply to neighborhood studies. For example, energy use, cost, and air pollutant and CO_2 emission coefficients are normally reusable at the neighborhood level. In contrast to regional planning, neighborhood evaluations can also include much more design detail in planning alternatives. Neighborhood energy planning can look for efficiency at the block or building levels. The neighborhood-level PLACE^{3}S design approach is described in Figure 4.3. It functions as a framework for selecting and applying efficiency measures from the PLACE^{3}S menu in Figure 2.3.

FIGURE 4.3
PLACE^{3}S NEIGHBORHOOD DESIGN APPROACH

Minimize Energy Demands

1. Use large-scale land forms and microclimate to identify the most weather-protected development sites, which will reduce building heating and cooling demands.
2. Consider small-scale land forms, landscape, existing buildings and pavement, solar orientation, and other issues that affect microclimate when subdividing parcels and siting buildings to further reduce building energy demands.
3 Increase land-use mixes and densities to reduce travel requirements, to further reduce building heating and cooling demands, and to increase infrastructure operating efficiencies.
4. Orient circulation and parking to pedestrians, bicycles, and transit to reduce auto dependence; and, provide infrastructure for alternative transportation fuels.
5. Minimize infrastructure and optimize its operation to reduce embodied and life-cycle energy needs.

Optimize Energy Supplies

6. Maximize the use of on-site renewable energy resources and high-efficiency technologies to rely less upon imported energy and reduce demands for grid-delivered electricity and natural gas, thereby prolonging the existing energy infrastructure's ability to deliver adequate supplies.
7. Interconnect with electric and natural gas grids at locations with sufficient capacity to avoid or minimize the need for new transmission or distribution lines and equipment.

NEIGHBORHOOD PLANNING STEPS

Figure 4.4 summarizes the five-step PLACE^{3}S neighborhood process. These planning steps are similar to the regional planning process. It would be worthwhile to review the regional process even if the reader is mainly interested in neighborhood-level studies.

FIGURE 4.4
PLACE^{3}S NEIGHBORHOOD PLANNING PROCESS

STEP 1: START-UP

1.1 Establish PLACE^{3}S relationship to neighborhood planning processes.
1.2 Initiate public involvement.
1.3 Assemble data on existing conditions.
1.4 Estimate existing energy use, costs, and air pollutant and CO_2 emissions.
1.5 Formulate neighborhood planning evaluation criteria.

STEP 2: CREATE BUSINESS-AS-USUAL ALTERNATIVE

2.1 Project land-use and travel conditions.
2.2 Estimate energy use, costs, and air pollutant and CO_2 emissions.
2.3 Conduct public review of Business-as-Usual Alternative.

STEP 3: CREATE AND ANALYZE PLANNING ALTERNATIVES

3.1 Formulate alternatives.
3.2 Evaluate residental and non-residential energy.
3.3 Evaluate transportation energy.
3.4 Evaluate infrastructure.
3.5 Evaluate energy supplies.
3.6 Conduct public review of comparative results.

STEP 4: CREATE PREFERRED ALTERNATIVE

4.1 Conduct stakeholder selection of Preferred Alternative.
4.2 Estimate energy use, costs, and air pollutant and CO_2 emissions.
4.3 Conduct public review.

STEP 5: ADOPT, IMPLEMENT AND MONITOR

5.1 Adopt and disseminate plan.
5.2 Select monitoring benchmarks.
5.3 Periodically collect and report performance data.

Step 1: Start-Up

1.1 Establish PLACE³S relationship to the neighborhood planning processes.

If PLACE³S is being done as a stand-alone project, define the scope and objectives of the project. Stakeholders will refine these in Step 1.2. If PLACE³S is part of another neighborhood planning process, identify ways to save energy through the goals and objectives of that process. Look for ways to integrate the five PLACE³S planning steps into other, already established processes. Set a target year consistent with other planning processes.

1.2 Initiate public involvement

Use existing neighborhood advisory organizations or convene a broad group of stakeholders to advise the PLACE³S project. Interview key neighborhood stakeholders at the outset to ensure that the PLACE³S methodology correctly addresses important neighborhood issues. This will also help in data collection and help to build the personal communication and trust needed to support the project.

Conduct a public workshop in the neighborhood to inform residents and business owners of the PLACE³S approach. Explain how they can be involved. Collect information about their values and visions to include in the evaluation criteria described in Step 1.5. Establish a regular briefing schedule with official neighborhood organizations, as well as the community's planning commission and elected officials.

1.3 Assemble data on existing conditions

As with regions, subdivide neighborhoods into logical units based on land area and the availability of subarea information. Large neighborhoods may comprise several traffic analysis zones (TAZs) from a regional transportation model, which could be used to tabulate neighborhood data. (See Chapter 3.) However, more detailed geographic information than the TAZ-level of analysis can achieve is needed to capture the energy effects of smaller-scale design features. Therefore, blocks are better subareas because they make it possible to measure accurately the physical details of a neighborhood. Once neighborhood subareas are identified, assemble the same data set described in Step 1.3 of the regional process. Again, consider increasing the level of detail to reflect unique neighborhood characteristics. For example, the presence of historic structures would be important information for neighborhood redevelopment planning because it could identify buildings that should be saved. This, in turn, could affect the possibility of changing uses or the density of housing near those historic structures.

1.4 Estimate existing energy use, costs, and air pollutant and CO_2 emissions

Assemble a neighborhood baseline of existing energy use for the most recent year for which complete data are available as follows:

Housing. Tabulate energy needed for building and operating neighborhood housing and the consequent costs and air pollutant and CO_2 emissions of such energy use:

- Reuse regional housing types and energy coefficients or establish housing types specific to the neighborhood along with new housing coefficients. Obtain advice on setting coefficients from local energy utilities and agencies, universities, or consultants. For example, regional housing data may be grouped into single-family and multi-family dwellings. At the neighborhood level, these data could be subdivided into single-family attached and detached and multi-family low-rise and high-rise data sets. Each of the housing types will have slightly different energy use coefficients.
- Estimate operating energy use by fuel type in peak and annual terms for space heating, space cooling, domestic hot water, lights, and appliances by multiplying dwelling units by the energy coefficients. Obtain help from local energy utilities and agencies in breaking down energy use by fuel type according to market shares in the neighborhood. For example, low-density residential areas often have mostly natural gas-fueled space heating in contrast to higher-density apartment areas that often use electricity for space heating.
- Estimate annual energy operating costs and air pollutant and CO_2 emissions. Use regional coefficients for these items without adjustment.
- If desired, estimate the energy embodied in constructing the neighborhood's existing or expected homes. Construction-embodied energy is the energy used to manufacture and transport building materials to a site. Square footage coefficients are available in databases published by U.S. Department of Energy, including the 1977 database called Energy Use for Building Construction. See Chapter 8 for other information sources.

"Seen together these studies (Næss and Larsen, 1995) leave a clear impression that urban density really affects energy use for transport."

Peter Næss,
Urban Form and
Energy Use for Transport

Employment. Tabulate the energy needed for neighborhood businesses, the associated energy costs, and pollutant and CO_2 emissions. As with housing, use regional coefficients if neighborhood business types are similar to regional types, or prepare neighborhood-specific coefficients. In some neighborhoods this category may include industries where process loads must be counted with owner assistance. These cannot be estimated with standardized coefficients because of the great variance in different industrial energy uses. For example, food processing plants can have widely varying requirements for hot water depending on their size and type of product.

Transportation. Tabulate the travel energy demands of neighborhood residents and workers according to trip generation rates, trip purposes, mode splits, and trip lengths. See Figure 3.6 for coefficient information. Use one or a combination of the following tools to estimate neighborhood conditions:

- A regional transportation model, if its TAZs match neighborhood boundaries
- A micro-site traffic model, which may be available from an agency or consultant; and/or
- Travel surveys that may have been done for the neighborhood or similar parts of the community

Multiply the motorized portion of the travel demands by regional transportation energy coefficients to obtain energy use, cost, and air pollutant and CO_2 emissions by fuel type.

Infrastructure. Tabulate the energy use, costs, and air pollutant and CO_2 emissions associated with the following infrastructure:

- Water supply. Estimate embodied energy according to the type and length of water pipelines and operating energy for any pump stations and treatment facilities located in the neighborhood (or for a fraction of a nearby pump station or treatment facility operation that is allocated to the neighborhood).
- Wastewater collection. Estimate embodied energy for storm water and sanitary sewer systems according to the type and length of wastewater pipelines. Calculate operating energy for any pump stations and treatment facilities, as described above for water supply.
- Street lights. Estimate operating energy according to the number and type of streetlights.
- Traffic signals. Estimate operating energy by the type and number of signal units.

On-site resources and technologies. Inventory the neighborhood for existing renewable energy use, such as direct solar, and for high-efficiency supply systems, such as district heating and cooling. Measure existing installations according to number and type, installed capacities, and annual output. This identifies the fraction of neighborhood demands that are being met with neighborhood resources.

Off-site supplies. Tabulate that portion of the neighborhood's energy demand that must be met with off-site supplies as follows:

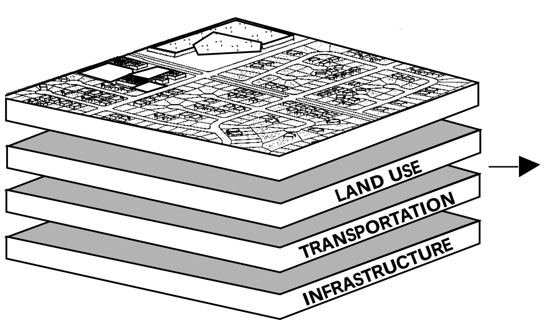
- Electricity. Subtract the estimated on-site production from the neighborhood's total electric needs to find the amount of electricity that must be "imported" into the neighborhood via the community's electric grid.
- Natural gas. Subtract the amount of on-site thermal production that displaces natural gas to find the amount of natural gas needed from the community grid.
- Transportation fuels. Subtract any neighborhood-based transportation energy production, such as photovoltaic vehicle charging, from the total travel energy demand to find the amount of conventional transportation fuel needed.

Tabulate costs and air pollutant and CO_2 emissions for each of these three supply categories using the regional coefficients described earlier.

Figure 4.5 summarizes the results of the existing conditions step.

FIGURE 4.5
EXISTING CONDITION RESULTS

Existing Conditions



Housing:	2,500 billion Btu/yr $30 M/yr 180,000 tons CO_2/yr
Employment:	1,100 billion Btu/yr $20 M/yr 100,000 tons CO_2/yr
Transportation:	8,300 billion Btu/yr $180 M/yr 825,000 tons CO_2/yr
Infrastructure:	900 billion Btu/yr $15 M/yr 75,000 tons CO_2/yr

1.5 Formulate neighborhood planning evaluation criteria

Develop evaluation criteria to measure the strengths and weaknesses of alternative neighborhood plans. There are many issues to address in the criteria in addition to energy efficiency. Figure 4.6 gives some examples of public values and criteria used to compare different planning and design options.

FIGURE 4.6
SAMPLE: NEIGHBORHOOD PLAN EVALUATION CRITERIA

Public Value	Evaluation Criteria
Clean air	Number of days in compliance with clear air regulations
Safe streets and crime	Per capita number of serious traffic accidents
Personal travel choices	Percent of population using non-auto travel modes
Local shopping	Percent of population living within one-quarter mile of shopping
Nearby play	Percent of population living within one-half mile of neighborhood park
Diverse neighborhood	Percent of minority residents in population
Affordable housing	Percent of low income residents
Efficient resource use	Total energy use and cost per capita

Step 2: Create Business-as-Usual Alternative

Project the Business-as-Usual Alternative out to the end of the planning horizon to simulate what the neighborhood would be like if existing policies and market trends continue unchanged.

2.1 Project land-use and travel conditions.

Assemble a land-use and travel demand profile for the horizon year by modifying Step 1.3 information. Use an assumed build-out of the neighborhood based on allowable land-uses and market trends. Estimate travel demands for the projected level of development.

2.2 Estimate energy use, costs, and air pollutant and CO_2 emissions.

Use the same method described in Step 1.4 to estimate energy needs for the modified land-uses and travel demands. Figure 4.7 summarizes the results of the future base case.

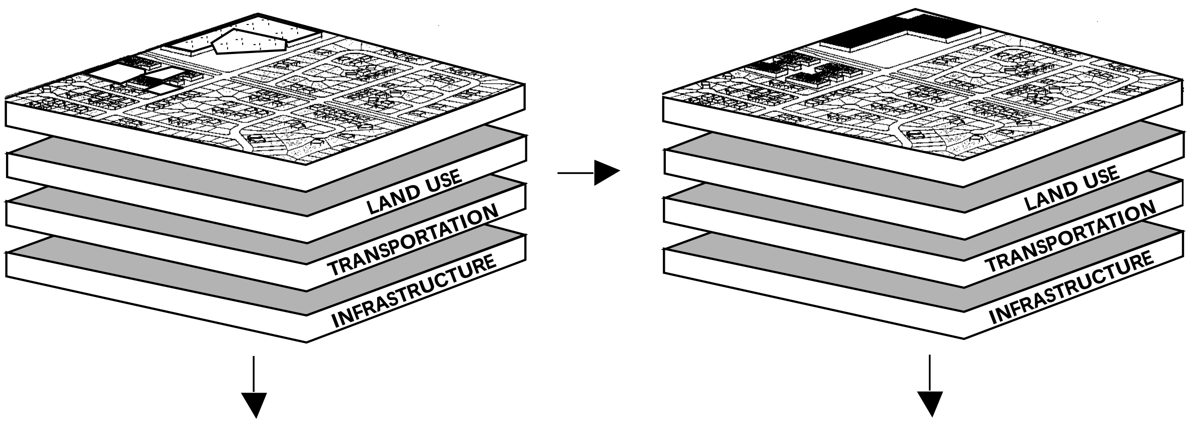
2.3 Conduct public review of the Business-as-Usual Alternative

Assemble the findings of the Business-as-Usual Alternative, including visual images of neighborhood features, to supplement tabular data and mapping. Review these materials with the advisory committee to confirm their accuracy. Use the neighborhood plan evaluation criteria from Step 1.5 to analyze the strengths and weaknesses of the Business-as-Usual Alternative.

Conduct a neighborhood workshop to present the findings of the assessment of the Business-as-Usual Alternative and the neighborhood plan evaluation criteria. Solicit public reaction to the merits of the Business-as-Usual Alternative. Use this input in Step 3.1 to help establish the planning alternatives. Following the workshop, brief the community's elected officials and planning commission on the results of the assessment of the Business-as-Usual Alternative and implications for alternative planning options. Also, disseminate Business-as-Usual results widely in the neighborhood itself to encourage participation in Step 3.

FIGURE 4.7
BUSINESS-AS-USUAL RESULTS

Existing Conditions | Business-as-Usual



Existing Conditions

Housing:	2,500 billion Btu/yr $30 M/yr 180,000 tons CO_2/yr
Employment:	1,100 billion Btu/yr $20 M/yr 100,000 tons CO_2/yr
Transportation:	8,300 billion Btu/yr $180 M/yr 825,000 tons CO_2/yr
Infrastructure:	900 billion Btu/yr $15 M/yr 75,000 tons CO_2/yr

Business-as-Usual

Housing:	3,000 billion Btu/yr $36 M/yr 216,000 tons CO_2/yr
Employment:	1,320 billion Btu/yr $24 M/yr 120,000 tons CO_2/yr
Transportation:	9,960 billion Btu/yr $220 M/yr 990,000 tons CO_2/yr
Infrastructure:	1080 billion Btu/yr $18 M/yr 90,000 tons CO_2/yr

Step 3: Create and Analyze Planning Alternatives

3.1 Formulate alternatives.

Most neighborhood planning processes with which PLACE^{3}S may be included are likely to have several alternative views of the future. The PLACE^{3}S methodology can analyze these in their original form. It can then re-evaluate them after they are modified with efficiency measures from the menu in Figure 2.3.

> "A community that does not scrutinize every significant proposal for new growth is gambling its future as surely as would a trip to Las Vegas with the municipal treasury. We can no longer heedlessly assume that any expansion will strengthen the community's economy."
>
> **Michael Kinsely & Hunter Lovins,** *Paying for Growth, Prospering from Development*

In the case of a stand-alone PLACE^{3}S project, define alternatives using stakeholder participation and the results of previous workshops. Establish alternatives that address the full range of public concerns so that all stakeholders can see their interests represented in one or more scenarios.

In both coordinated and stand-alone applications, one of the alternatives should be an "Advanced Alternative" that maximizes energy efficiency to demonstrate the full theoretical potential of sustainable development. The following subsections focus on the PLACE^{3}S menu of efficiency measures (Figure 2.3) and how they are used in the construction and analysis of alternatives.

3.2 Evaluate residential and non-residential energy

Tabulate energy needed for residential and non-residential (employment-related) uses. Tabulate the costs and air pollutant and CO_2 emissions of the energy used under each alternative. The following eight items present PLACE^{3}S efficiency measures according to their neighborhood design implications and discuss ways to adjust energy calculations to reflect differences in planning alternatives.

General siting and layout. In cases of a totally new or "greenfield" development, siting and layout options can be selected to take maximum advantage of the area's climate. Figure 4.8 summarizes siting considerations for the nation's four major climate zones. Figure 4.9 illustrates basic techniques for energy-efficient microclimate modification. Making major changes between alternatives in siting groups of homes and businesses requires remeasurement of heating and cooling demands. Obtain assistance from technical stakeholders or consultants to calculate the different heating and cooling demands. Ideally, a computer model of a few typical buildings for the neighborhood will estimate their heating and cooling demands under various siting and microclimatic conditions. Multiply the number of buildings of each type by the appropriate energy coefficient.

Density. Residential and non-residential density have major impacts on neighborhood energy demands. Both correlate significantly with auto driving. Figure 4.10 illustrates a range of residential densities. Recalculate building heating and cooling if the density changes affect the number of buildings with shared walls. For example, if a planning alternative changes part of a neighborhood from single-family residential to higher density apartments, the space heating required per square foot of dwelling could decline as much as 10 to 15 percent.

Mix. Land-use mix is also a powerful efficiency measure. Mixed-uses allow more efficient use of energy supplies because energy supply equipment and generation capacity can be shared among users. For example, a district heating and cooling system may become feasible with a broader variety of users nearby. Part 3.5 of this methodology discusses energy calculation adjustments needed for off-site energy use.

Solar orientation. Orienting neighborhood streets and lots to allow for passive and/or active solar use by buildings is a major efficiency opportunity in all regions of the nation. As shown in Figure 4.11 for five typical home styles in a cooling-dominated climate, orientation alone can reduce energy costs 10 to 30 percent. Solar orientation produces smaller, but still significant energy savings in heating-dominated climates. Therefore, changes in street or lot pattern orientation between alternatives require recalculation of energy needed for lighting, space heating, and cooling to account for changes in solar gain.

Landscaping. Strategic planting of trees and shrubbery can protect buildings from cold winter wind and hot summer sun. Figure 4.12 illustrates air conditioning savings from tree planting in different communities. Major changes in landscape location and density require remeasurement of space heating and cooling.

Exterior colors. In warm climates, lighten the color of exterior surfaces to decrease absorption of the sun's heat and cut the amount of energy needed to cool the building. Major changes in exterior surface colors require recalculation of space cooling energy demand.

FIGURE 4.8
ENERGY EFFICIENT SITING STRATEGIES BY CLIMATE ZONE

Objectives	Cool	Temperate	Hot, Humid	Hot, Arid
Adaptions	Maximize warming effect of solar radiation. Reduce impact of winter wind. Avoid local climatic cold pockets.	Maximize warming effects of sun in winter. Maximize shade in summer. Reduce impact of winter wind but allow air circulation in summer.	Maximize shade. Maximize wind.	Maximize shade late morning and all afternoon. Maximize humidity. Maximize air movement in summer.
Position on slope	Low for wind shelter.	Middle-upper for solar radiation exposure.	High for wind.	Low for cool air flow.
Orientation on slope	South to southeast.	South to southeast.	South.	East-southeast for P.M. shade.
Relation to water	Near large body of water.	Close to water, but avoid coastal fog.	Near any water.	On lee side of water.
Wind buffering/channeling	Sheltered from north and west.	Avoid continental cold winds.	Sheltered from north.	Exposed to prevailing winds.
Clustering	Around sunny areas.	Around a common, sunny terrace.	Open to wind.	Along E-W axis, for shade and wind.
Building orientation	Face southeast.	Face south to southeast.	Face south, toward prevailing wind.	Face south.
Trees	Deciduous trees near building, evergreen for windbreaks.	Deciduous trees nearby on west. No evergreens near on south.	High canopy trees. Use deciduous trees near building.	Trees overhanging roof if possible.
Road orientation	Crosswise to winter wind.	Crosswise to winter wind.	Broad channel, E-W axis.	Narrow, E-W axis.
Materials coloration	Medium to dark.	Medium.	Light, especially for roof.	Light on exposed surfaces, dark to avoid reflection.

Source: Adapted from American Institute of Architects, 1991.

FIGURE 4.9
ENERGY EFFICIENT SITING TECHNIQUES BY COMFORT OBJECTIVE

To make it warmer:
- Maximum solar exposure
- Paved areas, rock or masonry surfaces, south slopes for increased absorption of radiation
- Structural or plant "ceilings" to reflect back outgoing radiation at night
- Sun pockets
- Wind breaks and cold air diverters

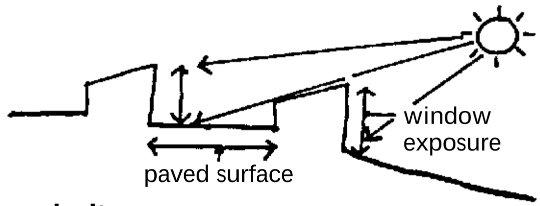
To make it cooler:
- Shade trees and vines
- Overhangs, awnings, canopies (cooler in day time, warmer at night)
- Light-colored roofs and pavement
- Planted ground covers, minimum pavement
- Pruning of lower growth for increased air circulatlon
- Evaporative cooling (sprinklers, pools, ponds and lakes)

To make it less windy:
- Wind breaks, baffles, diverters (plant material and structures)
- Berms, landform
- Semi-enclosed outdoor living areas

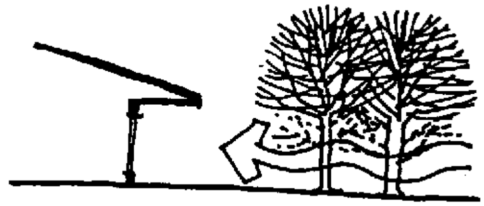
To make it breezier:
- Pruning of low branches of trees
- Minimum low plant growth
- Creation of breeze ways (structural and planted)

To make it more humid:
- Overhead planting (slows evaporation and adds transpiration)
- Low windbreaks

To make it dryer:
- Maximum solar exposure
- Maximum ventilation
- Efficient drainage system
- Paved ground surfaces

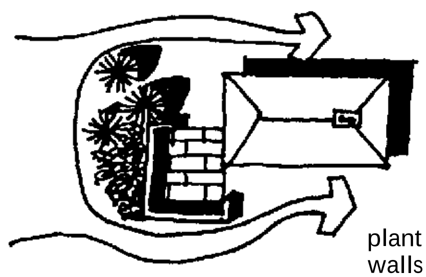


To make it warmer



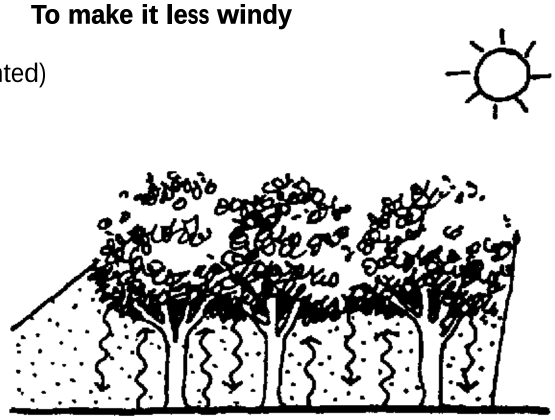
To make it cooler

prune lower growth
for increased air circulation



plant material,
walls to divert wind

To make it less windy



To make it more humid

overhead planting slows
evaporation adds transpiration

Adapted from the American Institute of Architects, 1991.

Water features. Sprinklers, pools, and lakes near buildings can provide evaporative cooling. Locating buildings near large water bodies requires remeasurement of space cooling energy demand.

Building materials. Recycled materials or items made from local resources can reduce energy used in constructing buildings. Using indigenous or recycled building materials requires remeasurement of construction-embodied energy. The U.S. Department of Energy's Energy Use for Building Construction (1977) database provides information needed to estimate the embodied energy value of a variety of building materials.

FIGURE 4.10
ALTERNATIVE HOUSING DENSITIES

5-7 units/acre* - standard single-family

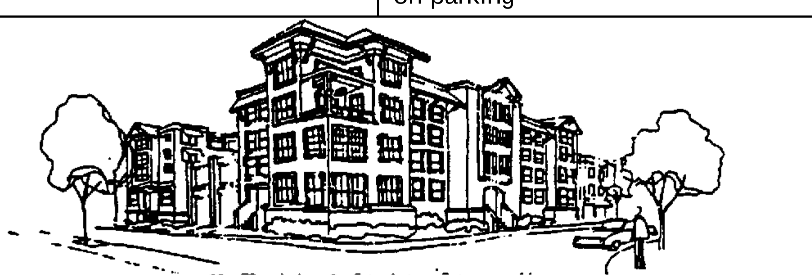
8-12 units/acre* - small lot single-family

12-18 units/acre* - 2-story townhouses

12-20 units/acre* - single family with second unit

15 to 23 units/acre* - 2-story flats

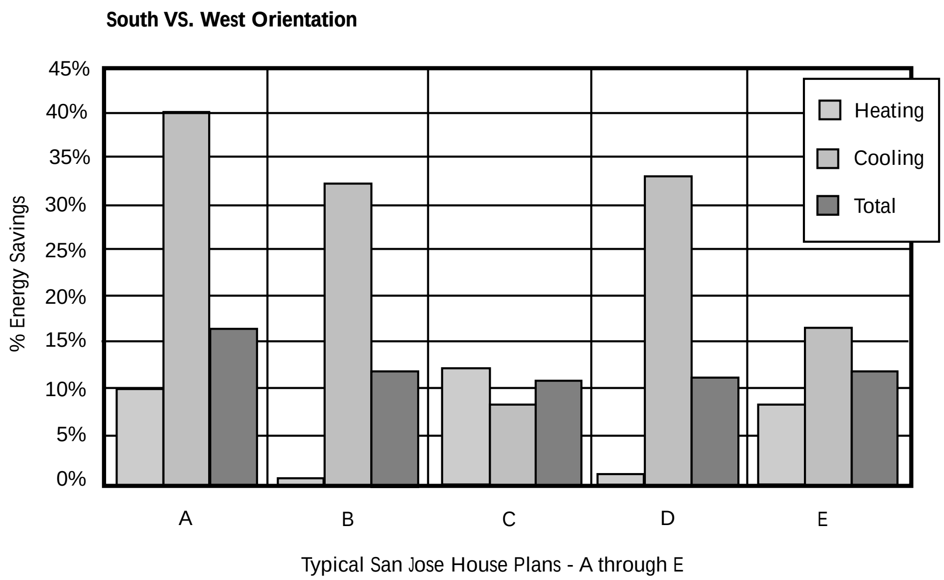
15 to 23 units/acre*- 3-story townhouses on parking



30 - 70 units/acre* - 3 to 4-story flats on parking

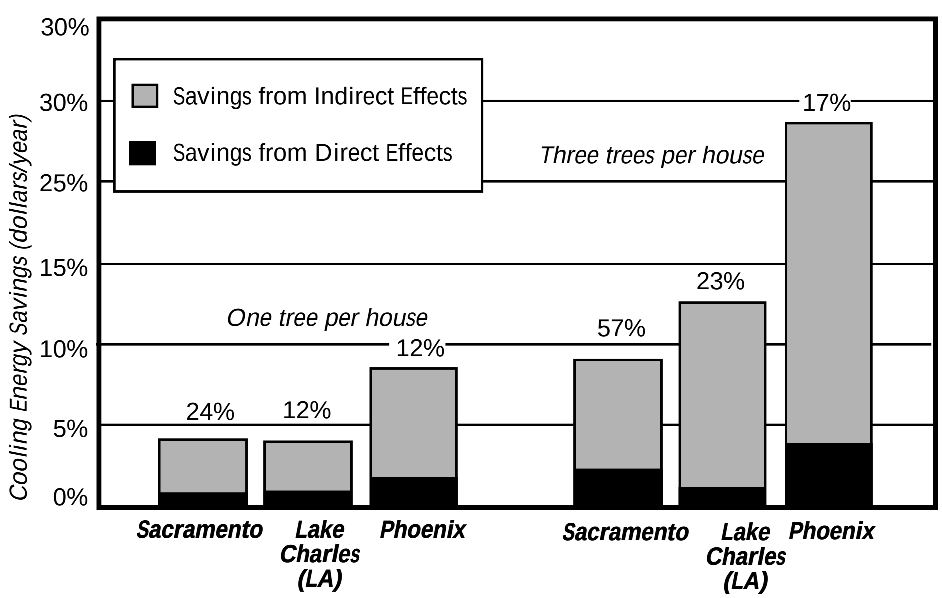
* Dwelling units per net residential acre
Source: California Air Resources Board, 1995

FIGURE 4.11
SOLAR ORIENTATION SAVINGS
SAN JOSE, CA CASE EXAMPLE



Source: City of San Jose, 1991.

FIGURE 4.12
ENERGY SAVINGS OF LANDSCAPING



Percentages refer to savings of total cooling energy. Direct savings include the direct shading effect of a tree on a house; indirect effects include the evapo-transpirative properties of trees. As the number of trees increase, the relative contribution of the indirect effect grows in comparison to the direct effects.

Source: EPA, 1992.

3.3 Evaluate transportation energy

Each alternative will have different travel demands and corresponding transportation options. Estimate the energy use, costs, and air pollutant and CO_2 emissions associated with each alternative. PLACE^{3}S transportation efficiency options include:

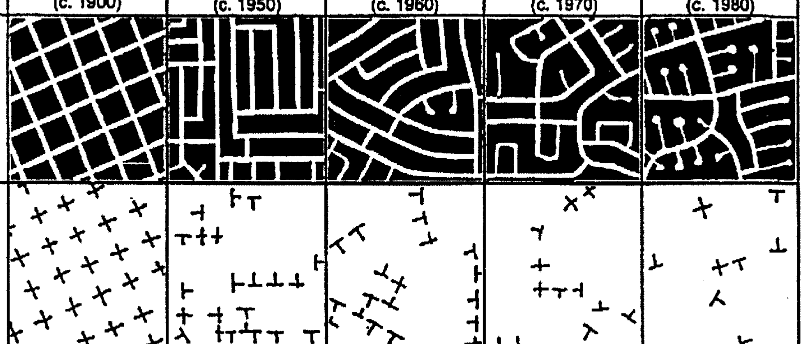
Density. Density correlates significantly with auto driving. Higher densities promote walking, biking, and transit use. Adjust mode split and trip length to account for the fact that people may be more likely to walk for some trips in a denser neighborhood and that transit may be more available. Also, some business trips, such as deliveries, may be shorter.

Mix. Having a mix of shops and community services available within a neighborhood reduces the amount of travel needed to reach them. Changes in land-use mix require reconsideration of travel modes and trip length to account for shifts to walking and bicycling in high mix areas and shorter trip distances in such areas. For example, if a mix of small shops is added to a residential area, residents' shopping trips will be shorter in length and possibly more amenable to walking or biking instead of driving.

After land-use density and mix, street network design is one of the most important determinants of neighborhood efficiency.

Multimodal, interconnected street networks. After land-use density and mix, street network design is one of the most important determinants of neighborhood efficiency. The street pattern heavily influences how conveniently and economically people can move within and to and from a neighborhood. Figure 4.13 illustrates a range of street designs with significantly different levels of accessibility and efficiency.

FIGURE 4.13
ALTERNATIVE STREET NETWORKS



	Gridiron (c. 1900)	Fragmented Parallel (c. 1950)	Warped Parallel (c. 1960)	Loops and Lollipops (c. 1970)	Lollipops on a Stick (c. 1980)
Street Patterns					
Intersections					
Lineal Feet of Streets	20,800	19,000	16,500	15,300	15,600
# of Blocks	28	19	14	12	8
# of Intersections	26	22	14	12	8
# of Access Points	19	10	7	6	4
# of Loops & Cul-de- Sacs	0	1	2	8	24

Examples of established street networks. Each has its own implications for transportation energy, embodied energy and maintenence energy.
Source: Peer, 1990.

Figure 4.14 compares the performance of suburban "loops and lollipops" versus a traditional "gridiron" pattern. Changes in street configurations require remeasurement of mode shares and trip lengths to account for new mode preferences in highly connected networks and the shorter distances of trips in such networks. Ideally, the neighborhood circulation system should be computer modeled to show the effects of various design changes quickly and easily. Transportation agencies, universities, and consultants can provide assistance estimating travel demand.

FIGURE 4.14
COMPARISON OF STREET NETWORK PERFORMANCE

Criteria	Conventional Suburban Development (CSD) Grid Style Street Network	Traditional Neighborhood Development (TND) Non-Grid Style Street Network	Difference
Daily Vehicle Miles of Travel (VMT), Internal Travel			
Arterial Streets	4,340	850	TND is 25% of CSD
Collector Streets	5,400	810	TND is 15% of CSD
Local Streets	1,250	4,600	TND is 4 times CSD
Total VMT	10,990	6,260	TND is 57% of CSD
Volume/Capacity Ratio			
Arterial Streets	0.92	0.83	TND is lower
Collector Streets	0.94	0.87	TND is lower
Local Streets	0.21	0.22	Nearly identical
Level-of-Service (LOS)			
Arterial Streets	D	B	TND has higher LOS
Collector Streets	D	D	Same
Local Streets	A	A	Same

In a well-connected grid street pattern, trips are made on routes dispersed throughout the neighborhood rather than concentrated on a few peripheral collector and arterial streets. The net result is fewer vehicle miles traveled and less congestion, particularly on arterials.

Source: Kulash, 1992.

Pedestrian, bicycle, and transit orientation. It is critical to emphasize direct and convenient pedestrian and bicycle access throughout the neighborhood to reduce auto dependence. Transit facilities should become the focus of neighborhood activity centers, and these locations should be fully integrated with the pedestrian and bicycle circulation system. Making new modes more attractive and, therefore, more likely to be used, will require remeasurement of modal shares in the new design.

High occupancy vehicle facilities. In addition to transit, neighborhoods can increase their efficiency by increasing the number of people in each private vehicle. Integrate facilities for carpooling or employer shuttles, such as dedicated turn-outs or stops, into the neighborhood design. Changes in such facilities require remeasurement of mode share to account for greater use of a mode that is more convenient.

Minimize pavement. Reducing the width of streets has multiple benefits: it slows local traffic; deters through traffic; frees up land for more beneficial uses; reduces costs to build and maintain streets; requires less embodied energy; and improves pedestrian environments by reducing the "heat island" effect of urban development and making streets easier to cross. Major changes in street width require recalculation of mode share and energy embodied in street construction.

Minimize parking and optimize siting. Reduce the size of parking lots to help deter auto dependence, lower the heat island effect, and reduce construction and maintenance-embodied energy. Recalculate auto mode share as a function of the parking supply. In warm climate zones, site parking lots on the north side of buildings to reduce building cooling demands. Recalculate building cooling demands based on the microclimatic effects of parking lot locations next to buildings.

3.4 Evaluate infrastructure.

Tabulate the energy use, costs, and air pollutant and CO_2 emissions associated with constructing and operating the neighborhood infrastructure that results from the alternative plans. In this category, PLACE^{3}S measures include taking advantage of topographical conditions to minimize pumping energy of all types. Minimize the length of pipes and wires through coordination of right-of-way planning and specify high-efficiency or premium motors and fixtures in pump stations and street lights.

Another way to evaluate the infrastructure changes is through cost changes that result from land-use mix and density changes. Figure 4.15 summarizes research demonstrating how infrastructure costs per dwelling unit generally decrease as residential densities increase.

FIGURE 4.15
EFFECTS OF DENSITY ON INFRASTRUCTURE COSTS

Residential Density (dwelling unit/acre)	Costs per Dwelling Unit ($)		
	Streets	Utilities	Schools
0.25	33,500	54,000	17,000
1	17,000	27,000	17,000
3	10,000	15,500	17,000
5	8,000	10,000	17,000
10	6,500	7,000	14,000
12	6,000	8,000	13,500
15	4,500	4,500	14,000
30	2,500	3,000	5,000

3.5 Evaluate energy supplies.

Examine the alternative futures for potential use of on-site renewable resources and high-efficiency supply technologies. The objective is to determine how much of the energy demands tabulated above can be met in a more renewable or sustainable manner than by serving all of the neighborhood's needs with conventional supplies, as shown in Figure 4.16. PLACE³S measures include:

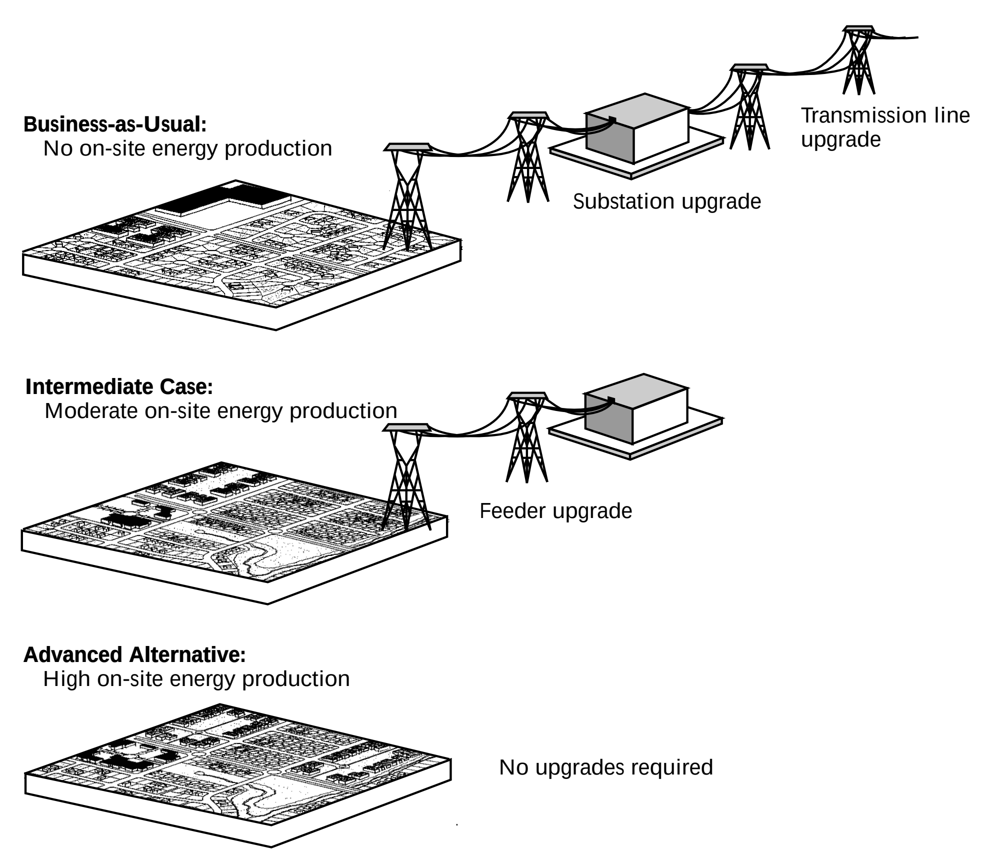
Solar direct-use. This includes passive use through building orientation and active heating and photovoltaic electric systems. Passive and/or active solar use requires recalculation of the amount of fuel needed for space heating, domestic hot water, lighting and other electric uses. Also, see solar orientation discussion in section 3.2 of this chapter.

Geothermal direct-use. Many communities in the western United States have low-temperature geothermal resources that are warm enough to be used directly for building and process heating. These are resources in the 100°F to 180°F range. Geothermal use requires remeasurement of fuel needed for space heating and domestic hot water.

Earth or water source heat pump systems. In many regions, heat pumps coupled to the earth or groundwater can be a highly efficient method of heating and cooling buildings. Use of groundwater and/or surface water in conjunction with heat pumps requires recalculation of space heating and cooling and domestic hot water fuel needs.

District heating and cooling. DHC is the production of hot and cold water at a central neighborhood plant for distribution to nearby buildings for their heating and cooling. Use of DHC requires recalculation of off-site natural gas and electric supplies based upon the amount of those fuels being displaced by DHC.

FIGURE 4.16
OFF-SITE UPGRADE IMPLICATIONS OF PLANNING ALTERNATIVES



Cogeneration. Cogeneration is the process of generating electricity and DHC together to increase the efficiency of both processes. Cogeneration plants are often conventionally fueled, but can sometimes use neighborhood renewable resources as partial fuel sources. Use of a cogeneration plant means that its electrical output can be subtracted from the amount needed from the community grid and its DHC output can be subtracted from displaced conventional heating and cooling fuels.

Solar and/or wind power. In some neighborhoods, solar and/or wind power generation may be feasible, depending upon local resource characteristics and electric rates. Use of solar or wind for power generation allows a reduction in the amount of electricity that must be “imported” into the neighborhood via the community electric grid. Such reductions not only make the neighborhood more self-reliant and sustainable, but also extend the capacity and life of the community electric grid.

Thermal energy storage. In regions that are especially warm or cold, storing thermal energy in the form of hot or cold water can reduce the peak capacity needed by community supply systems during especially hot or cold periods. The efficiency gain of thermal storage can be subtracted from the amount of conventional fuels that would otherwise be required for the neighborhood under peak conditions.

Fuel cell power generation. Although not fully-commercialized, fuel cell power generation is a rapidly emerging technology suitable for neighborhood siting because of its relatively small size and passive operating characteristics. Fuel cells can be either renewable or non-renewable sources of energy, depending upon the fuel source. Again, neighborhood electricity generation reduces off-site supply requirements.

The electric generation technologies listed above are known as "distributed" (rather than "centralized") power plants. These plants are smaller and cleaner than conventional generation systems. For these reasons, they can be located close to the electricity users and provide more efficient power. Figure 4.17 describes the characteristics of various distributed technologies that are now, or soon will be, ready for commercialization.

FIGURE 4.17

NEIGHBORHOOD-SCALE POWER PLANT TECHNOLOGIES

Technology	Generating Capacity	Land Required (square feet)	Commercial Availability	Cost	Fuel or Energy Source
Internal Combustion Engine and Diesel Generator	5 kW to 5 MW	0.9 to 1.3 ft^2/kW	now	$250 to $750/kW	low Btu gas, LPG, diesel
Combustion Turbine	500 kW to 5 MW	0.1 to 0.4 ft^2/kW	now	$400 to $1,000/kW	natural gas, liquid fuels
Fuel Cells	500 to 5 MW	2.5 ft^2/kW	1997 to 2000	$970 to $1,500/kW	natural gas, landfill gas, coal gasification, LPG, propane, nontraditional sources of natural gas
Batteries	1 to 5 MW	3 ft^2/kW	now	$400 to $1,000/kW	off-peak electricity
Photovoltaics	1 to 1 MW	400 ft^2/kW	now	$2 to $8/W	solar energy

Source: Electric Power Research Institute (EPRI)

Based on the on-site production tabulated above, determine how much off-site energy must be imported into the neighborhood to meet the remaining energy demands. Off-site supplies include:

Electricity. Calculate the amount of off-site electricity still needed after accounting for on-site production. Consult with the local electric utility to identify how the neighborhood is served by the community grid and the most efficient grid options for serving the various alternative plans.

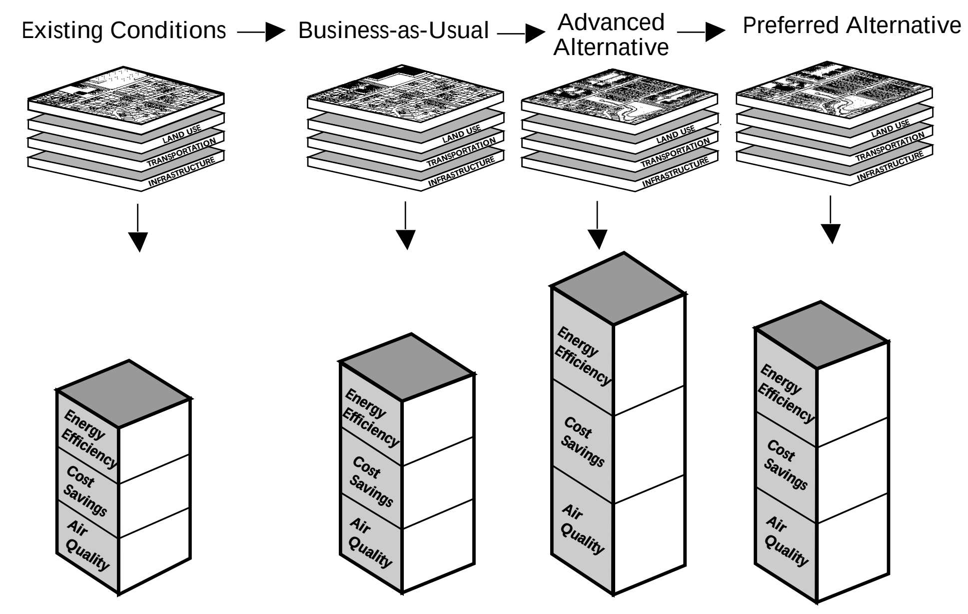
Natural gas. Repeat the same procedure with the local natural gas utility.

Transportation fuels. After accounting for any neighborhood-based transportation energy production, such as solar electric vehicle charging, tabulate the total amount of transportation energy needed for the alternative plans.

Tabulate the energy costs and air pollutant and CO_2 emissions for each of these three supply categories using the regional coefficients described earlier.

Figure 4.18 summarizes the comparison of alternative plans.

FIGURE 4.18
COMPARISON OF ENERGY EFFICIENCY BENEFITS OF ALTERNATIVES



Have the advisory committee rate each alternative using the neighborhood planning evaluation criteria, and disseminate the results widely.

3.6 Conduct public review of comparative results.

Assemble the results for each alternative plan into a comparative summary for stakeholder review and reaction. Prepare visual images that comprehensively describe each alternative. Be sure to explain the efficiency features of the Advanced Alternative. Have the advisory committee rate each alternative using the neighborhood planning evaluation criteria, and disseminate the results widely. Hold a workshop to review the alternatives in detail and to receive input on which alternative, or which parts of the alternatives, are most acceptable. Summarize and disseminate the workshop results to encourage participation in Step 4. Brief the community governing body and planning commission on the alternatives analysis and workshop results.

Step 4: Create Preferred Alternative

4.1 Conduct stakeholder selection of Preferred Alternative.

Present data and maps describing the energy, economic and environmental conditions expected to occur under Business-as-Usual (Step 2) and under each Planning Alternative, including the Advanced Alternative (Step 3), to stakeholders and public. Use the evaluation criteria to determine which components to discard and which to make part of the Preferred Alternative. Use techniques such as design charrettes to assist in selecting preferred features from the alternatives. The Preferred Alternative should eventually become the adopted plan.

4.2 Estimate energy use, costs, and air pollutant and CO_2 emissions.

Repeat the sequence of energy measures described above for the final components of the neighborhood plan. These estimates become long-range goals used to judge the neighborhood's incremental progress toward its future targets.

4.3 Conduct public review.

Continue stakeholder participation and review through the final adoption process of the neighborhood plan by the community planning commission and/or elected officials.

Step 5: Adopt, Implement and Monitor

5.1 Adopt and disseminate plan.

If the process concludes successfully, the local planning commission or elected officials will adopt the Preferred Alternative as the final plan. Following plan adoption, modify public information materials to reflect final changes to the plan and identify the local organizations responsible for implementing each component of the plan. Disseminate this information to appropriate stakeholder audiences and official bodies. Creating widespread awareness of efficiency goals is an important first step toward accomplishing the goals. Appoint an advisory committee to guide the implementation process.

5.2 Select monitoring benchmarks.

Select key indicators of neighborhood efficiency in order to monitor implementation of the adopted plan. Appropriate benchmarks include:

1) per capita use of energy;
2) percent of per capita personal income spent on energy;
3) per capita air pollutant and CO_2 emissions from energy consumption;
4) energy use per unit of land area, e.g., Btu per residential acre; and
5) ratio of total neighborhood energy expenses to total neighborhood energy jobs.

5.3 Periodically collect and report performance data.

With assistance of the advisory committee, assemble benchmark data every two to five years to determine whether the plan's implementation is showing results. This periodic evaluation should be distributed to neighborhood stakeholders to demonstrate how effective the plan is and determine if there is need for stronger or modified measures.

SPECIAL USES

ELECTRICITY AND NATURAL GAS PLANNING

Chapter 5

The arrangement of land-uses in a community has significant influence on the type, location and capacity of electrical transmission lines and natural gas systems. From a utility's perspective, PLACE^{3}S can help reduce the uncertainty inherent in community growth and development by providing utility resource planners with a "seat at the table" to help shape the overall energy market being served. PLACE^{3}S can help utilities and communities avoid capacity shortages, emergency or disaster-related service interruptions, and sometimes, the need for new or expanded transmission and distribution (T&D) facilities.

PLACE^{3}S is an ideal planning tool for cooperation between communities and their electricity and natural gas utilities. Community planners create the markets that electricity and natural gas utilities must ultimately serve. PLACE^{3}S describes the community in energy terms. It allows utility planners to view prospective patterns and sizes of demands. They can then work with community planners to make the connection between demands and distribution networks as efficient as possible. Figure 5.1 shows an example from Vancouver, B.C., where growth is straining the electric grid in several "hot spots."

"PLACE^{3}S provides tools to determine the optimum utility facilities plan to meet alternative growth scenarios."

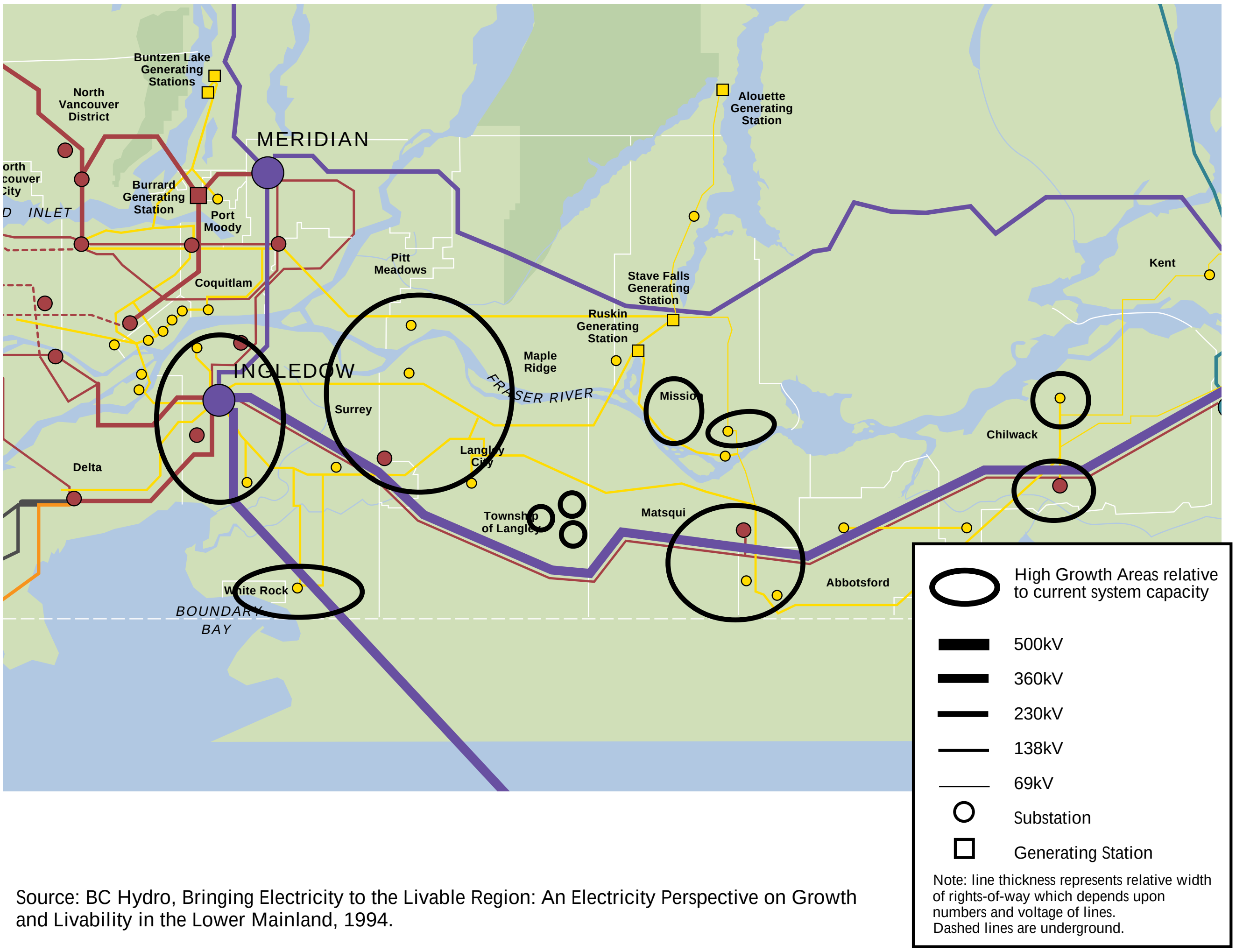
Bob Stewart, P.E.
Eugene Water & Electric Board

Utilities gain many benefits in using the PLACE^{3}S approach:

- Improved accuracy of load forecasting and more efficient T&D system budgeting.
- Reduced load allowing T&D investments to be avoided or deferred.
- Ability to target areas for energy efficiency programs and load shaping to get the greatest value from existing and planned T&D investments.
- Improved ability to reconfigure a T&D system to avoid or minimize environmental problems.
- Information and maps useful for educating local regulatory persons and the public about:
  - the need for T&D facility improvements or expansions;
  - the need for and benefits of distributed power plants and storage technologies; and
  - new electric markets such as electric vehicle charging and district cooling.

The PLACE^{3}S approach is particularly useful to electric utilities. On the macro scale, the PLACE^{3}S tool can help a utility reduce wheeling costs, defer bulk power banks and transmission lines, defer distribution transformers, avoid reconductoring, and allow for smaller line transformers. On a smaller scale, PLACE^{3}S enables a utility to work with community planners to guide the location, type and timing of development to avoid or defer substation and feed line investments. It can also show where changes in development patterns can improve substation load factors. While a utility's planning concerns are only one interest at the table, it is appropriate that all parties who are doing planning understand the full implications of their decisions. A utility cannot plan a community to meet its needs, but there is a great opportunity for a community and its utilities to find common interests in their planning needs. The net outcome will be a more economically and environmentally sustainable community.

FIGURE 5.1
HIGH GROWTH AREAS WHERE ELECTRICITY DEMAND LIKELY WILL EXCEED TRANSMISSION SYSTEM CAPACITY



Source: BC Hydro, Bringing Electricity to the Livable Region: An Electricity Perspective on Growth and Livability in the Lower Mainland, 1994.

AIR QUALITY PLANNING

PLACE³S can be a tool for air quality agencies, local governments and developers working to reduce the vehicle-related air quality impacts of development projects and land-use plans. Ways to do this include:

1) Reducing the need for travel through energy-efficient land-use and development plans
2) Influencing the travel choices people make by employing planning and design techniques that promote pedestrian, bicycle and transit methods of travel

PLACE^{3}S can be used to help a community understand and take action to reduce vehicle-related air pollution. It can estimate travel and air pollution attributable to the configuration of land uses, neighborhood design and the resulting type and amount of travel. In effect, PLACE^{3}S produces an audit of the pollutant levels generated by different planning alternatives, enabling stakeholders to focus on this aspect when appropriate.

As local governments and other agencies establish transportation-related emission goals, they can use PLACE^{3}S to gauge the effectiveness of different design scenarios and planning options for reducing motor vehicle emissions. One example of a set of transportation-related community goals was developed as part of a study in California (Figure 5.2).

"PLACE^{3}S enables cities, counties and private developers to create cost-effective development projects that meet vehicle-emissions reduction goals. PLACE^{3}S compares different designs and plans to determine how well each will reduce automobile use. This capability could substantially benefit air quality for many years to come by reducing the air pollution levels traditionally associated with growth."

Terry Parker,
California Air Resources Board

FIGURE 5.2
SUGGESTED INDIRECT SOURCE PERFORMANCE GOALS BY COMMUNITY TYPE

	Vehicle Trips[1]	VMT[2]	Mode Share of Person Trips[3]		Emissions[6]
			Auto Driver[4]	Other[5]	
Urban Communities					
Level 1	<1,600	<10,000	40%	60%	ROG: <31 CO: <348 NO_x: <27
Level 2	1,600 to 2,100	10,000 to 13,000	45%	55%	ROG: 31-40 CO: 348-455 NO_x: 27-35
Level 3	2,101 to 2,600	13,001 to 16,000	55%	45%	ROG: 40-50 CO: 455-562 NO_x: 35-43
Suburban Communities					
Level 1	<3,200	<20,000	60%	40%	ROG: <62 CO: <696 NO_x: <54
Level 2	3,200 to 3,500	20,000 to 22,000	65%	35%	ROG: 62-68 CO: 696-763 NO_x: 54-59
Level 3	3,501 to 4,000	22,001 to 25,000	70%	30%	ROG: 68-77 CO: 763-870 NO_x: 59-67
Exurban Communities					
Level 1	<4,500	<28,000	65%	35%	ROG: <87 CO: <977 NO_x: <76
Level 2	4,500 to 4,800	28,000 to 30,000	70%	30%	ROG: 87-93 CO: 977-1,044 NO_x: 76-81

1. Per household per year, on average.
2. Vehicle miles traveled per household per year, on average.
3. The percent of trips made by individuals by a given mode of travel.
4. Auto Drivers include single occupant vehicles and drivers of carpools and vanpools (40% means that for 100 person trips there are 40 vehicles on the road).
5. "Other" includes all non-motorized forms of transportation, transit riders, and passengers of car/vanpools.
6. Average pounds per household per year total emissions from light and medium duty vehicles and motor-cycles (see Appendix H for methodology). (ROG - Reactive Organic Gases; CO - Carbon Monoxide; NOx- Oxides of Nitrogen)

Source: California Air Resources Board (CARB), 1995.

MILITARY BASE PLANNING

Military bases are self-contained communities. Using the PLACE³S approach for planning military closure or base realignment (contraction, expansion or alteration of mission) can provide the same type of efficiency improvements, environmental benefits and economic stimulation that PLACE³S adds to civilian community planning.

> Many bases are islands of relatively less- developed property surrounded by dense urban development. These bases offer the surrounding community excellent opportunities to overcome long-standing growth problems.

Closure

When a military base closes, the community that receives the base property is faced with many housing, employment, and civic opportunities and challenges. All adaptations to the base must be coordinated with surrounding civilian land-uses, transportation systems and infrastructure. Many bases are islands of relatively less-developed property surrounded by dense urban development. These bases offer the surrounding community excellent opportunities to overcome long-standing growth problems. Often they can be a showcase for innovative urban redevelopment. PLACE³S can help ensure that redevelopment results in a net efficiency gain for the overall community.

One of the biggest challenges facing communities losing a military base is marketing the base to potential developers. Although closing military bases leave significant utility and transportation infrastructure in place, the extent, condition and capacity of the infrastructure often are poorly defined, leaving many uncertainties that can scare away investors. PLACE³S can help a community document the location, condition and capacity of infrastructure. This information can determine how effectively existing infrastructure assets are being used in each of the many reuse or realignment proposals put forward. In this way, the community can determine if it is getting as much value out of the inherited infrastructure systems as possible. PLACE³S-generated information also can be used as a marketing tool. For example, the community inheriting a closing base could use PLACE³S data and maps to show an industrial developer the location, condition and capacity of existing infrastructure; reducing uncertainties and touting valuable assets. This information can be combined with environmental data, such as toxic contamination data, to help locate the optimum site for industrial development.

Realignment

Some military facilities periodically change their mission. These changes, called realignment by the military, generally entail new development, redevelopment and demolition. The PLACE³S quantitative approach to planning is well suited to base property and infrastructure planning because the military encourages energy efficiency as a determinant in decision making. Realignment can strain existing transportation, natural gas, electricity, water, sewer and district heating infrastructure. Unfortunately, most master planning on military installations gives little consideration to energy use and generation or to utilities systems. PLACE³S can help master planners, public works directors, and utilities engineers better understand the limitations and opportunities that exist. They will be able to direct new construction and redevelopment to make best use of existing infrastructure and determine how to minimize capital outlays for infrastructure improvements. PLACE³S is being used at Fort Lewis in Washington to evaluate the three previously-prepared options for siting a new training complex.

Chapter 5:
Special Uses

Military installations are increasingly interested in their relationship with surrounding civilian communities. As bases provide less family housing, more military personnel live in and commute to work from surrounding communities. PLACE³S can be an effective tool for encouraging dialog and data sharing between civilian and military planners so that the resources of both can cooperatively meet the needs of the community.

CASE STUDIES

Chapter 6

Criterion, Inc. and McKeever/Morris, Inc., both of Portland, Oregon initiated the PLACE³S energy accounting approach to land use planning in 1991. The state energy offices in California, Oregon and Washington jointly supported an early application of the method in San Jose, California. Each state energy office saw promise in a planning method designed specifically to assist local governments in understanding the full impact of energy on their economy, environment and overall quality of life. The San Jose project did not use a geographic information or computer-aided design system. Results, however, were instrumental in creating a process for tracking implementation of the city's adopted energy efficiency goal.

Since the San Jose prototype project, the states and the consultants have refined the PLACE³S method and expanded it to address a broader set of urban design issues. It has been used in a variety of applications in five states, Canada, and Japan. PLACE³S projects to date have focused mainly on the technical feasibility of the method. Public involvement in each of the case studies has, thus far, been constrained by schedule and funding limitations. In late 1996, PLACE³S will be used with a full public involvement component in a neighborhood in San Diego, CA.

This section presents five case studies taken from California and Oregon. These case studies are:

Regional Applications

- San Diego use of PLACE³S to analyze alternatives as part of its Regional Growth Management Strategy process
- Eugene-Springfield metropolitan area of Oregon use of PLACE³S to asses the near-term and long-term cost and environmental value of its regional transportation plan update.

Neighborhood Applications

- The River District Urban Redevelopment Study, an inner-city redevelopment area in Portland, Oregon;
- Vista, California downtown transit focus area; and
- Murray West, a suburban transit-oriented development centered on a new light rail station in Beaverton, Oregon.

> "Some communities are going to be victims of change . . . they won't understand it, they won't adapt to it, and they will fail. Others will prosper, most likely those that understand that planning is a lot more than next week's zoning case . . .."
>
> **Henry Cisneros,**
> Secretary of Housing and Urban Development

REGIONAL APPLICATIONS

San Diego Association of Governments
San Diego, California

> "PLACE³S added value to our regional energy plan. The energy plan was widely supported because it included PLACE³S-generated estimates of the economic and environmental value of implementing the plan."
>
> **Elliot Parks,**
> Vice Chair,
> San Diego Association of Governments Board of Directors

Case Study Synopsis

The San Diego Association of Governments (SANDAG) used the PLACE³S methodology to assess the energy efficiency of the region's growth management strategy alternatives. SANDAG prepared the growth strategy in its capacity as the voter-approved Regional Planning and Growth Management Review Board. SANDAG used 1990 regional housing and transportation energy use as the baseline and projected energy use for three alternative plans out to 2010.

The most efficient alternative gained larger energy and cost savings than the other alternatives by shifting more growth at higher densities into transit focus areas. PLACE³S estimated that for this alternative transportation energy use would be reduced 11 percent and total energy use reduced by about 6 percent over business-as-usual conditions. PLACE³S also forecast that careful implementation of the most efficient alternative would cut total regional energy costs by about 5 percent, keeping $200 million per year, or about $3.0 billion by 2010, in the region. PLACE³S determined that the current regionally preferred growth management plan would result in savings of about $50 million per year, or $750 million by 2010.

Population

The San Diego region (western San Diego County and its 18 municipalities) had a 1990 population of about 2.5 million persons. SANDAG expects the population to grow about 30 percent, adding one million persons by 2010.

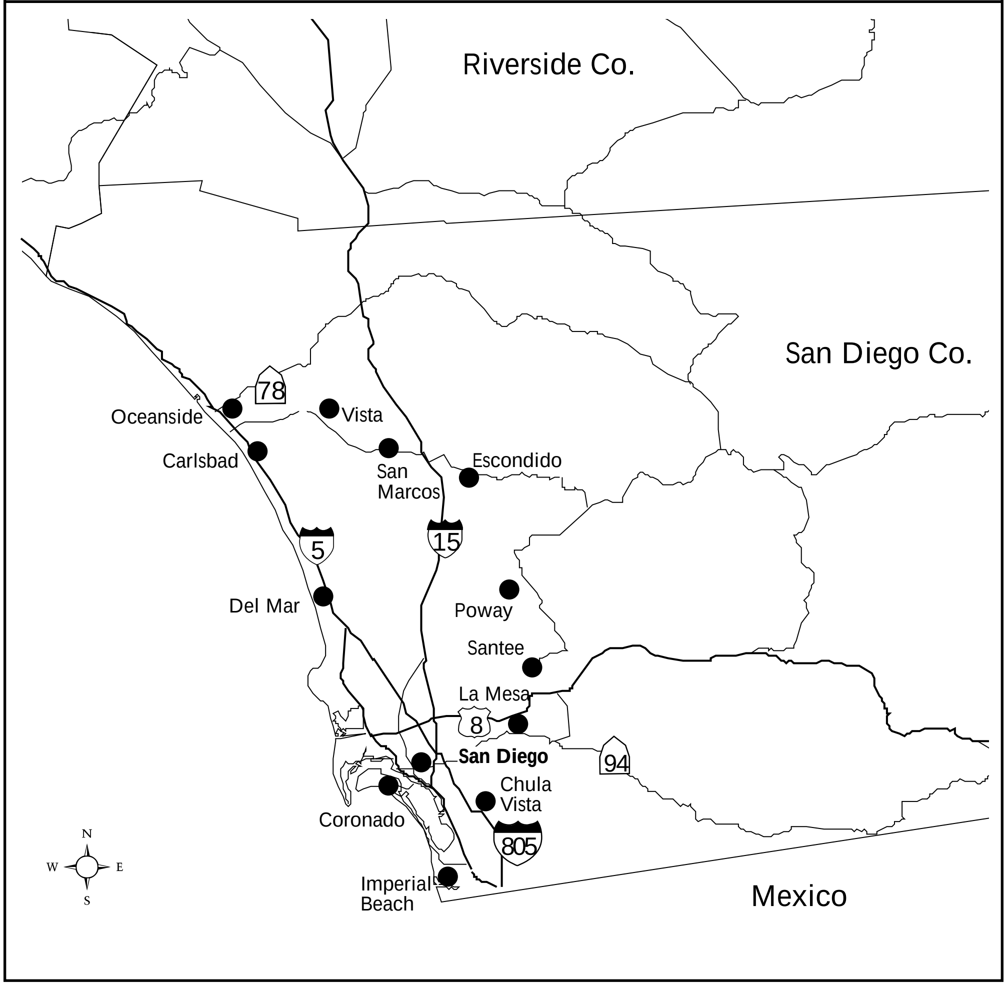
Area

The study area is about 2,000 square miles of western San Diego County along the Pacific ocean, as Figure 6.1 shows.

Planning Process

The San Diego Regional Growth Management Strategy process was a multi-year effort that included technical analysis and public information components. SANDAG staff worked with local planners to assemble growth projections, formulate alternatives, and propose land-use allocations. At the same time, it invited the public to comment on proposed growth management goals and policies. It incorporated the PLACE³S methodology into its growth management strategy via the Regional Energy Plan, a component of the strategy.

FIGURE 6.1
THE SAN DIEGO REGION



> "PLACE³S will be used to analyze the economic effects of implementing NAFTA — providing a more complete view of international development proposals and putting us in a better negotiating position. Also, PLACE³S will be used to decide when and where to add new energy technologies to service the growing boarder economy."
>
> **Dr. Alan Sweedler,**
> Director,
> Center for Energy Studies at the San Diego State University

Stakeholders

Stakeholders in the PLACE³S process included:

- SANDAG
- 18 cities and one county
- San Diego Gas and Electric
- San Diego Air Pollution Control District
- Regional economic and environmental interests
- California Energy Commission
- U.S. Navy
- Baja California, Mexico (due to cross-border economic and environmental relationships)

Public Involvement

The San Diego regional PLACE^{3}S case study did not include the extensive public involvement suggested in Chapter 3. In this case study, regular participation by SANDAG's regional energy advisory committee served as the public involvement element. This 32-member committee included public agencies, private corporations, environmental representatives, and citizen organizations. Public involvement was limited because the project focused on developing and testing the technical aspects of the regional PLACE^{3}S method.

> In December, 1995, SANDAG and San Diego Gas and Electric, the region's public utility, co-funded seed money to establish a nonprofit Regional Energy Office. This office will work to implement the Regional Energy Plan.

Scenarios Examined

SANDAG evaluated three scenarios:

1) existing conditions in 1990 and 2010, forming the Business-as-Usual Alternative;
2) the Quality of Life Alternative, which focused on placing growth in transit areas; and
3) the PLACE^{3}S-designed Advanced Alternative with even greater emphasis on transit-oriented growth.

PLACE^{3}S Measures Used

The Advanced Alternative increased housing and employment density in about 180 transit focus areas throughout the region to increase energy efficiency. Thus, the project focused almost exclusively on transportation energy savings. SANDAG limited the project in this way to simplify the GIS modeling for this first regional application of PLACE^{3}S. It may add other efficiency measures in future evaluations.

Results

The Business-as-Usual Alternative served as the energy efficiency baseline. PLACE^{3}S analyses found that the Quality of Life Alternative reduced regional energy consumption by 1.3 percent over baseline. The Advanced Alternative reduced total energy use by more than 6 percent over baseline. As Figure 6.2 shows, the Advanced Alternative quadrupled regional cost savings over the Business-as-Usual baseline forecast. Implementation of the PLACE^{3}S-designed Advanced Alternative would result in about $200 million retained in the regional economy each year.

SANDAG adapted its GIS data base to produce ratings of the combined land-use and transportation efficiency of the region's subareas. Figure 6.3 displays the PLACE^{3}S two-step efficiency ratings for the region's 4,500 traffic zones in SANDAG's Quality of Life Alternative. The region's planned efficiency ratings are notably lower than its location ratings, indicating areas where land-use designations could be adjusted to take full advantage of available employment, transit and other infrastructure to save energy and money and cut air pollution.

FIGURE 6.2
SAN DIEGO GROWTH ALTERNATIVES COMPARISON SUMMARY

LAND-USE DENSITY COMPARISON
(Transit Focus Areas)
2010

	Existing Policies	Quality of Life	Advanced
Dwelling units per acre	20	21	30
Employees per acre	26	29	37

ENERGY COMPARISON
(Trillion Btu)
2010

	Existing Policies	Quality of Life	Advanced
Housing & employment	139.6	139.6	137.6
Transportation	128.2	124.6	114.7
Total	267.8	264.2	252.3
Percent change from Existing Policies	- - -	-1.3	-6.0

ENERGY COST COMPARISON
(1994 $ billion)
2010

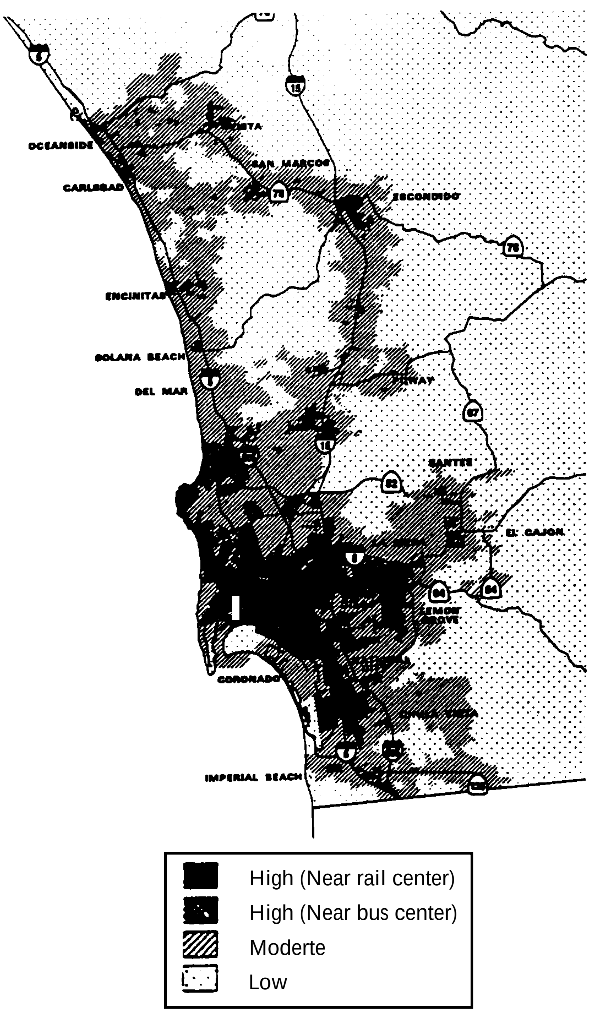
	Existing Policies	Quality of Life	Advanced
Housing & employment	2.746	2.746	2.704
Transportation	1.767	1.718	1.581
Total	4.513	4.464	4.285
Percent change from Existing Policies	- - -	-1.1	-5.1

Lessons Learned

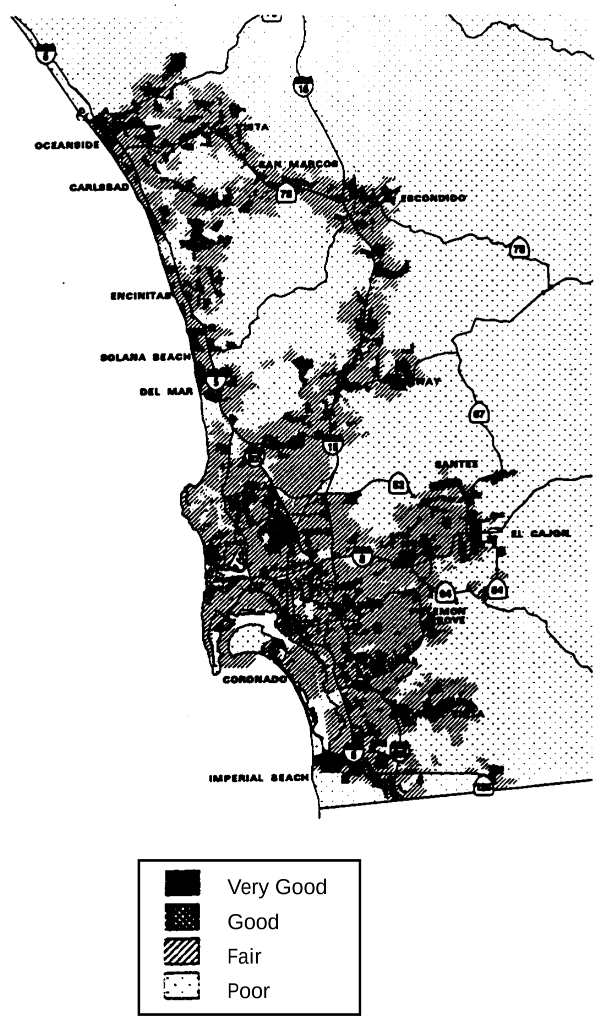
- An integrated GIS land-use and transportation model is a necessity for a large regional study. A GIS model that permits easy alteration of land-use designations to test how travel demand changes as land-use changes is especially valuable.
- The complex role energy plays in a region is under valued. Presenting numerical values for the economic and environmental benefits of the 17 action items contained in the Regional Energy Plan motivated stakeholders support the creation of a regional energy office to implement the plans.

FIGURE 6.3
SAN DIEGO EFFICIENCY RATINGS

Location Efficiency Ratings



Planned Efficiency Ratings



Implementation Status

In February 1995, SANDAG adopted a modified Quality of Life Alternative. Although not reaching the density and mix levels of the PLACE³S-designed Advanced Alternative, the adopted strategy encourages most new development to be transit-oriented.

In December, 1995, SANDAG and San Diego Gas and Electric, the region's public utility, co-funded seed money to establish a nonprofit Regional Energy Office. This office will work to implement the Regional Energy Plan. The goal of the Regional Energy Office is to help the region accrue the broad economic and environmental benefits of comprehensive energy management.

In 1996, SANDAG, the City of San Diego and the California Energy Commission began a detailed neighborhood-level PLACE³S study that will test local citizen acceptance of energy efficient urban design. Also, one of the region's larger suburban cities, Chula Vista, is preparing a greenhouse gas emission reduction plan that incorporates PLACE³S-generated assessments of many land-use and transportation efficiency measures.

> "The PLACE³S study was the first time such a comprehensive assessment of energy use has been modeled for the Eugene-Springfield area. I think PLACE³S has great potential for helping policy-makers understand the full implications of land use and transportation alternatives."
>
> **Susan Brody,**
> Oregon Transportation Commission

Lane Council Of Governments
Eugene-Springfield, Oregon

Case Study Synopsis

In the Eugene-Springfield region, the Lane Council of Governments (L-COG) used PLACE³S in its regional transportation plan update. It emphasized land-use coordination as a transportation efficiency strategy. In addition to transportation, the project addressed regional energy use in housing, employment, and infrastructure. The scope of the study was limited to a 1992 baseline of existing conditions compared to a projection of current plans to 2015.

PLACE³S estimated the region's 1992 energy use at about 124 MMBtu/yr/person based on 24 trillion Btu in total energy use. PLACE³S estimated the region's existing policies favoring compact growth and transit use, projected to 2015, produced about a 5 percent efficiency improvement, reducing per capita energy use to about 118 MMBtu/yr. This amounts to about $10 million in annual energy cost savings for the region.

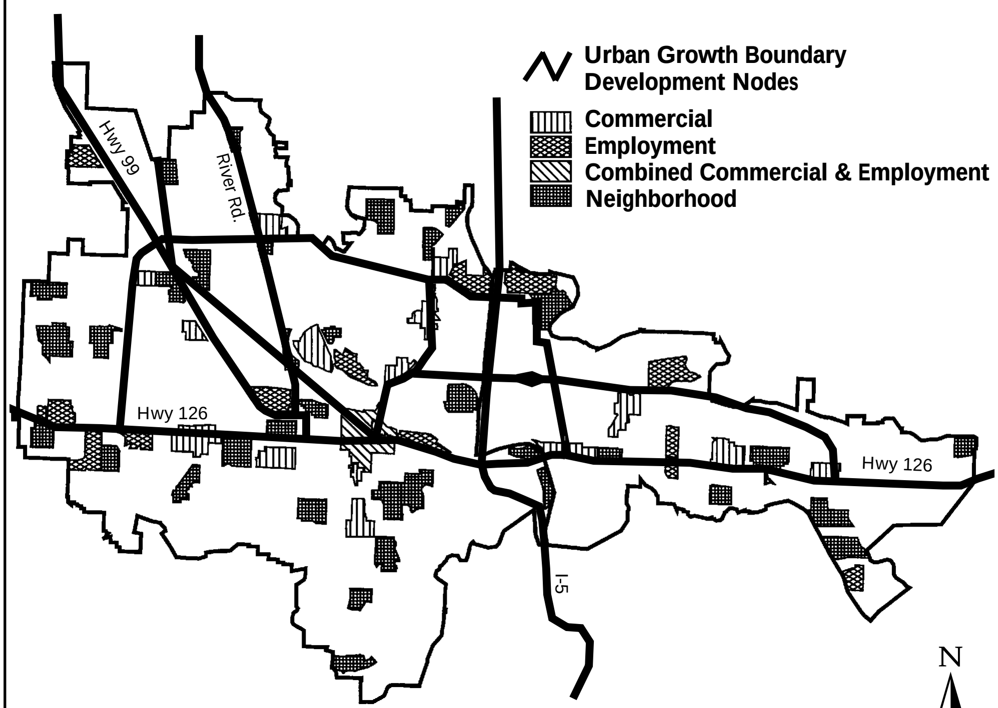
Population

The Eugene-Springfield metropolitan area had a 1992 population of 197,000 and a projected 2015 population of 293,000, which is a growth of nearly 50 percent for the period.

Area Size

The study area is about 134 square miles, including the cities of Eugene and Springfield and some surrounding unincorporated area. Figure 6.4 shows the urban growth boundary, which is the study area, along with proposed development nodes that L-COG evaluated as part of the transportation plan update.

FIGURE 6.4
EUGENE-SPRINGFIELD REGION



Source: Lane Council of Governments, 1995.

Planning Process

The Eugene-Springfield metropolitan transportation plan update is a multi-year process with a strong emphasis on land-use strategies to improve transportation choices, including:

- Reinforcing the region's compact urban growth policy through infill and redevelopment and by designing certain neighborhoods to accommodate more people.
- Creating more opportunities for people to walk and bicycle by bringing destinations closer to where they live and work.
- Supporting increased use of transit, bicycling, and walking by making them more convenient and practical.
- Protecting the environment and character of neighborhoods by using design principles that create pedestrian-oriented environments.

L-COG used the PLACE³S methodology to quantify the land-use and transportation relationships in energy terms. L-COG adapted its GIS to perform PLACE³S computer modeling.

Stakeholders

- Lane Council of Governments (L-COG).
- City of Eugene.
- City of Springfield.
- Eugene Water and Electric Board.
- Springfield Utility Board.
- Northwest Natural Gas.
- Lane Regional Air Pollution Agency.
- Oregon Department of Energy.
- Oregon Department of Transportation.

> "The dual costs of (1) providing new infrastructure for those who are moving outward, and (2) maintaining the old infrastructure for the population and economic entities that are left behind, cause taxes and development costs to rise throughout the metropolitan area, thus causing a regional rise in the costs either to do business or to reside in the area."
>
> **Robert W. Burchell & David Listokin,**
> *Land, Infrastructure, Housing Costs and Fiscal Impacts Associated With Growth*

Public Involvement

The PLACE³S case study did not include direct citizen involvement because of its focus on the technical aspects of GIS modeling. A steering committee of stakeholder representatives provided oversight of the study.

Scenarios Examined

L-COG evaluated two cases:
1) baseline conditions in 1992; and
2) existing policies projected to 2015.

PLACE³S Measures Used

The study did not include planning alternatives with efficiency improvements. Instead, it focused on the potential efficiencies embedded in the region's existing policies. In effect, this was an audit of the regional plan to determine how efficient its business-as-usual future is.

L-COG intends to evaluate other alternative futures with different combinations of PLACE³S efficiency measures in follow-up studies.

Results

Figure 6.5 shows existing and future base case estimates of energy use and costs. The region's 1992 baseline includes 24 trillion Btu in total use and approximately $207 million in energy costs. PLACE³S also estimated 1.2 million tons of CO_2 emissions from regional energy use. On a per capita basis, energy use in 1992 was 124 MMBtu/yr/person and energy costs were about $1,000/yr/person.

With a 48 percent population increase by 2015, existing policies favoring compact growth limit total growth in energy use to only 41 percent. This equates to a per capita efficiency improvement of approximately 5 percent between 1992 and 2015, an efficiency gain worth about $10 million in 2015 in annual savings to the region.

PLACE³S also revealed that, if continued, existing policies will notably improve geographic patterns of efficiency by 2015. Figure 6.6 shows that more subareas in 2015 have higher locational ratings and higher planned efficiencies in the excellent location category. This means that there are more areas that are well planned to take advantage of efficient services and that the areas that are efficient are becoming even more so. (See Chapter 3 for a discussion of the regional rating scheme.) In effect, focusing transit-supportive land-use at the strongest, most strategically-located subareas produces greater overall efficiency. Figure 6.7 illustrates the geography of these ratings, with the core "excellent" area growing larger by 2015, along with suburban areas whose ratings improve because of greater pedestrian and transit orientation.

Lessons Learned

- As in the San Diego study, this project again confirmed that an integrated GIS land-use/transportation model is necessary for efficient data management and "what if" analyses.
- A critical stakeholder task is selection of subarea efficiency evaluation criteria and the weighing of their relative importance. This requires a clear understanding of linkages between criteria and energy efficiency.
- The PLACE³S method is easily adaptable to already existing data sets on a well-developed GIS.

FIGURE 6.5
EUGENE-SPRINGFIELD REGIONAL ENERGY USE

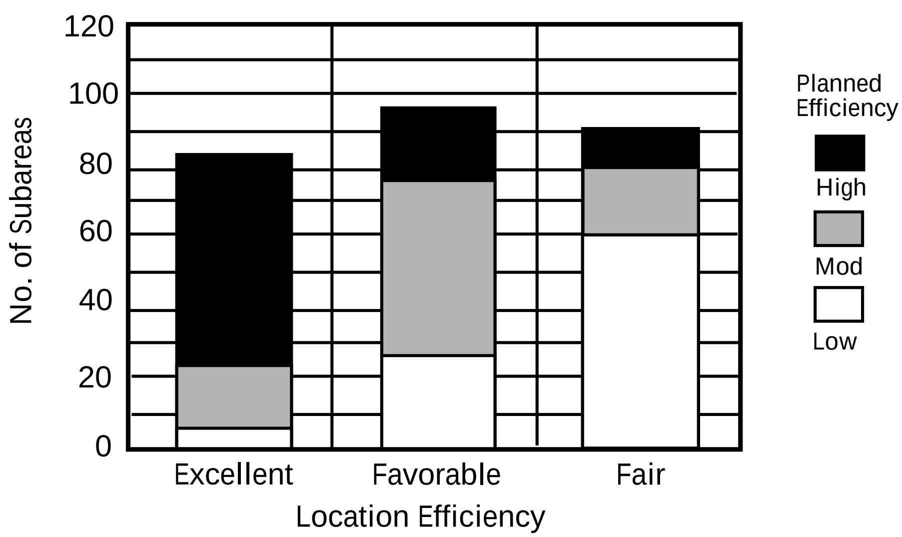
	1992			2015		
	MMBtu/yr	CO_2 Tons	$ MILLION	MMBtu/yr	CO_2 Tons	$ MILLION
End-Uses:						
Residential	5,500,000	210,791	50	8,000,000	662,250	91
Commercial/Industrial	11,900,000	535,372	95	17,000,000	1,303,827	184
Transportation	6,600,000	565,893	62	8,500,000	736,224	116
Total	24,000,000	1,312,056	207	33,500,000	2,702,301	391
Fuels:						
Electricity	10,200,000	318,530	106	14,300,000	1,322,110	174
Natural gas	7,200,000	427,633	39	10,700,000	643,967	100
Transportation	6,600,000	565,893	62	8,500,000	736,224	117
Total	24,000,000	1,312,056	207	33,500,000	2,702,301	391

Implementation Status

L-COG is using PLACE^{3}S results, along with other inputs, in the ongoing transportation plan update process. It will not complete the transportation planning process until 1996.

FIGURE 6.6
COMPARISON OF 1992 VS. 2015 EUGENE-SPRINGFIELD SUBAREA EFFICIENCY RATINGS

1992 Existing Conditions



2015 Business-as-Usual Forecast

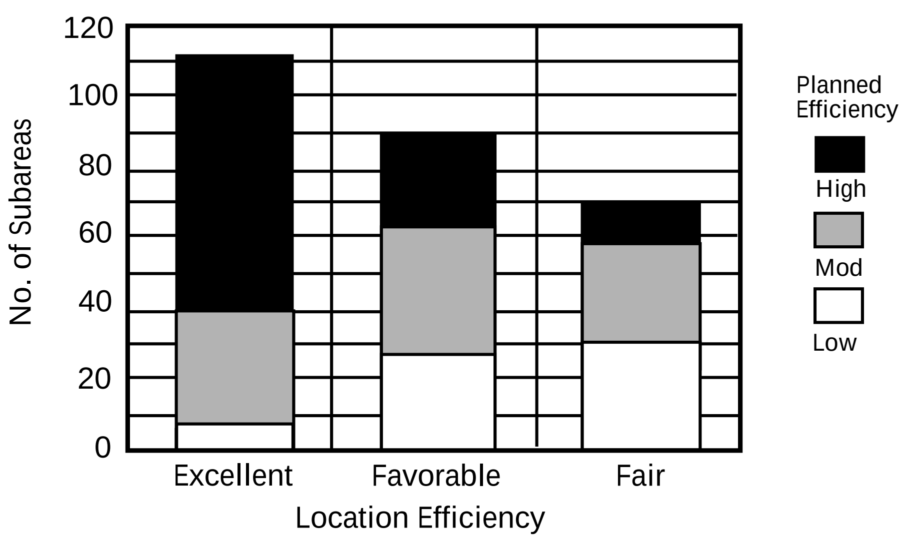
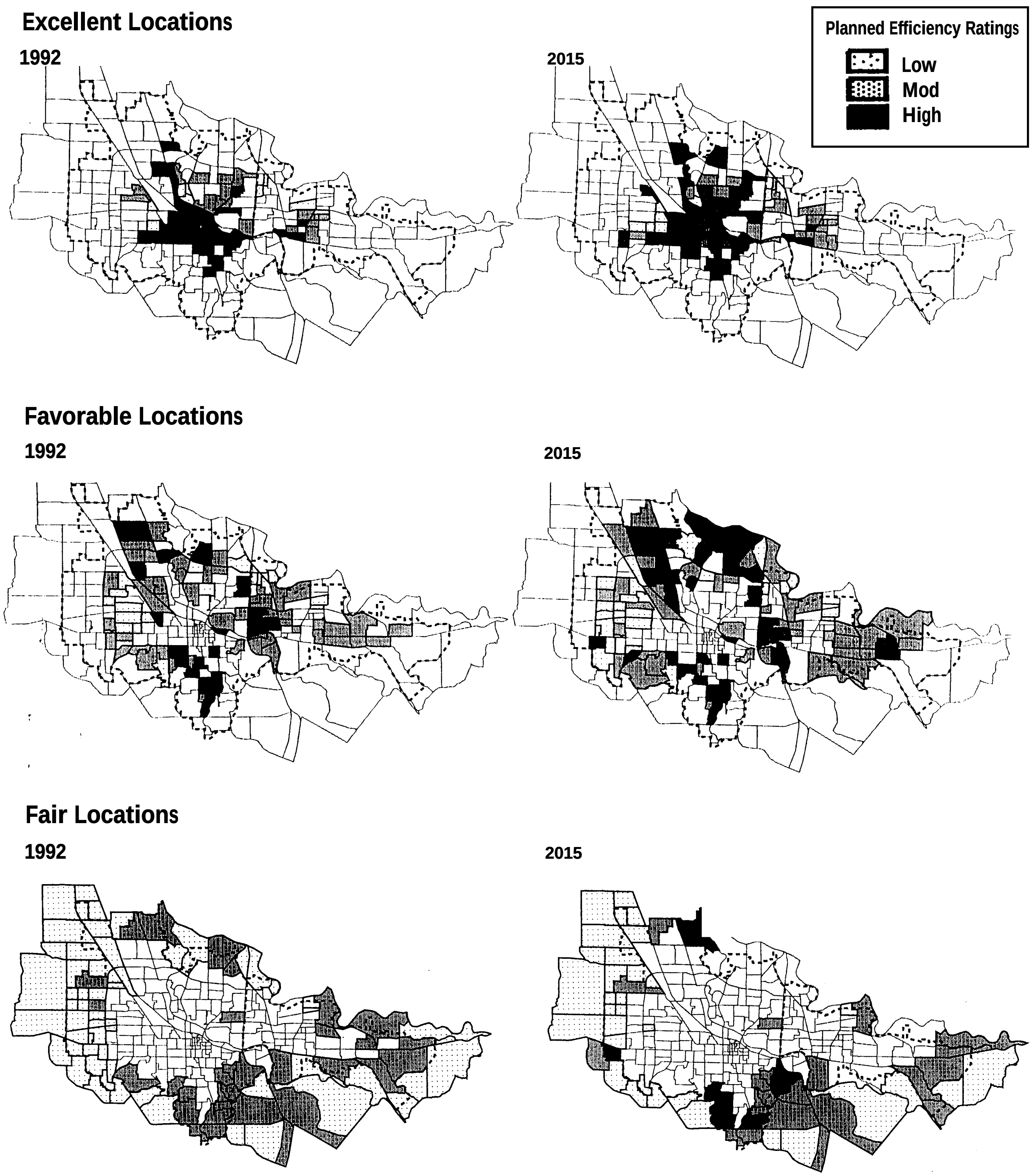


FIGURE 6.7
1992 VERSUS 2015 EUGENE-SPRINGFIELD TAZ RATINGS



NEIGHBORHOOD APPLICATIONS

River District Urban Redevelopment Study
Portland, Oregon

Case Study Synopsis

PLACE^{3}S was used as part of the redevelopment planning of the River District, an inner-city industrial area and former rail yard being converted to mixed residential and commercial uses. The PLACE^{3}S team examined four scenarios using projections to 2015:

1) a future base case of current policies;
2) an advanced case designed for maximum energy efficiency;
3) a developers' case prepared by property owners; and
4) a preferred case that combines features of the second and third scenarios.

The major variable in the study was the ratio of jobs to housing and how much housing the redevelopment plan would offer. In the advanced case, total per capita energy demand was reduced by 60 percent over the base case, mainly by avoiding commuter trips from suburbs into the central city. The base case and developers' case had significantly fewer employees than the advanced case. However, the team was not able to compare the advanced case savings with a nodal jobs/housing development scenario throughout the region. Therefore, the reduction in energy demand represents the "best-case" assumptions.

Population

The current population of the River District is only a few hundred persons because it is mostly a vacant rail yard. Current residents are mainly artists occupying converted industrial lofts. The following table lists future populations in the planning alternatives:

POPULATION DATA FOR ALTERNATIVES

	Base Case	Advanced Case	Developers' Case	Preferred Case
Residents	1,800	11,094	9,700	11,413
Employees	4,500	22,469	6,551	14,412
Total	6,300	33,563	16,251	25,825
Jobs/housing ratio	9	3	1	2

Study Area Overview

The River District study area is a 184-acre site near the center of Portland, as shown in Figure 6.8. Much of the area is currently abandoned rail yards and industrial uses. It is being developed as a major residential and commercial area over the next 20 years. The study area is adjacent to Portland's downtown central business district. As part of Portland's central city area, it has been the subject of intense interest and many planning studies over the past 10 to 15 years.

Regional planners forecast that the Portland area's population will increase 700,000 by the year 2040. Where those people live and work will have a major effect on the transportation system, the business community, and the region's quality of life. Regional plans show the River District to be a major transportation center: an existing light rail line runs along the south end of the study area; an Amtrak station and an interstate bus terminal are both in the area; the downtown transit mall extends into the area; and, a future streetcar system may connect the District to the other sections of the central city.

The eastern boundary of the River District is the Willamette River, a major waterway running through the heart of Portland. This creates opportunities for development of both public and private waterfront properties. Surrounding uses that also impact the study area include a linear park lined with low-density commercial buildings; a former industrial area, which has recently been gentrified with loft housing and upscale shops; an industrial sanctuary area; and some significant existing infrastructure. The latter includes an extensive bridge ramp system, which will be brought down to ground level, and a large port facility, which will be redeveloped into housing and retail.

Metro, the Portland area's regional elected government, and the City are promoting growth in jobs and housing in Portland's central city. The intent of this inner-city growth is to reduce suburban sprawl and its resulting traffic congestion, air pollution, and encroachment on farmland and open space.

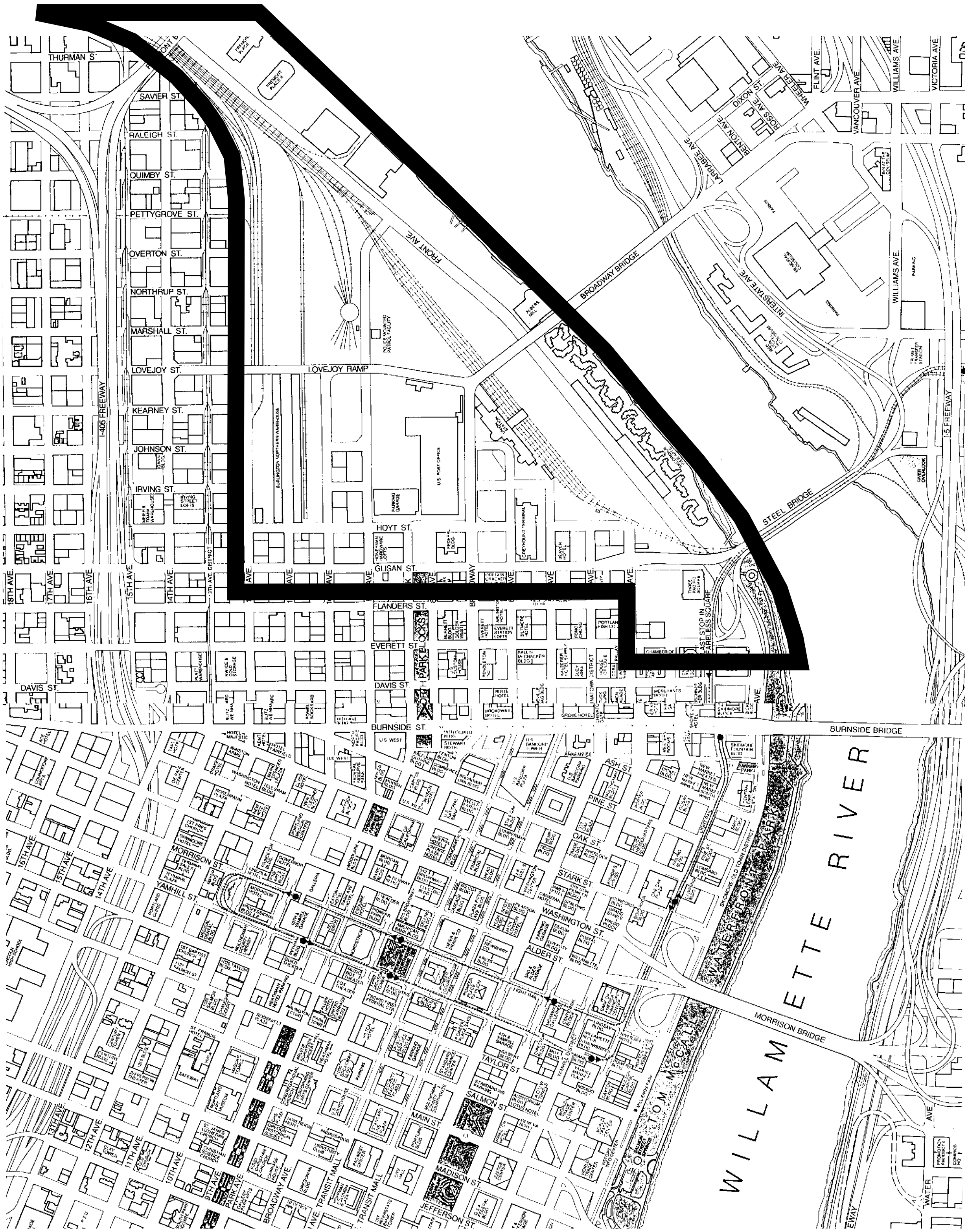
Planning Process

The PLACE[3]S planning team participated in an existing process, which the City and the owners had begun. Public and private stakeholders collaborated in a traditional master planning process for the neighborhood redevelopment planning. At the outset, the group identified preliminary goals and objectives for the neighborhood's future. It assembled a list of major opportunities and constraints. With that basis, the group began developing design scenarios. This was about a one-year process culminating in City Council hearings and adoption of the redevelopment plan.

Stakeholders

- Property owners
- Property owners' design team
- City of Portland staff
- Port of Portland staff and elected officials

FIGURE 6.8
RIVER DISTRICT PROJECT SITE, PORTLAND, OR



- Electric and natural gas utilities
- Oregon Department of Energy

Scenarios Examined

- Future base case: development will occur along typical patterns as they exist in the surrounding area, guided by existing planning and zoning requirements and market forces.
- Advanced case: the primary focus of development will be to maximize energy efficiencies.
- Developers' case: development will occur according to the master plan prepared by property owners, who intend to achieve a balance between traditional market demand and projected city requirements to increase the density in the area.
- Preferred case: a balance of the developers' case and the advanced case will create supportable development based on market forces and other "real world" development considerations, while increasing the density and the mix of users.

The information included here focuses primarily on the PLACE^{3}S advanced case, contrasting the results of that scenario with the future base case.

Public Involvement

There was no general public involvement in the PLACE^{3}S portion of the River District redevelopment planning. Instead, PLACE^{3}S was a technical component within the public/private master planning process. The City Council heard the results of the technical analyses, including PLACE^{3}S issues, at public hearings.

PLACE^{3}S Measures Used

Figure 6.9 summarizes the measures. The primary design challenges were to:

- Optimize the energy efficiency in the buildings, infrastructure, and transportation system.
- Make the area an attractive place to live, work, and shop.
- Achieve the highest possible residential densities while also maintaining open space objectives.
- Create a true community, not just a "bedroom" area to the downtown.

The vast majority of land in the study area is amenable to redevelopment. About 50 percent of the land was redevelopable in the base case. Applying PLACE^{3}S measures increased it to 90 percent, primarily by assuming older, inefficient structures would be demolished and by narrowing rights-of-way. The team added substantially to the amount of developable land with the use of narrow, or "skinny," street design. By reducing the standard rights-of-way throughout the study area and locating all of the parking off-street, it added an average of 12,000 square feet per block in developable land.

FIGURE 6.9
PLACE³S MEASURES PROPOSED FOR THE RIVER DISTRICT

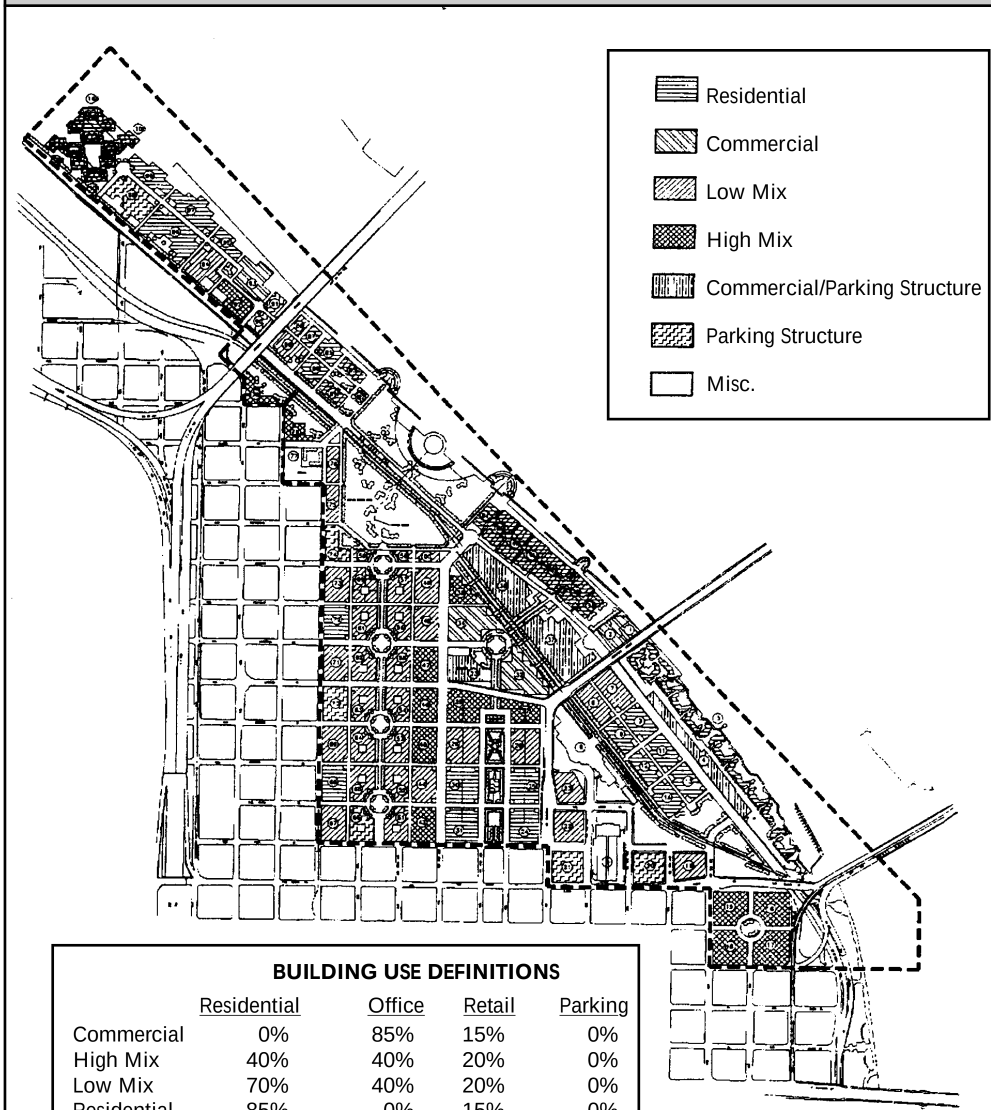
Measure	Proposed
Landform/Microclimate	
Topography	-
Reflectivity	✓
Vegetative cooling	✓
Evaporative cooling	✓
Wind channeling	✓
Land-Use	
Use density	✓
Use mix	✓
Activity concentration	✓
Site Design	
Solar orientation	✓
Pedestrian orientation	✓
Transit orientation	✓
Micro climatic building siting	-
Transportation	
Integrated street networks	✓
Pedestrian facilities	✓
Bicycle facilities	✓
Transit facilities	✓
Car pool facilities	-
Pavement minimization	✓
Parking minimization/siting	✓
EV charging/alt. fueling	✓
Infrastructure Efficiency	
Water supply/use	✓
Wastewater collection	✓
Storm drainage	✓
Street lighting	✓
Traffic signalization	✓
Recycling facilities	-
On-Site Energy	
Groundwater heating/cooling	✓
Surface water heating/cooling	✓
Wind power	-
Solar power	-
District heating/cooling	✓
Cogeneration	-
Thermal storage	-
Fuel cell power	-

On the other hand, the team slightly reduced some of the developable land by adding substantial amounts of landscaping and open space because there is virtually no vegetation in the area. It did this in part to improve the area's livability and to respond to the city's commitment to increasing open spaces. It included a grassy waterfront amphitheater, two one-acre waterfront parks, six one-acre planted traffic round-abouts, street trees, a pocket park, and rooftop gardens.

The team increased the planned residential population density for the River District from 10 persons per acre in the base case to 61 per acre in the advanced case. It increased the number of dwelling units from 7 per acre in the base case to 40 per acre with the advanced case. The team also proposed substantial increases in employment density, going from 58 jobs per acre in the base case to 124 per acre in the advanced case. The land-use plan in Figure 6.10 illustrates the mix of uses the team used in the advanced case.

The building standards the team proposed were limited to scale and size, the arrangement of buildings, and construction materials. The building scale the team recommended substantially changes the city's existing allowable floor area ratios and

FIGURE 6.10
ADVANCED ALTERNATIVE LAND-USE PLAN FOR THE RIVER DISTRICT



BUILDING USE DEFINITIONS

	Residential	Office	Retail	Parking
Commercial	0%	85%	15%	0%
High Mix	40%	40%	20%	0%
Low Mix	70%	40%	20%	0%
Residential	85%	0%	15%	0%
Parking	0%	0%	10%	90%
Commercial/Pkg	0%	30%	5%	65%

would require changes to the current code. However, the scale is also sensitive to enhancing the pedestrian experience. The team also oriented buildings for improved solar exposure. For example, the team designed residential units to maximize southern and to minimize western exposures in order to capture the winter sun and avoid summer heat. It oriented commercial structures to maximize good light from northern exposure and varied building elevations throughout the study area to maximize solar exposure and to minimize shading.

A significant benefit of creating a plan for an undeveloped area is the freedom to make it be whatever you want. The parking plan for the River District is a good example of what that freedom can yield. The team proposed no on-street parking spaces and no surface parking lots in the study area: all parking is located in structures, either above or below street level. The only exception is parking for two existing waterfront areas where it will be behind the buildings at street level. The ground floor of all parking structures is devoted to retail and service uses. No dwelling unit is more than two blocks (500 feet) from its allocated spaces.

The team used the following standards:

- Residential — 1 space/dwelling unit
- Office — 1 space/750 sq. ft. of floor area
- Retail — 1 space/2,000 sq. ft. of floor area

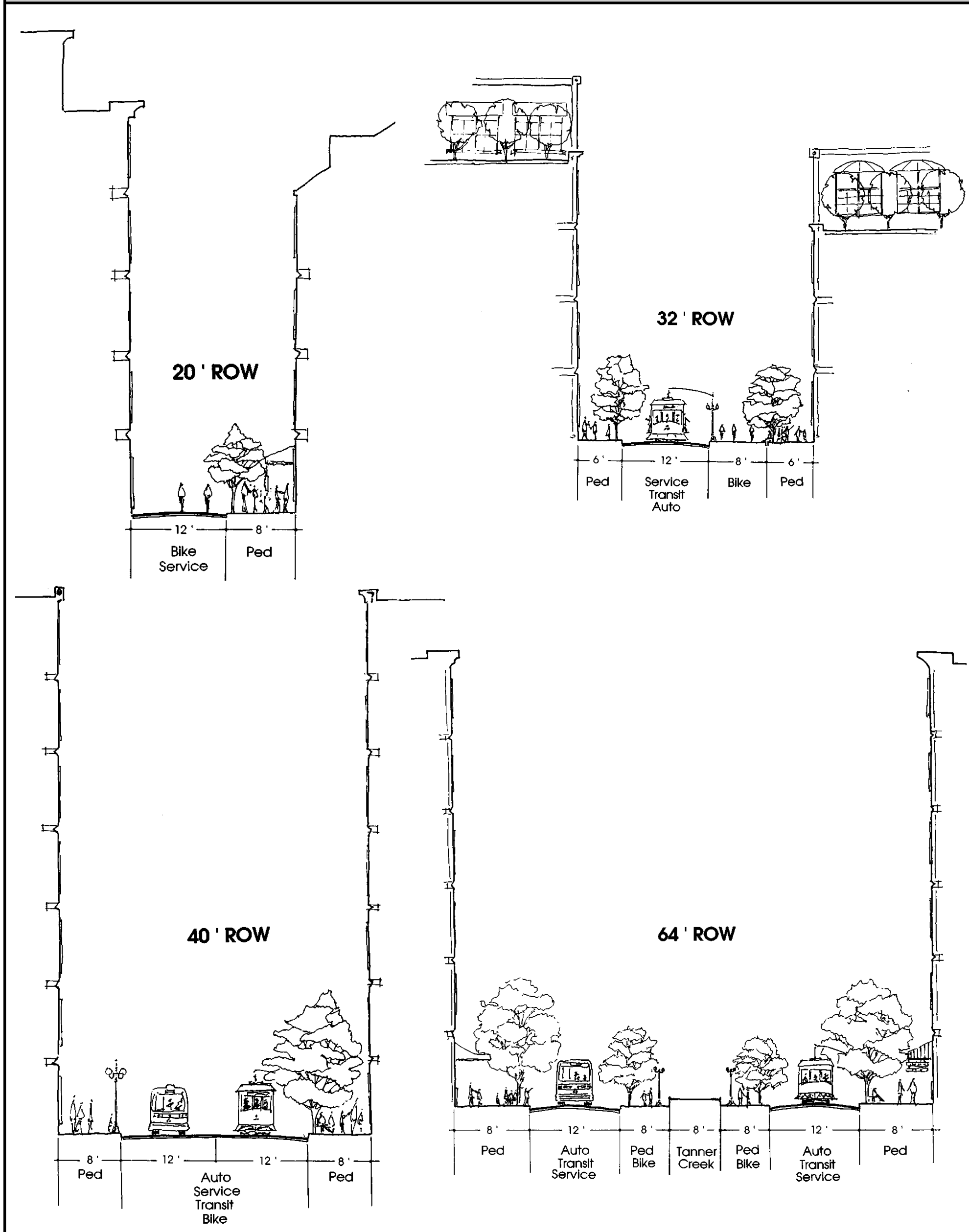
The average size per parking space is 220 square feet, compared to the local standard of 300 square feet. This reflects expected results from program to encourage smaller, more energy efficient vehicles. The team designed the size, number, and location of the parking spaces to be convenient for residents and employees while making them less convenient for drivers wanting to travel through the study area in traditionally large autos.

In order to create a truly pedestrian-oriented community, the team was determined to design a viable alternative to the traditional auto-dominated street system. It developed four street designs that reinforce the City of Portland’s small or skinny street standards. These designs combine pedestrians, bikes, autos, service vehicles, and transit to create a multimodal system.

Figure 6.11 illustrates typical cross sections for the River District street designs. With traditional 60 foot widths, 65 to 75 percent of the available right of way is dedicated to motor vehicles with only 25 to 35 percent set aside for pedestrians, and little or nothing is designated for bicycles. The team’s street designs average 40 percent of the right-of-way dedicated exclusively to pedestrians with additional space shared between bikes and autos. On all streets, it has given top priority to pedestrians, and bicycles have priority over autos. It also proposed other specific improvements for pedestrians and bicycles: a new pedestrian and bike crossing for one of the bridges on the Willamette River; continuation of the existing bike path along the waterfront south of the study area through the District; and, new bikeways and pedestrian paths throughout the study area.

Figure 6.12 summarizes these and other key design features for each of the four alternative futures.

FIGURE 6.11
ADVANCED ALTERNATIVE STREET CROSS-SECTIONS



Results

The advanced case achieved the most significant energy savings in three key areas relating to transportation: embodied energy; changes in mode share; and vehicle miles travelled (VMT).

FIGURE 6.12
RIVER DISTRICT ALTERNATIVE FUTURES

	Alternative Futures			
	Base	Advanced	Developer	Preferred
Area (acres)	184	184	184	184
Population				
Residents	1,830	11,094	10,142	11,413
Employees	10,681	22,816	6,417	14,412
Total	12,511	33,910	16,559	25,825
Uses (percent of total building sq. ft.)				
Residential	14	35	51	46
Office	39	27	19	20
Retail	3	16	5	15
Industrial	22	0	0	0
Civic	0	0	0	0
Parking	20	22	24	19
Other	2	—	——	——
General Design				
Average block face (ft.)	400	200	200	200
Percent multi-story buildings on total site	80	100	100	100
Percent buildings with vertical use mix	60	100	65	90
Housing				
DU/gross acre	7	40	37	42
Percent dwellings within 1/4 mile of store	20	90	60	85
Percent dwellings within 1/4 mile of park	15	80	50	80
Neighborhood Park acres/1,000 residents	1	2	3	3
Average off-street parking spaces/DU	1	1	1	1
Employment				
Jobs/housing ratio	9	3	1	2
Employees/gross total acre	58	124	35	78
Average nonresidential building FAR	2	4	3	35
Average nonresidential building front setback (ft.)	0	0	0	0
Average off-street parking spaces/1,000 sq.ft. building area	1.4	1.2	1.35	1.25
Travel				
DU/gross acre within 1/2 mile of rail stop	15	61	24	50
Employees/gross acre within 1/2 mile of rail stop	58	125	60	80
DU/gross acre within 1/4 mile of bus stop	15	61	24	50
Employees/gross acre within 1/4 mile of bus stop	58	125	60	80
Average street width (curb-curb ft.)	60	50	60	50
Percent streets with sidewalks both sides	100	100	100	100
Average sidewalk width (ft.)	5	10	6	10
Average intersection curb radii (ft.)	15	15	15	15
Average parking lot size (acres)	5	N/A	5	N/A

- **Infrastructure.** By implementing the skinny street and roundabout system, the District should be able to reduce the amount of paving by an average of 20 percent over the base case and developers' case, while also increasing the number of travel routes for all modes (autos, bikes, and transit). To most people, this will be the most visible sign that something works better in the River District.
- **Mode Share.** In the advanced case, the team assumed shortened distances between destinations and greatly reduced auto congestion and duration of vehicle stall times at key intersections. The greatest project benefit came from reducing vehicle operating energy by switching from autos to walking, bicycles, and transit. The team forecast a major decrease in auto use by increasing the number of travel routes and reorienting the streets to favor pedestrians and bicycles.
- **Vehicle Miles Traveled (VMT).** By offering a wider mix of uses and a more pedestrian and bicycle-friendly environment, the team expects to be able to shift the weighted average modal share for all trips from about 60 percent auto in the base case to about 30 percent in the advanced case. The developers' case, though better than the base case and close to the advanced case energy savings, trailed in VMT savings by about 30 percent because it lacked local retail and employment opportunities. The team expects this would force many more residents to travel to the suburbs to work and shop.

The team also assumed the plan would shift a substantial amount of trips onto transit by increasing housing and employment densities and by introducing a streetcar system. In the base case, transit accounted for about 20 percent of all vehicle miles traveled. In the advanced case, the team expected an increase in transit use to 40 percent by making the streetcar a viable option.

Figure 6.13 summarizes the overall energy efficiency results of the four cases.

FIGURE 6.13
RIVER DISTRICT ENERGY EFFICIENCY RESULTS

	Alternative Futures			
	Base	Advanced	Developer	Preferred
Energy use (MMBtu/yr)	851,325	1,936,764	897,193	1,399,848
Embodied energy (MMBtu)	5,300,660	17,581,633	7,243,496	12,505,629
On-site energy production (MMBtu/yr)	4,653	59,167	1,249	51,769
CO emissions (tons/yr)	1,177	2,692	1,151	1,887
CO_2 emissions (tons/yr)	85,848	243,420	75,195	171,854
Energy use per resident (MMBtu/yr)	466	175	88	123
Energy use per acre (MMBtu/yr)	4,652	10,583	4,903	7,649
CO emissions per resident (tons/yr)	0.64	0.24	0.11	0.17
CO_2 emissions per resident (tons/yr)	47	22	7	15

Lessons Learned

- Redevelopment projects within the city center offer efficient sites for accommodating metropolitan growth. Significant reductions in per capita energy use, costs, and pollutant emissions should be possible from a strong inner-city housing to jobs ratio.
- Property boundaries can constrain redevelopment efficiencies. Devising strategies to eliminate or reduce boundary constraints can notably improve the efficiency of a redevelopment design.
- A GIS was not available for the study. Consequently, mapping was done in CAD and calculations in separate spreadsheets. These parallel efforts increased the labor needed for "what-if" analyses and preparing the final report.

Implementation Status

In February 1995, the City Council adopted a redevelopment plan that is mix of the developers' master plan and the preferred case. Design and construction has started on several of the infrastructure components and housing projects. The neighborhood association is continuing to hold design charrettes to fine tune the redevelopment plan.

Transit Focus Area Study
Vista, California

Case Study Synopsis

The Vista study was a part of the San Diego Regional Energy Plan, a component to the voter-mandated Regional Growth Management Strategy. Vista was one of five transit focus areas in the San Diego region chosen for summary-level PLACE^{3}S evaluation. The objective was to evaluate the energy efficiency of regional land-use/transportation policies when applied to communities throughout the region.

Major variables in the study were the density and mix of housing and employment. The comparison of alternatives showed the Regional Growth Management Strategy Quality of Life Alternative resulted in small energy and cost savings over existing conditions. Implementation of the Advanced Alternative would save between 24 - 38 percent over existing conditions.

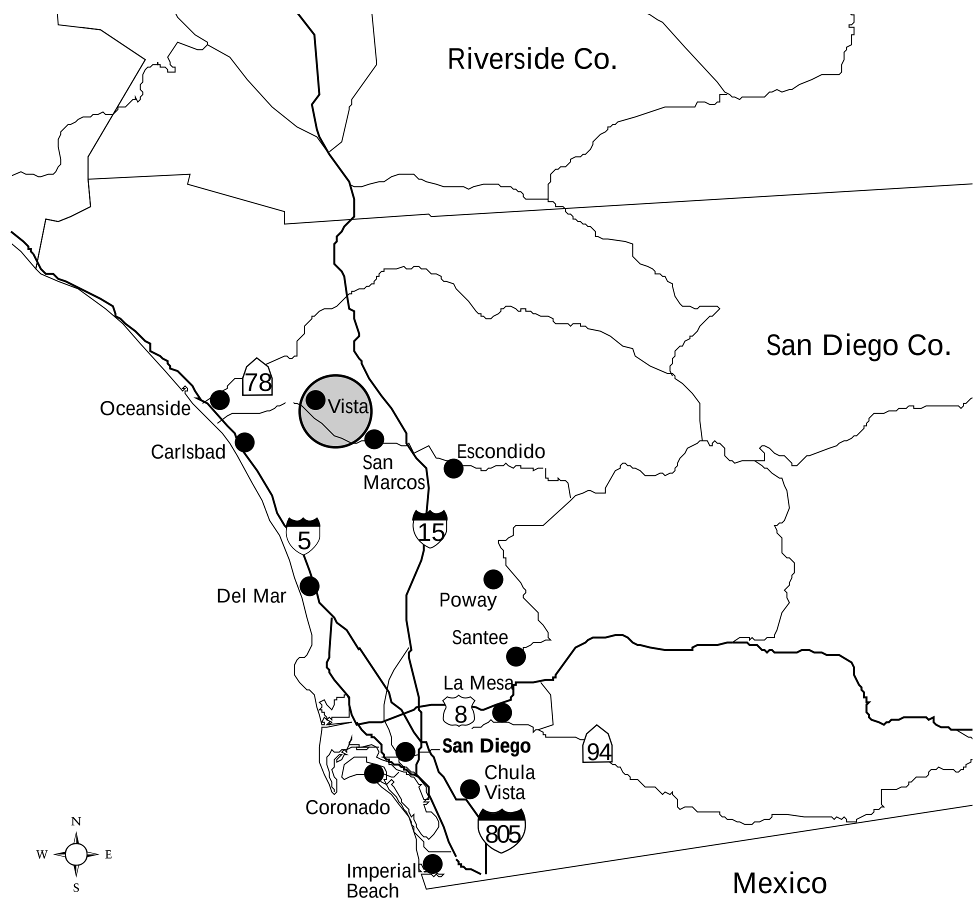
Population

The Vista transit focus area currently has a population of approximately 716.

Study Area Overview

Vista is a small, suburban community about 20 miles north of the San Diego city center (see Figure 6.14). SANDAG has designated the study area as a "transit focus area" with plans to increase bus service and eventually to extend San Diego's light rail service. There is a central business district that is predominantly low-density, single-story retail with abundant parking, both on-street and in surface lots. There are residential neighborhoods around the main business area within a three to five-minute walk of restaurants and other retail uses. Despite the nearby presence of potential customers, the core area has a high vacancy rate as well as a number of vacant lots and under-used properties.

FIGURE 6.14
VISTA VICINITY MAP



Two main arterial streets go around the business center, connecting directly with neighborhood streets. Many of the neighborhood streets dead-end at the edge of the core area, hindering pedestrian and auto access from the residential area to businesses. The arterials (a one-way couplet) are at full capacity during rush hours, but the local and neighborhood streets are always under capacity. Surrounding the study area are single family residential areas on the hillsides, with a few strip commercial areas and some government buildings and schools along the arterials.

Planning Process

This case study was conducted to contribute to the Regional Energy Element of the Regional Growth Management Strategy. A team of consultants working in cooperation with SANDAG and Vista staff prepared the study alternatives.

Stakeholders

- SANDAG
- Local government participants in the Regional Growth Management Strategy
- City of Vista
- California Energy Commission

Public Involvement

There was no direct public involvement in this case study because the project was a pilot test of the technical aspects of the PLACE³S method. SANDAG's energy advisory committee, comprised of 32 local government, utility, academic, and business representatives, reviewed the study findings

Scenarios Examined

- Existing Conditions: Development occurs according to patterns existing in the surrounding area, guided by current planning and zoning requirements and market forces.
- Quality of Life Alternative: Development occurs according to the regional vision developed by stakeholders in the Regional Growth Management Strategy process.
- Advanced Alternative: Development is designed to attain high levels of energy efficiency within the limits of existing development styles.

PLACE³S Measures Used

The PLACE³S efficiency measures used in Vista are listed in Figure 6.15. An illustrated perspective of the PLACE³S-designed Advanced Alternative developed for the study area is shown in Figure 6.16. The planning design challenges for the Vista study area were to:

- Increase employment and residential densities within the central business district by adding two and three-story mixed-use buildings (residences and offices above retail) and by developing vacant and under-used properties;
- Increase residential densities in neighborhoods that are within walking distance of the business area to provide customers and employees for the new businesses and to support the planned increases in transit service.
- Improve the street system so people can quickly and easily move between commercial and residential areas.

FIGURE 6.15
PLACE^{3}S MEASURES PROPOSED FOR VISTA

Measure	Proposed
Landform/Microclimate	
Topography	-
Reflectivity	-
Vegetative cooling	-
Evaporative cooling	-
Wind channeling	-
Land-Use	
Use density	✓
Use mix	✓
Activity concentration	✓
Site Design	
Solar orientation	-
Pedestrian orientation	✓
Transit orientation	✓
Micro climatic building siting	-
Transportation	
Integrated street networks	✓
Pedestrian facilities	✓
Bicycle facilities	✓
Transit facilities	✓
Car pool facilities	-
Pavement minimization	-
Parking minimization/siting	✓
EV charging/alt. fueling	-
Infrastructure Efficiency	
Water supply/use	✓
Wastewater collection	-
Storm drainage	-
Street lighting	-
Traffic signalization	✓
Recycling facilities	-
On-Site Energy	
Groundwater heating/cooling	-
Surface water heating/cooling	-
Wind power	-
Solar power	-
District heating/cooling	-
Cogeneration	-
Thermal storage	-
Fuel cell power	-

The Vista case study planning team proposed adding a much higher mix of residential and commercial uses and reducing the size of street rights-of-way in the developable area. They estimated that 23 percent of the study area was vacant or under-used and amenable to redevelopment. The team proposed to increase the planned residential density of the study area from 9 units per acre to 20.

They designated the majority of the increase to be developed as second and third story housing units above retail shops in the core area. They proposed three types of units for the majority of the residential development:

- Three story garden-style apartments in the city center.
- Town houses directly adjacent to the core.
- Carriage units (one bedroom, approximately 1000 square feet) on small lots subdivided from standard (70 x 100) lots in the main residential area.

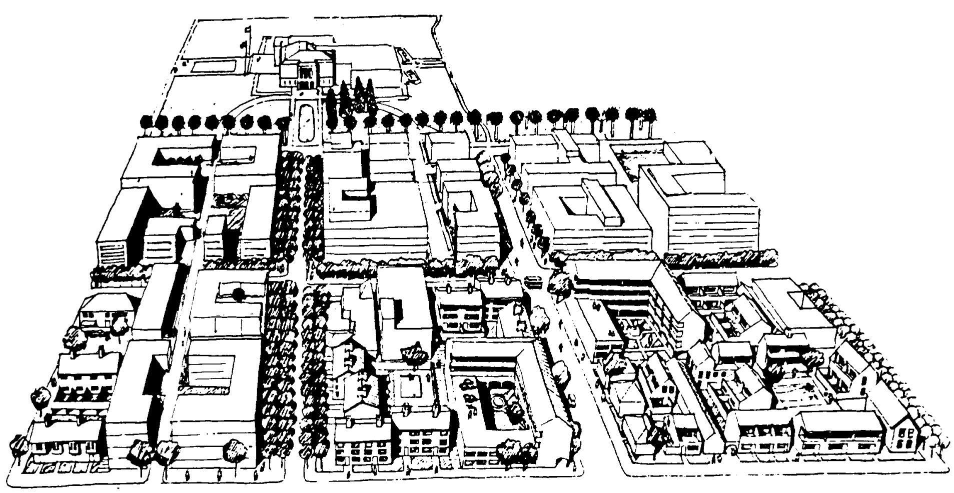
The team also proposed to increase the planned employment density from 17 jobs per acre to 30. To accomplish this they added civic and public uses at each end of the main business area connected by increased street level retail and low-rise (three stories or less) offices within the core. Within the predominantly residential sections of the plan, 20 percent of the area is designated for commercial uses (both office and retail). In the predominantly commercial areas, 20 percent is housing.

The team proposed a 2:1 jobs to housing balance for Vista. The relatively high number of jobs can be supported because there is a fair amount of surplus housing in the residential areas. Vista is ideally suited for a pedestrian-oriented core because a large number of both consumers and employees can live and work within walking distance of retail, service, and office sites. PLACE^{3}S analysis indicated that the Advanced Alternative land-use recommendations would yield a significant drop in vehicle-miles-traveled. For that reason, the team revised the standards used to project the number of needed parking spaces. For the Vista study area, the team used parking generation rates prepared by Calthorpe & Associates as part of the City of San Diego's Transit-Oriented Development Design Guidelines. The total area required for parking under these standards is 31 acres, a 20 to 25 percent reduction from conventional standards. An additional 15 percent reduction was possible because of the improved ability to use parking areas jointly (e.g., daytime retail spaces become residential spaces in the evening).

The team redesigned the local street system to create an active pedestrian-friendly central business area that will connect the community services on the east to the transit center on the west. The proposed changes include:

- **Reinforce the existing arterial street system.** The arterial streets are needed to keep through traffic moving around the core, allowing for a more pedestrian-friendly central business district.

FIGURE 6.16
ILLUSTRATED PERSPECTIVE OF PLACE^{3}S DESIGN OF ADVANCED ALTERNATIVE



View of central Vista at densities of 20 dwelling units per acre and 30 employees per acre.
(Looking East at Broadway)

FIGURE 6.17
VISTA ALTERNATIVE FUTURES

	Alternative Futures		
	Base	Quality of Life	Advanced
Area (acres)	125	125	125
Population			
Residents	716	716	2,787
Employees	1,609	1,826	2,820
Total	2,325	2,542	25,607
Uses (percent of total sq. ft.)			
Residential	19	35	45
Office	11	30	20
Retail	50	20	30
Industrial	0.00	0.00	0
Civic	0.00	5	5
Parking	20	10	20
General Design			
Average block face (ft.)	400	200	200
Percent multi-story buildings on total site	10	35	60
Percent buildings with vertical use mix	5	20	40
Housing			
DU/gross acre	9	9	20
Percent dwellings within 1/4 mile of store	50	80	75
Percent dwellings within 1/4 mile of park	50	80	75
Park acres/1,000 residents	0.5	3	3
Average off-street parking spaces/DU	2.1	1.4	1.1
Employment			
Jobs/housing ratio	6	7	2
Employees/net nonresidential acre	17	25	30
Average nonresidential building FAR	0.25	0.5	0.5
Average nonresidential building front setback (ft.)	25	20	10
Average off-street parking spaces/1,000 sq.ft. building area	2.5	2.1	1.5
Travel			
DU/gross acre within 1/2 mile of rail stop	9	12	20
Employees/gross acre within 1/2 mile of rail stop	17	25	30
DU/gross acre within 1/4 mile of bus stop	9	12	20
Employees/gross acre within 1/4 mile of bus stop	17	25	30
Average street width (curb-curb ft.)	75	70	50
Percent streets with sidewalks both sides	75	100	100
Average sidewalk width (ft.)	5	8	8
Average intersection curb radii (ft.)	15	15	15
Average parking lot size (acres)	0.25	0.25	0.15

- **Extend neighborhood streets and alleys.** Streets and alleys that now dead-end in residential areas should be connected to the central business district as well as to the one-way arterial streets.
- **Give priority to pedestrians and bicycles.** Extending the local street and alley system, widening sidewalks, and narrowing streets in the core promote pedestrian and bicycle travel while accommodating all expected vehicle traffic. Narrow streets help to slow auto traffic in the business area, making pedestrian and bicycle trips easier and more pleasant.
- **Add parking structures.** Additional parking structures are needed to reduce the number of surface parking lots. Any new parking structure should have street-level shops built into the structure and be placed at the edge of the central business district. This design and placement makes walking more interesting and safe and allows under-used surface parking lots to serve a more valuable function.

These and other design features of the transit focus area are summarized in Figure 6.17.

Results

The study's energy efficiency results are summarized below and detailed in Figure 6.18.

FIGURE 6.18
VISTA ENERGY EFFICIENCY RESULTS

	Base	Quality of Life	Advanced
Energy use (MMBtu/yr)	379,976	390,751	437,513
CO emissions (tons/yr)	322	322	277
CO_2 emissions (tons/yr	34,727	36,229	43,552
Energy use per resident (MMBtu/yr)	531	546	157
Energy use per acre (MMBtu/yr)	3,040	3,126	3,500
CO emissions per resident (tons/yr)	0.450	0.450	0.100
CO_2 emissions per resident (tons/yr)	49	51	16

	Base Case	Advanced Case	Percent Difference
Residents	716	2,787	+289
Employees	1,609	2,820	+75
Total Population (residents & employees)	2,325	5,607	+141
Housing energy (MMBtu/yr/resident)	18.56	19.24	+4
Employment energy (MMBtu/yr/employee)	110.73	49.83	-55
Transportation energy (MMBtu/yr/person)	401.72	87.92	-78
Total per capita energy (MMBtu/yr/resident)	531.00	157.00	-70

Lessons Learned

- The Vista transit focus area may be able to accommodate a greater mix of uses and higher residential and employment density than the Quality of Life Alternative assumed.
- The study successfully demonstrated the technical merits of the PLACE^{3}S methodology. Because public participation components of the PLACE^{3}S method were not used, implementation feasibility was not demonstrated.

Implementation Status

Vista and other local jurisdictions in the San Diego region are currently incorporating the new regional growth management strategy into their general plans and zoning ordinances. The Vista design was not intended to be implemented. Rather, it was done to test the neighborhood-scale validity of the regional PLACE^{3}S project.

Murray West, Transit-Oriented Design Assessment
Beaverton, Oregon

Case Study Synopsis

PLACE^{3}S was part of the preparation of a transit-oriented development (TOD) master plan surrounding a new light rail station in Beaverton, Oregon, a suburb of Portland. The case study was limited to the single master plan scenario created by the project's design team, lead by FFA Architects of Portland and including Calthorpe & Associates of San Francisco.

The PLACE^{3}S evaluation concluded that Murray West would be a more energy efficient neighborhood compared to typical developments in suburban Portland. In comparison to the metro average, a family living in Murray West would save $200 to $300 annually on energy and related costs for its home and travel needs. These savings come from reduced auto dependence and travel costs given the neighborhood's pedestrian and transit orientation and from lower residential energy costs associated with a large number of common-wall, multifamily structures.

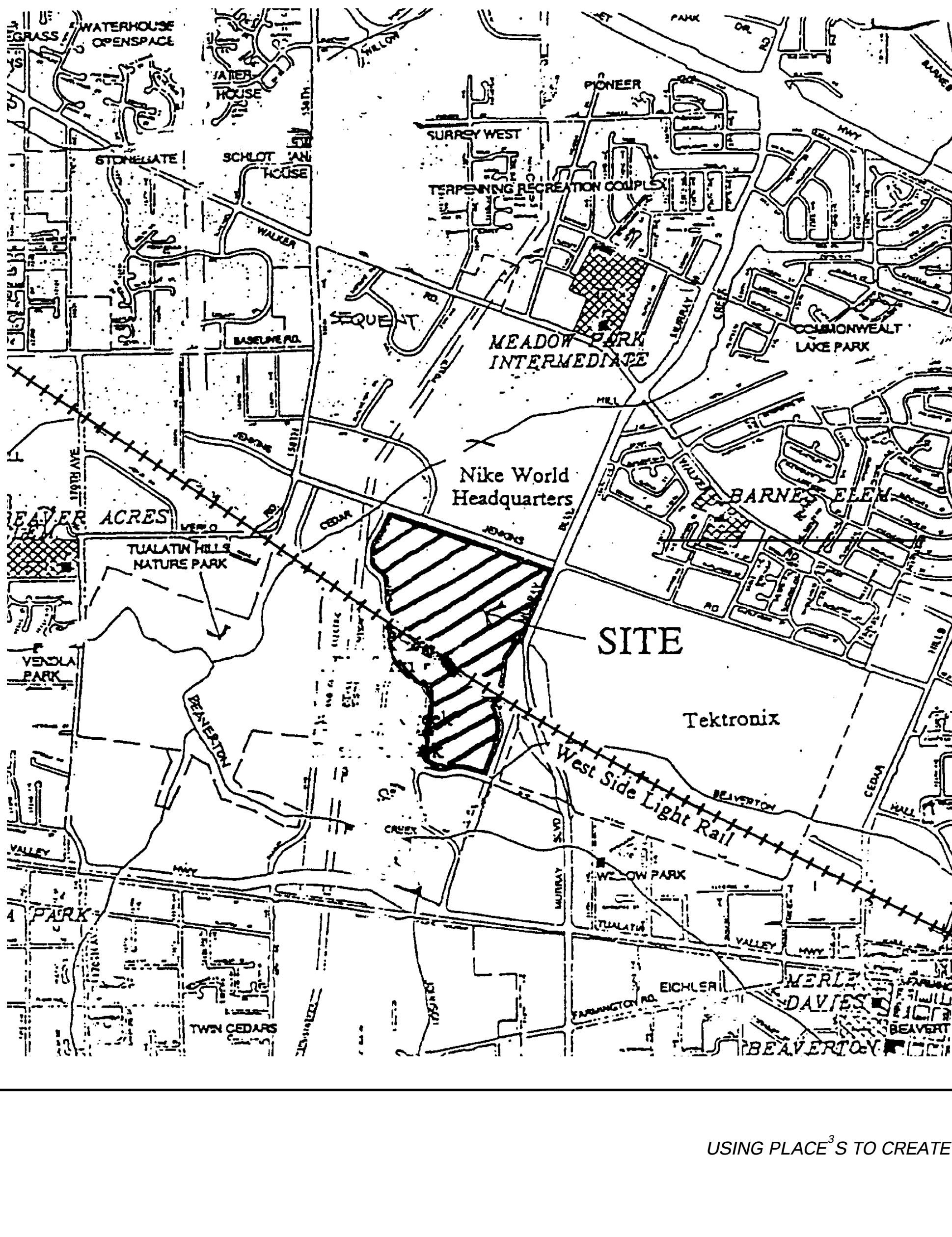
Population

The site is unoccupied. The master plan proposed a future resident population of approximately 3,800 and an employment population of about 1,500.

Area Description

The 120-acre study area is located in Beaverton, a suburb of about 50,000 persons. Low-density suburban mixed uses, including offices, light industrial facilities, and single and multifamily residential, surround the site, as shown in Figure 6.19. There is a large amount of corporate and high technology employment within the immediate vicinity.

FIGURE 6.19
MURRAY WEST VICINITY MAP



Planning Process

The applicable planning process was the City of Beaverton's conditional use permit procedure for TOD's. This included technical staff consultations over a nine month period, followed by formal hearings.

Stakeholders

- Property owners
- Tri-Met transit agency (light rail operator)
- City of Beaverton
- Washington County
- Oregon Department of Transportation
- Oregon Department of Environmental Quality
- Oregon Department of Energy

Public Involvement

The master planning process did not include any formal public involvement outside of the final public hearings before the City of Beaverton. Design team members, however, interviewed nearby residents and workers about the neighborhood features they desired around the light rail station.

Scenarios Examined

The PLACE^{3}S study was limited to the single master plan scenario prepared by the Murray West design team. The design process included several sub-alternatives at the outset, which eventually evolved into the final plan proposal, shown in Figure 6.20. This plan shows more detail than the master plan the developer submitted to the City of Beaverton.

PLACE^{3}S Measures Used

Figure 6.21 lists the energy efficient features the design team used in the detailed plan. The detailed design is summarized in Figure 6.22. These figures describe a neighborhood that is anchored by the light rail station and complimentary commercial uses, with virtually all housing and employment within a comfortable walking or biking distance.

The design team used a software version of the PLACE^{3}S methodology, INDEX®, to evaluate the design. INDEX is a proprietary program of Criterion, Inc.

Results

As summarized in Figure 6.23, PLACE^{3}S measurements found the detailed proposal for Murray West to be a relatively energy efficient neighborhood proposal compared to typical suburban practices. A majority of the efficiencies come from reduced auto dependence and travel costs given the project's high degree of transit and pedestrian orientation. Lower residential energy costs are also achieved with higher density, common-wall buildings.

The members of the design team found two possible design improvements: 1) increasing the mix of uses in multistory buildings, with more commercial and residential uses above ground-floor retail; and 2) improving the site's overall solar orientation. The former could significantly improve the efficiency of space conditioning and lighting systems in buildings. The latter could significantly reduce residential space heating demands and costs. PLACE³S members also recommended that developers of the site investigate groundwater heat pump systems for the large multifamily and nonresidential buildings.

Lessons Learned

- The value of the case study was substantially limited by having only one design alternative to evaluate.
- The design team used an open, collaborative process that encouraged early consideration of efficiency ideas.

FIGURE 6.20
MURRAY WEST DETAILED PLAN

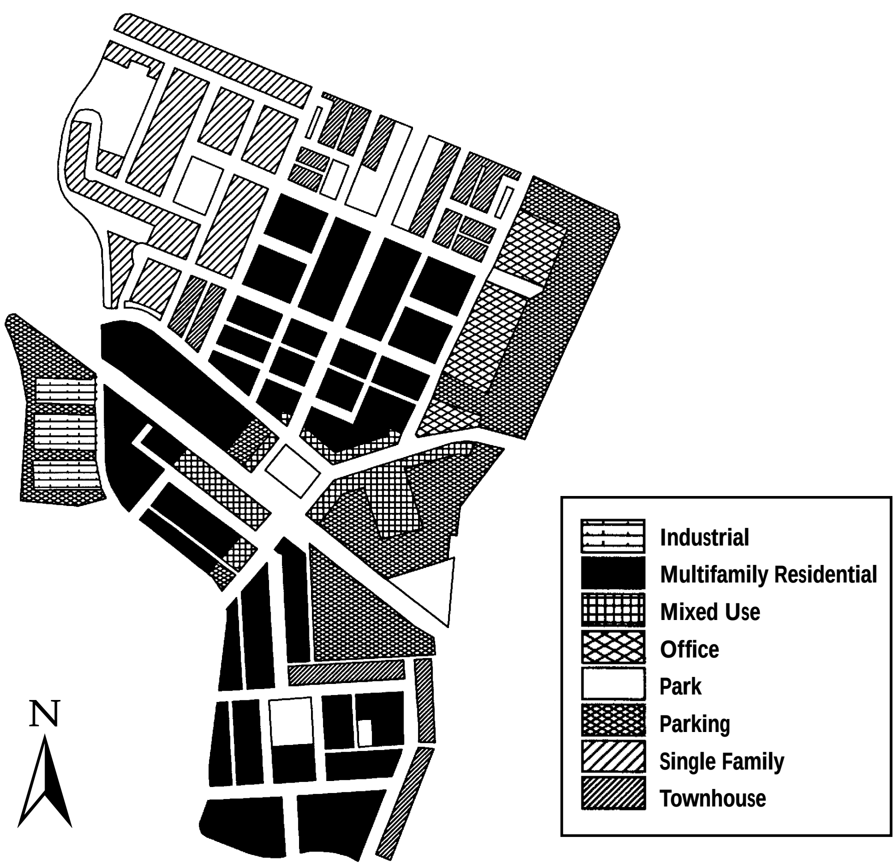


FIGURE 6.21
PLACE³S MEASURES PROPOSED FOR MURRAY WEST

Landform/Microclimate	
Topography	-
Reflectivity	-
Vegetative cooling	-
Evaporative cooling	-
Wind channeling	-
Land-Use	
Use density	✓
Use mix	✓
Activity concentration	✓
Site Design	
Solar orientation	-
Pedestrian orientation	✓
Transit orientation	✓
Micro climatic building siting	-
Transportation	
Integrated street networks	✓
Pedestrian facilities	✓
Bicycle facilities	✓
Transit facilities	✓
Car pool facilities	-
Pavement minimization	✓
Parking minimization/ siting	✓
EV charging/alt. fueling	-
Infrastructure Efficiency	
Water supply/use	-
Wastewater collection	-
Storm drainage	-
Street lighting	-
Traffic signalization	-
Recycling facilities	-
On-Site Energy	
Groundwater heating/ cooling	✓
Surface water heating/ cooling	-
Wind power	-
Solar power	-
District heating/cooling	✓
Cogeneration	-
Thermal storage	-
Fuel cell power	-

FIGURE 6.22
MURRAY WEST DESIGN PROFILE

Area (acres)	121
Population	
Residents	3,843
Employees	1,475
Total	5,318
Uses (percent of total sq. ft.)	
Residential	74
Office	13
Retail	8
Industrial	5
Parking (acres)	37
General Design	
Average block face (ft.)	272
Percent multi-story buildings on total site	98
Percent buildings with vertical use mix	0
Housing	
DU/net residential acre	26
percent dwellings within 1/4 mile of store	77
Percent dwellings within 1/4 mile of park	100
Park acres/1,000 residents	2.4
Average off-street parking spaces/DU	1.8
Employment	
Jobs/housing ratio	0.9
Employees/net nonresidential acre	50
Average nonresidential building FAR	0.6
Average nonresidential building front setback (ft.)	20
Average off-street parking spaces/1,000sq.ft. building area	2.4
Travel	
DU/gross acre within 1/4 mile of rail stop	16
Employees/gross acre within 1/4 mile of rail stop	17
DU/gross acre within 1/4 mile of bus stop	25
Employees/gross acre within 1/4 mile of bus stop	50
Average street width (curb-curb ft.)	31
Percent streets with sidewalks both sides	100
Average sidewalk width (ft.)	6
Average intersection curb radii (ft.)	15
Average parking lot size (acres)	2.8

FIGURE 6.23
MURRAY WEST ENERGY EFFICIENCY RESULTS

Master Plan	
Energy use (MMBtu/yr)	596,286
On-site energy production (MMBtu/yr)	584,801
Embodied energy (MMBtu)	11,000
CO emissions (tons/yr)	1,305
CO_2 emissions (tons/yr)	42,295
Energy use per resident (MMBtu/yr)	165
Energy use per acre (MMBtu/yr)	5,254
CO emissions per resident (tons/yr)	0.34
CO_2 emissions per resident (tons/yr)	11

Implementation Status

Development is beginning on the southern part of the property. Light rail construction is underway; and Tri-Met, the regional transit agency, expects to commence service in September 1998.

Shortly after the City of Beaverton approved the master plan in March 1995, the Nike Corporation purchased most of the northern part of the property. It has not announced how it will use the property, which is adjacent to its corporate headquarters.

Glossary of Terms and Acronyms

Chapter 7

> "A key role for planners in the development of integrated policy is to make the complexity of the interactions intelligible to decision makers and their constituents so that decisions are better informed."
>
> **Terry Moore and Paul Thorsnes**
> *The Transportation/Land-Use Connection*

Advanced Alternative— This is the Planning Alternative used to measure the economic and environmental benefits resulting from employing all or nearly all PLACE^{3}S urban energy efficiency measures.

Btu— British Thermal Unit. A standard measure of thermal energy. It takes one Btu to raise the temperature of one pound of water by one degree Fahrenheit at sea level.

Business-as-Usual Alternative— This is the alternative used to measure the economic and environmental benefits at the end of the planning horizon if the community grows according to market trends and no policy changes are made.

CAD— Computer-Aided Design.

Charrette— A meeting of stakeholders employing public process techniques and focused on creating a vision for the future.

Coefficient— A constant used as a multiplier to measure energy use, costs, and air pollutant emissions, e.g., the average amount of electricity used annually per house.

Embodied Energy— The energy needed to grow, harvest, extract, manufacture, or otherwise produce and deliver building products and construction materials for a building or infrastructure project.

Existing Conditions— A measure of how efficient a community is at the beginning of a planning project.

FAR— Floor Area Ratio. Ratio of total permitted floor area to parcel size. For example, with a 10,000 sq. ft. parcel and a 4:1 floor area ratio, it would be possible to build a total of 40,000 sq. ft. of development.

GIS— Geographic Information System. A computer system of hardware and software that enables mapping, analysis and modeling of geographic data.

Greenfield— A development on previously undeveloped land.

Heat Island Effect— The difference between urban and rural temperatures caused by replacing vegetation with concrete and asphalt and the absorption of solar energy by dark-colored paving and roofing materials.

Location Criteria— A numerical rating of the adequacy within a subarea of important community features to which people travel frequently, such as jobs, transit and shopping, and the features that subareas need to function efficiently, such as infrastructure.

Location Efficiency— A numerical rating of the adequacy within a subarea of the efficiency of a subarea based upon distance to important features such as jobs and transit. For example, a subarea near jobs and transit is generally more efficient for urban development than a subarea far away from such features.

MMBtu— Million Btu. Because a single Btu is a small amount, PLACE^{3}S uses one million Btu as its standard unit of energy measurement.

Mode Split— The amount of person trips divided among various travel modes, including walking, bicycle, automobile, trucks, and transit.

Planned Efficiency— The consistency of a subarea's land-use designation with its location qualities, e.g., a subarea near transit and jobs is generally more efficient if planned for high-density uses rather than low-density uses.

Planning Alternative— Each Planning Alternative reflects a unique stakeholder vision of the future. The set of Planning Alternatives should address the full range of stakeholder issues relevant to the project being studied.

Planning Criteria— The characteristics for judging a subarea's land-use and travel efficiency, including the number of land uses, number of residential units per acre, jobs per acre, and percent of trips made with only one person per vehicle.

Preferred Alternative— This alternative is the outcome of employing the PLACE^{3}S method in a public decision-making process. It is the final composite alternative constructed by stakeholders balancing the costs, benefits and impacts of each alternative.

SIC— Standard Industrial Classification. U.S. Government numerical code used to identify type of business activity or product produced.

Stakeholders— A group of people assembled to represent all issues and interests possibly affected by a proposed project. Stakeholder groups often include citizens, technical experts, public agency representatives, business and legal representatives, environmental and social advocates, and others.

TAZ— Traffic analysis zone. A common subarea division used in regional transportation GIS models.

TPMT— Transit passenger miles travelled. Miles travelled by mass transit passengers.

VMT— Vehicle miles travelled. Miles travelled by all motorized vehicle types, except transit.

ADDITIONAL INFORMATION

Chapter 8

This listing of organizations, periodicals, conferences and electronic resources is adapted from the U.S. Department of Energy's *Cities and Counties Resource Guide* produced by the National Renewable Energy Laboratory in Golden, Co.

> "A community that does not scrutinize . . . new growth is gambling its future as surely as would a trip to Las Vegas with the municipal treasury. We can no longer . . . assume that any expansion will strengthen the community's economy."
>
> **Michael Kinsely & Hunter Levins,**
> *Paying for Growth, Prospering from Development*

ORGANIZATIONS

Alliance to Save Energy (ASE)
1725 K Street, NW, Suite 509, Washington, DC 20006. 202-857-0666. A nonprofit coalition of government, business, environmental, and consumer leaders dedicated to increasing the efficiency of energy use. ASE formulates policy and program initiatives; publishes studies, manuals, and reports; and provides information about energy-efficient technologies.

American Council for an Energy-Efficient Economy (ACEEE)
1001 Connecticut Avenue, NW, Suite 801, Washington, DC 20036. 202-429-8873. A nonprofit information lobby working to inform government policy makers and others about the benefits of greater energy efficiency. Has an extensive publications list with many titles on energy policy.

American Public Power Association (APPA)
2301 M Street, NW, Washington, DC 20037-1484. 202-467-2900. This association represents the interests of municipally owned electric utilities, public utility districts, and state- and county-owned electric systems. The APPA conducts research programs, compiles statistics, and sponsors competitions. Also, it publishes technical papers, manuals, booklets, consumer folders and surveys, and the magazine *Public Power*. APPA also offers an information packet on demand side management and an Energy Services Exchange hot line for members.

American Public Transit Association (APTA)
201 New York Avenue, NW Suite 400, Washington, DC 20005. 202-898-4000. Manufacturers and suppliers of materials and services for rapid rail and motor bus transit systems. Maintains 10,000-volume library on urban transportation. Publishes the *APTA Directory, Passenger Transport: The Weekly Newspaper of the Transit Industry*, and *Transit Fact Book*, all annual. Holds an annual conference as well as a triennial international exposition in conjunction with the annual meeting (last held in 1993).

American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE)
1791 Tullie Circle, NE, Atlanta, GA 30329. 404-636-8400. Dedicated to advancing the technology and theory of heating, refrigeration, air conditioning, and ventilation. Sponsors research and develops standards documents that help establish acceptable

levels of performance for buildings and mechanical equipment. *The ASHRAE Handbooks*, technical texts on energy fundamentals and systems, and *ASHRAE Journal*, the society's monthly magazine, are considered essential sources of information for mechanical engineers. Large publications catalog.

American Solar Energy Society (ASES)
2400 Central Avenue, Unit G-l, Boulder, CO 80301. 303-443-3130. Promotes the development and use of reliable renewable energy technologies. Publishes *Solar Today* magazine and such books as *Economics of Solar Energy Technologies, Proceedings of the American Solar Energy Society Annual Conference*, and *Proceedings of the National Passive Solar Conference*.

American Wind Energy Association (AWEA)
122 C Street, NW, Fourth Floor, Washington, DC 20002-2109. 202-383-2600; Fax: 202-383-2670. A professional membership association whose purpose is to encourage a high standard of business practices within the wind energy industry. Assists members in designing, building, installing, operating, and maintaining wind energy conversion systems and system components in a manner compatible with public health, safety, and environmental values. AWEA has a large publications catalog. Magazines and newsletters include *Wind Energy Weekly* and *Windletter.*

Association of Energy Engineers (AEE)
4025 Pleasantdale Road, Suite 420, Atlanta, GA 30340. 404-447-5083. Membership organization of engineers, architects, and other professionals with an interest in energy efficiency and energy-related product manufacturers. Promotes scientific and educational interests of professionals engaged in energy management, cogeneration, and overall efficiency improvements. Publishes periodicals including *Energy Engineering,* a bimonthly; and *Strategic Planning for Energy and the Environment,* a quarterly. AEE also conducts seminars, technical meetings, and conferences on a variety of topics.

Bicycle Transportation Action (BTA)
308 East 79th Street, New York, NY 10021-0904. 212-288-3103. Promotes the use of bicycles as transportation to improve mobility and strengthen the economy.

Biomass Energy Research Association
1825 K Street, NW Suite 503, Washington, DC 20006. 202-785-2856. Promotes the development and commercialization of biomass energy systems. Supports technology transfer research of nonfossil fuels such as municipal solid waste, refuse-derived fuels, wood waste, and sludge.

Center for Ecological Technology
147 Tyler Street, Pittsfield, MA 01201. 413-445-4556. An organization that works to protect the environment, increase energy self-reliance, and reduce dependency on expensive and polluting technologies. Provides information and services on resource and energy efficiency.

Center of Excellence for Sustainable Development
1617 Cole Boulevard, Golden, CO 80401. 303-275-4826. Toll Free: 800-357-7732. E-mail: sustainable.development@hq.doe.gov. A U.S. Department of Energy service center established to provide information and technical advice to help communities strengthen their local economies and enhance the local environment and quality of life.

Center for Neighborhood Technology
2125 West North Avenue, Chicago, IL 60647. 312-278-4800.

Center for Policy Alternatives
1875 Connecticut Avenue, NW Suite 710, Washington, DC 20009. 202-387-6030. An organization that publishes reports on federal, state, and local government policies related to energy and the environment.

Center for Sustainable Transportation
1130 17th Street, NW, Suite 630, Washington, DC 20036. 202-466-2823. Gathers and disseminates information on sustainable transportation. Works for the elimination of cars powered by fossil fuel and the development of alternative means of transportation.

Cities for Climate Protection Campaign
US Cities for Climate Protection, 15 Shattuck Square, Suite 215, Berkeley, California 94704. 510-540-8893. This is the U.S. Office of the International Council for Local Environmental Initiatives' (ICLEI) world-wide Cities for Climate Protection Campaign. Through this Campaign, ICLEI is working with cities to find and evaluate practical land use strategies for reducing environmental impacts. The ICLEI World Secretariat's address is 8th Floor, East Tower, 100 Queen Street, Toronto, Ontario M5H 2N2, Canada. 416-392-1462.

Clearinghouse on Energy Financing Partnerships
2000 North 15th Street, Number 407, Arlington, VA 22201. 703-243-4900. An organization that maintains an extensive collection of information and literature on alternative financing, with special emphasis on shared savings contracting and procurement issues pertinent to public-sector applications. Bibliographies, referrals, and other selected publications may be obtained free of charge.

Community Transportation Association of America (CTAA)
725 15th Street, NW, Suite 900, Washington, DC 20005. 202-628-1480. Assists local governments in meeting their transportation service and developmental needs. Provides technical assistance to the community transportation industry.

Consumer Energy Council of America Research Foundation
2000 L Street, NW, Suite 802, Washington, DC 20036. 202-659-0404. The nation's oldest public interest organization for energy policy. Provides a wealth of information, analysis, and technical expertise on a wide variety of energy initiatives. Publishes *The Quad Report.*

Electric Power Research Institute (EPRI)
P.O. Box 10412, Palo Alto, CA 94303. 415-855-2000. An advanced and prolific electric power research institute. Its publications and research reports are searchable on-line through EPRINET and the EPRI data base on DIALOG. Reports span virtually all energy efficiency, renewable energy, and waste management topics related to electric power. Publishes the *EPRI Journal*, which summarizes EPRI research activities, eight times each year.

Energy Conservation Coalition
6930 Carrow Avenue, Sixth Floor, Takoma Park, MD 20912. 202-745-4874. Nonprofit coalition of 20 national consumer, environmental, scientific, and religious organizations dedicated to promoting energy efficiency in all sectors of the economy. Affiliated with the Environmental Action Foundation. Offers various publications.

Energy Efficiency and Renewable Energy Customer Service Center

P.O. Box 3048, Merrifield, VA 22116. 800-363-3732. World Wide Web Site: http://www.eren.doe.hq. Funded by the US Department of Energy, the center responds to phone, mail, and electronic inquiries on energy efficiency and renewable energy technologies. The center responds to questions ranging from simple requests for information to complex technical queries. Some of the energy efficiency and renewable energy programs covered by the center include: Cool Communities, Rebuild America, Clean Cities, NICE^3, Climate Wise, and the Industrial Assessment Center. All information is free of charge.

Energy Efficient Building Association (EEBA)

North Central Technical College, 1000 Campus Drive, Wausau, WI 54401-1899. 715-675-6331; Fax: 715-675-9776. An organization dedicated to the development and dissemination of information on the design, construction, and operation of efficient buildings. EEBA offers professional and technical publications and conference proceedings.

Energy Information Administration (EIA)

National Energy Information Center, EI-231, Energy Information Administration, Forrestal Building, Room 1F-048, Washington, DC 20585. 202-586-8800. World Wide Web Site: http://www.eia.doe.gov. E-mail at infoctr@eia.doe.gov.

Florida Solar Energy Center (FSEC)

300 State Road 401, Cape Canaveral, FL 32920-4099. 407-783-0300. An essential information resource for anyone building in hot, humid climates. Publications include *Design Notes* and *Energy Notes*, which cover topics such as passive cooling, radiant barriers, moisture control in hot climates, shading techniques, and more.

Gas Research Institute (GRI)

8600 West Bryn Mawr Avenue, Chicago, IL 60631. 312-399-8373. GRI is involved in developing energy-saving gas technologies, but has just begun to monitor gas demand side management (DSM) programs. Most current discussion of GRI's work in gas DSM is detailed in a 1991 report entitled *Integrated Resource Planning Challenges and Opportunities for the Gas Industry* by K. Kazmer, Director of Appliances and Building Systems for the Institute.

Geothermal Resources Council

2001 Second Street, Suite 5, Davis, CA 95617. 916-758-2360; Fax 916-758-2839. A leading proponent of geothermal energy and a major center for information in the geothermal area.

Global Cities Project

2962 Fillmore Street, San Francisco, CA 94123. 415-775-0791. A program of the Center for the Study of Law and Politics, a nonprofit, nonpartisan organization. This program is an ongoing, national environmental service for local governments, dedicated to the concept of economic and environmental sustainability.

Illuminating Engineering Society of North America (IES)

345 East 47th Street, New York, NY 10017. 212-705-7913. Technical society dealing with the art, science, or practice of illumination. Provides speakers, referrals, and assistance with technical problems. Conducts area symposia and seminars, workshops and lighting exhibitions, and slide presentations. Monthly publications include *IES News* and *Lighting Design and Application*. Also publishes standards, reports, booklets, and guides.

International District Energy Association
2425 18th Street, NW, Washington, DC 20009. 202-387-2026. Produces reports and conferences on cogeneration and district heating and cooling.

International Ground-Source Heat Pump Association
Oklahoma State University, College of Engineering, Architecture and Technology, 101 Industrial Building, Stillwater, OK 74078-0532. 405-744-5175.

Institute for Local Self-Reliance
2425 18th Street, NW, Washington, DC 20009. 202-232-4108. Provides highly detailed reports with policy recommendations on how communities are generating local jobs and income, saving energy and money, and solving environmental problems by improving and increasing local energy efficiency, reducing waste, and recycling natural resources.

Lawrence Berkeley Laboratory (LBL)
Center for Building Sciences, Applied Science Division, Berkeley, CA 94720. 510-486-6845. Operates the Center for Building Sciences and the California Institute for Energy Efficiency. Also conducts research in energy analysis, energy-efficient windows, and lighting systems.

Municipal Waste Management Association
Formerly National Resource Recovery Association, c/o U.S. Conference of Mayors, 1620 I Street, NW, Washington, DC 20006. 202-293-7330; Fax: 202-293-2352. Promotes the development and successful operation of resource recovery facilities, district heating and cooling systems, and thermal distribution systems using urban waste energy.

National Association of County Officials (NACO)
440 First Street, NW, Washington, DC 20001. 202-393-6226. An organization that works with the U.S. Environmental Protection Agency to encourage sustainable development within communities and to share information about sustainability among communities.

National Association of Home Builders (NAHB)
National Research Center, 400 Prince George Boulevard, Upper Marlboro, MD 20772-8731. 301-249-4000. The group that recently completed the Resource Conservation House, a demonstration home built with a variety of resource-efficient materials. Sells many books and publications on energy-efficient buildings and all other aspects of the building industry.

National Association of State Energy Officials (NASEO)
505 llth Street, SE, Washington, DC 20003. 202-546-2200. Among NASEO activities are informing Congress and the U.S. Department of Energy (DOE) about positive results of state energy programs, supporting relevant legislation, facilitating networking by members, and monitoring federal policies. Publishes a quarterly newsletter and a research report, *Showcase of State Energy Programs*, featuring the most successful federally financed energy efficiency programs nationwide.

National Fenestration Rating Council
c/o D&R International, Ltd., 962 Wayne Avenue, Suite 750, Silver Spring, MD 20910. A collaboration among industry, government, and public interest groups working to establish a viable and economical fenestration rating system that will be used by manufacturers in marketing windows.

National Growth Management Leadership Project
300 Willamette Building, 534 SW Third Avenue, Portland, OR 97204. 503-223-4396. Conducts national land-use transportation research to demonstrate how changes to land use can increase the economic feasibility of alternatives to vehicles.

National Hydropower Association
122 C Street, NW, Fourth Floor, Washington, DC 20001. 202-383-2530. Promotes the development of hydroelectric energy.

National League of Cities (NLC)
1301 Pennsylvania Avenue, NW, Washington, DC 20004. 202-626-3000. An organization for cities and businesses that trade with cities. Publishes *Nation's Cities Weekly*, a weekly newspaper; annual directories of city officials, state leagues, and NLC staff; case studies; guidebooks; and research reports.

National Renewable Energy Laboratory (NREL)
Center for Buildings and Thermal Energy Systems, 1829 Denver West Parkway, Golden, CO 80401. Switchboard: 303-275-3000. NREL is a DOE national laboratory devoted to renewable energy and energy efficiency technologies. NREL's Building Program comprises a dozen or so research projects. Some of these projects overlap; others are autonomous. Energy efficiency or renewable energy use in buildings are the common threads that loosely tie together the program's work. The major research projects include: BESTEST software development; Building America Program; desiccant cooling research; Federal Energy Management Program; heating, ventilating, and air conditioning retrofits; passive solar building design; short-term energy monitoring; solar domestic hot water research; transpired solar collector research; and weatherization programs. NREL also has programs in renewable fuels and efficient transportation technologies.

National Wood Energy Association (NWEA)
777 North Capitol Street, NE, Suite 805, Washington, DC 20002-4226. 202-408-0664; Fax: 202-408-8536. Lobbies Congress in support of biomass energy and works with federal agencies to address industry needs and concerns. Publishes *Biologue*, a quarterly magazine.

Natural Resources Defense Council (NRDC)
40 West 20th Street, New York, NY 10011. 212-727-2700. A group of experts in environmental law and policy. Frequent intervener in utility rate hearings and other public proceedings. Issues many reports about utility policy and legal issues relating to natural resources. Publishes *The Amicus Journal*, a quarterly that features the latest scientific and political developments on worldwide resource issues.

Oak Ridge National Laboratory (ORNL)
P.O. Box 2009, Oak Ridge, TN 37831-8218. 615-574-4192. A research and development laboratory under contract to DOE. Conducts thermal testing on full-size building components. The results of the laboratory's research are published and available to the public for a nominal fee.

Passive Solar Industries Council
1090 Vermont Avenue, NW, Suite 1200, Washington, DC 20005-4905. 202-371-0357. A council of building industry organizations and professionals founded to provide the industry with practical passive solar technology and energy-efficient building.

Photovoltaics for Utility-Scale Applications (PVUSA)
PVUSA Project Office, 3400 Crow Canyon Road, Sunset Building, San Ramon, CA 94583. 510-866-5569. PVUSA gives utilities hands-on experience with PV systems and allows PV manufacturers to gain experience in meeting the needs of utilities.

Renew America
1400 16th Street, NW, Suite 710, Washington, DC 20036. 202-232-2252. An organization that presents the annual Searching for Success: National Environmental Achievement Awards to the best examples of community efforts to solve energy and environmental problems. Maintains the Environmental Success Index, a data base of contacts from these community examples.

The Results Center
IRT Environment, P.O. Box 10990, Aspen, CO 81612-9689. 303-927-9428. Compiles evaluation results on utility and government energy efficiency programs, highlighting their economic and environmental benefits.

Rocky Mountain Institute (RMI)
1739 Snowmass Creek Road, Snowmass, CO 81654-9199. 303-927-3851. An organization that provides publications, tools, and training seminars to put sustainable development within reach of interested communities.

Sandia National Laboratories
Photovoltaics Design Assistance Center, Albuquerque, NM 87185. 505-844-3698. A DOE-funded resource for technical information about photovoltaic (PV) technology. Provides technical assistance to suppliers and users of PV technology. Publications available on PV power systems and the National Electric Code.

Solar Energy Industries Association (SEIA)
122 C Street, NW, Fourth Floor, Washington, DC 20002-2109. 202-383-2600; Fax: 202-383-2670. Ongoing reports on the state of the solar industry, including economic status and policy recommendations for accelerating most-effective technologies facing institutional barriers and market imperfections. Publishes *Solar Industry Journal*, a quarterly magazine.

Solid Waste Association of North America
P.O. Box 7219, 8750 Georgia Avenue, Suite 140, Silver Spring, MD 20910. 301-585-2898; Fax: 301-589-7068. Goal is to improve solid waste management services to the public and industry via training, education, technical assistance, and technology transfer. Publishes *Municipal Solid Waste News* a monthly newsletter, and *Meetings Proceedings.*

Surface Transportation Policy Project (STPP)
1400 16th Street, NW, Suite 300, Washington, DC 20036. 202-939-3470. Monitors transportation policies and investments to ensure that they conserve energy, protect environmental and aesthetic quality, strengthen the economy, promote social equity, and make communities more livable.

Transportation Research Board (TRB)
National Research Council, 2101 Constitution Avenue, NW, Washington, DC 20418. 202-334-2934. Sponsors research, conferences, and reports on transportation.

Urban Consortium Energy Task Force (UCETF)
1301 Pennsylvania Avenue, NW, Suite 800, Washington, DC 20004. 202-626-2400. This organization is funded by the U.S. Department of Energy (DOE) and contractor assisted by Public Technology, Inc. Provides publications and videotapes of successful local government projects, including the DOE Sustainable Cities Project.

Urban Land Institute
1090 Vermont Avenue, NW, Suite 300, Washington, DC 20005. 202-624-7000. An organization dedicated to improving the quality and standards of urban land use. Publishes a magazine and two newsletters.

Utility Wind Interest Group (UWIG)
Western Area Power Administration Representative, Steve Sargent, A0400, 1627 Cole Boulevard, Golden, CO 80401-3393. 303-231-1694.

Wisconsin Center for Demand-Side Research
595 Science Drive, Suite A, Madison, WI 53711. 608-238-4601. Funded by the state and utilities, the center maintains data bases of electric demand side management (DSM) and gas DSM programs (estimates the potential savings for gas technology options). It also studies occupant behavior to identify the most cost-effective options for various regions.

Worldwatch Institute
1776 Massachusetts Avenue, NW, Washington, DC 20036. 202-452-1999. An independent, nonprofit research organization established to alert decision makers and the general public to emerging global trends in resource availability and management. Worldwatch has produced books and papers on energy, food policy, population, development technology, environmental, human resources, and economic issues.

PUBLICATIONS

The Amicus Journal
Natural Resources Defense Council, 40 West 20th Street, New York, NY 10011. 212-727-2700. A quarterly that features scientific, political, and legal developments of environmental issues.

Biofuels Update
National Alternative Fuels Hotline, P.O. Box 12316, Arlington, VA 22209. 1-800-423-1DOE. Quarterly report on U.S. Department of Energy biofuels technology.

Biologue
National Wood Energy Foundation, 777 Capitol Street, NE, Washington, DC 20002. 202-408-0664. Reports quarterly on biomass energy projects for DOE. Also chronicles outstanding biomass energy projects overseas.

CADDET Energy Efficiency Newsletter
Center for the Analysis and Dissemination of Demonstrated Energy Technologies, Swentiboldstradt 21, 6137 AE Sitturd, The Netherlands. +31-46-595-224. A very informative and worthwhile magazine reporting on successful energy efficiency technologies and programs throughout the world. Available through Oak Ridge National Laboratory, 241 West Tyrone Road, Oak Ridge, TN 37831.

Clean Fuels Report
J.E. Sinor Consultants, Inc., Suite 1, 6964 North 79th Street, P.O. Box 649, Niwot, CO 80544. 303-652-2632. Reports monthly on regulations, legislation, economics, and technology related to alternative fuels.

Clean Cities Update
1925 North Lynn Street, Suite 1080, Arlington, VA 22209. 800-224-8437. Free quarterly newsletter.

COGEN
Formerly Cogeneration Resource Recovery Magazine, Cogeneration Publications, 747 Leigh Mill Road, Great Falls, VA 22066. 703-759-5060. Bimonthly magazine of economic and technical information on cogeneration.

The Cogeneration Monthly Letter
Cogeneration & Small Power Consulting & Information Services, 747 Leigh Mill Road, Great Falls, VA 22066. 703-759-5060. Published monthly.

District Energy
International District Energy Association, 1101 Connecticut Avenue, NW, Suite 700, Washington, DC 20036-4303. 202-429-5111.

Gee-Heat Center Quarterly Bulletin
Gee-Heat Center, Oregon Institute of Technology, Klamath Falls, OR 97601. 503-885-1750. A quarterly progress and development report on the direct use of geothermal resources.

Geothermal Resources Council Bulletin
Geothermal Resources Council, 2001 Second Street, Suite 5, Davis, CA 95617. 916-758-2360; Fax 916-758-2839. A monthly publication featuring on-the-spot reports from world correspondents.

Home Energy
2124 Kittredge, #95, Berkeley, CA 94704. 510-524-5405. A trade magazine for the weatherization industry that offers clearly written information on every aspect of energy efficiency for existing homes.

Hydro Review
HCI Publications, 410 Archibald Street, Kansas City, MO 64111-3046. 816-931-1311; Fax: 816-931-2015. Published eight times each year. Contains feature and technical articles of interest to the North American hydroelectric industry.

Independent Energy Magazine
620 Central Avenue, North, Milaca, MN 56353-1788. 612-983-6892. Provides a forum for relatively small, independent energy producers.

The Journal of Light Construction
RR #2, Box 146, Richmond, VT 05477. 802-434-4747. Articles on current developments in energy- and resource-efficient housing.

Journal of Wind Energy Technology, 1988
WindBooks, Inc., P.O. Box 4008, St. Johnsbury, VT 05819-4008. 802-748-5148. Examines the aerodynamic, meteorological, structural, electrical, and mechanical engineering of energy systems and their application worldwide.

Mass Transit
445 Broad Hollow Road, Melville, NY 11747. Mass transit industry magazine with articles on business, personal interest, technology, and safety.

New Fuels Report
Inside Washington Publishers, P.O. Box 7167, Ben Franklin Station, Washington, DC 20044. 800-424-9068. Weekly newsletter.

NHA News
National Hydropower Association, 122 C Street, NW Fourth Floor, Washington, DC 20001. 202-383-2530. Monthly newsletter for the hydro power industry.

NTIS Alert on Energy
National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161. 703-487-4650; ask for PR-797/CAU. Biweekly newsletter with abstracts. Provides an efficient and timely way to stay in touch with the latest research, technologies, and studies available from NTIS. Energy subjects include batteries; electric power production and transmission; policies and regulations; energy use, supply, and demand; engine studies; fuel conversion processes; geothermal and solar energy; and heating and cooling systems.

Photovoltaic Insider's Report
1011 West Colorado Boulevard, Dallas, TX 75208. 214-942-5248. Monthly publication for engineers and technologists interested in what's happening at the cutting edge of the photovoltaic industry worldwide.

Power
McGraw-Hill, Inc., 12201 Avenue of the Americas, New York, NY 10020. 212-512-2000. To subscribe, write P.O. Box 521, Hightstown, NJ 08520. Article topics include waste to energy, cogeneration, boiler operation, and utility operations from an engineering perspective.

PV News
Energy Systems, Inc., P.O. Box 290, Casanova, VA 22017. 703-788-9626. Monthly newsletter for the photovoltaics industry.

Solar Energy
Pergamon Press, 660 White Plains Road, Tarrytown, NY 10591-5153. 914-524-9200. International Solar Energy Society journal for scientists, engineers, and technologists in solar energy and its application. Published monthly.

Solar industry Journal
Solar Energy Industries Association, 122 C Street, NW, Fourth Floor, Washington, DC 20002-2109. 202-383-2600; Fax: 202-383-2670. Quarterly magazine. Once a year, the magazine publishes a useful list of solar industry manufacturers.

Solar Today
American Solar Energy Society, 2400 Central Avenue, Unit G-l, Boulder, CO 80301. 303-443-3130. A bimonthly publication that provides information for solar energy for engineers, scientists, architects, educators, practitioners, researchers, and users. Includes actual case histories, and reviews of different technologies.

TR News
Transportation Research Board, National Research Council, P.O. Box 289, Washington, DC 20055. Bimonthly magazine of news, research reports, and announcements for the transportation professional.

***Transit Research Abstracts,* Vol. 11, 1993**
Prepared from Urban Mass Transportation Research Information Service Records. Federal Transit Administration, U.S. Department of Energy, 400 Seventh Street, SW, Room 6102, Washington, DC 20590. 202-366-0080. Annual publication that features abstracts and research project summaries on planning, designing, financing, constructing, operating, maintaining, managing, and marketing all modes of public transit.

Waste Age Magazine
National Solid Wastes Management Association, 1730 Rhode Island Avenue, NW, Suite 1000, Washington, DC 20036. 800-829-5411.

Wind Energy News, 1987
WindBooks, Inc., P.O. Box 4008, St. Johnsbury, VT 05819-4008. 802-748-5148. International newsletter of wind power. Focuses on business, marketplace, and international policies of the windmill industry.

Wind Energy Report
WindBooks, Inc., P.O. Box 4008, St. Johnsbury, VT 05819-4008. 802-748-5148. The international journal of wind power. Discusses technology, economics, politics, business, marketing, and engineering of windmills and wind power applications and projects.

Wind Energy Weekly
American Wind Energy Association (AWEA), 122 C Street, NW, Fourth Floor, Washington, DC 20001. 202-383-2500.

CONFERENCES

American Public Transit Association (APTA) International Public Transit Expo
APTA, 201 New York Avenue, NW Suite 400, Washington, DC 20005. 202-898-4000. Holds an annual conference as well as a triennial international exposition in conjunction with the annual meeting (last held in 1993).

American Wind Energy Association Annual Conference and Exhibition
Sponsored by the American Wind Energy Association (AWEA), the U.S. Department of Energy, the National Renewable Energy Laboratory, and Northern States Power Company. Contact AWEA, 122 C Street, NW, Fourth Floor, Washington, DC 20002-2109. 202-383-2600; Fax: 202-383-2670.

Bicycle Network (BN)
P.O. Box 8194, Philadelphia, PA 19101. 215-222-1253. Conducts seminars and workshops and disseminates information.

Cities in Action, Working Together
Contact the National League of Cities, 1301 Pennsylvania Avenue, NW, Washington, DC 20004. 202-626-3000. Annual congress of cities with exposition.

Green Building Conference
National Institute of Standards and Technology, U.S. Department of Commerce, Public Affairs Division, A903 Administration Building, Gaithersburg, MD 20899-0001. 301-975-2762. Pertains to structures that minimize the impact on global, neighborhood, and internal environments during their design, construction, operation, and eventual demolition.

International Ecological Cities Conference
Contact Urban Ecology P.O. Box 10144, Berkeley, CA 94709. 510-549-1724. Biennial event that brings together people and resources on the cutting edge of eco-city design and development.

National Passive Solar Conference
American Solar Energy Society (ASES), 2400 Central Avenue, Suite G-l, Boulder, CO 80301. 303-443-3130. This conference is held in conjunction with the ASES National Solar Energy Conference (see description below).

National Solar Energy Conference
ASES, 2400 Central Avenue, Suite G-l, Boulder, CO 80301. 303-443-3130. Annual forum for exchange of information about advances in solar energy technologies, programs, and concepts.

Putting Our Communities Back on Their Feet: Land-Use Planning for More Livable Communities
Contact Local Government Commission, 909 12th Street, Suite 205, Sacramento, CA 95814. 916-448-1198. Conference agenda includes mixed-use projects and transit-based housing.

Solid Waste Association of North America
P.O. Box 7219, 8750 Georgia Avenue, Suite 140, Silver Spring, MD 20910. 301-585-2898; Fax: 301-589-7068. Holds an annual conference. Also holds an annual international Waste-to-Energy Symposium in collaboration with the Integrated Waste Services Association.

SOLTECH
Solar Energy Industries Association (SEIA), 122 C Street, NW Fourth Floor, Washington, DC 20002-2109. 202-383-2600; Fax: 202-383-2670. Conference for the solar energy industry with extensive vendor displays and sessions on technical and business topics related to solar technology.

Transportation Alternatives (TA)
92 Steer Marks Place, New York, NY 10009. 212-475-4600. Conducts seminars, public demonstrations, and conferences on auto-free cities.

Urban Forestry Conference
American Forestry Association, 1516 P Street, NW, Washington, DC 20036. 202-463-2459. Brings together a diverse group for discussion and technical presentations. Attendees include landscape architects, planners, planters, citizens' groups, and government officials.

World Energy Engineering Congress
Contact the Association of Energy Engineers, 4025 Pleasantdale Road, Suite 420, Atlanta, GA 30340. 404-447-5083. Features seminars and presentations on advanced topics relating to energy technology and policy. Conventions are held four times each year. Each conference and show features the leading experts in the industry, as well as a multidimensional exposition.

ELECTRONIC RESOURCES

Center of Excellence for Sustainable Development
Uniform Resource Locator: http://www.sustainable.doe.gov. A program created by DOE to provide information and technical advice to help communities become more sustainable. The center's Internet homepage provides in-depth information including a list of 800 sources of technical and financial assistance, 70 case studies, slide sets on rural and urban sustainability projects, articles on sustainability and much more.

Demand-Side Information Services (DSIS)
Electric Power Research Institute, P.O. Box 10412, Palo Alto, CA 94303. 415-855-2000. On-line system for addressing data bases on end-use technologies and demand side management programs is part of the larger electronic bulletin board system, EPRINET.

Electric Power Data Base
DIALOG Information Services, 3460 Hillview Avenue, Palo Alto, CA 94304. 800-334-2564. Compiled by Electric Power Research Institute. Electronic equivalent of the Digest of Research in the Utility Industry. Abstracts/reports on research in the United States and Canada on topics such as hydroelectricity, fossil fuels, transmission, energy efficiency, and the environment.

Energy
STN International, c/o Chemical Abstracts Service, 2540 Olentangy River Road, Box 3012, Columbus, OH 43210. 800-848-6533. A data base that covers worldwide literature on energy research and technology for all kinds of energy sources.

Energy Efficiency and Renewable Energy Network (EREN)
Uniform Resource Locator: http:/ /www.eren.doe.gov. EREN is a gateway to energy efficiency and renewable energy information from national laboratories and other organizations. Provides single-point access to computer bulletin boards; on-line catalogs; lists of manufacturers and vendors; and World Wide Web, Gopher, Telnet and Wide Area Information servers. For information call 800-363-3732.

Energy Ideas Clearinghouse Bulletin Board Service
Washington State Energy Office, 809 Legion Way, FA-II, Olympia, WA 98504. 206-956-2237. A helpful and comprehensive electronic bulletin board system for technical information about energy efficiency and renewable energy as applied to commercial and industrial facilities. Toll-free access is available from 18 western states (AZ, CA, CO, ID, IA, KS, MN, MT, NB, NV, NM, ND, OR, SD, TX, UT, WA, WY) by dialing 800-797-7584.

Energy Information Administration
World Wide Web Site: http://www.eia.doe.gov. National Energy Information Center, EI-231, Energy Information Administration, Forrestal Building, Room 1F-048, Washington, DC 20585. 202-586-8800. E-mail at infoctr@eia.doe.gov.

Energy, Science, and Technology

DIALOG Information Services, 3460 Hillview Avenue, Palo Alto, CA 94304. 800-334-2564. This U.S. Department of Energy (DOE) data base, formerly DOE Energy, is one of the world's largest sources of literature references on all aspects of energy-related topics such as environment, energy policy, and conservation.

Energyline

ORBIT Online, Inc., InfoPro Technologies, 8000 Westpark Drive, McLean, VA 22102. 800-955-0906; Fax: 703-893-0490. Also available on DIALOG Information Services, 3460 Hillview Avenue, Pale Alto, CA 94304; 800-334-2564. The on-line version of Energy Information Abstracts. Provides comprehensive coverage of energy information.

Enviroline

DIALOG Information Services, 3460 Hillview Avenue, Palo Alto, CA 94304. 800-334-2564. Indexing and abstracting coverage of more than 5000 international primary and secondary source publications reporting on all aspects of the environment. Included are such fields as management, technology, economics, and planning.

Solstice

Uniform Resource Locator: http:// solstice.crest.org/index.html. Operated by the Center for Renewable Energy and Sustainable Technologies, 777 North Capitol Street, NE, Suite 805, Washington, DC 20002. 202-289-5368; Fax: 202-289-5354. Solstice is an Internet-based information archive and server providing renewable energy information resources to File Transfer Protocol, World Wide Web, and Gopher users.

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DIALOG Information Services, 3460 Hillview Avenue, Palo Alto, CA 94304. 800-334-2564. Provides transportation research information on air, highway, rail, and maritime transportation. Covers regulations, legislation, energy, environment, and maintenance technology.

WATTSLINE

Association of DSM Professionals, 7040 West Palmetto Park Road, Suite 2315, Boca Raton, FL 33433. 408-297-4747; modem: 408-981-3667. This electronic bulletin board system facilitates sharing of information among DSM professionals. Features upcoming events and a data base of members.

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The following three tables are provided to assist in sorting the references in this bibliography by subject.

General Theory	Urban Form	Auto Alternatives: Walking, Biking, Transit and Telecommuting	Site and Neighborhood Design
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